



# »» DATA SHEET

(DOC No. HX8369-A02-DS)

## »» HX8369-A02

480RGB x 864 dot, 16.7M color,  
with internal GRAM,  
TFT Mobile Single Chip Driver  
*Version 01.00 October 2011*

# HX8369-A02

480RGB x 864 dot, 16.7M color, with internal  
GRAM, TFT Mobile Single Chip Driver



Himax Technologies, Inc.  
<http://www.himax.com.tw>

## List of Contents

|                                                                      |           |
|----------------------------------------------------------------------|-----------|
| <b>1. General Description .....</b>                                  | <b>11</b> |
| <b>2. Features .....</b>                                             | <b>12</b> |
| 2.1 Display .....                                                    | 12        |
| 2.2 Display module .....                                             | 12        |
| 2.3 Display / Control interface .....                                | 13        |
| 2.4 Input power .....                                                | 13        |
| 2.5 Miscellaneous .....                                              | 13        |
| <b>3. Device Overview .....</b>                                      | <b>14</b> |
| 3.1 Block diagram .....                                              | 14        |
| 3.2 Pin description .....                                            | 15        |
| 3.3 Pin assignment .....                                             | 19        |
| 3.4 PAD coordinates .....                                            | 20        |
| 3.4.1 Bump arrangement .....                                         | 28        |
| <b>4. Interface .....</b>                                            | <b>30</b> |
| 4.1 System interface .....                                           | 30        |
| 4.1.1 MIPI DBI-A / DBI-B interface .....                             | 32        |
| 4.2 Serial data transfer interface (MIPI DBI-C) .....                | 43        |
| 4.2.2 MIPI DPI interface (Display Pixel Interface) .....             | 47        |
| 4.2.3 DSI system interface .....                                     | 53        |
| 4.2.4 MDDI Interface (Mobile Display Digital Interface) .....        | 67        |
| 4.2.5 Terminology .....                                              | 68        |
| 4.2.6 Order of data transmission .....                               | 69        |
| 4.2.7 Data-STB encoding .....                                        | 69        |
| <b>5. Function Description .....</b>                                 | <b>82</b> |
| 5.1 Display data GRAM .....                                          | 82        |
| 5.2 Address counter (AC) .....                                       | 82        |
| 5.3 Source, gate and memory map .....                                | 83        |
| 5.3.1 480RGB x 864 resolution .....                                  | 83        |
| 5.3.2 480RGB x 854 resolution .....                                  | 84        |
| 5.3.3 480RGB x 800 resolution .....                                  | 85        |
| 5.3.4 480RGB x 640 resolution .....                                  | 86        |
| 5.3.5 360RGB x 640 resolution .....                                  | 87        |
| 5.3.6 480RGB x 720 resolution .....                                  | 88        |
| 5.4 MCU to memory write / read direction .....                       | 89        |
| 5.5 Fully display, partial display, vertical scrolling display ..... | 91        |
| 5.5.1 Fully display .....                                            | 91        |
| 5.5.2 Vertical scrolling display .....                               | 97        |
| 5.5.3 Tearing effect output line .....                               | 100       |
| 5.6 Color depth conversion .....                                     | 104       |
| 5.6.1 Color depth conversion Look-up tables .....                    | 104       |
| 5.7 Oscillator .....                                                 | 110       |
| 5.8 Source driver .....                                              | 111       |
| 5.9 LCD power generation scheme .....                                | 112       |
| 5.10 DC/DC converter circuit .....                                   | 113       |
| 5.10.1 Use PFM DC/DC converter .....                                 | 113       |
| 5.10.2 Use HX5186-A .....                                            | 114       |
| 5.11 Idle display .....                                              | 115       |
| 5.12 Gamma characteristic correction function .....                  | 116       |
| 5.13 Characteristics of I/O .....                                    | 158       |
| 5.13.1 Output or bi-directional (I/O) pins .....                     | 158       |

## List of Contents

October, 2011

|        |                                                                              |            |
|--------|------------------------------------------------------------------------------|------------|
| 5.13.2 | Input pins .....                                                             | 158        |
| 5.14   | GIP control signal .....                                                     | 159        |
| 5.15   | Sleep Out –command and self-diagnostic functions of the display module ..... | 160        |
| 5.15.1 | Register loading detection .....                                             | 160        |
| 5.15.2 | Functionality detection .....                                                | 161        |
| 5.16   | Power on/off sequence .....                                                  | 162        |
| 5.16.1 | Case 1: RESX line is held high or unstable by host at power on .....         | 163        |
| 5.16.2 | Case 2: RESX line is held low by host at power on .....                      | 164        |
| 5.17   | Uncontrolled power off .....                                                 | 164        |
| 5.18   | Content adaptive brightness control (CABC) function .....                    | 165        |
| 5.18.1 | Module architectures .....                                                   | 166        |
| 5.18.2 | CABC block .....                                                             | 167        |
| 5.18.3 | Brightness control block .....                                               | 168        |
| 5.18.4 | Minimum brightness setting of CABC function .....                            | 169        |
| 5.19   | OTP programming .....                                                        | 170        |
| 5.19.1 | OTP table .....                                                              | 170        |
| 5.19.2 | OTP programming flow .....                                                   | 173        |
| 5.19.3 | Programming sequence .....                                                   | 174        |
| 5.19.4 | OTP Programming example of VCOM setting VCMC_F and VCMC_B .....              | 175        |
| 5.19.5 | OTP Programming example of ID1, ID2 and ID3 .....                            | 176        |
| 5.19.6 | OTP read example of 0x1Bh (VCOM setting re-load) .....                       | 177        |
| 5.19.7 | OTP read example of VCMC_F1 .....                                            | 178        |
| 6.     | <b>Command .....</b>                                                         | <b>179</b> |
| 6.1    | Command list .....                                                           | 179        |
| 6.1.1  | Standard command .....                                                       | 179        |
| 6.1.2  | User define command list table .....                                         | 183        |
| 6.2    | Command description .....                                                    | 187        |
| 6.2.1  | NOP (00h) .....                                                              | 187        |
| 6.2.2  | Software reset (01h) .....                                                   | 188        |
| 6.2.3  | RDNUMPE: Read number of the parity errors (05h) .....                        | 189        |
| 6.2.4  | Get_red_channel (06h) .....                                                  | 190        |
| 6.2.5  | Get_green_channel (07h) .....                                                | 191        |
| 6.2.6  | Get_blue_channel (08h) .....                                                 | 192        |
| 6.2.7  | Get_power_mode (0Ah) .....                                                   | 193        |
| 6.2.8  | Read display MADCTL (0Bh) .....                                              | 194        |
| 6.2.9  | Get_pixel_format (0Ch) .....                                                 | 196        |
| 6.2.10 | Get_display_mode (0Dh) .....                                                 | 198        |
| 6.2.11 | Get_signal_mode (0Eh) .....                                                  | 199        |
| 6.2.12 | Get_diagnostic_result (0Fh) .....                                            | 200        |
| 6.2.13 | Enter_sleep_mode (10h) .....                                                 | 201        |
| 6.2.14 | Exit_sleep_mode (11h) .....                                                  | 202        |
| 6.2.15 | Enter_partial_mode (12h) .....                                               | 203        |
| 6.2.16 | Enter_normal_mode (13h) .....                                                | 204        |
| 6.2.17 | Exit_inversion_mode (20h) .....                                              | 205        |
| 6.2.18 | Enter_inversion_mode (21h) .....                                             | 206        |
| 6.2.19 | Set_gamma_curve (26h) .....                                                  | 207        |
| 6.2.20 | Set_display_off (28h) .....                                                  | 208        |
| 6.2.21 | Set_display_on (29h) .....                                                   | 209        |
| 6.2.22 | Set_column_address (2Ah) .....                                               | 210        |
| 6.2.23 | Set_page_address (2Bh) .....                                                 | 211        |
| 6.2.24 | Write_memory_start (2Ch) .....                                               | 212        |
| 6.2.25 | Colour Set (2Dh) .....                                                       | 213        |
| 6.2.26 | Read_memory_start (2Eh) .....                                                | 216        |
| 6.2.27 | Set_partial_area (30h) .....                                                 | 217        |

# HX8369-A02

480RGB x 864 dot, 16.7M color, with internal  
GRAM, TFT Mobile Single Chip Driver



Himax Technologies, Inc.  
<http://www.himax.com.tw>

## List of Contents

October, 2011

|           |                                                                      |            |
|-----------|----------------------------------------------------------------------|------------|
| 6.2.28    | Set_scroll_area (33h) .....                                          | 219        |
| 6.2.29    | Tearing effect line off (34h) .....                                  | 222        |
| 6.2.30    | Set_tear_on (35h) .....                                              | 223        |
| 6.2.31    | Set_address_mode (36h) .....                                         | 224        |
| 6.2.32    | Set_scroll_start (37h) .....                                         | 226        |
| 6.2.33    | Idle mode off (38h) .....                                            | 227        |
| 6.2.34    | Enter_Idle_mode (39h) .....                                          | 228        |
| 6.2.35    | Set_pixel_format (3Ah) .....                                         | 229        |
| 6.2.36    | Write_memory_contiune (3Ch) .....                                    | 230        |
| 6.2.37    | Raed_memory_continue (3Eh) .....                                     | 231        |
| 6.2.38    | Set tear scan lines (44h) .....                                      | 232        |
| 6.2.39    | Get the current scanline(45h) .....                                  | 233        |
| 6.2.40    | Write display brightness (51h) .....                                 | 234        |
| 6.2.41    | Read display brightness value (52h) .....                            | 235        |
| 6.2.42    | Write CTRL display (53h) .....                                       | 236        |
| 6.2.43    | Read CTRL value display (54h) .....                                  | 237        |
| 6.2.44    | Write content adaptive brightness control (55h) .....                | 238        |
| 6.2.45    | Read content adaptive brightness control (56h) .....                 | 239        |
| 6.2.46    | Write CABC minimum brightness (5Eh) .....                            | 240        |
| 6.2.47    | Read CABC minimum brightness (5Fh) .....                             | 241        |
| 6.2.48    | Read automatic brightness control self-diagnostic result (68h) ..... | 242        |
| 6.2.49    | Read_DDB_start (A1h) .....                                           | 243        |
| 6.2.50    | Read_DDB_continue (A8h) .....                                        | 245        |
| 6.2.51    | Read ID1 (DAh) .....                                                 | 246        |
| 6.2.52    | Read ID2 (DBh) .....                                                 | 247        |
| 6.2.53    | Read ID3 (DCh) .....                                                 | 248        |
| 6.2.54    | SETOSC: Set internal oscillator (B0h) .....                          | 249        |
| 6.2.55    | SETPOWER: Set power (B1h) .....                                      | 250        |
| 6.2.56    | SETDISP: Set display related register (B2h) .....                    | 259        |
| 6.2.57    | SETRGBIF: Set RGB interface related register (B3h) .....             | 262        |
| 6.2.58    | SETCYC: Set display waveform cycle (B4h) .....                       | 263        |
| 6.2.59    | SETVCOM: Set VCOM voltage (B6h) .....                                | 266        |
| 6.2.60    | SETEXTC: Set extension command (B9h) .....                           | 269        |
| 6.2.61    | SETMIPI: (BAh) .....                                                 | 270        |
| 6.2.62    | SETOTP: Set OTP (BBh) .....                                          | 272        |
| 6.2.63    | SETDGLUT: Set DGC LUT (C1h) .....                                    | 273        |
| 6.2.64    | SETID: Set ID (C3h) .....                                            | 275        |
| 6.2.65    | SETCABC: Set CABC Control (C9h) .....                                | 276        |
| 6.2.66    | SETPANEL (CCh) .....                                                 | 278        |
| 6.2.67    | SETGIP (D5h) .....                                                   | 279        |
| 6.2.68    | SETGAMMA: Set gamma curve related setting (E0h) .....                | 286        |
| 6.2.69    | SETOTPKEY (E9h) .....                                                | 288        |
| 6.2.70    | GETHXID (F4h) .....                                                  | 289        |
| 6.2.71    | SETCNCD/GETCNCD (FDh) .....                                          | 290        |
| 6.2.72    | SET SPI READ INDEX (FEh) .....                                       | 291        |
| 6.2.73    | GETSPIREAD: Read command data (FFh) .....                            | 292        |
| <b>7.</b> | <b>Power Supply .....</b>                                            | <b>293</b> |
| 7.1       | Power supply setup .....                                             | 293        |
| 7.1.1     | Architecture 1 with PFM circuit .....                                | 293        |
| 7.1.2     | Architecture 2 with HX5186-A .....                                   | 294        |
| 7.2       | Voltage configuration .....                                          | 295        |
| <b>8.</b> | <b>Electrical Characteristics .....</b>                              | <b>296</b> |
| 8.1       | Absolute maximum ratings .....                                       | 296        |

Himax Confidential

This information contained herein is the exclusive property of Himax and shall not be distributed, reproduced, or disclosed in whole or in part without prior written permission of Himax.

- P.4 -

October, 2011

# >> **HX8369-A02**

480RGB x 864 dot, 16.7M color, with internal  
GRAM, TFT Mobile Single Chip Driver



Himax Technologies, Inc.  
<http://www.himax.com.tw>

## **List of Contents**

October, 2011

|       |                                            |     |
|-------|--------------------------------------------|-----|
| 8.2   | ESD protection level .....                 | 296 |
| 8.3   | DC characteristics .....                   | 297 |
| 8.4   | AC characteristics .....                   | 298 |
| 8.4.1 | DBI Type A interface characteristics ..... | 298 |
| 8.4.2 | DBI Type B interface characteristics ..... | 299 |
| 8.4.3 | DBI Type C interface characteristics ..... | 300 |
| 8.4.4 | DPI interface characteristics .....        | 301 |
| 8.4.5 | Reset input timing .....                   | 304 |
| 8.4.6 | MDDI electrical characteristics .....      | 305 |
| 8.4.7 | DPI Interface Power On/Off Timing .....    | 308 |
| 8.4.8 | DSI D-PHY electrical characteristics ..... | 310 |
| 9.    | Layout Recommendation .....                | 318 |
| 10.   | Maximum Layout Resistance .....            | 319 |
| 11.   | Ordering Information .....                 | 320 |
| 12.   | Revision History .....                     | 320 |

## List of Figures

October, 2011

|                                                                                                   |    |
|---------------------------------------------------------------------------------------------------|----|
| Figure 4.1: DBI-A system interface protocol, write to register or GRAM .....                      | 32 |
| Figure 4.2: DBI-A system interface protocol, read from register or GRAM.....                      | 32 |
| Figure 4.3: DBI-B system interface protocol, write to register or GRAM .....                      | 33 |
| Figure 4.4: DBI-B system interface protocol, read from register or GRAM.....                      | 33 |
| Figure 4.5 Example of DBI-B system 18-bit parallel bus interface.....                             | 34 |
| Figure 4.6: Write data for RGB 8-8-8 (16.7M colours) bit Input in 24-bit parallel interface.....  | 34 |
| Figure 4.7: Example of DBI-A- / DBI-B system 18-bit parallel bus interface.....                   | 35 |
| Figure 4.8: Write data for RGB 5-6-5 (65k colours) bit input in 18-bit parallel interface .....   | 35 |
| Figure 4.9: Write data for RGB 6-6-6(262k colours) bit input in 18-bit parallel interface .....   | 35 |
| Figure 4.10: Write data for RGB 8-8-8 (16.7M colours) bit input in 18-bit parallel interface..... | 36 |
| Figure 4.11: Example of DBI-A- / DBI-B system 16-bit bus interface.....                           | 37 |
| Figure 4.12: Write data for RGB 5-6-5 (65k colours) bit input in 16-bit parallel interface .....  | 37 |
| Figure 4.13: Write data for RGB 6-6-6 (262k colours) bit input in 16-bit parallel interface ..... | 38 |
| Figure 4.14: Write data for RGB 8-8-8-bit (16.7M colours) input in 16-bit parallel interface..... | 38 |
| Figure 4.15: Example of DBI-A- / DBI-B- system 9-bit bus interface .....                          | 39 |
| Figure 4.16: Write data for RGB 5-6-5(65k colours) bit input in 9-bit parallel interface .....    | 39 |
| Figure 4.17: Write data for RGB 6-6-6-bit (262k colours) input in 9-bit parallel interface.....   | 40 |
| Figure 4.18: Write data for RGB 8-8-8-bit (16.7 M colours) input in 9-bit parallel interface..... | 40 |
| Figure 4.19: Example of DBI-A- / DBI-B-system 8-bit bus interface .....                           | 41 |
| Figure 4.20: Write data for RGB 5-6-5 (65k colours) bit input in 8-bit parallel interface .....   | 41 |
| Figure 4.21: Write data for RGB 6-6-6-bit (262k colours) input in 8-bit parallel interface.....   | 42 |
| Figure 4.22: Write data for RGB 8-8-8-bit (16.7 M colours) input in 8-bit parallel interface..... | 42 |
| Figure 4.23: Serial data stream, write mode .....                                                 | 43 |
| Figure 4.24: DBI Type C: Serial interface protocol 3-wire/4-wire, write mode .....                | 44 |
| Figure 4.25: Type C:Serial interface protocol 3-wire/4-wire read mode.....                        | 45 |
| Figure 4.26: Display module data transfer recovery .....                                          | 46 |
| Figure 4.27: PCLK cycle.....                                                                      | 47 |
| Figure 4.28: General timing diagram.....                                                          | 48 |
| Figure 4.29: DPI (480RGB x 864) timing diagram .....                                              | 48 |
| Figure 4.30: 16-bit / pixel 65K colours order on the DPI I/F.....                                 | 50 |
| Figure 4.31: 18-bit / pixel: 262k colours order on the DPI I/F .....                              | 51 |
| Figure 4.32: 24-bit / pixel color order on the RGB I/F .....                                      | 52 |
| Figure 4.33: DSI transmitter and receiver interface .....                                         | 53 |
| Figure 4.34: DSI transmitter and receiver interface .....                                         | 54 |
| Figure 4.35: Multiple HS transmission packets .....                                               | 55 |
| Figure 4.36: Structure of the short packet.....                                                   | 55 |
| Figure 4.37: Structure of the long packet.....                                                    | 56 |
| Figure 4.38: The format of data ID .....                                                          | 56 |
| Figure 4.39: show Short- / Long-packet transmission command sequence .....                        | 57 |
| Figure 4.40: Physical connection of MDDI host and client.....                                     | 67 |
| Figure 4.41: MDDI terminology .....                                                               | 68 |
| Figure 4.42: Example of Bi-directional MDDI communication.....                                    | 68 |
| Figure 4.43: Transmission bit ordering for each type .....                                        | 69 |
| Figure 4.44: Data-STB encoding.....                                                               | 70 |
| Figure 4.45: Data / STB generation & recovery circuit.....                                        | 70 |
| Figure 4.46: Differential connection between host and client .....                                | 71 |
| Figure 4.47 MDDI packet structure .....                                                           | 72 |
| Figure 4.48: MDDI Transceiver / Receiver state in hibernation .....                               | 79 |
| Figure 4.49: Host-initiated link wakeup sequence .....                                            | 80 |
| Figure 4.50: MDDI operation mode.....                                                             | 81 |
| Figure 5.1: MCU to Memory write / read direction .....                                            | 89 |
| Figure 5.2: MY, MX, MV setting of 480RGB x 864 dot .....                                          | 89 |
| Figure 5.3: MY, MX, MV setting of 480RGB x 864 dot .....                                          | 89 |
| Figure 5.4: Address direction settings.....                                                       | 90 |
| Figure 5.5: 480RGB x 864 resolution.....                                                          | 91 |



## List of Figures

2October, 2011

|                                                                                   |     |
|-----------------------------------------------------------------------------------|-----|
| Figure 5.6: 480RGB x 854 resolution .....                                         | 92  |
| Figure 5.7: 480RGB x 800 resolution .....                                         | 93  |
| Figure 5.8: 480RGB x 640 resolution .....                                         | 94  |
| Figure 5.9: 360RGB x 640 resolution .....                                         | 95  |
| Figure 5.10: 480RGB x 720 resolution .....                                        | 96  |
| Figure 5.11: Vertical scrolling .....                                             | 97  |
| Figure 5.12: Memory map of vertical scrolling 1 .....                             | 97  |
| Figure 5.13: Memory map of vertical scrolling 2 .....                             | 98  |
| Figure 5.14: Vertical scroll example 1 .....                                      | 99  |
| Figure 5.15: Vertical scroll example 2 .....                                      | 99  |
| Figure 5.16: Tearing effect output line—mode 1 .....                              | 100 |
| Figure 5.17: Tearing effect output line—mode 2 .....                              | 100 |
| Figure 5.18: Tearing effect output line—timing diagram .....                      | 100 |
| Figure 5.19: Tearing effect output line—tearing effect line timing .....          | 101 |
| Figure 5.20: Tearing effect output line—definition of $t_f$ , $t_r$ .....         | 101 |
| Figure 5.21: Tearing effect output line—example 1 (Timing) .....                  | 102 |
| Figure 5.22: Tearing effect output line—example 1 (Image) .....                   | 102 |
| Figure 5.23: Tearing effect output line—example 2 (Timing) .....                  | 103 |
| Figure 5.24: Tearing effect output line—example 2 (Image) .....                   | 103 |
| Figure 5.25: OSC aritecture .....                                                 | 110 |
| Figure 5.26: LCD power generation scheme .....                                    | 112 |
| Figure 5.27: DC/DC converter circuit (PFM Type C)—PCCS=10 .....                   | 113 |
| Figure 5.28: DC/DC converter circuit (HX5186-A) .....                             | 114 |
| Figure 5.29: Idle mode grayscale control .....                                    | 115 |
| Figure 5.30: Grayscale control .....                                              | 116 |
| Figure 5.31: Gamma resister stream and gamma reference voltage .....              | 118 |
| Figure 5.32: Gamma resister stream .....                                          | 119 |
| Figure 5.33: Sleep out flow chart—command and self-diagnostic functions .....     | 160 |
| Figure 5.34: Sleep out flow chart internal function detection .....               | 161 |
| Figure 5.35: Case 1: RESX line is held high or unstable by host at power on ..... | 163 |
| Figure 5.36: Case 2: RESX line is held low by host at power on .....              | 164 |
| Figure 5.37: CABC block diagram .....                                             | 165 |
| Figure 5.38: Module architecture .....                                            | 166 |
| Figure 5.39: CABC gain / CABC duty generation .....                               | 167 |
| Figure 5.40: CABC_PWM_OUT output duty .....                                       | 168 |
| Figure 5.41: OTP programming sequence .....                                       | 173 |
| Figure 5.42: OTP programming sequence example 1 .....                             | 175 |
| Figure 5.43: OTP programming sequence example 2 .....                             | 176 |
| Figure 5.44: OTP programming sequence index 0x1Bh read flow. ....                 | 177 |
| Figure 5.45: OTP programming sequence read flow. ....                             | 178 |
| Figure 7.1: Power supply with PFM circuit .....                                   | 293 |
| Figure 7.2: Power supply with HX5186-A .....                                      | 294 |
| Figure 8.1: DBI Type A interface characteristics(CLK-E mode) .....                | 298 |
| Figure 8.2: DBI Type B interface characteristics .....                            | 299 |
| Figure 8.3: DBI Type C interface characteristics .....                            | 300 |
| Figure 8.4: DPI interface characteristics .....                                   | 301 |
| Figure 8.5: Vertical Timings for RGB I/F .....                                    | 302 |
| Figure 8.6: Horizontal Timing for RGB I/F .....                                   | 303 |
| Figure 8.7: Reset input timing .....                                              | 304 |
| Figure 8.8 Power On Timing .....                                                  | 308 |
| Figure 8.9 Power Off Timing .....                                                 | 309 |
| Figure 8.10: Electrical functions of a fully D-PHY transceiver .....              | 310 |
| Figure 8.11: Shows both the HS and LP signal levels .....                         | 310 |
| Figure 8.12: Input Glitch Rejections of Low-Power Receivers .....                 | 313 |
| Figure 8.13: DDR Clock Definition .....                                           | 315 |

# >> HX8369-A02

480RGB x 864 dot, 16.7M color, with internal  
GRAM, TFT Mobile Single Chip Driver



Himax Technologies, Inc.  
<http://www.himax.com.tw>

## List of Figures

October, 2011

|                                                    |     |
|----------------------------------------------------|-----|
| Figure 8.14: Data to Clock Timing Definitions..... | 316 |
| Figure 9.1: Layout recommendation .....            | 318 |

Himax Confidential  
Do Not Copy



# >> HX8369-A02

480RGB x 864 dot, 16.7M color, with internal  
GRAM, TFT Mobile Single Chip Driver



Himax Technologies, Inc.  
<http://www.himax.com.tw>

## List of Tables

October, 2011

|                                                                        |     |
|------------------------------------------------------------------------|-----|
| Table 4.1: Interface selection .....                                   | 30  |
| Table 4.2: Pin connection based on different interface .....           | 31  |
| Table 4.3: Data types for processor-sourced packets.....               | 58  |
| Table 4.4: Shows the error report bit definitions.....                 | 65  |
| Table 4.5: The complete set of peripheral-to-processor data types..... | 66  |
| Table 4.6: List of supported MDDI packet .....                         | 73  |
| Table 4.7: Operation mode list .....                                   | 81  |
| Table 5.1: Addresses counter range.....                                | 82  |
| Table 5.2: Memory map of 480RGB x 864 resolution .....                 | 83  |
| Table 5.3: Memory map of 480RGB x 854 resolution .....                 | 84  |
| Table 5.4: Memory map of 480RGB x 800 resolution .....                 | 85  |
| Table 5.5: Memory map of 480RGB x 640 resolution .....                 | 86  |
| Table 5.6: Memory map of 360RGB x 640 resolution .....                 | 87  |
| Table 5.7: Memory map of 480RGB x 720 resolution .....                 | 88  |
| Table 5.8: 480RGB x 864 resolution (SRAM assignment) .....             | 91  |
| Table 5.9: 480RGB x 854 resolution (SRAM assignment) .....             | 92  |
| Table 5.10: 480RGB x 800 resolution (SRAM assignment) .....            | 93  |
| Table 5.11: 480RGB x 640 resolution (SRAM assignment) .....            | 94  |
| Table 5.12: 360RGB x 640 resolution (SRAM assignment) .....            | 95  |
| Table 5.13: 480RGB x 720 resolution (SRAM assignment) .....            | 96  |
| Table 5.14: AC characteristics of tearing effect signal .....          | 101 |
| Table 5.15: Look-up tables-1 .....                                     | 104 |
| Table 5.16: Look-up tables-2 .....                                     | 105 |
| Table 5.17: Look-up tables-3 .....                                     | 106 |
| Table 5.18: Look-up tables-4 .....                                     | 107 |
| Table 5.19: Look-up tables-5 .....                                     | 108 |
| Table 5.20: Look-up tables-6 .....                                     | 109 |
| Table 5.21: Gamma-Adjustment registers.....                            | 117 |
| Table 5.22: Offset adjustment 0~5 .....                                | 120 |
| Table 5.23: Center adjustment .....                                    | 120 |
| Table 5.24: VinP0 .....                                                | 121 |
| Table 5.25: VinP1 .....                                                | 122 |
| Table 5.26: VinP2 .....                                                | 123 |
| Table 5.27: VinP14 .....                                               | 124 |
| Table 5.28: VinP15 .....                                               | 125 |
| Table 5.29: VinP16 .....                                               | 126 |
| Table 5.30: VinP5 .....                                                | 128 |
| Table 5.31: VinP11 .....                                               | 130 |
| Table 5.32: VinP3 .....                                                | 131 |
| Table 5.33: VinP4 .....                                                | 132 |
| Table 5.34: VinP6 .....                                                | 132 |
| Table 5.35: VinP7 .....                                                | 133 |
| Table 5.36: VinP8 .....                                                | 133 |
| Table 5.37: VinP9 .....                                                | 134 |
| Table 5.38: VinP10 .....                                               | 134 |
| Table 5.39: VinP12 .....                                               | 135 |
| Table 5.40: VinP13 .....                                               | 135 |
| Table 5.41: VinN0 .....                                                | 136 |
| Table 5.42: VinN1 .....                                                | 137 |
| Table 5.43: VinN2 .....                                                | 138 |
| Table 5.44: VinN14 .....                                               | 139 |
| Table 5.45: VinN15 .....                                               | 140 |
| Table 5.46: VinN16 .....                                               | 141 |
| Table 5.47: VinN5 .....                                                | 143 |
| Table 5.48: VinN11 .....                                               | 145 |

|                                                                                                    |     |
|----------------------------------------------------------------------------------------------------|-----|
| Table 5.49: VinN3 .....                                                                            | 146 |
| Table 5.50: VinN4 .....                                                                            | 147 |
| Table 5.51: VinN6 .....                                                                            | 147 |
| Table 5.52: VinN7 .....                                                                            | 148 |
| Table 5.53: VinN8 .....                                                                            | 148 |
| Table 5.54: VinN9 .....                                                                            | 149 |
| Table 5.55: VinN10 .....                                                                           | 149 |
| Table 5.56: VinN12 .....                                                                           | 150 |
| Table 5.57: VinN13 .....                                                                           | 150 |
| Table 5.58: Voltage calculation formula of 64-grayscale voltage (positive polarity).....           | 152 |
| Table 5.59: Voltage calculation formula of 64-grayscale voltage (negative polarity) .....          | 154 |
| Table 5.60: Voltage calculation formula of 256-grayscale voltage (positive/negative polarity)..... | 157 |
| Table 5.61: Characteristics of output or bi-directional (I/O) pins .....                           | 158 |
| Table 5.62: Characteristics of input pins .....                                                    | 158 |
| Table 5.63: CABC timing table .....                                                                | 168 |
| Table 5.64: OTP Programming sequence .....                                                         | 174 |
| Table 7.1: Adoptability of component .....                                                         | 295 |
| Table 8.1: Absolute maximum rating .....                                                           | 296 |
| Table 8.2: ESD protection level .....                                                              | 296 |
| Table 8.3: DC characteristic .....                                                                 | 297 |
| Table 8.4: DBI Type A interface characteristics .....                                              | 298 |
| Table 8.5: DBI Type B interface characteristics .....                                              | 299 |
| Table 8.6: DBI Type C interface characteristics .....                                              | 300 |
| Table 8.7: DPI interface characteristics .....                                                     | 301 |
| Table 8.8: Vertical Timings for RGB I/F .....                                                      | 302 |
| Table 8.9: Horizontal Timings for RGB I/F .....                                                    | 303 |
| Table 8.10: Reset timing .....                                                                     | 304 |
| Table 8.11: LP Transmitter DC Specifications .....                                                 | 311 |
| Table 8.12: LP Transmitter AC Specifications .....                                                 | 311 |
| Table 8.13: HS Receiver DC Specifications .....                                                    | 312 |
| Table 8.14: HS Receiver AC Specifications .....                                                    | 312 |
| Table 8.15: LP Receiver DC Specifications .....                                                    | 313 |
| Table 8.16: LP Receiver AC Specifications .....                                                    | 313 |
| Table 8.17: Contention Detector DC Specifications .....                                            | 314 |
| Table 8.18: HS Data Transmission Timing Parameters .....                                           | 315 |
| Table 8.19: Data to Clock Timing Specifications .....                                              | 317 |
| Table 10.1: Maximum layout resistance .....                                                        | 319 |

# >> **HX8369-A02**

480RGB x 864 dot, 16.7M color, with internal  
GRAM, TFT Mobile Single Chip Driver



Himax Technologies, Inc.  
<http://www.himax.com.tw>

***Version 01***

*October, 2011*

## **1. General Description**

This document describes Himax's HX8369-A02 supports WVGA resolution driving controller. The HX8369-A02 is designed to provide a single-chip solution that combines a source driver, power supply circuit to drive a TFT dot matrix LCD with 480RGBx864 dots at maximum.

The HX8369-A02 can be operated in low-voltage condition for the interface and integrated internal boosters that produce the liquid crystal voltage, breeder resistance and the voltage follower circuit for liquid crystal driver. In addition, The HX8369-A02 also supports various functions to reduce the power consumption of a LCD system via software control.

The HX8369-A02 supports several interface modes, including MPU MIPI DBI Type A/Type B interface mode, MIPI DPI/DBI Type C interface mode, MIPI DSI (Display Serial Interface) interface mode and MDDI (Mobile Display Digital Interface) interface mode. The interface mode is selected by the external hardware pins BS3~0.

The HX8369-A02 is suitable for any small portable battery-driven and long-term driving products, such as small PDAs, digital cellular phones and bi-directional pagers.

## 2. Features

### 2.1 Display

- Single chip solution for a WVGA GIP (Gate In Panel) type TFT LCD display
- Resolution:
  - 480RGB x 864
  - 480RGB x 854
  - 480RGB x 800
  - 480RGB x 640
  - 480RGB x 720
  - 360RGB x 640
- Display color modes
  - Full color mode:
    - 16.7M colours (24-bit 8(R):8(G):8(B))
  - Reduce color mode:
    - 262k colours (18-bit 6(R):6(G):6(B))
    - 65k colours (16-bit 5(R):6(G):5(B))
    - 8 colors (Idle mode on): 8 colors (3-bit binary mode)

### 2.2 Display module

- Support 1440 source channel outputs
- Internal level shifter for GIP gate control
- Supports 1-dot / 2-dot / column / Zig-Zag inversion
- Gamma correction (1 preset gamma curve)
- On module VCOM control (-2 to 0V common electrode output voltage range)
- On module DC/DC converter
  - VSP=4.7 to 5.7V
  - VSN=-5.7 to -4.7V
  - Positive source output voltage level: VSPR=3.5V to 5V
  - Negative source output voltage level: VSNR=-5V to -3.5V
  - Positive gate driver output voltage level: VGH=+9V to +20V
  - Negative gate driver output voltage level: VGL=-6V to -13.5V
  - GIP most negative reference voltage: LVGL=VGL -VDD3
  - VCOM=-2.0V to 0V, a step=16mV
- Frame memory area 480 (H) x 864 (V) x 24-bit

## 2.3 Display / Control interface

- Display interface types supported
  - MPU mode
    - MIPI-DBI Type B (80 System) interface (16- / 18- / 24-bit bus)
    - MIPI-DBI Type A (68 System) interface (16- / 18- bit bus)
    - MIPI-DBI Type C (Serial data transfer interface) interface
  - MIPI-DSI (Display Serial Interface) interface
    - Support DSI Version 1.01
    - Support D-PHY version 0.90
  - MDDI (Mobile Display Digital Interface) interface
    - Support VESA Mobile Display Digital Interface Standard Version 1.2
  - RGB mode
    - 16 bit/pixel R(5), G(6), B(5)
    - 18 bit/pixel R(6), G(6), B(6)
    - 24 bit/pixel R(8), G(8), B(8)

## 2.4 Input power

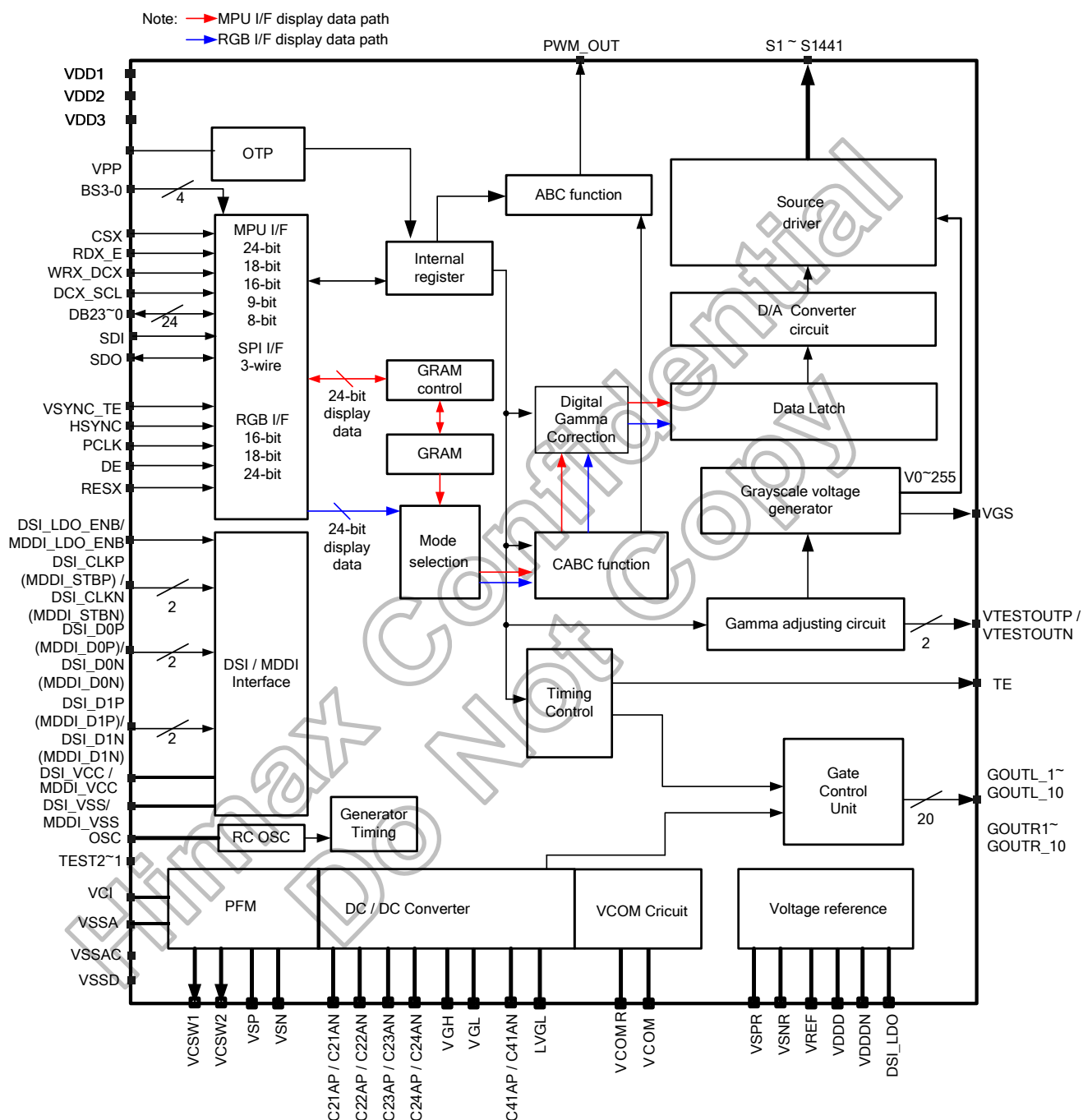
- I/O and interface power supply (VDD1): 1.65V to 3.3V
- Analog power supply (VDD2): 2.3V to 4.8V
- Logic power supply (VDD3): 2.3V to 4.8V
- DSI power supply (DSI\_VCC): 1.65V to 3.3V
- MDDI power supply (DSI\_VCC): 2.3V to 3.3V
- OTP programming voltage (VPP): 7.5V  $\pm$  0.2V

## 2.5 Miscellaneous

- Partial display mode
- Software programmable color depth mode
- Oscillator for display clock generation
- Low power consumption, suitable for battery operated systems
- CMOS compatible inputs
- Proprietary multi phase driving for lower power consumption
- GAS function for preventing image sticking when abnormal power off
- Optimized layout for COG assembly
- Temperature range: -40 to +85 °C
- HBM ESD (Human Body Mode)>2KV, MM(Machine Mode)> $\pm$ 200V and Latch up> $\pm$ 200mA
- Support inversion mode
- DC/DC converter for source
- Support DC COM driving
- VCOM voltage generator
- On-chip OTP program voltage generator
- OTP memory to store initialization register settings
- 3 times MTP for VCOM setting ,ID setting
- Support CAB (Content Adaptive Brightness Control) function
- Support DGC (Digital Gamma Correction) function

## 3. Device Overview

### 3.1 Block diagram





### 3.2 Pin description

| Host interface pins |     |         |                      |                                                                                                                                                                                                          |     |     |     |                                                      |                                                               |              |
|---------------------|-----|---------|----------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|-----|-----|------------------------------------------------------|---------------------------------------------------------------|--------------|
| Signals             | I/O | Pin no. | Connected with       | Description                                                                                                                                                                                              |     |     |     |                                                      |                                                               |              |
| BS3 ~ BS0           | I   | 4       | VSSD / VDD1          | Select the MPU interface mode as listed below:                                                                                                                                                           |     |     |     |                                                      |                                                               |              |
|                     |     |         |                      | BS3                                                                                                                                                                                                      | BS2 | BS1 | BS0 | MPU interface mode                                   | DB pins                                                       | Display mode |
|                     |     |         |                      | 0                                                                                                                                                                                                        | 0   | 0   | 0   | DBI TYPE-A 8-bit (CLK-E)                             | DB23-DB8: Unused, DB7-DB0: Data                               | Type 1       |
|                     |     |         |                      | 0                                                                                                                                                                                                        | 0   | 0   | 1   | DBI TYPE-A 9-bit (CLK-E)                             | DB23-DB9:Unused, DB8-DB0: Data                                | Type 1       |
|                     |     |         |                      | 0                                                                                                                                                                                                        | 0   | 1   | 0   | DBI TYPE-A 16-bit (CLK-E)                            | DB23-DB16: Unused, DB15-DB0: Data                             | Type 1       |
|                     |     |         |                      | 0                                                                                                                                                                                                        | 0   | 1   | 1   | DBI TYPE-A 18-bit (CLK-E)                            | DB23-DB18: Unused, DB17-DB0: Data                             | Type 1       |
|                     |     |         |                      | 0                                                                                                                                                                                                        | 1   | 0   | 0   | DBI TYPE-B 8-bit                                     | DB23-DB8: Unused DB7-DB0: Data                                | Type 1       |
|                     |     |         |                      | 0                                                                                                                                                                                                        | 1   | 0   | 1   | DBI TYPE-B 9-bit                                     | DB23-DB9:Unused, DB8-DB0: Data                                | Type 1       |
|                     |     |         |                      | 0                                                                                                                                                                                                        | 1   | 1   | 0   | DBI TYPE-B 16-bit                                    | DB23-DB16: Unused, DB15-DB0: Data                             | Type 1       |
|                     |     |         |                      | 0                                                                                                                                                                                                        | 1   | 1   | 1   | DBI TYPE-B 18-bit                                    | DB23-DB18: Unused, DB17-DB0: Data                             | Type 1       |
|                     |     |         |                      | 1                                                                                                                                                                                                        | 0   | 0   | 0   | DSI (Command mode)                                   | DSI_CLKP, DSI_CLKN, DSI_D0P, DSI_D0N, DSI_D1P, DSI_D1N        | Type 1       |
|                     |     |         |                      | 1                                                                                                                                                                                                        | 0   | 0   | 1   | 3-wire serial + MDDI interface + external R (note 1) | MDDI_STBP, MDDI_STBN, MDDI_D0P, MDDI_D0N, MDDI_D1P, MDDI_D1N, | -            |
|                     |     |         |                      | 1                                                                                                                                                                                                        | 0   | 1   | 0   | DBI TYPE-B 24-bit                                    | DB23-DB0: Data                                                | Type 1       |
|                     |     |         |                      | 1                                                                                                                                                                                                        | 0   | 1   | 1   | 3-wire serial + MDDI interface + internal R (note 1) | MDDI_STBP, MDDI_STBN, MDDI_D0P, MDDI_D0N, MDDI_D1P, MDDI_D1N, | -            |
|                     |     |         |                      | 1                                                                                                                                                                                                        | 1   | 0   | 0   | DSI (Video mode)                                     | DSI_CLKP, DSI_CLKN, DSI_D0P, DSI_D0N, DSI_D1P, DSI_D1N        | Type 3       |
|                     |     |         |                      | 1                                                                                                                                                                                                        | 1   | 0   | 1   | DPI/DBI TYPE-C Option 1                              | SDI/SDO, DB23-DB0                                             | Type 3       |
|                     |     |         |                      | 1                                                                                                                                                                                                        | 1   | 1   | 0   | DPI/DBI TYPE-C Option 2                              | SDI/SDO, DB23-DB0                                             | Type 3       |
|                     |     |         |                      | 1                                                                                                                                                                                                        | 1   | 1   | 1   | DPI/DBI TYPE-C Option 3                              | SDI/SDO, DB23-DB0                                             | Type 3       |
|                     |     |         |                      | Pixel format (RGB565 / RGB666 / RGB888) is selected by DCS command (0x3Ah)<br>Note 1: 3-wire serial Interface only active on MDDI / Hibernation mode(1-lane only).<br>Must be connected to VSSD or VDD1. |     |     |     |                                                      |                                                               |              |
| CSX                 | I   | 1       | MPU                  | Chip select signal.<br>Low: chip can be accessed;<br>High: chip cannot be accessed.<br>If this pin is not used, please connect it to VSSD or VDD1.                                                       |     |     |     |                                                      |                                                               |              |
| RESX                | I   | 1       | MPU or reset circuit | Reset pin. Setting either pin low initializes the LSI. Must be reset after power is supplied (Must be connected to VSSD or VDD1).                                                                        |     |     |     |                                                      |                                                               |              |
| RDX_E               | I   | 1       | MPU                  | DBI Type-A: 0: Read/Write disable, 1: Read / Write enable.<br>DBI Type-B: Serves as a read signal and read data at the low level.<br>If not use, let it open or connected to VDD1.                       |     |     |     |                                                      |                                                               |              |
| DCX_SCL             | I   | 1       | MPU                  | DBI Type-A/B: Data / Command Selection pin<br>DBI Type-C: it servers as SCL (Serial Clock)<br>If not use, let it open or connected to VDD1.                                                              |     |     |     |                                                      |                                                               |              |

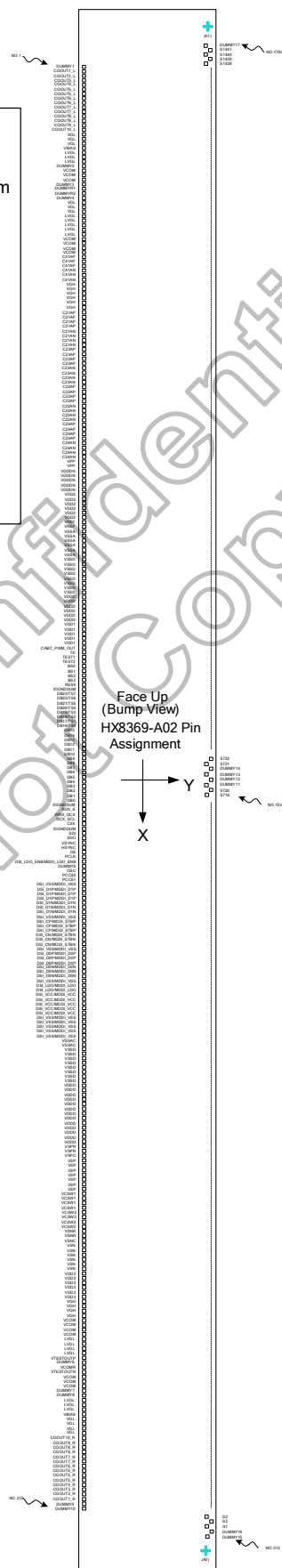
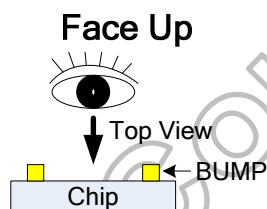
|                                                                                                                       |                              |                               |     |                                                                                                                                                                                                |                              |                                    |
|-----------------------------------------------------------------------------------------------------------------------|------------------------------|-------------------------------|-----|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------|------------------------------------|
| WRX_DCX                                                                                                               | I                            | 1                             | MPU | DBI Type-B mode: Serves as a write signal and write data at the low level.<br>DBI Type-A mode: 0: Read/Write disable, 1: Read / Write enable.<br>If not use, let it open or connected to VDD1. |                              |                                    |
| DB23~0                                                                                                                | I/O                          | 24                            | MPU | DBI type interface:                                                                                                                                                                            |                              |                                    |
|                                                                                                                       |                              |                               |     | Data bus                                                                                                                                                                                       | Used                         | Unused                             |
|                                                                                                                       |                              |                               |     | 8-bit bus                                                                                                                                                                                      | DB7-0                        | DB23-8                             |
|                                                                                                                       |                              |                               |     | 9-bit bus                                                                                                                                                                                      | DB8-0                        | DB23-9                             |
|                                                                                                                       |                              |                               |     | 16-bit bus                                                                                                                                                                                     | DB15-0                       | DB23-16                            |
|                                                                                                                       |                              |                               |     | 18-bit bus                                                                                                                                                                                     | DB17-0                       | DB23-18                            |
|                                                                                                                       |                              |                               |     | 24-bit bus                                                                                                                                                                                     | DB23-0                       | -                                  |
|                                                                                                                       |                              |                               |     | DPI type interface:                                                                                                                                                                            |                              |                                    |
|                                                                                                                       |                              |                               |     | Data bus                                                                                                                                                                                       | Used                         | Unused                             |
|                                                                                                                       |                              |                               |     | 16-bit bus                                                                                                                                                                                     | DB21-17,<br>DB13-8,<br>DB5-1 | DB23-22,<br>DB16-14,<br>DB7-6, DB0 |
| 18-bit bus                                                                                                            | DB21-16,<br>DB13-8,<br>DB5-0 | DB23-22,<br>DB15-14,<br>DB7-6 |     |                                                                                                                                                                                                |                              |                                    |
| 24-bit bus                                                                                                            | DB23-0                       | -                             |     |                                                                                                                                                                                                |                              |                                    |
| Let the unused pins open for each mode.                                                                               |                              |                               |     |                                                                                                                                                                                                |                              |                                    |
| SDO                                                                                                                   | O                            | 1                             | MPU | Serial data output. Let it to open in MPU interface mode.                                                                                                                                      |                              |                                    |
| SDI                                                                                                                   | I                            | 1                             | MPU | Serial data input pin in serial interface operation.                                                                                                                                           |                              |                                    |
| Clock input and RGB interface                                                                                         |                              |                               |     |                                                                                                                                                                                                |                              |                                    |
| HSYNC                                                                                                                 | I                            | 1                             | MPU | Line synchronizing signal.<br>Must be connected to VSSD or VDD1 if not used.                                                                                                                   |                              |                                    |
| DE                                                                                                                    | I                            | 1                             | MPU | A data enable signal in RGB I/F mode. Has to be fixed to VSSD level in MPU interface mode.                                                                                                     |                              |                                    |
| VSYNC                                                                                                                 | I                            | 1                             | MPU | Serves VS signal pin on RGB interface. (Input pad).<br>Must be connected to VSSD or VDD1 if not used.                                                                                          |                              |                                    |
| PCLK                                                                                                                  | I                            | 1                             | MPU | Dot clock signal.<br>Must be connected to VSSD or VDD1 if not used.                                                                                                                            |                              |                                    |
| Source driver output pins                                                                                             |                              |                               |     |                                                                                                                                                                                                |                              |                                    |
| S1 to S1441                                                                                                           | O                            | 1441                          | LCD | Output voltages applied to the liquid crystal.                                                                                                                                                 |                              |                                    |
|                                                                                                                       |                              |                               |     | RGB resolution                                                                                                                                                                                 | Source channels              |                                    |
|                                                                                                                       |                              |                               |     | 360RGB                                                                                                                                                                                         | S1 ~ S540, S901 ~ S1440      |                                    |
|                                                                                                                       |                              |                               |     | 480RGB                                                                                                                                                                                         | S1 to S1440                  |                                    |
| 480RGB+Z inversion                                                                                                    | S1 to S1441                  |                               |     |                                                                                                                                                                                                |                              |                                    |
| TE                                                                                                                    | O                            | 1                             | MPU | Serves TE (Tearing Effect ) pin on MPU interface.                                                                                                                                              |                              |                                    |
| GIP control singal and bias voltage                                                                                   |                              |                               |     |                                                                                                                                                                                                |                              |                                    |
| CGOUT1_L<br>CGOUT2_L<br>CGOUT3_L<br>CGOUT4_L<br>CGOUT5_L<br>CGOUT6_L<br>CGOUT7_L<br>CGOUT8_L<br>CGOUT9_L<br>CGOUT10_L | O                            | 14                            | GIP | Signals for right side GIP on panel view (Left side in IC bump view),<br>Unused pins should be left open.                                                                                      |                              |                                    |
| CGOUT1_R<br>CGOUT2_R<br>CGOUT3_R<br>CGOUT4_R<br>CGOUT5_R<br>CGOUT6_R<br>CGOUT7_R<br>CGOUT8_R<br>CGOUT9_R<br>CGOUT10_R | O                            | 14                            | GIP | Signals for Right side GIP on panel view (Right side in IC bump view),<br>Unused pins should be left open.                                                                                     |                              |                                    |
| VBIAS                                                                                                                 | O                            | 2                             | GIP | Bias voltage for some special GIP circuits. If not used, leave this pin open.                                                                                                                  |                              |                                    |

| Power supply pins                          |     |                                |                       |                                                                                                                                                                                           |       |                                |
|--------------------------------------------|-----|--------------------------------|-----------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|--------------------------------|
| PCCS0 ~ PCCS1                              | I   | 2                              | VSSD / VDD3           | Select the VSP/VSN bumping method as listed below:                                                                                                                                        |       |                                |
|                                            |     |                                |                       | PCCS1                                                                                                                                                                                     | PCCS0 | Driving mode                   |
|                                            |     |                                |                       | 0                                                                                                                                                                                         | 0     | Setting invalid                |
|                                            |     |                                |                       | 0                                                                                                                                                                                         | 1     | Setting invalid                |
|                                            |     |                                |                       | 1                                                                                                                                                                                         | 0     | PFM one Inductor Mode (Type C) |
| 1                                          | 1   | Charge Bump Mode(Use HX5186-A) |                       |                                                                                                                                                                                           |       |                                |
|                                            |     |                                |                       | Must be connected to VSSD or VDD3.                                                                                                                                                        |       |                                |
| VDD1                                       | I   | 5                              | Power supply          | A power supply for the I/O circuit. VDD1=1.65 to 3.3V                                                                                                                                     |       |                                |
| VDD2                                       | I   | 6                              | Power supply          | A power supply for the analog power. VDD2=2.3 to 4.8V<br>VDD2 input level should be same as VDD3 input level to avoid the level-mismatching at internal level shifter circuit.            |       |                                |
| VDD3                                       | I   | 6                              | Power supply          | A power supply for the logic power, DC/DC converter VDD3=2.3 to 4.8V.                                                                                                                     |       |                                |
| VSSA                                       | P   | 6                              | Power supply          | Analoge ground. VSSA=0V. When using the COG method, connect to VSSD on the FPC to prevent noise.                                                                                          |       |                                |
| VSSAC                                      | P   | 2                              | Power supply          | Analoge ground. Must connect to VSSA on the FPC.                                                                                                                                          |       |                                |
| VSSD                                       | P   | 16                             | Power supply          | Ground for the internal logic. VSSD=0V. When using the COG method, connect to VSSA on the FPC to prevent noise.                                                                           |       |                                |
| VPP                                        | I   | 2                              | Power supply          | External high voltage pin used in OTP mode and operates at 7.5V. If not used, let it open.                                                                                                |       |                                |
| Output Pins of Power and reference voltage |     |                                |                       |                                                                                                                                                                                           |       |                                |
| VSP                                        | I   | 7                              | Stabilizing capacitor | Input voltage from the set-up circuit (4.7V to 5.5V). it is generated from VDD3.                                                                                                          |       |                                |
| VSN                                        | I   | 6                              | Stabilizing capacitor | Input voltage from the set-up circuit (-4.7V to -5.5V). it is generated from VDD3.                                                                                                        |       |                                |
| VSPC                                       | I   | 1                              | VSP                   | Positive boosting reference voltage input.                                                                                                                                                |       |                                |
| VSNC                                       | I   | 1                              | VSN                   | Negative boosting reference voltage input.                                                                                                                                                |       |                                |
| VSPR                                       | O   | 2                              | Stabilizing capacitor | Positive regulated voltage output (3.5V to VSP - 0.5)                                                                                                                                     |       |                                |
| VSNR                                       | O   | 2                              | Stabilizing capacitor | Positive regulated voltage output (-3.5V to VSN + 0.5)                                                                                                                                    |       |                                |
| VDDD                                       | O   | 19                             | Stabilizing capacitor | Internal logic voltage output                                                                                                                                                             |       |                                |
| VDDDN                                      | O   | 5                              | Stabilizing capacitor | Internal logic voltage output (-2.5V fixed)                                                                                                                                               |       |                                |
| VREF                                       | O   | 2                              | Stabilizing capacitor | Reference voltage from internal band gap circuit. The tolerance of VREF voltage is $\pm 3\%$ .(1.8V fixed)                                                                                |       |                                |
| VGH                                        | O   | 10                             | Stabilizing capacitor | Output voltage from the step-up circuit, it is generated from VSP and VSN. Connect to a stabilizing capacitor between VSSA and VGH.                                                       |       |                                |
| VGL                                        | O   | 10                             | Stabilizing capacitor | Output voltage from the step-up circuit, it is generated from VSP and VSN. Connect to a stabilizing capacitor between VSSA and VGL. Place a schottkey barrier diode between VSSA and VGL. |       |                                |
| LVGL                                       | O   | 15                             | Stabilizing capacitor | Most negative voltage for some special GIP circuits. If not used, connect to VGL.                                                                                                         |       |                                |
| VCOM                                       | O   | 14                             | Stabilizing capacitor | The power supply of common voltage in DC com driving. The voltage range is set between -2V to 0V. It must be connected a stabilizing capacitor 2.2u to VSSD.                              |       |                                |
| VCOMR                                      | I   | 1                              | Input                 | The input pad of external VCOM voltage.                                                                                                                                                   |       |                                |
| DC/DC pumping                              |     |                                |                       |                                                                                                                                                                                           |       |                                |
| C21AP, C21AN<br>C22AP, C22AN               | I/O | 16                             | Step-up Capacitor     | Connect to the step-up capacitors according to the DC/DC pumping factor by pumping the VGL voltage.                                                                                       |       |                                |
| C23AP, C23AN<br>C24AP, C24AN               | I/O | 16                             | Step-up Capacitor     | Connect to the step-up capacitors according to the DC/DC pumping factor by pumping the VGH voltage.                                                                                       |       |                                |
| C41AP, C41AN                               | I/O | 6                              | Step-up Capacitor     | Connect to the step-up capacitors according to the DC/DC pumping factor by pumping the LVGL voltage.                                                                                      |       |                                |
| VCSW1                                      | O   | 4                              | -                     | Boosting control output1, it needs to connect to the gate pin of NMOS on external DC/DC converter circuit. (0 to VDD3)                                                                    |       |                                |
| VCSW2                                      | O   | 4                              | -                     | Boosting control output2, it needs to connect to the gate pin of PMOS on external DC/DC converter circuit. (0 to VDD3)                                                                    |       |                                |

| CABC & ABC & Ambient light sensor |     |    |                           |                                                                                                                                                                                                                                                           |
|-----------------------------------|-----|----|---------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| CABC_PWM_OUT                      | O   | 1  | -                         | Backlight on/fff control pin. If use CABC function, the pin can connect to external LED driver IC. The output voltage range=0 to VDD1.                                                                                                                    |
| Test Pins                         |     |    |                           |                                                                                                                                                                                                                                                           |
| OSC                               | I   | 1  | Open                      | Oscillator input for test purpose.<br>If not used, please let it open or connected to VSSD.(weak pull low)                                                                                                                                                |
| TEST1                             | I   | 1  | Open                      | A test pin. This pin is by internal logic function test.This pin can output on FPC. If not used, let it open or connected to VSSD.(weak pull low)                                                                                                         |
| TEST2                             | I   | 1  | Open                      | A test pin. This pin is by internal logic function test.This pin can output on FPC. If not used, let it open or connected to VSSD.(weak pull low)                                                                                                         |
| VTESTOUTP                         | O   | 1  | Open                      | A test pin. Disconnect it. This pin will output Gamma voltage. This pin can output on FPC.                                                                                                                                                                |
| VTESTOUTN                         | O   | 1  | Open                      | A test pin. Disconnect it. This pin will output Gamma voltage. This pin can output on FPC.                                                                                                                                                                |
| DUMMYR1<br>DUMMYR2                | -   | 2  | Open                      | Dummy pads. Available for measuring the COG contact resistance. They are short-circuited within the chip.                                                                                                                                                 |
| DUMMY17~1                         | -   | 17 | Open                      | Not used. Let it open.                                                                                                                                                                                                                                    |
| IOGNDDUM                          | -   | 3  | Open                      | Dummy pad. Connect to grand internally.                                                                                                                                                                                                                   |
| MIPI-DSI interface parts          |     |    |                           |                                                                                                                                                                                                                                                           |
| DSI_D0P,<br>DSI_D0N               | I/O | 6  | DSI Host                  | MIPI-DSI Data differential signal input pins. (Data lane 0)<br>If not used, please let it connected to VSSD.                                                                                                                                              |
| DSI_CP,<br>DSI_CN                 | I   | 6  | DSI Host                  | MIPI-DSI CLOCK differential signal input pins.<br>If not used, please let it connected to VSSD.                                                                                                                                                           |
| DSI_D1P,<br>DSI_D1N               | I   | 6  | DSI Host                  | MIPI-DSI Data differential signal input pins. (Data lane 1)<br>If not used, please let it connected to VSSD.                                                                                                                                              |
| DSI_VCC                           | P   | 5  | Power Supply              | Power supply for the MIPI DSI analog power.DSI_VCC=1.65V to 3.3V                                                                                                                                                                                          |
| DSI_VSS                           | P   | 9  | Ground                    | MIPI DSI analogy ground. DSI_VSS=0V. When using the COG method, connect to VSSA on the FPC to prevent noise.                                                                                                                                              |
| DSI_LDO                           | O   | 2  | Capacitor                 | DSI:<br>DSI regulator output pin. (1.2V to 1.3V)<br>Connect to a stabilizing capacitor between DSI_VSS and DSI_LDO<br>If not used, please open these pins.                                                                                                |
| DSI_LDO_ENB                       | I   | 1  | Input                     | DSI I/F:<br>Control signal of DSI_LDO. The default setting of DSI_LDO_ENB is Low.<br>High: Disable the DSI_LDO.<br>Low: Enable the DSI_LDO.<br>It must be connected to VDD1 or VSSD. (latch type)                                                         |
| MDDI interface parts              |     |    |                           |                                                                                                                                                                                                                                                           |
| MDDI_STBP,<br>MDDI_STBN           | -   | 6  | High Speed Interface Host | High Speed Interface clock differential signal input pins.<br>When BS[3:0]=1001(MDDI interface + external R), please connect to a terminal resistance (100Ω) between MDDI_STBP and MDDI_STBN.<br>If not used, please let it connected to VSSD.            |
| MDDI_D0P,<br>MDDI_D0N             | -   | 6  | High Speed Interface Host | High Speed Interface Data differential signal input pins (Data lane 0).<br>When BS[3:0]=1001(MDDI interface + external R), please connect to a terminal resistance (100Ω) between MDDI_D0P and MDDI_D0N.<br>If not used, please let it connected to VSSD. |
| MDDI_D1P,<br>MDDI_D1N             | -   | 6  | High Speed Interface Host | High Speed Interface Data differential signal input pins. (Data lane 1)<br>When BS[3:0]=1001(MDDI interface + external R), please connect to a terminal resistance (100Ω) between MDDI_D1P and MDDI_D1N.<br>If not used, please let it connected to VSSD. |
| MDDI_VCC                          | P   | 5  | Power Supply or Capacitor | High Speed Interface I/O power supply pin, 2.3V to 3.3V.                                                                                                                                                                                                  |
| MDDI_VSS                          | P   | 9  | Ground                    | High Speed Interface I/O ground pin.                                                                                                                                                                                                                      |
| MDDI_LDO                          | O   | 2  | Capacitor                 | High Speed Interface regulator output pin.<br>Connect to a stabilizing capacitor between MDDI_VSS and MDDI_LDO.<br>If not used, please open these pins.                                                                                                   |
| MDDI_LDO_ENB                      | I   | 1  | Input                     | MDDI I/F:<br>Control signal of MDDI_LDO. The default setting of MDDI_LDO_ENB is Low.<br>High: Disable the MDDI_LDO.<br>Low: Enable the MDDI_LDO.<br>It must be connected to VDD1 or VSSD. (latch type)                                                    |

## 3.3 Pin assignment

- Chip Size : 22430 x 1701  $\mu\text{m}$   
(Include scribe line = 80  $\mu\text{m}$ )
- Chip thickness: 250  $\mu\text{m} \pm 25 \mu\text{m}$
- Pad Location: PAD Center
- Coordinate Origin: Chip Center
- Au Bump Size:
  1. 50  $\mu\text{m} \times 80 \mu\text{m}$   
Input:  
No.1 ~ No.312
  2. 15  $\mu\text{m} \times 95 \mu\text{m}$   
Staggered LCD output side  
No.313 ~ No.1760
- The chip size includes the core size seal ring size, and scribe line size
- Au bump pitch: Refer to Pad Coordinate
- Au bump height: 12  $\mu\text{m} \pm 3 \mu\text{m}$
- Numbers in the figure corresponds to pad coordinate numbers





### 3.4 PAD coordinates

| No. | Name      | X      | Y    | No. | Name  | X     | Y    | No. | Name               | X     | Y    | No. | Name               | X    | Y    |
|-----|-----------|--------|------|-----|-------|-------|------|-----|--------------------|-------|------|-----|--------------------|------|------|
| 1   | DUMMY1    | -10885 | -672 | 61  | C21AN | -6685 | -672 | 121 | VDDD               | -2485 | -672 | 181 | DSI D1P / MDDI D1P | 1715 | -672 |
| 2   | CGOUT1_L  | -10815 | -672 | 62  | C21AN | -6615 | -672 | 122 | VDD1               | -2415 | -672 | 182 | DSI DIN / MDDI D1N | 1785 | -672 |
| 3   | CGOUT2_L  | -10745 | -672 | 63  | C23AP | -6545 | -672 | 123 | VDD1               | -2345 | -672 | 183 | DSI DIN / MDDI D1N | 1855 | -672 |
| 4   | CGOUT3_L  | -10675 | -672 | 64  | C23AP | -6475 | -672 | 124 | VDD1               | -2275 | -672 | 184 | DSI DIN / MDDI D1N | 1925 | -672 |
| 5   | CGOUT4_L  | -10605 | -672 | 65  | C23AP | -6405 | -672 | 125 | VDD1               | -2205 | -672 | 185 | DSI VSS / MDDI VSS | 1995 | -672 |
| 6   | CGOUT5_L  | -10535 | -672 | 66  | C23AP | -6335 | -672 | 126 | VDD1               | -2135 | -672 | 186 | DSI CP / MDDI STBP | 2065 | -672 |
| 7   | CGOUT5_L  | -10465 | -672 | 67  | C23AN | -6265 | -672 | 127 | CABC_PWM_OUT       | -2065 | -672 | 187 | DSI CP / MDDI STBP | 2135 | -672 |
| 8   | CGOUT6_L  | -10395 | -672 | 68  | C23AN | -6195 | -672 | 128 | TE                 | -1995 | -672 | 188 | DSI CP / MDDI STBP | 2205 | -672 |
| 9   | CGOUT6_L  | -10325 | -672 | 69  | C23AN | -6125 | -672 | 129 | TEST1              | -1925 | -672 | 189 | DSI CN / MDDI STBN | 2275 | -672 |
| 10  | CGOUT7_L  | -10255 | -672 | 70  | C23AN | -6055 | -672 | 130 | TEST2              | -1855 | -672 | 190 | DSI CN / MDDI STBN | 2345 | -672 |
| 11  | CGOUT7_L  | -10185 | -672 | 71  | C22AP | -5985 | -672 | 131 | BS0                | -1785 | -672 | 191 | DSI CN / MDDI STBN | 2415 | -672 |
| 12  | CGOUT8_L  | -10115 | -672 | 72  | C22AP | -5915 | -672 | 132 | BS1                | -1715 | -672 | 192 | DSI VSS / MDDI VSS | 2485 | -672 |
| 13  | CGOUT8_L  | -10045 | -672 | 73  | C22AP | -5845 | -672 | 133 | BS2                | -1645 | -672 | 193 | DSI DOP / MDDI DOP | 2555 | -672 |
| 14  | CGOUT9_L  | -9975  | -672 | 74  | C22AP | -5775 | -672 | 134 | BS3                | -1575 | -672 | 194 | DSI DOP / MDDI DOP | 2625 | -672 |
| 15  | CGOUT10_L | -9905  | -672 | 75  | C22AN | -5705 | -672 | 135 | RESX               | -1505 | -672 | 195 | DSI DOP / MDDI DOP | 2695 | -672 |
| 16  | VGL       | -9835  | -672 | 76  | C22AN | -5635 | -672 | 136 | IOGNDDUM           | -1435 | -672 | 196 | DSI DON / MDDI DON | 2765 | -672 |
| 17  | VGL       | -9765  | -672 | 77  | C22AN | -5565 | -672 | 137 | DB23               | -1365 | -672 | 197 | DSI DON / MDDI DON | 2835 | -672 |
| 18  | VGL       | -9695  | -672 | 78  | C22AN | -5495 | -672 | 138 | DB22               | -1295 | -672 | 198 | DSI DON / MDDI DON | 2905 | -672 |
| 19  | VBIAS     | -9625  | -672 | 79  | C24AP | -5425 | -672 | 139 | DB21               | -1225 | -672 | 199 | DSI VSS / MDDI VSS | 2975 | -672 |
| 20  | LVGL      | -9555  | -672 | 80  | C24AP | -5355 | -672 | 140 | DB20               | -1155 | -672 | 200 | DSI LDO / MDDI LDO | 3045 | -672 |
| 21  | LVGL      | -9485  | -672 | 81  | C24AP | -5285 | -672 | 141 | DB19               | -1085 | -672 | 201 | DSI LDO / MDDI LDO | 3115 | -672 |
| 22  | LVGL      | -9415  | -672 | 82  | C24AP | -5215 | -672 | 142 | DB18               | -1015 | -672 | 202 | DSI VCC / MDDI VCC | 3185 | -672 |
| 23  | DUMMY2    | -9345  | -672 | 83  | C24AN | -5145 | -672 | 143 | DB17               | -945  | -672 | 203 | DSI VCC / MDDI VCC | 3255 | -672 |
| 24  | VCOM      | -9275  | -672 | 84  | C24AN | -5075 | -672 | 144 | DB16               | -875  | -672 | 204 | DSI VCC / MDDI VCC | 3325 | -672 |
| 25  | VCOM      | -9205  | -672 | 85  | C24AN | -5005 | -672 | 145 | DB15               | -805  | -672 | 205 | DSI VCC / MDDI VCC | 3395 | -672 |
| 26  | VCOM      | -9135  | -672 | 86  | C24AN | -4935 | -672 | 146 | DB14               | -735  | -672 | 206 | DSI VCC / MDDI VCC | 3465 | -672 |
| 27  | DUMMY3    | -9065  | -672 | 87  | VPP   | -4865 | -672 | 147 | DB13               | -665  | -672 | 207 | DSI VSS / MDDI VSS | 3535 | -672 |
| 28  | DUMMYR1   | -8995  | -672 | 88  | VPP   | -4795 | -672 | 148 | DB12               | -595  | -672 | 208 | DSI VSS / MDDI VSS | 3605 | -672 |
| 29  | DUMMYR2   | -8925  | -672 | 89  | VDDDN | -4725 | -672 | 149 | DB11               | -525  | -672 | 209 | DSI VSS / MDDI VSS | 3675 | -672 |
| 30  | DUMMY4    | -8855  | -672 | 90  | VDDDN | -4655 | -672 | 150 | DB10               | -455  | -672 | 210 | DSI VSS / MDDI VSS | 3745 | -672 |
| 31  | VGL       | -8785  | -672 | 91  | VDDDN | -4585 | -672 | 151 | DB9                | -385  | -672 | 211 | DSI VSS / MDDI VSS | 3815 | -672 |
| 32  | VGL       | -8715  | -672 | 92  | VDDDN | -4515 | -672 | 152 | DB8                | -315  | -672 | 212 | VSSAC              | 3885 | -672 |
| 33  | VGL       | -8645  | -672 | 93  | VDDDN | -4445 | -672 | 153 | DB7                | -245  | -672 | 213 | VSSAC              | 3955 | -672 |
| 34  | LVGL      | -8575  | -672 | 94  | VDD2  | -4375 | -672 | 154 | DB6                | -175  | -672 | 214 | VSSD               | 4025 | -672 |
| 35  | LVGL      | -8505  | -672 | 95  | VDD2  | -4305 | -672 | 155 | DB5                | -105  | -672 | 215 | VSSD               | 4095 | -672 |
| 36  | LVGL      | -8435  | -672 | 96  | VDD2  | -4235 | -672 | 156 | DB4                | -35   | -672 | 216 | VSSD               | 4165 | -672 |
| 37  | LVGL      | -8365  | -672 | 97  | VDD2  | -4165 | -672 | 157 | DB3                | 35    | -672 | 217 | VSSD               | 4235 | -672 |
| 38  | LVGL      | -8295  | -672 | 98  | VDD2  | -4095 | -672 | 158 | DB2                | 105   | -672 | 218 | VSSD               | 4305 | -672 |
| 39  | VCOM      | -8225  | -672 | 99  | VDD2  | -4025 | -672 | 159 | DB1                | 175   | -672 | 219 | VSSD               | 4375 | -672 |
| 40  | VCOM      | -8155  | -672 | 100 | VREF  | -3955 | -672 | 160 | DB0                | 245   | -672 | 220 | VSSD               | 4445 | -672 |
| 41  | VCOM      | -8085  | -672 | 101 | VREF  | -3885 | -672 | 161 | IOGNDDUM           | 315   | -672 | 221 | VSSD               | 4515 | -672 |
| 42  | VCOM      | -8015  | -672 | 102 | VSSA  | -3815 | -672 | 162 | RDX_E              | 385   | -672 | 222 | VDDD               | 4585 | -672 |
| 43  | C41AP     | -7945  | -672 | 103 | VSSA  | -3745 | -672 | 163 | WRX_DCX            | 455   | -672 | 223 | VDDD               | 4655 | -672 |
| 44  | C41AP     | -7875  | -672 | 104 | VSSA  | -3675 | -672 | 164 | DCX_SCL            | 525   | -672 | 224 | VDDD               | 4725 | -672 |
| 45  | C41AP     | -7805  | -672 | 105 | VSSA  | -3605 | -672 | 165 | CSX                | 595   | -672 | 225 | VDDD               | 4795 | -672 |
| 46  | C41AN     | -7735  | -672 | 106 | VSSA  | -3535 | -672 | 166 | IOGNDDUM           | 665   | -672 | 226 | VDDD               | 4865 | -672 |
| 47  | C41AN     | -7665  | -672 | 107 | VSSA  | -3465 | -672 | 167 | SDI                | 735   | -672 | 227 | VDDD               | 4935 | -672 |
| 48  | C41AN     | -7595  | -672 | 108 | VSSD  | -3395 | -672 | 168 | SDO                | 805   | -672 | 228 | VDDD               | 5005 | -672 |
| 49  | VGH       | -7525  | -672 | 109 | VSSD  | -3325 | -672 | 169 | VSXNC              | 875   | -672 | 229 | VDDD               | 5075 | -672 |
| 50  | VGH       | -7455  | -672 | 110 | VSSD  | -3255 | -672 | 170 | HSXNC              | 945   | -672 | 230 | VDDD               | 5145 | -672 |
| 51  | VGH       | -7385  | -672 | 111 | VSSD  | -3185 | -672 | 171 | DE                 | 1015  | -672 | 231 | VDDD               | 5215 | -672 |
| 52  | VGH       | -7315  | -672 | 112 | VSSD  | -3115 | -672 | 172 | PCLK               | 1085  | -672 | 232 | VDDD               | 5285 | -672 |
| 53  | VGH       | -7245  | -672 | 113 | VSSD  | -3045 | -672 | 173 | DSI_LDO_ENB        | 1155  | -672 | 233 | VDDD               | 5355 | -672 |
| 54  | VGH       | -7175  | -672 | 114 | VSSD  | -2975 | -672 | 174 | DUMMY5             | 1225  | -672 | 234 | VDDD               | 5425 | -672 |
| 55  | C21AP     | -7105  | -672 | 115 | VSSD  | -2905 | -672 | 175 | OSC                | 1295  | -672 | 235 | VSPR               | 5495 | -672 |
| 56  | C21AP     | -7035  | -672 | 116 | VDDD  | -2835 | -672 | 176 | PCCS0              | 1365  | -672 | 236 | VSPR               | 5565 | -672 |
| 57  | C21AP     | -6965  | -672 | 117 | VDDD  | -2765 | -672 | 177 | PCCS1              | 1435  | -672 | 237 | VSPC               | 5635 | -672 |
| 58  | C21AP     | -6895  | -672 | 118 | VDDD  | -2695 | -672 | 178 | DSI_VSS / MDDI_VSS | 1505  | -672 | 238 | VSP                | 5705 | -672 |
| 59  | C21AN     | -6825  | -672 | 119 | VDDD  | -2625 | -672 | 179 | DSI_D1P / MDDI_D1P | 1575  | -672 | 239 | VSP                | 5775 | -672 |
| 60  | C21AN     | -6755  | -672 | 120 | VDDD  | -2555 | -672 | 180 | DSI_D1P / MDDI_D1P | 1645  | -672 | 240 | VSP                | 5845 | -672 |



| No. | Name      | X     | Y    | No. | Name     | X     | Y    | No. | Name | X     | Y   | No. | Name | X    | Y   |
|-----|-----------|-------|------|-----|----------|-------|------|-----|------|-------|-----|-----|------|------|-----|
| 241 | VSP       | 5915  | -672 | 301 | CGOUT7_R | 10115 | -672 | 361 | S47  | 10230 | 500 | 421 | S107 | 9330 | 500 |
| 242 | VSP       | 5985  | -672 | 302 | CGOUT7_R | 10185 | -672 | 362 | S48  | 10215 | 613 | 422 | S108 | 9315 | 613 |
| 243 | VSP       | 6055  | -672 | 303 | CGOUT6_R | 10255 | -672 | 363 | S49  | 10200 | 500 | 423 | S109 | 9300 | 500 |
| 244 | VSP       | 6125  | -672 | 304 | CGOUT6_R | 10325 | -672 | 364 | S50  | 10185 | 613 | 424 | S110 | 9285 | 613 |
| 245 | VCSW1     | 6195  | -672 | 305 | CGOUT5_R | 10395 | -672 | 365 | S51  | 10170 | 500 | 425 | S111 | 9270 | 500 |
| 246 | VCSW1     | 6265  | -672 | 306 | CGOUT5_R | 10465 | -672 | 366 | S52  | 10155 | 613 | 426 | S112 | 9255 | 613 |
| 247 | VCSW1     | 6335  | -672 | 307 | CGOUT4_R | 10535 | -672 | 367 | S53  | 10140 | 500 | 427 | S113 | 9240 | 500 |
| 248 | VCSW1     | 6405  | -672 | 308 | CGOUT3_R | 10605 | -672 | 368 | S54  | 10125 | 613 | 428 | S114 | 9225 | 613 |
| 249 | VCSW2     | 6475  | -672 | 309 | CGOUT2_R | 10675 | -672 | 369 | S55  | 10110 | 500 | 429 | S115 | 9210 | 500 |
| 250 | VCSW2     | 6545  | -672 | 310 | CGOUT1_R | 10745 | -672 | 370 | S56  | 10095 | 613 | 430 | S116 | 9195 | 613 |
| 251 | VCSW2     | 6615  | -672 | 311 | DUMMY9   | 10815 | -672 | 371 | S57  | 10080 | 500 | 431 | S117 | 9180 | 500 |
| 252 | VCSW2     | 6685  | -672 | 312 | DUMMY10  | 10885 | -672 | 372 | S58  | 10065 | 613 | 432 | S118 | 9165 | 613 |
| 253 | VSNR      | 6755  | -672 | 313 | DUMMY15  | 10950 | 500  | 373 | S59  | 10050 | 500 | 433 | S119 | 9150 | 500 |
| 254 | VSNR      | 6825  | -672 | 314 | DUMMY16  | 10935 | 613  | 374 | S60  | 10035 | 613 | 434 | S120 | 9135 | 613 |
| 255 | VSNC      | 6895  | -672 | 315 | S1       | 10920 | 500  | 375 | S61  | 10020 | 500 | 435 | S121 | 9120 | 500 |
| 256 | VSN       | 6965  | -672 | 316 | S2       | 10905 | 613  | 376 | S62  | 10005 | 613 | 436 | S122 | 9105 | 613 |
| 257 | VSN       | 7035  | -672 | 317 | S3       | 10890 | 500  | 377 | S63  | 9990  | 500 | 437 | S123 | 9090 | 500 |
| 258 | VSN       | 7105  | -672 | 318 | S4       | 10875 | 613  | 378 | S64  | 9975  | 613 | 438 | S124 | 9075 | 613 |
| 259 | VSN       | 7175  | -672 | 319 | S5       | 10860 | 500  | 379 | S65  | 9960  | 500 | 439 | S125 | 9060 | 500 |
| 260 | VSN       | 7245  | -672 | 320 | S6       | 10845 | 613  | 380 | S66  | 9945  | 613 | 440 | S126 | 9045 | 613 |
| 261 | VSN       | 7315  | -672 | 321 | S7       | 10830 | 500  | 381 | S67  | 9930  | 500 | 441 | S127 | 9030 | 500 |
| 262 | VDD3      | 7385  | -672 | 322 | S8       | 10815 | 613  | 382 | S68  | 9915  | 613 | 442 | S128 | 9015 | 613 |
| 263 | VDD3      | 7455  | -672 | 323 | S9       | 10800 | 500  | 383 | S69  | 9900  | 500 | 443 | S129 | 9000 | 500 |
| 264 | VDD3      | 7525  | -672 | 324 | S10      | 10785 | 613  | 384 | S70  | 9885  | 613 | 444 | S130 | 8985 | 613 |
| 265 | VDD3      | 7595  | -672 | 325 | S11      | 10770 | 500  | 385 | S71  | 9870  | 500 | 445 | S131 | 8970 | 500 |
| 266 | VDD3      | 7665  | -672 | 326 | S12      | 10755 | 613  | 386 | S72  | 9855  | 613 | 446 | S132 | 8955 | 613 |
| 267 | VDD3      | 7735  | -672 | 327 | S13      | 10740 | 500  | 387 | S73  | 9840  | 500 | 447 | S133 | 8940 | 500 |
| 268 | VGH       | 7805  | -672 | 328 | S14      | 10725 | 613  | 388 | S74  | 9825  | 613 | 448 | S134 | 8925 | 613 |
| 269 | VGH       | 7875  | -672 | 329 | S15      | 10710 | 500  | 389 | S75  | 9810  | 500 | 449 | S135 | 8910 | 500 |
| 270 | VGH       | 7945  | -672 | 330 | S16      | 10695 | 613  | 390 | S76  | 9795  | 613 | 450 | S136 | 8895 | 613 |
| 271 | VGH       | 8015  | -672 | 331 | S17      | 10680 | 500  | 391 | S77  | 9780  | 500 | 451 | S137 | 8880 | 500 |
| 272 | VCOM      | 8085  | -672 | 332 | S18      | 10665 | 613  | 392 | S78  | 9765  | 613 | 452 | S138 | 8865 | 613 |
| 273 | VCOM      | 8155  | -672 | 333 | S19      | 10650 | 500  | 393 | S79  | 9750  | 500 | 453 | S139 | 8850 | 500 |
| 274 | VCOM      | 8225  | -672 | 334 | S20      | 10635 | 613  | 394 | S80  | 9735  | 613 | 454 | S140 | 8835 | 613 |
| 275 | VCOM      | 8295  | -672 | 335 | S21      | 10620 | 500  | 395 | S81  | 9720  | 500 | 455 | S141 | 8820 | 500 |
| 276 | LVGL      | 8365  | -672 | 336 | S22      | 10605 | 613  | 396 | S82  | 9705  | 613 | 456 | S142 | 8805 | 613 |
| 277 | LVGL      | 8435  | -672 | 337 | S23      | 10590 | 500  | 397 | S83  | 9690  | 500 | 457 | S143 | 8790 | 500 |
| 278 | LVGL      | 8505  | -672 | 338 | S24      | 10575 | 613  | 398 | S84  | 9675  | 613 | 458 | S144 | 8775 | 613 |
| 279 | LVGL      | 8575  | -672 | 339 | S25      | 10560 | 500  | 399 | S85  | 9660  | 500 | 459 | S145 | 8760 | 500 |
| 280 | VTESTOUTP | 8645  | -672 | 340 | S26      | 10545 | 613  | 400 | S86  | 9645  | 613 | 460 | S146 | 8745 | 613 |
| 281 | DUMMY6    | 8715  | -672 | 341 | S27      | 10530 | 500  | 401 | S87  | 9630  | 500 | 461 | S147 | 8730 | 500 |
| 282 | VCOMR     | 8785  | -672 | 342 | S28      | 10515 | 613  | 402 | S88  | 9615  | 613 | 462 | S148 | 8715 | 613 |
| 283 | VTESTOUTN | 8855  | -672 | 343 | S29      | 10500 | 500  | 403 | S89  | 9600  | 500 | 463 | S149 | 8700 | 500 |
| 284 | VCOM      | 8925  | -672 | 344 | S30      | 10485 | 613  | 404 | S90  | 9585  | 613 | 464 | S150 | 8685 | 613 |
| 285 | VCOM      | 8995  | -672 | 345 | S31      | 10470 | 500  | 405 | S91  | 9570  | 500 | 465 | S151 | 8670 | 500 |
| 286 | VCOM      | 9065  | -672 | 346 | S32      | 10455 | 613  | 406 | S92  | 9555  | 613 | 466 | S152 | 8655 | 613 |
| 287 | DUMMY7    | 9135  | -672 | 347 | S33      | 10440 | 500  | 407 | S93  | 9540  | 500 | 467 | S153 | 8640 | 500 |
| 288 | DUMMY8    | 9205  | -672 | 348 | S34      | 10425 | 613  | 408 | S94  | 9525  | 613 | 468 | S154 | 8625 | 613 |
| 289 | LVGL      | 9275  | -672 | 349 | S35      | 10410 | 500  | 409 | S95  | 9510  | 500 | 469 | S155 | 8610 | 500 |
| 290 | LVGL      | 9345  | -672 | 350 | S36      | 10395 | 613  | 410 | S96  | 9495  | 613 | 470 | S156 | 8595 | 613 |
| 291 | LVGL      | 9415  | -672 | 351 | S37      | 10380 | 500  | 411 | S97  | 9480  | 500 | 471 | S157 | 8580 | 500 |
| 292 | VBIAS     | 9485  | -672 | 352 | S38      | 10365 | 613  | 412 | S98  | 9465  | 613 | 472 | S158 | 8565 | 613 |
| 293 | VGL       | 9555  | -672 | 353 | S39      | 10350 | 500  | 413 | S99  | 9450  | 500 | 473 | S159 | 8550 | 500 |
| 294 | VGL       | 9625  | -672 | 354 | S40      | 10335 | 613  | 414 | S100 | 9435  | 613 | 474 | S160 | 8535 | 613 |
| 295 | VGL       | 9695  | -672 | 355 | S41      | 10320 | 500  | 415 | S101 | 9420  | 500 | 475 | S161 | 8520 | 500 |
| 296 | VGL       | 9765  | -672 | 356 | S42      | 10305 | 613  | 416 | S102 | 9405  | 613 | 476 | S162 | 8505 | 613 |
| 297 | CGOUT10_R | 9835  | -672 | 357 | S43      | 10290 | 500  | 417 | S103 | 9390  | 500 | 477 | S163 | 8490 | 500 |
| 298 | CGOUT9_R  | 9905  | -672 | 358 | S44      | 10275 | 613  | 418 | S104 | 9375  | 613 | 478 | S164 | 8475 | 613 |
| 299 | CGOUT8_R  | 9975  | -672 | 359 | S45      | 10260 | 500  | 419 | S105 | 9360  | 500 | 479 | S165 | 8460 | 500 |
| 300 | CGOUT8_R  | 10045 | -672 | 360 | S46      | 10245 | 613  | 420 | S106 | 9345  | 613 | 480 | S166 | 8445 | 613 |

| No. | Name | X    | Y   | No. | Name | X    | Y   | No. | Name | X    | Y   | No. | Name | X    | Y   |
|-----|------|------|-----|-----|------|------|-----|-----|------|------|-----|-----|------|------|-----|
| 481 | S167 | 8430 | 500 | 541 | S227 | 7530 | 500 | 601 | S287 | 6630 | 500 | 661 | S347 | 5730 | 500 |
| 482 | S168 | 8415 | 613 | 542 | S228 | 7515 | 613 | 602 | S288 | 6615 | 613 | 662 | S348 | 5715 | 613 |
| 483 | S169 | 8400 | 500 | 543 | S229 | 7500 | 500 | 603 | S289 | 6600 | 500 | 663 | S349 | 5700 | 500 |
| 484 | S170 | 8385 | 613 | 544 | S230 | 7485 | 613 | 604 | S290 | 6585 | 613 | 664 | S350 | 5685 | 613 |
| 485 | S171 | 8370 | 500 | 545 | S231 | 7470 | 500 | 605 | S291 | 6570 | 500 | 665 | S351 | 5670 | 500 |
| 486 | S172 | 8355 | 613 | 546 | S232 | 7455 | 613 | 606 | S292 | 6555 | 613 | 666 | S352 | 5655 | 613 |
| 487 | S173 | 8340 | 500 | 547 | S233 | 7440 | 500 | 607 | S293 | 6540 | 500 | 667 | S353 | 5640 | 500 |
| 488 | S174 | 8325 | 613 | 548 | S234 | 7425 | 613 | 608 | S294 | 6525 | 613 | 668 | S354 | 5625 | 613 |
| 489 | S175 | 8310 | 500 | 549 | S235 | 7410 | 500 | 609 | S295 | 6510 | 500 | 669 | S355 | 5610 | 500 |
| 490 | S176 | 8295 | 613 | 550 | S236 | 7395 | 613 | 610 | S296 | 6495 | 613 | 670 | S356 | 5595 | 613 |
| 491 | S177 | 8280 | 500 | 551 | S237 | 7380 | 500 | 611 | S297 | 6480 | 500 | 671 | S357 | 5580 | 500 |
| 492 | S178 | 8265 | 613 | 552 | S238 | 7365 | 613 | 612 | S298 | 6465 | 613 | 672 | S358 | 5565 | 613 |
| 493 | S179 | 8250 | 500 | 553 | S239 | 7350 | 500 | 613 | S299 | 6450 | 500 | 673 | S359 | 5550 | 500 |
| 494 | S180 | 8235 | 613 | 554 | S240 | 7335 | 613 | 614 | S300 | 6435 | 613 | 674 | S360 | 5535 | 613 |
| 495 | S181 | 8220 | 500 | 555 | S241 | 7320 | 500 | 615 | S301 | 6420 | 500 | 675 | S361 | 5520 | 500 |
| 496 | S182 | 8205 | 613 | 556 | S242 | 7305 | 613 | 616 | S302 | 6405 | 613 | 676 | S362 | 5505 | 613 |
| 497 | S183 | 8190 | 500 | 557 | S243 | 7290 | 500 | 617 | S303 | 6390 | 500 | 677 | S363 | 5490 | 500 |
| 498 | S184 | 8175 | 613 | 558 | S244 | 7275 | 613 | 618 | S304 | 6375 | 613 | 678 | S364 | 5475 | 613 |
| 499 | S185 | 8160 | 500 | 559 | S245 | 7260 | 500 | 619 | S305 | 6360 | 500 | 679 | S365 | 5460 | 500 |
| 500 | S186 | 8145 | 613 | 560 | S246 | 7245 | 613 | 620 | S306 | 6345 | 613 | 680 | S366 | 5445 | 613 |
| 501 | S187 | 8130 | 500 | 561 | S247 | 7230 | 500 | 621 | S307 | 6330 | 500 | 681 | S367 | 5430 | 500 |
| 502 | S188 | 8115 | 613 | 562 | S248 | 7215 | 613 | 622 | S308 | 6315 | 613 | 682 | S368 | 5415 | 613 |
| 503 | S189 | 8100 | 500 | 563 | S249 | 7200 | 500 | 623 | S309 | 6300 | 500 | 683 | S369 | 5400 | 500 |
| 504 | S190 | 8085 | 613 | 564 | S250 | 7185 | 613 | 624 | S310 | 6285 | 613 | 684 | S370 | 5385 | 613 |
| 505 | S191 | 8070 | 500 | 565 | S251 | 7170 | 500 | 625 | S311 | 6270 | 500 | 685 | S371 | 5370 | 500 |
| 506 | S192 | 8055 | 613 | 566 | S252 | 7155 | 613 | 626 | S312 | 6255 | 613 | 686 | S372 | 5355 | 613 |
| 507 | S193 | 8040 | 500 | 567 | S253 | 7140 | 500 | 627 | S313 | 6240 | 500 | 687 | S373 | 5340 | 500 |
| 508 | S194 | 8025 | 613 | 568 | S254 | 7125 | 613 | 628 | S314 | 6225 | 613 | 688 | S374 | 5325 | 613 |
| 509 | S195 | 8010 | 500 | 569 | S255 | 7110 | 500 | 629 | S315 | 6210 | 500 | 689 | S375 | 5310 | 500 |
| 510 | S196 | 7995 | 613 | 570 | S256 | 7095 | 613 | 630 | S316 | 6195 | 613 | 690 | S376 | 5295 | 613 |
| 511 | S197 | 7980 | 500 | 571 | S257 | 7080 | 500 | 631 | S317 | 6180 | 500 | 691 | S377 | 5280 | 500 |
| 512 | S198 | 7965 | 613 | 572 | S258 | 7065 | 613 | 632 | S318 | 6165 | 613 | 692 | S378 | 5265 | 613 |
| 513 | S199 | 7950 | 500 | 573 | S259 | 7050 | 500 | 633 | S319 | 6150 | 500 | 693 | S379 | 5250 | 500 |
| 514 | S200 | 7935 | 613 | 574 | S260 | 7035 | 613 | 634 | S320 | 6135 | 613 | 694 | S380 | 5235 | 613 |
| 515 | S201 | 7920 | 500 | 575 | S261 | 7020 | 500 | 635 | S321 | 6120 | 500 | 695 | S381 | 5220 | 500 |
| 516 | S202 | 7905 | 613 | 576 | S262 | 7005 | 613 | 636 | S322 | 6105 | 613 | 696 | S382 | 5205 | 613 |
| 517 | S203 | 7890 | 500 | 577 | S263 | 6990 | 500 | 637 | S323 | 6090 | 500 | 697 | S383 | 5190 | 500 |
| 518 | S204 | 7875 | 613 | 578 | S264 | 6975 | 613 | 638 | S324 | 6075 | 613 | 698 | S384 | 5175 | 613 |
| 519 | S205 | 7860 | 500 | 579 | S265 | 6960 | 500 | 639 | S325 | 6060 | 500 | 699 | S385 | 5160 | 500 |
| 520 | S206 | 7845 | 613 | 580 | S266 | 6945 | 613 | 640 | S326 | 6045 | 613 | 700 | S386 | 5145 | 613 |
| 521 | S207 | 7830 | 500 | 581 | S267 | 6930 | 500 | 641 | S327 | 6030 | 500 | 701 | S387 | 5130 | 500 |
| 522 | S208 | 7815 | 613 | 582 | S268 | 6915 | 613 | 642 | S328 | 6015 | 613 | 702 | S388 | 5115 | 613 |
| 523 | S209 | 7800 | 500 | 583 | S269 | 6900 | 500 | 643 | S329 | 6000 | 500 | 703 | S389 | 5100 | 500 |
| 524 | S210 | 7785 | 613 | 584 | S270 | 6885 | 613 | 644 | S330 | 5985 | 613 | 704 | S390 | 5085 | 613 |
| 525 | S211 | 7770 | 500 | 585 | S271 | 6870 | 500 | 645 | S331 | 5970 | 500 | 705 | S391 | 5070 | 500 |
| 526 | S212 | 7755 | 613 | 586 | S272 | 6855 | 613 | 646 | S332 | 5955 | 613 | 706 | S392 | 5055 | 613 |
| 527 | S213 | 7740 | 500 | 587 | S273 | 6840 | 500 | 647 | S333 | 5940 | 500 | 707 | S393 | 5040 | 500 |
| 528 | S214 | 7725 | 613 | 588 | S274 | 6825 | 613 | 648 | S334 | 5925 | 613 | 708 | S394 | 5025 | 613 |
| 529 | S215 | 7710 | 500 | 589 | S275 | 6810 | 500 | 649 | S335 | 5910 | 500 | 709 | S395 | 5010 | 500 |
| 530 | S216 | 7695 | 613 | 590 | S276 | 6795 | 613 | 650 | S336 | 5895 | 613 | 710 | S396 | 4995 | 613 |
| 531 | S217 | 7680 | 500 | 591 | S277 | 6780 | 500 | 651 | S337 | 5880 | 500 | 711 | S397 | 4980 | 500 |
| 532 | S218 | 7665 | 613 | 592 | S278 | 6765 | 613 | 652 | S338 | 5865 | 613 | 712 | S398 | 4965 | 613 |
| 533 | S219 | 7650 | 500 | 593 | S279 | 6750 | 500 | 653 | S339 | 5850 | 500 | 713 | S399 | 4950 | 500 |
| 534 | S220 | 7635 | 613 | 594 | S280 | 6735 | 613 | 654 | S340 | 5835 | 613 | 714 | S400 | 4935 | 613 |
| 535 | S221 | 7620 | 500 | 595 | S281 | 6720 | 500 | 655 | S341 | 5820 | 500 | 715 | S401 | 4920 | 500 |
| 536 | S222 | 7605 | 613 | 596 | S282 | 6705 | 613 | 656 | S342 | 5805 | 613 | 716 | S402 | 4905 | 613 |
| 537 | S223 | 7590 | 500 | 597 | S283 | 6690 | 500 | 657 | S343 | 5790 | 500 | 717 | S403 | 4890 | 500 |
| 538 | S224 | 7575 | 613 | 598 | S284 | 6675 | 613 | 658 | S344 | 5775 | 613 | 718 | S404 | 4875 | 613 |
| 539 | S225 | 7560 | 500 | 599 | S285 | 6660 | 500 | 659 | S345 | 5760 | 500 | 719 | S405 | 4860 | 500 |
| 540 | S226 | 7545 | 613 | 600 | S286 | 6645 | 613 | 660 | S346 | 5745 | 613 | 720 | S406 | 4845 | 613 |

| No. | Name | X    | Y   | No. | Name | X    | Y   | No. | Name | X    | Y   | No. | Name | X    | Y   |
|-----|------|------|-----|-----|------|------|-----|-----|------|------|-----|-----|------|------|-----|
| 721 | S407 | 4830 | 500 | 781 | S467 | 3930 | 500 | 841 | S527 | 3030 | 500 | 901 | S587 | 2130 | 500 |
| 722 | S408 | 4815 | 613 | 782 | S468 | 3915 | 613 | 842 | S528 | 3015 | 613 | 902 | S588 | 2115 | 613 |
| 723 | S409 | 4800 | 500 | 783 | S469 | 3900 | 500 | 843 | S529 | 3000 | 500 | 903 | S589 | 2100 | 500 |
| 724 | S410 | 4785 | 613 | 784 | S470 | 3885 | 613 | 844 | S530 | 2985 | 613 | 904 | S590 | 2085 | 613 |
| 725 | S411 | 4770 | 500 | 785 | S471 | 3870 | 500 | 845 | S531 | 2970 | 500 | 905 | S591 | 2070 | 500 |
| 726 | S412 | 4755 | 613 | 786 | S472 | 3855 | 613 | 846 | S532 | 2955 | 613 | 906 | S592 | 2055 | 613 |
| 727 | S413 | 4740 | 500 | 787 | S473 | 3840 | 500 | 847 | S533 | 2940 | 500 | 907 | S593 | 2040 | 500 |
| 728 | S414 | 4725 | 613 | 788 | S474 | 3825 | 613 | 848 | S534 | 2925 | 613 | 908 | S594 | 2025 | 613 |
| 729 | S415 | 4710 | 500 | 789 | S475 | 3810 | 500 | 849 | S535 | 2910 | 500 | 909 | S595 | 2010 | 500 |
| 730 | S416 | 4695 | 613 | 790 | S476 | 3795 | 613 | 850 | S536 | 2895 | 613 | 910 | S596 | 1995 | 613 |
| 731 | S417 | 4680 | 500 | 791 | S477 | 3780 | 500 | 851 | S537 | 2880 | 500 | 911 | S597 | 1980 | 500 |
| 732 | S418 | 4665 | 613 | 792 | S478 | 3765 | 613 | 852 | S538 | 2865 | 613 | 912 | S598 | 1965 | 613 |
| 733 | S419 | 4650 | 500 | 793 | S479 | 3750 | 500 | 853 | S539 | 2850 | 500 | 913 | S599 | 1950 | 500 |
| 734 | S420 | 4635 | 613 | 794 | S480 | 3735 | 613 | 854 | S540 | 2835 | 613 | 914 | S600 | 1935 | 613 |
| 735 | S421 | 4620 | 500 | 795 | S481 | 3720 | 500 | 855 | S541 | 2820 | 500 | 915 | S601 | 1920 | 500 |
| 736 | S422 | 4605 | 613 | 796 | S482 | 3705 | 613 | 856 | S542 | 2805 | 613 | 916 | S602 | 1905 | 613 |
| 737 | S423 | 4590 | 500 | 797 | S483 | 3690 | 500 | 857 | S543 | 2790 | 500 | 917 | S603 | 1890 | 500 |
| 738 | S424 | 4575 | 613 | 798 | S484 | 3675 | 613 | 858 | S544 | 2775 | 613 | 918 | S604 | 1875 | 613 |
| 739 | S425 | 4560 | 500 | 799 | S485 | 3660 | 500 | 859 | S545 | 2760 | 500 | 919 | S605 | 1860 | 500 |
| 740 | S426 | 4545 | 613 | 800 | S486 | 3645 | 613 | 860 | S546 | 2745 | 613 | 920 | S606 | 1845 | 613 |
| 741 | S427 | 4530 | 500 | 801 | S487 | 3630 | 500 | 861 | S547 | 2730 | 500 | 921 | S607 | 1830 | 500 |
| 742 | S428 | 4515 | 613 | 802 | S488 | 3615 | 613 | 862 | S548 | 2715 | 613 | 922 | S608 | 1815 | 613 |
| 743 | S429 | 4500 | 500 | 803 | S489 | 3600 | 500 | 863 | S549 | 2700 | 500 | 923 | S609 | 1800 | 500 |
| 744 | S430 | 4485 | 613 | 804 | S490 | 3585 | 613 | 864 | S550 | 2685 | 613 | 924 | S610 | 1785 | 613 |
| 745 | S431 | 4470 | 500 | 805 | S491 | 3570 | 500 | 865 | S551 | 2670 | 500 | 925 | S611 | 1770 | 500 |
| 746 | S432 | 4455 | 613 | 806 | S492 | 3555 | 613 | 866 | S552 | 2655 | 613 | 926 | S612 | 1755 | 613 |
| 747 | S433 | 4440 | 500 | 807 | S493 | 3540 | 500 | 867 | S553 | 2640 | 500 | 927 | S613 | 1740 | 500 |
| 748 | S434 | 4425 | 613 | 808 | S494 | 3525 | 613 | 868 | S554 | 2625 | 613 | 928 | S614 | 1725 | 613 |
| 749 | S435 | 4410 | 500 | 809 | S495 | 3510 | 500 | 869 | S555 | 2610 | 500 | 929 | S615 | 1710 | 500 |
| 750 | S436 | 4395 | 613 | 810 | S496 | 3495 | 613 | 870 | S556 | 2595 | 613 | 930 | S616 | 1695 | 613 |
| 751 | S437 | 4380 | 500 | 811 | S497 | 3480 | 500 | 871 | S557 | 2580 | 500 | 931 | S617 | 1680 | 500 |
| 752 | S438 | 4365 | 613 | 812 | S498 | 3465 | 613 | 872 | S558 | 2565 | 613 | 932 | S618 | 1665 | 613 |
| 753 | S439 | 4350 | 500 | 813 | S499 | 3450 | 500 | 873 | S559 | 2550 | 500 | 933 | S619 | 1650 | 500 |
| 754 | S440 | 4335 | 613 | 814 | S500 | 3435 | 613 | 874 | S560 | 2535 | 613 | 934 | S620 | 1635 | 613 |
| 755 | S441 | 4320 | 500 | 815 | S501 | 3420 | 500 | 875 | S561 | 2520 | 500 | 935 | S621 | 1620 | 500 |
| 756 | S442 | 4305 | 613 | 816 | S502 | 3405 | 613 | 876 | S562 | 2505 | 613 | 936 | S622 | 1605 | 613 |
| 757 | S443 | 4290 | 500 | 817 | S503 | 3390 | 500 | 877 | S563 | 2490 | 500 | 937 | S623 | 1590 | 500 |
| 758 | S444 | 4275 | 613 | 818 | S504 | 3375 | 613 | 878 | S564 | 2475 | 613 | 938 | S624 | 1575 | 613 |
| 759 | S445 | 4260 | 500 | 819 | S505 | 3360 | 500 | 879 | S565 | 2460 | 500 | 939 | S625 | 1560 | 500 |
| 760 | S446 | 4245 | 613 | 820 | S506 | 3345 | 613 | 880 | S566 | 2445 | 613 | 940 | S626 | 1545 | 613 |
| 761 | S447 | 4230 | 500 | 821 | S507 | 3330 | 500 | 881 | S567 | 2430 | 500 | 941 | S627 | 1530 | 500 |
| 762 | S448 | 4215 | 613 | 822 | S508 | 3315 | 613 | 882 | S568 | 2415 | 613 | 942 | S628 | 1515 | 613 |
| 763 | S449 | 4200 | 500 | 823 | S509 | 3300 | 500 | 883 | S569 | 2400 | 500 | 943 | S629 | 1500 | 500 |
| 764 | S450 | 4185 | 613 | 824 | S510 | 3285 | 613 | 884 | S570 | 2385 | 613 | 944 | S630 | 1485 | 613 |
| 765 | S451 | 4170 | 500 | 825 | S511 | 3270 | 500 | 885 | S571 | 2370 | 500 | 945 | S631 | 1470 | 500 |
| 766 | S452 | 4155 | 613 | 826 | S512 | 3255 | 613 | 886 | S572 | 2355 | 613 | 946 | S632 | 1455 | 613 |
| 767 | S453 | 4140 | 500 | 827 | S513 | 3240 | 500 | 887 | S573 | 2340 | 500 | 947 | S633 | 1440 | 500 |
| 768 | S454 | 4125 | 613 | 828 | S514 | 3225 | 613 | 888 | S574 | 2325 | 613 | 948 | S634 | 1425 | 613 |
| 769 | S455 | 4110 | 500 | 829 | S515 | 3210 | 500 | 889 | S575 | 2310 | 500 | 949 | S635 | 1410 | 500 |
| 770 | S456 | 4095 | 613 | 830 | S516 | 3195 | 613 | 890 | S576 | 2295 | 613 | 950 | S636 | 1395 | 613 |
| 771 | S457 | 4080 | 500 | 831 | S517 | 3180 | 500 | 891 | S577 | 2280 | 500 | 951 | S637 | 1380 | 500 |
| 772 | S458 | 4065 | 613 | 832 | S518 | 3165 | 613 | 892 | S578 | 2265 | 613 | 952 | S638 | 1365 | 613 |
| 773 | S459 | 4050 | 500 | 833 | S519 | 3150 | 500 | 893 | S579 | 2250 | 500 | 953 | S639 | 1350 | 500 |
| 774 | S460 | 4035 | 613 | 834 | S520 | 3135 | 613 | 894 | S580 | 2235 | 613 | 954 | S640 | 1335 | 613 |
| 775 | S461 | 4020 | 500 | 835 | S521 | 3120 | 500 | 895 | S581 | 2220 | 500 | 955 | S641 | 1320 | 500 |
| 776 | S462 | 4005 | 613 | 836 | S522 | 3105 | 613 | 896 | S582 | 2205 | 613 | 956 | S642 | 1305 | 613 |
| 777 | S463 | 3990 | 500 | 837 | S523 | 3090 | 500 | 897 | S583 | 2190 | 500 | 957 | S643 | 1290 | 500 |
| 778 | S464 | 3975 | 613 | 838 | S524 | 3075 | 613 | 898 | S584 | 2175 | 613 | 958 | S644 | 1275 | 613 |
| 779 | S465 | 3960 | 500 | 839 | S525 | 3060 | 500 | 899 | S585 | 2160 | 500 | 959 | S645 | 1260 | 500 |
| 780 | S466 | 3945 | 613 | 840 | S526 | 3045 | 613 | 900 | S586 | 2145 | 613 | 960 | S646 | 1245 | 613 |

| No.  | Name | X    | Y   | No.  | Name    | X    | Y   | No.  | Name | X     | Y   | No.  | Name | X     | Y   |
|------|------|------|-----|------|---------|------|-----|------|------|-------|-----|------|------|-------|-----|
| 961  | S647 | 1230 | 500 | 1021 | S707    | 330  | 500 | 1081 | S763 | -765  | 613 | 1141 | S823 | -1665 | 613 |
| 962  | S648 | 1215 | 613 | 1022 | S708    | 315  | 613 | 1082 | S764 | -780  | 500 | 1142 | S824 | -1680 | 500 |
| 963  | S649 | 1200 | 500 | 1023 | S709    | 300  | 500 | 1083 | S765 | -795  | 613 | 1143 | S825 | -1695 | 613 |
| 964  | S650 | 1185 | 613 | 1024 | S710    | 285  | 613 | 1084 | S766 | -810  | 500 | 1144 | S826 | -1710 | 500 |
| 965  | S651 | 1170 | 500 | 1025 | S711    | 270  | 500 | 1085 | S767 | -825  | 613 | 1145 | S827 | -1725 | 613 |
| 966  | S652 | 1155 | 613 | 1026 | S712    | 255  | 613 | 1086 | S768 | -840  | 500 | 1146 | S828 | -1740 | 500 |
| 967  | S653 | 1140 | 500 | 1027 | S713    | 240  | 500 | 1087 | S769 | -855  | 613 | 1147 | S829 | -1755 | 613 |
| 968  | S654 | 1125 | 613 | 1028 | S714    | 225  | 613 | 1088 | S770 | -870  | 500 | 1148 | S830 | -1770 | 500 |
| 969  | S655 | 1110 | 500 | 1029 | S715    | 210  | 500 | 1089 | S771 | -885  | 613 | 1149 | S831 | -1785 | 613 |
| 970  | S656 | 1095 | 613 | 1030 | S716    | 195  | 613 | 1090 | S772 | -900  | 500 | 1150 | S832 | -1800 | 500 |
| 971  | S657 | 1080 | 500 | 1031 | S717    | 180  | 500 | 1091 | S773 | -915  | 613 | 1151 | S833 | -1815 | 613 |
| 972  | S658 | 1065 | 613 | 1032 | S718    | 165  | 613 | 1092 | S774 | -930  | 500 | 1152 | S834 | -1830 | 500 |
| 973  | S659 | 1050 | 500 | 1033 | S719    | 150  | 500 | 1093 | S775 | -945  | 613 | 1153 | S835 | -1845 | 613 |
| 974  | S660 | 1035 | 613 | 1034 | S720    | 135  | 613 | 1094 | S776 | -960  | 500 | 1154 | S836 | -1860 | 500 |
| 975  | S661 | 1020 | 500 | 1035 | DUMMY11 | 90   | 613 | 1095 | S777 | -975  | 613 | 1155 | S837 | -1875 | 613 |
| 976  | S662 | 1005 | 613 | 1036 | DUMMY12 | 30   | 613 | 1096 | S778 | -990  | 500 | 1156 | S838 | -1890 | 500 |
| 977  | S663 | 990  | 500 | 1037 | DUMMY13 | -30  | 613 | 1097 | S779 | -1005 | 613 | 1157 | S839 | -1905 | 613 |
| 978  | S664 | 975  | 613 | 1038 | DUMMY14 | -90  | 613 | 1098 | S780 | -1020 | 500 | 1158 | S840 | -1920 | 500 |
| 979  | S665 | 960  | 500 | 1039 | S721    | -135 | 613 | 1099 | S781 | -1035 | 613 | 1159 | S841 | -1935 | 613 |
| 980  | S666 | 945  | 613 | 1040 | S722    | -150 | 500 | 1100 | S782 | -1050 | 500 | 1160 | S842 | -1950 | 500 |
| 981  | S667 | 930  | 500 | 1041 | S723    | -165 | 613 | 1101 | S783 | -1065 | 613 | 1161 | S843 | -1965 | 613 |
| 982  | S668 | 915  | 613 | 1042 | S724    | -180 | 500 | 1102 | S784 | -1080 | 500 | 1162 | S844 | -1980 | 500 |
| 983  | S669 | 900  | 500 | 1043 | S725    | -195 | 613 | 1103 | S785 | -1095 | 613 | 1163 | S845 | -1995 | 613 |
| 984  | S670 | 885  | 613 | 1044 | S726    | -210 | 500 | 1104 | S786 | -1110 | 500 | 1164 | S846 | -2010 | 500 |
| 985  | S671 | 870  | 500 | 1045 | S727    | -225 | 613 | 1105 | S787 | -1125 | 613 | 1165 | S847 | -2025 | 613 |
| 986  | S672 | 855  | 613 | 1046 | S728    | -240 | 500 | 1106 | S788 | -1140 | 500 | 1166 | S848 | -2040 | 500 |
| 987  | S673 | 840  | 500 | 1047 | S729    | -255 | 613 | 1107 | S789 | -1155 | 613 | 1167 | S849 | -2055 | 613 |
| 988  | S674 | 825  | 613 | 1048 | S730    | -270 | 500 | 1108 | S790 | -1170 | 500 | 1168 | S850 | -2070 | 500 |
| 989  | S675 | 810  | 500 | 1049 | S731    | -285 | 613 | 1109 | S791 | -1185 | 613 | 1169 | S851 | -2085 | 613 |
| 990  | S676 | 795  | 613 | 1050 | S732    | -300 | 500 | 1110 | S792 | -1200 | 500 | 1170 | S852 | -2100 | 500 |
| 991  | S677 | 780  | 500 | 1051 | S733    | -315 | 613 | 1111 | S793 | -1215 | 613 | 1171 | S853 | -2115 | 613 |
| 992  | S678 | 765  | 613 | 1052 | S734    | -330 | 500 | 1112 | S794 | -1230 | 500 | 1172 | S854 | -2130 | 500 |
| 993  | S679 | 750  | 500 | 1053 | S735    | -345 | 613 | 1113 | S795 | -1245 | 613 | 1173 | S855 | -2145 | 613 |
| 994  | S680 | 735  | 613 | 1054 | S736    | -360 | 500 | 1114 | S796 | -1260 | 500 | 1174 | S856 | -2160 | 500 |
| 995  | S681 | 720  | 500 | 1055 | S737    | -375 | 613 | 1115 | S797 | -1275 | 613 | 1175 | S857 | -2175 | 613 |
| 996  | S682 | 705  | 613 | 1056 | S738    | -390 | 500 | 1116 | S798 | -1290 | 500 | 1176 | S858 | -2190 | 500 |
| 997  | S683 | 690  | 500 | 1057 | S739    | -405 | 613 | 1117 | S799 | -1305 | 613 | 1177 | S859 | -2205 | 613 |
| 998  | S684 | 675  | 613 | 1058 | S740    | -420 | 500 | 1118 | S800 | -1320 | 500 | 1178 | S860 | -2220 | 500 |
| 999  | S685 | 660  | 500 | 1059 | S741    | -435 | 613 | 1119 | S801 | -1335 | 613 | 1179 | S861 | -2235 | 613 |
| 1000 | S686 | 645  | 613 | 1060 | S742    | -450 | 500 | 1120 | S802 | -1350 | 500 | 1180 | S862 | -2250 | 500 |
| 1001 | S687 | 630  | 500 | 1061 | S743    | -465 | 613 | 1121 | S803 | -1365 | 613 | 1181 | S863 | -2265 | 613 |
| 1002 | S688 | 615  | 613 | 1062 | S744    | -480 | 500 | 1122 | S804 | -1380 | 500 | 1182 | S864 | -2280 | 500 |
| 1003 | S689 | 600  | 500 | 1063 | S745    | -495 | 613 | 1123 | S805 | -1395 | 613 | 1183 | S865 | -2295 | 613 |
| 1004 | S690 | 585  | 613 | 1064 | S746    | -510 | 500 | 1124 | S806 | -1410 | 500 | 1184 | S866 | -2310 | 500 |
| 1005 | S691 | 570  | 500 | 1065 | S747    | -525 | 613 | 1125 | S807 | -1425 | 613 | 1185 | S867 | -2325 | 613 |
| 1006 | S692 | 555  | 613 | 1066 | S748    | -540 | 500 | 1126 | S808 | -1440 | 500 | 1186 | S868 | -2340 | 500 |
| 1007 | S693 | 540  | 500 | 1067 | S749    | -555 | 613 | 1127 | S809 | -1455 | 613 | 1187 | S869 | -2355 | 613 |
| 1008 | S694 | 525  | 613 | 1068 | S750    | -570 | 500 | 1128 | S810 | -1470 | 500 | 1188 | S870 | -2370 | 500 |
| 1009 | S695 | 510  | 500 | 1069 | S751    | -585 | 613 | 1129 | S811 | -1485 | 613 | 1189 | S871 | -2385 | 613 |
| 1010 | S696 | 495  | 613 | 1070 | S752    | -600 | 500 | 1130 | S812 | -1500 | 500 | 1190 | S872 | -2400 | 500 |
| 1011 | S697 | 480  | 500 | 1071 | S753    | -615 | 613 | 1131 | S813 | -1515 | 613 | 1191 | S873 | -2415 | 613 |
| 1012 | S698 | 465  | 613 | 1072 | S754    | -630 | 500 | 1132 | S814 | -1530 | 500 | 1192 | S874 | -2430 | 500 |
| 1013 | S699 | 450  | 500 | 1073 | S755    | -645 | 613 | 1133 | S815 | -1545 | 613 | 1193 | S875 | -2445 | 613 |
| 1014 | S700 | 435  | 613 | 1074 | S756    | -660 | 500 | 1134 | S816 | -1560 | 500 | 1194 | S876 | -2460 | 500 |
| 1015 | S701 | 420  | 500 | 1075 | S757    | -675 | 613 | 1135 | S817 | -1575 | 613 | 1195 | S877 | -2475 | 613 |
| 1016 | S702 | 405  | 613 | 1076 | S758    | -690 | 500 | 1136 | S818 | -1590 | 500 | 1196 | S878 | -2490 | 500 |
| 1017 | S703 | 390  | 500 | 1077 | S759    | -705 | 613 | 1137 | S819 | -1605 | 613 | 1197 | S879 | -2505 | 613 |
| 1018 | S704 | 375  | 613 | 1078 | S760    | -720 | 500 | 1138 | S820 | -1620 | 500 | 1198 | S880 | -2520 | 500 |
| 1019 | S705 | 360  | 500 | 1079 | S761    | -735 | 613 | 1139 | S821 | -1635 | 613 | 1199 | S881 | -2535 | 613 |
| 1020 | S706 | 345  | 613 | 1080 | S762    | -750 | 500 | 1140 | S822 | -1650 | 500 | 1200 | S882 | -2550 | 500 |

| No.  | Name | X     | Y   | No.  | Name  | X     | Y   | No.  | Name  | X     | Y   | No.  | Name  | X     | Y   |
|------|------|-------|-----|------|-------|-------|-----|------|-------|-------|-----|------|-------|-------|-----|
| 1201 | S883 | -2565 | 613 | 1261 | S943  | -3465 | 613 | 1321 | S1003 | -4365 | 613 | 1381 | S1063 | -5265 | 613 |
| 1202 | S884 | -2580 | 500 | 1262 | S944  | -3480 | 500 | 1322 | S1004 | -4380 | 500 | 1382 | S1064 | -5280 | 500 |
| 1203 | S885 | -2595 | 613 | 1263 | S945  | -3495 | 613 | 1323 | S1005 | -4395 | 613 | 1383 | S1065 | -5295 | 613 |
| 1204 | S886 | -2610 | 500 | 1264 | S946  | -3510 | 500 | 1324 | S1006 | -4410 | 500 | 1384 | S1066 | -5310 | 500 |
| 1205 | S887 | -2625 | 613 | 1265 | S947  | -3525 | 613 | 1325 | S1007 | -4425 | 613 | 1385 | S1067 | -5325 | 613 |
| 1206 | S888 | -2640 | 500 | 1266 | S948  | -3540 | 500 | 1326 | S1008 | -4440 | 500 | 1386 | S1068 | -5340 | 500 |
| 1207 | S889 | -2655 | 613 | 1267 | S949  | -3555 | 613 | 1327 | S1009 | -4455 | 613 | 1387 | S1069 | -5355 | 613 |
| 1208 | S890 | -2670 | 500 | 1268 | S950  | -3570 | 500 | 1328 | S1010 | -4470 | 500 | 1388 | S1070 | -5370 | 500 |
| 1209 | S891 | -2685 | 613 | 1269 | S951  | -3585 | 613 | 1329 | S1011 | -4485 | 613 | 1389 | S1071 | -5385 | 613 |
| 1210 | S892 | -2700 | 500 | 1270 | S952  | -3600 | 500 | 1330 | S1012 | -4500 | 500 | 1390 | S1072 | -5400 | 500 |
| 1211 | S893 | -2715 | 613 | 1271 | S953  | -3615 | 613 | 1331 | S1013 | -4515 | 613 | 1391 | S1073 | -5415 | 613 |
| 1212 | S894 | -2730 | 500 | 1272 | S954  | -3630 | 500 | 1332 | S1014 | -4530 | 500 | 1392 | S1074 | -5430 | 500 |
| 1213 | S895 | -2745 | 613 | 1273 | S955  | -3645 | 613 | 1333 | S1015 | -4545 | 613 | 1393 | S1075 | -5445 | 613 |
| 1214 | S896 | -2760 | 500 | 1274 | S956  | -3660 | 500 | 1334 | S1016 | -4560 | 500 | 1394 | S1076 | -5460 | 500 |
| 1215 | S897 | -2775 | 613 | 1275 | S957  | -3675 | 613 | 1335 | S1017 | -4575 | 613 | 1395 | S1077 | -5475 | 613 |
| 1216 | S898 | -2790 | 500 | 1276 | S958  | -3690 | 500 | 1336 | S1018 | -4590 | 500 | 1396 | S1078 | -5490 | 500 |
| 1217 | S899 | -2805 | 613 | 1277 | S959  | -3705 | 613 | 1337 | S1019 | -4605 | 613 | 1397 | S1079 | -5505 | 613 |
| 1218 | S900 | -2820 | 500 | 1278 | S960  | -3720 | 500 | 1338 | S1020 | -4620 | 500 | 1398 | S1080 | -5520 | 500 |
| 1219 | S901 | -2835 | 613 | 1279 | S961  | -3735 | 613 | 1339 | S1021 | -4635 | 613 | 1399 | S1081 | -5535 | 613 |
| 1220 | S902 | -2850 | 500 | 1280 | S962  | -3750 | 500 | 1340 | S1022 | -4650 | 500 | 1400 | S1082 | -5550 | 500 |
| 1221 | S903 | -2865 | 613 | 1281 | S963  | -3765 | 613 | 1341 | S1023 | -4665 | 613 | 1401 | S1083 | -5565 | 613 |
| 1222 | S904 | -2880 | 500 | 1282 | S964  | -3780 | 500 | 1342 | S1024 | -4680 | 500 | 1402 | S1084 | -5580 | 500 |
| 1223 | S905 | -2895 | 613 | 1283 | S965  | -3795 | 613 | 1343 | S1025 | -4695 | 613 | 1403 | S1085 | -5595 | 613 |
| 1224 | S906 | -2910 | 500 | 1284 | S966  | -3810 | 500 | 1344 | S1026 | -4710 | 500 | 1404 | S1086 | -5610 | 500 |
| 1225 | S907 | -2925 | 613 | 1285 | S967  | -3825 | 613 | 1345 | S1027 | -4725 | 613 | 1405 | S1087 | -5625 | 613 |
| 1226 | S908 | -2940 | 500 | 1286 | S968  | -3840 | 500 | 1346 | S1028 | -4740 | 500 | 1406 | S1088 | -5640 | 500 |
| 1227 | S909 | -2955 | 613 | 1287 | S969  | -3855 | 613 | 1347 | S1029 | -4755 | 613 | 1407 | S1089 | -5655 | 613 |
| 1228 | S910 | -2970 | 500 | 1288 | S970  | -3870 | 500 | 1348 | S1030 | -4770 | 500 | 1408 | S1090 | -5670 | 500 |
| 1229 | S911 | -2985 | 613 | 1289 | S971  | -3885 | 613 | 1349 | S1031 | -4785 | 613 | 1409 | S1091 | -5685 | 613 |
| 1230 | S912 | -3000 | 500 | 1290 | S972  | -3900 | 500 | 1350 | S1032 | -4800 | 500 | 1410 | S1092 | -5700 | 500 |
| 1231 | S913 | -3015 | 613 | 1291 | S973  | -3915 | 613 | 1351 | S1033 | -4815 | 613 | 1411 | S1093 | -5715 | 613 |
| 1232 | S914 | -3030 | 500 | 1292 | S974  | -3930 | 500 | 1352 | S1034 | -4830 | 500 | 1412 | S1094 | -5730 | 500 |
| 1233 | S915 | -3045 | 613 | 1293 | S975  | -3945 | 613 | 1353 | S1035 | -4845 | 613 | 1413 | S1095 | -5745 | 613 |
| 1234 | S916 | -3060 | 500 | 1294 | S976  | -3960 | 500 | 1354 | S1036 | -4860 | 500 | 1414 | S1096 | -5760 | 500 |
| 1235 | S917 | -3075 | 613 | 1295 | S977  | -3975 | 613 | 1355 | S1037 | -4875 | 613 | 1415 | S1097 | -5775 | 613 |
| 1236 | S918 | -3090 | 500 | 1296 | S978  | -3990 | 500 | 1356 | S1038 | -4890 | 500 | 1416 | S1098 | -5790 | 500 |
| 1237 | S919 | -3105 | 613 | 1297 | S979  | -4005 | 613 | 1357 | S1039 | -4905 | 613 | 1417 | S1099 | -5805 | 613 |
| 1238 | S920 | -3120 | 500 | 1298 | S980  | -4020 | 500 | 1358 | S1040 | -4920 | 500 | 1418 | S1100 | -5820 | 500 |
| 1239 | S921 | -3135 | 613 | 1299 | S981  | -4035 | 613 | 1359 | S1041 | -4935 | 613 | 1419 | S1101 | -5835 | 613 |
| 1240 | S922 | -3150 | 500 | 1300 | S982  | -4050 | 500 | 1360 | S1042 | -4950 | 500 | 1420 | S1102 | -5850 | 500 |
| 1241 | S923 | -3165 | 613 | 1301 | S983  | -4065 | 613 | 1361 | S1043 | -4965 | 613 | 1421 | S1103 | -5865 | 613 |
| 1242 | S924 | -3180 | 500 | 1302 | S984  | -4080 | 500 | 1362 | S1044 | -4980 | 500 | 1422 | S1104 | -5880 | 500 |
| 1243 | S925 | -3195 | 613 | 1303 | S985  | -4095 | 613 | 1363 | S1045 | -4995 | 613 | 1423 | S1105 | -5895 | 613 |
| 1244 | S926 | -3210 | 500 | 1304 | S986  | -4110 | 500 | 1364 | S1046 | -5010 | 500 | 1424 | S1106 | -5910 | 500 |
| 1245 | S927 | -3225 | 613 | 1305 | S987  | -4125 | 613 | 1365 | S1047 | -5025 | 613 | 1425 | S1107 | -5925 | 613 |
| 1246 | S928 | -3240 | 500 | 1306 | S988  | -4140 | 500 | 1366 | S1048 | -5040 | 500 | 1426 | S1108 | -5940 | 500 |
| 1247 | S929 | -3255 | 613 | 1307 | S989  | -4155 | 613 | 1367 | S1049 | -5055 | 613 | 1427 | S1109 | -5955 | 613 |
| 1248 | S930 | -3270 | 500 | 1308 | S990  | -4170 | 500 | 1368 | S1050 | -5070 | 500 | 1428 | S1110 | -5970 | 500 |
| 1249 | S931 | -3285 | 613 | 1309 | S991  | -4185 | 613 | 1369 | S1051 | -5085 | 613 | 1429 | S1111 | -5985 | 613 |
| 1250 | S932 | -3300 | 500 | 1310 | S992  | -4200 | 500 | 1370 | S1052 | -5100 | 500 | 1430 | S1112 | -6000 | 500 |
| 1251 | S933 | -3315 | 613 | 1311 | S993  | -4215 | 613 | 1371 | S1053 | -5115 | 613 | 1431 | S1113 | -6015 | 613 |
| 1252 | S934 | -3330 | 500 | 1312 | S994  | -4230 | 500 | 1372 | S1054 | -5130 | 500 | 1432 | S1114 | -6030 | 500 |
| 1253 | S935 | -3345 | 613 | 1313 | S995  | -4245 | 613 | 1373 | S1055 | -5145 | 613 | 1433 | S1115 | -6045 | 613 |
| 1254 | S936 | -3360 | 500 | 1314 | S996  | -4260 | 500 | 1374 | S1056 | -5160 | 500 | 1434 | S1116 | -6060 | 500 |
| 1255 | S937 | -3375 | 613 | 1315 | S997  | -4275 | 613 | 1375 | S1057 | -5175 | 613 | 1435 | S1117 | -6075 | 613 |
| 1256 | S938 | -3390 | 500 | 1316 | S998  | -4290 | 500 | 1376 | S1058 | -5190 | 500 | 1436 | S1118 | -6090 | 500 |
| 1257 | S939 | -3405 | 613 | 1317 | S999  | -4305 | 613 | 1377 | S1059 | -5205 | 613 | 1437 | S1119 | -6105 | 613 |
| 1258 | S940 | -3420 | 500 | 1318 | S1000 | -4320 | 500 | 1378 | S1060 | -5220 | 500 | 1438 | S1120 | -6120 | 500 |
| 1259 | S941 | -3435 | 613 | 1319 | S1001 | -4335 | 613 | 1379 | S1061 | -5235 | 613 | 1439 | S1121 | -6135 | 613 |
| 1260 | S942 | -3450 | 500 | 1320 | S1002 | -4350 | 500 | 1380 | S1062 | -5250 | 500 | 1440 | S1122 | -6150 | 500 |

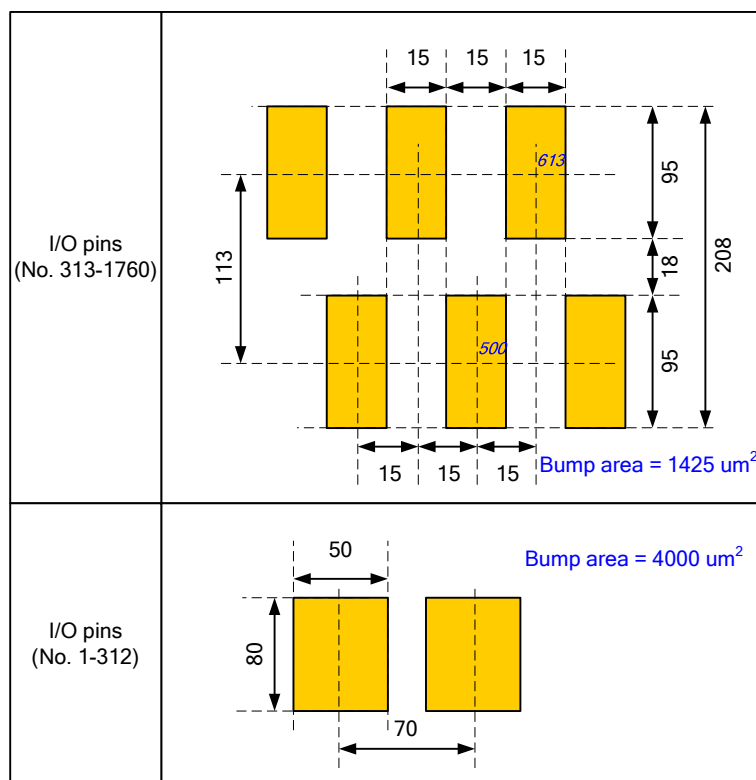


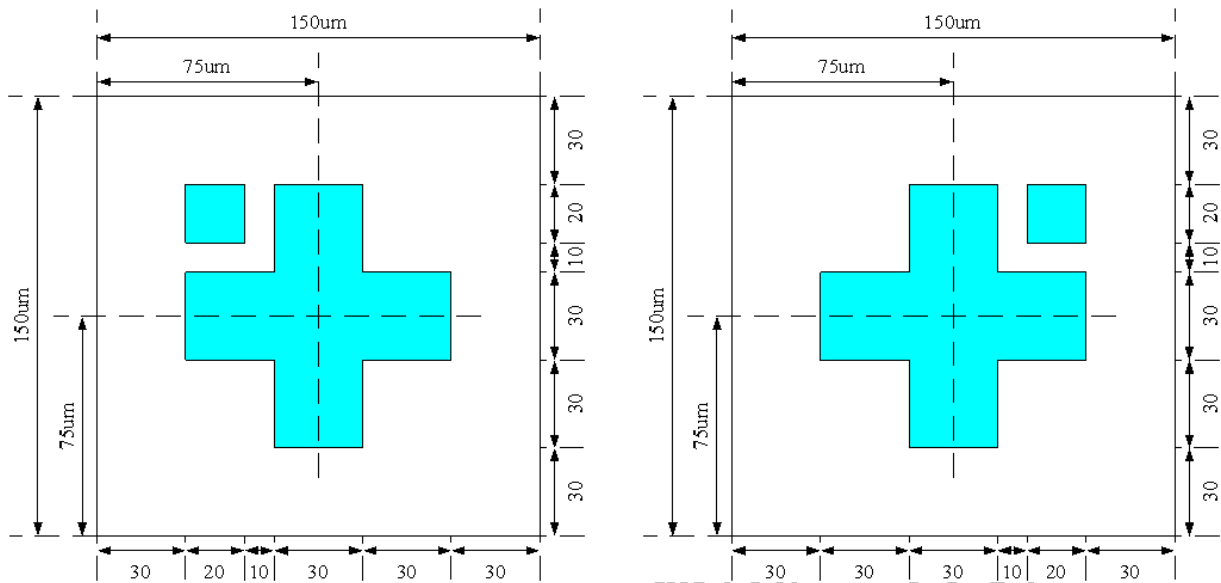
| No.  | Name  | X     | Y   | No.  | Name  | X     | Y   | No.  | Name  | X     | Y   | No.  | Name  | X     | Y   |
|------|-------|-------|-----|------|-------|-------|-----|------|-------|-------|-----|------|-------|-------|-----|
| 1441 | S1123 | -6165 | 613 | 1501 | S1183 | -7065 | 613 | 1561 | S1243 | -7965 | 613 | 1621 | S1303 | -8865 | 613 |
| 1442 | S1124 | -6180 | 500 | 1502 | S1184 | -7080 | 500 | 1562 | S1244 | -7980 | 500 | 1622 | S1304 | -8880 | 500 |
| 1443 | S1125 | -6195 | 613 | 1503 | S1185 | -7095 | 613 | 1563 | S1245 | -7995 | 613 | 1623 | S1305 | -8895 | 613 |
| 1444 | S1126 | -6210 | 500 | 1504 | S1186 | -7110 | 500 | 1564 | S1246 | -8010 | 500 | 1624 | S1306 | -8910 | 500 |
| 1445 | S1127 | -6225 | 613 | 1505 | S1187 | -7125 | 613 | 1565 | S1247 | -8025 | 613 | 1625 | S1307 | -8925 | 613 |
| 1446 | S1128 | -6240 | 500 | 1506 | S1188 | -7140 | 500 | 1566 | S1248 | -8040 | 500 | 1626 | S1308 | -8940 | 500 |
| 1447 | S1129 | -6255 | 613 | 1507 | S1189 | -7155 | 613 | 1567 | S1249 | -8055 | 613 | 1627 | S1309 | -8955 | 613 |
| 1448 | S1130 | -6270 | 500 | 1508 | S1190 | -7170 | 500 | 1568 | S1250 | -8070 | 500 | 1628 | S1310 | -8970 | 500 |
| 1449 | S1131 | -6285 | 613 | 1509 | S1191 | -7185 | 613 | 1569 | S1251 | -8085 | 613 | 1629 | S1311 | -8985 | 613 |
| 1450 | S1132 | -6300 | 500 | 1510 | S1192 | -7200 | 500 | 1570 | S1252 | -8100 | 500 | 1630 | S1312 | -9000 | 500 |
| 1451 | S1133 | -6315 | 613 | 1511 | S1193 | -7215 | 613 | 1571 | S1253 | -8115 | 613 | 1631 | S1313 | -9015 | 613 |
| 1452 | S1134 | -6330 | 500 | 1512 | S1194 | -7230 | 500 | 1572 | S1254 | -8130 | 500 | 1632 | S1314 | -9030 | 500 |
| 1453 | S1135 | -6345 | 613 | 1513 | S1195 | -7245 | 613 | 1573 | S1255 | -8145 | 613 | 1633 | S1315 | -9045 | 613 |
| 1454 | S1136 | -6360 | 500 | 1514 | S1196 | -7260 | 500 | 1574 | S1256 | -8160 | 500 | 1634 | S1316 | -9060 | 500 |
| 1455 | S1137 | -6375 | 613 | 1515 | S1197 | -7275 | 613 | 1575 | S1257 | -8175 | 613 | 1635 | S1317 | -9075 | 613 |
| 1456 | S1138 | -6390 | 500 | 1516 | S1198 | -7290 | 500 | 1576 | S1258 | -8190 | 500 | 1636 | S1318 | -9090 | 500 |
| 1457 | S1139 | -6405 | 613 | 1517 | S1199 | -7305 | 613 | 1577 | S1259 | -8205 | 613 | 1637 | S1319 | -9105 | 613 |
| 1458 | S1140 | -6420 | 500 | 1518 | S1200 | -7320 | 500 | 1578 | S1260 | -8220 | 500 | 1638 | S1320 | -9120 | 500 |
| 1459 | S1141 | -6435 | 613 | 1519 | S1201 | -7335 | 613 | 1579 | S1261 | -8235 | 613 | 1639 | S1321 | -9135 | 613 |
| 1460 | S1142 | -6450 | 500 | 1520 | S1202 | -7350 | 500 | 1580 | S1262 | -8250 | 500 | 1640 | S1322 | -9150 | 500 |
| 1461 | S1143 | -6465 | 613 | 1521 | S1203 | -7365 | 613 | 1581 | S1263 | -8265 | 613 | 1641 | S1323 | -9165 | 613 |
| 1462 | S1144 | -6480 | 500 | 1522 | S1204 | -7380 | 500 | 1582 | S1264 | -8280 | 500 | 1642 | S1324 | -9180 | 500 |
| 1463 | S1145 | -6495 | 613 | 1523 | S1205 | -7395 | 613 | 1583 | S1265 | -8295 | 613 | 1643 | S1325 | -9195 | 613 |
| 1464 | S1146 | -6510 | 500 | 1524 | S1206 | -7410 | 500 | 1584 | S1266 | -8310 | 500 | 1644 | S1326 | -9210 | 500 |
| 1465 | S1147 | -6525 | 613 | 1525 | S1207 | -7425 | 613 | 1585 | S1267 | -8325 | 613 | 1645 | S1327 | -9225 | 613 |
| 1466 | S1148 | -6540 | 500 | 1526 | S1208 | -7440 | 500 | 1586 | S1268 | -8340 | 500 | 1646 | S1328 | -9240 | 500 |
| 1467 | S1149 | -6555 | 613 | 1527 | S1209 | -7455 | 613 | 1587 | S1269 | -8355 | 613 | 1647 | S1329 | -9255 | 613 |
| 1468 | S1150 | -6570 | 500 | 1528 | S1210 | -7470 | 500 | 1588 | S1270 | -8370 | 500 | 1648 | S1330 | -9270 | 500 |
| 1469 | S1151 | -6585 | 613 | 1529 | S1211 | -7485 | 613 | 1589 | S1271 | -8385 | 613 | 1649 | S1331 | -9285 | 613 |
| 1470 | S1152 | -6600 | 500 | 1530 | S1212 | -7500 | 500 | 1590 | S1272 | -8400 | 500 | 1650 | S1332 | -9300 | 500 |
| 1471 | S1153 | -6615 | 613 | 1531 | S1213 | -7515 | 613 | 1591 | S1273 | -8415 | 613 | 1651 | S1333 | -9315 | 613 |
| 1472 | S1154 | -6630 | 500 | 1532 | S1214 | -7530 | 500 | 1592 | S1274 | -8430 | 500 | 1652 | S1334 | -9330 | 500 |
| 1473 | S1155 | -6645 | 613 | 1533 | S1215 | -7545 | 613 | 1593 | S1275 | -8445 | 613 | 1653 | S1335 | -9345 | 613 |
| 1474 | S1156 | -6660 | 500 | 1534 | S1216 | -7560 | 500 | 1594 | S1276 | -8460 | 500 | 1654 | S1336 | -9360 | 500 |
| 1475 | S1157 | -6675 | 613 | 1535 | S1217 | -7575 | 613 | 1595 | S1277 | -8475 | 613 | 1655 | S1337 | -9375 | 613 |
| 1476 | S1158 | -6690 | 500 | 1536 | S1218 | -7590 | 500 | 1596 | S1278 | -8490 | 500 | 1656 | S1338 | -9390 | 500 |
| 1477 | S1159 | -6705 | 613 | 1537 | S1219 | -7605 | 613 | 1597 | S1279 | -8505 | 613 | 1657 | S1339 | -9405 | 613 |
| 1478 | S1160 | -6720 | 500 | 1538 | S1220 | -7620 | 500 | 1598 | S1280 | -8520 | 500 | 1658 | S1340 | -9420 | 500 |
| 1479 | S1161 | -6735 | 613 | 1539 | S1221 | -7635 | 613 | 1599 | S1281 | -8535 | 613 | 1659 | S1341 | -9435 | 613 |
| 1480 | S1162 | -6750 | 500 | 1540 | S1222 | -7650 | 500 | 1600 | S1282 | -8550 | 500 | 1660 | S1342 | -9450 | 500 |
| 1481 | S1163 | -6765 | 613 | 1541 | S1223 | -7665 | 613 | 1601 | S1283 | -8565 | 613 | 1661 | S1343 | -9465 | 613 |
| 1482 | S1164 | -6780 | 500 | 1542 | S1224 | -7680 | 500 | 1602 | S1284 | -8580 | 500 | 1662 | S1344 | -9480 | 500 |
| 1483 | S1165 | -6795 | 613 | 1543 | S1225 | -7695 | 613 | 1603 | S1285 | -8595 | 613 | 1663 | S1345 | -9495 | 613 |
| 1484 | S1166 | -6810 | 500 | 1544 | S1226 | -7710 | 500 | 1604 | S1286 | -8610 | 500 | 1664 | S1346 | -9510 | 500 |
| 1485 | S1167 | -6825 | 613 | 1545 | S1227 | -7725 | 613 | 1605 | S1287 | -8625 | 613 | 1665 | S1347 | -9525 | 613 |
| 1486 | S1168 | -6840 | 500 | 1546 | S1228 | -7740 | 500 | 1606 | S1288 | -8640 | 500 | 1666 | S1348 | -9540 | 500 |
| 1487 | S1169 | -6855 | 613 | 1547 | S1229 | -7755 | 613 | 1607 | S1289 | -8655 | 613 | 1667 | S1349 | -9555 | 613 |
| 1488 | S1170 | -6870 | 500 | 1548 | S1230 | -7770 | 500 | 1608 | S1290 | -8670 | 500 | 1668 | S1350 | -9570 | 500 |
| 1489 | S1171 | -6885 | 613 | 1549 | S1231 | -7785 | 613 | 1609 | S1291 | -8685 | 613 | 1669 | S1351 | -9585 | 613 |
| 1490 | S1172 | -6900 | 500 | 1550 | S1232 | -7800 | 500 | 1610 | S1292 | -8700 | 500 | 1670 | S1352 | -9600 | 500 |
| 1491 | S1173 | -6915 | 613 | 1551 | S1233 | -7815 | 613 | 1611 | S1293 | -8715 | 613 | 1671 | S1353 | -9615 | 613 |
| 1492 | S1174 | -6930 | 500 | 1552 | S1234 | -7830 | 500 | 1612 | S1294 | -8730 | 500 | 1672 | S1354 | -9630 | 500 |
| 1493 | S1175 | -6945 | 613 | 1553 | S1235 | -7845 | 613 | 1613 | S1295 | -8745 | 613 | 1673 | S1355 | -9645 | 613 |
| 1494 | S1176 | -6960 | 500 | 1554 | S1236 | -7860 | 500 | 1614 | S1296 | -8760 | 500 | 1674 | S1356 | -9660 | 500 |
| 1495 | S1177 | -6975 | 613 | 1555 | S1237 | -7875 | 613 | 1615 | S1297 | -8775 | 613 | 1675 | S1357 | -9675 | 613 |
| 1496 | S1178 | -6990 | 500 | 1556 | S1238 | -7890 | 500 | 1616 | S1298 | -8790 | 500 | 1676 | S1358 | -9690 | 500 |
| 1497 | S1179 | -7005 | 613 | 1557 | S1239 | -7905 | 613 | 1617 | S1299 | -8805 | 613 | 1677 | S1359 | -9705 | 613 |
| 1498 | S1180 | -7020 | 500 | 1558 | S1240 | -7920 | 500 | 1618 | S1300 | -8820 | 500 | 1678 | S1360 | -9720 | 500 |
| 1499 | S1181 | -7035 | 613 | 1559 | S1241 | -7935 | 613 | 1619 | S1301 | -8835 | 613 | 1679 | S1361 | -9735 | 613 |
| 1500 | S1182 | -7050 | 500 | 1560 | S1242 | -7950 | 500 | 1620 | S1302 | -8850 | 500 | 1680 | S1362 | -9750 | 500 |



| No.  | Name  | X      | Y   | No.  | Name                | X      | Y   | Alignment mark | X      | Y   |
|------|-------|--------|-----|------|---------------------|--------|-----|----------------|--------|-----|
| 1681 | S1363 | -9765  | 613 | 1741 | S1423               | -10665 | 613 | A1             | -11060 | 600 |
| 1682 | S1364 | -9780  | 500 | 1742 | S1424               | -10680 | 500 | A2             | 11060  | 600 |
| 1683 | S1365 | -9795  | 613 | 1743 | S1425               | -10695 | 613 |                |        |     |
| 1684 | S1366 | -9810  | 500 | 1744 | S1426               | -10710 | 500 |                |        |     |
| 1685 | S1367 | -9825  | 613 | 1745 | S1427               | -10725 | 613 |                |        |     |
| 1686 | S1368 | -9840  | 500 | 1746 | S1428               | -10740 | 500 |                |        |     |
| 1687 | S1369 | -9855  | 613 | 1747 | S1429               | -10755 | 613 |                |        |     |
| 1688 | S1370 | -9870  | 500 | 1748 | S1430               | -10770 | 500 |                |        |     |
| 1689 | S1371 | -9885  | 613 | 1749 | S1431               | -10785 | 613 |                |        |     |
| 1690 | S1372 | -9900  | 500 | 1750 | S1432               | -10800 | 500 |                |        |     |
| 1691 | S1373 | -9915  | 613 | 1751 | S1433               | -10815 | 613 |                |        |     |
| 1692 | S1374 | -9930  | 500 | 1752 | S1434               | -10830 | 500 |                |        |     |
| 1693 | S1375 | -9945  | 613 | 1753 | S1435               | -10845 | 613 |                |        |     |
| 1694 | S1376 | -9960  | 500 | 1754 | S1436               | -10860 | 500 |                |        |     |
| 1695 | S1377 | -9975  | 613 | 1755 | S1437               | -10875 | 613 |                |        |     |
| 1696 | S1378 | -9990  | 500 | 1756 | S1438               | -10890 | 500 |                |        |     |
| 1697 | S1379 | -10005 | 613 | 1757 | S1439               | -10905 | 613 |                |        |     |
| 1698 | S1380 | -10020 | 500 | 1758 | S1440               | -10920 | 500 |                |        |     |
| 1699 | S1381 | -10035 | 613 | 1759 | S1441 (for Zig-Zag) | -10935 | 613 |                |        |     |
| 1700 | S1382 | -10050 | 500 | 1760 | Dummy17             | -10950 | 500 |                |        |     |
| 1701 | S1383 | -10065 | 613 |      |                     |        |     |                |        |     |
| 1702 | S1384 | -10080 | 500 |      |                     |        |     |                |        |     |
| 1703 | S1385 | -10095 | 613 |      |                     |        |     |                |        |     |
| 1704 | S1386 | -10110 | 500 |      |                     |        |     |                |        |     |
| 1705 | S1387 | -10125 | 613 |      |                     |        |     |                |        |     |
| 1706 | S1388 | -10140 | 500 |      |                     |        |     |                |        |     |
| 1707 | S1389 | -10155 | 613 |      |                     |        |     |                |        |     |
| 1708 | S1390 | -10170 | 500 |      |                     |        |     |                |        |     |
| 1709 | S1391 | -10185 | 613 |      |                     |        |     |                |        |     |
| 1710 | S1392 | -10200 | 500 |      |                     |        |     |                |        |     |
| 1711 | S1393 | -10215 | 613 |      |                     |        |     |                |        |     |
| 1712 | S1394 | -10230 | 500 |      |                     |        |     |                |        |     |
| 1713 | S1395 | -10245 | 613 |      |                     |        |     |                |        |     |
| 1714 | S1396 | -10260 | 500 |      |                     |        |     |                |        |     |
| 1715 | S1397 | -10275 | 613 |      |                     |        |     |                |        |     |
| 1716 | S1398 | -10290 | 500 |      |                     |        |     |                |        |     |
| 1717 | S1399 | -10305 | 613 |      |                     |        |     |                |        |     |
| 1718 | S1400 | -10320 | 500 |      |                     |        |     |                |        |     |
| 1719 | S1401 | -10335 | 613 |      |                     |        |     |                |        |     |
| 1720 | S1402 | -10350 | 500 |      |                     |        |     |                |        |     |
| 1721 | S1403 | -10365 | 613 |      |                     |        |     |                |        |     |
| 1722 | S1404 | -10380 | 500 |      |                     |        |     |                |        |     |
| 1723 | S1405 | -10395 | 613 |      |                     |        |     |                |        |     |
| 1724 | S1406 | -10410 | 500 |      |                     |        |     |                |        |     |
| 1725 | S1407 | -10425 | 613 |      |                     |        |     |                |        |     |
| 1726 | S1408 | -10440 | 500 |      |                     |        |     |                |        |     |
| 1727 | S1409 | -10455 | 613 |      |                     |        |     |                |        |     |
| 1728 | S1410 | -10470 | 500 |      |                     |        |     |                |        |     |
| 1729 | S1411 | -10485 | 613 |      |                     |        |     |                |        |     |
| 1730 | S1412 | -10500 | 500 |      |                     |        |     |                |        |     |
| 1731 | S1413 | -10515 | 613 |      |                     |        |     |                |        |     |
| 1732 | S1414 | -10530 | 500 |      |                     |        |     |                |        |     |
| 1733 | S1415 | -10545 | 613 |      |                     |        |     |                |        |     |
| 1734 | S1416 | -10560 | 500 |      |                     |        |     |                |        |     |
| 1735 | S1417 | -10575 | 613 |      |                     |        |     |                |        |     |
| 1736 | S1418 | -10590 | 500 |      |                     |        |     |                |        |     |
| 1737 | S1419 | -10605 | 613 |      |                     |        |     |                |        |     |
| 1738 | S1420 | -10620 | 500 |      |                     |        |     |                |        |     |
| 1739 | S1421 | -10635 | 613 |      |                     |        |     |                |        |     |
| 1740 | S1422 | -10650 | 500 |      |                     |        |     |                |        |     |

### 3.4.1 Bump arrangement





## 4. Interface

### 4.1 System interface

The HX8369-A02 supports MDDI (Mobile Display Digital Interface) and MIPI interfaces: DBI (Display Bus Interface), DPI (Display Pixel Interface), DSI (Display Serial Interface). Where DBI supports (16-/9-/8-bit interface) Parallel Interface (Type A, Type B) and Serial interface (Type C). The interface mode can be selected by BS3-0 pins setting as show in Table 4.1.

| BS3 | BS2 | BS1 | BS0 | Interface                                | Display data | Display mode |
|-----|-----|-----|-----|------------------------------------------|--------------|--------------|
| 0   | 0   | 0   | 0   | DBI TYPE-A 8-bit (CLK-E)                 | GRAM         | Type 1       |
| 0   | 0   | 0   | 1   | DBI TYPE-A 9-bit (CLK-E)                 | GRAM         | Type 1       |
| 0   | 0   | 1   | 0   | DBI TYPE-A 16-bit (CLK-E)                | GRAM         | Type 1       |
| 0   | 0   | 1   | 1   | DBI TYPE-A 18-bit (CLK-E)                | GRAM         | Type 1       |
| 0   | 1   | 0   | 0   | DBI TYPE-B 8-bit                         | GRAM         | Type 1       |
| 0   | 1   | 0   | 1   | DBI TYPE-B 9-bit                         | GRAM         | Type 1       |
| 0   | 1   | 1   | 0   | DBI TYPE-B 16-bit                        | GRAM         | Type 1       |
| 0   | 1   | 1   | 1   | DBI TYPE-B 18-bit                        | GRAM         | Type 1       |
| 1   | 0   | 0   | 0   | DSI (Command mode)                       | GRAM         | Type 1       |
| 1   | 0   | 0   | 1   | MDDI (3-wire serial + MDDI + external R) | GRAM         | -            |
| 1   | 0   | 1   | 0   | DBI TYPE-B 24-bit                        | GRAM         | Type 1       |
| 1   | 0   | 1   | 1   | MDDI (3-wire serial + MDDI + internal R) | GRAM         | -            |
| 1   | 1   | 0   | 0   | DSI (Video mode)                         | DSI I/F      | Type 3       |
| 1   | 1   | 0   | 1   | DPI / DBI TYPE-C Option 1                | DPI / GRAM   | Type 3       |
| 1   | 1   | 1   | 0   | DPI / DBI TYPE-C Option 2                | DPI / GRAM   | Type 3       |
| 1   | 1   | 1   | 1   | DPI / DBI TYPE-C Option 3                | DPI / GRAM   | Type 3       |

**Table 4.1: Interface selection**

The HX8369-A02 includes an index register (IR), which is stored the index data of internal control register and GRAM. When DCX="L", the command via DBI interface write into register. When DCX="H", GRAM data via R2Ch register can be written through data bus. When the data is written into the GRAM from the MPU, it is first written into the write-data latch and then automatically written into the GRAM by internal operation. Data is read through the read-data latch when reading from the GRAM.

When data is read from the GRAM to the MPU, it is first read from GRAM to the read-data latch and then data is read to MPU through the read-data latch in next read operation. Therefore, the read data in data bus in first read operation is invalid, and the read data in data bus in second and the following read operation is valid.

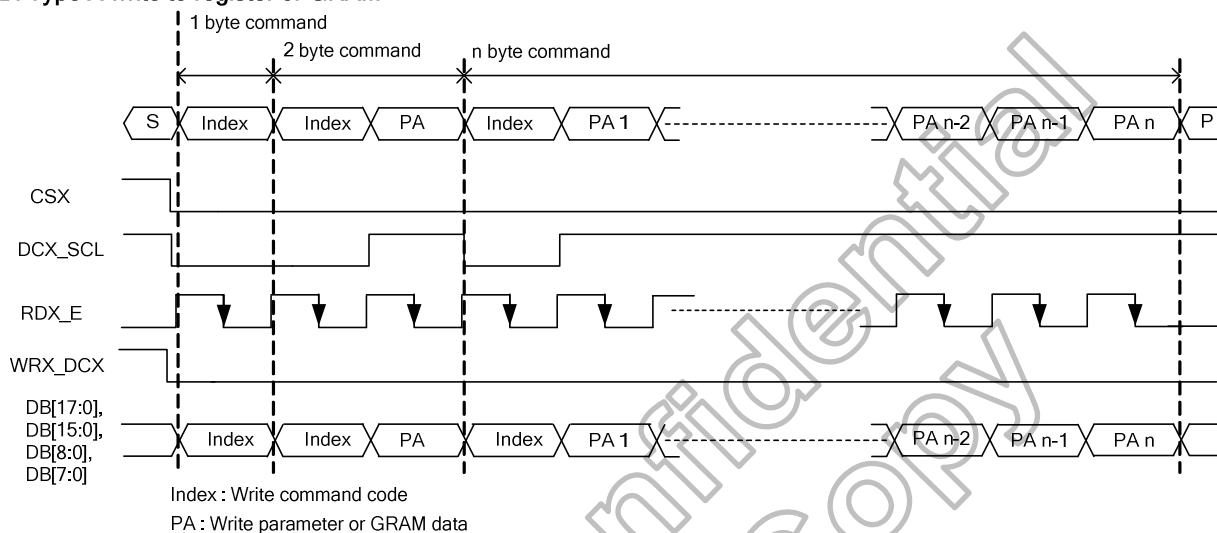
| Interface                                          | RDX_E  | WRX_DCX | DCX_SCL | D23-D0 or other input pin                                                                                                                    |
|----------------------------------------------------|--------|---------|---------|----------------------------------------------------------------------------------------------------------------------------------------------|
| DBI Type C 3-wire serial interface + DPI interface | Unused | Unused  | SCL     | DB23-DB0: 24-bit data bus<br>DB21-DB16, DB13-DB8,<br>DB5-DB0: 18-bit data bus<br>DB21-DB17, DB13-DB8,<br>DB5-DB1: 16-bit data bus<br>SDI/SDO |
| DBI Type A 8-bit parallel                          | E      | RW      | DCX     | DB23-DB8: Unused,<br>DB7-DB0: 8-bit data bus                                                                                                 |
| DBI Type A 9-bit parallel                          | E      | RW      | DCX     | DB23-DB9: Unused,<br>DB8-DB0: 9-bit data bus                                                                                                 |
| DBI Type A 16-bit parallel                         | E      | RW      | DCX     | DB23-DB16: Unused,<br>DB15-DB0: 16-bit data bus                                                                                              |
| DBI Type A 18-bit parallel                         | E      | RW      | DCX     | DB23-DB18: Unused,<br>DB17-DB0: 18-bit data bus                                                                                              |
| DBI Type C 4-wire serial interface + DPI interface | Unused | DCX     | SCL     | DB23-DB0: 24-bit data bus<br>DB21-DB16, DB13-DB8,<br>DB5-DB0: 18-bit data bus<br>DB21-DB17, DB13-DB8,<br>DB5-DB1: 16-bit data bus<br>SDI/SDO |
| DBI Type B 8-bit parallel                          | RDX    | WRX     | DCX     | DB23-DB8: Unused,<br>D7-D0: 8-bit data bus                                                                                                   |
| DBI Type B 9-bit parallel                          | RDX    | WRX     | DCX     | DB23-DB9: Unused,<br>DB8-DB0: 9-bit data bus                                                                                                 |
| DBI Type B 16-bit parallel                         | RDX    | WRX     | DCX     | DB23-DB16: Unused,<br>DB15-DB0: 16-bit data bus                                                                                              |
| DBI Type B 18-bit parallel                         | RDX    | WRX     | DCX     | DB23-DB18: Unused,<br>DB17-DB0: 18-bit data bus                                                                                              |
| DBI Type B 24-bit parallel                         | RDX    | WRX     | DCX     | DB23-DB0: 24-bit data bus                                                                                                                    |
| DSI<br>(Display Serial Interface)                  | Unused | Unused  | Unused  | DSI_CP, DSI_CN,<br>DSI_D0P, DSI_D0N,<br>DSI_D1P, DSI_D1N,                                                                                    |
| MDDI<br>(Mobile Display Digital Interface)         | Unused | Unused  | Unused  | MDDI_STBP, MDDI_STBN,<br>MDDI_D0P, MDDI_D0N,<br>MDDI_D1P, MDDI_D1N                                                                           |

Table 4.2: Pin connection based on different interface

### 4.1.1 MIPI DBI-A / DBI-B interface

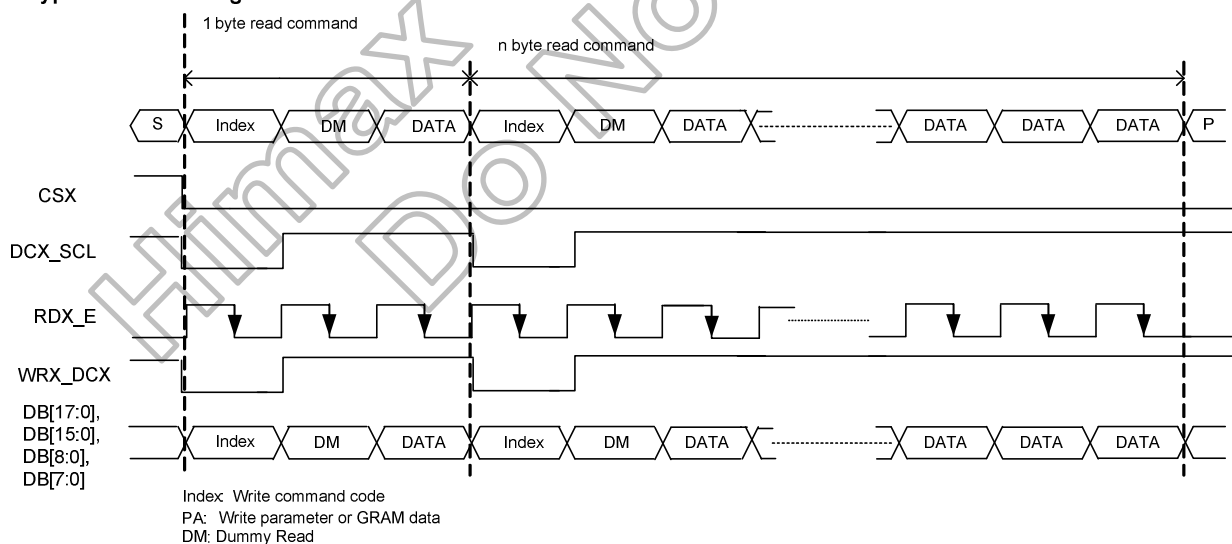
The selection of DBI interface is by BS3 pin. When this pin is low state (VSSD), the interface is use DBI system. And use BS2 to BS0 pins to select DBI interfacr mode. The parallel interface timing diagram is described in Figure 4.1 to Figure 4.4.

**DBI Type A write to register or GRAM-CLK-E mode**



**Figure 4.1: DBI-A system interface protocol, write to register or GRAM**

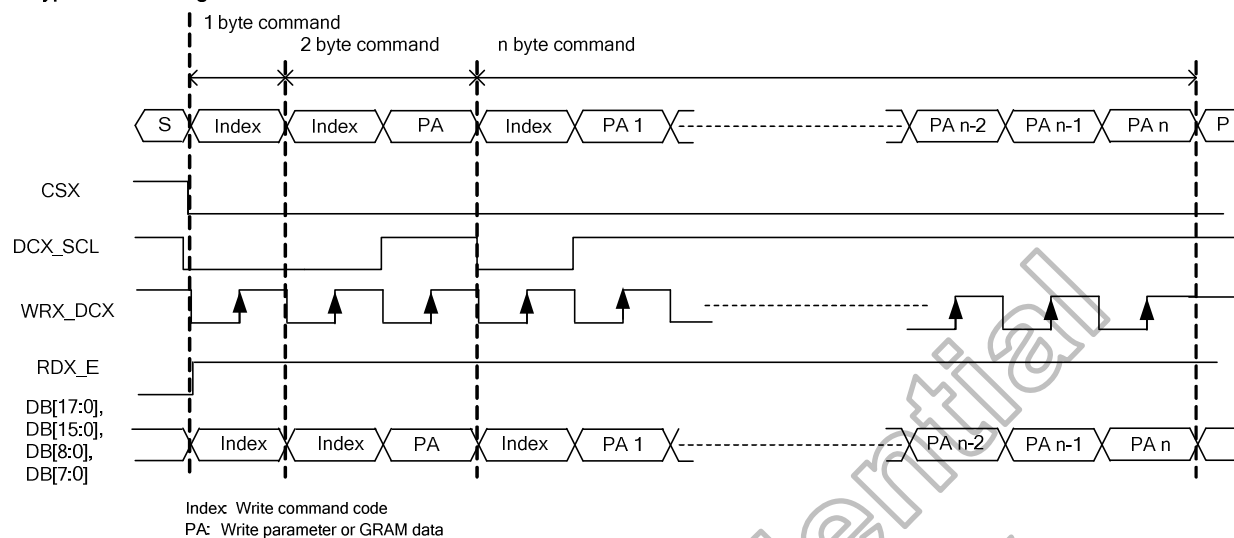
**DBI Type A read from register or GRAM – CLK-E mode**



**Figure 4.2: DBI-A system interface protocol, read from register or GRAM**

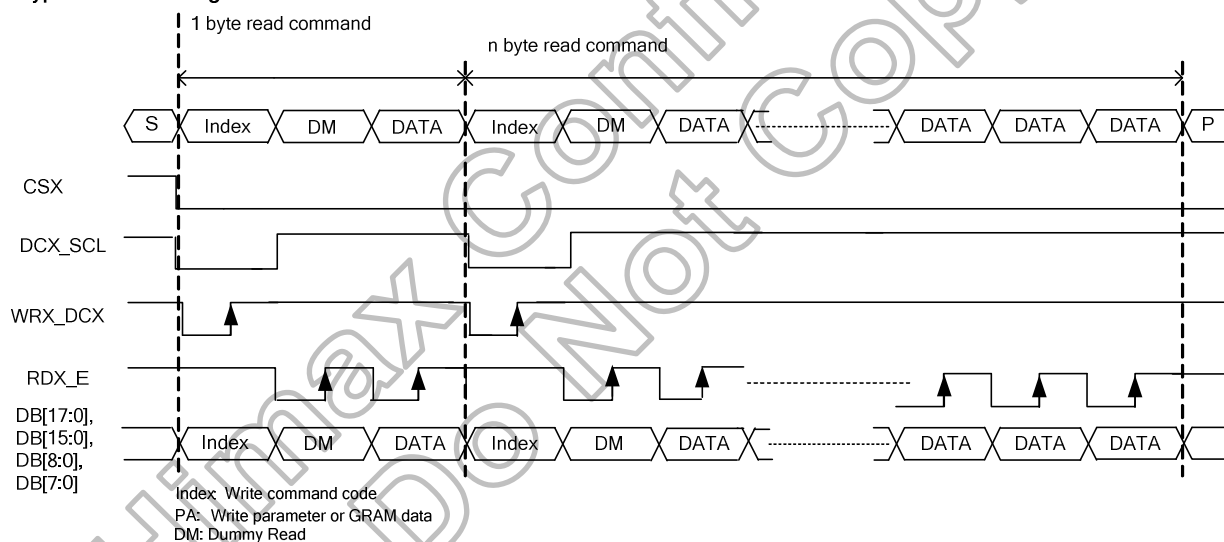


**DBI Type B write to register or GRAM**



**Figure 4.3: DBI-B system interface protocol, write to register or GRAM**

**DBI Type B read from register or GRAM**



**Figure 4.4: DBI-B system interface protocol, read from register or GRAM**

#### 4.1.1.1 24-bit parallel bus system interface

The DBI-B system 24-bit bus parallel data transfer can be used by setting “BS3-0” pins to “1010”. The Figure 4.5 is the example of interface with 18-bit DBI-A / DBI-B microcomputer system interface.

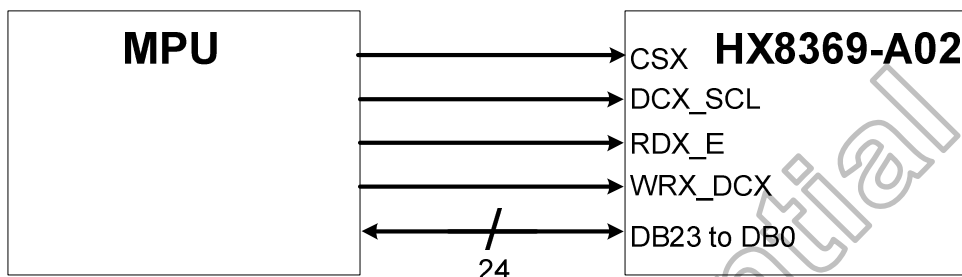


Figure 4.5 Example of DBI-B system 18-bit parallel bus interface

There are one type data format to write display data at 24-bit bus Interface. See Figure 4.6.

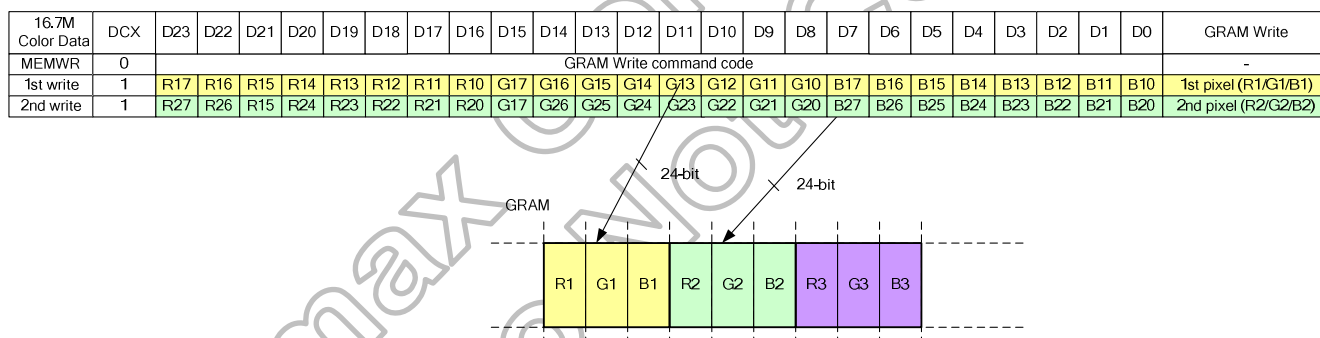


Figure 4.6: Write data for RGB 8-8-8 (16.7M colours) bit Input in 24-bit parallel interface

## 4.1.1.2 18-bit parallel bus system interface

The DBI-A system 18-bit bus parallel data transfer can be used by setting “BS3-0” pins to “0011”. And the DBI-B system 18-bit bus parallel data transfer can be used by setting “BS3-0” pins to “0111”. The Figure 4.7 is the example of interface with 18-bit DBI-A / DBI-B microcomputer system interface.

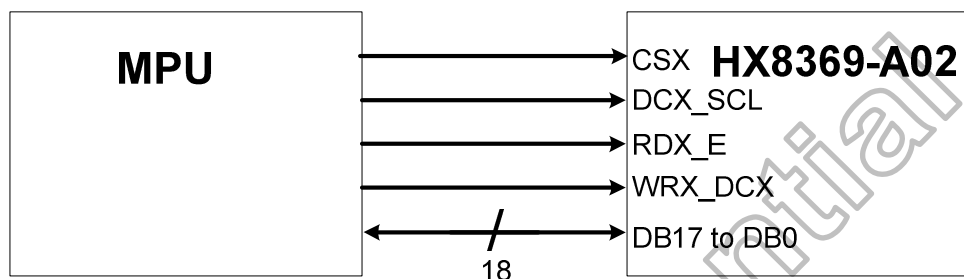


Figure 4.7: Example of DBI-A / DBI-B system 18-bit parallel bus interface

There are three types data format to write display data at 18-bit bus Interface. See Figure 4.8 to Figure 4.10. Under this type, the data format can select as 16- / 18- / 24-bit by register R3Ah. (set\_pixel\_format)

| 65k Color Data | DCX | D17 | D16 | D15 | D14 | D13 | D12 | D11 | D10 | D9 | D8 | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 | GRAM Write           |
|----------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|----|----|----|----|----|----|----|----|----|----|----------------------|
| MEMWR          | 0   |     |     |     |     |     |     |     |     |    |    |    |    |    |    |    |    |    |    | -                    |
| 1st write      | 1   | x   | x   |     |     |     |     |     |     |    |    |    |    |    |    |    |    |    |    | 1st pixel (R1/G1/B1) |
| 2nd write      | 1   | x   | x   |     |     |     |     |     |     |    |    |    |    |    |    |    |    |    |    | 2nd pixel (R2/G2/B2) |

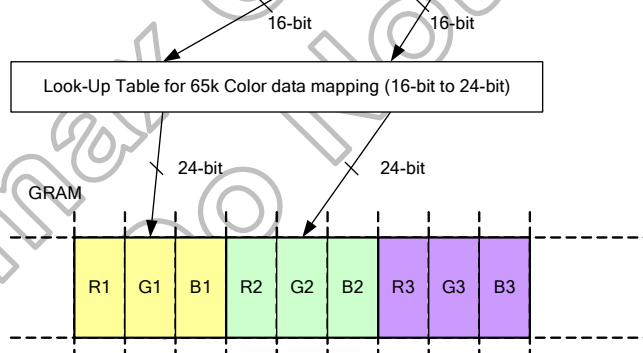


Figure 4.8: Write data for RGB 5-6-5 (65k colours) bit input in 18-bit parallel interface

| 262k Color Data | DCX | D17 | D16 | D15 | D14 | D13 | D12 | D11 | D10 | D9 | D8 | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 | GRAM Write           |
|-----------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|----|----|----|----|----|----|----|----|----|----|----------------------|
| MEMWR           | 0   |     |     |     |     |     |     |     |     |    |    |    |    |    |    |    |    |    |    | -                    |
| 1st write       | 1   |     |     |     |     |     |     |     |     |    |    |    |    |    |    |    |    |    |    | 1st pixel (R1/G1/B1) |
| 2nd write       | 1   |     |     |     |     |     |     |     |     |    |    |    |    |    |    |    |    |    |    | 2nd pixel (R2/G2/B2) |

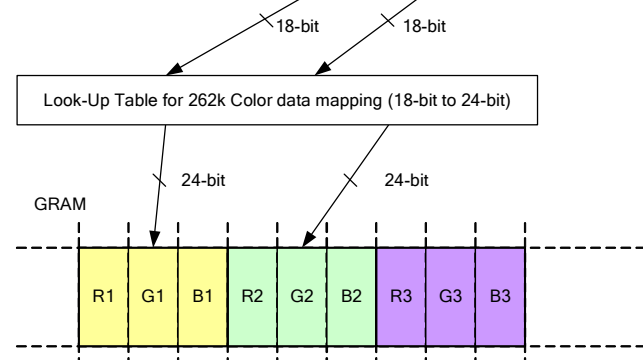
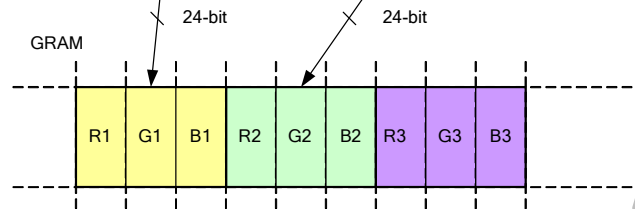
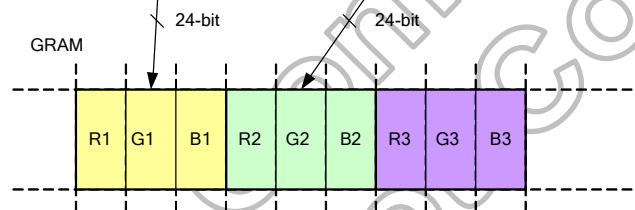


Figure 4.9: Write data for RGB 6-6-6(262k colours) bit input in 18-bit parallel interface

| 16.7M Color Data | DCX | D17                     | D16 | D15 | D14 | D13 | D12 | D11 | D10 | D9 | D8 | D7  | D6  | D5  | D4  | D3  | D2  | D1  | D0  | GRAM Write           |
|------------------|-----|-------------------------|-----|-----|-----|-----|-----|-----|-----|----|----|-----|-----|-----|-----|-----|-----|-----|-----|----------------------|
| MEMWR            | 0   | GRAM Write command code |     |     |     |     |     |     |     |    |    |     |     |     |     |     |     |     |     | -                    |
| 1st write        | 1   | R17                     | R16 | R15 | R14 | R13 | R12 | R11 | R10 | x  | x  | G17 | G16 | G15 | G14 | G13 | G12 | G11 | G10 | 1st pixel (R1/G1/B1) |
| 2nd write        | 1   | B17                     | B16 | B15 | B14 | B13 | B12 | B11 | B10 | x  | x  | R27 | R26 | R25 | R24 | R23 | R22 | R21 | R20 | x                    |
| 3rd write        | 1   | G27                     | G26 | G25 | G24 | G23 | G22 | G21 | G20 | x  | x  | B27 | B26 | B25 | B24 | B23 | B22 | B21 | B20 | 2nd pixel (R2/G2/B2) |



| 16.7M Color Data | DCX | D17                     | D16 | D15 | D14 | D13 | D12 | D11 | D10 | D9 | D8 | D7  | D6  | D5  | D4  | D3  | D2  | D1  | D0  | GRAM Write           |
|------------------|-----|-------------------------|-----|-----|-----|-----|-----|-----|-----|----|----|-----|-----|-----|-----|-----|-----|-----|-----|----------------------|
| MEMWR            | 0   | GRAM Write command code |     |     |     |     |     |     |     |    |    |     |     |     |     |     |     |     |     | -                    |
| 1st write        | 1   | R17                     | R16 | R15 | R14 | R13 | R12 | R11 | R10 | x  | x  | G17 | G16 | G15 | G14 | G13 | G12 | G11 | G10 | 1st pixel (R1/G1/B1) |
| 2nd write        | 1   | B17                     | B16 | B15 | B14 | B13 | B12 | B11 | B10 | x  | x  | R27 | R26 | R25 | R24 | R23 | R22 | R21 | R20 | -                    |
| -                | 0   | The other command       |     |     |     |     |     |     |     |    |    |     |     |     |     |     |     |     |     | -                    |
| MEMWR            | 0   | GRAM Write command code |     |     |     |     |     |     |     |    |    |     |     |     |     |     |     |     |     | -                    |
| 1st write        | 1   | R27                     | R26 | R25 | R24 | R23 | R22 | R21 | R20 | x  | x  | G27 | G26 | G25 | G24 | G23 | G22 | G21 | G20 | 2nd pixel (R2/G2/B2) |
| 2nd write        | 1   | B27                     | B26 | B25 | B24 | B23 | B22 | B21 | B20 | x  | x  | R37 | R36 | R35 | R34 | R33 | R32 | R31 | R30 | -                    |
| 3rd write        | 1   | G37                     | G36 | G35 | G34 | G33 | G32 | G31 | G30 | x  | x  | B37 | B36 | B35 | B34 | B33 | B32 | B31 | B30 | 3rd pixel (R3/G3/B3) |



R27 ~ R20 will be neglected and are not used

Figure 4.10: Write data for RGB 8-8-8 (16.7M colours) bit input in 18-bit parallel interface

### 4.1.1.3 16-bit parallel bus system interface

The DBI-A system 16-bit bus parallel data transfer can be used by setting “BS3-0” pins to “0010”. And the DBI-B system 16-bit bus parallel data transfer can be used by setting “BS3-0” pins to “0110”. The Figure 4.11 is the example of interface with 16-bit DBI-A / DBI-B microcomputer system interface.

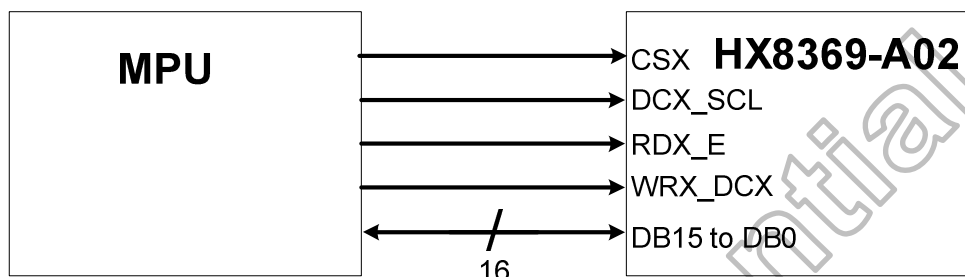


Figure 4.11: Example of DBI-A- / DBI-B system 16-bit bus interface

There are three types data format to write display data at 16-bit bus Interface. See Figure 4.12 to Figure 4. 14. Under this type, the data format can select as 16- / 18- / 24-bit by register R3Ah. (set\_pixel\_format)

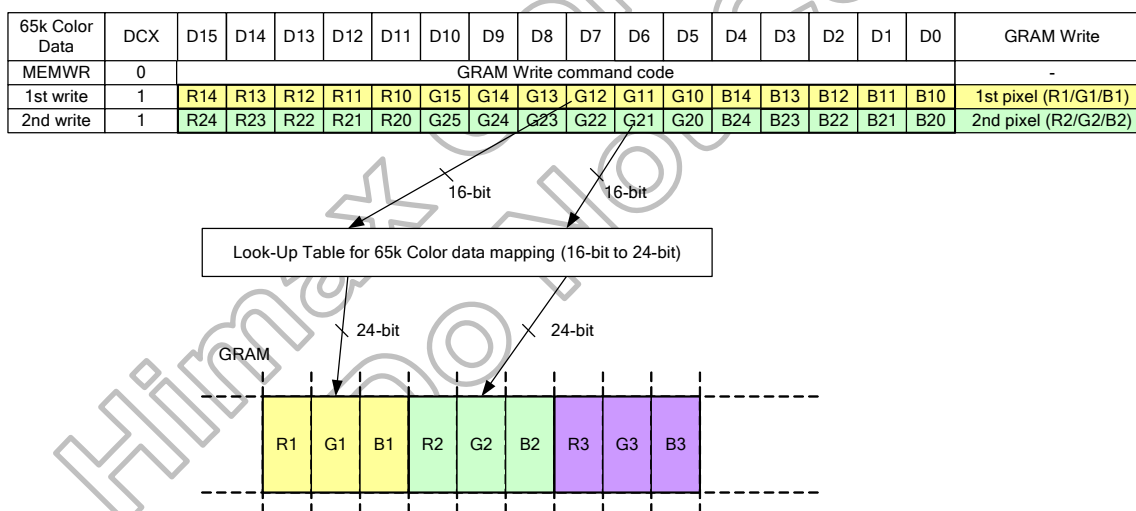


Figure 4.12: Write data for RGB 5-6-5 (65k colours) bit input in 16-bit parallel interface

| 262K Color Data | DCX | D15                     | D14 | D13 | D12 | D11 | D10 | D9 | D8 | D7  | D6  | D5  | D4  | D3  | D2  | D1 | D0 | GRAM Write           |
|-----------------|-----|-------------------------|-----|-----|-----|-----|-----|----|----|-----|-----|-----|-----|-----|-----|----|----|----------------------|
| MEMWR           | 0   | GRAM Write command code |     |     |     |     |     |    |    |     |     |     |     |     |     |    |    | -                    |
| 1st write       | 1   | R15                     | R14 | R13 | R12 | R11 | R10 | x  | x  | G15 | G14 | G13 | G12 | G11 | G10 | x  | x  | 1st pixel (R1/G1/B1) |
| 2nd write       | 1   | B15                     | B14 | B13 | B12 | B11 | B10 | x  | x  | R25 | R24 | R23 | R22 | R21 | R20 | x  | x  | -                    |
| 3rd write       | 1   | G25                     | G24 | G23 | G22 | G21 | G20 | x  | x  | B25 | B24 | B23 | B22 | B21 | B20 | x  | x  | 2nd pixel (R2/G2/B2) |

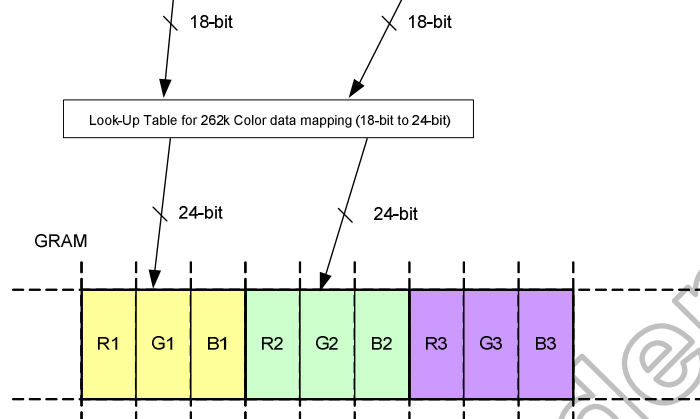


Figure 4.13: Write data for RGB 6-6-6 (262k colours) bit input in 16-bit parallel interface

| 16.7M Color Data | DCX | D15                     | D14 | D13 | D12 | D11 | D10 | D9  | D8  | D7  | D6  | D5  | D4  | D3  | D2  | D1  | D0  | GRAM Write           |
|------------------|-----|-------------------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|----------------------|
| MEMWR            | 0   | GRAM Write command code |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     | -                    |
| 1st write        | 1   | R17                     | R16 | R15 | R14 | R13 | R12 | R11 | R10 | G17 | G16 | G15 | G14 | G13 | G12 | G11 | G10 | 1st pixel (R1/G1/B1) |
| 2nd write        | 1   | B17                     | B16 | B15 | B14 | B13 | B12 | B11 | B10 | R27 | R26 | R25 | R24 | R23 | R22 | R21 | R20 | -                    |
| 3rd write        | 1   | G27                     | G26 | G25 | G24 | G23 | G22 | G21 | G20 | B27 | B26 | B25 | B24 | B23 | B22 | B21 | B20 | 2nd pixel (R2/G2/B2) |

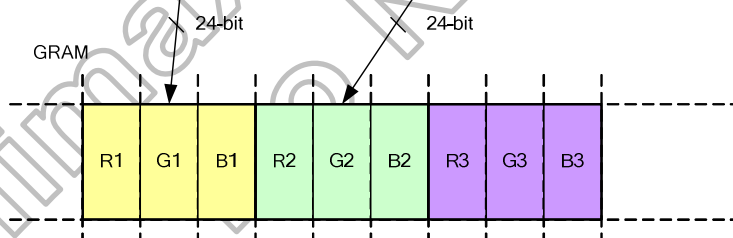


Figure 4.14: Write data for RGB 8-8-8-bit (16.7M colours) input in 16-bit parallel interface



#### 4.1.1.4 9-bit parallel bus system interface

The DBI-A system 9-bit bus parallel data transfer can be used by setting “BS3-0” pins to “0001”. And the DBI-B system 9-bit bus parallel data transfer can be used by setting “BS3-0” pins to “0101”. The Figure 4.15 is the example of interface with 9-bit DBI-A / DBI-B microcomputer system interface.

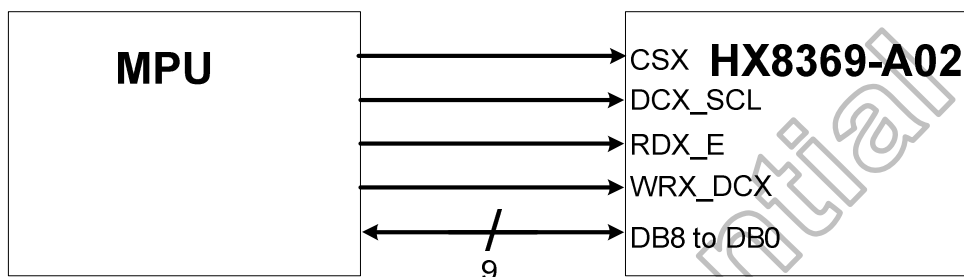


Figure 4.15: Example of DBI-A / DBI-B- system 9-bit bus interface

There are three types data format to write display data at 9-bit bus Interface. See Figure 4.16 to Figure 4. 18. Under this type, the data format can select as 16-/18-/ 24-bit by register R3Ah. (set\_pixel\_format)

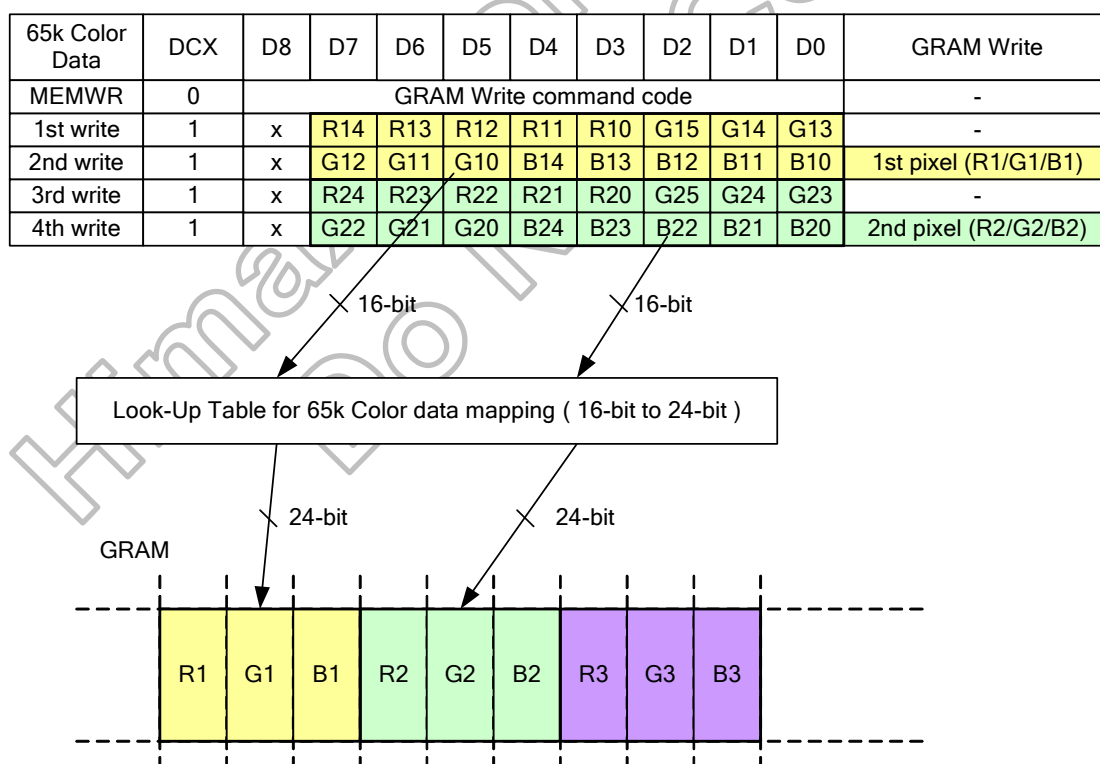


Figure 4.16: Write data for RGB 5-6-5(65k colours) bit input in 9-bit parallel interface

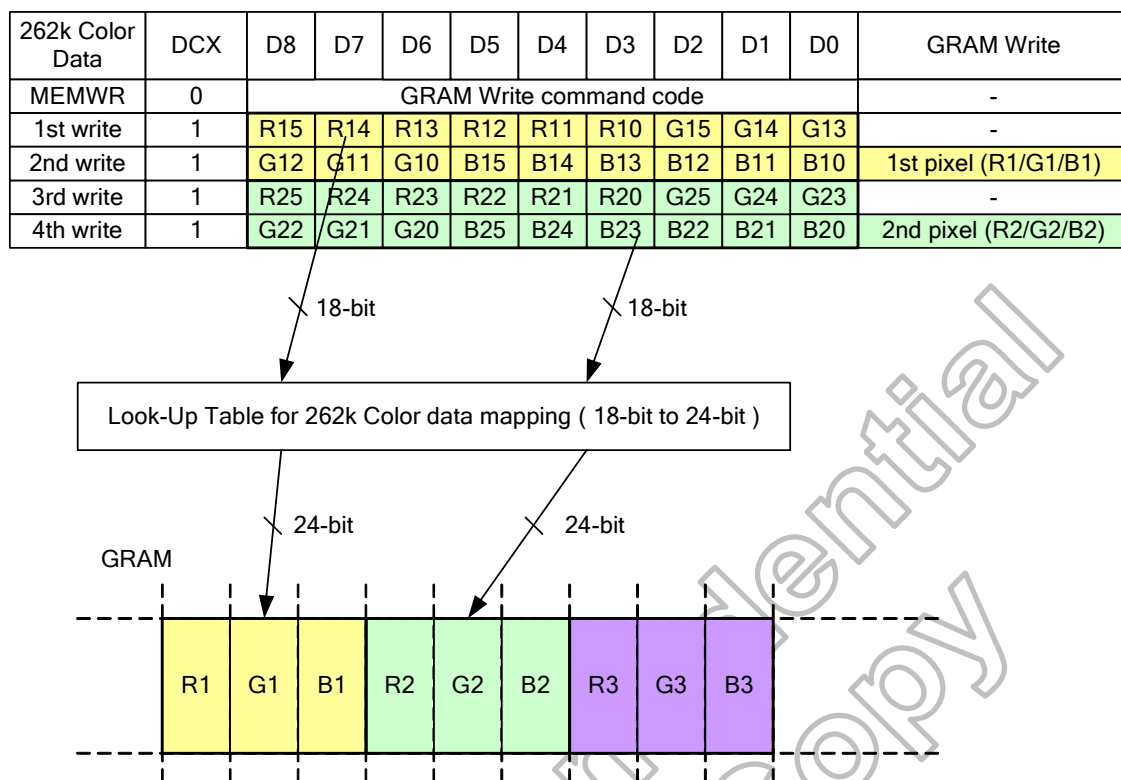


Figure 4.17: Write data for RGB 6-6-6-bit (262k colours) input in 9-bit parallel interface

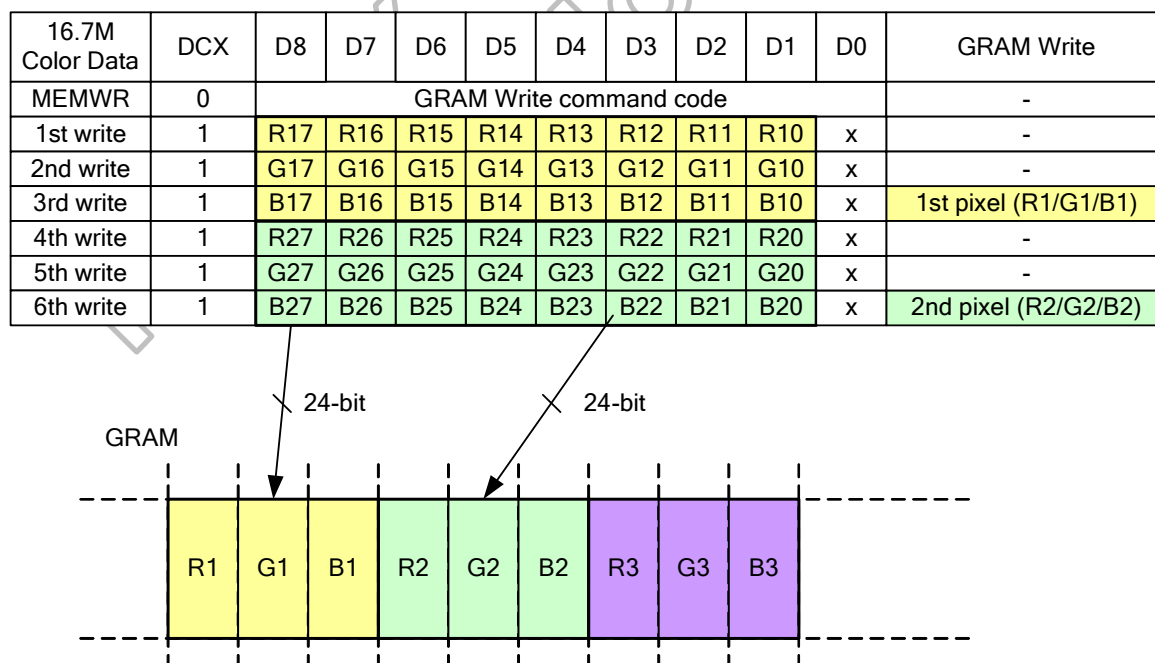


Figure 4.18: Write data for RGB 8-8-8-bit (16.7 M colours) input in 9-bit parallel interface

#### 4.1.1.5 8-bit parallel bus system interface

The DBI-A system 8-bit bus parallel data transfer can be used by setting “BS3-0” pins to “0000”. And the DBI-B system 8-bit bus parallel data transfer can be used by setting “BS3-0” pins to “0100”. The Figure 4.19 is the example of interface with 8-bit DBI-A / DBI-B microcomputer system interface.

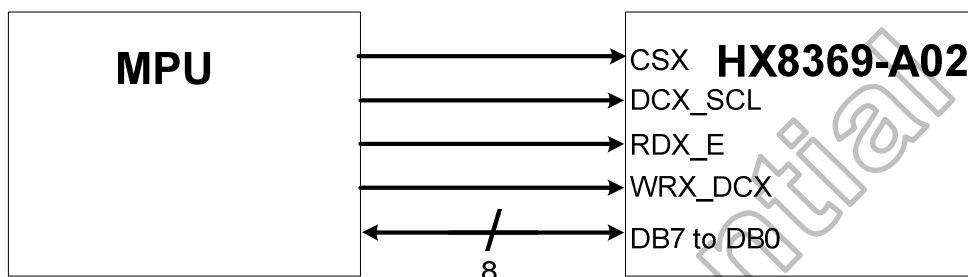


Figure 4.19: Example of DBI-A- / DBI-B-system 8-bit bus interface

There are three types data format to write display data at 8-bit bus Interface. See Figure 4. 20 to Figure 4. 22. Under this type, the data format can select as 16-/18-/ 24-bit by register R3Ah. (set\_pixel\_format)

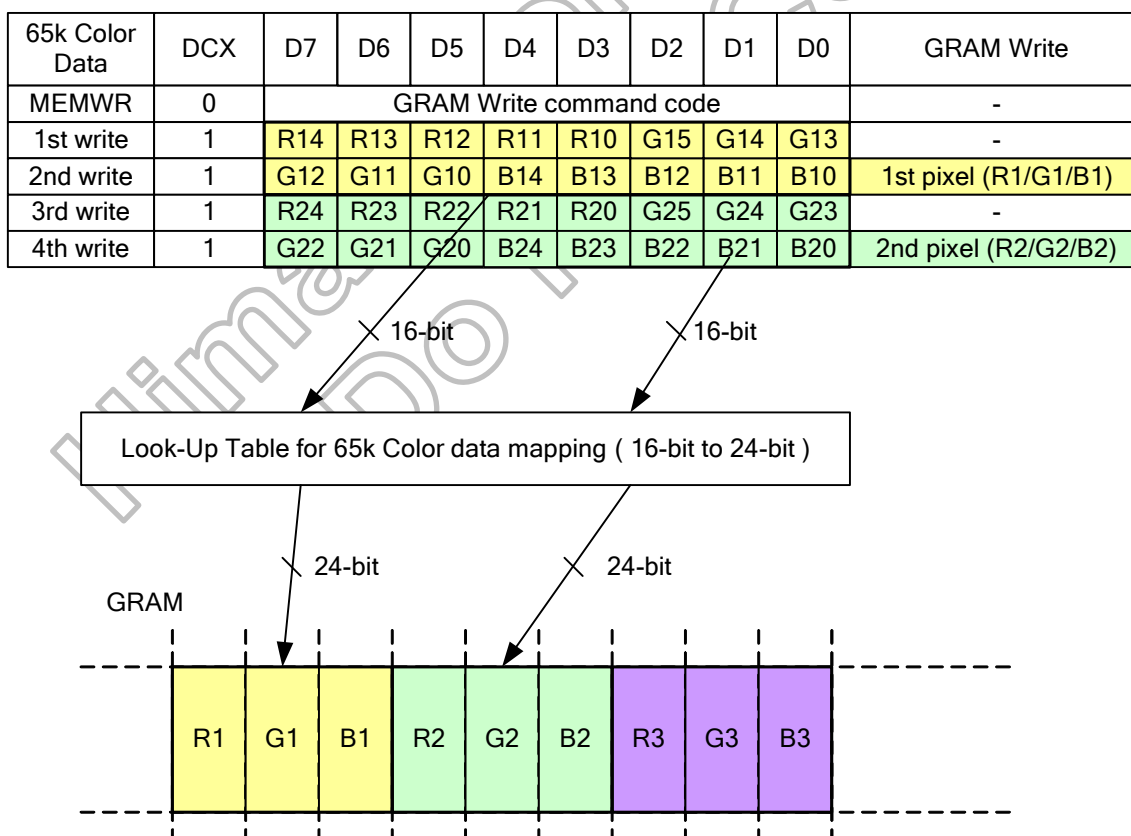


Figure 4.20: Write data for RGB 5-6-5 (65k colours) bit input in 8-bit parallel interface

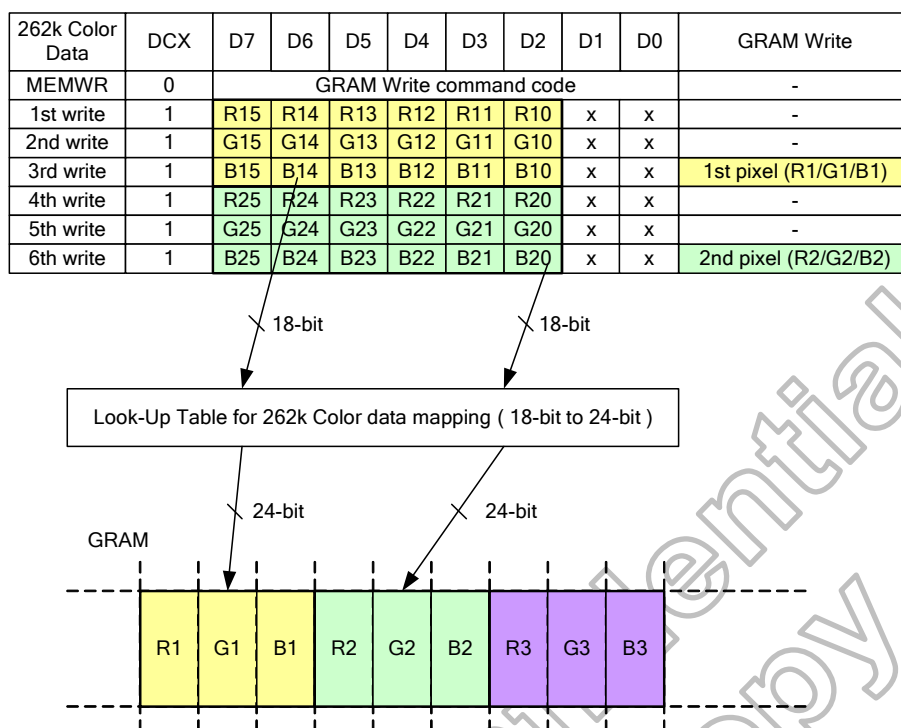


Figure 4.21: Write data for RGB 6-6-6-bit (262k colours) input in 8-bit parallel interface

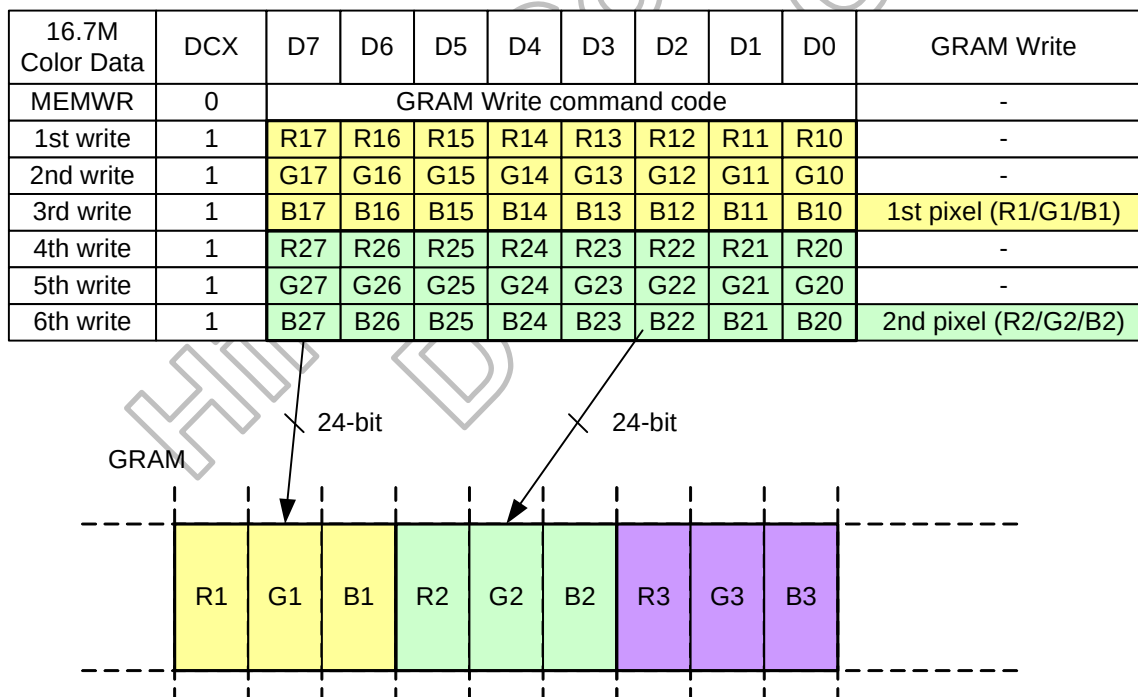


Figure 4.22: Write data for RGB 8-8-8-bit (16.7 M colours) input in 8-bit parallel interface

## 4.2 Serial data transfer interface (MIPI DBI-C)

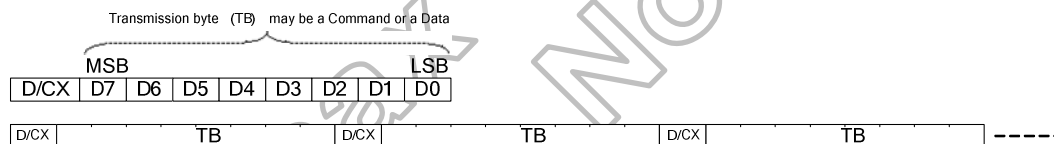
The HX8369-A02 supports three type serial data transfer interface, the interface selection by setting BS3-0 pins. The BS3-0 set "1101" is select 3-wire option 1 serial bus. The BS3-0 set "1110" is select 3-wire option 2 serial bus. The BS3-0 is set "1111" when select 4-wire option 3 serial bus.

The 3-wire serial bus is use: chip select line (CSX), serial input/output data (SDI and SDO) and the serial transfer clock line (DCX\_SCL). The 4-wire serial bus is use: chip select line (CSX), data/command select (WRX\_DCX), serial input/output data (SDI and SDO) and the serial transfer clock line (DCX\_SCL).

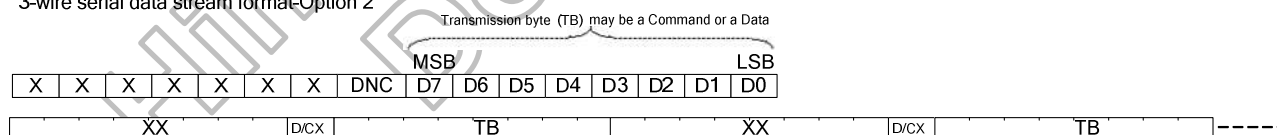
### 4.2.1.1 Serial data write mode

The 3-pin serial data packet contains a control bit D/CX and a transmission byte and in 4-pin serial case, data packet contains just transmission byte and control signal D/CX is transferred by WRX\_DCX pin. If DCX is low, the transmission byte is command byte. If D/CX is high, the transmission byte is stored in to command register or GRAM. The MSB is transmitted first. The serial interface is initialized when CSX is high. In this state, SCL clock pulse or serial input/output data (SDI and SDO) have no effect. A falling edge on CSX enables the serial interface and indicates the start of data transmission. Where 3-wire serial write format include two types (8-/16-bit) is according command code.

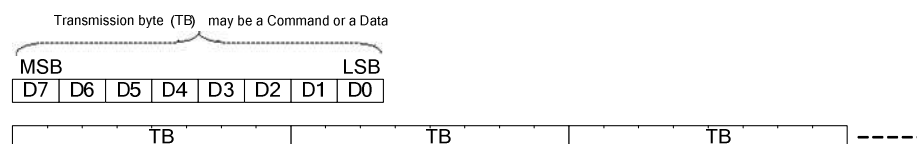
3-wire serial data stream format-Option 1



3-wire serial data stream format-Option 2

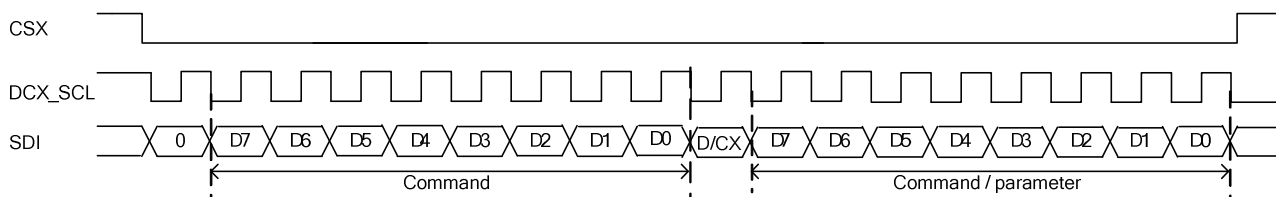


4-wire serial data stream format-Option 3

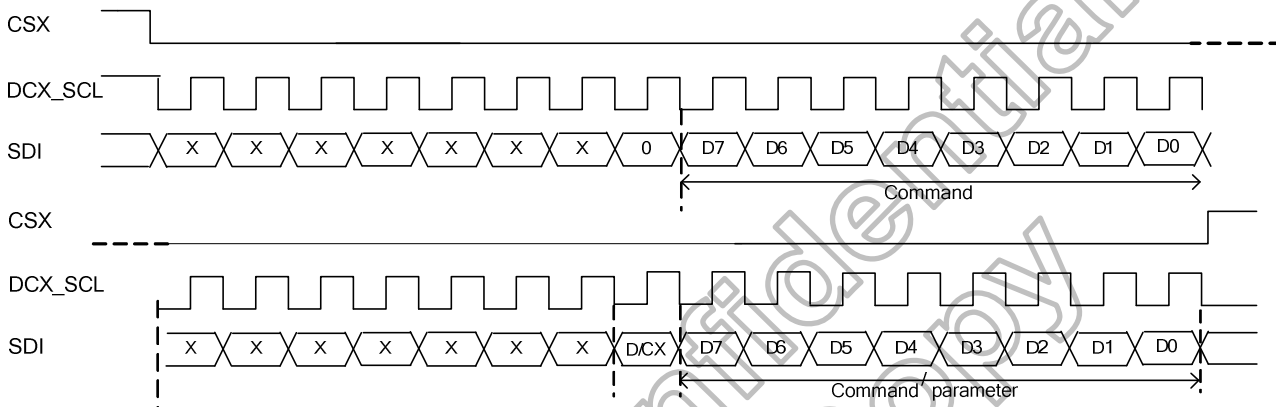


**Figure 4.23: Serial data stream, write mode**

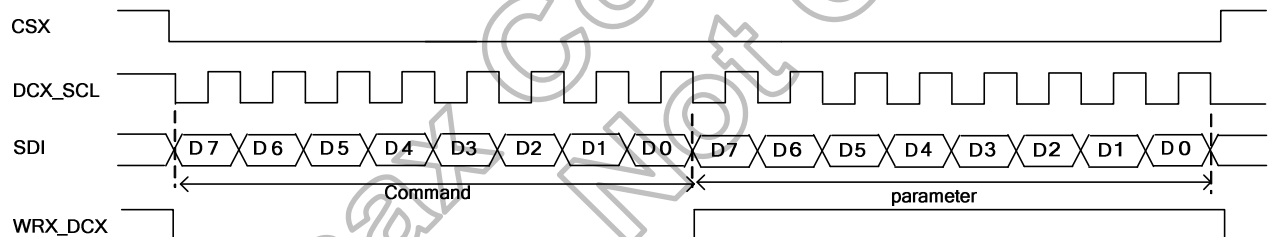
**DBI Type C: Interface protocol-Option 1 (3-wire)**



**DBI Type C: Interface protocol-Option 2 (3-wire)**



**DBI Type C: Interface protocol Option 3 (4-wire)**



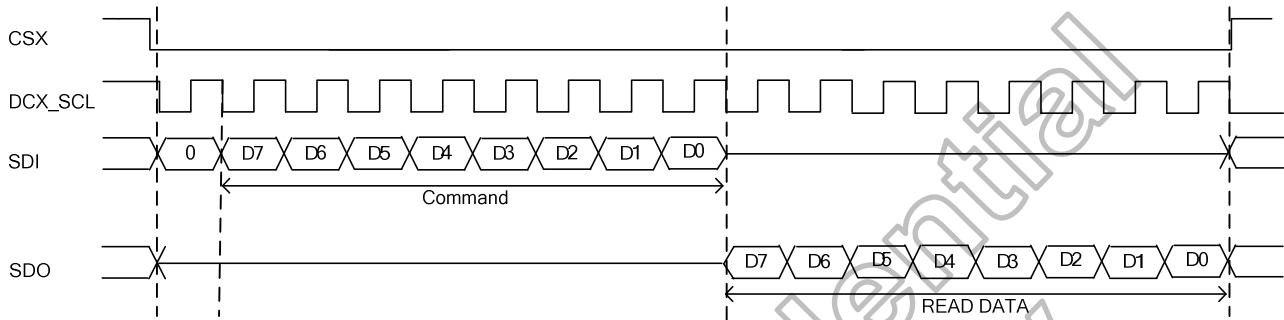
**Figure 4.24: DBI Type C: Serial interface protocol 3-wire/4-wire, write mode**



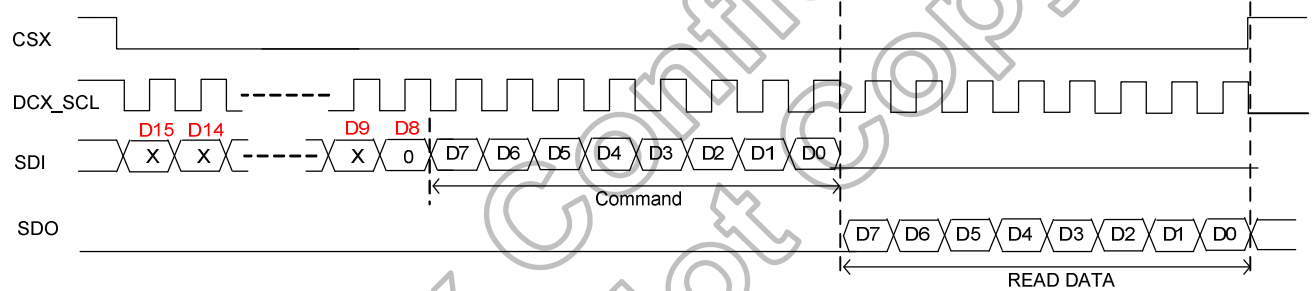
#### 4.2.1.2 Serial data read mode

The micro-controller first has to send a command and then the following byte is transmitted in the opposite direction. The 3-wire serial read data format which just needs 8-bit.

DBI Type C: Interface protocol-Option 1 (3-wire)



DBI Type-C Interface Protocol – Option 2 (3 wire)



DBI Type-C Interface Protocol – Option 3 (4 wire)

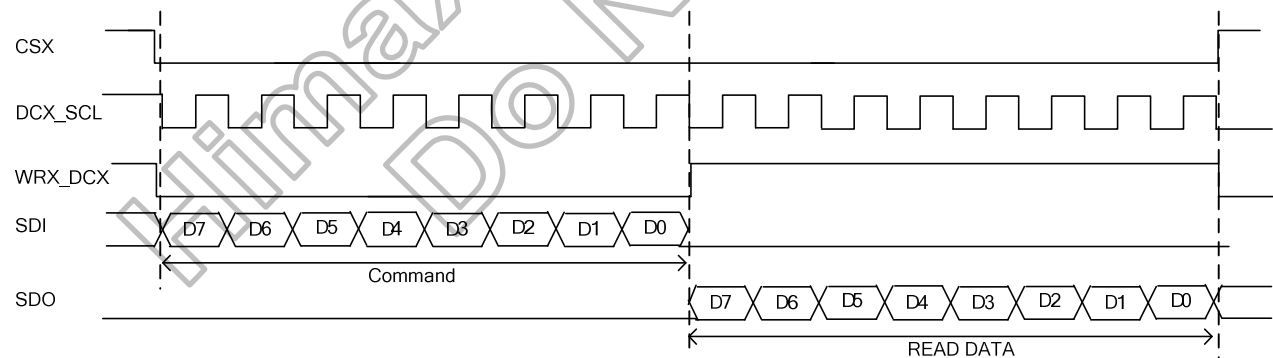


Figure 4.25: Type C:Serial interface protocol 3-wire/4-wire read mode

If there is a break on data transmission when transmit a command before a whole byte has been completed, then the display module will have reset the interface such that it will be ready to receive the same byte re-transmitted when the chip select line (CSX) is next activated. See the following figure.

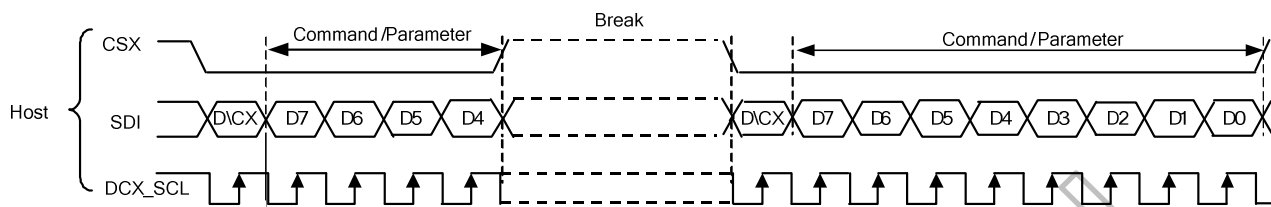
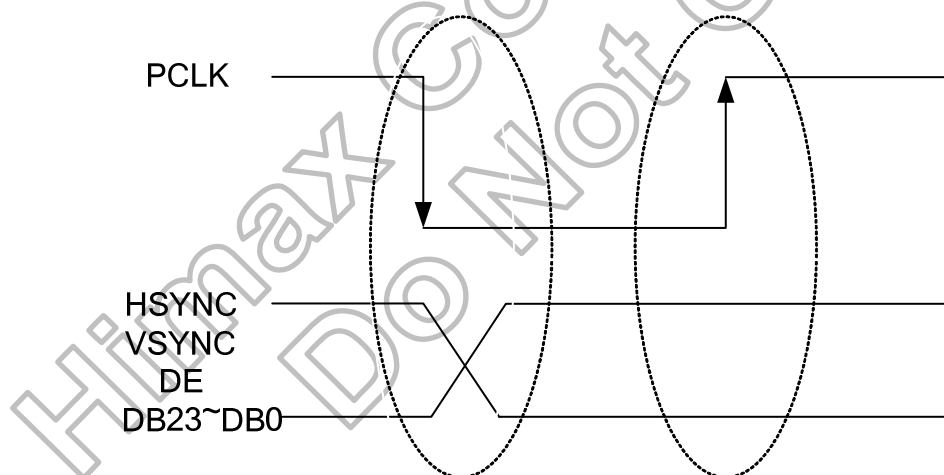


Figure 4.26: Display module data transfer recovery

## 4.2.2 MIPI DPI interface (Display Pixel Interface)

The HX8369-A02 uses 16 or 18-bit or 24-bit parallel RGB interface which includes: HS, VSYNC, DE, PCLK, DB23~DB0. The interface is active after Power On sequence. Pixel clock (PCLK) is running all the time without stopping and it is used to entering HSYNC, VSYNC, DE and DB23~DB0– lines states when there is a rising edge of the PCLK. The PCLK cannot be used as continue internal clock for other functions of the display module e.g. Sleep In– mode etc. Vertical synchronization (VSYNC) is used to tell when there is received a new frame of the display. This is negative (“–”, “0”, low) active and its state is read to the display module by a rising edge of the PCLK-line. Horizontal synchronization (HSYNC) is used to tell when there is received a new line of the frame. This is negative (“–”, “0”, low) active and its state is read to the display module by a rising edge of the PCLK- line. Data enable (DE) is used to tell when there is received RGB information that should be transferred on the display. This is positive (“+”, “1”, high) active and its state is read to the display module by a rising edge of the PCLK-line. DB23~DB0 (24 bit: R7-R0, G7-G0 and B7-B0; 18 bit: R5- R0, G5-G0 and B5-B0; 16 bit: R4- R0, G5-G0 and B4-B0) are used to tell what is the information of the image that is transferred on the display (when DE=1 and there is a rising edge of PCLK). DB23~DB0– lines can be set to “0” (low) or “1” (high). These lines are read by a rising edge of the PCLK-line.

The pixel clock cycle is described in the following figure.



**Note:** PCLK is an unsynchronized signal (It can be stopped).

**Figure 4.27: PCLK cycle**

### 4.2.2.1 General timing diagram

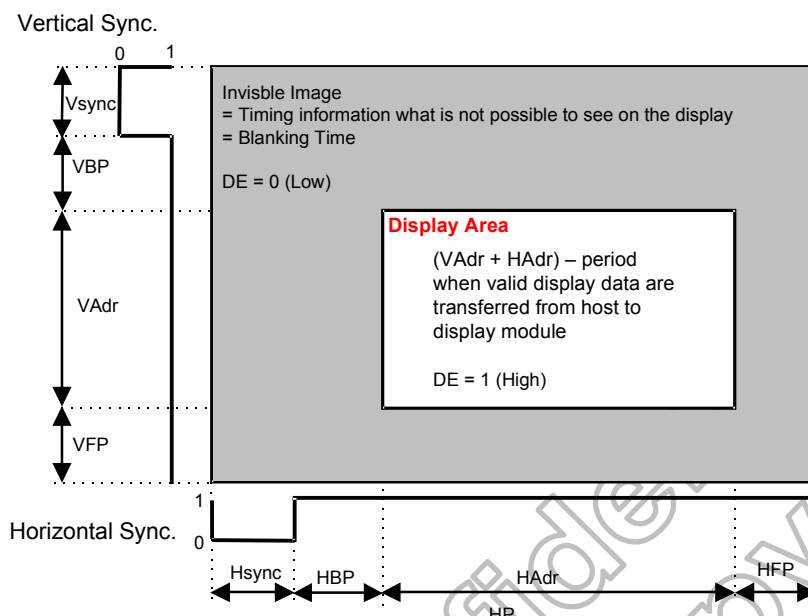


Figure 4.28: General timing diagram

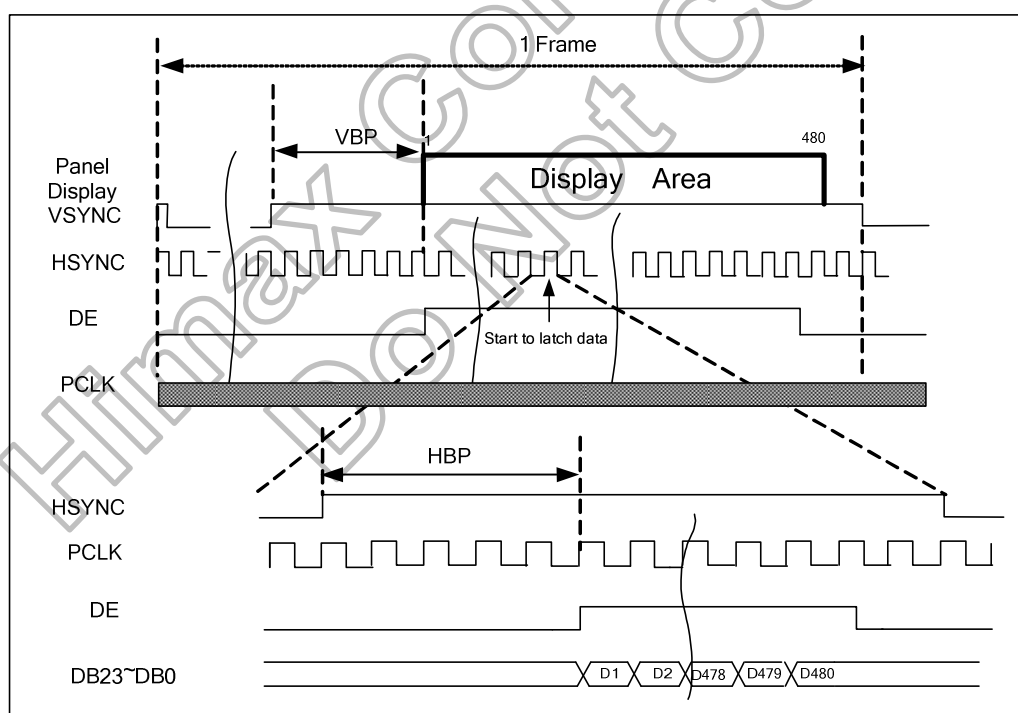


Figure 4.29: DPI (480RGB x 864) timing diagram

The image information must be correct on the display, when the timings are in range on the interface. However, the image information can be incorrect on the display, when timings are out of the range on the interface (Out of the range timings cannot cause any damage on the display module or it cannot cause any damage on the host side). The correct image information must be displayed automatically (by the display module) on the next frame (vertical sync.), when there is returned from out of the range to in range interface timings.

The MIPI DPI interface includes two types which are 16-/18-/24-bit data format by register 3Ah (set\_pixel\_format) to select.

DPI interface displaying moving pictures can be selected to rewrite into the GRAM or not through GRAM. The selection is set by register DM[1:0] and RM.

RM The bit is used to select an interface for the Frame Memory access operation. The Frame Memory is accessed only via the interface defined by RM bit. Because the interface can be selected separately from display operation mode, writing data to the Frame Memory is possible via system interface when RM = 0, even in the DPI display operation.

RM setting is enabled from the next frame. Wait 1 frame to transfer data after setting.

| RM | Interface for RAM access |
|----|--------------------------|
| 0  | DBI Interface (CPU)      |
| 1  | DPI Interface (RGB)      |

DM[1:0] The bit is used to select display operation mode. The setting allows switching between display operation in synchronization with internal oscillation clock, VSYNC, or DPI signal.

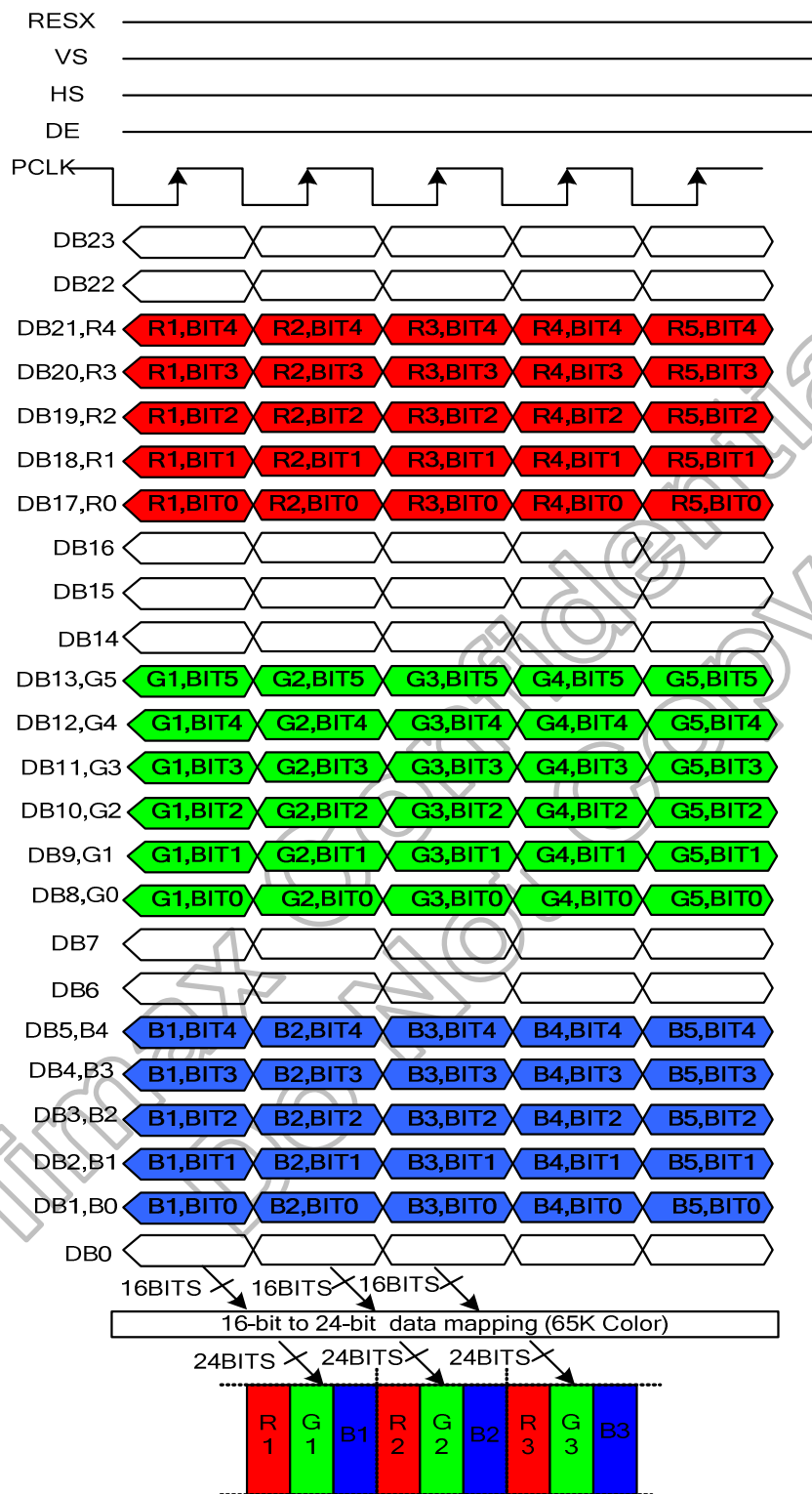
Note that switching between VSYNC and DPI operation is prohibited.

| DM 1 | DM 0 | Display Mode               |
|------|------|----------------------------|
| 0    | 0    | Internal oscillation clock |
| 0    | 1    | DPI signal (VSYNC+HSYNC)   |
| 1    | 0    | VSYNC signal only          |
| 1    | 1    | RGB data bypass GRAM mode  |

| Operation Mode                                                                             | Frame Memory Access Setting (RM) | Display Operation Mode (DM[1:0])      |
|--------------------------------------------------------------------------------------------|----------------------------------|---------------------------------------|
| Internal clock operation (displaying still pictures)                                       | MPU interface (RM=0)             | Internal clock operation (DM[1:0]=00) |
| RGB interface : capture mode 1 (displaying moving pictures)                                | RGB interface (RM=1)             | RGB interface : VS & HS (DM[1:0]=01)  |
| RGB interface : capture mode 2 (rewriting still pictures while displaying moving pictures) | MPU interface (RM=0)             | RGB interface : VS & HS (DM[1:0]=01)  |
| RGB interface : through mode (displaying moving pictures)                                  | Bypass frame memory              | RGB interface : VS & HS (DM[1:0]=11)  |
| Internal clock operation RGB data format                                                   | RGB interface (RM=1)             | Internal clock operation (DM[1:0]=00) |

**Note:** RGB interface capture mode is only for 24-bit / pixel color order.

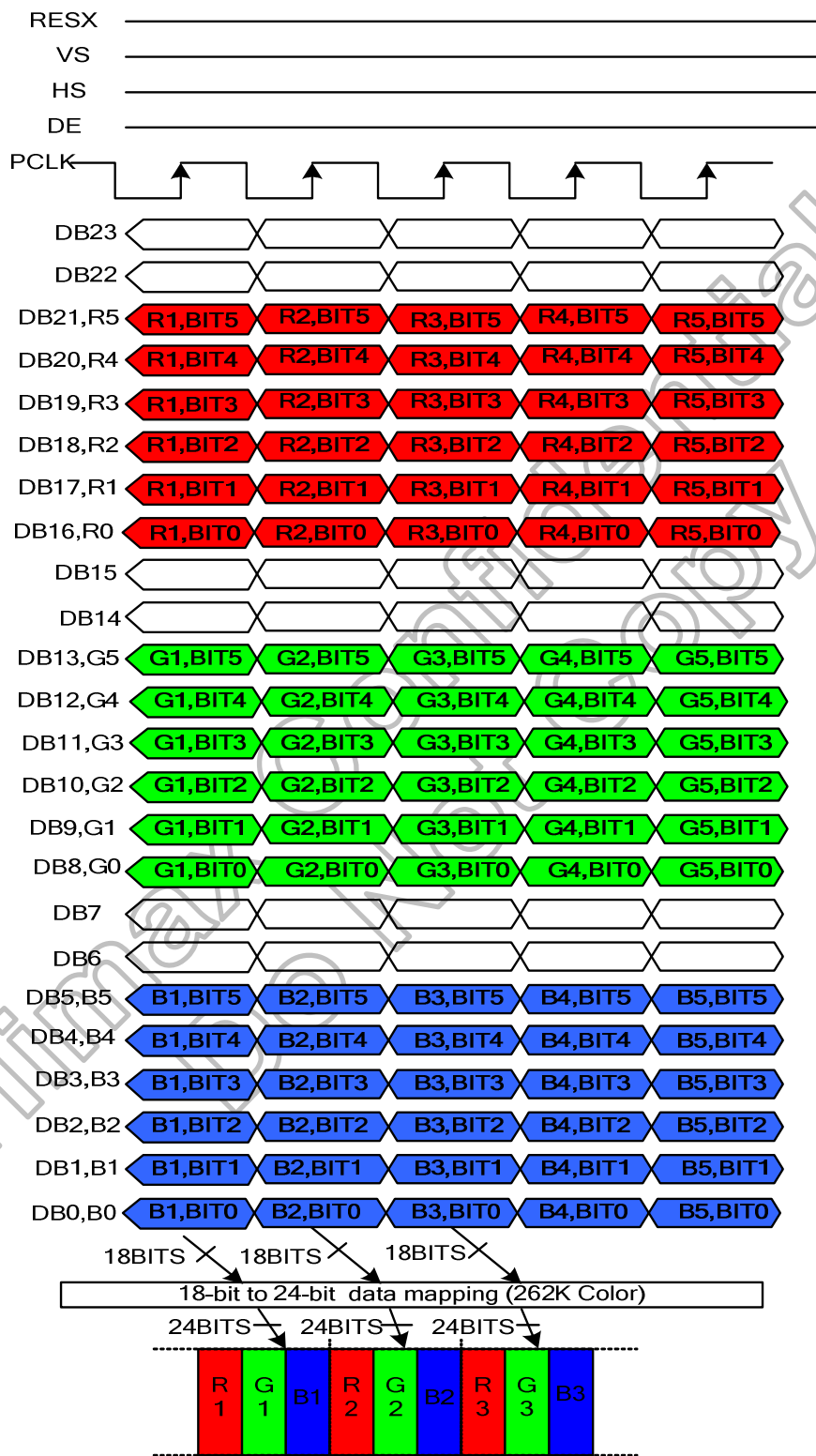
## 4.2.2.2 16-bit / pixel color order on the DPI I/F



**Note:** The data order is shown as follows, MSB=DB23, LSB=DB0 and picture data is MSB=Bit5, LSB=Bit0 for Green data and MSB=Bit4, LSB=Bit0 for Red and Blue data. Un-used pin DB23, DB22, DB16, DB15, DB14, DB7, DB6 and DB0 are set to open.

**Figure 4.30: 16-bit / pixel 65K colours order on the DPI I/F**

## 4.2.2.3 18-bit / pixel color order on the DPI I/F

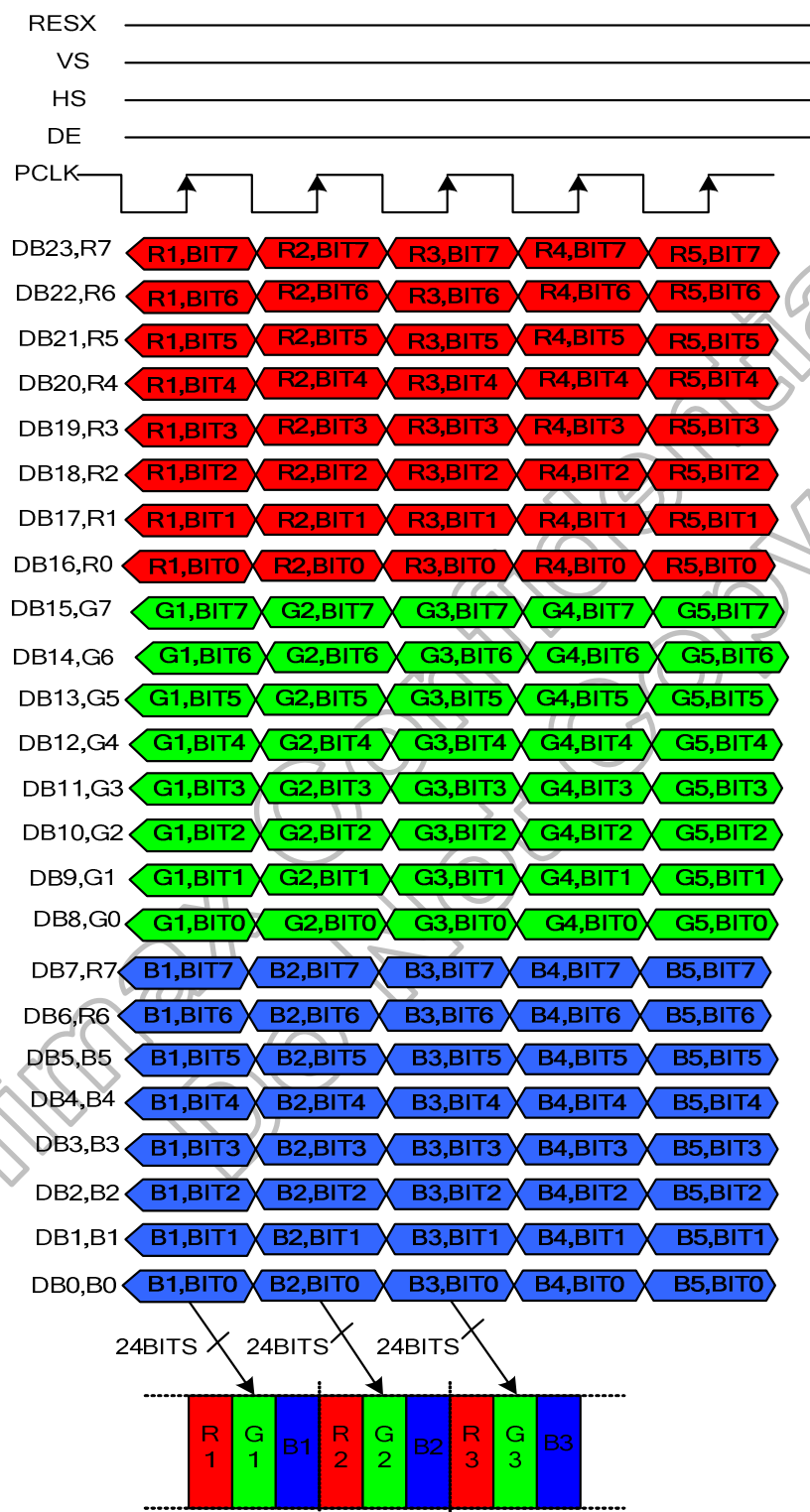


**Note:** The Data order is shown as follows, MSB = DB23, LSB = DB0 and Picture Data is MSB = Bit5, LSB = Bit0 for Red, Green and Blue data. Un-used pin DB23, DB22, DB15, DB14, DB7 and DB6 are set to open.

Figure 4.31: 18-bit / pixel: 262k colours order on the DPI I/F



## 4.2.2.4 24-bit / pixel color order on the RGB I/F



**Note:** The Data order is shown as follows, MSB = DB23, LSB = DB0 and Picture Data is MSB = Bit7, LSB = Bit0 for Red, Green and Blue data.

Figure 4.32: 24-bit / pixel color order on the RGB I/F

### 4.2.3 DSI system interface

The selection of interface is by BS(3-0) = "1000" or "1100", the DSI specifies the interface between a host processor and a peripheral such as a display module. Figure 4.33 shows a simplified DSI interface. From a conceptual viewpoint, a DSI-compliant interface also sends pixels or commands to the peripheral, and can read back status or pixel information from the peripheral. The main difference is that DSI serializes all pixel data, commands, and events that. DSI-compliant peripherals support Command Mode. Which mode is used depends on the architecture and capabilities of the peripheral. The mode definitions reflect the primary intended use of DSI for display.

Command Mode refers to operation in which transactions primarily take the form of sending Commands and data to a peripheral, such as a display module, that incorporates a display controller. The display controller may include local registers and a frame buffer. Systems using Command Mode write to, and read from, the registers and frame buffer memory. The host processor indirectly controls activity at the peripheral by sending commands, parameters and data to the display controller. The host processor can also read display module status information or the contents of the frame memory. Command Mode operation requires a bidirectional interface.

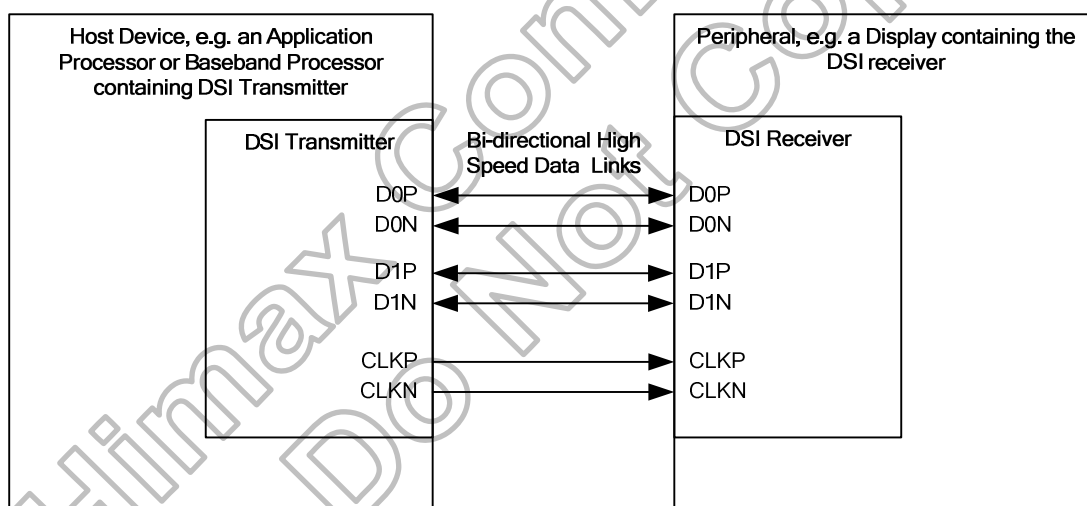


Figure 4.33: DSI transmitter and receiver interface

Please refer to "DRAFT MIPI Alliance Standard for DSI" for DSI detailed specifications.

#### 4.2.3.1 DSI layer definitions

According Figure 4.34 DSI transmitter and Receiver interface to understand simple interface block diagram. Then under diagram is internal block for DSI which include four types: PHY Layer, Lane Management Layer, Low level protocol and Application Layer.

The PHY Layer specifies the characteristics of transmission medium and electrical parameters for signaling the timing relationship between clock and Data Lanes.

The Lane Management Layer specifies DSI is Lane-scalable for increased performance. The data signals maybe transmission through one or more channel depending on the bandwidth requirements of the application.

The Protocol Layer specifies at the lowest level, DSI protocol specifies the sequence and value of bits and bytes traversing the interface. It specifies how bytes are organized into defined groups called packets.

The Application Layer describes higher-level encoding and interpretation of data contained in the data stream. The DSI specification describes the mapping of pixel values, commands and command's parameters to bytes in the packet assembly.

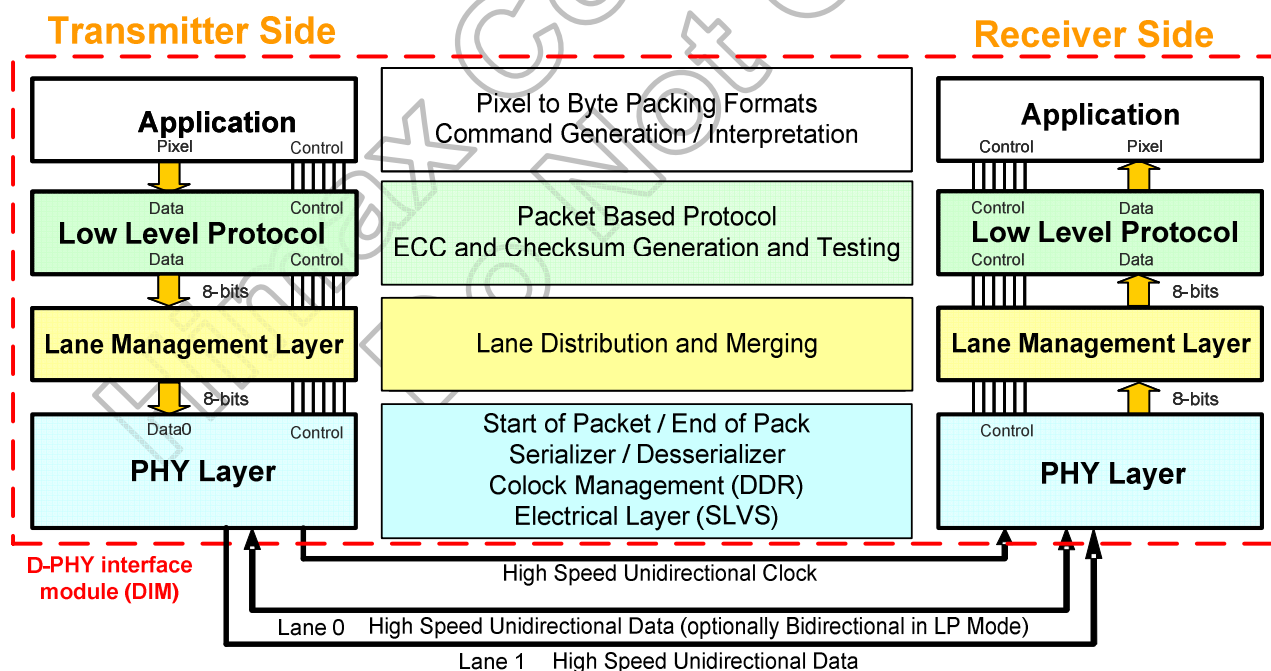
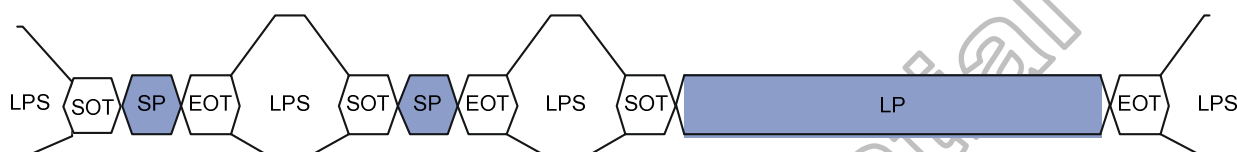


Figure 4.34: DSI transmitter and receiver interface

### 4.2.3.2 DSI protocol

The protocol layer appends packet-protocol information and headers. The receiver side of a DSI Link performs the converse of the transmitter side, decomposing the packet into parallel data, signal events and commands. The DSI protocol permits multiple packets which is useful for events such as peripheral initialization, where many registers may be loaded separate write commands at system startup. Figure 4.35 illustrates multiple HS Transmission packets.

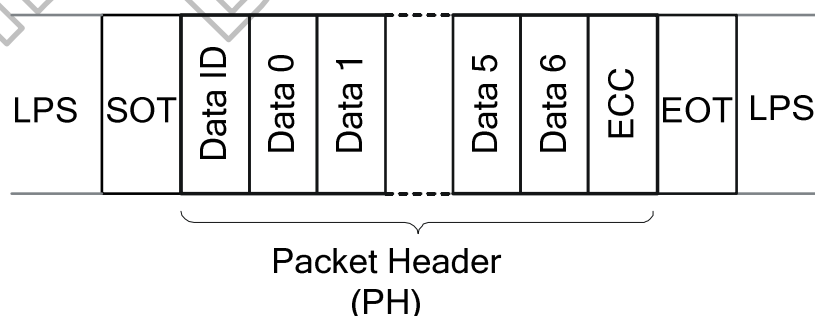


LPS : Low power state  
SOT : Start of Transmission  
SP : Short Packet  
LP : Long Packet  
EOT : End of Transmission

**Figure 4.35: Multiple HS transmission packets**

The packet includes two types which are Long packet and short packet. The first byte of the packet, the Data Identifier (DI), includes information specifying the length of the packet. Command Mode systems send commands and an associated set of parameters, with the number of parameters depending on the command type.

**Short packets** specify the payload length using the Data Type field and are from two to nine bytes in length. Short packet is used for most Command Mode commands and associated parameters. Where short packets format include an 8-bit Data ID followed by zero to seven bytes and an 8-bit ECC. Figure 4.36 shows the structure of the Short packet.



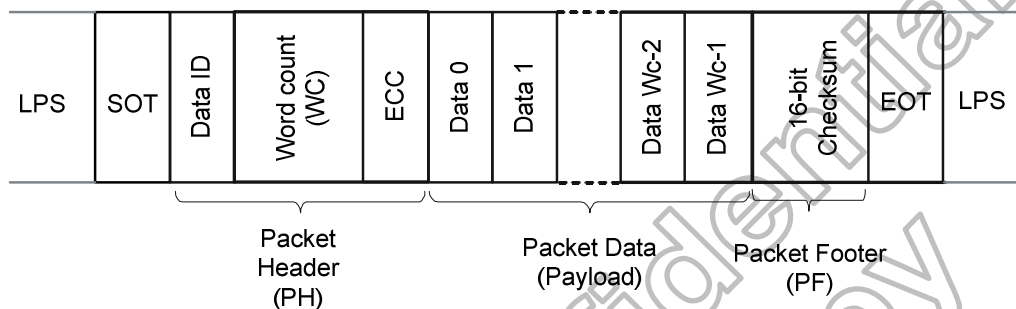
**DI(Data ID)** : Contain Virtual Channel Identifier and Data Type.

**ECC(Error Correction Code)** : The Error Correction Code allows single-bit errors to be corrected and 2-bit errors to be detected in the Packet Header.

**Figure 4.36: Structure of the short packet**

**Long packets** specify the payload length using a two-byte Word Count field and then the payload maybe from 0 to 65,541 bytes in length. Long packets permit transmission of large blocks of pixel or other data.. Figure 4.37 shows the structure of the Long packet. Long Packet Header composed of three elements: an 8-bit Data Identifier, a 16-bit Word Count, and 8-bit ECC. The Packet Footer has one element, a 16-bit checksum. Long packets can be from 6 to 65,541 bytes in length.

Where 65,541 bytes =  $(2^{16}-1) + 4 \text{ bytes PH} + 2 \text{ bytes PF}$



**DI (Data ID)** : Contain Virtual Channel Identifier and Data Type.

**WC (Word Count)** : The receiver use WC to define packet end.

**ECC (Error Correction Code)** : The Error Correction Code allows single-bit errors to be corrected and 2-bit errors to be detected in the Packet Header.

**PF(Packet Footer)** : Mean 16-bit Checksum.

**Figure 4.37: Structure of the long packet**

According to packet form, basic elements include DI and ECC. Figure 4.38 the shows format of Data ID.

|                      |     |                |     |     |     |     |     |
|----------------------|-----|----------------|-----|-----|-----|-----|-----|
| DI7                  | DI6 | DI5            | DI4 | DI3 | DI2 | DI1 | DI0 |
| VC (Virtual Channel) |     | DT (Data Type) |     |     |     |     |     |

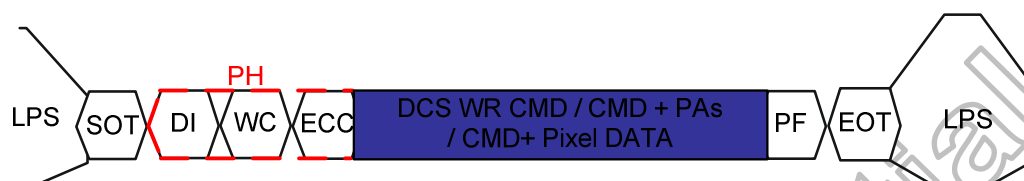
DI[7:6] → These two bits identify the data as directed to one of four virtual channels.

DI[5:0]: These six bits specify the Data Type, which specifies the size, format and, in some cases, the interpretation of the packet contents.

**Figure 4.38: The format of data ID.**

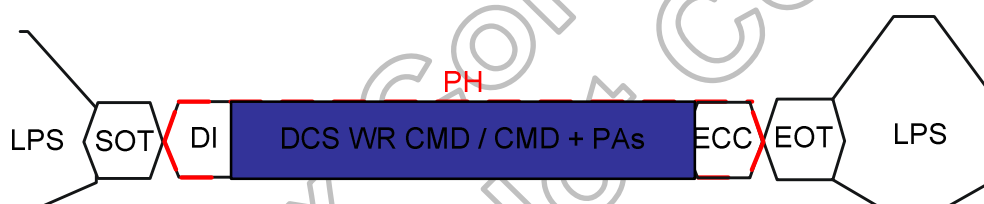
Due to Data Type (DT) mean format of transmission type, Figure 4.39 show Short- / Long-packet transmission command sequence.

Long packet write Command / Parameters / Pixel Datas



DI → Write suitable Data type.  
 WC → Write number of Payload Data.  
 Ex: One CMD write, WC setting as 1.  
 CMD + PAs write, WC setting as number of (CMD+PAs).  
 CMD + DATA write, WC setting as number of (CMD + Pixel DATA).

Short packet write Command / Parameters



DI → Write suitable Data type.  
 Ex: One CMD write, DI + DCS WR CMD  
 CMD + PAs write, DI + DCS WR CMD + PAs

Figure 4.39: show Short- / Long-packet transmission command sequence

#### 4.2.3.3 Processor to peripheral direction packets data types

The set of transaction types sent from the host processor to a peripheral, such as a display module, are shown in Table 4.3 Data Types for Processor-sourced Packets.

| Data type, hex           | Data type, binary  | Description packet                                                         | Size  |
|--------------------------|--------------------|----------------------------------------------------------------------------|-------|
| 01h                      | 00 0001            | Sync Event, V Sync Start                                                   | Short |
| 11h                      | 01 0001            | Sync Event, V Sync End                                                     | Short |
| 21h                      | 10 0001            | Sync Event, H Sync Start                                                   | Short |
| 31h                      | 11 0001            | Sync Event, H Sync End                                                     | Short |
| 22h                      | 10 0010            | Shut Down Peripheral Command                                               | Short |
| 32h                      | 11 0010            | Turn On Peripheral Command                                                 | Short |
| 05h                      | 000101             | DCS WRITE, no parameter                                                    | Short |
| 15h                      | 010101             | DCS WRITE, 1 parameter                                                     | Short |
| 06h                      | 00 0110            | DCS READ, no parameters                                                    | Short |
| 37h                      | 11 0111            | Set Maximum Return Packet Size                                             | Short |
| 09h                      | 00 1001            | Null Packet, no data                                                       | Long  |
| 19h                      | 01 1001            | Blanking Packet, no data                                                   | Long  |
| 39h                      | 11 1001            | DCS Long Write/write LUT Command Packet                                    | Long  |
| 0Eh                      | 00 1110            | Packed Pixel Stream, 16-bit RGB, 5-6-5 Format                              | Long  |
| 1Eh                      | 01 1110            | Packed Pixel Stream, 18-bit RGB, 6-6-6 Format                              | Long  |
| 2Eh                      | 10 1110            | Loosely Packed Pixel Stream, 18-bit RGB, 6-6-6 Format                      | Long  |
| 3Eh                      | 11 1110            | Packed Pixel Stream, 24-bit RGB, 8-8-8 Format<br>(This project is not use) | Long  |
| X0h and XFh, unspecified | xx 0000<br>xx 1111 | DO NOT USE<br>All unspecified codes are reserved                           | -     |

**Table 4.3: Data types for processor-sourced packets**



Under tables list all detail function of all data types

| Sync event (H start, H end, V start, V end), data type=xx 0001 (x1h)                                                                                                                                     |                                   |                                 |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------|---------------------------------|
| Data type, hex                                                                                                                                                                                           | Function description              | Number of bytes                 |
| 01h                                                                                                                                                                                                      | V Sync start, Start of VSA pulse. | 4 bytes<br>(DI+Data0+Data1+ECC) |
| 11h                                                                                                                                                                                                      | V Sync End, End of VSA pulse.     |                                 |
| 21h                                                                                                                                                                                                      | H Sync Start, Start of HSA pulse. |                                 |
| 31h                                                                                                                                                                                                      | H Sync End, End of HSA pulse.     |                                 |
| <b>Note:</b> V Sync Start and V Sync End event represents the start and end of the VSA, respectively. Similarly H Sync Start and H Sync End event represents the start and end of the HSA, respectively. |                                   |                                 |

| Display status (shutdown command, turn-on command )                                                                          |                                                                                                  |                                 |
|------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------|---------------------------------|
| Data type, hex                                                                                                               | Function description                                                                             | Number of bytes                 |
| 22h                                                                                                                          | Shutdown Peripheral command that turns off the display in a Video Mode display for power saving. | 4 bytes<br>(DI+Data0+Data1+ECC) |
| 32h                                                                                                                          | Turn On Peripheral command that turns on the display in Video Mode display for normal display.   |                                 |
| <b>Note:</b> When use shutdown command, interface shall remain powered in order to receive the turn-on, or wake-up, command. |                                                                                                  |                                 |

| Color mode status (Color Mode On, Color Mode Off)                                                                                                                                                                                                                                                     |                                                                                                    |                                 |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------|---------------------------------|
| Data type, hex                                                                                                                                                                                                                                                                                        | Function description                                                                               | Number of bytes                 |
| 05h and 15h                                                                                                                                                                                                                                                                                           | DCS Short Write command, 0 or 1 parameter, Data Types = 00 0101(05h), 01 0101 (15h), Respectively. | 4 bytes<br>(DI+Data0+Data1+ECC) |
| <b>NOTE:</b> (1) For write part, If DCS Short Write command, followed by BTA, the peripheral shall respond with <b>ACK</b> when without error was detected in the transmission (Host → Slave). Unless an error was detected, the peripheral shall respond with <b>Acknowledge with Error Report</b> . |                                                                                                    |                                 |

For example: 05h DCS WRITE for no parameter command set.

|     |     |   |     |
|-----|-----|---|-----|
| 05h | CMD | 0 | ECC |
|-----|-----|---|-----|

Ex. 05h, 29h, 00, 1Ch — Display On(29h)

For example: 15h DCS WRITE for only one parameter command set.

|     |     |     |     |
|-----|-----|-----|-----|
| 15h | CMD | Par | ECC |
|-----|-----|-----|-----|

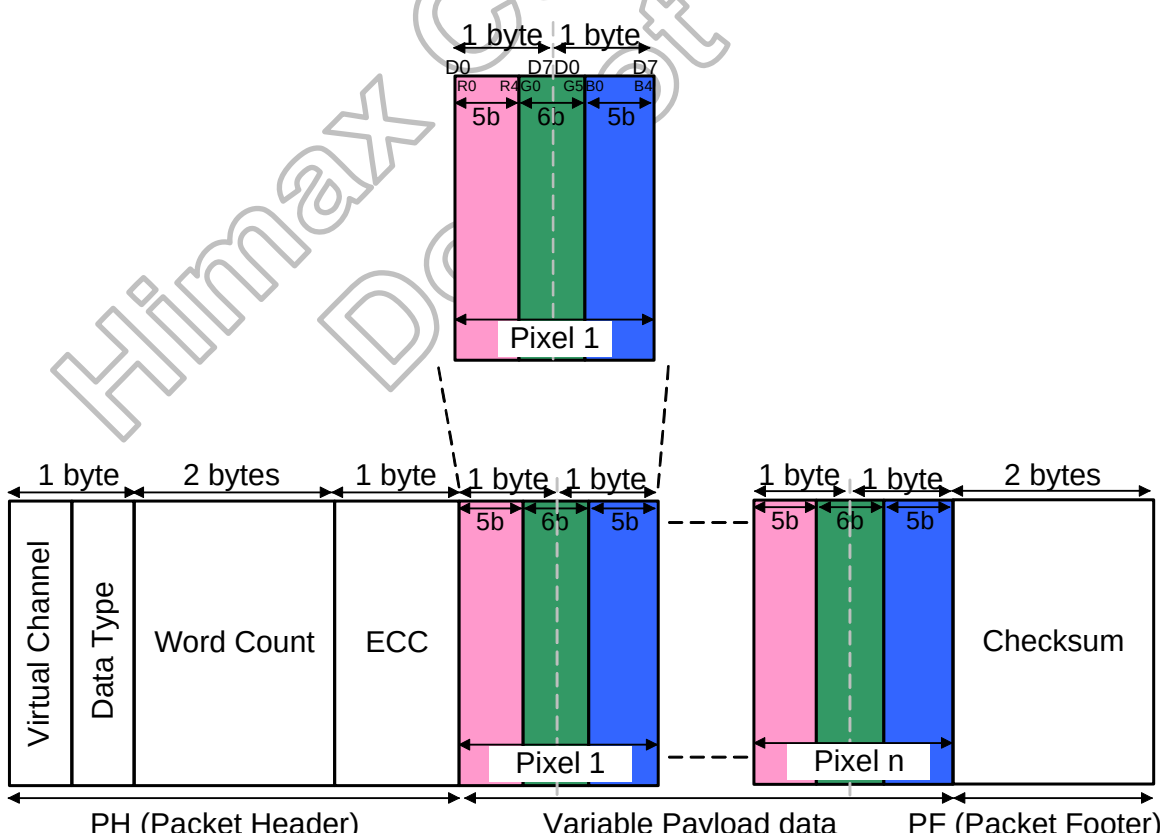
Ex. 15h, 36h, 08h, 11h — MADCTL(36h)-BGR bit=1

| DCS command setting                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                                                                        |                                                                             |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------|
| Data type, hex                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Function description                                                                                                                   | Number of bytes                                                             |
| 06h                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | DCS Read command, the returned data may be of Short or Long packet format.                                                             | 4 bytes<br>(DI+Data0+Data1+ECC)                                             |
| 39h                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | DCS Long Write/ Write _ LUT Command is used to send larger blocks of data to a display module that implements the Display Command Set. | Up to 65541 bytes<br>( DI + WC + ECC<br>+ DCS CMD.<br>+ Payload DATA + PF ) |
| <b>NOTE:</b> (1) When use DCS Read Command, the <b>Set Max Return Packet Size</b> command will limit the size of returning packets.<br>(2) The peripheral shall respond to DCS Read Command Request in one of the following ways:<br>◆ If an error was detected by the peripheral, it shall send <i>Acknowledge with Error Report</i> . So the peripheral shall transmit the requested READ data packet with suitable ECC in the same transmission.<br>◆ If no error was detected by the peripheral, it shall send the requested READ packet (Short or Long) with appropriate ECC and Checksum, if either or both features are enabled.<br>(3) <b>One byte &lt;= Length of payload DATA &lt;= 2<sup>WC</sup>-1</b> |                                                                                                                                        |                                                                             |

| Return packet size setting                                                                                                                                                                           |                                                                                                                                                        |                            |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------|
| Data type, hex                                                                                                                                                                                       | Function description                                                                                                                                   | Number of bytes            |
| 37h                                                                                                                                                                                                  | Set Maximum Return Packet Size that specifies the maximum size of the payload in a Long packet transmitted from peripheral back to the host processor. | 4 bytes<br>(DI + WC + ECC) |
| <b>Note:</b> The two-byte value is transmitted with LS byte first. And during a power-on or Reset sequence, the Maximum Return Packet Size shall be set by the peripheral to a default value of one. |                                                                                                                                                        |                            |

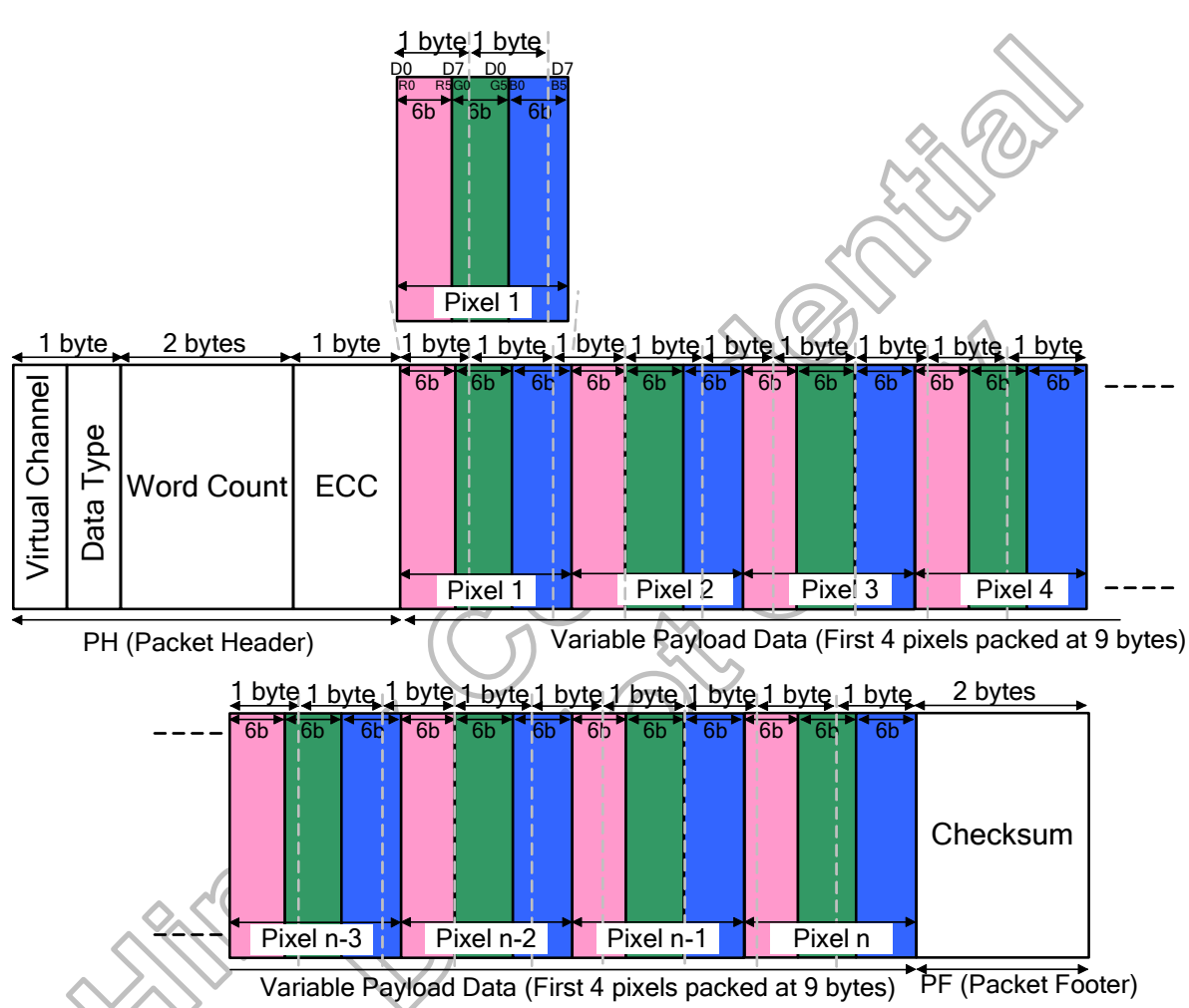
| Variable data packet                                                                                                                                                                                                                                                                                     |                                                                                                             |                                                   |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------|---------------------------------------------------|
| Data type, hex                                                                                                                                                                                                                                                                                           | Function description                                                                                        | Number of bytes                                   |
| 09h                                                                                                                                                                                                                                                                                                      | Null Packet is a mechanism for keeping the serial Data Lane(s) in High-Speed mode while sending dummy data. | Up to 65541 bytes<br>(DI + WC + ECC<br>+ DCS CMD. |
| 19h                                                                                                                                                                                                                                                                                                      | Blanking packet is used to convey blanking timing information in a Long packet.                             | + Payload DATA + PF)                              |
| <b>Note:</b> (1) When <b>Null Packet</b> , the Payload Data belong "null" Data, actual data values sent are irrelevant because the peripheral does not capture or store the data.<br>(2) When <b>Blanking packet</b> , the packet represents a period between active scan lines of a Video Mode display, |                                                                                                             |                                                   |

| Data stream format |                                                                                                                                                                                               |                                                                           |
|--------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------|
| Data type, hex     | Function description                                                                                                                                                                          | Number of bytes                                                           |
| 0Eh                | Packed Pixel Stream 16-Bit Format is used to transmit image data formatted as 16-bit pixels to a Video Mode display module. Pixel format is "(5 bits) red, (6 bits) green and (5 bits) blue". | Up to 65541 bytes<br>(DI + WC + ECC<br>+ DCS CMD.<br>+ Payload DATA + PF) |

**Note:** Within a color component, the "LSB is sent first, the MSB last".

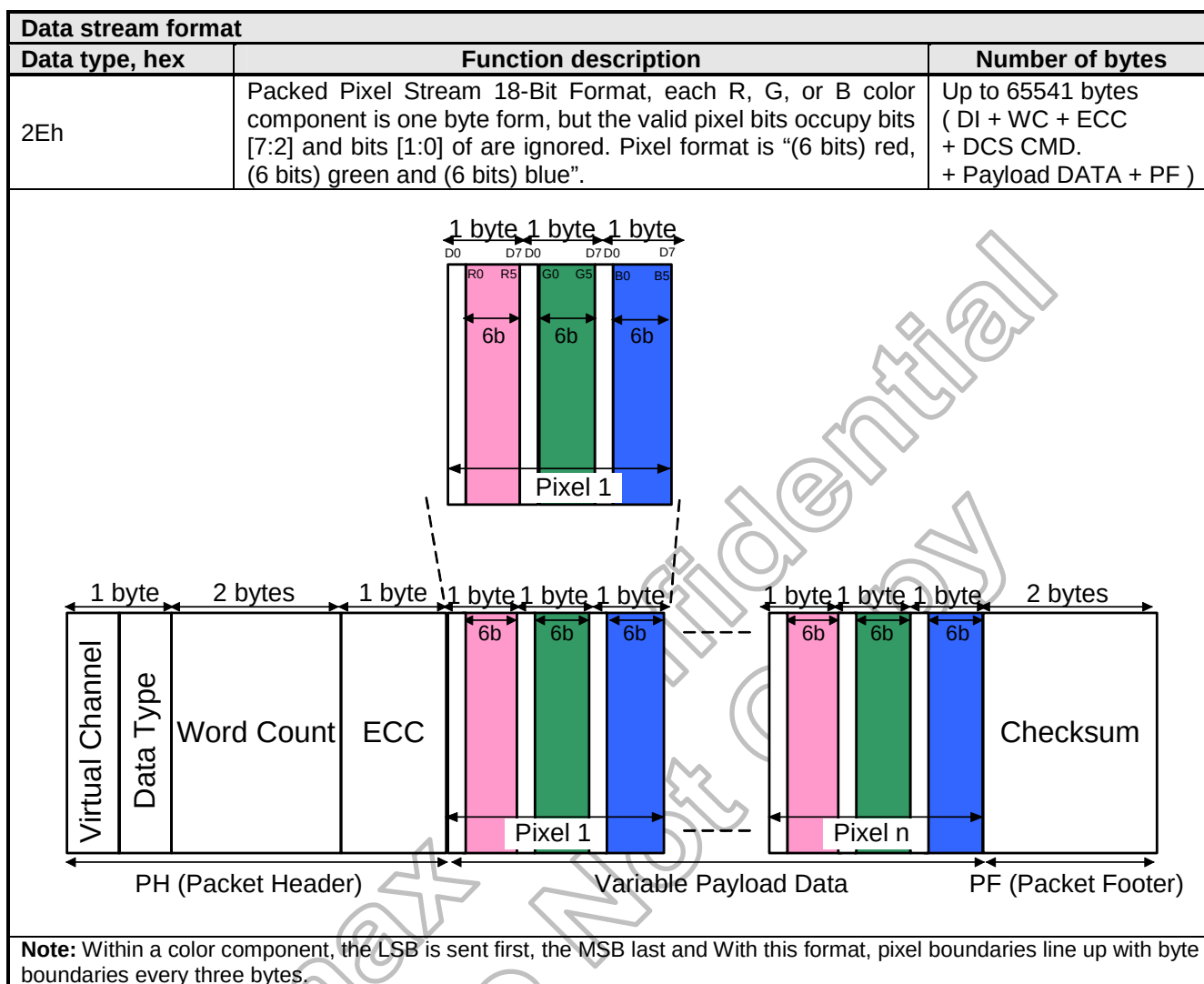
| Data stream format |                                                                                                                                                                                               |                                                                             |
|--------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------|
| Data type, hex     | Function description                                                                                                                                                                          | Number of bytes                                                             |
| 1Eh                | Packed Pixel Stream 18-Bit Format is used to transmit image data formatted as 18-bit pixels to a Video Mode display module. Pixel format is "(6 bits) red, (6 bits) green and (6 bits) blue". | Up to 65541 bytes<br>( DI + WC + ECC<br>+ DCS CMD.<br>+ Payload DATA + PF ) |

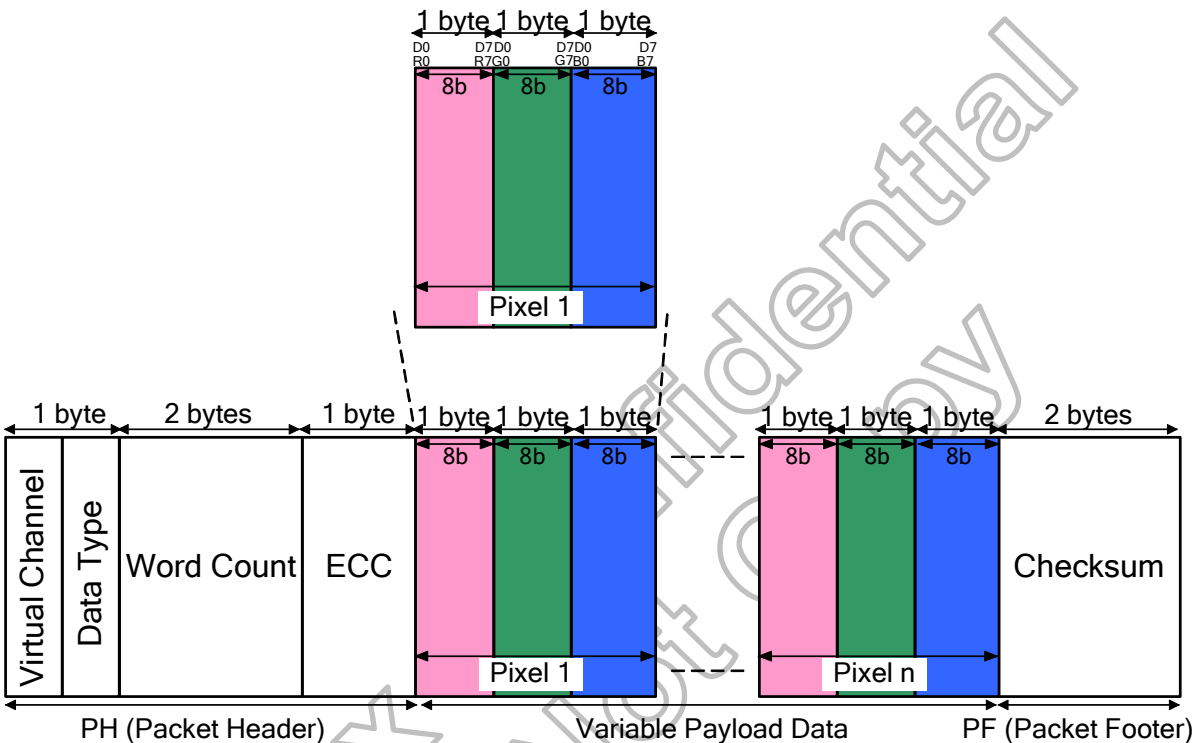
  


The diagram illustrates the data stream format for the HX8369-A02. It shows a sequence of bytes representing the data stream. The packet structure is as follows:

- PH (Packet Header):** Consists of a 1-byte Virtual Channel, a 2-byte Data Type, a 1-byte Word Count, and a 1-byte ECC.
- Variable Payload Data:** The first 4 pixels are packed at 9 bytes. Each pixel is 18 bits (6 bits red, 6 bits green, 6 bits blue). The diagram shows Pixel 1, Pixel 2, Pixel 3, and Pixel 4.
- Checksum:** A 2-byte checksum is calculated over the payload data.
- PF (Packet Footer):** The packet footer, which includes the checksum.

**Note:** Within a color component, the LSB is sent first and the MSB last and pixel boundaries only line up with byte boundaries every four pixels (nine bytes). Preferably, display modules employing this format have a horizontal extent (width in pixels) evenly divisible by four, so no partial bytes remain at the end of the display line data. It is possible to send pixel data that represent a line width that is not a multiple of four pixels, but the display logic on the receiver end shall dispose of the extra bits of the partial byte at the end of active display and ensure a "clean start" for the next line.



| Packed pixel stream, 24-bit format                                                                                                                                                                                                                           |                                                                                                                                                                                             |                                                                             |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------|
| Data type, hex                                                                                                                                                                                                                                               | Function description                                                                                                                                                                        | Number of bytes                                                             |
| 3Eh                                                                                                                                                                                                                                                          | Packed Pixel Stream 24-Bit Format is used to transmit image data formatted as 24-bit pixels to a Video Mode display module. Pixel format is (8 bits) red, (8 bits) green and (8 bits) blue. | Up to 65541 bytes<br>( DI + WC + ECC<br>+ DCS CMD.<br>+ Payload DATA + PF ) |
|  <p><b>Note:</b> Within a color component, the LSB is sent first, the MSB last and With this format, pixel boundaries line up with byte boundaries every three bytes.</p> |                                                                                                                                                                                             |                                                                             |

#### 4.2.3.4 Peripheral to processor (reverse direction)

All Command Mode systems require bidirectional capability for returning READ data, ACK or error information to the host processor. Command Mode that use DCS shall have a bidirectional data path. Short packets and the header of Long packets may use ECC and Checksum to provide a higher level of data integrity. The Checksum feature enables detection of errors in the payload of Long packets. The packet structure for peripheral-to-processor transactions is the same as for the processor-to-peripheral direction.

Peripheral-to-processor transactions are of four basic types:

- A. *Tearing Effect* is a Trigger message sent to convey display timing information to the host processor. Trigger messages are signal byte packets sent by a peripheral's PHY layer in response to a signal from the DSI protocol layer.
- B. *Acknowledge* is a Trigger Message sent when the current transmission, as well as all preceding transmissions since the last peripheral to host communication.
- C. *Acknowledge and Error Report* is a Short packet sent if any errors were detected in preceding transmission from the host processor. Once reported, accumulated errors in the error register are cleared.
- D. *Response to Read Request* may be Short or Long packet that returns data requested by the preceding READ command from the processor.

In general, if the host processor completes a transmission to the peripheral with BTA asserted, the peripheral shall respond with one or more appropriate packet(s), and then return bus ownership to the host processor. If BTA is not asserted following a transmission from the host processor, the peripheral shall not communicate an Acknowledge or other error information back to the host processor.

The processor-to-peripheral transactions with BTA asserted, can contain under form.

- A. Following a **non-Read command** in which no error was detected, the peripheral shall respond with Acknowledge.
- B. Following a **Read request** in which no error was detected, the peripheral shall send the requested READ data.
- C. Following a **Read request in which the ECC error** was detected and corrected, the Peripheral shall send the requested READ data in a Long or Short packet, followed by a 4-byte (Acknowledge with Error Report) packet in the same LP transmission. The Error Report shall have the ECC Error flag set.
- D. Following a **non-Read command in which the ECC error** was detected and corrected, the peripheral shall proceed to execute the command, and shall respond to BTA by sending a 4-byte (Acknowledge with Error Report) packet, the Error Report shall have the ECC Error flag set.
- E. Following any command in which **SoT Error, SoT Sync Error, EoT Sync Error, LP Transmit Sync Error, checksum error or DSI VC ID Invalid** was detected, or the DSI command was not recognized, the peripheral shall send a 4-byte Acknowledge with Error Report response, with the appropriate error flags set in the two-byte error field. Only the ACK/Error Report packet shall be transmitted; no read or write accesses shall take place on the peripheral in response.

Which,

- A. "Acknowledge" includes 2 bytes which are DI (VC + Acknowledge Data Type) and ECC.
- B. "Acknowledge with Error Report" include 4 bytes which are DI, 2 bytes Error report and ECC.
- C. "Response to Read Request" contains 2 types which are Short packet and long packet.

An error report is comprised of two bytes following the DI byte, with an ECC byte following the error report bytes. Table 4.4 shows the Error Report Bit Definitions. And Table 4.5 list complete set of peripheral-to-processor Data Types.

| Bit | Description                                    |
|-----|------------------------------------------------|
| 0   | SoT Error                                      |
| 1   | SoT Sync Error                                 |
| 2   | reserved                                       |
| 3   | Escape Mode Entry Command Error                |
| 4   | Low-Power Transmit Sync Error                  |
| 5   | LP-TX Timeout Error                            |
| 6   | reserved                                       |
| 7   | reserved                                       |
| 8   | ECC Error, single-bit (detected and corrected) |
| 9   | ECC Error, multi-bit (detected, not corrected) |
| 10  | Checksum Error (long packet only)              |
| 11  | DSI Data Type Not Recognized                   |
| 12  | DSI VC ID Invalid                              |
| 13  | reserved                                       |
| 14  | reserved                                       |
| 15  | reserved                                       |

**Table 4.4: Shows the error report bit definitions.**



| Data type, hex   | Data type, binary | Description packet            | Size  |
|------------------|-------------------|-------------------------------|-------|
| 02h              | 00 0010           | Acknowledge with Error Report | Short |
| 1Ch              | 01 1100           | DCS Long READ Response        | Long  |
| Others (00h→3Fh) |                   | Reserved                      | -     |

**Table 4.5: The complete set of peripheral-to-processor data types.**

| Acknowledge types                                                                                                                                                                               |                                                                                  |                 |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------|-----------------|
| Data type, hex                                                                                                                                                                                  | Function description                                                             | Number of bytes |
| 02                                                                                                                                                                                              | Get Acknowledge with Error report when Error occurs from processor transmission. | 4 bytes         |
| <b>Note:</b> When processor transmits complete Payload, following signal by BTA, peripheral must respond to processor.<br>With error→Acknowledge with error report, Without error→ Acknowledge. |                                                                                  |                 |

| DCS Read types                                                                                                                                                                                                                                                                                                                                                                                                                   |                                                            |                                                                             |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------|-----------------------------------------------------------------------------|
| Data type, hex                                                                                                                                                                                                                                                                                                                                                                                                                   | Function description                                       | Number of bytes                                                             |
| 1Ch                                                                                                                                                                                                                                                                                                                                                                                                                              | This is the long-packet response to DCS Long Read Request. | Up to 65541 bytes<br>( DI + WC + ECC + DCS<br>CMD. + Payload DATA +<br>PF ) |
| <b>Note:</b> If the peripheral is Checksum capable, is shall return a calculated two-byte Checksum appended to the N-byte payload data. If the peripheral does not support Checksum, it shall return 0000h.<br>If the DCS command itself is possibly corrupt, due to an uncorrectable ECC error, SoT or SoT Sync error, the requested READ data packet shall not be sent after the Acknowledge with Error Report packet be sent. |                                                            |                                                                             |

## 4.2.4 MDDI Interface (Mobile Display Digital Interface)

### 4.2.4.1 Introduction of MDDI

The HX8369-A02 support MDDI, which is a differential serial interface with high-speed · low voltage swing characteristics. Both command and display image data can be transferred by MDDI. The devices connected by Data and STB link are host and client part.

Host transfer data to client in “forward” direction, client transfer data to host in “reverse” direction. The Data line is Dual direction, both command and image data are all send through the Data line. The STB line send strobe signal from host to client.

Data transferred in MDDI link are encoded as packet type.

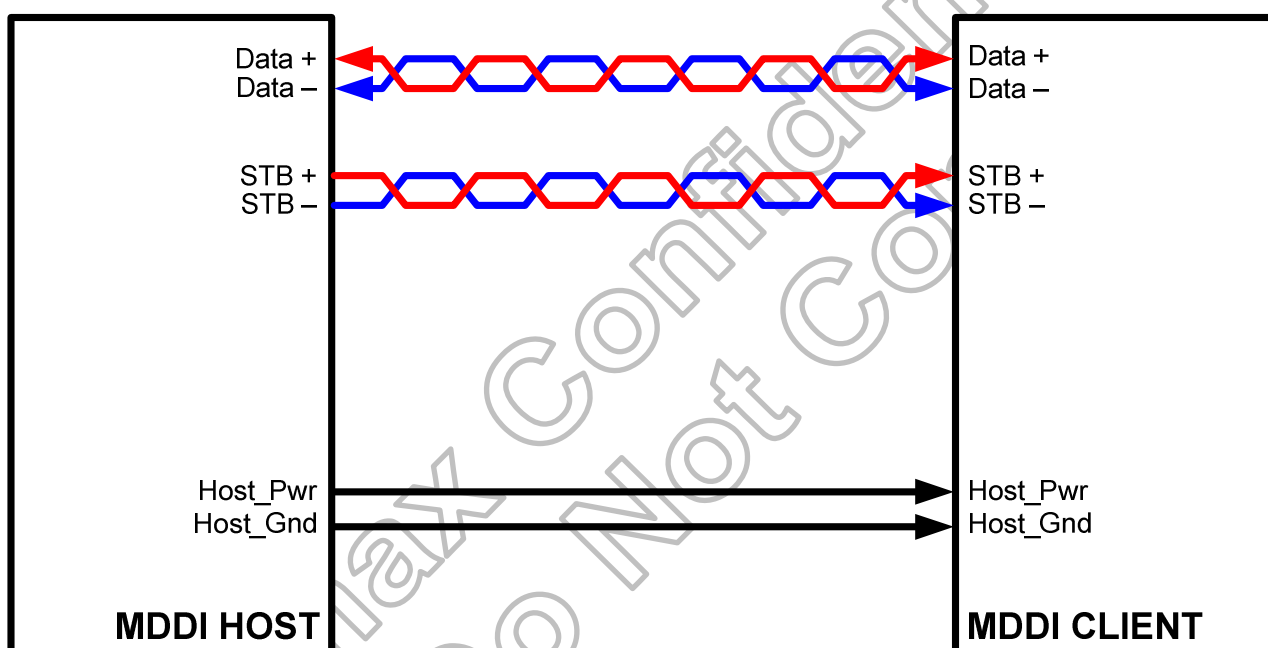


Figure 4.40: Physical connection of MDDI host and client

## 4.2.5 Terminology

The devices connected by the MDDI link are called the host and client. Data going from the host to the client travels in the **forward** direction, and data from the client to the host travels in the **reverse** direction.

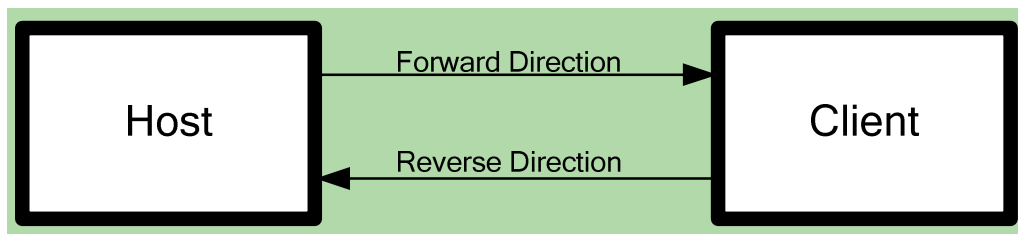


Figure 4.41: MDDI terminology

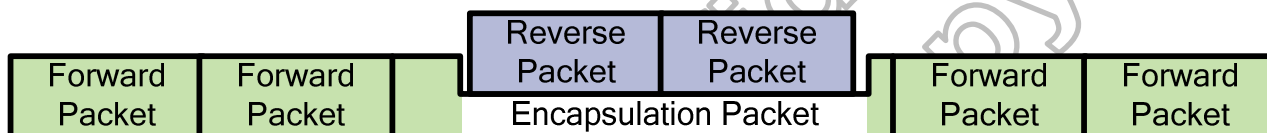


Figure 4.42: Example of Bi-directional MDDI communication

## 4.2.6 Order of data transmission

All fields are transmitted with the LSB first and the MSB transmitted last. Parameters that are more than one byte in length are transmitted in little-endian format, i.e. the least significant byte first. The data fields of each packet are transmitted in the exact order that they are defined in the subsequent sections below, with the first field listed being transmitted first, and the last field described being transmitted last.

MDDI\_Data0 is always aligned with bit 0 of bytes transmitted on the interface in any mode: Type 1, Type 2, Type 3, or Type 4.

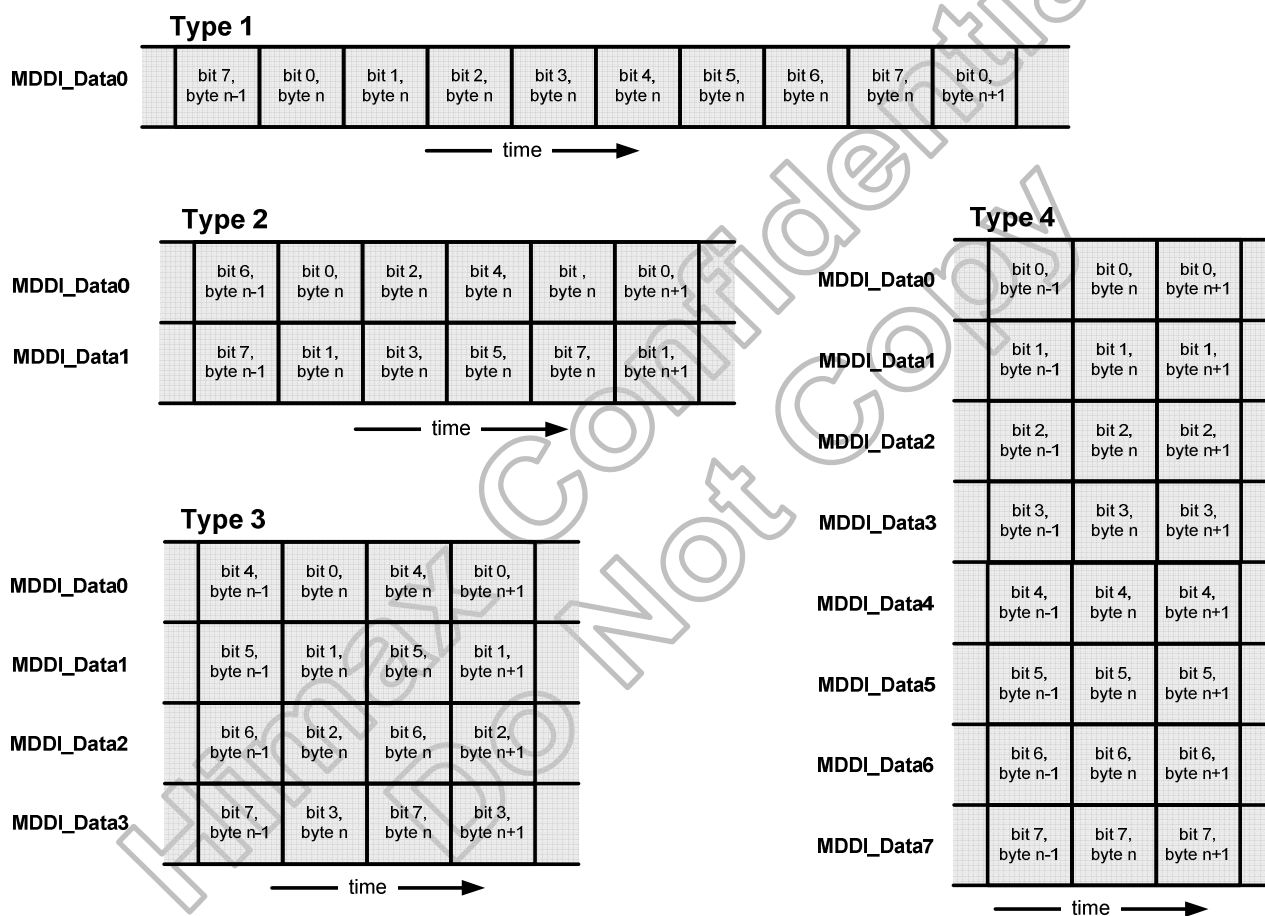


Figure 4.43: Transmission bit ordering for each type

## 4.2.7 Data-STB encoding

Data is encoded using a DATA-STB format. DATA is carried over a bi-directional differential cable, while STB is carried over a unidirectional differential cable driven only by the host. Figure 4.44 illustrates how the data sequence “1110001011” is transmitted by using DATA-STB encoding.

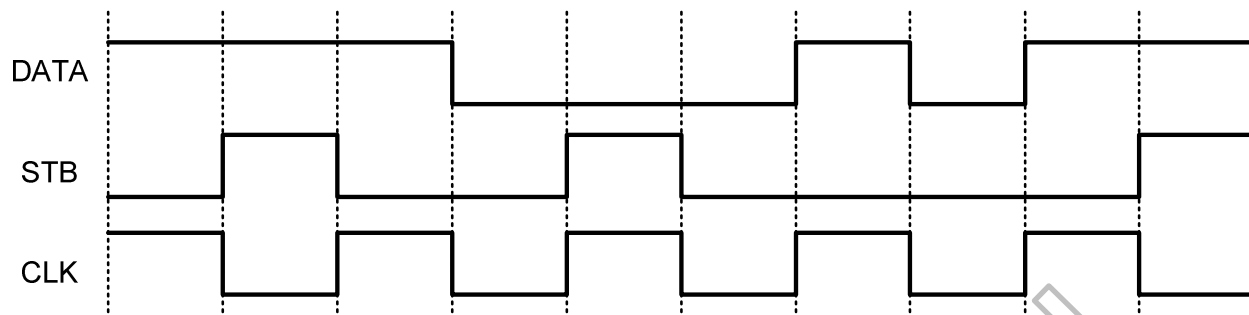


Figure 4.44: Data-STB encoding

Figure 4.45 shows a sample circuit to generate DATA and STB from input data, and then decodes the DATA and STB to the Output Data.

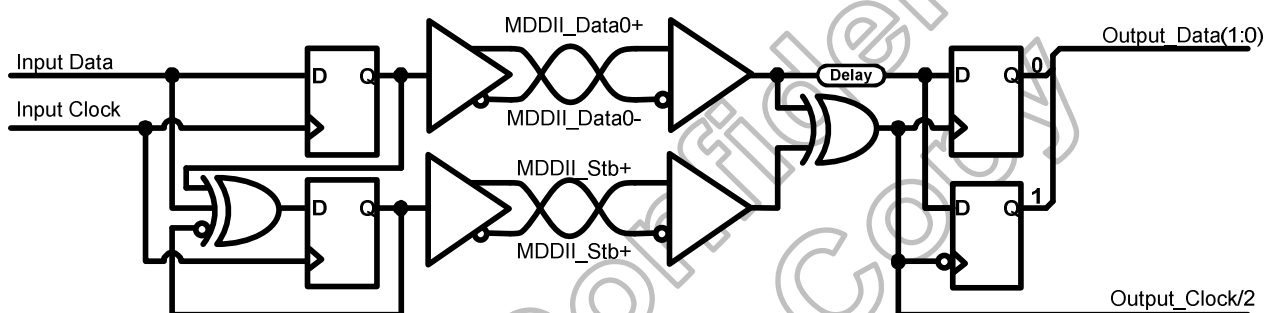
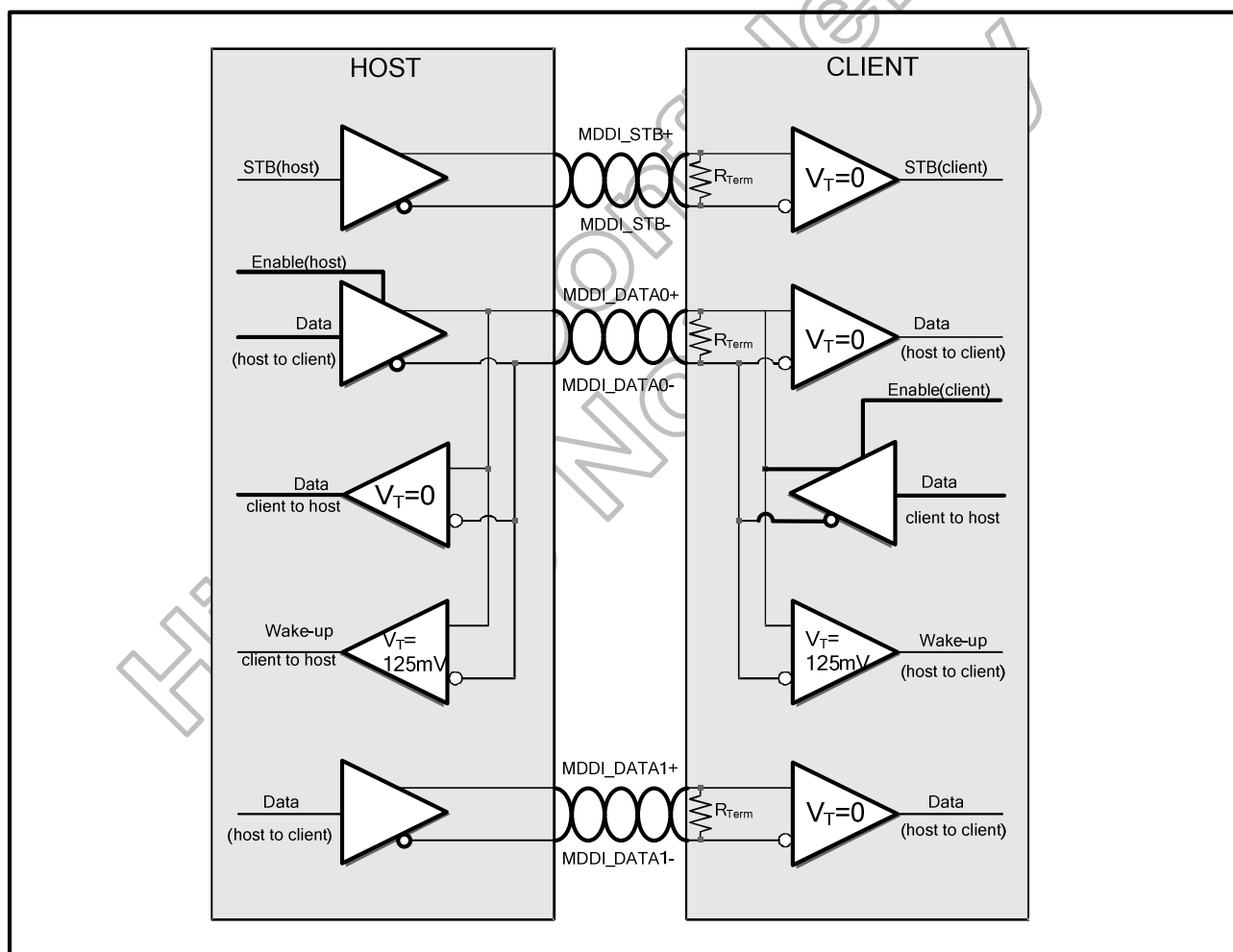


Figure 4.45: Data / STB generation & recovery circuit

#### 4.2.7.1 MDDI data / STB

The data (MDP/MDN) and STB (MSP/MSN) signals are always operated in a differential mode to maximize noise immunity. Each differential pair is parallel-terminated with the characteristic impedance of the cable. All parallel-terminations are in the client device. Figure below illustrates the configuration of the drivers, receivers, and terminations. The driver of each signal pair has a differential current output. While receiving MDDI packets the MDDI\_DATA and MDDI\_STB pairs use a conventional differential receiver with a differential voltage threshold of zero volts. In the hibernation state the driver outputs are disabled and the parallel termination resistors pull the differential voltage on each signal pair to zero volts. During hibernation a special receiver on the MDDI\_DATA pairs has an offset input differential voltage threshold of positive 125 mV, which causes the hibernation line receiver to interpret the un-driven signal pair as logic-zero level.



**Figure 4.46: Differential connection between host and client**

## 4.2.7.2 MDDI packet

Data transmission over the MDDI link is grouped into packets. Several packets format is supported in HX8369-A02. Most packets are in forward direction, transferred from host to client; reverse encapsulation packet is in reverse direction, transferred from MDDI client to host. A number of packets, started by sub-frame header packet, construct one sub frame.

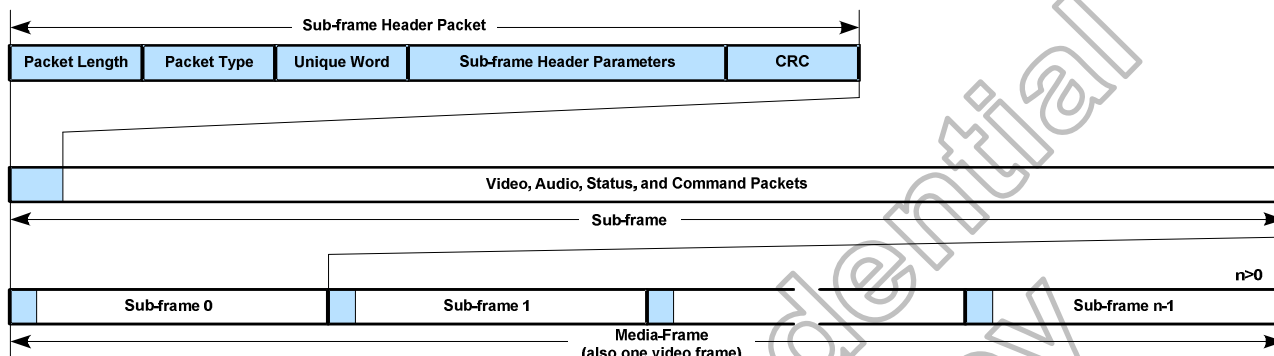
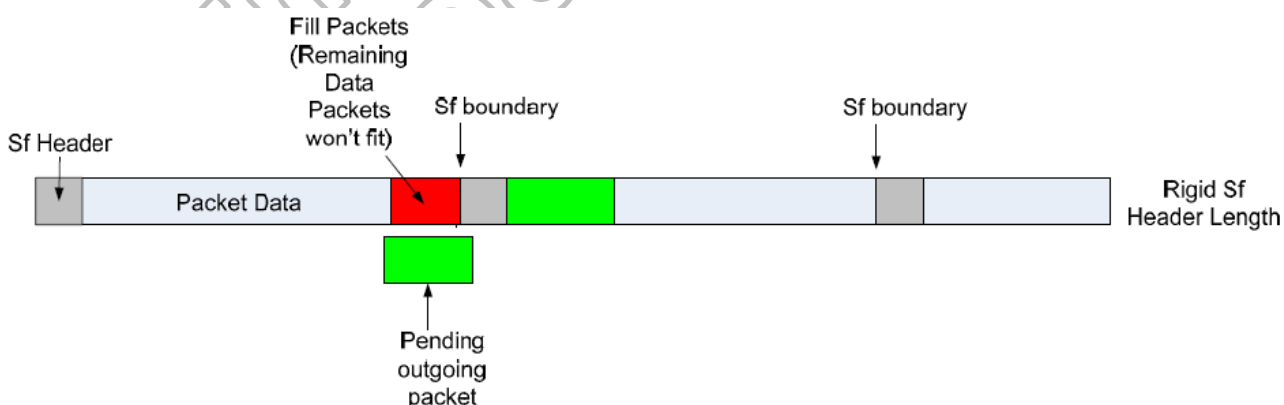


Figure 4.47 MDDI packet structure

Refer to MDDI frame structure, sub-frame header packet is placed in front of a sub-frame, and some sub-frames make up a media-frame.

The length of sub-frame has three mode Fixed, Flexible and Unlimited.

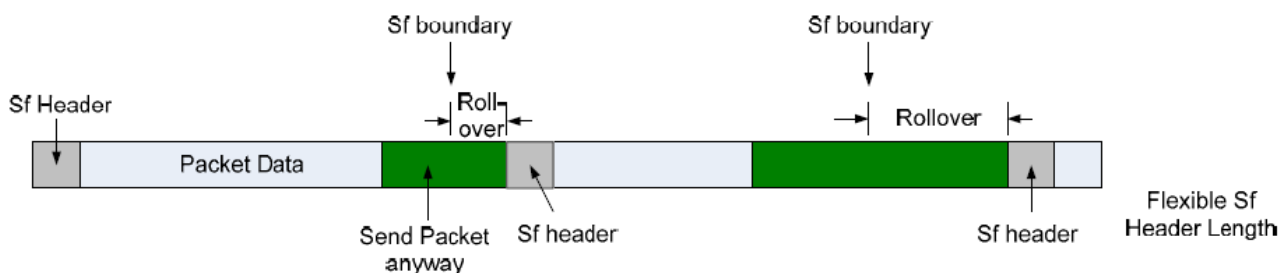
Fixed sub-frame length means the total byte in a sub-frame will meet the value which defined in the sub-frame header packet in front of a sub-frame.



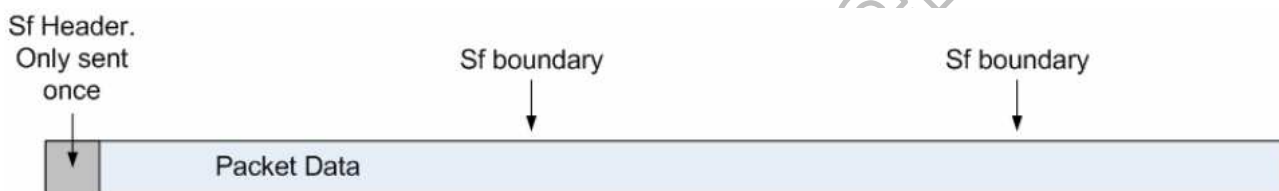
In flexible sub-frame When a packet is requested to be transmitted, it will never be blocked. This may cause a packet to cross a sub-frame boundary. The host therefore must maintain the sub-frame timing within its core to keep track of sub-frames that havelengths greater than the target length, to then transmit a matched number and length of sub-frames that are



less than the target sub-frame length to ensure an average sub-frame length that matches the target length.



hibernation to help the client sync up with the unique word pattern. The MDDI host is allowed to transmit a sub-frame at any time if it wishes, however it is not required.



HX8369-A02 support these packets, which described in the table below.

| Packet                                       | Function                        | Direction       |
|----------------------------------------------|---------------------------------|-----------------|
| Sub-frame header packet                      | Header of each sub frame        | Forward         |
| Register access packet                       | Register setting                | Forward         |
| Video stream packet                          | Video data transfer             | Forward         |
| Windowless Video stream packet               | Video data transfer             | Forward         |
| Flexible Video stream packet                 | Video data transfer             | Forward         |
| Filler packet                                | Fill empty packet space         | Forward         |
| Reverse link encapsulation packet            | Reverse data packet             | Reverse         |
| Round-trip delay measurement packet          | Host->client->host delay check  | Forward/Reverse |
| Enhanced Round-trip delay measurement packet | Host->client->host delay check  | Forward/Reverse |
| Client capability packet                     | Capability of client check      | Reverse         |
| Client request and status packet             | Information about client status | Reverse         |
| Forward Link Skew Calibration Packet         | Use to Calibrate the delay skew | Forward         |
| Perform Type Handoff Packet                  | Change operate Type             | Forward         |
| Link shutdown packet                         | End of frame                    | Forward         |

Table 4.6: List of supported MDDI packet

## Sub-frame header packet

| Packet Length | Packet type =0x3bffh | Unique word =0x005a | Reserved 1 | Sub-frame length | Protocol Version | Sub-frame Count | Media-frame Count | CRC     |
|---------------|----------------------|---------------------|------------|------------------|------------------|-----------------|-------------------|---------|
| 2 bytes       | 2 bytes              | 2 bytes             | 2 bytes    | 4 bytes          | 2 bytes          | 2 bytes         | 4 bytes           | 2 bytes |

|                   |   |                                                                                                                                                                                                                       |
|-------------------|---|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| packet length     | : | total number of bytes in the packet not including the packet length field, always 20                                                                                                                                  |
| packet type       | : | packet type, 0x3bffh for sub-frame header packet                                                                                                                                                                      |
| unique word       | : | link packet type to form a 32-bit unique word for good autocorrelation.                                                                                                                                               |
| reserved 1        | : | not used(all zero)                                                                                                                                                                                                    |
| sub-frame length  | : | In fixed Sub-Frame mode, this value specifies number of bytes per sub-frame.<br>In the Flexible Sub-Frame mode, this value represents the target length.<br>In the unlimited Sub-Frame mode, the value is set to zero |
|                   | : | All zero define the length of the sub-frame is undefined.                                                                                                                                                             |
| protocol version  | : | set all zero                                                                                                                                                                                                          |
| sub-frame count   | : | specifies number of sub-frame header packet.                                                                                                                                                                          |
| media frame count | : | specifies number of media frame                                                                                                                                                                                       |
| CRC               | : | error check                                                                                                                                                                                                           |

## Register access packet

| Packet Length | Packet type =146 | bClient ID | Read/Write Info | Register Address | Parameter CRC | Register Data list | Register Data CRC |
|---------------|------------------|------------|-----------------|------------------|---------------|--------------------|-------------------|
| 2 bytes       | 2 bytes          | 2 bytes    | 2 bytes         | 4 bytes          | 2 bytes       | P_length-14 bytes  | 4 bytes           |

|                    |   |                                                                                                                                                      |
|--------------------|---|------------------------------------------------------------------------------------------------------------------------------------------------------|
| packet length      | : | total number of bytes in the packet not including the packet length field                                                                            |
| packet type        | : | packet type, 146(decimal) for register access packet                                                                                                 |
| bClient ID         | : | set all zero                                                                                                                                         |
| Read/Write Info    | : | when write value to register, bit[15:14] = "00"<br>when request data from register, bit[15:14] = "10"<br>when data from client, bit[15:14] = "11"    |
|                    | : | bit[13:0] : A 14-bit unsigned integer that specifies the number of 32-bit register Data List items to be transferred in the Register Data List field |
| register address   | : | Register address is set written here.                                                                                                                |
| parameter CRC      | : | To error check from packet length to register address                                                                                                |
| register data list | : | A list of 4-byte register data values.                                                                                                               |

#### Video stream packet

| Packet Length | Packet type =16 | bClient ID | video data format descriptor | pixel data attributes | X left edge | Y top edge | X right edge | Y bottom dedge | X start | Y start |
|---------------|-----------------|------------|------------------------------|-----------------------|-------------|------------|--------------|----------------|---------|---------|
| 2 bytes       | 2 bytes         | 2 bytes    | 2 bytes                      | 2 bytes               | 2 bytes     | 2 bytes    | 2 bytes      | 2 bytes        | 2 bytes | 2 bytes |

| pixel count | parameter CRC | pixel data               | pixel data CRC |
|-------------|---------------|--------------------------|----------------|
| 2 bytes     | 2 bytes       | packet length - 26 bytes | 2 bytes        |

- packet length : total number of bytes in the packet not including the packet length field
- packet type : packet type, 16 (decimal) for register access packet
- bClient ID : set all zero
- video data format descriptor : bits[15:13]=010, raw RGB format (fixed value)  
bit[12]=1, only packed type is available (fixed value)  
bits[11:0]=number of bits per pixel,  
bits[11:8]=for Red, bits[7:4]=for Green, bits[3:0]=for Blue  
bits[1:0]=11, displayed both eyes (fixed value)
- pixel data attributes : others are all zero
- X left edge : X coordinate of the left edge of the active window filled by the Pixel Data field.
- X top edge : Y coordinate of the top edge of the active window filled by the Pixel Data field
- X right edge : X coordinate of the right edge of the active window filled by the Pixel Data field.
- Y bottom edge : Y coordinate of the bottom edge of the active window filled by the Pixel Data field.
- X start : X coordinate of the first pixel in the Pixel Data field below
- Y start : X coordinate of the first pixel in the Pixel Data field below
- Pixel count : Write number of pixel
- Parameter CRC : To error check from packet length to pixel count
- pixel data : pixel data info. Number of pixel data must not be over 65509
- pixel data CRC : To pixel data error check.

#### Windowless video stream packet

| Packet Length | Packet type =22 | bClient ID | video data format descriptor | pixel data attributes | pixel count | parameter CRC | pixel data               | pixel data CRC |
|---------------|-----------------|------------|------------------------------|-----------------------|-------------|---------------|--------------------------|----------------|
| 2 bytes       | 2 bytes         | 2 bytes    | 2 bytes                      | 2 bytes               | 2 bytes     | 2 bytes       | packet length - 14 bytes | 2 bytes        |

- packet length : total number of bytes in the packet not including the packet length field
- packet type : packet type, 22 (decimal) for register access packet
- bClient ID : set all zero
- video data format descriptor : bits[15:13]=010, raw RGB format (fixed value)  
bit[12]=1, only packed type is available (fixed value)  
bits[11:0]=number of bits per pixel,  
bits[11:8]=for Red, bits[7:4]=for Green, bits[3:0]=for Blue  
bits[1:0]=11, displayed both eyes (fixed value)
- pixel data attributes : others are all zero
- Pixel count : Write number of pixel
- Parameter CRC : To error check from packet length to pixel count
- pixel data : pixel data info. Number of pixel data must not be over 65509
- pixel data CRC : To pixel data error check.

#### Flexible video stream packet

| Packet Length | Packet type =20 | bClient ID | Field Present Flags | video data format descriptor | pixel data attributes | X left edge | Y top edge | X right edge | Y bottom dedge | X start | Y start |
|---------------|-----------------|------------|---------------------|------------------------------|-----------------------|-------------|------------|--------------|----------------|---------|---------|
| 2 bytes       | 2 bytes         | 2 bytes    |                     | 2 bytes                      | 2 bytes               | 2 bytes     | 2 bytes    | 2 bytes      | 2 bytes        | 2 bytes | 2 bytes |

| pixel count | parameter CRC | pixel data                           | pixel data CRC |
|-------------|---------------|--------------------------------------|----------------|
| 2 bytes     | 2 bytes       | packet length – present header bytes | 2 bytes        |

|                              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| packet length                | : total number of bytes in the packet not including the packet length fie                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| packet type                  | : packet type, 16 (decimal) for register access packet                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| bClient ID                   | : set all zero                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| Field Present Flags          | : A value of '1' for each bit indicates that the field is present in the packet.<br>A value of '0' for the bit indicates that the field is not present.<br>o Bit 0 indicates the presence of the Video Data Format Descriptor field.<br>o Bit 1 indicates the presence of the Pixel Data Attributes field.<br>o Bit 2 indicates the presence of the X Left Edge field.<br>o Bit 3 indicates the presence of the Y Top Edge field.<br>o Bit 4 indicates the presence of the X Right Edge field.<br>o Bit 5 indicates the presence of the Y Bottom Edge field.<br>o Bit 6 indicates the presence of the X Start field.<br>o Bit 7 indicates the presence of the Y Start field.<br>o Bit 8 indicates the presence of the Pixel Count field.<br>o Bits [15:9] must be set to '0'. |
| video data format descriptor | : bits[15:13]=010, raw RGB format (fixed value)<br>bit[12]=1,only packed type is available (fixed value)<br>bits[11:0]=number of bits per pixel,<br>bits[11:8]=for Red,bits[7:4]=for Green,bits[3:0]=for Blue                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| pixel data attributes        | : bits[1:0]=11, displayed both eyes (fixed value)<br>others are all zero                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| X left edge                  | : X coordinate of the left edge of the active window filled by the Pixel D                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| X top edge                   | : Y coordinate of the top edge of the active window filled by the Pixel D                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| X right edge                 | : X coordinate of the right edge of the active window filled by the Pixel                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| Y bottom edge                | : Y coordinate of the bottom edge of the active window filled by the Pix                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| X start                      | : X coordinate of the first pixel in the Pixel Data field below                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| Y start                      | : X coordinate of the first pixel in the Pixel Data field below                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| Pixel count                  | : Write number of pixel                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| Patameter CRC                | : To error check from packet length to pixel count                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| pixel data                   | : pixel data info. Number of pixel data must not be over 65509                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| pixel data CRC               | : To pixel data error check.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |

### Perform type handoff packet

| Packet Length | Packet type =77 | Interface Type | Reserved1 | Delay filler            | CRC     |
|---------------|-----------------|----------------|-----------|-------------------------|---------|
| 2 bytes       | 2 bytes         | 1 byte         | 1 byte    | Packet Length - 6 bytes | 2 bytes |

|                |   |                                                                                                                                                                                                                                                    |
|----------------|---|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| packet length  | : | total number of bytes in the packet not including the packet length field                                                                                                                                                                          |
| packet type    | : | packet type, 77(decimal) for perform type handoff packet                                                                                                                                                                                           |
| interface type | : | contain the new type to be used.<br>Bit[2:0], define the forward link<br>1: handoff to type1<br>2: handoff to type2<br>others: not used.<br>Bit[5:3], define the reverse link<br>1: handoff to type1<br>others not used<br>bit[7:6], set all zero. |
| Reserved1      | : | Set all zero                                                                                                                                                                                                                                       |
| delay filler   | : | Set all zero<br>Forward link is Type1, Delay filler is 16byte<br>Forward link is Type2, Delay filler is 32byte                                                                                                                                     |
| CRC            | : | To error check                                                                                                                                                                                                                                     |

### Forward link skew calibration pack

| Packet Length | Packet type =83 | hClient ID | CRC     | All Zero1 | Calibration Data Sequence | All Zero2 |
|---------------|-----------------|------------|---------|-----------|---------------------------|-----------|
| 2 bytes       | 2 bytes         | 2 bytes    | 2 bytes | 8 bytes   | Packet Length - 22 bytes  | 8 bytes   |

|                           |   |                                                                                                                                                                                                                        |
|---------------------------|---|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| packet length             | : | total number of bytes in the packet not including the packet length field                                                                                                                                              |
| packet type               | : | packet type, 83(decimal) for perform type handoff packet                                                                                                                                                               |
| hClient ID                | : | contain the new type to be used.                                                                                                                                                                                       |
| CRC                       | : | To error check                                                                                                                                                                                                         |
| All Zero 1                | : | Set all zero                                                                                                                                                                                                           |
| Calibration Data Sequence | : | a data sequence that causes the MDDI_Data signals to toggle at every data period.<br>o Type 1 – (64 byte data sequence) AAh, AAh ... or 55h, 55h...<br>o Type 2 – (128 byte data sequence) CCh, CCh ... or 33h, 33h... |
| All Zero 2                | : | Set all zero                                                                                                                                                                                                           |

### Filler packet

| Packet Length | Packet type =0 | filler bytes (all zero) | CRC     |
|---------------|----------------|-------------------------|---------|
| 2 bytes       | 2 bytes        | packet length - 4 bytes | 2 bytes |

- packet length      □ total number of bytes in the packet not including the packet length field
- packet type        □ packet type, 0 (decimal) for register access packet
- filler bytes        □ set to all zero (The size is under packet length available)
- CRC                 □ To error check

### Link shutdown packet

| Packet Length | Packet type =69 | CRC     | All zeros |
|---------------|-----------------|---------|-----------|
| 2 bytes       | 2 bytes         | 2 bytes | 16 bytes  |

- packet length      □ total number of bytes in the packet not including the packet length field
- packet type        □ packet type, 16 (decimal) for register access packet
- CRC                 □ To error check
- All zeros           □ write all zero (size is 16 bytes, because MDDI for HX8369-A is type 1)

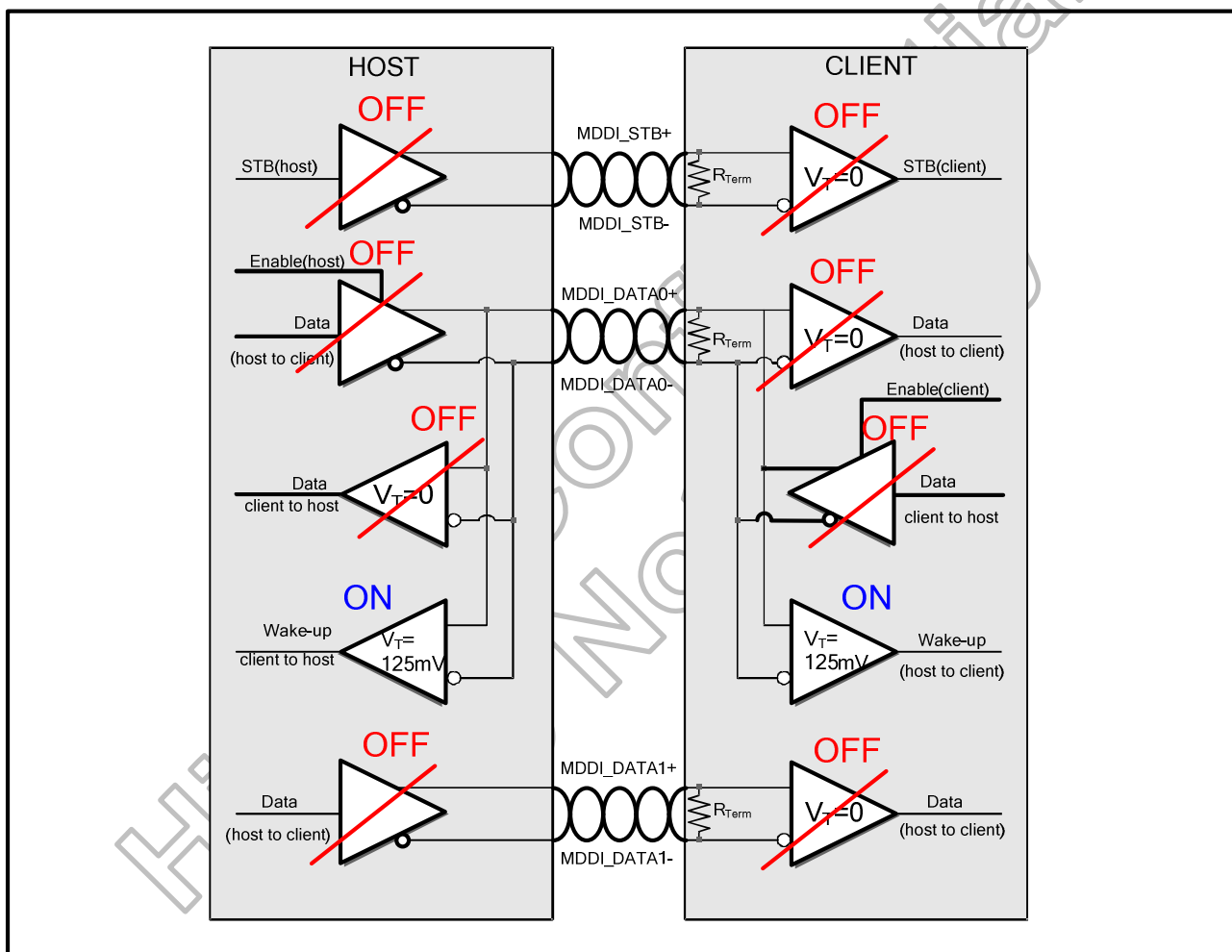


Fixed Value

For more information about MDDI packet refer to VESA MDDI spec.

### 4.2.7.3 Hibernation / Wake up

HX8369-A02 MDDI provides the hibernation mode to reduce the power consumption. The MDDI link can enter the hibernation state quickly and wake up from hibernation quickly. This allows the system to force the MDDI link into hibernation frequently to reduce power consumption. In hibernation mode, hi-speed drivers and receivers are disabled and low-speed & low-power receivers are enabled to detect wake-up sequence.



**Figure 4.48: MDDI Transceiver / Receiver state in hibernation**

When the link wakes up from hibernation the host and client exchange a sequence of pulses. These pulses can be detected using low-speed line receivers that consume only a fraction of the current as the differential receivers required to receive the signals at the maximum link operating speed.



#### 4.2.7.4 MDDI link wakeup sequence

Figure below provide a host-initiated wake-up is described below without contention from the client trying to wake up at the same time. The labeled events are :

##### Host-Initiated Wake-up

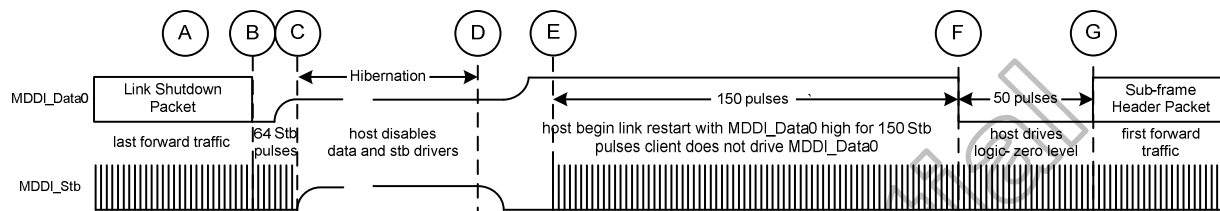


Figure 4.49: Host-initiated link wakeup sequence

An example of a typical client-initiated service request event with no contention is illustrated in below figure. The labeled events are :

- The host sends a Link Shutdown Packet to inform the client that the link will transition to the low-power hibernation state.
- Following the CRC of the Link Shutdown Packet the host toggles MDDI\_Stb for 64 cycles to allow processing in the client to finish before it stops MDDI\_Stb from toggling which stops the recovered clock in the client device. Also during this interval the host initially sets MDDI\_Data0 to a logic-zero level, and then disables the MDDI\_Data0 output in the range of 16 to 48 MDDI\_Stb cycles (including output disable propagation delays) after the CRC. It may be desirable for the client to place its high-speed receivers for MDDI\_Data0 and MDDI\_Stb into a low power state any time after 48 MDDI\_Stb cycles after the CRC and before point C.
- The host enters the low-power hibernation state by disabling the MDDI\_Data0 and MDDI\_Stb drivers and by placing the host controller into a low-power hibernation state. It is also allowable for MDDI\_Stb to be driven to a logic-zero level or to continue toggling during hibernation. The client is also in the low-power hibernation state.
- After a while, the host begins the link restart sequence by enabling the MDDI\_Data0 and MDDI\_Stb driver outputs. The host drives MDDI\_Data0 to a logic-one level and MDDI\_Stb to a logic-zero level for at least the time it takes for the drivers to fully enable their outputs. The host shall wait at least 200 nsec after MDDI\_Data0 reaches a valid logic-one level and MDDI\_Stb reaches a valid logic-zero level before driving pulses on MDDI\_Stb. This gives the client sufficient time to prepare to receive high-speed pulses on MDDI\_Stb. The client first detects the wake-up pulse using a low-power differential receiver having a +125mV input offset voltage.
- The host drivers are fully enabled and MDDI\_Data0 is being driven to a logic-one level. The host begins to toggle MDDI\_Stb in a manner consistent with having a logic-zero level on MDDI\_Data0 for a duration of 150 MDDI\_Stb cycles.
- The host drives MDDI\_Data0 to a logic-zero level for 50 MDDI\_Stb cycles. The client begins to look for the Sub-frame Header Packet after MDDI\_Data0 is at a logic-zero level for 40 MDDI\_Stb cycles.
- The host begins to transmit data on the forward link by sending a Sub-frame Header Packet. Beginning at point G the MDDI host generates MDDI\_Stb based on the logic level on MDDI\_Data0 so that proper data-strobe encoding commences from point G.

#### 4.2.7.5 MDDI operation mode

The MDDI Link provides six operation modes, the mode flow is illustrated as below.

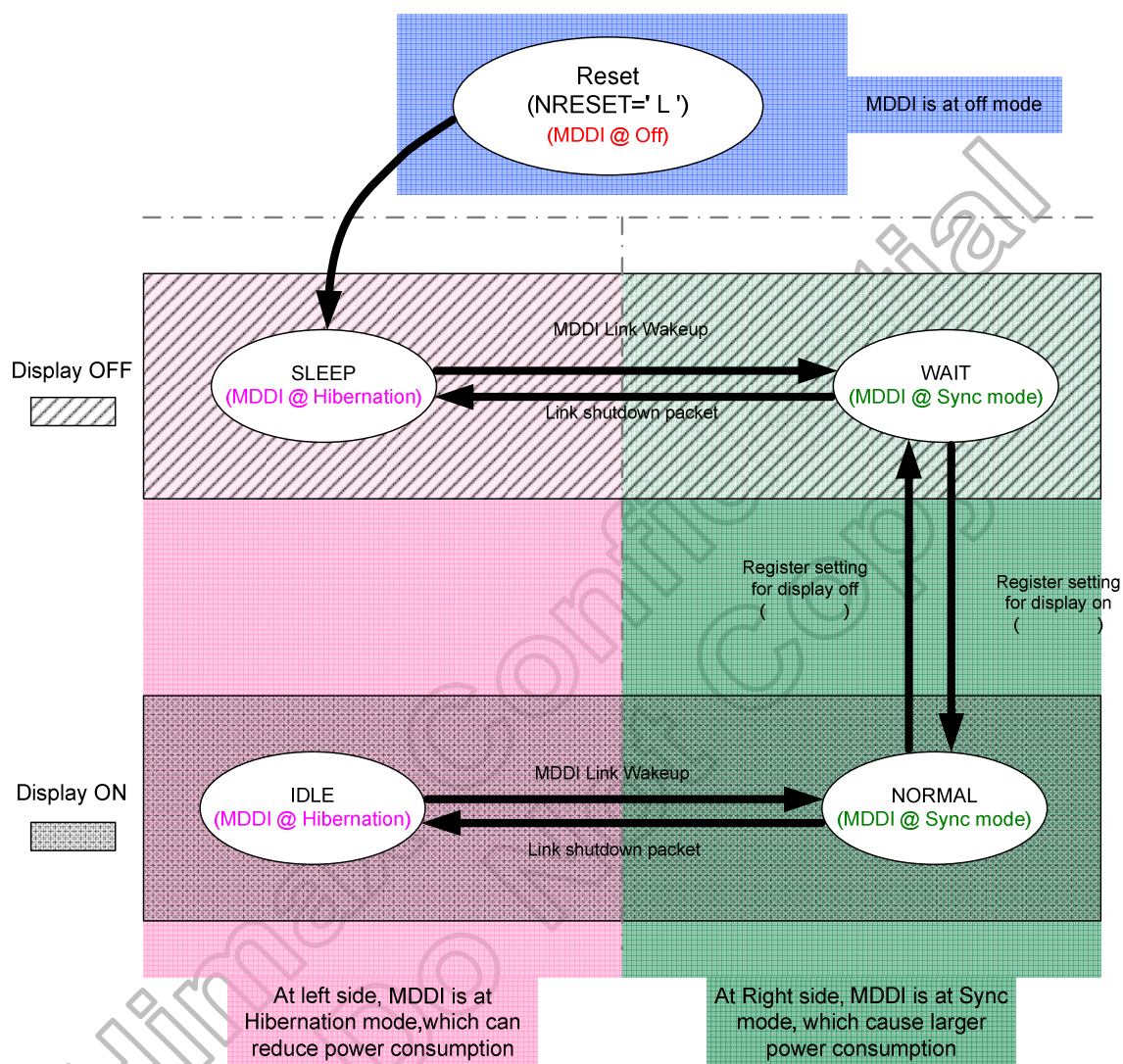


Figure 4.50: MDDI operation mode

The MDDI link provides five operation modes that are listed in the Table 4.7.

| Function                              | RESET   | SLEEP   | WAIT                  | NORMAL            | IDLE              |
|---------------------------------------|---------|---------|-----------------------|-------------------|-------------------|
| MDDI hibernation receiver             | OFF     | ON      | OFF                   | OFF               | ON                |
| MDDI normal receiver or normal driver | OFF     | OFF     | ON                    | ON                | OFF               |
| Register and RAM access               | Disable | Disable | Enable                | Enable            | Disable           |
| Internal oscillator(OSC)              | OFF     | OFF     | ON/OFF <sup>(1)</sup> | ON <sup>(2)</sup> | ON <sup>(2)</sup> |
| Booster(VSP,VSN,VGH,VGL)              | OFF     | OFF     | OFF                   | ON                | ON                |
| Regulator (VCOM,VSPR,VSNR)            | OFF     | OFF     | OFF                   | ON                | ON                |

Note: (1) While OSC\_EN = 0 is defined the operation as OFF, and OSC\_EN = 1 is ON.

(2) Do not set OSC\_EN = 1 in Normal mode, If OSC stopped, indication also stops.

Table 4.7: Operation mode list

## 5. Function Description

### 5.1 Display data GRAM

HX8369-A02 support the display data RAM that stores display dots and consists of 9,953,280 bits (480x864x24 bits). There is no restriction on access to the RAM even when the display data on the same address is loaded to DAC. There will be no abnormal visible effect on the display when there is a simultaneous Panel Read and Interface Read or Write to the same location of the Frame Memory.

### 5.2 Address counter (AC)

The HX8369-A02 contains an address counter (AC) which assigns address for writing/reading pixel data to/from GRAM. The address pointers set the position of GRAM whose addresses range:

| RES_SEL2 | RES_SEL 1 | RES_SEL 0 | MV | X range | Y range | Panel resolution |
|----------|-----------|-----------|----|---------|---------|------------------|
| 0        | 0         | 0         | 0  | 0~479d. | 0~863d. | 480RGBX864 dot   |
|          |           |           | 1  | 0~863d. | 0~479d. |                  |
| 0        | 0         | 1         | 0  | 0~479d. | 0~853d. | 480RGBX854 dot   |
|          |           |           | 1  | 0~853d. | 0~479d. |                  |
| 0        | 1         | 0         | 0  | 0~479d. | 0~799d. | 480RGBX800 dot   |
|          |           |           | 1  | 0~799d. | 0~479d. |                  |
| 0        | 1         | 1         | 0  | 0~479d. | 0~639d. | 480RGBX640 dot   |
|          |           |           | 1  | 0~639d. | 0~479d. |                  |
| 1        | 0         | 0         | 0  | 0~359d. | 0~639d. | 360 RGBX640 dot  |
|          |           |           | 1  | 0~639d. | 0~359d. |                  |
| 1        | 0         | 1         | 0  | 0~479d. | 0~719d. | 480RGBX720 dot   |
|          |           |           | 1  | 0~719d. | 0~479d. |                  |

**Table 5.1: Addresses counter range**

Every time when a pixel data is written into the GRAM, the X address or Y address of AC will be automatically increased by 1 (or decreased by 1), which is decided by the register (MV, MX and MY bit) setting.

To simplify the address control of GRAM access, the window address function allows for writing data only to a window area of GRAM specified by registers. After data is written to the GRAM, the AC will be increased or decreased within setting window address-range which is specified by the Column address register (start: SC, end: EC) or the Row address register (start: SP, end: EP). Therefore, the data can be written consecutively without thinking a data wrap by those bit function.

## 5.3 Source, gate and memory map

### 5.3.1 480RGB x 864 resolution

R36h: B5=0

| Source Out |      | S1     | S2     | S3     | S4     | S5     | S6     | --- | S1435    | S1436    | S1437    | S1438    | S1439    | S1440    |      |      |
|------------|------|--------|--------|--------|--------|--------|--------|-----|----------|----------|----------|----------|----------|----------|------|------|
|            |      | RGB=0  | RGB=1  | RGB=0  | RGB=1  | RGB=0  | RGB=1  |     | RGB=0    | RGB=1    | RGB=0    | RGB=1    | RGB=0    | RGB=1    |      |      |
| RA         |      |        |        |        |        |        |        |     |          |          |          |          |          |          | SA   |      |
| MY=0       | MY=1 |        |        |        |        |        |        |     |          |          |          |          |          |          | ML=0 | ML=1 |
| 0          | 863  | R0 7-0 | G0 7-0 | B0 7-0 | R1 7-0 | G1 7-0 | B1 7-0 | --- | R478 7-0 | G478 7-0 | B478 7-0 | R479 7-0 | G479 7-0 | B479 7-0 | 0    | 863  |
| 1          | 862  |        |        |        |        |        |        | --- |          |          |          |          |          |          | 1    | 862  |
| 2          | 861  |        |        |        |        |        |        | --- |          |          |          |          |          |          | 2    | 861  |
| 3          | 860  |        |        |        |        |        |        | --- |          |          |          |          |          |          | 3    | 860  |
| 4          | 859  |        |        |        |        |        |        | --- |          |          |          |          |          |          | 4    | 859  |
| 5          | 858  |        |        |        |        |        |        | --- |          |          |          |          |          |          | 5    | 858  |
| 6          | 857  |        |        |        |        |        |        | --- |          |          |          |          |          |          | 6    | 857  |
| 7          | 856  |        |        |        |        |        |        | --- |          |          |          |          |          |          | 7    | 856  |
| 8          | 855  |        |        |        |        |        |        | --- |          |          |          |          |          |          | 8    | 855  |
| 9          | 854  |        |        |        |        |        |        | --- |          |          |          |          |          |          | 9    | 854  |
| :          | :    | :      | :      | :      | :      | :      | :      | :   | :        | :        | :        | :        | :        | :        | :    | :    |
| :          | :    | :      | :      | :      | :      | :      | :      | :   | :        | :        | :        | :        | :        | :        | :    | :    |
| :          | :    | :      | :      | :      | :      | :      | :      | :   | :        | :        | :        | :        | :        | :        | :    | :    |
| :          | :    | :      | :      | :      | :      | :      | :      | :   | :        | :        | :        | :        | :        | :        | :    | :    |
| 856        | 7    |        |        |        |        |        |        | --- |          |          |          |          |          |          | 856  | 7    |
| 857        | 6    |        |        |        |        |        |        | --- |          |          |          |          |          |          | 857  | 6    |
| 858        | 5    |        |        |        |        |        |        | --- |          |          |          |          |          |          | 858  | 5    |
| 859        | 4    |        |        |        |        |        |        | --- |          |          |          |          |          |          | 859  | 4    |
| 860        | 3    |        |        |        |        |        |        | --- |          |          |          |          |          |          | 860  | 3    |
| 861        | 2    |        |        |        |        |        |        | --- |          |          |          |          |          |          | 861  | 2    |
| 862        | 1    |        |        |        |        |        |        | --- |          |          |          |          |          |          | 862  | 1    |
| 863        | 0    |        |        |        |        |        |        | --- |          |          |          |          |          |          | 863  | 0    |
| CA         | MX=0 | 0      |        | 1      |        | ---    |        |     | 478      |          | 479      |          |          |          |      |      |
|            | MX=1 | 479    |        | 478    |        | ---    |        |     | 1        |          | 0        |          |          |          |      |      |

Note: RA=Row Address  
 CA=Column Address  
 SA=Scan Address  
 MX=Column address direction parameter  
 MY=Row address direction parameter  
 ML=Scan direction parameter  
 RGB=Red,Green and Blue pixel position change

Table 5.2: Memory map of 480RGB x 864 resolution

### 5.3.2 480RGB x 854 resolution

R36h: B5=0

| Source Out |      | S1     | S2     | S3     | S4     | S5     | S6     | --- | S1435    | S1436    | S1437    | S1438    | S1439    | S1440    |      |      |  |
|------------|------|--------|--------|--------|--------|--------|--------|-----|----------|----------|----------|----------|----------|----------|------|------|--|
| RA         |      | RGB=0  | RGB=1  |        | RGB=0  | RGB=1  |        |     | RGB=0    | RGB=1    |          | RGB=0    | RGB=1    |          | SA   |      |  |
| MY=0       | MY=1 | R0 7-0 | G0 7-0 | B0 7-0 | R1 7-0 | G1 7-0 | B1 7-0 | --- | R478 7-0 | G478 7-0 | B478 7-0 | R479 7-0 | G479 7-0 | B479 7-0 | ML=0 | ML=1 |  |
| 0          | 853  |        |        |        |        |        |        | --- |          |          |          |          |          |          | 0    | 853  |  |
| 1          | 852  |        |        |        |        |        |        | --- |          |          |          |          |          |          | 1    | 852  |  |
| 2          | 851  |        |        |        |        |        |        | --- |          |          |          |          |          |          | 2    | 851  |  |
| 3          | 850  |        |        |        |        |        |        | --- |          |          |          |          |          |          | 3    | 850  |  |
| 4          | 849  |        |        |        |        |        |        | --- |          |          |          |          |          |          | 4    | 849  |  |
| 5          | 848  |        |        |        |        |        |        | --- |          |          |          |          |          |          | 5    | 848  |  |
| 6          | 847  |        |        |        |        |        |        | --- |          |          |          |          |          |          | 6    | 847  |  |
| 7          | 846  |        |        |        |        |        |        | --- |          |          |          |          |          |          | 7    | 846  |  |
| 8          | 845  |        |        |        |        |        |        | --- |          |          |          |          |          |          | 8    | 845  |  |
| 9          | 844  |        |        |        |        |        |        | --- |          |          |          |          |          |          | 9    | 844  |  |
| :          | :    | :      | :      | :      | :      | :      | :      | :   | :        | :        | :        | :        | :        | :        | :    | :    |  |
| :          | :    | :      | :      | :      | :      | :      | :      | :   | :        | :        | :        | :        | :        | :        | :    | :    |  |
| :          | :    | :      | :      | :      | :      | :      | :      | :   | :        | :        | :        | :        | :        | :        | :    | :    |  |
| :          | :    | :      | :      | :      | :      | :      | :      | :   | :        | :        | :        | :        | :        | :        | :    | :    |  |
| 846        | 7    |        |        |        |        |        |        | --- |          |          |          |          |          |          | 846  | 7    |  |
| 847        | 6    |        |        |        |        |        |        | --- |          |          |          |          |          |          | 847  | 6    |  |
| 848        | 5    |        |        |        |        |        |        | --- |          |          |          |          |          |          | 848  | 5    |  |
| 849        | 4    |        |        |        |        |        |        | --- |          |          |          |          |          |          | 849  | 4    |  |
| 850        | 3    |        |        |        |        |        |        | --- |          |          |          |          |          |          | 850  | 3    |  |
| 851        | 2    |        |        |        |        |        |        | --- |          |          |          |          |          |          | 851  | 2    |  |
| 852        | 1    |        |        |        |        |        |        | --- |          |          |          |          |          |          | 852  | 1    |  |
| 853        | 0    |        |        |        |        |        |        | --- |          |          |          |          |          |          | 853  | 0    |  |
| CA         | MX=0 | 0      |        |        |        | 1      |        |     |          | 478      |          |          |          | 479      |      |      |  |
|            | MX=1 | 479    |        |        |        | 478    |        |     |          | 1        |          |          |          | 0        |      |      |  |

Note: RA=Row Address  
 CA=Column Address  
 SA=Scan Address  
 MX=Column address direction parameter  
 MY=Row address direction parameter  
 ML=Scan direction parameter  
 RGB=Red,Green and Blue pixel position change

**Table 5.3: Memory map of 480RGB x 854 resolution**

### 5.3.3 480RGB x 800 resolution

R36h: B5=0

| Source Out |      | S1     | S2     | S3     | S4     | S5     | S6     | --- | S1435    | S1436    | S1437    | S1438    | S1439    | S1440    |      |      |  |
|------------|------|--------|--------|--------|--------|--------|--------|-----|----------|----------|----------|----------|----------|----------|------|------|--|
| RA         |      | RGB=0  | RGB=1  |        | RGB=0  | RGB=1  |        |     | RGB=0    | RGB=1    |          | RGB=0    | RGB=1    |          | SA   |      |  |
| MY=0       | MY=1 |        |        |        |        |        |        |     |          |          |          |          |          |          | ML=0 | ML=1 |  |
| 0          | 799  | R0 7-0 | G0 7-0 | B0 7-0 | R1 7-0 | G1 7-0 | B1 7-0 | --- | R478 7-0 | G478 7-0 | B478 7-0 | R479 7-0 | G479 7-0 | B479 7-0 | 0    | 799  |  |
| 1          | 798  |        |        |        |        |        |        | --- |          |          |          |          |          |          | 1    | 798  |  |
| 2          | 797  |        |        |        |        |        |        | --- |          |          |          |          |          |          | 2    | 797  |  |
| 3          | 796  |        |        |        |        |        |        | --- |          |          |          |          |          |          | 3    | 796  |  |
| 4          | 795  |        |        |        |        |        |        | --- |          |          |          |          |          |          | 4    | 795  |  |
| 5          | 794  |        |        |        |        |        |        | --- |          |          |          |          |          |          | 5    | 794  |  |
| 6          | 793  |        |        |        |        |        |        | --- |          |          |          |          |          |          | 6    | 793  |  |
| 7          | 792  |        |        |        |        |        |        | --- |          |          |          |          |          |          | 7    | 792  |  |
| 8          | 791  |        |        |        |        |        |        | --- |          |          |          |          |          |          | 8    | 791  |  |
| 9          | 790  |        |        |        |        |        |        | --- |          |          |          |          |          |          | 9    | 790  |  |
| :          | :    | :      | :      | :      | :      | :      | :      | :   | :        | :        | :        | :        | :        | :        | :    | :    |  |
| :          | :    | :      | :      | :      | :      | :      | :      | :   | :        | :        | :        | :        | :        | :        | :    | :    |  |
| :          | :    | :      | :      | :      | :      | :      | :      | :   | :        | :        | :        | :        | :        | :        | :    | :    |  |
| :          | :    | :      | :      | :      | :      | :      | :      | :   | :        | :        | :        | :        | :        | :        | :    | :    |  |
| 792        | 7    |        |        |        |        |        |        | --- |          |          |          |          |          |          | 792  | 7    |  |
| 793        | 6    |        |        |        |        |        |        | --- |          |          |          |          |          |          | 793  | 6    |  |
| 794        | 5    |        |        |        |        |        |        | --- |          |          |          |          |          |          | 794  | 5    |  |
| 795        | 4    |        |        |        |        |        |        | --- |          |          |          |          |          |          | 795  | 4    |  |
| 796        | 3    |        |        |        |        |        |        | --- |          |          |          |          |          |          | 796  | 3    |  |
| 797        | 2    |        |        |        |        |        |        | --- |          |          |          |          |          |          | 797  | 2    |  |
| 798        | 1    |        |        |        |        |        |        | --- |          |          |          |          |          |          | 798  | 1    |  |
| 799        | 0    |        |        |        |        |        |        | --- |          |          |          |          |          |          | 799  | 0    |  |
| CA         | MX=0 | 0      |        |        |        | 1      |        |     |          | 478      |          |          |          | 479      |      |      |  |
|            | MX=1 | 479    |        |        |        | 478    |        |     |          | 1        |          |          |          | 0        |      |      |  |

Note: RA=Row Address  
CA=Column Address  
SA=Scan Address  
MX=Column address direction parameter  
MY=Row address direction parameter  
ML=Scan direction parameter  
RGB=Red,Green and Blue pixel position change

Table 5.4: Memory map of 480RGB x 800 resolution



### 5.3.4 480RGB x 640 resolution

R36h: B5=0

| Source Out |      | S1     | S2     | S3     | S4     | S5     | S6     | --- | S1435    | S1436    | S1437    | S1438    | S1439    | S1440    |      |      |  |
|------------|------|--------|--------|--------|--------|--------|--------|-----|----------|----------|----------|----------|----------|----------|------|------|--|
| RA         |      | RGB=0  | RGB=1  |        | RGB=0  | RGB=1  |        |     | RGB=0    | RGB=1    |          | RGB=0    | RGB=1    |          | SA   |      |  |
| MY=0       | MY=1 | R0 7-0 | G0 7-0 | B0 7-0 | R1 7-0 | G1 7-0 | B1 7-0 | --- | R478 7-0 | G478 7-0 | B478 7-0 | R479 7-0 | G479 7-0 | B479 7-0 | ML=0 | ML=1 |  |
| 0          | 639  |        |        |        |        |        |        | --- |          |          |          |          |          |          | 0    | 639  |  |
| 1          | 638  |        |        |        |        |        |        | --- |          |          |          |          |          |          | 1    | 638  |  |
| 2          | 637  |        |        |        |        |        |        | --- |          |          |          |          |          |          | 2    | 637  |  |
| 3          | 636  |        |        |        |        |        |        | --- |          |          |          |          |          |          | 3    | 636  |  |
| 4          | 635  |        |        |        |        |        |        | --- |          |          |          |          |          |          | 4    | 635  |  |
| 5          | 634  |        |        |        |        |        |        | --- |          |          |          |          |          |          | 5    | 634  |  |
| 6          | 633  |        |        |        |        |        |        | --- |          |          |          |          |          |          | 6    | 633  |  |
| 7          | 632  |        |        |        |        |        |        | --- |          |          |          |          |          |          | 7    | 632  |  |
| 8          | 631  |        |        |        |        |        |        | --- |          |          |          |          |          |          | 8    | 631  |  |
| 9          | 630  |        |        |        |        |        |        | --- |          |          |          |          |          |          | 9    | 630  |  |
| :          | :    | :      | :      | :      | :      | :      | :      | :   | :        | :        | :        | :        | :        | :        | :    | :    |  |
| :          | :    | :      | :      | :      | :      | :      | :      | :   | :        | :        | :        | :        | :        | :        | :    | :    |  |
| :          | :    | :      | :      | :      | :      | :      | :      | :   | :        | :        | :        | :        | :        | :        | :    | :    |  |
| :          | :    | :      | :      | :      | :      | :      | :      | :   | :        | :        | :        | :        | :        | :        | :    | :    |  |
| 632        | 7    |        |        |        |        |        |        | --- |          |          |          |          |          |          | 632  | 7    |  |
| 633        | 6    |        |        |        |        |        |        | --- |          |          |          |          |          |          | 633  | 6    |  |
| 634        | 5    |        |        |        |        |        |        | --- |          |          |          |          |          |          | 634  | 5    |  |
| 635        | 4    |        |        |        |        |        |        | --- |          |          |          |          |          |          | 635  | 4    |  |
| 636        | 3    |        |        |        |        |        |        | --- |          |          |          |          |          |          | 636  | 3    |  |
| 637        | 2    |        |        |        |        |        |        | --- |          |          |          |          |          |          | 637  | 2    |  |
| 638        | 1    |        |        |        |        |        |        | --- |          |          |          |          |          |          | 638  | 1    |  |
| 639        | 0    |        |        |        |        |        |        | --- |          |          |          |          |          |          | 639  | 0    |  |
| CA         | MX=0 | 0      |        |        |        | 1      |        |     |          | 478      |          |          |          | 479      |      |      |  |
|            | MX=1 | 479    |        |        |        | 478    |        |     |          | 1        |          |          |          | 0        |      |      |  |

Note: RA=Row Address  
CA=Column Address  
SA=Scan Address  
MX=Column address direction parameter  
MY=Row address direction parameter  
ML=Scan direction parameter  
RGB=Red,Green and Blue pixel position change

**Table 5.5: Memory map of 480RGB x 640 resolution**



### 5.3.5 360RGB x 640 resolution

R36h: B5=0

| Source Out |      | S1     |  |  | S2     |  |  | S3     |  |  | S4     |  |  | S5     |  |  | S6     |  |  | ---   |  |  | S1435    |  |  | S1436    |  |  | S1437    |  |  | S1438    |  |  | S1439    |  |  | S1440    |     |  |
|------------|------|--------|--|--|--------|--|--|--------|--|--|--------|--|--|--------|--|--|--------|--|--|-------|--|--|----------|--|--|----------|--|--|----------|--|--|----------|--|--|----------|--|--|----------|-----|--|
| RA         |      | RGB=0  |  |  | RGB=1  |  |  | RGB=0  |  |  | RGB=1  |  |  | RGB=0  |  |  | RGB=1  |  |  | RGB=0 |  |  | RGB=1    |  |  | RGB=0    |  |  | RGB=1    |  |  | RGB=0    |  |  | RGB=1    |  |  |          |     |  |
| MY=0       | MY=1 | R0 7-0 |  |  | G0 7-0 |  |  | B0 7-0 |  |  | R1 7-0 |  |  | G1 7-0 |  |  | B1 7-0 |  |  | ---   |  |  | R358 7-0 |  |  | G358 7-0 |  |  | B358 7-0 |  |  | R359 7-0 |  |  | G359 7-0 |  |  | B359 7-0 |     |  |
| 0          | 639  |        |  |  |        |  |  |        |  |  |        |  |  |        |  |  |        |  |  | ---   |  |  |          |  |  |          |  |  |          |  |  |          |  |  |          |  |  | 0        | 639 |  |
| 1          | 638  |        |  |  |        |  |  |        |  |  |        |  |  |        |  |  |        |  |  | ---   |  |  |          |  |  |          |  |  |          |  |  |          |  |  |          |  |  | 1        | 638 |  |
| 2          | 637  |        |  |  |        |  |  |        |  |  |        |  |  |        |  |  |        |  |  | ---   |  |  |          |  |  |          |  |  |          |  |  |          |  |  |          |  |  | 2        | 637 |  |
| 3          | 636  |        |  |  |        |  |  |        |  |  |        |  |  |        |  |  |        |  |  | ---   |  |  |          |  |  |          |  |  |          |  |  |          |  |  |          |  |  | 3        | 636 |  |
| 4          | 635  |        |  |  |        |  |  |        |  |  |        |  |  |        |  |  |        |  |  | ---   |  |  |          |  |  |          |  |  |          |  |  |          |  |  |          |  |  | 4        | 635 |  |
| 5          | 634  |        |  |  |        |  |  |        |  |  |        |  |  |        |  |  |        |  |  | ---   |  |  |          |  |  |          |  |  |          |  |  |          |  |  |          |  |  | 5        | 634 |  |
| 6          | 633  |        |  |  |        |  |  |        |  |  |        |  |  |        |  |  |        |  |  | ---   |  |  |          |  |  |          |  |  |          |  |  |          |  |  |          |  |  | 6        | 633 |  |
| 7          | 632  |        |  |  |        |  |  |        |  |  |        |  |  |        |  |  |        |  |  | ---   |  |  |          |  |  |          |  |  |          |  |  |          |  |  |          |  |  | 7        | 632 |  |
| 8          | 631  |        |  |  |        |  |  |        |  |  |        |  |  |        |  |  |        |  |  | ---   |  |  |          |  |  |          |  |  |          |  |  |          |  |  |          |  |  | 8        | 631 |  |
| 9          | 630  |        |  |  |        |  |  |        |  |  |        |  |  |        |  |  |        |  |  | ---   |  |  |          |  |  |          |  |  |          |  |  |          |  |  |          |  |  | 9        | 630 |  |
| :          | :    | :      |  |  | :      |  |  | :      |  |  | :      |  |  | :      |  |  | :      |  |  | :     |  |  | :        |  |  | :        |  |  | :        |  |  | :        |  |  | :        |  |  | :        | :   |  |
| :          | :    | :      |  |  | :      |  |  | :      |  |  | :      |  |  | :      |  |  | :      |  |  | :     |  |  | :        |  |  | :        |  |  | :        |  |  | :        |  |  | :        |  |  | :        | :   |  |
| :          | :    | :      |  |  | :      |  |  | :      |  |  | :      |  |  | :      |  |  | :      |  |  | :     |  |  | :        |  |  | :        |  |  | :        |  |  | :        |  |  | :        |  |  | :        | :   |  |
| :          | :    | :      |  |  | :      |  |  | :      |  |  | :      |  |  | :      |  |  | :      |  |  | :     |  |  | :        |  |  | :        |  |  | :        |  |  | :        |  |  | :        |  |  | :        | :   |  |
| 632        | 7    |        |  |  |        |  |  |        |  |  |        |  |  |        |  |  |        |  |  | ---   |  |  |          |  |  |          |  |  |          |  |  |          |  |  |          |  |  | 632      | 7   |  |
| 633        | 6    |        |  |  |        |  |  |        |  |  |        |  |  |        |  |  |        |  |  | ---   |  |  |          |  |  |          |  |  |          |  |  |          |  |  |          |  |  | 633      | 6   |  |
| 634        | 5    |        |  |  |        |  |  |        |  |  |        |  |  |        |  |  |        |  |  | ---   |  |  |          |  |  |          |  |  |          |  |  |          |  |  |          |  |  | 634      | 5   |  |
| 635        | 4    |        |  |  |        |  |  |        |  |  |        |  |  |        |  |  |        |  |  | ---   |  |  |          |  |  |          |  |  |          |  |  |          |  |  |          |  |  | 635      | 4   |  |
| 636        | 3    |        |  |  |        |  |  |        |  |  |        |  |  |        |  |  |        |  |  | ---   |  |  |          |  |  |          |  |  |          |  |  |          |  |  |          |  |  | 636      | 3   |  |
| 637        | 2    |        |  |  |        |  |  |        |  |  |        |  |  |        |  |  |        |  |  | ---   |  |  |          |  |  |          |  |  |          |  |  |          |  |  |          |  |  | 637      | 2   |  |
| 638        | 1    |        |  |  |        |  |  |        |  |  |        |  |  |        |  |  |        |  |  | ---   |  |  |          |  |  |          |  |  |          |  |  |          |  |  |          |  |  | 638      | 1   |  |
| 639        | 0    |        |  |  |        |  |  |        |  |  |        |  |  |        |  |  |        |  |  | ---   |  |  |          |  |  |          |  |  |          |  |  |          |  |  |          |  |  | 639      | 0   |  |
| CA         | MX=0 | 0      |  |  |        |  |  | 1      |  |  |        |  |  | ---    |  |  | 358    |  |  |       |  |  | 359      |  |  |          |  |  |          |  |  |          |  |  |          |  |  |          |     |  |
|            | MX=1 | 359    |  |  |        |  |  | 358    |  |  |        |  |  | ---    |  |  | 1      |  |  |       |  |  | 0        |  |  |          |  |  |          |  |  |          |  |  |          |  |  |          |     |  |

Note: RA=Row Address  
CA=Column Address  
SA=Scan Address  
MX=Column address direction parameter  
MY=Row address direction parameter  
ML=Scan direction parameter  
RGB=Red, Green and Blue pixel position change

Table 5.6: Memory map of 360RGB x640 resolution

### 5.3.6 480RGB x 720 resolution

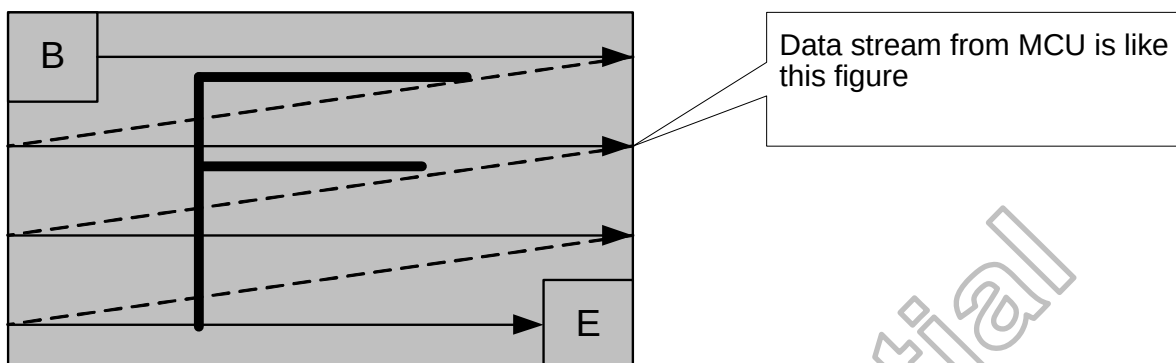
R36h: B5=0

| Source Out |      | S1         | S2         | S3     | S4         | S5         | S6     | --- | S1435      | S1436      | S1437    | S1438      | S1439      | S1440    |      |      |
|------------|------|------------|------------|--------|------------|------------|--------|-----|------------|------------|----------|------------|------------|----------|------|------|
| RA         |      | ↑<br>RGB=0 | ↑<br>RGB=1 | ↑      | ↑<br>RGB=0 | ↑<br>RGB=1 | ↑      |     | ↑<br>RGB=0 | ↑<br>RGB=1 | ↑        | ↑<br>RGB=0 | ↑<br>RGB=1 | ↑        | SA   |      |
| MY=0       | MY=1 |            |            |        |            |            |        |     |            |            |          |            |            |          | ML=0 | ML=1 |
| 0          | 719  | R0 7-0     | G0 7-0     | B0 7-0 | R1 7-0     | G1 7-0     | B1 7-0 | --- | R478 7-0   | G478 7-0   | B478 7-0 | R479 7-0   | G479 7-0   | B479 7-0 | 0    | 719  |
| 1          | 718  |            |            |        |            |            |        | --- |            |            |          |            |            |          | 1    | 718  |
| 2          | 717  |            |            |        |            |            |        | --- |            |            |          |            |            |          | 2    | 717  |
| 3          | 716  |            |            |        |            |            |        | --- |            |            |          |            |            |          | 3    | 716  |
| 4          | 715  |            |            |        |            |            |        | --- |            |            |          |            |            |          | 4    | 715  |
| 5          | 714  |            |            |        |            |            |        | --- |            |            |          |            |            |          | 5    | 714  |
| 6          | 713  |            |            |        |            |            |        | --- |            |            |          |            |            |          | 6    | 713  |
| 7          | 712  |            |            |        |            |            |        | --- |            |            |          |            |            |          | 7    | 712  |
| 8          | 711  |            |            |        |            |            |        | --- |            |            |          |            |            |          | 8    | 711  |
| 9          | 710  |            |            |        |            |            |        | --- |            |            |          |            |            |          | 9    | 710  |
| :          | :    | :          | :          | :      | :          | :          | :      | :   | :          | :          | :        | :          | :          | :        | :    | :    |
| :          | :    | :          | :          | :      | :          | :          | :      | :   | :          | :          | :        | :          | :          | :        | :    | :    |
| :          | :    | :          | :          | :      | :          | :          | :      | :   | :          | :          | :        | :          | :          | :        | :    | :    |
| :          | :    | :          | :          | :      | :          | :          | :      | :   | :          | :          | :        | :          | :          | :        | :    | :    |
| 712        | 7    |            |            |        |            |            |        | --- |            |            |          |            |            |          | 712  | 7    |
| 713        | 6    |            |            |        |            |            |        | --- |            |            |          |            |            |          | 713  | 6    |
| 714        | 5    |            |            |        |            |            |        | --- |            |            |          |            |            |          | 714  | 5    |
| 715        | 4    |            |            |        |            |            |        | --- |            |            |          |            |            |          | 715  | 4    |
| 716        | 3    |            |            |        |            |            |        | --- |            |            |          |            |            |          | 716  | 3    |
| 717        | 2    |            |            |        |            |            |        | --- |            |            |          |            |            |          | 717  | 2    |
| 718        | 1    |            |            |        |            |            |        | --- |            |            |          |            |            |          | 718  | 1    |
| 719        | 0    |            |            |        |            |            |        | --- |            |            |          |            |            |          | 719  | 0    |
| CA         | MX=0 | 0          |            |        | 1          |            |        | --- | 478        |            |          | 479        |            |          |      |      |
|            | MX=1 | 479        |            |        | 478        |            |        | --- | 1          |            |          | 0          |            |          |      |      |

Note: RA=Row Address  
CA=Column Address  
SA=Scan Address  
MX=Column address direction parameter  
MY=Row address direction parameter  
ML=Scan direction parameter  
RGB=Red, Green and Blue pixel position change

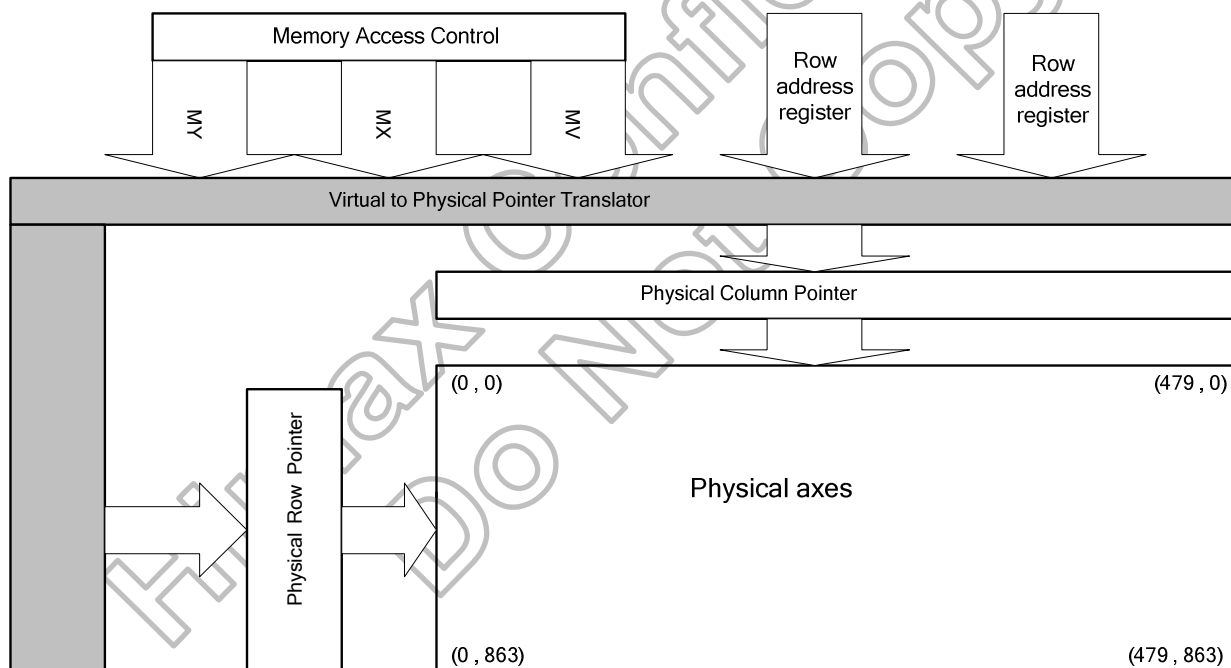
**Table 5.7: Memory map of 480RGB x 720 resolution**

## 5.4 MCU to memory write / read direction



**Figure 5.1: MCU to Memory write / read direction**

The data is written in the order as illustrated above. The counter that dictates which physical memory the data is to be written is controlled by “Memory Access Control” Command, Bits MY, MX, MV as described below.



**Figure 5.2: MY, MX, MV setting of 480RGB x 864 dot**

| MV | MX | MY | CASET                                   | PASET                                        |
|----|----|----|-----------------------------------------|----------------------------------------------|
| 0  | 0  | 0  | Direct to Physical Column Pointer       | Direct to Physical Row Pointer               |
| 0  | 0  | 1  | Direct to Physical Column Pointer       | Direct to (863-Physical Row Pointer) with SC |
| 0  | 1  | 0  | Direct to (479-Physical Column Pointer) | Direct to Physical Row Pointer               |
| 0  | 1  | 1  | Direct to (479-Physical Column Pointer) | Direct to (863-Physical Row Pointer)         |
| 1  | 0  | 0  | Direct to Physical Row Pointer          | Direct to Physical Column Pointer            |
| 1  | 0  | 1  | Direct to (863-Physical Row Pointer)    | Direct to Physical Column Pointer            |
| 1  | 1  | 0  | Direct to Physical Row Pointer          | Direct to (479-Physical Column Pointer)      |
| 1  | 1  | 1  | Direct to (863-Physical Row Pointer)    | Direct to (479-Physical Column Pointer)      |

**Figure 5.3: MY, MX, MV setting of 480RGB x 864 dot**

The following figure depicts the update method set by MV, MX and MY bit.

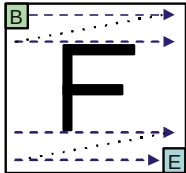
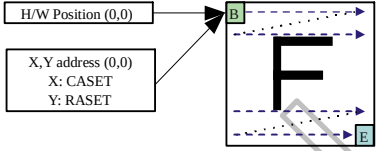
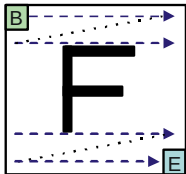
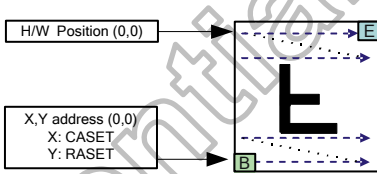
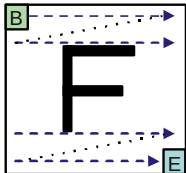
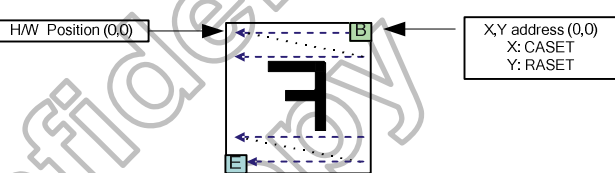
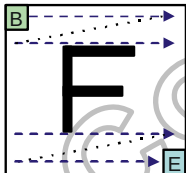
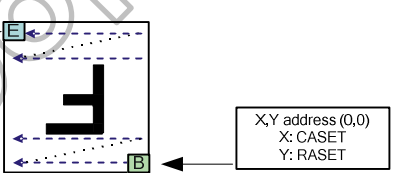
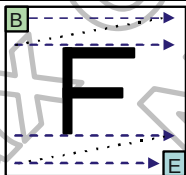
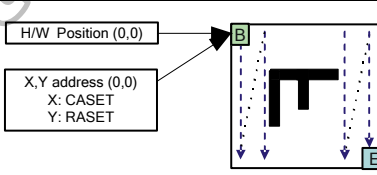
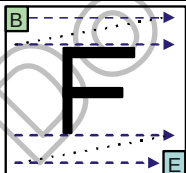
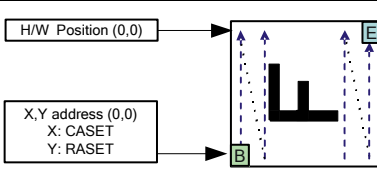
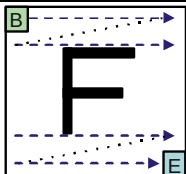
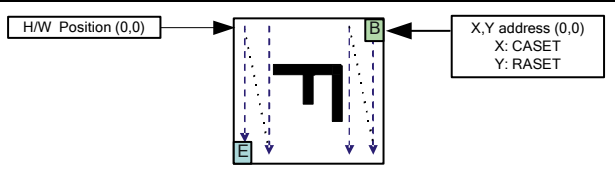
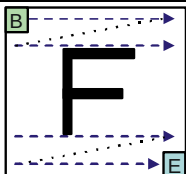
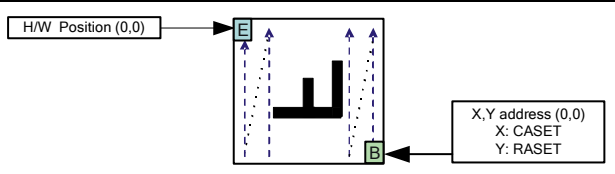
| Display Data Direction         | Memory Access Control |    |    | Image in the Host                                                                   | Image in the Driver (GRAM)                                                           |
|--------------------------------|-----------------------|----|----|-------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|
|                                | MV                    | MX | MY |                                                                                     |                                                                                      |
| Normal                         | 0                     | 0  | 0  |    |    |
| Y-Mirror                       | 0                     | 0  | 1  |    |    |
| X-Mirror                       | 0                     | 1  | 0  |    |    |
| X-Mirror Y-Mirror              | 0                     | 1  | 1  |   |  |
| X-Y Exchange                   | 1                     | 0  | 0  |  |  |
| X-Y Exchange Y-Mirror          | 1                     | 0  | 1  |  |  |
| X-Y Exchange X-Mirror          | 1                     | 1  | 0  |  |  |
| X-Y Exchange X-Mirror Y-Mirror | 1                     | 1  | 1  |  |  |

Figure 5.4: Address direction settings

## 5.5 Fully display, partial display, vertical scrolling display

### 5.5.1 Fully display

- Example: (1) 480RGBx864 dot display mode.  
 (2) NORON (Normal Display Mode On) instruction (R13h).  
 (3) SC=0x000h, EC=0x1DFh (R2Ah) and SP=0x000h, EP=0x35Fh (R2Bh), ML=0.

| GRAM | 000h<br>DB---DB<br>23 ---0 | 001h<br>DB---DB<br>23 ---0 | -----<br>----- | 1DEh<br>DB---DB<br>23 ---0 | 1DFh<br>DB---DB<br>23 ---0 |
|------|----------------------------|----------------------------|----------------|----------------------------|----------------------------|
| 000h | 000000H                    | 000001H                    | -----          | 0001DEH                    | 0001DFH                    |
| 001h | 001000H                    | 001001H                    | -----          | 0011DEH                    | 0011DFH                    |
| 002h | 002000H                    | 002001H                    | -----          | 0021DEH                    | 0021DFH                    |
| 003h | 003000H                    | 003001H                    | -----          | 0031DEH                    | 0031DFH                    |
| 004h | 004000H                    | 004001H                    | -----          | 0041DEH                    | 0041DFH                    |
| 005h | 005000H                    | 005001H                    | -----          | 0051DEH                    | 0051DFH                    |
| ⋮    | ⋮                          | ⋮                          | -----          | ⋮                          | ⋮                          |
| 35Ah | 35A000H                    | 35A001H                    | -----          | 35A1DEH                    | 35A1DFH                    |
| 35Bh | 35B000H                    | 35B001H                    | -----          | 35B1DEH                    | 35B1DFH                    |
| 35Ch | 35C000H                    | 35C001H                    | -----          | 35C1DEH                    | 35C1DFH                    |
| 35Dh | 35D000H                    | 35D001H                    | -----          | 35D1DEH                    | 35D1DFH                    |
| 35Eh | 35E000H                    | 35E001H                    | -----          | 35E1DEH                    | 35E1DFH                    |
| 35Fh | 35F000H                    | 35F001H                    | -----          | 35F1DEH                    | 35F1DFH                    |

Table 5.8: 480RGB x 864 resolution (SRAM assignment)

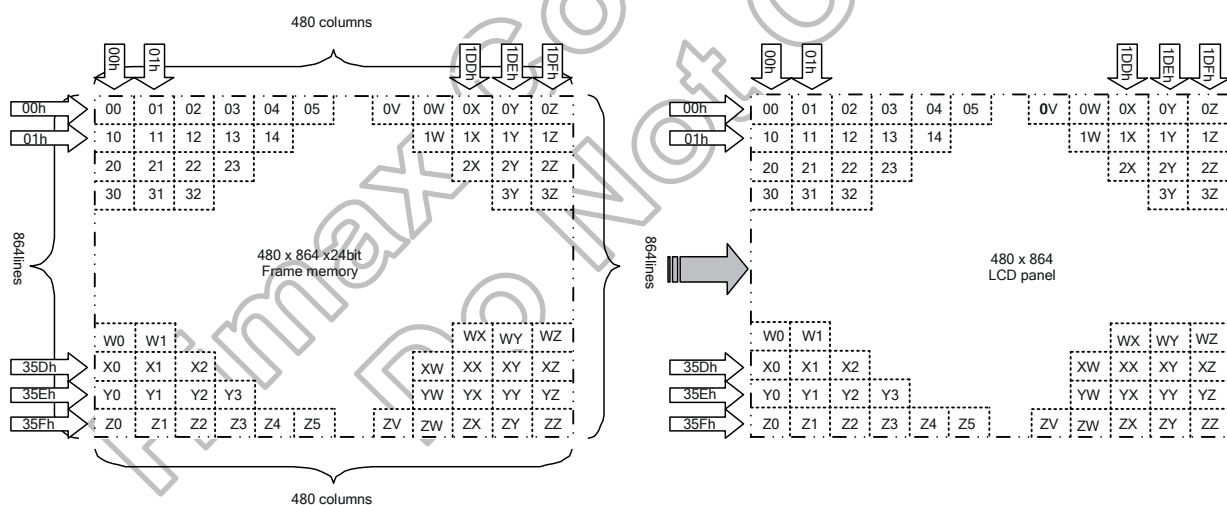


Figure 5.5: 480RGB x 864 resolution

Example: (1) 480RGBx854 dot display mode.  
 (2) NORON (Normal Display Mode On) instruction (R13h).  
 (3) SC=0x000h, EC=0x1DFh (R2Ah) and SP=0x000h, EP=0x355h (R2Bh), ML=0.

| GRAM | 000h    | 001h    | ----- | 1DEh    | 1DFh    |
|------|---------|---------|-------|---------|---------|
|      | DB---DB | DB---DB |       | DB---DB | DB---DB |
|      | 23 ---0 | 23 ---0 |       | 23 ---0 | 23 ---0 |
| 000h | 000000H | 000001H | ----- | 0001DEH | 0001DFH |
| 001h | 001000H | 001001H | ----- | 0011DEH | 0011DFH |
| 002h | 002000H | 002001H | ----- | 0021DEH | 0021DFH |
| 003h | 003000H | 003001H | ----- | 0031DEH | 0031DFH |
| 004h | 004000H | 004001H | ----- | 0041DEH | 0041DFH |
| 005h | 005000H | 005001H | ----- | 0051DEH | 0051DFH |
| ⋮    | ⋮       | ⋮       | ----- | ⋮       | ⋮       |
| 350h | 350000H | 350001H | ----- | 3501DEH | 3501DFH |
| 351h | 351000H | 351001H | ----- | 3511DEH | 3511DFH |
| 352h | 352000H | 352001H | ----- | 3521DEH | 3521DFH |
| 353h | 353000H | 353001H | ----- | 3531DEH | 3531DFH |
| 354h | 354000H | 354001H | ----- | 3541DEH | 3541DFH |
| 355h | 355000H | 355001H | ----- | 3551DEH | 3551DFH |

Table 5.9: 480RGB x 854 resolution (SRAM assignment)

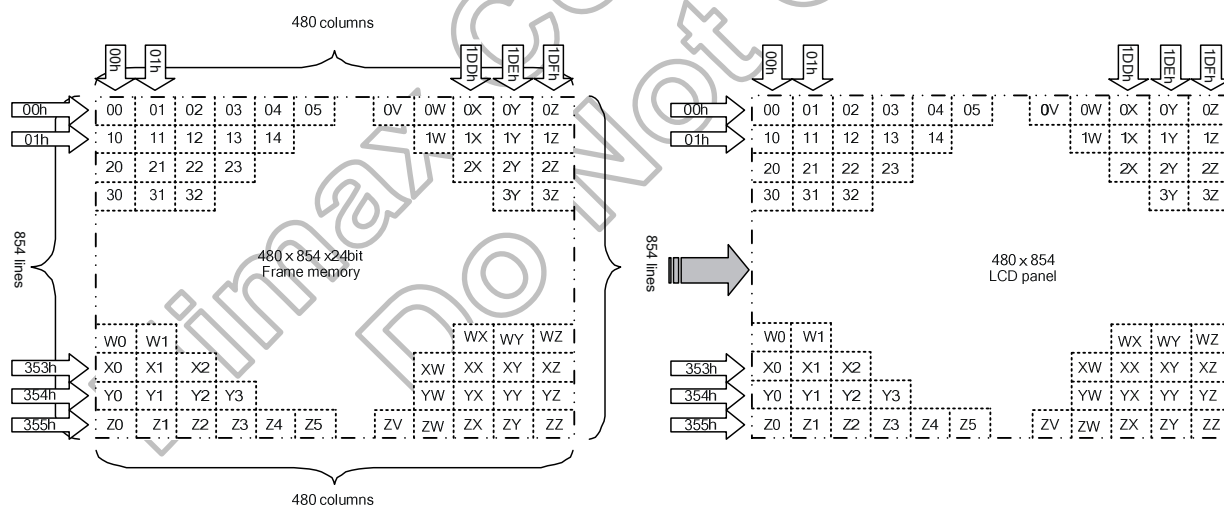


Figure 5.6: 480RGB x 854 resolution

Example: (1) 480RGBx800 dot display mode.  
 (2) NORON (Normal Display Mode On) instruction (R13h).  
 (3) SC=0x000h, EC=0x1DFh (R2Ah) and SP=0x000h, EP=0x31Fh (R2Bh), ML=0.

| GRAM | 000h               | 001h               | ----- | 1DEh               | 1DFh               |
|------|--------------------|--------------------|-------|--------------------|--------------------|
|      | DB---DB<br>23 ---0 | DB---DB<br>23 ---0 | ----- | DB---DB<br>23 ---0 | DB---DB<br>23 ---0 |
| 000h | 000000H            | 000001H            | ----- | 0001DEH            | 0001DFH            |
| 001h | 001000H            | 001001H            | ----- | 0011DEH            | 0011DFH            |
| 002h | 002000H            | 002001H            | ----- | 0021DEH            | 0021DFH            |
| 003h | 003000H            | 003001H            | ----- | 0031DEH            | 0031DFH            |
| 004h | 004000H            | 004001H            | ----- | 0041DEH            | 0041DFH            |
| 005h | 005000H            | 005001H            | ----- | 0051DEH            | 0051DFH            |
| ⋮    | ⋮                  | ⋮                  | ----- | ⋮                  | ⋮                  |
| 31Ah | 31A000H            | 31A001H            | ----- | 31A1DEH            | 31A1DFH            |
| 31Bh | 31B000H            | 31B001H            | ----- | 31B1DEH            | 31B1DFH            |
| 31Ch | 31C000H            | 31C001H            | ----- | 31C1DEH            | 31C1DFH            |
| 31Dh | 31D000H            | 31D001H            | ----- | 31D1DEH            | 31D1DFH            |
| 31Eh | 31E000H            | 31E001H            | ----- | 31E1DEH            | 31E1DFH            |
| 31Fh | 31F000H            | 31F001H            | ----- | 31F1DEH            | 31F1DFH            |

Table 5.10: 480RGB x 800 resolution (SRAM assignment)

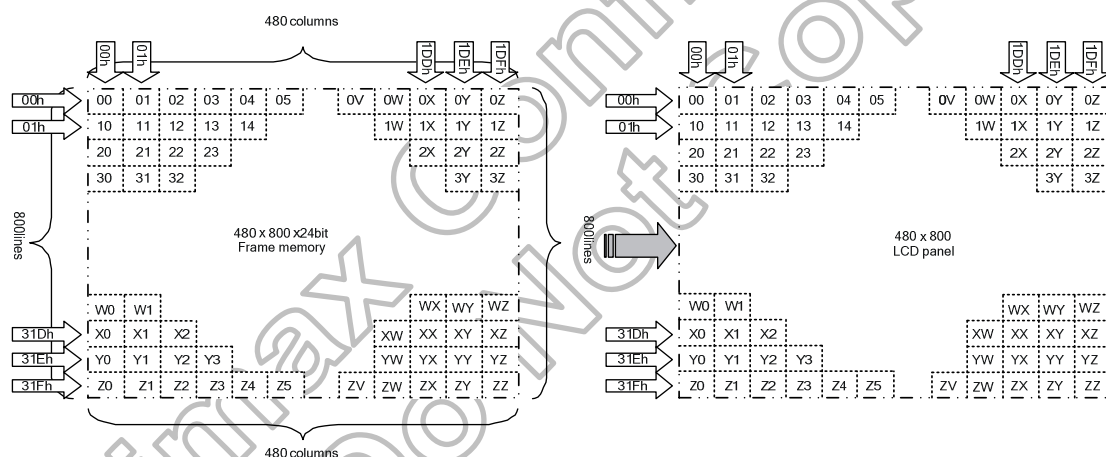


Figure 5.7: 480RGB x 800 resolution



- Example: (1) 480RGBx640 dot display mode.  
 (2) NORON (Normal Display Mode On) instruction (R13h).  
 (3) SC=0x000h, EC=0x1DFh (R2Ah) and SP=0x000h, EP=0x27Fh (R2Bh), ML=0.

| GRAM | 000h<br>DB---DB<br>23 ---0 | 001h<br>DB---DB<br>23 ---0 | -----<br>-----<br>----- | 1DEh<br>DB---DB<br>23 ---0 | 1DFh<br>DB---DB<br>23 ---0 |
|------|----------------------------|----------------------------|-------------------------|----------------------------|----------------------------|
| 000h | 000000H                    | 000001H                    | -----                   | 0001DEH                    | 0001DFH                    |
| 001h | 001000H                    | 001001H                    | -----                   | 0011DEH                    | 0011DFH                    |
| 002h | 002000H                    | 002001H                    | -----                   | 0021DEH                    | 0021DFH                    |
| 003h | 003000H                    | 003001H                    | -----                   | 0031DEH                    | 0031DFH                    |
| 004h | 004000H                    | 004001H                    | -----                   | 0041DEH                    | 0041DFH                    |
| 005h | 005000H                    | 005001H                    | -----                   | 0051DEH                    | 0051DFH                    |
| ⋮    | ⋮                          | ⋮                          | -----                   | ⋮                          | ⋮                          |
| 27Ah | 27A000H                    | 27A001H                    | -----                   | 27A1DEH                    | 27A1DFH                    |
| 27Bh | 27B000H                    | 27B001H                    | -----                   | 27B1DEH                    | 27B1DFH                    |
| 27Ch | 27C000H                    | 27C001H                    | -----                   | 27C1DEH                    | 27C1DFH                    |
| 27Dh | 27D000H                    | 27D001H                    | -----                   | 27D1DEH                    | 27D1DFH                    |
| 27Eh | 27E000H                    | 27E001H                    | -----                   | 27E1DEH                    | 27E1DFH                    |
| 27Fh | 27F000H                    | 27F001H                    | -----                   | 27F1DEH                    | 27F1DFH                    |

Table 5.11: 480RGB x 640 resolution (SRAM assignment)

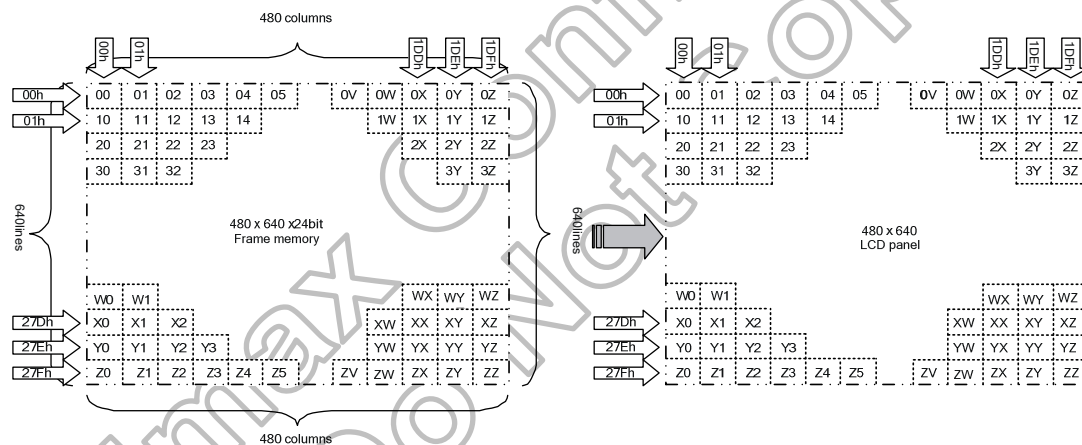


Figure 5.8: 480RGB x 640 resolution

- Example: (1) 360RGBx640 dot display mode.  
 (2) NORON (Normal Display Mode On) instruction (R13h).  
 (3) SC=0x000h, EC=0x167h (R2Ah) and SP=0x000h, EP=0x27Fh (R2Bh), ML=0.

| GRAM | 000h<br>DB---DB<br>23 ---0 | 001h<br>DB---DB<br>23 ---0 | -----<br>-----<br>----- | 166h<br>DB---DB<br>23 ---0 | 167h<br>DB---DB<br>23 ---0 |
|------|----------------------------|----------------------------|-------------------------|----------------------------|----------------------------|
| 000h | 000000H                    | 000001H                    | -----                   | 000166H                    | 000167H                    |
| 001h | 001000H                    | 001001H                    | -----                   | 001166H                    | 001167H                    |
| 002h | 002000H                    | 002001H                    | -----                   | 002166H                    | 002167H                    |
| 003h | 003000H                    | 003001H                    | -----                   | 003166H                    | 003167H                    |
| 004h | 004000H                    | 004001H                    | -----                   | 004166H                    | 004167H                    |
| 005h | 005000H                    | 005001H                    | -----                   | 005166H                    | 005167H                    |
| ⋮    | ⋮                          | ⋮                          | -----                   | ⋮                          | ⋮                          |
| 27Ah | 27A000H                    | 27A001H                    | -----                   | 27A166H                    | 27A167H                    |
| 27Bh | 27B000H                    | 27B001H                    | -----                   | 27B166H                    | 27B167H                    |
| 27Ch | 27C000H                    | 27C001H                    | -----                   | 27C166H                    | 27C167H                    |
| 27Dh | 27D000H                    | 27D001H                    | -----                   | 27D166H                    | 27D167H                    |
| 27Eh | 27E000H                    | 27E001H                    | -----                   | 27E166H                    | 27E167H                    |
| 27Fh | 27F000H                    | 27F001H                    | -----                   | 27F166H                    | 27F167H                    |

Table 5.12: 360RGB x 640 resolution (SRAM assignment)

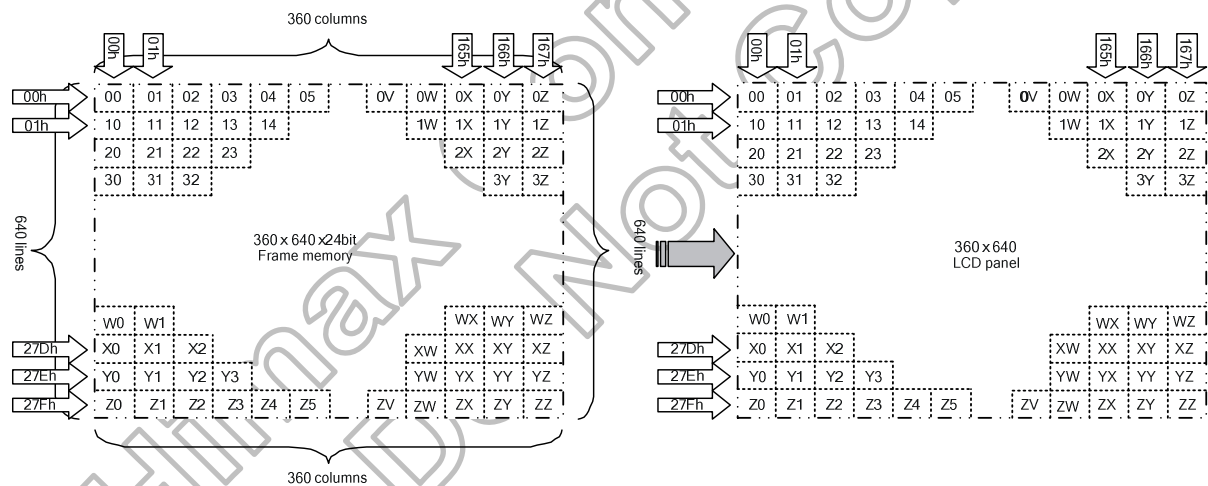


Figure 5.9: 360RGB x 640 resolution

Example: (1) 480RGBx720 dot display mode.  
 (2) NORON (Normal Display Mode On) instruction (R13h).  
 (3) SC=0x000h, EC=0x1DFh (R2Ah) and SP=0x000h, EP=0x2CFh (R2Bh), ML=0.

| GRAM | 000h               | 001h               | ----- | 1DEh               | 1DFh               |
|------|--------------------|--------------------|-------|--------------------|--------------------|
|      | DB---DB<br>23 ---0 | DB---DB<br>23 ---0 | ----- | DB---DB<br>23 ---0 | DB---DB<br>23 ---0 |
| 000h | 000000H            | 000001H            | ----- | 0001DEH            | 0001DFH            |
| 001h | 001000H            | 001001H            | ----- | 0011DEH            | 0011DFH            |
| 002h | 002000H            | 002001H            | ----- | 0021DEH            | 0021DFH            |
| 003h | 003000H            | 003001H            | ----- | 0031DEH            | 0031DFH            |
| 004h | 004000H            | 004001H            | ----- | 0041DEH            | 0041DFH            |
| 005h | 005000H            | 005001H            | ----- | 0051DEH            | 0051DFH            |
| ⋮    | ⋮                  | ⋮                  | ----- | ⋮                  | ⋮                  |
| 2CAh | 2CA000H            | 2CA001H            | ----- | 2CA1DEH            | 2CA1DFH            |
| 2CBh | 2CB000H            | 2CB001H            | ----- | 2CB1DEH            | 2CB1DFH            |
| 2CCh | 2CC000H            | 2CC001H            | ----- | 2CC1DEH            | 2CC1DFH            |
| 2CDh | 2CD000H            | 2CD001H            | ----- | 2CD1DEH            | 2CD1DFH            |
| 2CEh | 2CE000H            | 2CE001H            | ----- | 2CE1DEH            | 2CE1DFH            |
| 2CFh | 2CF000H            | 2CF001H            | ----- | 2CF1DEH            | 2CF1DFH            |

Table 5.13: 480RGB x 720 resolution (SRAM assignment)

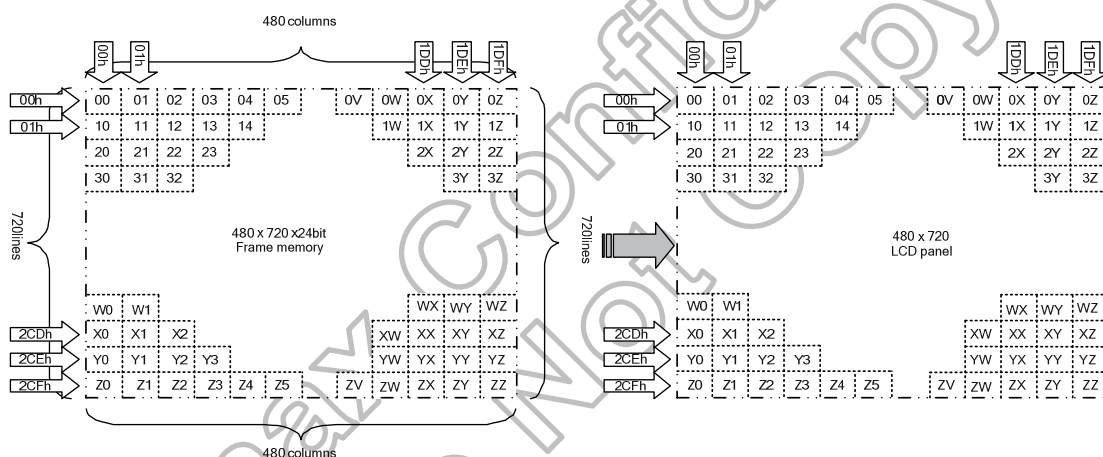


Figure 5.10: 480RGB x 720 resolution

## 5.5.2 Vertical scrolling display

The vertical scrolling display is specified by VSCRDEF instruction (R33h) and VSCRADD instruction (R37h).

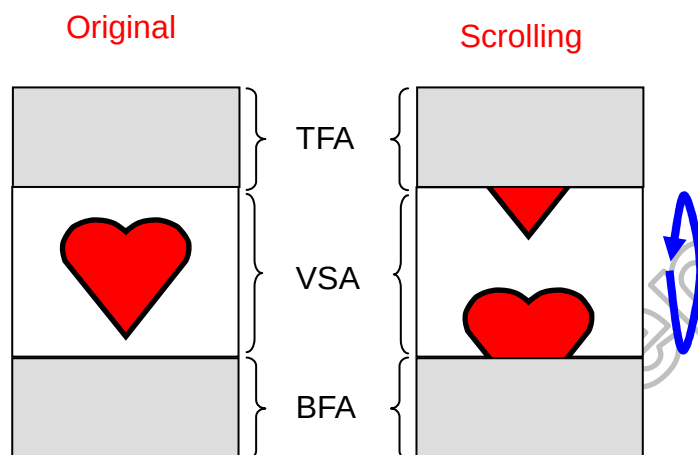


Figure 5.11: Vertical scrolling

When Vertical Scrolling Definition Parameters (TFA+VSA+BFA)=Panel total scan lines. In this case, scrolling is applied as shown below.

### 5.5.2.1 Example: 480RGB X 864

When Vertical Scrolling Definition Parameters (TFA+VSA+BFA)=864. In this case, scrolling is applied as shown below.

Example (1) TFA=2, VSA=862, BFA=0 when MADCTL B4=0

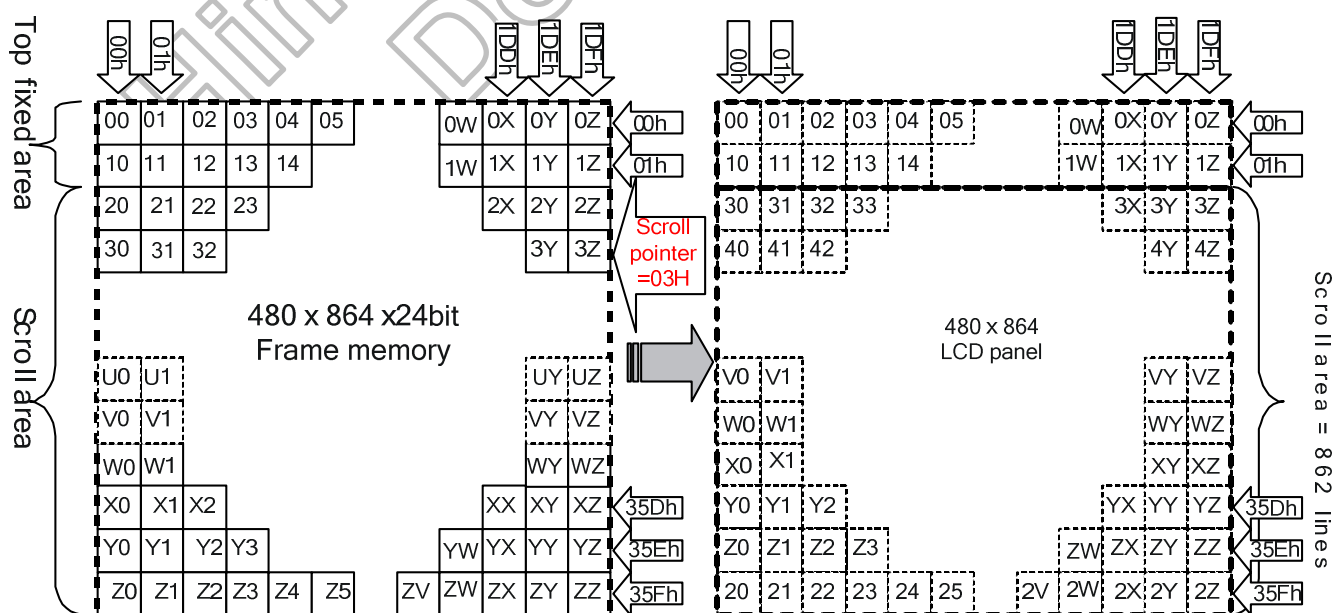


Figure 5.12: Memory map of vertical scrolling 1

Example (2) TFA=2, VSA=860, BFA=2 when MADCTL B4=0

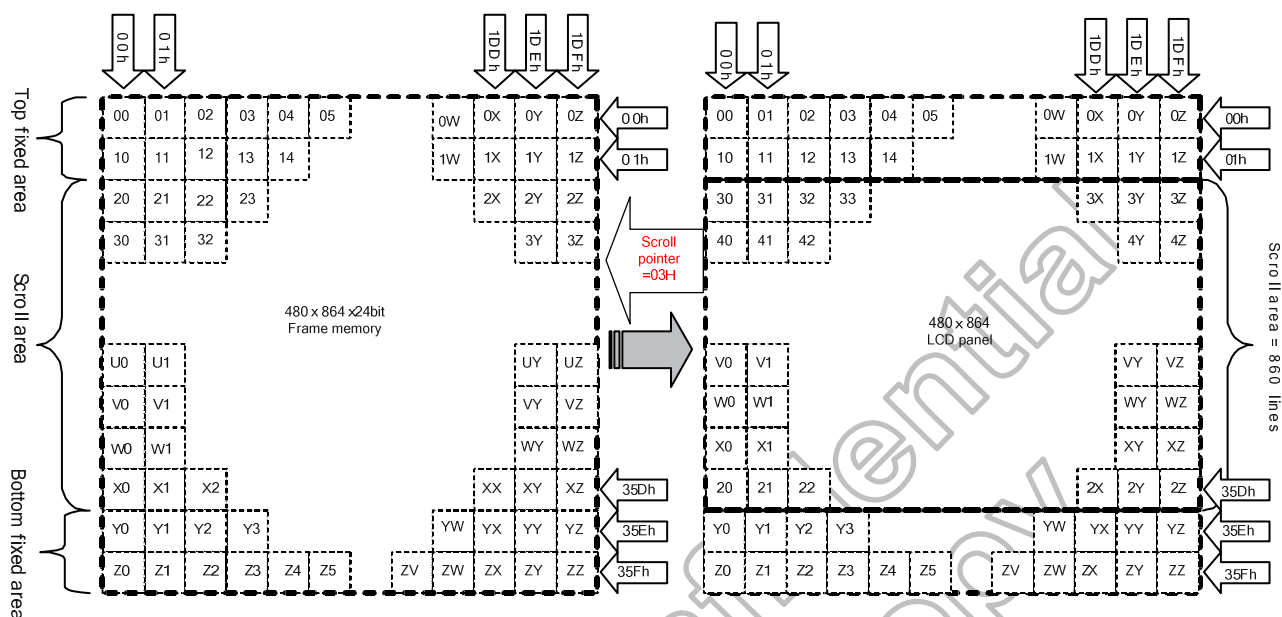


Figure 5.13: Memory map of vertical scrolling 2

### 5.5.2.2 Vertical scroll example

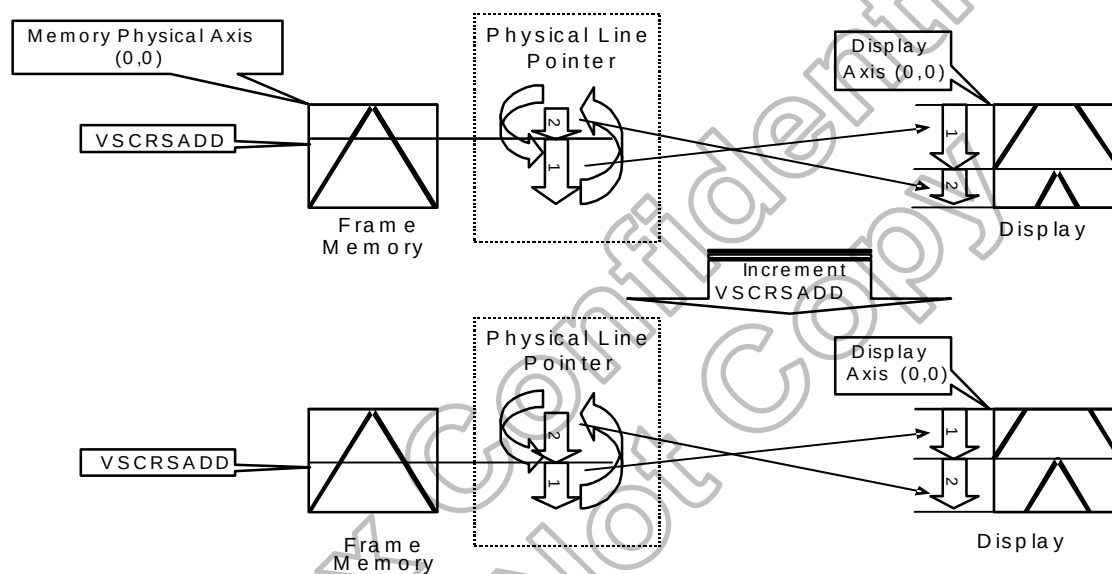
There are 2 types of vertical scrolling, which are determined by the commands “Vertical Scrolling Definition” (33h) and “Vertical Scrolling Start Address” (37h).

Case 1: TFA + VSA + BFA≠864

Do not set TFA + VSA + BFA≠864. In that case, unexpected picture will be shown.

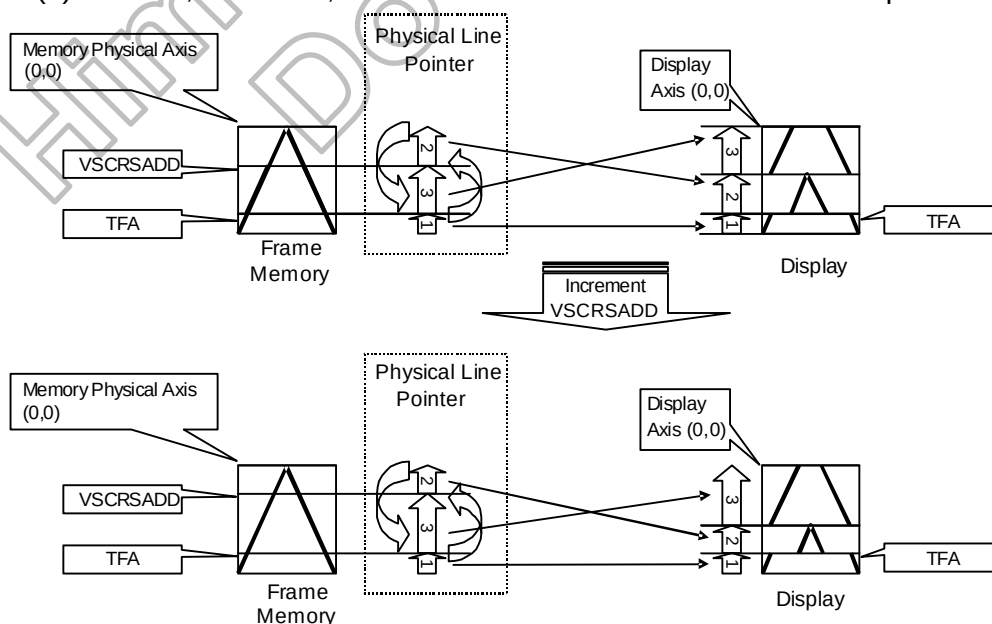
Case 2: TFA + VSA + BFA=864 (Scrolling)

Example (1) When TFA=0, VSA=864, BFA=0 and VSCRSADD=40. MADCTL parameter B4=“0”



**Figure 5.14: Vertical scroll example 1**

Example (2) TFA=30, VSA=834, BFA=0 and VSCRSADD =80. MADCTRL parameter B4=“1”



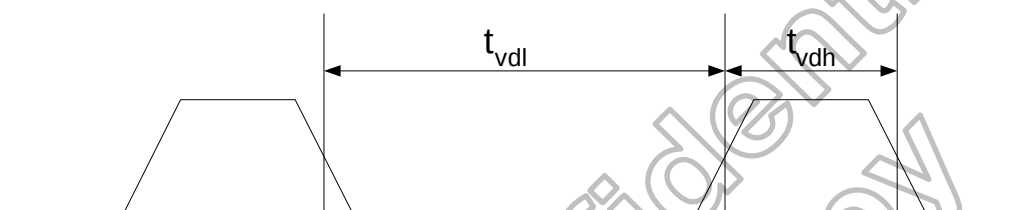
**Figure 5.15: Vertical scroll example 2**

### 5.5.3 Tearing effect output line

The Tearing Effect output line supplies to the MPU a Panel synchronization signal. This signal can be enabled or disabled by the Tearing Effect Line Off & On commands. The mode of the Tearing Effect signal is defined by the parameter of the Tearing Effect Line On command. The signal can be used by the MPU to synchronize Frame Memory Writing when displaying video images.

#### Tearing Effect Line Modes

**Mode 1**, the Tearing Effect Output signal consists of V-Blanking Information only:



**Figure 5.16: Tearing effect output line-mode 1**

tvdh=The LCD display is not updated from the Frame Memory

tvdL=The LCD display is updated from the Frame Memory (except Invisible Line – see below)

**Mode 2**, the Tearing Effect Output signal consists of V-Blanking and H-Blanking Information, there is one V-sync and N H-sync pulses per field.

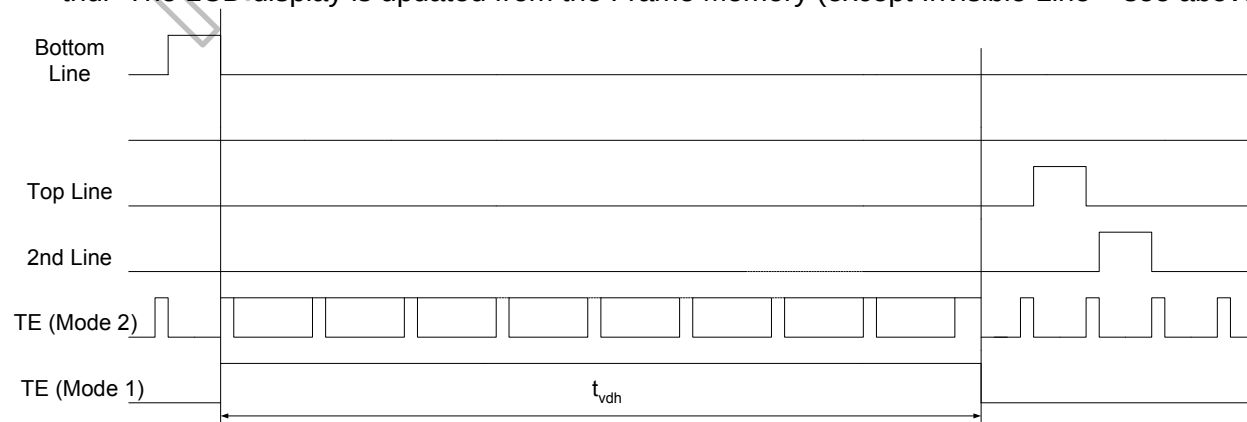
N: If RES\_SEL [2:0] set to = 3'b000, the resolution is 480 RGB X 864, the N=864.



**Figure 5.17: Tearing effect output line-mode 2**

thdh=The LCD display is not updated from the Frame Memory

thdL=The LCD display is updated from the Frame Memory (except Invisible Line – see above)



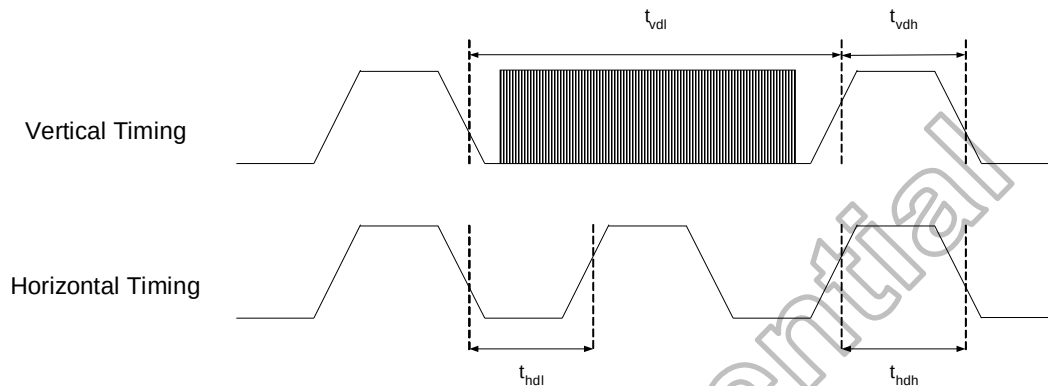
**Note:** During Sleep In Mode, the Tearing Output Pin is active Low.

**Figure 5.18: Tearing effect output line-timing diagram**



### 5.5.3.1 Tearing effect line timing

The Tearing Effect signal is described below:



**Figure 5.19: Tearing effect output line –tearing effect line timing**

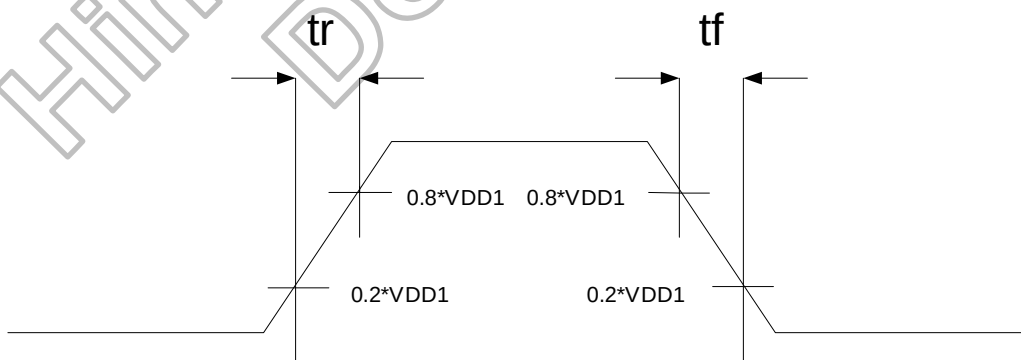
Idle Mode Off (Resolution 480x800 RGB, Frame Rate = 60.5 Hz)

| Symbol           | Parameter                       | Min. | Max. | Unit |
|------------------|---------------------------------|------|------|------|
| t <sub>vdl</sub> | Vertical Timing Low Duration    | 15   | -    | ms   |
| t <sub>vdh</sub> | Vertical Timing High Duration   | 1000 | -    | us   |
| t <sub>hdl</sub> | Horizontal Timing Low Duration  | 18   | -    | us   |
| t <sub>hdh</sub> | Horizontal Timing High Duration | 0.13 | 500  | us   |
| t <sub>r</sub>   | Rise time                       | -    | 15   | ns   |
| t <sub>f</sub>   | Fall time                       | -    | 15   | ns   |

**Note:** The timings in Table 5.13 apply when MADCTL ML=0 and ML=1

**Table 5.14: AC characteristics of tearing effect signal**

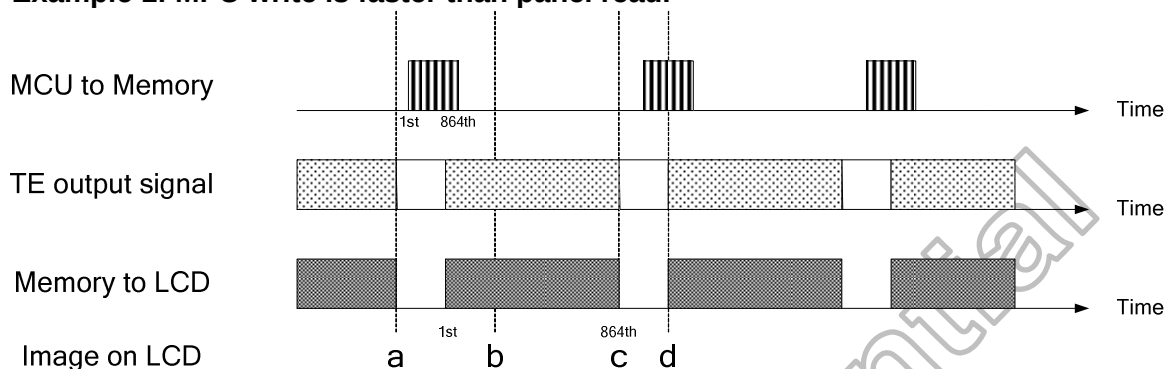
The signal's rise and fall times (t<sub>f</sub>, t<sub>r</sub>) are stipulated to be equal to or less than 15ns.



**Figure 5.20: Tearing effect output line–definition of t<sub>f</sub>, t<sub>r</sub>**

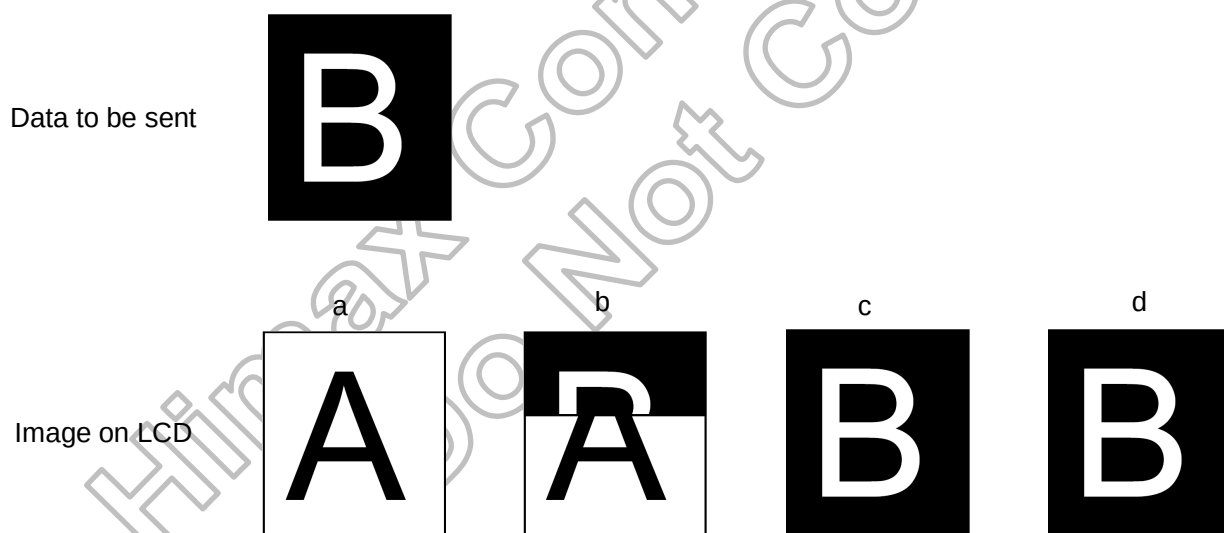
The Tearing Effect Output Line is fed back to the MPU and should be used as shown below to avoid Tearing Effect.

**Example 1: MPU write is faster than panel read.**



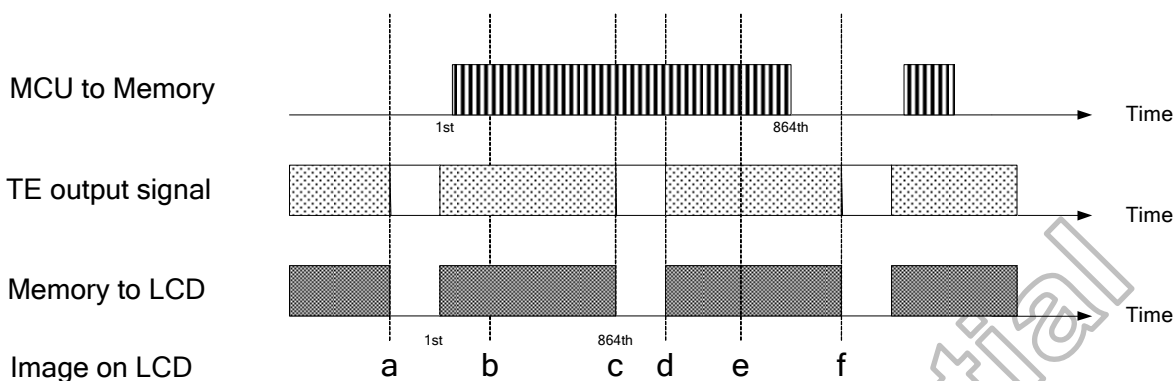
**Figure 5.21: Tearing effect output line-example 1 (Timing)**

Data write to Frame Memory is now synchronized to the Panel Scan. It should be written during the vertical sync pulse of the Tearing Effect Output Line. This ensures that data is always written ahead of the panel scan and each Panel Frame refresh has a complete new image:



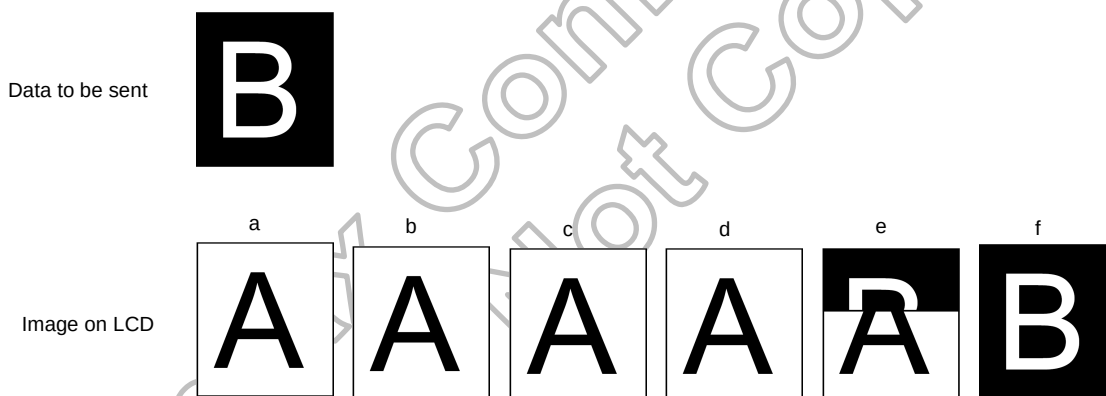
**Figure 5.22: Tearing effect output line-example 1 (Image)**

**Example 2: MPU write is slower than panel read.**



**Figure 5.23: Tearing effect output line-example 2 (Timing)**

The MPU to Frame Memory write begins just after Panel Read has commenced i.e. after one horizontal sync pulse of the Tearing Effect Output Line. This allows time for the image to download behind the Panel Read pointer and finishing download during the subsequent Frame before the Read Pointer "catches" the MPU to Frame memory write position.



**Figure 5.24: Tearing effect output line-example 2 (Image)**

## 5.6 Color depth conversion

### 5.6.1 Color depth conversion Look-up tables

| R input (5-bit)<br>16-bit / pixel<br>mode<br>65,536<br>colours | R input (6-bit)<br>18-bit / pixel<br>mode<br>262,144<br>colours | R output (8-bit)<br>24-bit / pixel<br>mode<br>16,777,216<br>colours | RGBSET<br>Parameter |
|----------------------------------------------------------------|-----------------------------------------------------------------|---------------------------------------------------------------------|---------------------|
| 00000                                                          | 000000                                                          | R007 R006R005 R004R003R002R001R000                                  | 1                   |
| 00001                                                          | 000001                                                          | R017R016R015R014R013R012R011R010                                    | 2                   |
| 00010                                                          | 000010                                                          | R027R026R025R024R023R022R021R020                                    | 3                   |
| 00011                                                          | 000011                                                          | R037R036R035R034R033R032R031R030                                    | 4                   |
| 00100                                                          | 000100                                                          | R047R046R045R044R043R042R041R040                                    | 5                   |
| 00101                                                          | 000101                                                          | R057R056R055R054R053R052R051R050                                    | 6                   |
| 00110                                                          | 000110                                                          | R067R066R065R064R063R062R061R060                                    | 7                   |
| 00111                                                          | 000111                                                          | R077R076R075R074R073R072R071R070                                    | 8                   |
| 01000                                                          | 001000                                                          | R087R086R085R084R083R082R081R080                                    | 9                   |
| 01001                                                          | 001001                                                          | R097R096R095R094R093R092R091R090                                    | 10                  |
| 01010                                                          | 001010                                                          | R107R106R105R104R103R102R101R100                                    | 11                  |
| 01011                                                          | 001011                                                          | R117R116R115R114R113R112R111R110                                    | 12                  |
| 01100                                                          | 001100                                                          | R127R126R125R124R123R122R121R120                                    | 13                  |
| 01101                                                          | 001101                                                          | R137R136R135R134R133R132R131R130                                    | 14                  |
| 01110                                                          | 001110                                                          | R147R146R145R144R143R142R141R140                                    | 15                  |
| 01111                                                          | 001111                                                          | R157R156R155R154R153R152R151R150                                    | 16                  |
| 10000                                                          | 010000                                                          | R167R166R165R164R163R162R161R160                                    | 17                  |
| 10001                                                          | 010001                                                          | R177R176R175R174R173R172R171R170                                    | 18                  |
| 10010                                                          | 010010                                                          | R187R186R185R184R183R182R181R180                                    | 19                  |
| 10011                                                          | 010011                                                          | R197R196R195R194R193R192R191R190                                    | 20                  |
| 10100                                                          | 010100                                                          | R207R206R205R204R203R202R201R200                                    | 21                  |
| 10101                                                          | 010101                                                          | R217R216R215R214R213R212R211R210                                    | 22                  |
| 10110                                                          | 010110                                                          | R227R226R225R224R223R222R221R220                                    | 23                  |
| 10111                                                          | 010111                                                          | R237R236R235R234R233R232R231R230                                    | 24                  |
| 11000                                                          | 011000                                                          | R247R246R245R244R243R242R241R240                                    | 25                  |
| 11001                                                          | 011001                                                          | R257R256R255R254R253R252R251R250                                    | 26                  |
| 11010                                                          | 011010                                                          | R267R266R265R264R263R262R261R260                                    | 27                  |
| 11011                                                          | 011011                                                          | R277R276R275R274R273R272R271R270                                    | 28                  |
| 11100                                                          | 011100                                                          | R287R286R285R284R283R282R281R280                                    | 29                  |
| 11101                                                          | 011101                                                          | R297R296R295R294R293R292R291R290                                    | 30                  |
| 11110                                                          | 011110                                                          | R307R306R305R304R303R302R301R300                                    | 31                  |
| 11111                                                          | 011111                                                          | R317R316R315R314R313R312R311R310                                    | 32                  |

Table 5.15: Look-up tables-1

| R input (5-bit)<br>16-bit / pixel<br>mode<br>65,536<br>colours | R input (6-bit)<br>18-bit / pixel<br>mode<br>262,144<br>colours | R output (8-bit)<br>24-bit / pixel<br>mode<br>16,777,216<br>colours | RGBSET<br>Parameter |
|----------------------------------------------------------------|-----------------------------------------------------------------|---------------------------------------------------------------------|---------------------|
| No Input                                                       | 100000                                                          | R327 R326R325 R324R323R322R321R320                                  | 33                  |
| No Input                                                       | 100001                                                          | R337R336R335R334R333R332R331R330                                    | 34                  |
| No Input                                                       | 100010                                                          | R347R346R345R344R343R342R341R340                                    | 35                  |
| No Input                                                       | 100011                                                          | R357R356R355R354R353R352R351R350                                    | 36                  |
| No Input                                                       | 100100                                                          | R367R366R365R364R363R362R361R360                                    | 37                  |
| No Input                                                       | 100101                                                          | R377R376R375R374R373R372R371R370                                    | 38                  |
| No Input                                                       | 100110                                                          | R387R386R385R384R383R382R381R380                                    | 39                  |
| No Input                                                       | 100111                                                          | R397R396R395R394R393R392R391R390                                    | 40                  |
| No Input                                                       | 101000                                                          | R407R406R405R404R403R402R401R400                                    | 41                  |
| No Input                                                       | 101001                                                          | R417R416R415R414R413R412R411R410                                    | 42                  |
| No Input                                                       | 101010                                                          | R427R426R425R424R423R422R421R420                                    | 43                  |
| No Input                                                       | 101011                                                          | R437R436R435R434R433R432R431R430                                    | 44                  |
| No Input                                                       | 101100                                                          | R447R446R445R444R443R442R441R440                                    | 45                  |
| No Input                                                       | 101101                                                          | R457R456R455R454R453R452R451R450                                    | 46                  |
| No Input                                                       | 101110                                                          | R467R466R465R464R463R462R461R460                                    | 47                  |
| No Input                                                       | 101111                                                          | R477R476R475R474R473R472R471R470                                    | 48                  |
| No Input                                                       | 110000                                                          | R487R486R485R484R483R482R481R480                                    | 49                  |
| No Input                                                       | 110001                                                          | R497R496R495R494R493R492R491R490                                    | 50                  |
| No Input                                                       | 110010                                                          | R507R506R505R504R503R502R501R500                                    | 51                  |
| No Input                                                       | 110011                                                          | R517R516R515R514R513R512R511R510                                    | 52                  |
| No Input                                                       | 110100                                                          | R527R526R525R524R523R522R521R520                                    | 53                  |
| No Input                                                       | 110101                                                          | R537R536R535R534R533R532R531R530                                    | 54                  |
| No Input                                                       | 110110                                                          | R547R546R545R544R543R542R541R540                                    | 55                  |
| No Input                                                       | 110111                                                          | R557R556R555R554R553R552R551R550                                    | 56                  |
| No Input                                                       | 111000                                                          | R567R566R565R564R563R562R561R560                                    | 57                  |
| No Input                                                       | 111001                                                          | R577R576R575R574R573R572R571R570                                    | 58                  |
| No Input                                                       | 111010                                                          | R587R586R585R584R583R582R581R580                                    | 59                  |
| No Input                                                       | 111011                                                          | R597R596R595R594R593R592R591R590                                    | 60                  |
| No Input                                                       | 111100                                                          | R607R606R605R604R603R602R601R600                                    | 61                  |
| No Input                                                       | 111101                                                          | R617R616R615R614R613R612R611R610                                    | 62                  |
| No Input                                                       | 111110                                                          | R627R626R625R624R623R622R621R620                                    | 63                  |
| No Input                                                       | 111111                                                          | R637R636R635R634R633R632R631R630                                    | 64                  |

Table 5.16: Look-up tables-2

| G input (5-bit)<br>16-bit / pixel<br>mode<br>65,536<br>colours | G input (6-bit)<br>18-bit / pixel<br>mode<br>262,144<br>colours | G output (8-bit)<br>24-bit / pixel<br>mode<br>16,777,216<br>colours | RGBSET<br>Parameter |
|----------------------------------------------------------------|-----------------------------------------------------------------|---------------------------------------------------------------------|---------------------|
| 000000                                                         | 000000                                                          | G007 G006G005 G004G003G002G001G000                                  | 65                  |
| 000001                                                         | 000001                                                          | G017G016G015G014G013G012G011G010                                    | 66                  |
| 000010                                                         | 000010                                                          | G027G026G025G024G023G022G021G020                                    | 67                  |
| 000011                                                         | 000011                                                          | G037G036G035G034G033G032G031G030                                    | 68                  |
| 000100                                                         | 000100                                                          | G047G046G045G044G043G042G041G040                                    | 69                  |
| 000101                                                         | 000101                                                          | G057G056G055G054G053G052G051G050                                    | 70                  |
| 000110                                                         | 000110                                                          | G067G066G065G064G063G062G061G060                                    | 71                  |
| 000111                                                         | 000111                                                          | G077G076G075G074G073G072G071G070                                    | 72                  |
| 001000                                                         | 001000                                                          | G087G086G085G084G083G082G081G080                                    | 73                  |
| 001001                                                         | 001001                                                          | G097G096G095G094G093G092G091G090                                    | 74                  |
| 001010                                                         | 001010                                                          | G107G106G105G104G103G102G101G100                                    | 75                  |
| 001011                                                         | 001011                                                          | G117G116G115G114G113G112G111G110                                    | 76                  |
| 001100                                                         | 001100                                                          | G127G126G125G124G123G122G121G120                                    | 77                  |
| 001101                                                         | 001101                                                          | G137G136G135G134G133G132G131G130                                    | 78                  |
| 001110                                                         | 001110                                                          | G147G146G145G144G143G142G141G140                                    | 79                  |
| 001111                                                         | 001111                                                          | G157G156G155G154G153G152G151G150                                    | 80                  |
| 010000                                                         | 010000                                                          | G167G166G165G164G163G162G161G160                                    | 81                  |
| 010001                                                         | 010001                                                          | G177G176G175G174G173G172G171G170                                    | 82                  |
| 010010                                                         | 010010                                                          | G187G186G185G184G183G182G181G180                                    | 83                  |
| 010011                                                         | 010011                                                          | G197G196G195G194G193G192G191G190                                    | 84                  |
| 010100                                                         | 010100                                                          | G207G206G205G204G203G202G201G200                                    | 85                  |
| 010101                                                         | 010101                                                          | G217G216G215G214G213G212G211G210                                    | 86                  |
| 010110                                                         | 010110                                                          | G227G226G225G224G223G222G221G220                                    | 87                  |
| 010111                                                         | 010111                                                          | G237G236G235G234G233G232G231G230                                    | 88                  |
| 011000                                                         | 011000                                                          | G247G246G245G244G243G242G241G240                                    | 89                  |
| 011001                                                         | 011001                                                          | G257G256G255G254G253G252G251G250                                    | 90                  |
| 011010                                                         | 011010                                                          | G267G266G265G264G263G262G261G260                                    | 91                  |
| 011011                                                         | 011011                                                          | G277G276G275G274G273G272G271G270                                    | 92                  |
| 011100                                                         | 011100                                                          | G287G286G285G284G283G282G281G280                                    | 93                  |
| 011101                                                         | 011101                                                          | G297G296G295G294G293G292G291G290                                    | 94                  |
| 011110                                                         | 011110                                                          | G307G306G305G304G303G302G301G300                                    | 95                  |
| 011111                                                         | 011111                                                          | G317G316G315G314G313G312G311G310                                    | 96                  |

Table 5.17: Look-up tables-3

| G input (5-bit)<br>16-bit / pixel<br>mode<br>65,536<br>colours | G input (6-bit)<br>18-bit / pixel<br>mode<br>262,144<br>colours | G output (8-bit)<br>24-bit / pixel<br>mode<br>16,777,216<br>colours | RGBSET<br>Parameter |
|----------------------------------------------------------------|-----------------------------------------------------------------|---------------------------------------------------------------------|---------------------|
| 100000                                                         | 100000                                                          | G327 G326G325 G324G323G322G321G320                                  | 97                  |
| 100001                                                         | 100001                                                          | G337G336G335G334G333G332G331G330                                    | 98                  |
| 100010                                                         | 100010                                                          | G347G346G345G344G343G342G341G340                                    | 99                  |
| 100011                                                         | 100011                                                          | G357G356G355G354G353G352G351G350                                    | 100                 |
| 100100                                                         | 100100                                                          | G367G366G365G364G363G362G361G360                                    | 101                 |
| 100101                                                         | 100101                                                          | G377G376G375G374G373G372G371G370                                    | 102                 |
| 100110                                                         | 100110                                                          | G387G386G385G384G383G382G381G380                                    | 103                 |
| 100111                                                         | 100111                                                          | G397G396G395G394G393G392G391G390                                    | 104                 |
| 101000                                                         | 101000                                                          | G407G406G405G404G403G402G401G400                                    | 105                 |
| 101001                                                         | 101001                                                          | G417G416G415G414G413G412G411G410                                    | 106                 |
| 101010                                                         | 101010                                                          | G427G426G425G424G423G422G421G420                                    | 107                 |
| 101011                                                         | 101011                                                          | G437G436G435G434G433G432G431G430                                    | 108                 |
| 101100                                                         | 101100                                                          | G447G446G445G444G443G442G441G440                                    | 109                 |
| 101101                                                         | 101101                                                          | G457G456G455G454G453G452G451G450                                    | 110                 |
| 101110                                                         | 101110                                                          | G467G466G465G464G463G462G461G460                                    | 111                 |
| 101111                                                         | 101111                                                          | G477G476G475G474G473G472G471G470                                    | 112                 |
| 110000                                                         | 110000                                                          | G487 G486G485 G484G483G482G481G480                                  | 113                 |
| 110001                                                         | 110001                                                          | G497G496G495G494G493G492G491G490                                    | 114                 |
| 110010                                                         | 110010                                                          | G507G506G505G504G503G502G501G500                                    | 115                 |
| 110011                                                         | 110011                                                          | G517G516G515G514G513G512G511G510                                    | 116                 |
| 110100                                                         | 110100                                                          | G527G526G525G524G523G522G521G520                                    | 117                 |
| 110101                                                         | 110101                                                          | G537G536G535G534G533G532G531G530                                    | 118                 |
| 110110                                                         | 110110                                                          | G547G546G545G544G543G542G541G540                                    | 119                 |
| 110111                                                         | 110111                                                          | G557G556G555G554G553G552G551G550                                    | 120                 |
| 111000                                                         | 111000                                                          | G567G566G565G564G563G562G561G560                                    | 121                 |
| 111001                                                         | 111001                                                          | G577G576G575G574G573G572G571G570                                    | 122                 |
| 111010                                                         | 111010                                                          | G587G586G585G584G583G582G581G580                                    | 123                 |
| 111011                                                         | 111011                                                          | G597G596G595G594G593G592G591G590                                    | 124                 |
| 111100                                                         | 111100                                                          | G607G606G605G604G603G602G601G600                                    | 125                 |
| 111101                                                         | 111101                                                          | G617G616G615G614G613G612G611G610                                    | 126                 |
| 111110                                                         | 111110                                                          | G627G626G625G624G623G622G621G620                                    | 127                 |
| 111111                                                         | 111111                                                          | G637G636G635G634G633G632G631G630                                    | 128                 |

Table 5.18: Look-up tables-4



| B input (5-bit)<br>16-bit / pixel<br>mode<br>65,536<br>colours | B input (6-bit)<br>18-bit / pixel<br>mode<br>262,144<br>colours | B output (8-bit)<br>24-bit / pixel<br>mode<br>16,777,216<br>colours | RGBSET<br>Parameter |
|----------------------------------------------------------------|-----------------------------------------------------------------|---------------------------------------------------------------------|---------------------|
| 00000                                                          | 000000                                                          | B007 B006B005 B004B003B002B001B000                                  | 129                 |
| 00001                                                          | 000001                                                          | B017 B016B015B014B013B012B011B010                                   | 130                 |
| 00010                                                          | 000010                                                          | B027 B026B025B024B023B022B021B020                                   | 131                 |
| 00011                                                          | 000011                                                          | B037 B036B035B034B033B032B031B030                                   | 132                 |
| 00100                                                          | 000100                                                          | B047 B046B045B044B043B042B041B040                                   | 133                 |
| 00101                                                          | 000101                                                          | B057 B056B055B054B053B052B051B050                                   | 134                 |
| 00110                                                          | 000110                                                          | B067 B066B065B064B063B062B061B060                                   | 135                 |
| 00111                                                          | 000111                                                          | B077 B076B075B074B073B072B071B070                                   | 136                 |
| 01000                                                          | 001000                                                          | B087 B086B085B084B083B082B081B080                                   | 137                 |
| 01001                                                          | 001001                                                          | B097 B096B095B094B093B092B091B090                                   | 138                 |
| 01010                                                          | 001010                                                          | B107 B106B105B104B103B102B101B100                                   | 139                 |
| 01011                                                          | 001011                                                          | B117 B116B115B114B113B112B111B110                                   | 140                 |
| 01100                                                          | 001100                                                          | B127 B126B125B124B123B122B121B120                                   | 141                 |
| 01101                                                          | 001101                                                          | B137 B136B135B134B133B132B131B130                                   | 142                 |
| 01110                                                          | 001110                                                          | B147 B146B145B144B143B142B141B140                                   | 143                 |
| 01111                                                          | 001111                                                          | B157 B156B155B154B153B152B151B150                                   | 144                 |
| 10000                                                          | 010000                                                          | B167 B166B165B164B163B162B161B160                                   | 145                 |
| 10001                                                          | 010001                                                          | B177 B176B175B174B173B172B171B170                                   | 146                 |
| 10010                                                          | 010010                                                          | B187 B186B185B184B183B182B181B180                                   | 147                 |
| 10011                                                          | 010011                                                          | B197 B196B195B194B193B192B191B190                                   | 148                 |
| 10100                                                          | 010100                                                          | B207 B206B205B204B203B202B201B200                                   | 149                 |
| 10101                                                          | 010101                                                          | B217 B216B215B214B213B212B211B210                                   | 150                 |
| 10110                                                          | 010110                                                          | B227 B226B225B224B223B222B221B220                                   | 151                 |
| 10111                                                          | 010111                                                          | B237 B236B235B234B233B232B231B230                                   | 152                 |
| 11000                                                          | 011000                                                          | B247 B246B245B244B243B242B241B240                                   | 153                 |
| 11001                                                          | 011001                                                          | B257 B256B255B254B253B252B251B250                                   | 154                 |
| 11010                                                          | 011010                                                          | B267 B266B265B264B263B262B261B260                                   | 155                 |
| 11011                                                          | 011011                                                          | B277 B276B275B274B273B272B271B270                                   | 156                 |
| 11100                                                          | 011100                                                          | B287 B286B285B284B283B282B281B280                                   | 157                 |
| 11101                                                          | 011101                                                          | B297 B296B295B294B293B292B291B290                                   | 158                 |
| 11110                                                          | 011110                                                          | B307 B306B305B304B303B302B301B300                                   | 159                 |
| 11111                                                          | 011111                                                          | B317 B316B315B314B313B312B311B310                                   | 160                 |

Table 5.19: Look-up tables-5

| B input (5-bit)<br>16-bit / pixel<br>mode<br>65,536<br>colours | B input (6-bit)<br>18-bit / pixel<br>mode<br>262,144<br>colours | B output (8-bit)<br>24-bit / pixel<br>mode<br>16,777,216<br>colours                                                                     | RGBSET<br>Parameter |
|----------------------------------------------------------------|-----------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------|---------------------|
| No Input                                                       | 100000                                                          | B <sub>327</sub> B <sub>326</sub> B <sub>325</sub> B <sub>324</sub> B <sub>323</sub> B <sub>322</sub> B <sub>321</sub> B <sub>320</sub> | 161                 |
| No Input                                                       | 100001                                                          | B <sub>337</sub> B <sub>336</sub> B <sub>335</sub> B <sub>334</sub> B <sub>333</sub> B <sub>332</sub> B <sub>331</sub> B <sub>330</sub> | 162                 |
| No Input                                                       | 100010                                                          | B <sub>347</sub> B <sub>346</sub> B <sub>345</sub> B <sub>344</sub> B <sub>343</sub> B <sub>342</sub> B <sub>341</sub> B <sub>340</sub> | 163                 |
| No Input                                                       | 100011                                                          | B <sub>357</sub> B <sub>356</sub> B <sub>355</sub> B <sub>354</sub> B <sub>353</sub> B <sub>352</sub> B <sub>351</sub> B <sub>350</sub> | 164                 |
| No Input                                                       | 100100                                                          | B <sub>367</sub> B <sub>366</sub> B <sub>365</sub> B <sub>364</sub> B <sub>363</sub> B <sub>362</sub> B <sub>361</sub> B <sub>360</sub> | 165                 |
| No Input                                                       | 100101                                                          | B <sub>377</sub> B <sub>376</sub> B <sub>375</sub> B <sub>374</sub> B <sub>373</sub> B <sub>372</sub> B <sub>371</sub> B <sub>370</sub> | 166                 |
| No Input                                                       | 100110                                                          | B <sub>387</sub> B <sub>386</sub> B <sub>385</sub> B <sub>384</sub> B <sub>383</sub> B <sub>382</sub> B <sub>381</sub> B <sub>380</sub> | 167                 |
| No Input                                                       | 100111                                                          | B <sub>397</sub> B <sub>396</sub> B <sub>395</sub> B <sub>394</sub> B <sub>393</sub> B <sub>392</sub> B <sub>391</sub> B <sub>390</sub> | 168                 |
| No Input                                                       | 101000                                                          | B <sub>407</sub> B <sub>406</sub> B <sub>405</sub> B <sub>404</sub> B <sub>403</sub> B <sub>402</sub> B <sub>401</sub> B <sub>400</sub> | 169                 |
| No Input                                                       | 101001                                                          | B <sub>417</sub> B <sub>416</sub> B <sub>415</sub> B <sub>414</sub> B <sub>413</sub> B <sub>412</sub> B <sub>411</sub> B <sub>410</sub> | 170                 |
| No Input                                                       | 101010                                                          | B <sub>427</sub> B <sub>426</sub> B <sub>425</sub> B <sub>424</sub> B <sub>423</sub> B <sub>422</sub> B <sub>421</sub> B <sub>420</sub> | 171                 |
| No Input                                                       | 101011                                                          | B <sub>437</sub> B <sub>436</sub> B <sub>435</sub> B <sub>434</sub> B <sub>433</sub> B <sub>432</sub> B <sub>431</sub> B <sub>430</sub> | 172                 |
| No Input                                                       | 101100                                                          | B <sub>447</sub> B <sub>446</sub> B <sub>445</sub> B <sub>444</sub> B <sub>443</sub> B <sub>442</sub> B <sub>441</sub> B <sub>440</sub> | 173                 |
| No Input                                                       | 101101                                                          | B <sub>457</sub> B <sub>456</sub> B <sub>455</sub> B <sub>454</sub> B <sub>453</sub> B <sub>452</sub> B <sub>451</sub> B <sub>450</sub> | 174                 |
| No Input                                                       | 101110                                                          | B <sub>467</sub> B <sub>466</sub> B <sub>465</sub> B <sub>464</sub> B <sub>463</sub> B <sub>462</sub> B <sub>461</sub> B <sub>460</sub> | 175                 |
| No Input                                                       | 101111                                                          | B <sub>477</sub> B <sub>476</sub> B <sub>475</sub> B <sub>474</sub> B <sub>473</sub> B <sub>472</sub> B <sub>471</sub> B <sub>470</sub> | 176                 |
| No Input                                                       | 110000                                                          | B <sub>487</sub> B <sub>486</sub> B <sub>485</sub> B <sub>484</sub> B <sub>483</sub> B <sub>482</sub> B <sub>481</sub> B <sub>480</sub> | 177                 |
| No Input                                                       | 110001                                                          | B <sub>497</sub> B <sub>496</sub> B <sub>495</sub> B <sub>494</sub> B <sub>493</sub> B <sub>492</sub> B <sub>491</sub> B <sub>490</sub> | 178                 |
| No Input                                                       | 110010                                                          | B <sub>507</sub> B <sub>506</sub> B <sub>505</sub> B <sub>504</sub> B <sub>503</sub> B <sub>502</sub> B <sub>501</sub> B <sub>500</sub> | 179                 |
| No Input                                                       | 110011                                                          | B <sub>517</sub> B <sub>516</sub> B <sub>515</sub> B <sub>514</sub> B <sub>513</sub> B <sub>512</sub> B <sub>511</sub> B <sub>510</sub> | 180                 |
| No Input                                                       | 110100                                                          | B <sub>527</sub> B <sub>526</sub> B <sub>525</sub> B <sub>524</sub> B <sub>523</sub> B <sub>522</sub> B <sub>521</sub> B <sub>520</sub> | 181                 |
| No Input                                                       | 110101                                                          | B <sub>537</sub> B <sub>536</sub> B <sub>535</sub> B <sub>534</sub> B <sub>533</sub> B <sub>532</sub> B <sub>531</sub> B <sub>530</sub> | 182                 |
| No Input                                                       | 110110                                                          | B <sub>547</sub> B <sub>546</sub> B <sub>545</sub> B <sub>544</sub> B <sub>543</sub> B <sub>542</sub> B <sub>541</sub> B <sub>540</sub> | 183                 |
| No Input                                                       | 110111                                                          | B <sub>557</sub> B <sub>556</sub> B <sub>555</sub> B <sub>554</sub> B <sub>553</sub> B <sub>552</sub> B <sub>551</sub> B <sub>550</sub> | 184                 |
| No Input                                                       | 111000                                                          | B <sub>567</sub> B <sub>566</sub> B <sub>565</sub> B <sub>564</sub> B <sub>563</sub> B <sub>562</sub> B <sub>561</sub> B <sub>560</sub> | 185                 |
| No Input                                                       | 111001                                                          | B <sub>577</sub> B <sub>576</sub> B <sub>575</sub> B <sub>574</sub> B <sub>573</sub> B <sub>572</sub> B <sub>571</sub> B <sub>570</sub> | 186                 |
| No Input                                                       | 111010                                                          | B <sub>587</sub> B <sub>586</sub> B <sub>585</sub> B <sub>584</sub> B <sub>583</sub> B <sub>582</sub> B <sub>581</sub> B <sub>580</sub> | 187                 |
| No Input                                                       | 111011                                                          | B <sub>597</sub> B <sub>596</sub> B <sub>595</sub> B <sub>594</sub> B <sub>593</sub> B <sub>592</sub> B <sub>591</sub> B <sub>590</sub> | 188                 |
| No Input                                                       | 111100                                                          | B <sub>607</sub> B <sub>606</sub> B <sub>605</sub> B <sub>604</sub> B <sub>603</sub> B <sub>602</sub> B <sub>601</sub> B <sub>600</sub> | 189                 |
| No Input                                                       | 111101                                                          | B <sub>617</sub> B <sub>616</sub> B <sub>615</sub> B <sub>614</sub> B <sub>613</sub> B <sub>612</sub> B <sub>611</sub> B <sub>610</sub> | 190                 |
| No Input                                                       | 111110                                                          | B <sub>627</sub> B <sub>626</sub> B <sub>625</sub> B <sub>624</sub> B <sub>623</sub> B <sub>622</sub> B <sub>621</sub> B <sub>620</sub> | 191                 |
| No Input                                                       | 111111                                                          | B <sub>637</sub> B <sub>636</sub> B <sub>635</sub> B <sub>634</sub> B <sub>633</sub> B <sub>632</sub> B <sub>631</sub> B <sub>630</sub> | 192                 |

Table 5.20: Look-up tables-6

## 5.7 Oscillator

The HX8369-A02 can oscillate an internal R-C oscillator with an internal oscillation resistor (Rf). The oscillation frequency is changed according to the UADJ[3:0] internal register. Please refer to OSC control register (RB0h). The default frequency is 15MHz.

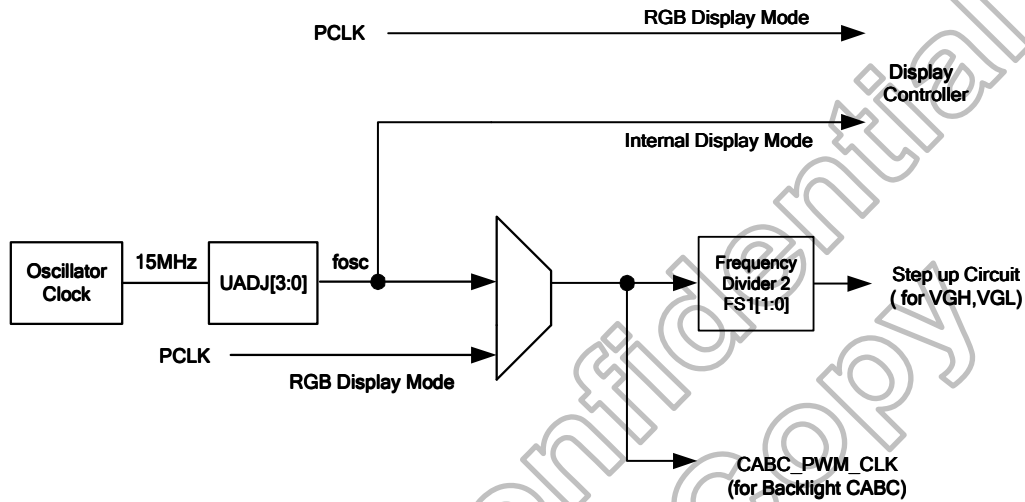
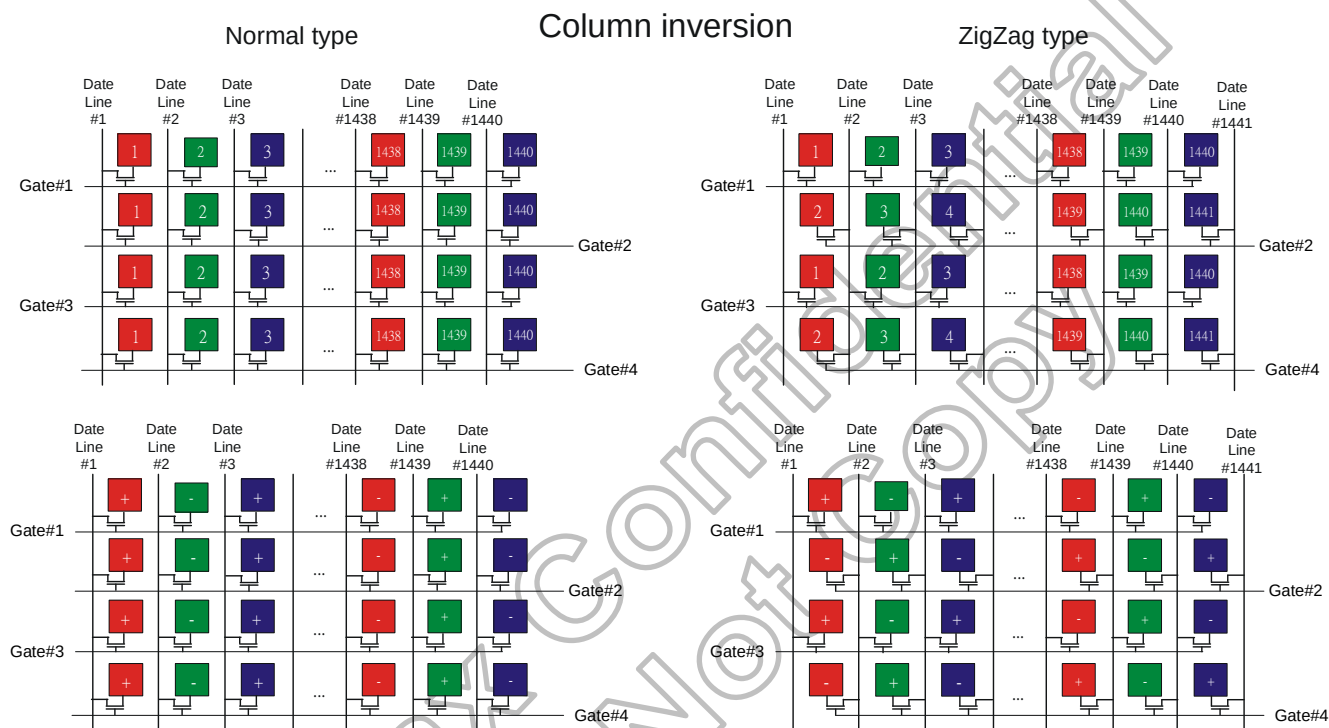


Figure 5.25: OSC aritecture

## 5.8 Source driver

The HX8369-A02 contains a 1440 channels of source driver (normal S1~S1440; Zig-zag S1~S1441) which is used for driving the source line of TFT LCD panel. The source driver converts the digital data from GRAM into the analog voltage for 1440 channels and generates corresponding gray scale voltage output, which can realize a 16.7M colors display simultaneously. Since the output circuit of this source driver incorporates an operational amplifier, a positive and a negative voltage can be alternately outputted from each channel.



## 5.9 LCD power generation scheme

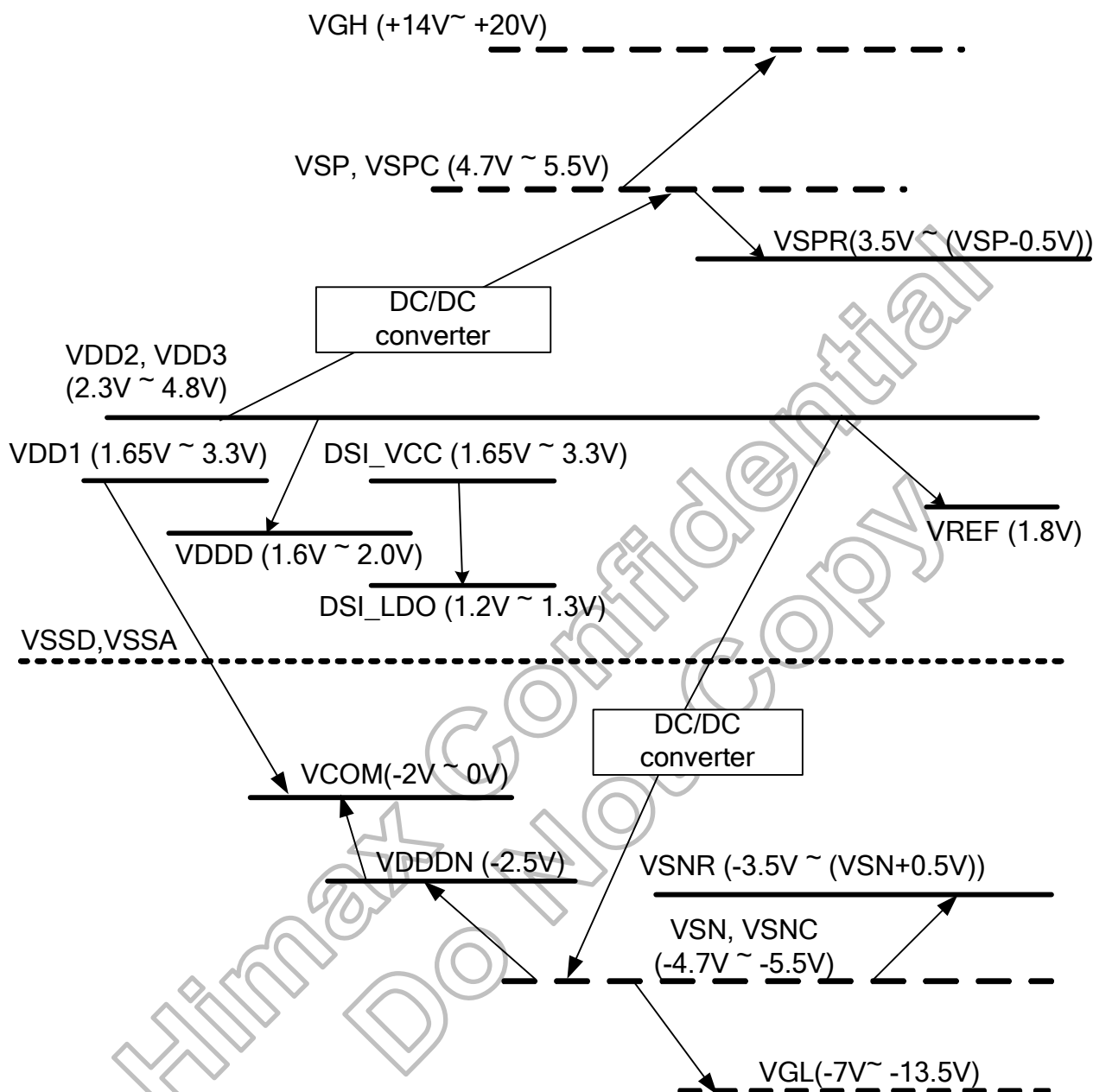


Figure 5.26: LCD power generation scheme

## 5.10 DC/DC converter circuit

### 5.10.1 Use PFM DC/DC converter

The PFM DC-DC converter generates the high voltage level VSP/VSN required for source drivers. HX8369-A02 contains sub-circuits of the PFM boost converter, including a precision 1.8V reference voltage, comparator, PFM controlling logic, and the output buffer. The boost converter uses a external power transistor to provide maximum efficiency and to minimize the number of external components. The output voltage of the boost converter can be set from 4.7 to 5.5 (VSP) and -4.7 to -5.5V (VSN)

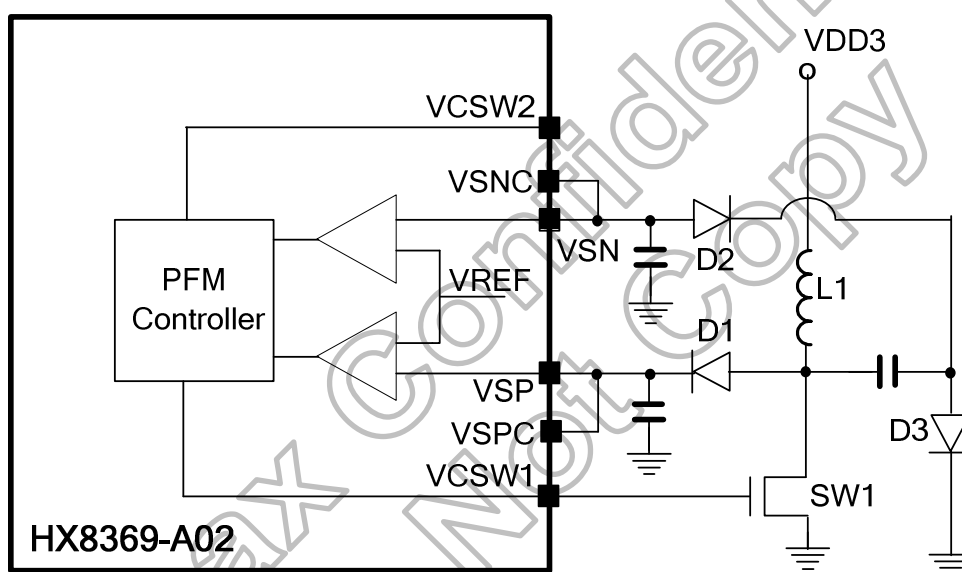


Figure 5.27: DC/DC converter circuit (PFM Type C)–PCCS=10

### 5.10.2 Use HX5186-A

The HX5186-A is highly efficient switching voltage generator circuits that generate the high voltage level VSP/VSN required for source drivers. HX8369-A02 contains Charge Pump Controller for HX5186-A, including a comparator for VSP/VSN feedback control. HX5186-A can provide maximum efficiency and use minimum number of external components. The output voltage of the boost converter can be set from 4.7 to 5.5 (VSP) and -4.7 to -5.5V (VSN)

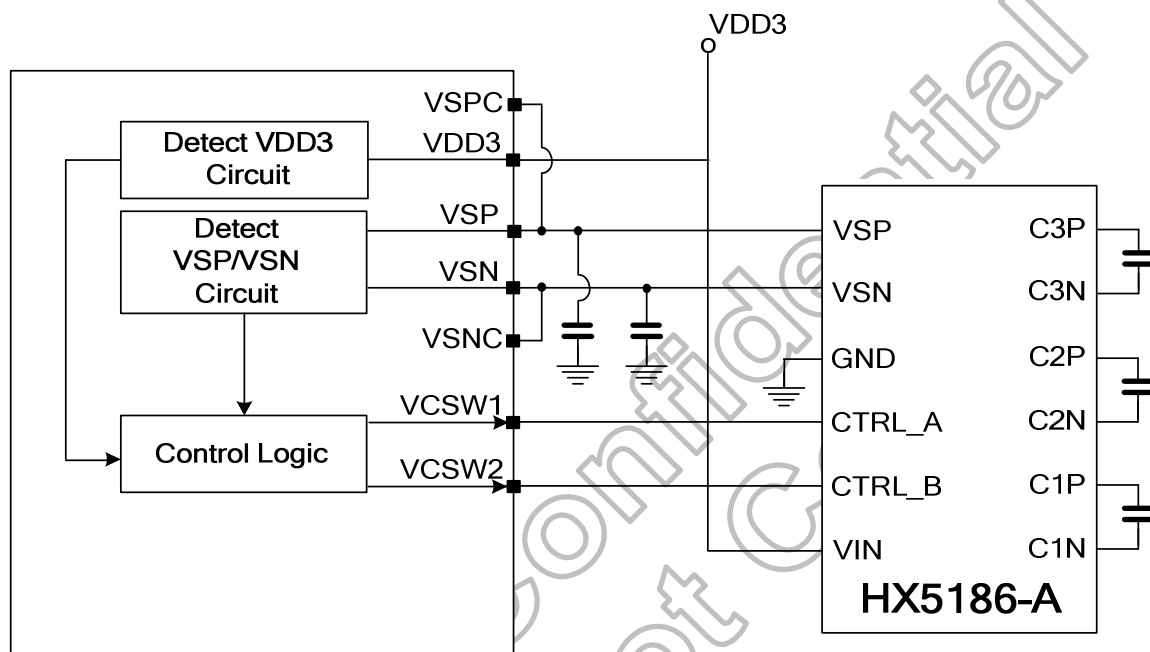


Figure 5.28: DC/DC converter circuit (HX5186-A)



## 5.11 Idle display

The HX8369-A02 supports an idle display mode. The grayscale level to be used is V0 and V64 with R7, G7, B7 decoding, and the other levels (V1-V63) are halted to reduce power consumption. In idle display mode, the Gamma-micro-adjustment registers are invalid and only the upper bits of RGB are used for display.

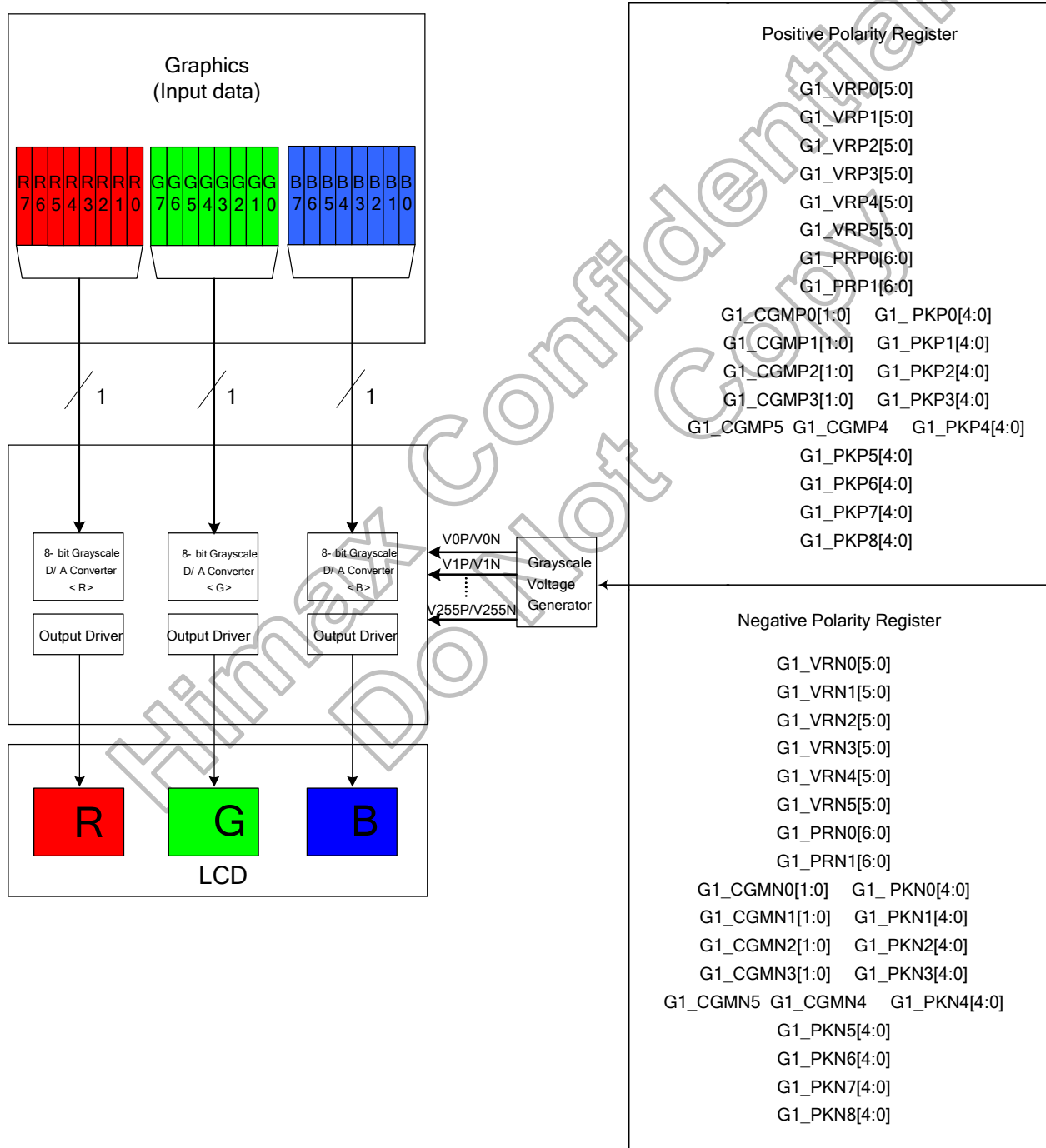


Figure 5.29: Idle mode grayscale control

## 5.12 Gamma characteristic correction function

The HX8369-A02 incorporates gamma adjustment function for the 16,777,216-color display (256 grayscale for each R, G, B color). Gamma adjustment operation is implemented by deciding the 16 grayscale levels firstly in gamma adjustment control registers to match the LCD panel. Then total 512 grayscale levels are generated in grayscale voltage generator. These registers are available for both polarities.

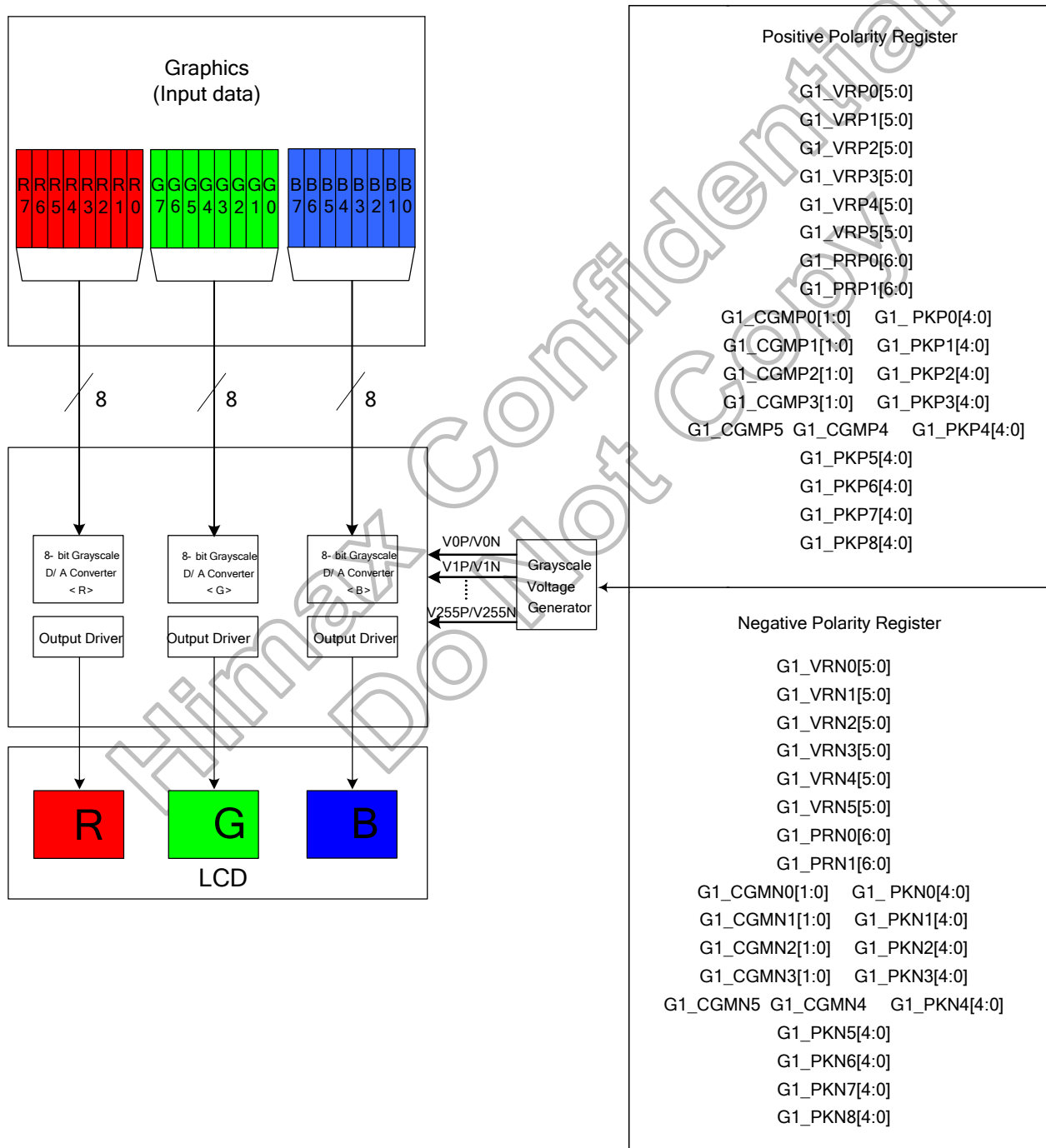


Figure 5.30: Grayscale control

## Gamma-Characteristics adjustment register

This HX8369-A02 has register groups for specifying a series grayscale voltage that meets the Gamma-characteristics for the LCD panel used. These registers are divided into two groups, which correspond to the gradient, amplitude, and macro adjustment of the voltage for the grayscale characteristics. The polarity of each register can be specified independently.

### (1) Offset adjustment registers

The offset adjustment variable registers are used to adjust the amplitude of the grayscale voltage. This function is implemented by controlling these variable resistors in the top and bottom of the gamma resistor stream for reference gamma voltage generation. These registers are available for both positive and negative polarities.

### (2) Gamma center adjustment registers

The gamma center adjustment registers are used to adjust the reference gamma voltage in the middle level of grayscale without changing the dynamic range. This function is implemented by choosing one input of 88 to 1 selector in the gamma resistor stream for reference gamma voltage generation. These registers are available for both positive and negative polarities.

### (3) Gamma macro adjustment registers

The gamma macro adjustment registers can be used for fine adjustment of the reference gamma voltage. This function is implemented by controlling the 32-to-1 selectors (PKP/N0~5), each of which has 5 inputs and generates one reference voltage output (Vg(P/N)3, 7, 19, 25, 32, 38, 44, 56, 60).

| Register Groups   | Positive Polarity | Negative Polarity | Description                                                                                                   |
|-------------------|-------------------|-------------------|---------------------------------------------------------------------------------------------------------------|
| Center Adjustment | PRP0 6-0          | PRN0 6-0          | Variable resistor (PRP/N0) for center adjustment                                                              |
|                   | PRP1 6-0          | PRN1 6-0          | Variable resistor (PRP/N1) for center adjustment                                                              |
| Macro Adjustment  | PKP0 4-0          | PKN0 4-0          | 32-to-1 selector (voltage level of grayscale 3)                                                               |
|                   | PKP1 4-0          | PKN1 4-0          | 32-to-1 selector (voltage level of grayscale 7)                                                               |
|                   | PKP2 4-0          | PKN2 4-0          | 32-to-1 selector (voltage level of grayscale 19)                                                              |
|                   | PKP3 4-0          | PKN3 4-0          | 32-to-1 selector (voltage level of grayscale 25)                                                              |
|                   | PKP4 4-0          | PKN4 4-0          | 32-to-1 selector (voltage level of grayscale 32 for positive polarity and grayscale 31 for negative polarity) |
|                   | PKP5 4-0          | PKN5 4-0          | 32-to-1 selector (voltage level of grayscale 38)                                                              |
|                   | PKP6 4-0          | PKN6 4-0          | 32-to-1 selector (voltage level of grayscale 44)                                                              |
|                   | PKP7 4-0          | PKN7 4-0          | 32-to-1 selector (voltage level of grayscale 56)                                                              |
|                   | PKP8 4-0          | PKN8 4-0          | 32-to-1 selector (voltage level of grayscale 60)                                                              |
|                   |                   |                   |                                                                                                               |
| Offset Adjustment | VRP0 5-0          | VRN0 5-0          | Variable resistor (VRP/N0) for offset adjustment                                                              |
|                   | VRP1 5-0          | VRN1 5-0          | Variable resistor (VRP/N1) for offset adjustment                                                              |
|                   | VRP2 5-0          | VRN2 5-0          | Variable resistor (VRP/N2) for offset adjustment                                                              |
|                   | VRP3 5-0          | VRN3 5-0          | Variable resistor (VRP/N3) for offset adjustment                                                              |
|                   | VRP4 5-0          | VRN4 5-0          | Variable resistor (VRP/N4) for offset adjustment                                                              |
|                   | VRP5 5-0          | VRN5 5-0          | Variable resistor (VRP/N5) for offset adjustment                                                              |

Table 5.21: Gamma-Adjustment registers

# Gamma resister stream and 8 to 1 selector

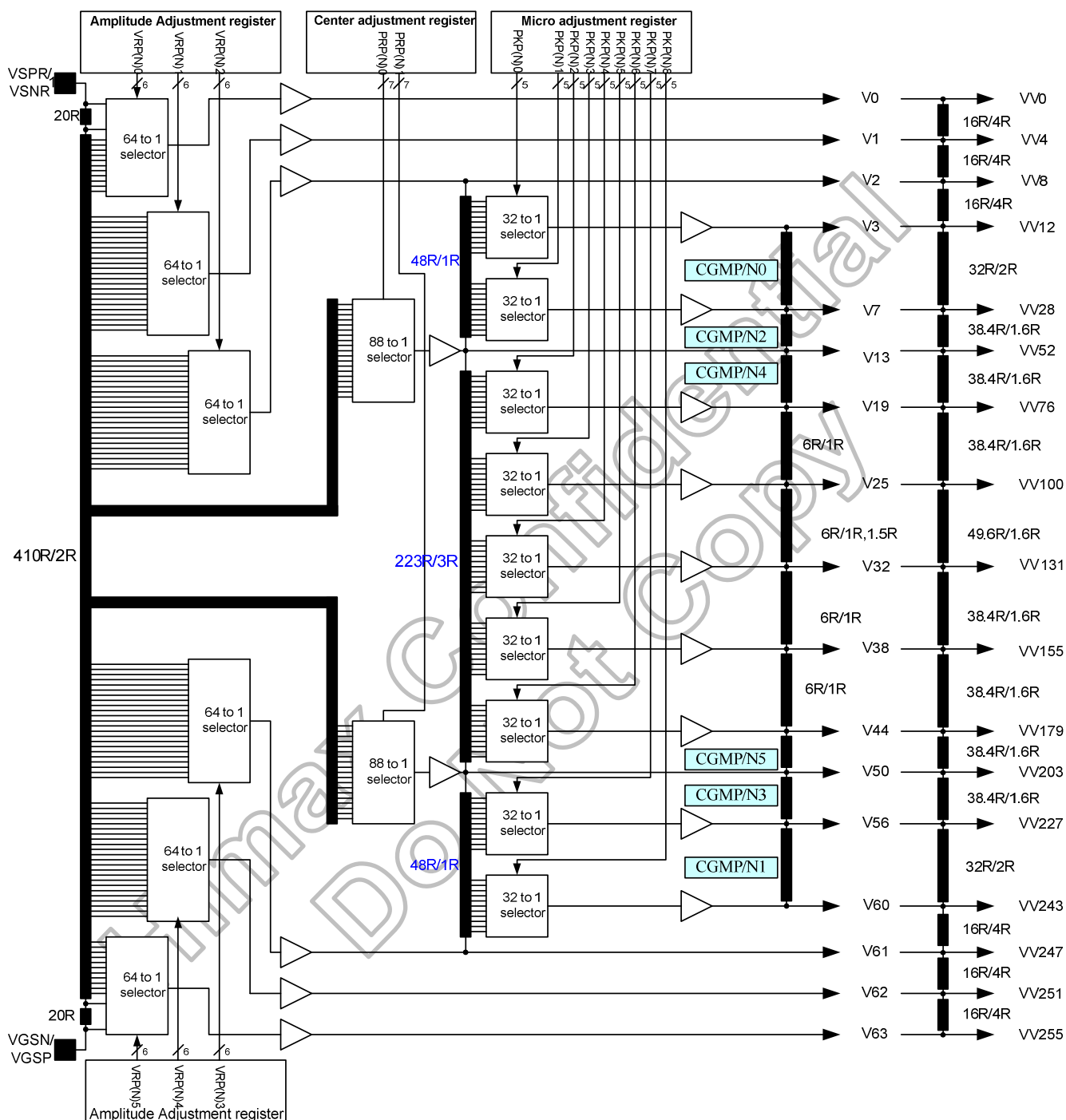


Figure 5.31: Gamma resister stream and gamma reference voltage

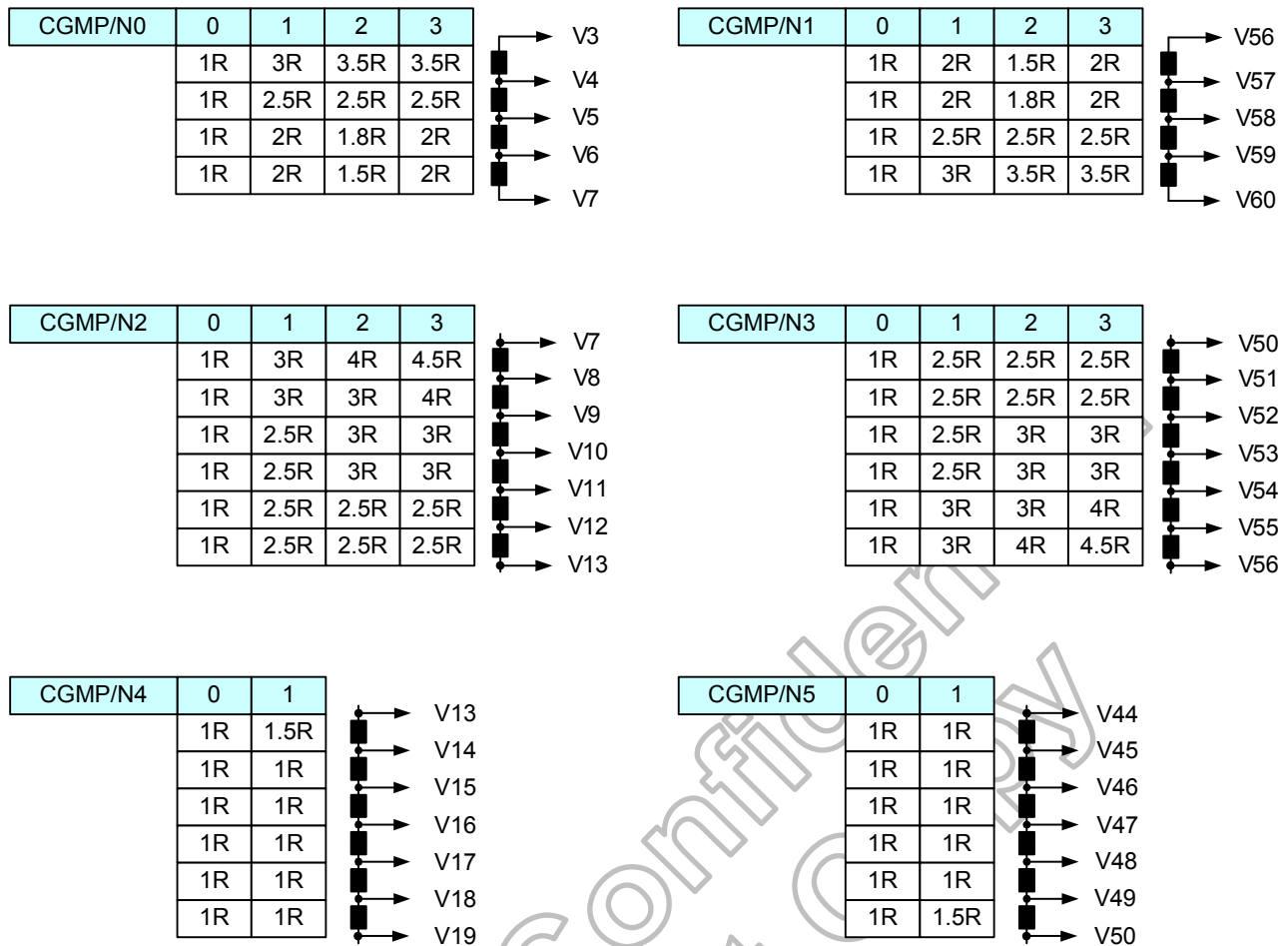


Figure 5.32: Gamma register stream

### Variable resister

There are two types of variable resistors, one is for center adjustment and the other is for offset adjustment. The resistances are decided by setting values in the center adjustment, offset adjustment registers. Their relationships are shown below.

| Value in Register<br>VR(P/N)0 5-0 | Resistance<br>VR(P/N)0 | Value in Register<br>VR(P/N)1 5-0 | Resistance<br>VR(P/N)1 | Value in Register<br>VR(P/N)2 5-0 | Resistance<br>VR(P/N)2 |
|-----------------------------------|------------------------|-----------------------------------|------------------------|-----------------------------------|------------------------|
| 000000                            | 0R                     | 000000                            | 0R                     | 000000                            | 0R                     |
| 000001                            | 20R                    | 000001                            | 2R                     | 000001                            | 2R                     |
| 000010                            | 22R                    | 000010                            | 4R                     | 000010                            | 4R                     |
| 000011                            | 24R                    | 000011                            | 6R                     | 000011                            | 6R                     |
| •                                 | •                      | •                                 | •                      | •                                 | •                      |
| •                                 | •                      | •                                 | •                      | •                                 | •                      |
| 011101                            | 76R                    | 011101                            | 58R                    | 011101                            | 58R                    |
| 011110                            | 78R                    | 011110                            | 60R                    | 011110                            | 60R                    |
| 011111                            | 80R                    | 011111                            | 62R                    | 011111                            | 62R                    |
| 100000                            | 82R                    | 100000                            | 64R                    | 100000                            | 64R                    |
| 100001                            | 84R                    | 100001                            | 66R                    | 100001                            | 66R                    |
| 100010                            | 86R                    | 100010                            | 68R                    | 100010                            | 68R                    |
| •                                 | •                      | •                                 | •                      | •                                 | •                      |
| •                                 | •                      | •                                 | •                      | •                                 | •                      |
| 111101                            | 140R                   | 111101                            | 122R                   | 111101                            | 122R                   |
| 111110                            | 142R                   | 111110                            | 124R                   | 111110                            | 124R                   |
| 111111                            | 144R                   | 111111                            | 126R                   | 111111                            | 126R                   |

| Value in Register<br>VR(P/N)3 5-0 | Resistance<br>VR(P/N)3 | Value in Register<br>VR(P/N)4 5-0 | Resistance<br>VR(P/N)4 | Value in Register<br>VR(P/N)5 5-0 | Resistance<br>VR(P/N)2 |
|-----------------------------------|------------------------|-----------------------------------|------------------------|-----------------------------------|------------------------|
| 000000                            | 0R                     | 000000                            | 0R                     | 000000                            | 0R                     |
| 000001                            | 2R                     | 000001                            | 2R                     | 000001                            | 2R                     |
| 000010                            | 4R                     | 000010                            | 4R                     | 000010                            | 4R                     |
| •                                 | •                      | •                                 | •                      | •                                 | •                      |
| •                                 | •                      | •                                 | •                      | •                                 | •                      |
| 011101                            | 58R                    | 011101                            | 58R                    | 011101                            | 58R                    |
| 011110                            | 60R                    | 011110                            | 60R                    | 011110                            | 60R                    |
| 011111                            | 62R                    | 011111                            | 62R                    | 011111                            | 62R                    |
| 100000                            | 64R                    | 100000                            | 64R                    | 100000                            | 64R                    |
| 100001                            | 66R                    | 100001                            | 66R                    | 100001                            | 66R                    |
| 100010                            | 68R                    | 100010                            | 68R                    | 100010                            | 68R                    |
| •                                 | •                      | •                                 | •                      | •                                 | •                      |
| •                                 | •                      | •                                 | •                      | •                                 | •                      |
| 111100                            | 120R                   | 111100                            | 120R                   | 111100                            | 120R                   |
| 111101                            | 122R                   | 111101                            | 122R                   | 111101                            | 122R                   |
| 111110                            | 124R                   | 111110                            | 124R                   | 111110                            | 124R                   |
| 111111                            | 126R                   | 111111                            | 126R                   | 111111                            | 144R                   |

Table 5.22: Offset adjustment 0~5

| Value in Register<br>PR(P/N)0 6-0 | Resistance<br>PR(P/N)0 | Value in Register<br>PR(P/N)1 6-0 | Resistance<br>PR(P/N)1 |
|-----------------------------------|------------------------|-----------------------------------|------------------------|
| 0000000                           | 0R                     | 0000000                           | 0R                     |
| 0000001                           | 2R                     | 0000001                           | 2R                     |
| 0000010                           | 4R                     | 0000010                           | 4R                     |
| •                                 | •                      | •                                 | •                      |
| •                                 | •                      | •                                 | •                      |
| 1010101                           | 170R                   | 1010101                           | 170R                   |
| 1010110                           | 172R                   | 1010110                           | 172R                   |
| 1010111                           | 174R                   | 1010111                           | 174R                   |

Table 5.23: Center adjustment



The grayscale levels are determined by the following formulas:

| Reference voltage | Macro adjustment value | VinP0 formula                                   |
|-------------------|------------------------|-------------------------------------------------|
| VinP0             | VRP0 5-0 = 000000      | VSPR                                            |
|                   | VRP0 5-0 = 000001      | $((450R - 20R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP0 5-0 = 000010      | $((450R - 22R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP0 5-0 = 000011      | $((450R - 24R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP0 5-0 = 000100      | $((450R - 26R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP0 5-0 = 000101      | $((450R - 28R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP0 5-0 = 000110      | $((450R - 30R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP0 5-0 = 000111      | $((450R - 32R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP0 5-0 = 001000      | $((450R - 34R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP0 5-0 = 001001      | $((450R - 36R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP0 5-0 = 001010      | $((450R - 38R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP0 5-0 = 001011      | $((450R - 40R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP0 5-0 = 001100      | $((450R - 42R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP0 5-0 = 001101      | $((450R - 44R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP0 5-0 = 001110      | $((450R - 46R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP0 5-0 = 001111      | $((450R - 48R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP0 5-0 = 010000      | $((450R - 50R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP0 5-0 = 010001      | $((450R - 52R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP0 5-0 = 010010      | $((450R - 54R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP0 5-0 = 010011      | $((450R - 56R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP0 5-0 = 010100      | $((450R - 58R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP0 5-0 = 010101      | $((450R - 60R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP0 5-0 = 010110      | $((450R - 62R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP0 5-0 = 010111      | $((450R - 64R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP0 5-0 = 011000      | $((450R - 66R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP0 5-0 = 011001      | $((450R - 68R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP0 5-0 = 011010      | $((450R - 70R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP0 5-0 = 011011      | $((450R - 72R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP0 5-0 = 011100      | $((450R - 74R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP0 5-0 = 011101      | $((450R - 76R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP0 5-0 = 011110      | $((450R - 78R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP0 5-0 = 011111      | $((450R - 80R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP0 5-0 = 100000      | $((450R - 82R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP0 5-0 = 100001      | $((450R - 84R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP0 5-0 = 100010      | $((450R - 86R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP0 5-0 = 100011      | $((450R - 88R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP0 5-0 = 100100      | $((450R - 90R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP0 5-0 = 100101      | $((450R - 92R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP0 5-0 = 100110      | $((450R - 94R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP0 5-0 = 100111      | $((450R - 96R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP0 5-0 = 101000      | $((450R - 98R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP0 5-0 = 101001      | $((450R - 100R) / 450R) * (VSPR - VGSP) + VGSP$ |
|                   | VRP0 5-0 = 101010      | $((450R - 102R) / 450R) * (VSPR - VGSP) + VGSP$ |
|                   | VRP0 5-0 = 101011      | $((450R - 104R) / 450R) * (VSPR - VGSP) + VGSP$ |
|                   | VRP0 5-0 = 101100      | $((450R - 106R) / 450R) * (VSPR - VGSP) + VGSP$ |
|                   | VRP0 5-0 = 101101      | $((450R - 108R) / 450R) * (VSPR - VGSP) + VGSP$ |
|                   | VRP0 5-0 = 101110      | $((450R - 110R) / 450R) * (VSPR - VGSP) + VGSP$ |
|                   | VRP0 5-0 = 101111      | $((450R - 112R) / 450R) * (VSPR - VGSP) + VGSP$ |
|                   | VRP0 5-0 = 110000      | $((450R - 114R) / 450R) * (VSPR - VGSP) + VGSP$ |
|                   | VRP0 5-0 = 110001      | $((450R - 116R) / 450R) * (VSPR - VGSP) + VGSP$ |
|                   | VRP0 5-0 = 110010      | $((450R - 118R) / 450R) * (VSPR - VGSP) + VGSP$ |
|                   | VRP0 5-0 = 110011      | $((450R - 120R) / 450R) * (VSPR - VGSP) + VGSP$ |
|                   | VRP0 5-0 = 110100      | $((450R - 122R) / 450R) * (VSPR - VGSP) + VGSP$ |
|                   | VRP0 5-0 = 110101      | $((450R - 124R) / 450R) * (VSPR - VGSP) + VGSP$ |
|                   | VRP0 5-0 = 110110      | $((450R - 126R) / 450R) * (VSPR - VGSP) + VGSP$ |
|                   | VRP0 5-0 = 110111      | $((450R - 128R) / 450R) * (VSPR - VGSP) + VGSP$ |
|                   | VRP0 5-0 = 111000      | $((450R - 130R) / 450R) * (VSPR - VGSP) + VGSP$ |
|                   | VRP0 5-0 = 111001      | $((450R - 132R) / 450R) * (VSPR - VGSP) + VGSP$ |
|                   | VRP0 5-0 = 111010      | $((450R - 134R) / 450R) * (VSPR - VGSP) + VGSP$ |
|                   | VRP0 5-0 = 111011      | $((450R - 136R) / 450R) * (VSPR - VGSP) + VGSP$ |
|                   | VRP0 5-0 = 111100      | $((450R - 138R) / 450R) * (VSPR - VGSP) + VGSP$ |
|                   | VRP0 5-0 = 111101      | $((450R - 140R) / 450R) * (VSPR - VGSP) + VGSP$ |
|                   | VRP0 5-0 = 111110      | $((450R - 142R) / 450R) * (VSPR - VGSP) + VGSP$ |
|                   | VRP0 5-0 = 111111      | $((450R - 144R) / 450R) * (VSPR - VGSP) + VGSP$ |

Table 5.24: VinP0



| Reference voltage | Macro adjustment value | VinP1 formula                                   |
|-------------------|------------------------|-------------------------------------------------|
| VinP1             | VRP1 5-0 = 000000      | $((430R / 450R) * (VSPR - VGSP) + VGSP)$        |
|                   | VRP1 5-0 = 000001      | $((430R - 2R) / 450R) * (VSPR - VGSP) + VGSP$   |
|                   | VRP1 5-0 = 000010      | $((430R - 4R) / 450R) * (VSPR - VGSP) + VGSP$   |
|                   | VRP1 5-0 = 000011      | $((430R - 6R) / 450R) * (VSPR - VGSP) + VGSP$   |
|                   | VRP1 5-0 = 000100      | $((430R - 8R) / 450R) * (VSPR - VGSP) + VGSP$   |
|                   | VRP1 5-0 = 000101      | $((430R - 10R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP1 5-0 = 000110      | $((430R - 12R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP1 5-0 = 000111      | $((430R - 14R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP1 5-0 = 001000      | $((430R - 16R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP1 5-0 = 001001      | $((430R - 18R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP1 5-0 = 001010      | $((430R - 20R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP1 5-0 = 001011      | $((430R - 22R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP1 5-0 = 001100      | $((430R - 24R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP1 5-0 = 001101      | $((430R - 26R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP1 5-0 = 001110      | $((430R - 28R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP1 5-0 = 001111      | $((430R - 30R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP1 5-0 = 010000      | $((430R - 32R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP1 5-0 = 010001      | $((430R - 34R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP1 5-0 = 010010      | $((430R - 36R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP1 5-0 = 010011      | $((430R - 38R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP1 5-0 = 010100      | $((430R - 40R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP1 5-0 = 010101      | $((430R - 42R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP1 5-0 = 010110      | $((430R - 44R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP1 5-0 = 010111      | $((430R - 46R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP1 5-0 = 011000      | $((430R - 48R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP1 5-0 = 011001      | $((430R - 50R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP1 5-0 = 011010      | $((430R - 52R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP1 5-0 = 011011      | $((430R - 54R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP1 5-0 = 011100      | $((430R - 56R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP1 5-0 = 011101      | $((430R - 58R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP1 5-0 = 011110      | $((430R - 60R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP1 5-0 = 011111      | $((430R - 62R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP1 5-0 = 100000      | $((430R - 64R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP1 5-0 = 100001      | $((430R - 66R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP1 5-0 = 100010      | $((430R - 68R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP1 5-0 = 100011      | $((430R - 70R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP1 5-0 = 100100      | $((430R - 72R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP1 5-0 = 100101      | $((430R - 74R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP1 5-0 = 100110      | $((430R - 76R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP1 5-0 = 100111      | $((430R - 78R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP1 5-0 = 101000      | $((430R - 80R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP1 5-0 = 101001      | $((430R - 82R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP1 5-0 = 101010      | $((430R - 84R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP1 5-0 = 101011      | $((430R - 86R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP1 5-0 = 101100      | $((430R - 88R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP1 5-0 = 101101      | $((430R - 90R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP1 5-0 = 101110      | $((430R - 92R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP1 5-0 = 101111      | $((430R - 94R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP1 5-0 = 110000      | $((430R - 96R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP1 5-0 = 110001      | $((430R - 98R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP1 5-0 = 110010      | $((430R - 100R) / 450R) * (VSPR - VGSP) + VGSP$ |
|                   | VRP1 5-0 = 110011      | $((430R - 102R) / 450R) * (VSPR - VGSP) + VGSP$ |
|                   | VRP1 5-0 = 110100      | $((430R - 104R) / 450R) * (VSPR - VGSP) + VGSP$ |
|                   | VRP1 5-0 = 110101      | $((430R - 106R) / 450R) * (VSPR - VGSP) + VGSP$ |
|                   | VRP1 5-0 = 110110      | $((430R - 108R) / 450R) * (VSPR - VGSP) + VGSP$ |
|                   | VRP1 5-0 = 110111      | $((430R - 110R) / 450R) * (VSPR - VGSP) + VGSP$ |
|                   | VRP1 5-0 = 111000      | $((430R - 112R) / 450R) * (VSPR - VGSP) + VGSP$ |
|                   | VRP1 5-0 = 111001      | $((430R - 114R) / 450R) * (VSPR - VGSP) + VGSP$ |
|                   | VRP1 5-0 = 111010      | $((430R - 116R) / 450R) * (VSPR - VGSP) + VGSP$ |
|                   | VRP1 5-0 = 111011      | $((430R - 118R) / 450R) * (VSPR - VGSP) + VGSP$ |
|                   | VRP1 5-0 = 111100      | $((430R - 120R) / 450R) * (VSPR - VGSP) + VGSP$ |
|                   | VRP1 5-0 = 111101      | $((430R - 122R) / 450R) * (VSPR - VGSP) + VGSP$ |
|                   | VRP1 5-0 = 111110      | $((430R - 124R) / 450R) * (VSPR - VGSP) + VGSP$ |
|                   | VRP1 5-0 = 111111      | $((430R - 126R) / 450R) * (VSPR - VGSP) + VGSP$ |

Table 5.25: VinP1

| Reference voltage | Macro adjustment value | VinP2 formula                                   |
|-------------------|------------------------|-------------------------------------------------|
| VinP2             | VRP2 5-0 = 000000      | $(420R / 450R) * (VSPR - VGSP) + VGSP$          |
|                   | VRP2 5-0 = 000001      | $((420R - 2R) / 450R) * (VSPR - VGSP) + VGSP$   |
|                   | VRP2 5-0 = 000010      | $((420R - 4R) / 450R) * (VSPR - VGSP) + VGSP$   |
|                   | VRP2 5-0 = 000011      | $((420R - 6R) / 450R) * (VSPR - VGSP) + VGSP$   |
|                   | VRP2 5-0 = 000100      | $((420R - 8R) / 450R) * (VSPR - VGSP) + VGSP$   |
|                   | VRP2 5-0 = 000101      | $((420R - 10R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP2 5-0 = 000110      | $((420R - 12R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP2 5-0 = 000111      | $((420R - 14R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP2 5-0 = 001000      | $((420R - 16R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP2 5-0 = 001001      | $((420R - 18R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP2 5-0 = 001010      | $((420R - 20R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP2 5-0 = 001011      | $((420R - 22R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP2 5-0 = 001100      | $((420R - 24R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP2 5-0 = 001101      | $((420R - 26R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP2 5-0 = 001110      | $((420R - 28R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP2 5-0 = 001111      | $((420R - 30R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP2 5-0 = 010000      | $((420R - 32R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP2 5-0 = 010001      | $((420R - 34R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP2 5-0 = 010010      | $((420R - 36R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP2 5-0 = 010011      | $((420R - 38R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP2 5-0 = 010100      | $((420R - 40R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP2 5-0 = 010101      | $((420R - 42R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP2 5-0 = 010110      | $((420R - 44R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP2 5-0 = 010111      | $((420R - 46R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP2 5-0 = 011000      | $((420R - 48R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP2 5-0 = 011001      | $((420R - 50R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP2 5-0 = 011010      | $((420R - 52R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP2 5-0 = 011011      | $((420R - 54R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP2 5-0 = 011100      | $((420R - 56R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP2 5-0 = 011101      | $((420R - 58R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP2 5-0 = 011110      | $((420R - 60R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP2 5-0 = 011111      | $((420R - 62R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP2 5-0 = 100000      | $((420R - 64R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP2 5-0 = 100001      | $((420R - 66R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP2 5-0 = 100010      | $((420R - 68R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP2 5-0 = 100011      | $((420R - 70R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP2 5-0 = 100100      | $((420R - 72R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP2 5-0 = 100101      | $((420R - 74R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP2 5-0 = 100110      | $((420R - 76R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP2 5-0 = 100111      | $((420R - 78R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP2 5-0 = 101000      | $((420R - 80R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP2 5-0 = 101001      | $((420R - 82R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP2 5-0 = 101010      | $((420R - 84R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP2 5-0 = 101011      | $((420R - 86R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP2 5-0 = 101100      | $((420R - 88R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP2 5-0 = 101101      | $((420R - 90R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP2 5-0 = 101110      | $((420R - 92R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP2 5-0 = 101111      | $((420R - 94R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP2 5-0 = 110000      | $((420R - 96R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP2 5-0 = 110001      | $((420R - 98R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP2 5-0 = 110010      | $((420R - 100R) / 450R) * (VSPR - VGSP) + VGSP$ |
|                   | VRP2 5-0 = 110011      | $((420R - 102R) / 450R) * (VSPR - VGSP) + VGSP$ |
|                   | VRP2 5-0 = 110100      | $((420R - 104R) / 450R) * (VSPR - VGSP) + VGSP$ |
|                   | VRP2 5-0 = 110101      | $((420R - 106R) / 450R) * (VSPR - VGSP) + VGSP$ |
|                   | VRP2 5-0 = 110110      | $((420R - 108R) / 450R) * (VSPR - VGSP) + VGSP$ |
|                   | VRP2 5-0 = 110111      | $((420R - 110R) / 450R) * (VSPR - VGSP) + VGSP$ |
|                   | VRP2 5-0 = 111000      | $((420R - 112R) / 450R) * (VSPR - VGSP) + VGSP$ |
|                   | VRP2 5-0 = 111001      | $((420R - 114R) / 450R) * (VSPR - VGSP) + VGSP$ |
|                   | VRP2 5-0 = 111010      | $((420R - 116R) / 450R) * (VSPR - VGSP) + VGSP$ |
|                   | VRP2 5-0 = 111011      | $((420R - 118R) / 450R) * (VSPR - VGSP) + VGSP$ |
|                   | VRP2 5-0 = 111100      | $((420R - 120R) / 450R) * (VSPR - VGSP) + VGSP$ |
|                   | VRP2 5-0 = 111101      | $((420R - 122R) / 450R) * (VSPR - VGSP) + VGSP$ |
|                   | VRP2 5-0 = 111110      | $((420R - 124R) / 450R) * (VSPR - VGSP) + VGSP$ |
|                   | VRP2 5-0 = 111111      | $((420R - 126R) / 450R) * (VSPR - VGSP) + VGSP$ |

Table 5.26: VinP2

| Reference voltage | Macro adjustment value | VinP14 formula                                  |
|-------------------|------------------------|-------------------------------------------------|
| VinP14            | VRP3 5-0 = 000000      | $(156R / 450R) * (VSPR - VGSP) + VGSP$          |
|                   | VRP3 5-0 = 000001      | $((156R - 2R) / 450R) * (VSPR - VGSP) + VGSP$   |
|                   | VRP3 5-0 = 000010      | $((156R - 4R) / 450R) * (VSPR - VGSP) + VGSP$   |
|                   | VRP3 5-0 = 000011      | $((156R - 6R) / 450R) * (VSPR - VGSP) + VGSP$   |
|                   | VRP3 5-0 = 000100      | $((156R - 8R) / 450R) * (VSPR - VGSP) + VGSP$   |
|                   | VRP3 5-0 = 000101      | $((156R - 10R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP3 5-0 = 000110      | $((156R - 12R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP3 5-0 = 000111      | $((156R - 14R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP3 5-0 = 001000      | $((156R - 16R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP3 5-0 = 001001      | $((156R - 18R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP3 5-0 = 001010      | $((156R - 20R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP3 5-0 = 001011      | $((156R - 22R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP3 5-0 = 001100      | $((156R - 24R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP3 5-0 = 001101      | $((156R - 26R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP3 5-0 = 001110      | $((156R - 28R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP3 5-0 = 001111      | $((156R - 30R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP3 5-0 = 010000      | $((156R - 32R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP3 5-0 = 010001      | $((156R - 34R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP3 5-0 = 010010      | $((156R - 36R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP3 5-0 = 010011      | $((156R - 38R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP3 5-0 = 010100      | $((156R - 40R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP3 5-0 = 010101      | $((156R - 42R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP3 5-0 = 010110      | $((156R - 44R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP3 5-0 = 010111      | $((156R - 46R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP3 5-0 = 011000      | $((156R - 48R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP3 5-0 = 011001      | $((156R - 50R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP3 5-0 = 011010      | $((156R - 52R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP3 5-0 = 011011      | $((156R - 54R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP3 5-0 = 011100      | $((156R - 56R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP3 5-0 = 011101      | $((156R - 58R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP3 5-0 = 011110      | $((156R - 60R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP3 5-0 = 011111      | $((156R - 62R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP3 5-0 = 100000      | $((156R - 64R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP3 5-0 = 100001      | $((156R - 66R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP3 5-0 = 100010      | $((156R - 68R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP3 5-0 = 100011      | $((156R - 70R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP3 5-0 = 100100      | $((156R - 72R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP3 5-0 = 100101      | $((156R - 74R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP3 5-0 = 100110      | $((156R - 76R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP3 5-0 = 100111      | $((156R - 78R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP3 5-0 = 101000      | $((156R - 80R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP3 5-0 = 101001      | $((156R - 82R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP3 5-0 = 101010      | $((156R - 84R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP3 5-0 = 101011      | $((156R - 86R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP3 5-0 = 101100      | $((156R - 88R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP3 5-0 = 101101      | $((156R - 90R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP3 5-0 = 101110      | $((156R - 92R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP3 5-0 = 101111      | $((156R - 94R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP3 5-0 = 110000      | $((156R - 96R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP3 5-0 = 110001      | $((156R - 98R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP3 5-0 = 110010      | $((156R - 100R) / 450R) * (VSPR - VGSP) + VGSP$ |
|                   | VRP3 5-0 = 110011      | $((156R - 102R) / 450R) * (VSPR - VGSP) + VGSP$ |
|                   | VRP3 5-0 = 110100      | $((156R - 104R) / 450R) * (VSPR - VGSP) + VGSP$ |
|                   | VRP3 5-0 = 110101      | $((156R - 106R) / 450R) * (VSPR - VGSP) + VGSP$ |
|                   | VRP3 5-0 = 110110      | $((156R - 108R) / 450R) * (VSPR - VGSP) + VGSP$ |
|                   | VRP3 5-0 = 110111      | $((156R - 110R) / 450R) * (VSPR - VGSP) + VGSP$ |
|                   | VRP3 5-0 = 111000      | $((156R - 112R) / 450R) * (VSPR - VGSP) + VGSP$ |
|                   | VRP3 5-0 = 111001      | $((156R - 114R) / 450R) * (VSPR - VGSP) + VGSP$ |
|                   | VRP3 5-0 = 111010      | $((156R - 116R) / 450R) * (VSPR - VGSP) + VGSP$ |
|                   | VRP3 5-0 = 111011      | $((156R - 118R) / 450R) * (VSPR - VGSP) + VGSP$ |
|                   | VRP3 5-0 = 111100      | $((156R - 120R) / 450R) * (VSPR - VGSP) + VGSP$ |
|                   | VRP3 5-0 = 111101      | $((156R - 122R) / 450R) * (VSPR - VGSP) + VGSP$ |
|                   | VRP3 5-0 = 111110      | $((156R - 124R) / 450R) * (VSPR - VGSP) + VGSP$ |
|                   | VRP3 5-0 = 111111      | $((156R - 126R) / 450R) * (VSPR - VGSP) + VGSP$ |

Table 5.27: VinP14

| Reference voltage | Macro adjustment value | VinP15 formula                                  |
|-------------------|------------------------|-------------------------------------------------|
| VinP15            | VRP4 5-0 = 000000      | $(146R / 450R) * (VSPR - VGSP) + VGSP$          |
|                   | VRP4 5-0 = 000001      | $((146R - 2R) / 450R) * (VSPR - VGSP) + VGSP$   |
|                   | VRP4 5-0 = 000010      | $((146R - 4R) / 450R) * (VSPR - VGSP) + VGSP$   |
|                   | VRP4 5-0 = 000011      | $((146R - 6R) / 450R) * (VSPR - VGSP) + VGSP$   |
|                   | VRP4 5-0 = 000100      | $((146R - 8R) / 450R) * (VSPR - VGSP) + VGSP$   |
|                   | VRP4 5-0 = 000101      | $((146R - 10R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP4 5-0 = 000110      | $((146R - 12R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP4 5-0 = 000111      | $((146R - 14R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP4 5-0 = 001000      | $((146R - 16R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP4 5-0 = 001001      | $((146R - 18R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP4 5-0 = 001010      | $((146R - 20R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP4 5-0 = 001011      | $((146R - 22R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP4 5-0 = 001100      | $((146R - 24R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP4 5-0 = 001101      | $((146R - 26R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP4 5-0 = 001110      | $((146R - 28R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP4 5-0 = 001111      | $((146R - 30R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP4 5-0 = 010000      | $((146R - 32R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP4 5-0 = 010001      | $((146R - 34R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP4 5-0 = 010010      | $((146R - 36R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP4 5-0 = 010011      | $((146R - 38R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP4 5-0 = 010100      | $((146R - 40R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP4 5-0 = 010101      | $((146R - 42R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP4 5-0 = 010110      | $((146R - 44R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP4 5-0 = 010111      | $((146R - 46R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP4 5-0 = 011000      | $((146R - 48R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP4 5-0 = 011001      | $((146R - 50R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP4 5-0 = 011010      | $((146R - 52R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP4 5-0 = 011011      | $((146R - 54R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP4 5-0 = 011100      | $((146R - 56R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP4 5-0 = 011101      | $((146R - 58R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP4 5-0 = 011110      | $((146R - 60R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP4 5-0 = 011111      | $((146R - 62R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP4 5-0 = 100000      | $((146R - 64R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP4 5-0 = 100001      | $((146R - 66R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP4 5-0 = 100010      | $((146R - 68R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP4 5-0 = 100011      | $((146R - 70R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP4 5-0 = 100100      | $((146R - 72R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP4 5-0 = 100101      | $((146R - 74R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP4 5-0 = 100110      | $((146R - 76R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP4 5-0 = 100111      | $((146R - 78R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP4 5-0 = 101000      | $((146R - 80R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP4 5-0 = 101001      | $((146R - 82R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP4 5-0 = 101010      | $((146R - 84R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP4 5-0 = 101011      | $((146R - 86R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP4 5-0 = 101100      | $((146R - 88R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP4 5-0 = 101101      | $((146R - 90R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP4 5-0 = 101110      | $((146R - 92R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP4 5-0 = 101111      | $((146R - 94R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP4 5-0 = 110000      | $((146R - 96R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP4 5-0 = 110001      | $((146R - 98R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP4 5-0 = 110010      | $((146R - 100R) / 450R) * (VSPR - VGSP) + VGSP$ |
|                   | VRP4 5-0 = 110011      | $((146R - 102R) / 450R) * (VSPR - VGSP) + VGSP$ |
|                   | VRP4 5-0 = 110100      | $((146R - 104R) / 450R) * (VSPR - VGSP) + VGSP$ |
|                   | VRP4 5-0 = 110101      | $((146R - 106R) / 450R) * (VSPR - VGSP) + VGSP$ |
|                   | VRP4 5-0 = 110110      | $((146R - 108R) / 450R) * (VSPR - VGSP) + VGSP$ |
|                   | VRP4 5-0 = 110111      | $((146R - 110R) / 450R) * (VSPR - VGSP) + VGSP$ |
|                   | VRP4 5-0 = 111000      | $((146R - 112R) / 450R) * (VSPR - VGSP) + VGSP$ |
|                   | VRP4 5-0 = 111001      | $((146R - 114R) / 450R) * (VSPR - VGSP) + VGSP$ |
|                   | VRP4 5-0 = 111010      | $((146R - 116R) / 450R) * (VSPR - VGSP) + VGSP$ |
|                   | VRP4 5-0 = 111011      | $((146R - 118R) / 450R) * (VSPR - VGSP) + VGSP$ |
|                   | VRP4 5-0 = 111100      | $((146R - 120R) / 450R) * (VSPR - VGSP) + VGSP$ |
|                   | VRP4 5-0 = 111101      | $((146R - 122R) / 450R) * (VSPR - VGSP) + VGSP$ |
|                   | VRP4 5-0 = 111110      | $((146R - 124R) / 450R) * (VSPR - VGSP) + VGSP$ |
|                   | VRP4 5-0 = 111111      | $((146R - 126R) / 450R) * (VSPR - VGSP) + VGSP$ |

Table 5.28: VinP15



| Reference voltage | Macro adjustment value | VinP16 formula                                  |
|-------------------|------------------------|-------------------------------------------------|
| VinP16            | VRP5 5-0 = 000000      | $(144R / 450R) * (VSPR - VGSP) + VGSP$          |
|                   | VRP5 5-0 = 000001      | $((144R - 2R) / 450R) * (VSPR - VGSP) + VGSP$   |
|                   | VRP5 5-0 = 000010      | $((144R - 4R) / 450R) * (VSPR - VGSP) + VGSP$   |
|                   | VRP5 5-0 = 000011      | $((144R - 6R) / 450R) * (VSPR - VGSP) + VGSP$   |
|                   | VRP5 5-0 = 000100      | $((144R - 8R) / 450R) * (VSPR - VGSP) + VGSP$   |
|                   | VRP5 5-0 = 000101      | $((144R - 10R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP5 5-0 = 000110      | $((144R - 12R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP5 5-0 = 000111      | $((144R - 14R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP5 5-0 = 001000      | $((144R - 16R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP5 5-0 = 001001      | $((144R - 18R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP5 5-0 = 001010      | $((144R - 20R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP5 5-0 = 001011      | $((144R - 22R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP5 5-0 = 001100      | $((144R - 24R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP5 5-0 = 001101      | $((144R - 26R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP5 5-0 = 001110      | $((144R - 28R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP5 5-0 = 001111      | $((144R - 30R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP5 5-0 = 010000      | $((144R - 32R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP5 5-0 = 010001      | $((144R - 34R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP5 5-0 = 010010      | $((144R - 36R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP5 5-0 = 010011      | $((144R - 38R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP5 5-0 = 010100      | $((144R - 40R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP5 5-0 = 010101      | $((144R - 42R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP5 5-0 = 010110      | $((144R - 44R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP5 5-0 = 010111      | $((144R - 46R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP5 5-0 = 011000      | $((144R - 48R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP5 5-0 = 011001      | $((144R - 50R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP5 5-0 = 011010      | $((144R - 52R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP5 5-0 = 011011      | $((144R - 54R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP5 5-0 = 011100      | $((144R - 56R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP5 5-0 = 011101      | $((144R - 58R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP5 5-0 = 011110      | $((144R - 60R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP5 5-0 = 011111      | $((144R - 62R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP5 5-0 = 100000      | $((144R - 64R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP5 5-0 = 100001      | $((144R - 66R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP5 5-0 = 100010      | $((144R - 68R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP5 5-0 = 100011      | $((144R - 70R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP5 5-0 = 100100      | $((144R - 72R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP5 5-0 = 100101      | $((144R - 74R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP5 5-0 = 100110      | $((144R - 76R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP5 5-0 = 100111      | $((144R - 78R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP5 5-0 = 101000      | $((144R - 80R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP5 5-0 = 101001      | $((144R - 82R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP5 5-0 = 101010      | $((144R - 84R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP5 5-0 = 101011      | $((144R - 86R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP5 5-0 = 101100      | $((144R - 88R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP5 5-0 = 101101      | $((144R - 90R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP5 5-0 = 101110      | $((144R - 92R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP5 5-0 = 101111      | $((144R - 94R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP5 5-0 = 110000      | $((144R - 96R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP5 5-0 = 110001      | $((144R - 98R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | VRP5 5-0 = 110010      | $((144R - 100R) / 450R) * (VSPR - VGSP) + VGSP$ |
|                   | VRP5 5-0 = 110011      | $((144R - 102R) / 450R) * (VSPR - VGSP) + VGSP$ |
|                   | VRP5 5-0 = 110100      | $((144R - 104R) / 450R) * (VSPR - VGSP) + VGSP$ |
|                   | VRP5 5-0 = 110101      | $((144R - 106R) / 450R) * (VSPR - VGSP) + VGSP$ |
|                   | VRP5 5-0 = 110110      | $((144R - 108R) / 450R) * (VSPR - VGSP) + VGSP$ |
|                   | VRP5 5-0 = 110111      | $((144R - 110R) / 450R) * (VSPR - VGSP) + VGSP$ |
|                   | VRP5 5-0 = 111000      | $((144R - 112R) / 450R) * (VSPR - VGSP) + VGSP$ |
|                   | VRP5 5-0 = 111001      | $((144R - 114R) / 450R) * (VSPR - VGSP) + VGSP$ |
|                   | VRP5 5-0 = 111010      | $((144R - 116R) / 450R) * (VSPR - VGSP) + VGSP$ |
|                   | VRP5 5-0 = 111011      | $((144R - 118R) / 450R) * (VSPR - VGSP) + VGSP$ |
|                   | VRP5 5-0 = 111100      | $((144R - 120R) / 450R) * (VSPR - VGSP) + VGSP$ |
|                   | VRP5 5-0 = 111101      | $((144R - 122R) / 450R) * (VSPR - VGSP) + VGSP$ |
|                   | VRP5 5-0 = 111110      | $((144R - 124R) / 450R) * (VSPR - VGSP) + VGSP$ |
|                   | VRP5 5-0 = 111111      | VGSP                                            |

Table 5.29: VinP16

| Reference voltage | Macro adjustment value | VinP5 formula                                   |
|-------------------|------------------------|-------------------------------------------------|
| VinP5             | PRP0 6-0 = 0000000     | $(350R / 450R) (VSPR - VGSP) + VGSP$            |
|                   | PRP0 6-0 = 0000001     | $((350R - 2R) / 450R) * (VSPR - VGSP) + VGSP$   |
|                   | PRP0 6-0 = 0000010     | $((350R - 4R) / 450R) * (VSPR - VGSP) + VGSP$   |
|                   | PRP0 6-0 = 0000011     | $((350R - 6R) / 450R) * (VSPR - VGSP) + VGSP$   |
|                   | PRP0 6-0 = 0000100     | $((350R - 8R) / 450R) * (VSPR - VGSP) + VGSP$   |
|                   | PRP0 6-0 = 0000101     | $((350R - 10R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | PRP0 6-0 = 0000110     | $((350R - 12R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | PRP0 6-0 = 0000111     | $((350R - 14R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | PRP0 6-0 = 0001000     | $((350R - 16R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | PRP0 6-0 = 0001001     | $((350R - 18R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | PRP0 6-0 = 0001010     | $((350R - 20R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | PRP0 6-0 = 0001011     | $((350R - 22R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | PRP0 6-0 = 0001100     | $((350R - 24R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | PRP0 6-0 = 0001101     | $((350R - 26R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | PRP0 6-0 = 0001110     | $((350R - 28R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | PRP0 6-0 = 0001111     | $((350R - 30R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | PRP0 6-0 = 0010000     | $((350R - 32R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | PRP0 6-0 = 0010001     | $((350R - 34R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | PRP0 6-0 = 0010010     | $((350R - 36R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | PRP0 6-0 = 0010011     | $((350R - 38R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | PRP0 6-0 = 0010100     | $((350R - 40R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | PRP0 6-0 = 0010101     | $((350R - 42R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | PRP0 6-0 = 0010110     | $((350R - 44R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | PRP0 6-0 = 0010111     | $((350R - 46R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | PRP0 6-0 = 0011000     | $((350R - 48R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | PRP0 6-0 = 0011001     | $((350R - 50R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | PRP0 6-0 = 0011010     | $((350R - 52R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | PRP0 6-0 = 0011011     | $((350R - 54R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | PRP0 6-0 = 0011100     | $((350R - 56R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | PRP0 6-0 = 0011101     | $((350R - 58R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | PRP0 6-0 = 0011110     | $((350R - 60R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | PRP0 6-0 = 0011111     | $((350R - 62R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | PRP0 6-0 = 0100000     | $((350R - 64R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | PRP0 6-0 = 0100001     | $((350R - 66R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | PRP0 6-0 = 0100010     | $((350R - 68R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | PRP0 6-0 = 0100011     | $((350R - 70R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | PRP0 6-0 = 0100100     | $((350R - 72R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | PRP0 6-0 = 0100101     | $((350R - 74R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | PRP0 6-0 = 0100110     | $((350R - 76R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | PRP0 6-0 = 0100111     | $((350R - 78R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | PRP0 6-0 = 0101000     | $((350R - 80R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | PRP0 6-0 = 0101001     | $((350R - 82R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | PRP0 6-0 = 0101010     | $((350R - 84R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | PRP0 6-0 = 0101011     | $((350R - 86R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | PRP0 6-0 = 0101100     | $((350R - 88R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | PRP0 6-0 = 0101101     | $((350R - 90R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | PRP0 6-0 = 0101110     | $((350R - 92R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | PRP0 6-0 = 0101111     | $((350R - 94R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | PRP0 6-0 = 0110000     | $((350R - 96R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | PRP0 6-0 = 0110001     | $((350R - 98R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | PRP0 6-0 = 0110010     | $((350R - 100R) / 450R) * (VSPR - VGSP) + VGSP$ |
|                   | PRP0 6-0 = 0110011     | $((350R - 102R) / 450R) * (VSPR - VGSP) + VGSP$ |
|                   | PRP0 6-0 = 0110100     | $((350R - 104R) / 450R) * (VSPR - VGSP) + VGSP$ |
|                   | PRP0 6-0 = 0110101     | $((350R - 106R) / 450R) * (VSPR - VGSP) + VGSP$ |
|                   | PRP0 6-0 = 0110110     | $((350R - 108R) / 450R) * (VSPR - VGSP) + VGSP$ |
|                   | PRP0 6-0 = 0110111     | $((350R - 110R) / 450R) * (VSPR - VGSP) + VGSP$ |
|                   | PRP0 6-0 = 0111000     | $((350R - 112R) / 450R) * (VSPR - VGSP) + VGSP$ |
|                   | PRP0 6-0 = 0111001     | $((350R - 114R) / 450R) * (VSPR - VGSP) + VGSP$ |
|                   | PRP0 6-0 = 0111010     | $((350R - 116R) / 450R) * (VSPR - VGSP) + VGSP$ |
|                   | PRP0 6-0 = 0111011     | $((350R - 118R) / 450R) * (VSPR - VGSP) + VGSP$ |
|                   | PRP0 6-0 = 0111100     | $((350R - 120R) / 450R) * (VSPR - VGSP) + VGSP$ |
|                   | PRP0 6-0 = 0111101     | $((350R - 122R) / 450R) * (VSPR - VGSP) + VGSP$ |
|                   | PRP0 6-0 = 0111110     | $((350R - 124R) / 450R) * (VSPR - VGSP) + VGSP$ |
|                   | PRP0 6-0 = 0111111     | $((350R - 126R) / 450R) * (VSPR - VGSP) + VGSP$ |
|                   | PRP0 6-0 = 1000000     | $((350R - 128R) / 450R) * (VSPR - VGSP) + VGSP$ |
|                   | PRP0 6-0 = 1000001     | $((350R - 130R) / 450R) * (VSPR - VGSP) + VGSP$ |
|                   | PRP0 6-0 = 1000010     | $((350R - 132R) / 450R) * (VSPR - VGSP) + VGSP$ |
|                   | PRP0 6-0 = 1000011     | $((350R - 134R) / 450R) * (VSPR - VGSP) + VGSP$ |
|                   | PRP0 6-0 = 1000100     | $((350R - 136R) / 450R) * (VSPR - VGSP) + VGSP$ |

|                    |                                                 |
|--------------------|-------------------------------------------------|
| PRP0 6-0 = 1000101 | $((350R - 138R) / 450R) * (VSPR - VGSP) + VGSP$ |
| PRP0 6-0 = 1000110 | $((350R - 140R) / 450R) * (VSPR - VGSP) + VGSP$ |
| PRP0 6-0 = 1000111 | $((350R - 142R) / 450R) * (VSPR - VGSP) + VGSP$ |
| PRP0 6-0 = 1001000 | $((350R - 144R) / 450R) * (VSPR - VGSP) + VGSP$ |
| PRP0 6-0 = 1001001 | $((350R - 146R) / 450R) * (VSPR - VGSP) + VGSP$ |
| PRP0 6-0 = 1001010 | $((350R - 148R) / 450R) * (VSPR - VGSP) + VGSP$ |
| PRP0 6-0 = 1001011 | $((350R - 150R) / 450R) * (VSPR - VGSP) + VGSP$ |
| PRP0 6-0 = 1001100 | $((350R - 152R) / 450R) * (VSPR - VGSP) + VGSP$ |
| PRP0 6-0 = 1001101 | $((350R - 154R) / 450R) * (VSPR - VGSP) + VGSP$ |
| PRP0 6-0 = 1001110 | $((350R - 156R) / 450R) * (VSPR - VGSP) + VGSP$ |
| PRP0 6-0 = 1001111 | $((350R - 158R) / 450R) * (VSPR - VGSP) + VGSP$ |
| PRP0 6-0 = 1010000 | $((350R - 160R) / 450R) * (VSPR - VGSP) + VGSP$ |
| PRP0 6-0 = 1010001 | $((350R - 162R) / 450R) * (VSPR - VGSP) + VGSP$ |
| PRP0 6-0 = 1010010 | $((350R - 164R) / 450R) * (VSPR - VGSP) + VGSP$ |
| PRP0 6-0 = 1010011 | $((350R - 166R) / 450R) * (VSPR - VGSP) + VGSP$ |
| PRP0 6-0 = 1010100 | $((350R - 168R) / 450R) * (VSPR - VGSP) + VGSP$ |
| PRP0 6-0 = 1010101 | $((350R - 170R) / 450R) * (VSPR - VGSP) + VGSP$ |
| PRP0 6-0 = 1010110 | $((350R - 172R) / 450R) * (VSPR - VGSP) + VGSP$ |
| PRP0 6-0 = 1010111 | $((350R - 174R) / 450R) * (VSPR - VGSP) + VGSP$ |
| PRP0 6-0 = 1011000 | inhibit                                         |
| PRP0 6-0 = 1011001 | inhibit                                         |
| PRP0 6-0 = 1011010 | inhibit                                         |
| PRP0 6-0 = 1011011 | inhibit                                         |
| PRP0 6-0 = 1011100 | inhibit                                         |
| PRP0 6-0 = 1011101 | inhibit                                         |
| PRP0 6-0 = 1011110 | inhibit                                         |
| PRP0 6-0 = 1011111 | inhibit                                         |
| PRP0 6-0 = 1100000 | inhibit                                         |
| PRP0 6-0 = 1100001 | inhibit                                         |
| PRP0 6-0 = 1100010 | inhibit                                         |
| PRP0 6-0 = 1100011 | inhibit                                         |
| PRP0 6-0 = 1100100 | inhibit                                         |
| PRP0 6-0 = 1100101 | inhibit                                         |
| PRP0 6-0 = 1100110 | inhibit                                         |
| PRP0 6-0 = 1100111 | inhibit                                         |
| PRP0 6-0 = 1101000 | inhibit                                         |
| PRP0 6-0 = 1101001 | inhibit                                         |
| PRP0 6-0 = 1101010 | inhibit                                         |
| PRP0 6-0 = 1101011 | inhibit                                         |
| PRP0 6-0 = 1101100 | inhibit                                         |
| PRP0 6-0 = 1101101 | inhibit                                         |
| PRP0 6-0 = 1101110 | inhibit                                         |
| PRP0 6-0 = 1101111 | inhibit                                         |
| PRP0 6-0 = 1110000 | inhibit                                         |
| PRP0 6-0 = 1110001 | inhibit                                         |
| PRP0 6-0 = 1110010 | inhibit                                         |
| PRP0 6-0 = 1110011 | inhibit                                         |
| PRP0 6-0 = 1110100 | inhibit                                         |
| PRP0 6-0 = 1110101 | inhibit                                         |
| PRP0 6-0 = 1110110 | inhibit                                         |
| PRP0 6-0 = 1110111 | inhibit                                         |
| PRP0 6-0 = 1111000 | inhibit                                         |
| PRP0 6-0 = 1111001 | inhibit                                         |
| PRP0 6-0 = 1111010 | inhibit                                         |
| PRP0 6-0 = 1111011 | inhibit                                         |
| PRP0 6-0 = 1111100 | inhibit                                         |
| PRP0 6-0 = 1111101 | inhibit                                         |
| PRP0 6-0 = 1111110 | inhibit                                         |
| PRP0 6-0 = 1111111 | inhibit                                         |

Table 5.30: VinP5



| Reference voltage | Macro adjustment value | VinP11 formula                                  |
|-------------------|------------------------|-------------------------------------------------|
| VinP11            | PRP1 6-0 = 0000000     | $(274R / 450R) (VSPR - VGSP) + VGSP$            |
|                   | PRP1 6-0 = 0000001     | $((274R - 2R) / 450R) * (VSPR - VGSP) + VGSP$   |
|                   | PRP1 6-0 = 0000010     | $((274R - 4R) / 450R) * (VSPR - VGSP) + VGSP$   |
|                   | PRP1 6-0 = 0000011     | $((274R - 6R) / 450R) * (VSPR - VGSP) + VGSP$   |
|                   | PRP1 6-0 = 0000100     | $((274R - 8R) / 450R) * (VSPR - VGSP) + VGSP$   |
|                   | PRP1 6-0 = 0000101     | $((274R - 10R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | PRP1 6-0 = 0000110     | $((274R - 12R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | PRP1 6-0 = 0000111     | $((274R - 14R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | PRP1 6-0 = 0001000     | $((274R - 16R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | PRP1 6-0 = 0001001     | $((274R - 18R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | PRP1 6-0 = 0001010     | $((274R - 20R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | PRP1 6-0 = 0001011     | $((274R - 22R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | PRP1 6-0 = 0001100     | $((274R - 24R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | PRP1 6-0 = 0001101     | $((274R - 26R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | PRP1 6-0 = 0001110     | $((274R - 28R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | PRP1 6-0 = 0001111     | $((274R - 30R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | PRP1 6-0 = 0010000     | $((274R - 32R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | PRP1 6-0 = 0010001     | $((274R - 34R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | PRP1 6-0 = 0010010     | $((274R - 36R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | PRP1 6-0 = 0010011     | $((274R - 38R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | PRP1 6-0 = 0010100     | $((274R - 40R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | PRP1 6-0 = 0010101     | $((274R - 42R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | PRP1 6-0 = 0010110     | $((274R - 44R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | PRP1 6-0 = 0010111     | $((274R - 46R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | PRP1 6-0 = 0011000     | $((274R - 48R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | PRP1 6-0 = 0011001     | $((274R - 50R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | PRP1 6-0 = 0011010     | $((274R - 52R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | PRP1 6-0 = 0011011     | $((274R - 54R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | PRP1 6-0 = 0011100     | $((274R - 56R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | PRP1 6-0 = 0011101     | $((274R - 58R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | PRP1 6-0 = 0011110     | $((274R - 60R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | PRP1 6-0 = 0011111     | $((274R - 62R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | PRP1 6-0 = 0100000     | $((274R - 64R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | PRP1 6-0 = 0100001     | $((274R - 66R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | PRP1 6-0 = 0100010     | $((274R - 68R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | PRP1 6-0 = 0100011     | $((274R - 70R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | PRP1 6-0 = 0100100     | $((274R - 72R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | PRP1 6-0 = 0100101     | $((274R - 74R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | PRP1 6-0 = 0100110     | $((274R - 76R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | PRP1 6-0 = 0100111     | $((274R - 78R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | PRP1 6-0 = 0101000     | $((274R - 80R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | PRP1 6-0 = 0101001     | $((274R - 82R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | PRP1 6-0 = 0101010     | $((274R - 84R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | PRP1 6-0 = 0101011     | $((274R - 86R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | PRP1 6-0 = 0101100     | $((274R - 88R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | PRP1 6-0 = 0101101     | $((274R - 90R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | PRP1 6-0 = 0101110     | $((274R - 92R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | PRP1 6-0 = 0101111     | $((274R - 94R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | PRP1 6-0 = 0110000     | $((274R - 96R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | PRP1 6-0 = 0110001     | $((274R - 98R) / 450R) * (VSPR - VGSP) + VGSP$  |
|                   | PRP1 6-0 = 0110010     | $((274R - 100R) / 450R) * (VSPR - VGSP) + VGSP$ |
|                   | PRP1 6-0 = 0110011     | $((274R - 102R) / 450R) * (VSPR - VGSP) + VGSP$ |
|                   | PRP1 6-0 = 0110100     | $((274R - 104R) / 450R) * (VSPR - VGSP) + VGSP$ |
|                   | PRP1 6-0 = 0110101     | $((274R - 106R) / 450R) * (VSPR - VGSP) + VGSP$ |
|                   | PRP1 6-0 = 0110110     | $((274R - 108R) / 450R) * (VSPR - VGSP) + VGSP$ |
|                   | PRP1 6-0 = 0110111     | $((274R - 110R) / 450R) * (VSPR - VGSP) + VGSP$ |
|                   | PRP1 6-0 = 0111000     | $((274R - 112R) / 450R) * (VSPR - VGSP) + VGSP$ |
|                   | PRP1 6-0 = 0111001     | $((274R - 114R) / 450R) * (VSPR - VGSP) + VGSP$ |
|                   | PRP1 6-0 = 0111010     | $((274R - 116R) / 450R) * (VSPR - VGSP) + VGSP$ |
|                   | PRP1 6-0 = 0111011     | $((274R - 118R) / 450R) * (VSPR - VGSP) + VGSP$ |
|                   | PRP1 6-0 = 0111100     | $((274R - 120R) / 450R) * (VSPR - VGSP) + VGSP$ |
|                   | PRP1 6-0 = 0111101     | $((274R - 122R) / 450R) * (VSPR - VGSP) + VGSP$ |
|                   | PRP1 6-0 = 0111110     | $((274R - 124R) / 450R) * (VSPR - VGSP) + VGSP$ |
|                   | PRP1 6-0 = 0111111     | $((274R - 126R) / 450R) * (VSPR - VGSP) + VGSP$ |
|                   | PRP1 6-0 = 1000000     | $((274R - 128R) / 450R) * (VSPR - VGSP) + VGSP$ |
|                   | PRP1 6-0 = 1000001     | $((274R - 130R) / 450R) * (VSPR - VGSP) + VGSP$ |
|                   | PRP1 6-0 = 1000010     | $((274R - 132R) / 450R) * (VSPR - VGSP) + VGSP$ |
|                   | PRP1 6-0 = 1000011     | $((274R - 134R) / 450R) * (VSPR - VGSP) + VGSP$ |
|                   | PRP1 6-0 = 1000100     | $((274R - 136R) / 450R) * (VSPR - VGSP) + VGSP$ |

|                    |                                                 |
|--------------------|-------------------------------------------------|
| PRP1 6-0 = 1000101 | $((274R - 138R) / 450R) * (VSPR - VGSP) + VGSP$ |
| PRP1 6-0 = 1000110 | $((274R - 140R) / 450R) * (VSPR - VGSP) + VGSP$ |
| PRP1 6-0 = 1000111 | $((274R - 142R) / 450R) * (VSPR - VGSP) + VGSP$ |
| PRP1 6-0 = 1001000 | $((274R - 144R) / 450R) * (VSPR - VGSP) + VGSP$ |
| PRP1 6-0 = 1001001 | $((274R - 146R) / 450R) * (VSPR - VGSP) + VGSP$ |
| PRP1 6-0 = 1001010 | $((274R - 148R) / 450R) * (VSPR - VGSP) + VGSP$ |
| PRP1 6-0 = 1001011 | $((274R - 150R) / 450R) * (VSPR - VGSP) + VGSP$ |
| PRP1 6-0 = 1001100 | $((274R - 152R) / 450R) * (VSPR - VGSP) + VGSP$ |
| PRP1 6-0 = 1001101 | $((274R - 154R) / 450R) * (VSPR - VGSP) + VGSP$ |
| PRP1 6-0 = 1001110 | $((274R - 156R) / 450R) * (VSPR - VGSP) + VGSP$ |
| PRP1 6-0 = 1001111 | $((274R - 158R) / 450R) * (VSPR - VGSP) + VGSP$ |
| PRP1 6-0 = 1010000 | $((274R - 160R) / 450R) * (VSPR - VGSP) + VGSP$ |
| PRP1 6-0 = 1010001 | $((274R - 162R) / 450R) * (VSPR - VGSP) + VGSP$ |
| PRP1 6-0 = 1010010 | $((274R - 164R) / 450R) * (VSPR - VGSP) + VGSP$ |
| PRP1 6-0 = 1010011 | $((274R - 166R) / 450R) * (VSPR - VGSP) + VGSP$ |
| PRP1 6-0 = 1010100 | $((274R - 168R) / 450R) * (VSPR - VGSP) + VGSP$ |
| PRP1 6-0 = 1010101 | $((274R - 170R) / 450R) * (VSPR - VGSP) + VGSP$ |
| PRP1 6-0 = 1010110 | $((274R - 172R) / 450R) * (VSPR - VGSP) + VGSP$ |
| PRP1 6-0 = 1010111 | $((274R - 174R) / 450R) * (VSPR - VGSP) + VGSP$ |
| PRP1 6-0 = 1011000 | inhibit                                         |
| PRP1 6-0 = 1011001 | inhibit                                         |
| PRP1 6-0 = 1011010 | inhibit                                         |
| PRP1 6-0 = 1011011 | inhibit                                         |
| PRP1 6-0 = 1011100 | inhibit                                         |
| PRP1 6-0 = 1011101 | inhibit                                         |
| PRP1 6-0 = 1011110 | inhibit                                         |
| PRP1 6-0 = 1011111 | inhibit                                         |
| PRP1 6-0 = 1100000 | inhibit                                         |
| PRP1 6-0 = 1100001 | inhibit                                         |
| PRP1 6-0 = 1100010 | inhibit                                         |
| PRP1 6-0 = 1100011 | inhibit                                         |
| PRP1 6-0 = 1100100 | inhibit                                         |
| PRP1 6-0 = 1100101 | inhibit                                         |
| PRP1 6-0 = 1100110 | inhibit                                         |
| PRP1 6-0 = 1100111 | inhibit                                         |
| PRP1 6-0 = 1101000 | inhibit                                         |
| PRP1 6-0 = 1101001 | inhibit                                         |
| PRP1 6-0 = 1101010 | inhibit                                         |
| PRP1 6-0 = 1101011 | inhibit                                         |
| PRP1 6-0 = 1101100 | inhibit                                         |
| PRP1 6-0 = 1101101 | inhibit                                         |
| PRP1 6-0 = 1101110 | inhibit                                         |
| PRP1 6-0 = 1101111 | inhibit                                         |
| PRP1 6-0 = 1110000 | inhibit                                         |
| PRP1 6-0 = 1110001 | inhibit                                         |
| PRP1 6-0 = 1110010 | inhibit                                         |
| PRP1 6-0 = 1110011 | inhibit                                         |
| PRP1 6-0 = 1110100 | inhibit                                         |
| PRP1 6-0 = 1110101 | inhibit                                         |
| PRP1 6-0 = 1110110 | inhibit                                         |
| PRP1 6-0 = 1110111 | inhibit                                         |
| PRP1 6-0 = 1111000 | inhibit                                         |
| PRP1 6-0 = 1111001 | inhibit                                         |
| PRP1 6-0 = 1111010 | inhibit                                         |
| PRP1 6-0 = 1111011 | inhibit                                         |
| PRP1 6-0 = 1111100 | inhibit                                         |
| PRP1 6-0 = 1111101 | inhibit                                         |
| PRP1 6-0 = 1111110 | inhibit                                         |
| PRP1 6-0 = 1111111 | inhibit                                         |

Table 5.31: VinP11

| Reference voltage | Macro adjustment value | VinP3 formula                                   |
|-------------------|------------------------|-------------------------------------------------|
| VinP3             | PKP0 4-0 = 00000       | $(47R / 48R) * (VinP2 - VinP5) + VinP5$         |
|                   | PKP0 4-0 = 00001       | $((47R - 1R) / 48R) * (VinP2 - VinP5) + VinP5$  |
|                   | PKP0 4-0 = 00010       | $((47R - 2R) / 48R) * (VinP2 - VinP5) + VinP5$  |
|                   | PKP0 4-0 = 00011       | $((47R - 3R) / 48R) * (VinP2 - VinP5) + VinP5$  |
|                   | PKP0 4-0 = 00100       | $((47R - 4R) / 48R) * (VinP2 - VinP5) + VinP5$  |
|                   | PKP0 4-0 = 00101       | $((47R - 5R) / 48R) * (VinP2 - VinP5) + VinP5$  |
|                   | PKP0 4-0 = 00110       | $((47R - 6R) / 48R) * (VinP2 - VinP5) + VinP5$  |
|                   | PKP0 4-0 = 00111       | $((47R - 7R) / 48R) * (VinP2 - VinP5) + VinP5$  |
|                   | PKP0 4-0 = 01000       | $((47R - 8R) / 48R) * (VinP2 - VinP5) + VinP5$  |
|                   | PKP0 4-0 = 01001       | $((47R - 9R) / 48R) * (VinP2 - VinP5) + VinP5$  |
|                   | PKP0 4-0 = 01010       | $((47R - 10R) / 48R) * (VinP2 - VinP5) + VinP5$ |
|                   | PKP0 4-0 = 01011       | $((47R - 11R) / 48R) * (VinP2 - VinP5) + VinP5$ |
|                   | PKP0 4-0 = 01100       | $((47R - 12R) / 48R) * (VinP2 - VinP5) + VinP5$ |
|                   | PKP0 4-0 = 01101       | $((47R - 13R) / 48R) * (VinP2 - VinP5) + VinP5$ |
|                   | PKP0 4-0 = 01110       | $((47R - 14R) / 48R) * (VinP2 - VinP5) + VinP5$ |
|                   | PKP0 4-0 = 01111       | $((47R - 15R) / 48R) * (VinP2 - VinP5) + VinP5$ |
|                   | PKP0 4-0 = 10000       | $((47R - 16R) / 48R) * (VinP2 - VinP5) + VinP5$ |
|                   | PKP0 4-0 = 10001       | $((47R - 17R) / 48R) * (VinP2 - VinP5) + VinP5$ |
|                   | PKP0 4-0 = 10010       | $((47R - 18R) / 48R) * (VinP2 - VinP5) + VinP5$ |
|                   | PKP0 4-0 = 10011       | $((47R - 19R) / 48R) * (VinP2 - VinP5) + VinP5$ |
|                   | PKP0 4-0 = 10100       | $((47R - 20R) / 48R) * (VinP2 - VinP5) + VinP5$ |
|                   | PKP0 4-0 = 10101       | $((47R - 21R) / 48R) * (VinP2 - VinP5) + VinP5$ |
|                   | PKP0 4-0 = 10110       | $((47R - 22R) / 48R) * (VinP2 - VinP5) + VinP5$ |
|                   | PKP0 4-0 = 10111       | $((47R - 23R) / 48R) * (VinP2 - VinP5) + VinP5$ |
|                   | PKP0 4-0 = 11000       | $((47R - 24R) / 48R) * (VinP2 - VinP5) + VinP5$ |
|                   | PKP0 4-0 = 11001       | $((47R - 25R) / 48R) * (VinP2 - VinP5) + VinP5$ |
|                   | PKP0 4-0 = 11010       | $((47R - 26R) / 48R) * (VinP2 - VinP5) + VinP5$ |
|                   | PKP0 4-0 = 11011       | $((47R - 27R) / 48R) * (VinP2 - VinP5) + VinP5$ |
|                   | PKP0 4-0 = 11100       | $((47R - 28R) / 48R) * (VinP2 - VinP5) + VinP5$ |
|                   | PKP0 4-0 = 11101       | $((47R - 29R) / 48R) * (VinP2 - VinP5) + VinP5$ |
|                   | PKP0 4-0 = 11110       | $((47R - 30R) / 48R) * (VinP2 - VinP5) + VinP5$ |
|                   | PKP0 4-0 = 11111       | $((47R - 31R) / 48R) * (VinP2 - VinP5) + VinP5$ |

Table 5.32: VinP3

| Reference voltage | Macro adjustment value | VinP4 formula                                   |
|-------------------|------------------------|-------------------------------------------------|
| VinP4             | PKP1 4-0 = 00000       | $(32R / 48R) * (VinP2 - VinP5) + VinP5$         |
|                   | PKP1 4-0 = 00001       | $((32R - 1R) / 48R) * (VinP2 - VinP5) + VinP5$  |
|                   | PKP1 4-0 = 00010       | $((32R - 2R) / 48R) * (VinP2 - VinP5) + VinP5$  |
|                   | PKP1 4-0 = 00011       | $((32R - 3R) / 48R) * (VinP2 - VinP5) + VinP5$  |
|                   | PKP1 4-0 = 00100       | $((32R - 4R) / 48R) * (VinP2 - VinP5) + VinP5$  |
|                   | PKP1 4-0 = 00101       | $((32R - 5R) / 48R) * (VinP2 - VinP5) + VinP5$  |
|                   | PKP1 4-0 = 00110       | $((32R - 6R) / 48R) * (VinP2 - VinP5) + VinP5$  |
|                   | PKP1 4-0 = 00111       | $((32R - 7R) / 48R) * (VinP2 - VinP5) + VinP5$  |
|                   | PKP1 4-0 = 01000       | $((32R - 8R) / 48R) * (VinP2 - VinP5) + VinP5$  |
|                   | PKP1 4-0 = 01001       | $((32R - 9R) / 48R) * (VinP2 - VinP5) + VinP5$  |
|                   | PKP1 4-0 = 01010       | $((32R - 10R) / 48R) * (VinP2 - VinP5) + VinP5$ |
|                   | PKP1 4-0 = 01011       | $((32R - 11R) / 48R) * (VinP2 - VinP5) + VinP5$ |
|                   | PKP1 4-0 = 01100       | $((32R - 12R) / 48R) * (VinP2 - VinP5) + VinP5$ |
|                   | PKP1 4-0 = 01101       | $((32R - 13R) / 48R) * (VinP2 - VinP5) + VinP5$ |
|                   | PKP1 4-0 = 01110       | $((32R - 14R) / 48R) * (VinP2 - VinP5) + VinP5$ |
|                   | PKP1 4-0 = 01111       | $((32R - 15R) / 48R) * (VinP2 - VinP5) + VinP5$ |
|                   | PKP1 4-0 = 10000       | $((32R - 16R) / 48R) * (VinP2 - VinP5) + VinP5$ |
|                   | PKP1 4-0 = 10001       | $((32R - 17R) / 48R) * (VinP2 - VinP5) + VinP5$ |
|                   | PKP1 4-0 = 10010       | $((32R - 18R) / 48R) * (VinP2 - VinP5) + VinP5$ |
|                   | PKP1 4-0 = 10011       | $((32R - 19R) / 48R) * (VinP2 - VinP5) + VinP5$ |
|                   | PKP1 4-0 = 10100       | $((32R - 20R) / 48R) * (VinP2 - VinP5) + VinP5$ |
|                   | PKP1 4-0 = 10101       | $((32R - 21R) / 48R) * (VinP2 - VinP5) + VinP5$ |
|                   | PKP1 4-0 = 10110       | $((32R - 22R) / 48R) * (VinP2 - VinP5) + VinP5$ |
|                   | PKP1 4-0 = 10111       | $((32R - 23R) / 48R) * (VinP2 - VinP5) + VinP5$ |
|                   | PKP1 4-0 = 11000       | $((32R - 24R) / 48R) * (VinP2 - VinP5) + VinP5$ |
|                   | PKP1 4-0 = 11001       | $((32R - 25R) / 48R) * (VinP2 - VinP5) + VinP5$ |
|                   | PKP1 4-0 = 11010       | $((32R - 26R) / 48R) * (VinP2 - VinP5) + VinP5$ |
|                   | PKP1 4-0 = 11011       | $((32R - 27R) / 48R) * (VinP2 - VinP5) + VinP5$ |
|                   | PKP1 4-0 = 11100       | $((32R - 28R) / 48R) * (VinP2 - VinP5) + VinP5$ |
|                   | PKP1 4-0 = 11101       | $((32R - 29R) / 48R) * (VinP2 - VinP5) + VinP5$ |
|                   | PKP1 4-0 = 11110       | $((32R - 30R) / 48R) * (VinP2 - VinP5) + VinP5$ |
|                   | PKP1 4-0 = 11111       | $((32R - 31R) / 48R) * (VinP2 - VinP5) + VinP5$ |

Table 5.33: VinP4

| Reference voltage | Macro adjustment value | VinP6 formula                                       |
|-------------------|------------------------|-----------------------------------------------------|
| VinP6             | PKP2 4-0 = 00000       | $(220R / 223R) * (VinP5 - VinP11) + VinP11$         |
|                   | PKP2 4-0 = 00001       | $((220R - 3R) / 223R) * (VinP5 - VinP11) + VinP11$  |
|                   | PKP2 4-0 = 00010       | $((220R - 6R) / 223R) * (VinP5 - VinP11) + VinP11$  |
|                   | PKP2 4-0 = 00011       | $((220R - 9R) / 223R) * (VinP5 - VinP11) + VinP11$  |
|                   | PKP2 4-0 = 00100       | $((220R - 12R) / 223R) * (VinP5 - VinP11) + VinP11$ |
|                   | PKP2 4-0 = 00101       | $((220R - 15R) / 223R) * (VinP5 - VinP11) + VinP11$ |
|                   | PKP2 4-0 = 00110       | $((220R - 18R) / 223R) * (VinP5 - VinP11) + VinP11$ |
|                   | PKP2 4-0 = 00111       | $((220R - 21R) / 223R) * (VinP5 - VinP11) + VinP11$ |
|                   | PKP2 4-0 = 01000       | $((220R - 24R) / 223R) * (VinP5 - VinP11) + VinP11$ |
|                   | PKP2 4-0 = 01001       | $((220R - 27R) / 223R) * (VinP5 - VinP11) + VinP11$ |
|                   | PKP2 4-0 = 01010       | $((220R - 30R) / 223R) * (VinP5 - VinP11) + VinP11$ |
|                   | PKP2 4-0 = 01011       | $((220R - 33R) / 223R) * (VinP5 - VinP11) + VinP11$ |
|                   | PKP2 4-0 = 01100       | $((220R - 36R) / 223R) * (VinP5 - VinP11) + VinP11$ |
|                   | PKP2 4-0 = 01101       | $((220R - 39R) / 223R) * (VinP5 - VinP11) + VinP11$ |
|                   | PKP2 4-0 = 01110       | $((220R - 42R) / 223R) * (VinP5 - VinP11) + VinP11$ |
|                   | PKP2 4-0 = 01111       | $((220R - 45R) / 223R) * (VinP5 - VinP11) + VinP11$ |
|                   | PKP2 4-0 = 10000       | $((220R - 48R) / 223R) * (VinP5 - VinP11) + VinP11$ |
|                   | PKP2 4-0 = 10001       | $((220R - 51R) / 223R) * (VinP5 - VinP11) + VinP11$ |
|                   | PKP2 4-0 = 10010       | $((220R - 54R) / 223R) * (VinP5 - VinP11) + VinP11$ |
|                   | PKP2 4-0 = 10011       | $((220R - 57R) / 223R) * (VinP5 - VinP11) + VinP11$ |
|                   | PKP2 4-0 = 10100       | $((220R - 60R) / 223R) * (VinP5 - VinP11) + VinP11$ |
|                   | PKP2 4-0 = 10101       | $((220R - 63R) / 223R) * (VinP5 - VinP11) + VinP11$ |
|                   | PKP2 4-0 = 10110       | $((220R - 66R) / 223R) * (VinP5 - VinP11) + VinP11$ |
|                   | PKP2 4-0 = 10111       | $((220R - 69R) / 223R) * (VinP5 - VinP11) + VinP11$ |
|                   | PKP2 4-0 = 11000       | $((220R - 72R) / 223R) * (VinP5 - VinP11) + VinP11$ |
|                   | PKP2 4-0 = 11001       | $((220R - 75R) / 223R) * (VinP5 - VinP11) + VinP11$ |
|                   | PKP2 4-0 = 11010       | $((220R - 78R) / 223R) * (VinP5 - VinP11) + VinP11$ |
|                   | PKP2 4-0 = 11011       | $((220R - 81R) / 223R) * (VinP5 - VinP11) + VinP11$ |
|                   | PKP2 4-0 = 11100       | $((220R - 84R) / 223R) * (VinP5 - VinP11) + VinP11$ |
|                   | PKP2 4-0 = 11101       | $((220R - 87R) / 223R) * (VinP5 - VinP11) + VinP11$ |
|                   | PKP2 4-0 = 11110       | $((220R - 90R) / 223R) * (VinP5 - VinP11) + VinP11$ |
|                   | PKP2 4-0 = 11111       | $((220R - 93R) / 223R) * (VinP5 - VinP11) + VinP11$ |

Table 5.34: VinP6

| Reference voltage | Macro adjustment value | VinP7 formula                                       |
|-------------------|------------------------|-----------------------------------------------------|
| VinP7             | PKP3 4-0 = 00000       | $(193R / 223R) * (VinP5 - VinP11) + VinP11$         |
|                   | PKP3 4-0 = 00001       | $((193R - 3R) / 223R) * (VinP5 - VinP11) + VinP11$  |
|                   | PKP3 4-0 = 00010       | $((193R - 6R) / 223R) * (VinP5 - VinP11) + VinP11$  |
|                   | PKP3 4-0 = 00011       | $((193R - 9R) / 223R) * (VinP5 - VinP11) + VinP11$  |
|                   | PKP3 4-0 = 00100       | $((193R - 12R) / 223R) * (VinP5 - VinP11) + VinP11$ |
|                   | PKP3 4-0 = 00101       | $((193R - 15R) / 223R) * (VinP5 - VinP11) + VinP11$ |
|                   | PKP3 4-0 = 00110       | $((193R - 18R) / 223R) * (VinP5 - VinP11) + VinP11$ |
|                   | PKP3 4-0 = 00111       | $((193R - 21R) / 223R) * (VinP5 - VinP11) + VinP11$ |
|                   | PKP3 4-0 = 01000       | $((193R - 24R) / 223R) * (VinP5 - VinP11) + VinP11$ |
|                   | PKP3 4-0 = 01001       | $((193R - 27R) / 223R) * (VinP5 - VinP11) + VinP11$ |
|                   | PKP3 4-0 = 01010       | $((193R - 30R) / 223R) * (VinP5 - VinP11) + VinP11$ |
|                   | PKP3 4-0 = 01011       | $((193R - 33R) / 223R) * (VinP5 - VinP11) + VinP11$ |
|                   | PKP3 4-0 = 01100       | $((193R - 36R) / 223R) * (VinP5 - VinP11) + VinP11$ |
|                   | PKP3 4-0 = 01101       | $((193R - 39R) / 223R) * (VinP5 - VinP11) + VinP11$ |
|                   | PKP3 4-0 = 01110       | $((193R - 42R) / 223R) * (VinP5 - VinP11) + VinP11$ |
|                   | PKP3 4-0 = 01111       | $((193R - 45R) / 223R) * (VinP5 - VinP11) + VinP11$ |
|                   | PKP3 4-0 = 10000       | $((193R - 48R) / 223R) * (VinP5 - VinP11) + VinP11$ |
|                   | PKP3 4-0 = 10001       | $((193R - 51R) / 223R) * (VinP5 - VinP11) + VinP11$ |
|                   | PKP3 4-0 = 10010       | $((193R - 54R) / 223R) * (VinP5 - VinP11) + VinP11$ |
|                   | PKP3 4-0 = 10011       | $((193R - 57R) / 223R) * (VinP5 - VinP11) + VinP11$ |
|                   | PKP3 4-0 = 10100       | $((193R - 60R) / 223R) * (VinP5 - VinP11) + VinP11$ |
|                   | PKP3 4-0 = 10101       | $((193R - 63R) / 223R) * (VinP5 - VinP11) + VinP11$ |
|                   | PKP3 4-0 = 10110       | $((193R - 66R) / 223R) * (VinP5 - VinP11) + VinP11$ |
|                   | PKP3 4-0 = 10111       | $((193R - 69R) / 223R) * (VinP5 - VinP11) + VinP11$ |
|                   | PKP3 4-0 = 11000       | $((193R - 72R) / 223R) * (VinP5 - VinP11) + VinP11$ |
|                   | PKP3 4-0 = 11001       | $((193R - 75R) / 223R) * (VinP5 - VinP11) + VinP11$ |
|                   | PKP3 4-0 = 11010       | $((193R - 78R) / 223R) * (VinP5 - VinP11) + VinP11$ |
|                   | PKP3 4-0 = 11011       | $((193R - 81R) / 223R) * (VinP5 - VinP11) + VinP11$ |
|                   | PKP3 4-0 = 11100       | $((193R - 84R) / 223R) * (VinP5 - VinP11) + VinP11$ |
|                   | PKP3 4-0 = 11101       | $((193R - 87R) / 223R) * (VinP5 - VinP11) + VinP11$ |
|                   | PKP3 4-0 = 11110       | $((193R - 90R) / 223R) * (VinP5 - VinP11) + VinP11$ |
|                   | PKP3 4-0 = 11111       | $((193R - 93R) / 223R) * (VinP5 - VinP11) + VinP11$ |

Table 5.35: VinP7

| Reference voltage | Macro adjustment value | VinP8 formula                                       |
|-------------------|------------------------|-----------------------------------------------------|
| VinP8             | PKP4 4-0 = 00000       | $(158R / 223R) * (VinP5 - VinP11) + VinP11$         |
|                   | PKP4 4-0 = 00001       | $((158R - 3R) / 223R) * (VinP5 - VinP11) + VinP11$  |
|                   | PKP4 4-0 = 00010       | $((158R - 6R) / 223R) * (VinP5 - VinP11) + VinP11$  |
|                   | PKP4 4-0 = 00011       | $((158R - 9R) / 223R) * (VinP5 - VinP11) + VinP11$  |
|                   | PKP4 4-0 = 00100       | $((158R - 12R) / 223R) * (VinP5 - VinP11) + VinP11$ |
|                   | PKP4 4-0 = 00101       | $((158R - 15R) / 223R) * (VinP5 - VinP11) + VinP11$ |
|                   | PKP4 4-0 = 00110       | $((158R - 18R) / 223R) * (VinP5 - VinP11) + VinP11$ |
|                   | PKP4 4-0 = 00111       | $((158R - 21R) / 223R) * (VinP5 - VinP11) + VinP11$ |
|                   | PKP4 4-0 = 01000       | $((158R - 24R) / 223R) * (VinP5 - VinP11) + VinP11$ |
|                   | PKP4 4-0 = 01001       | $((158R - 27R) / 223R) * (VinP5 - VinP11) + VinP11$ |
|                   | PKP4 4-0 = 01010       | $((158R - 30R) / 223R) * (VinP5 - VinP11) + VinP11$ |
|                   | PKP4 4-0 = 01011       | $((158R - 33R) / 223R) * (VinP5 - VinP11) + VinP11$ |
|                   | PKP4 4-0 = 01100       | $((158R - 36R) / 223R) * (VinP5 - VinP11) + VinP11$ |
|                   | PKP4 4-0 = 01101       | $((158R - 39R) / 223R) * (VinP5 - VinP11) + VinP11$ |
|                   | PKP4 4-0 = 01110       | $((158R - 42R) / 223R) * (VinP5 - VinP11) + VinP11$ |
|                   | PKP4 4-0 = 01111       | $((158R - 45R) / 223R) * (VinP5 - VinP11) + VinP11$ |
|                   | PKP4 4-0 = 10000       | $((158R - 48R) / 223R) * (VinP5 - VinP11) + VinP11$ |
|                   | PKP4 4-0 = 10001       | $((158R - 51R) / 223R) * (VinP5 - VinP11) + VinP11$ |
|                   | PKP4 4-0 = 10010       | $((158R - 54R) / 223R) * (VinP5 - VinP11) + VinP11$ |
|                   | PKP4 4-0 = 10011       | $((158R - 57R) / 223R) * (VinP5 - VinP11) + VinP11$ |
|                   | PKP4 4-0 = 10100       | $((158R - 60R) / 223R) * (VinP5 - VinP11) + VinP11$ |
|                   | PKP4 4-0 = 10101       | $((158R - 63R) / 223R) * (VinP5 - VinP11) + VinP11$ |
|                   | PKP4 4-0 = 10110       | $((158R - 66R) / 223R) * (VinP5 - VinP11) + VinP11$ |
|                   | PKP4 4-0 = 10111       | $((158R - 69R) / 223R) * (VinP5 - VinP11) + VinP11$ |
|                   | PKP4 4-0 = 11000       | $((158R - 72R) / 223R) * (VinP5 - VinP11) + VinP11$ |
|                   | PKP4 4-0 = 11001       | $((158R - 75R) / 223R) * (VinP5 - VinP11) + VinP11$ |
|                   | PKP4 4-0 = 11010       | $((158R - 78R) / 223R) * (VinP5 - VinP11) + VinP11$ |
|                   | PKP4 4-0 = 11011       | $((158R - 81R) / 223R) * (VinP5 - VinP11) + VinP11$ |
|                   | PKP4 4-0 = 11100       | $((158R - 84R) / 223R) * (VinP5 - VinP11) + VinP11$ |
|                   | PKP4 4-0 = 11101       | $((158R - 87R) / 223R) * (VinP5 - VinP11) + VinP11$ |
|                   | PKP4 4-0 = 11110       | $((158R - 90R) / 223R) * (VinP5 - VinP11) + VinP11$ |
|                   | PKP4 4-0 = 11111       | $((158R - 93R) / 223R) * (VinP5 - VinP11) + VinP11$ |

Table 5.36: VinP8



| Reference voltage | Macro adjustment value | VinP9 formula                                       |
|-------------------|------------------------|-----------------------------------------------------|
| VinP9             | PKP5 4-0 = 00000       | $(123R / 223R) * (VinP5 - VinP11) + VinP11$         |
|                   | PKP5 4-0 = 00001       | $((123R - 3R) / 223R) * (VinP5 - VinP11) + VinP11$  |
|                   | PKP5 4-0 = 00010       | $((123R - 6R) / 223R) * (VinP5 - VinP11) + VinP11$  |
|                   | PKP5 4-0 = 00011       | $((123R - 9R) / 223R) * (VinP5 - VinP11) + VinP11$  |
|                   | PKP5 4-0 = 00100       | $((123R - 12R) / 223R) * (VinP5 - VinP11) + VinP11$ |
|                   | PKP5 4-0 = 00101       | $((123R - 15R) / 223R) * (VinP5 - VinP11) + VinP11$ |
|                   | PKP5 4-0 = 00110       | $((123R - 18R) / 223R) * (VinP5 - VinP11) + VinP11$ |
|                   | PKP5 4-0 = 00111       | $((123R - 21R) / 223R) * (VinP5 - VinP11) + VinP11$ |
|                   | PKP5 4-0 = 01000       | $((123R - 24R) / 223R) * (VinP5 - VinP11) + VinP11$ |
|                   | PKP5 4-0 = 01001       | $((123R - 27R) / 223R) * (VinP5 - VinP11) + VinP11$ |
|                   | PKP5 4-0 = 01010       | $((123R - 30R) / 223R) * (VinP5 - VinP11) + VinP11$ |
|                   | PKP5 4-0 = 01011       | $((123R - 33R) / 223R) * (VinP5 - VinP11) + VinP11$ |
|                   | PKP5 4-0 = 01100       | $((123R - 36R) / 223R) * (VinP5 - VinP11) + VinP11$ |
|                   | PKP5 4-0 = 01101       | $((123R - 39R) / 223R) * (VinP5 - VinP11) + VinP11$ |
|                   | PKP5 4-0 = 01110       | $((123R - 42R) / 223R) * (VinP5 - VinP11) + VinP11$ |
|                   | PKP5 4-0 = 01111       | $((123R - 45R) / 223R) * (VinP5 - VinP11) + VinP11$ |
|                   | PKP5 4-0 = 10000       | $((123R - 48R) / 223R) * (VinP5 - VinP11) + VinP11$ |
|                   | PKP5 4-0 = 10001       | $((123R - 51R) / 223R) * (VinP5 - VinP11) + VinP11$ |
|                   | PKP5 4-0 = 10010       | $((123R - 54R) / 223R) * (VinP5 - VinP11) + VinP11$ |
|                   | PKP5 4-0 = 10011       | $((123R - 57R) / 223R) * (VinP5 - VinP11) + VinP11$ |
|                   | PKP5 4-0 = 10100       | $((123R - 60R) / 223R) * (VinP5 - VinP11) + VinP11$ |
|                   | PKP5 4-0 = 10101       | $((123R - 63R) / 223R) * (VinP5 - VinP11) + VinP11$ |
|                   | PKP5 4-0 = 10110       | $((123R - 66R) / 223R) * (VinP5 - VinP11) + VinP11$ |
|                   | PKP5 4-0 = 10111       | $((123R - 69R) / 223R) * (VinP5 - VinP11) + VinP11$ |
|                   | PKP5 4-0 = 11000       | $((123R - 72R) / 223R) * (VinP5 - VinP11) + VinP11$ |
|                   | PKP5 4-0 = 11001       | $((123R - 75R) / 223R) * (VinP5 - VinP11) + VinP11$ |
|                   | PKP5 4-0 = 11010       | $((123R - 78R) / 223R) * (VinP5 - VinP11) + VinP11$ |
|                   | PKP5 4-0 = 11011       | $((123R - 81R) / 223R) * (VinP5 - VinP11) + VinP11$ |
|                   | PKP5 4-0 = 11100       | $((123R - 84R) / 223R) * (VinP5 - VinP11) + VinP11$ |
|                   | PKP5 4-0 = 11101       | $((123R - 87R) / 223R) * (VinP5 - VinP11) + VinP11$ |
|                   | PKP5 4-0 = 11110       | $((123R - 90R) / 223R) * (VinP5 - VinP11) + VinP11$ |
|                   | PKP5 4-0 = 11111       | $((123R - 93R) / 223R) * (VinP5 - VinP11) + VinP11$ |

Table 5.37: VinP9

| Reference voltage | Macro adjustment value | VinP10 formula                                     |
|-------------------|------------------------|----------------------------------------------------|
| VinP10            | PKP6 4-0 = 00000       | $(96R / 223R) * (VinP5 - VinP11) + VinP11$         |
|                   | PKP6 4-0 = 00001       | $((96R - 3R) / 223R) * (VinP5 - VinP11) + VinP11$  |
|                   | PKP6 4-0 = 00010       | $((96R - 6R) / 223R) * (VinP5 - VinP11) + VinP11$  |
|                   | PKP6 4-0 = 00011       | $((96R - 9R) / 223R) * (VinP5 - VinP11) + VinP11$  |
|                   | PKP6 4-0 = 00100       | $((96R - 12R) / 223R) * (VinP5 - VinP11) + VinP11$ |
|                   | PKP6 4-0 = 00101       | $((96R - 15R) / 223R) * (VinP5 - VinP11) + VinP11$ |
|                   | PKP6 4-0 = 00110       | $((96R - 18R) / 223R) * (VinP5 - VinP11) + VinP11$ |
|                   | PKP6 4-0 = 00111       | $((96R - 21R) / 223R) * (VinP5 - VinP11) + VinP11$ |
|                   | PKP6 4-0 = 01000       | $((96R - 24R) / 223R) * (VinP5 - VinP11) + VinP11$ |
|                   | PKP6 4-0 = 01001       | $((96R - 27R) / 223R) * (VinP5 - VinP11) + VinP11$ |
|                   | PKP6 4-0 = 01010       | $((96R - 30R) / 223R) * (VinP5 - VinP11) + VinP11$ |
|                   | PKP6 4-0 = 01011       | $((96R - 33R) / 223R) * (VinP5 - VinP11) + VinP11$ |
|                   | PKP6 4-0 = 01100       | $((96R - 36R) / 223R) * (VinP5 - VinP11) + VinP11$ |
|                   | PKP6 4-0 = 01101       | $((96R - 39R) / 223R) * (VinP5 - VinP11) + VinP11$ |
|                   | PKP6 4-0 = 01110       | $((96R - 42R) / 223R) * (VinP5 - VinP11) + VinP11$ |
|                   | PKP6 4-0 = 01111       | $((96R - 45R) / 223R) * (VinP5 - VinP11) + VinP11$ |
|                   | PKP6 4-0 = 10000       | $((96R - 48R) / 223R) * (VinP5 - VinP11) + VinP11$ |
|                   | PKP6 4-0 = 10001       | $((96R - 51R) / 223R) * (VinP5 - VinP11) + VinP11$ |
|                   | PKP6 4-0 = 10010       | $((96R - 54R) / 223R) * (VinP5 - VinP11) + VinP11$ |
|                   | PKP6 4-0 = 10011       | $((96R - 57R) / 223R) * (VinP5 - VinP11) + VinP11$ |
|                   | PKP6 4-0 = 10100       | $((96R - 60R) / 223R) * (VinP5 - VinP11) + VinP11$ |
|                   | PKP6 4-0 = 10101       | $((96R - 63R) / 223R) * (VinP5 - VinP11) + VinP11$ |
|                   | PKP6 4-0 = 10110       | $((96R - 66R) / 223R) * (VinP5 - VinP11) + VinP11$ |
|                   | PKP6 4-0 = 10111       | $((96R - 69R) / 223R) * (VinP5 - VinP11) + VinP11$ |
|                   | PKP6 4-0 = 11000       | $((96R - 72R) / 223R) * (VinP5 - VinP11) + VinP11$ |
|                   | PKP6 4-0 = 11001       | $((96R - 75R) / 223R) * (VinP5 - VinP11) + VinP11$ |
|                   | PKP6 4-0 = 11010       | $((96R - 78R) / 223R) * (VinP5 - VinP11) + VinP11$ |
|                   | PKP6 4-0 = 11011       | $((96R - 81R) / 223R) * (VinP5 - VinP11) + VinP11$ |
|                   | PKP6 4-0 = 11100       | $((96R - 84R) / 223R) * (VinP5 - VinP11) + VinP11$ |
|                   | PKP6 4-0 = 11101       | $((96R - 87R) / 223R) * (VinP5 - VinP11) + VinP11$ |
|                   | PKP6 4-0 = 11110       | $((96R - 90R) / 223R) * (VinP5 - VinP11) + VinP11$ |
|                   | PKP6 4-0 = 11111       | $((96R - 93R) / 223R) * (VinP5 - VinP11) + VinP11$ |

Table 5.38: VinP10

| Reference voltage | Macro adjustment value | VinP12 formula                                     |
|-------------------|------------------------|----------------------------------------------------|
| VinP12            | PKP7 4-0 = 00000       | $(47R / 48R) * (VinP11 - VinP14) + VinP14$         |
|                   | PKP7 4-0 = 00001       | $((47R - 1R) / 48R) * (VinP11 - VinP14) + VinP14$  |
|                   | PKP7 4-0 = 00010       | $((47R - 2R) / 48R) * (VinP11 - VinP14) + VinP14$  |
|                   | PKP7 4-0 = 00011       | $((47R - 3R) / 48R) * (VinP11 - VinP14) + VinP14$  |
|                   | PKP7 4-0 = 00100       | $((47R - 4R) / 48R) * (VinP11 - VinP14) + VinP14$  |
|                   | PKP7 4-0 = 00101       | $((47R - 5R) / 48R) * (VinP11 - VinP14) + VinP14$  |
|                   | PKP7 4-0 = 00110       | $((47R - 6R) / 48R) * (VinP11 - VinP14) + VinP14$  |
|                   | PKP7 4-0 = 00111       | $((47R - 7R) / 48R) * (VinP11 - VinP14) + VinP14$  |
|                   | PKP7 4-0 = 01000       | $((47R - 8R) / 48R) * (VinP11 - VinP14) + VinP14$  |
|                   | PKP7 4-0 = 01001       | $((47R - 9R) / 48R) * (VinP11 - VinP14) + VinP14$  |
|                   | PKP7 4-0 = 01010       | $((47R - 10R) / 48R) * (VinP11 - VinP14) + VinP14$ |
|                   | PKP7 4-0 = 01011       | $((47R - 11R) / 48R) * (VinP11 - VinP14) + VinP14$ |
|                   | PKP7 4-0 = 01100       | $((47R - 12R) / 48R) * (VinP11 - VinP14) + VinP14$ |
|                   | PKP7 4-0 = 01101       | $((47R - 13R) / 48R) * (VinP11 - VinP14) + VinP14$ |
|                   | PKP7 4-0 = 01110       | $((47R - 14R) / 48R) * (VinP11 - VinP14) + VinP14$ |
|                   | PKP7 4-0 = 01111       | $((47R - 15R) / 48R) * (VinP11 - VinP14) + VinP14$ |
|                   | PKP7 4-0 = 10000       | $((47R - 16R) / 48R) * (VinP11 - VinP14) + VinP14$ |
|                   | PKP7 4-0 = 10001       | $((47R - 17R) / 48R) * (VinP11 - VinP14) + VinP14$ |
|                   | PKP7 4-0 = 10010       | $((47R - 18R) / 48R) * (VinP11 - VinP14) + VinP14$ |
|                   | PKP7 4-0 = 10011       | $((47R - 19R) / 48R) * (VinP11 - VinP14) + VinP14$ |
|                   | PKP7 4-0 = 10100       | $((47R - 20R) / 48R) * (VinP11 - VinP14) + VinP14$ |
|                   | PKP7 4-0 = 10101       | $((47R - 21R) / 48R) * (VinP11 - VinP14) + VinP14$ |
|                   | PKP7 4-0 = 10110       | $((47R - 22R) / 48R) * (VinP11 - VinP14) + VinP14$ |
|                   | PKP7 4-0 = 10111       | $((47R - 23R) / 48R) * (VinP11 - VinP14) + VinP14$ |
|                   | PKP7 4-0 = 11000       | $((47R - 24R) / 48R) * (VinP11 - VinP14) + VinP14$ |
|                   | PKP7 4-0 = 11001       | $((47R - 25R) / 48R) * (VinP11 - VinP14) + VinP14$ |
|                   | PKP7 4-0 = 11010       | $((47R - 26R) / 48R) * (VinP11 - VinP14) + VinP14$ |
|                   | PKP7 4-0 = 11011       | $((47R - 27R) / 48R) * (VinP11 - VinP14) + VinP14$ |
|                   | PKP7 4-0 = 11100       | $((47R - 28R) / 48R) * (VinP11 - VinP14) + VinP14$ |
|                   | PKP7 4-0 = 11101       | $((47R - 29R) / 48R) * (VinP11 - VinP14) + VinP14$ |
|                   | PKP7 4-0 = 11110       | $((47R - 30R) / 48R) * (VinP11 - VinP14) + VinP14$ |
|                   | PKP7 4-0 = 11111       | $((47R - 31R) / 48R) * (VinP11 - VinP14) + VinP14$ |

Table 5.39: VinP12

| Reference voltage | Macro adjustment value | VinP13 formula                                     |
|-------------------|------------------------|----------------------------------------------------|
| VinP13            | PKP8 4-0 = 00000       | $(32R / 48R) * (VinP11 - VinP14) + VinP14$         |
|                   | PKP8 4-0 = 00001       | $((32R - 1R) / 48R) * (VinP11 - VinP14) + VinP14$  |
|                   | PKP8 4-0 = 00010       | $((32R - 2R) / 48R) * (VinP11 - VinP14) + VinP14$  |
|                   | PKP8 4-0 = 00011       | $((32R - 3R) / 48R) * (VinP11 - VinP14) + VinP14$  |
|                   | PKP8 4-0 = 00100       | $((32R - 4R) / 48R) * (VinP11 - VinP14) + VinP14$  |
|                   | PKP8 4-0 = 00101       | $((32R - 5R) / 48R) * (VinP11 - VinP14) + VinP14$  |
|                   | PKP8 4-0 = 00110       | $((32R - 6R) / 48R) * (VinP11 - VinP14) + VinP14$  |
|                   | PKP8 4-0 = 00111       | $((32R - 7R) / 48R) * (VinP11 - VinP14) + VinP14$  |
|                   | PKP8 4-0 = 01000       | $((32R - 8R) / 48R) * (VinP11 - VinP14) + VinP14$  |
|                   | PKP8 4-0 = 01001       | $((32R - 9R) / 48R) * (VinP11 - VinP14) + VinP14$  |
|                   | PKP8 4-0 = 01010       | $((32R - 10R) / 48R) * (VinP11 - VinP14) + VinP14$ |
|                   | PKP8 4-0 = 01011       | $((32R - 11R) / 48R) * (VinP11 - VinP14) + VinP14$ |
|                   | PKP8 4-0 = 01100       | $((32R - 12R) / 48R) * (VinP11 - VinP14) + VinP14$ |
|                   | PKP8 4-0 = 01101       | $((32R - 13R) / 48R) * (VinP11 - VinP14) + VinP14$ |
|                   | PKP8 4-0 = 01110       | $((32R - 14R) / 48R) * (VinP11 - VinP14) + VinP14$ |
|                   | PKP8 4-0 = 01111       | $((32R - 15R) / 48R) * (VinP11 - VinP14) + VinP14$ |
|                   | PKP8 4-0 = 10000       | $((32R - 16R) / 48R) * (VinP11 - VinP14) + VinP14$ |
|                   | PKP8 4-0 = 10001       | $((32R - 17R) / 48R) * (VinP11 - VinP14) + VinP14$ |
|                   | PKP8 4-0 = 10010       | $((32R - 18R) / 48R) * (VinP11 - VinP14) + VinP14$ |
|                   | PKP8 4-0 = 10011       | $((32R - 19R) / 48R) * (VinP11 - VinP14) + VinP14$ |
|                   | PKP8 4-0 = 10100       | $((32R - 20R) / 48R) * (VinP11 - VinP14) + VinP14$ |
|                   | PKP8 4-0 = 10101       | $((32R - 21R) / 48R) * (VinP11 - VinP14) + VinP14$ |
|                   | PKP8 4-0 = 10110       | $((32R - 22R) / 48R) * (VinP11 - VinP14) + VinP14$ |
|                   | PKP8 4-0 = 10111       | $((32R - 23R) / 48R) * (VinP11 - VinP14) + VinP14$ |
|                   | PKP8 4-0 = 11000       | $((32R - 24R) / 48R) * (VinP11 - VinP14) + VinP14$ |
|                   | PKP8 4-0 = 11001       | $((32R - 25R) / 48R) * (VinP11 - VinP14) + VinP14$ |
|                   | PKP8 4-0 = 11010       | $((32R - 26R) / 48R) * (VinP11 - VinP14) + VinP14$ |
|                   | PKP8 4-0 = 11011       | $((32R - 27R) / 48R) * (VinP11 - VinP14) + VinP14$ |
|                   | PKP8 4-0 = 11100       | $((32R - 28R) / 48R) * (VinP11 - VinP14) + VinP14$ |
|                   | PKP8 4-0 = 11101       | $((32R - 29R) / 48R) * (VinP11 - VinP14) + VinP14$ |
|                   | PKP8 4-0 = 11110       | $((32R - 30R) / 48R) * (VinP11 - VinP14) + VinP14$ |
|                   | PKP8 4-0 = 11111       | $((32R - 31R) / 48R) * (VinP11 - VinP14) + VinP14$ |

Table 5.40: VinP13



| Reference voltage | Macro adjustment value | VinN0 formula                                   |
|-------------------|------------------------|-------------------------------------------------|
| VinN0             | VRN0 5-0 = 000000      | VSNR                                            |
|                   | VRN0 5-0 = 000001      | $((450R - 20R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN0 5-0 = 000010      | $((450R - 22R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN0 5-0 = 000011      | $((450R - 24R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN0 5-0 = 000100      | $((450R - 26R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN0 5-0 = 000101      | $((450R - 28R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN0 5-0 = 000110      | $((450R - 30R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN0 5-0 = 000111      | $((450R - 32R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN0 5-0 = 001000      | $((450R - 34R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN0 5-0 = 001001      | $((450R - 36R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN0 5-0 = 001010      | $((450R - 38R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN0 5-0 = 001011      | $((450R - 40R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN0 5-0 = 001100      | $((450R - 42R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN0 5-0 = 001101      | $((450R - 44R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN0 5-0 = 001110      | $((450R - 46R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN0 5-0 = 001111      | $((450R - 48R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN0 5-0 = 010000      | $((450R - 50R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN0 5-0 = 010001      | $((450R - 52R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN0 5-0 = 010010      | $((450R - 54R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN0 5-0 = 010011      | $((450R - 56R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN0 5-0 = 010100      | $((450R - 58R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN0 5-0 = 010101      | $((450R - 60R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN0 5-0 = 010110      | $((450R - 62R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN0 5-0 = 010111      | $((450R - 64R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN0 5-0 = 011000      | $((450R - 66R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN0 5-0 = 011001      | $((450R - 68R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN0 5-0 = 011010      | $((450R - 70R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN0 5-0 = 011011      | $((450R - 72R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN0 5-0 = 011100      | $((450R - 74R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN0 5-0 = 011101      | $((450R - 76R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN0 5-0 = 011110      | $((450R - 78R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN0 5-0 = 011111      | $((450R - 80R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN0 5-0 = 100000      | $((450R - 82R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN0 5-0 = 100001      | $((450R - 84R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN0 5-0 = 100010      | $((450R - 86R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN0 5-0 = 100011      | $((450R - 88R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN0 5-0 = 100100      | $((450R - 90R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN0 5-0 = 100101      | $((450R - 92R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN0 5-0 = 100110      | $((450R - 94R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN0 5-0 = 100111      | $((450R - 96R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN0 5-0 = 101000      | $((450R - 98R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN0 5-0 = 101001      | $((450R - 100R) / 450R) * (VSNR - VGSN) + VGSN$ |
|                   | VRN0 5-0 = 101010      | $((450R - 102R) / 450R) * (VSNR - VGSN) + VGSN$ |
|                   | VRN0 5-0 = 101011      | $((450R - 104R) / 450R) * (VSNR - VGSN) + VGSN$ |
|                   | VRN0 5-0 = 101100      | $((450R - 106R) / 450R) * (VSNR - VGSN) + VGSN$ |
|                   | VRN0 5-0 = 101101      | $((450R - 108R) / 450R) * (VSNR - VGSN) + VGSN$ |
|                   | VRN0 5-0 = 101110      | $((450R - 110R) / 450R) * (VSNR - VGSN) + VGSN$ |
|                   | VRN0 5-0 = 101111      | $((450R - 112R) / 450R) * (VSNR - VGSN) + VGSN$ |
|                   | VRN0 5-0 = 110000      | $((450R - 114R) / 450R) * (VSNR - VGSN) + VGSN$ |
|                   | VRN0 5-0 = 110001      | $((450R - 116R) / 450R) * (VSNR - VGSN) + VGSN$ |
|                   | VRN0 5-0 = 110010      | $((450R - 118R) / 450R) * (VSNR - VGSN) + VGSN$ |
|                   | VRN0 5-0 = 110011      | $((450R - 120R) / 450R) * (VSNR - VGSN) + VGSN$ |
|                   | VRN0 5-0 = 110100      | $((450R - 122R) / 450R) * (VSNR - VGSN) + VGSN$ |
|                   | VRN0 5-0 = 110101      | $((450R - 124R) / 450R) * (VSNR - VGSN) + VGSN$ |
|                   | VRN0 5-0 = 110110      | $((450R - 126R) / 450R) * (VSNR - VGSN) + VGSN$ |
|                   | VRN0 5-0 = 110111      | $((450R - 128R) / 450R) * (VSNR - VGSN) + VGSN$ |
|                   | VRN0 5-0 = 111000      | $((450R - 130R) / 450R) * (VSNR - VGSN) + VGSN$ |
|                   | VRN0 5-0 = 111001      | $((450R - 132R) / 450R) * (VSNR - VGSN) + VGSN$ |
|                   | VRN0 5-0 = 111010      | $((450R - 134R) / 450R) * (VSNR - VGSN) + VGSN$ |
|                   | VRN0 5-0 = 111011      | $((450R - 136R) / 450R) * (VSNR - VGSN) + VGSN$ |
|                   | VRN0 5-0 = 111100      | $((450R - 138R) / 450R) * (VSNR - VGSN) + VGSN$ |
|                   | VRN0 5-0 = 111101      | $((450R - 140R) / 450R) * (VSNR - VGSN) + VGSN$ |
|                   | VRN0 5-0 = 111110      | $((450R - 142R) / 450R) * (VSNR - VGSN) + VGSN$ |
|                   | VRN0 5-0 = 111111      | $((450R - 144R) / 450R) * (VSNR - VGSN) + VGSN$ |

Table 5.41: VinN0

| Reference voltage | Macro adjustment value | VinN1 formula                                   |
|-------------------|------------------------|-------------------------------------------------|
| VinN1             | VRN1 5-0 = 000000      | $(430R / 450R) * (VSNR - VGSN) + VGSN$          |
|                   | VRN1 5-0 = 000001      | $((430R - 2R) / 450R) * (VSNR - VGSN) + VGSN$   |
|                   | VRN1 5-0 = 000010      | $((430R - 4R) / 450R) * (VSNR - VGSN) + VGSN$   |
|                   | VRN1 5-0 = 000011      | $((430R - 6R) / 450R) * (VSNR - VGSN) + VGSN$   |
|                   | VRN1 5-0 = 000100      | $((430R - 8R) / 450R) * (VSNR - VGSN) + VGSN$   |
|                   | VRN1 5-0 = 000101      | $((430R - 10R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN1 5-0 = 000110      | $((430R - 12R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN1 5-0 = 000111      | $((430R - 14R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN1 5-0 = 001000      | $((430R - 16R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN1 5-0 = 001001      | $((430R - 18R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN1 5-0 = 001010      | $((430R - 20R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN1 5-0 = 001011      | $((430R - 22R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN1 5-0 = 001100      | $((430R - 24R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN1 5-0 = 001101      | $((430R - 26R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN1 5-0 = 001110      | $((430R - 28R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN1 5-0 = 001111      | $((430R - 30R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN1 5-0 = 010000      | $((430R - 32R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN1 5-0 = 010001      | $((430R - 34R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN1 5-0 = 010010      | $((430R - 36R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN1 5-0 = 010011      | $((430R - 38R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN1 5-0 = 010100      | $((430R - 40R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN1 5-0 = 010101      | $((430R - 42R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN1 5-0 = 010110      | $((430R - 44R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN1 5-0 = 010111      | $((430R - 46R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN1 5-0 = 011000      | $((430R - 48R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN1 5-0 = 011001      | $((430R - 50R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN1 5-0 = 011010      | $((430R - 52R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN1 5-0 = 011011      | $((430R - 54R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN1 5-0 = 011100      | $((430R - 56R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN1 5-0 = 011101      | $((430R - 58R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN1 5-0 = 011110      | $((430R - 60R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN1 5-0 = 011111      | $((430R - 62R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN1 5-0 = 100000      | $((430R - 64R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN1 5-0 = 100001      | $((430R - 66R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN1 5-0 = 100010      | $((430R - 68R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN1 5-0 = 100011      | $((430R - 70R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN1 5-0 = 100100      | $((430R - 72R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN1 5-0 = 100101      | $((430R - 74R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN1 5-0 = 100110      | $((430R - 76R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN1 5-0 = 100111      | $((430R - 78R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN1 5-0 = 101000      | $((430R - 80R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN1 5-0 = 101001      | $((430R - 82R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN1 5-0 = 101010      | $((430R - 84R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN1 5-0 = 101011      | $((430R - 86R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN1 5-0 = 101100      | $((430R - 88R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN1 5-0 = 101101      | $((430R - 90R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN1 5-0 = 101110      | $((430R - 92R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN1 5-0 = 101111      | $((430R - 94R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN1 5-0 = 110000      | $((430R - 96R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN1 5-0 = 110001      | $((430R - 98R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN1 5-0 = 110010      | $((430R - 100R) / 450R) * (VSNR - VGSN) + VGSN$ |
|                   | VRN1 5-0 = 110011      | $((430R - 102R) / 450R) * (VSNR - VGSN) + VGSN$ |
|                   | VRN1 5-0 = 110100      | $((430R - 104R) / 450R) * (VSNR - VGSN) + VGSN$ |
|                   | VRN1 5-0 = 110101      | $((430R - 106R) / 450R) * (VSNR - VGSN) + VGSN$ |
|                   | VRN1 5-0 = 110110      | $((430R - 108R) / 450R) * (VSNR - VGSN) + VGSN$ |
|                   | VRN1 5-0 = 110111      | $((430R - 110R) / 450R) * (VSNR - VGSN) + VGSN$ |
|                   | VRN1 5-0 = 111000      | $((430R - 112R) / 450R) * (VSNR - VGSN) + VGSN$ |
|                   | VRN1 5-0 = 111001      | $((430R - 114R) / 450R) * (VSNR - VGSN) + VGSN$ |
|                   | VRN1 5-0 = 111010      | $((430R - 116R) / 450R) * (VSNR - VGSN) + VGSN$ |
|                   | VRN1 5-0 = 111011      | $((430R - 118R) / 450R) * (VSNR - VGSN) + VGSN$ |
|                   | VRN1 5-0 = 111100      | $((430R - 120R) / 450R) * (VSNR - VGSN) + VGSN$ |
|                   | VRN1 5-0 = 111101      | $((430R - 122R) / 450R) * (VSNR - VGSN) + VGSN$ |
|                   | VRN1 5-0 = 111110      | $((430R - 124R) / 450R) * (VSNR - VGSN) + VGSN$ |
|                   | VRN1 5-0 = 111111      | $((430R - 126R) / 450R) * (VSNR - VGSN) + VGSN$ |

Table 5.42: VinN1

| Reference voltage | Macro adjustment value | VinN2 formula                                   |
|-------------------|------------------------|-------------------------------------------------|
| VinN2             | VRN2 5-0 = 000000      | $(420R / 450R) * (VSNR - VGSN) + VGSN$          |
|                   | VRN2 5-0 = 000001      | $((420R - 2R) / 450R) * (VSNR - VGSN) + VGSN$   |
|                   | VRN2 5-0 = 000010      | $((420R - 4R) / 450R) * (VSNR - VGSN) + VGSN$   |
|                   | VRN2 5-0 = 000011      | $((420R - 6R) / 450R) * (VSNR - VGSN) + VGSN$   |
|                   | VRN2 5-0 = 000100      | $((420R - 8R) / 450R) * (VSNR - VGSN) + VGSN$   |
|                   | VRN2 5-0 = 000101      | $((420R - 10R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN2 5-0 = 000110      | $((420R - 12R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN2 5-0 = 000111      | $((420R - 14R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN2 5-0 = 001000      | $((420R - 16R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN2 5-0 = 001001      | $((420R - 18R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN2 5-0 = 001010      | $((420R - 20R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN2 5-0 = 001011      | $((420R - 22R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN2 5-0 = 001100      | $((420R - 24R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN2 5-0 = 001101      | $((420R - 26R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN2 5-0 = 001110      | $((420R - 28R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN2 5-0 = 001111      | $((420R - 30R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN2 5-0 = 010000      | $((420R - 32R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN2 5-0 = 010001      | $((420R - 34R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN2 5-0 = 010010      | $((420R - 36R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN2 5-0 = 010011      | $((420R - 38R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN2 5-0 = 010100      | $((420R - 40R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN2 5-0 = 010101      | $((420R - 42R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN2 5-0 = 010110      | $((420R - 44R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN2 5-0 = 010111      | $((420R - 46R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN2 5-0 = 011000      | $((420R - 48R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN2 5-0 = 011001      | $((420R - 50R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN2 5-0 = 011010      | $((420R - 52R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN2 5-0 = 011011      | $((420R - 54R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN2 5-0 = 011100      | $((420R - 56R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN2 5-0 = 011101      | $((420R - 58R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN2 5-0 = 011110      | $((420R - 60R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN2 5-0 = 011111      | $((420R - 62R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN2 5-0 = 100000      | $((420R - 64R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN2 5-0 = 100001      | $((420R - 66R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN2 5-0 = 100010      | $((420R - 68R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN2 5-0 = 100011      | $((420R - 70R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN2 5-0 = 100100      | $((420R - 72R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN2 5-0 = 100101      | $((420R - 74R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN2 5-0 = 100110      | $((420R - 76R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN2 5-0 = 100111      | $((420R - 78R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN2 5-0 = 101000      | $((420R - 80R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN2 5-0 = 101001      | $((420R - 82R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN2 5-0 = 101010      | $((420R - 84R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN2 5-0 = 101011      | $((420R - 86R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN2 5-0 = 101100      | $((420R - 88R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN2 5-0 = 101101      | $((420R - 90R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN2 5-0 = 101110      | $((420R - 92R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN2 5-0 = 101111      | $((420R - 94R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN2 5-0 = 110000      | $((420R - 96R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN2 5-0 = 110001      | $((420R - 98R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN2 5-0 = 110010      | $((420R - 100R) / 450R) * (VSNR - VGSN) + VGSN$ |
|                   | VRN2 5-0 = 110011      | $((420R - 102R) / 450R) * (VSNR - VGSN) + VGSN$ |
|                   | VRN2 5-0 = 110100      | $((420R - 104R) / 450R) * (VSNR - VGSN) + VGSN$ |
|                   | VRN2 5-0 = 110101      | $((420R - 106R) / 450R) * (VSNR - VGSN) + VGSN$ |
|                   | VRN2 5-0 = 110110      | $((420R - 108R) / 450R) * (VSNR - VGSN) + VGSN$ |
|                   | VRN2 5-0 = 110111      | $((420R - 110R) / 450R) * (VSNR - VGSN) + VGSN$ |
|                   | VRN2 5-0 = 111000      | $((420R - 112R) / 450R) * (VSNR - VGSN) + VGSN$ |
|                   | VRN2 5-0 = 111001      | $((420R - 114R) / 450R) * (VSNR - VGSN) + VGSN$ |
|                   | VRN2 5-0 = 111010      | $((420R - 116R) / 450R) * (VSNR - VGSN) + VGSN$ |
|                   | VRN2 5-0 = 111011      | $((420R - 118R) / 450R) * (VSNR - VGSN) + VGSN$ |
|                   | VRN2 5-0 = 111100      | $((420R - 120R) / 450R) * (VSNR - VGSN) + VGSN$ |
|                   | VRN2 5-0 = 111101      | $((420R - 122R) / 450R) * (VSNR - VGSN) + VGSN$ |
|                   | VRN2 5-0 = 111110      | $((420R - 124R) / 450R) * (VSNR - VGSN) + VGSN$ |
|                   | VRN2 5-0 = 111111      | $((420R - 126R) / 450R) * (VSNR - VGSN) + VGSN$ |

Table 5.43: VinN2

| Reference voltage | Macro adjustment value | VinN14 formula                                  |
|-------------------|------------------------|-------------------------------------------------|
| VinN14            | VRN3 5-0 = 000000      | $(156R / 450R) * (VSNR - VGSN) + VGSN$          |
|                   | VRN3 5-0 = 000001      | $((156R - 2R) / 450R) * (VSNR - VGSN) + VGSN$   |
|                   | VRN3 5-0 = 000010      | $((156R - 4R) / 450R) * (VSNR - VGSN) + VGSN$   |
|                   | VRN3 5-0 = 000011      | $((156R - 6R) / 450R) * (VSNR - VGSN) + VGSN$   |
|                   | VRN3 5-0 = 000100      | $((156R - 8R) / 450R) * (VSNR - VGSN) + VGSN$   |
|                   | VRN3 5-0 = 000101      | $((156R - 10R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN3 5-0 = 000110      | $((156R - 12R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN3 5-0 = 000111      | $((156R - 14R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN3 5-0 = 001000      | $((156R - 16R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN3 5-0 = 001001      | $((156R - 18R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN3 5-0 = 001010      | $((156R - 20R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN3 5-0 = 001011      | $((156R - 22R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN3 5-0 = 001100      | $((156R - 24R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN3 5-0 = 001101      | $((156R - 26R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN3 5-0 = 001110      | $((156R - 28R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN3 5-0 = 001111      | $((156R - 30R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN3 5-0 = 010000      | $((156R - 32R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN3 5-0 = 010001      | $((156R - 34R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN3 5-0 = 010010      | $((156R - 36R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN3 5-0 = 010011      | $((156R - 38R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN3 5-0 = 010100      | $((156R - 40R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN3 5-0 = 010101      | $((156R - 42R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN3 5-0 = 010110      | $((156R - 44R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN3 5-0 = 010111      | $((156R - 46R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN3 5-0 = 011000      | $((156R - 48R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN3 5-0 = 011001      | $((156R - 50R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN3 5-0 = 011010      | $((156R - 52R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN3 5-0 = 011011      | $((156R - 54R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN3 5-0 = 011100      | $((156R - 56R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN3 5-0 = 011101      | $((156R - 58R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN3 5-0 = 011110      | $((156R - 60R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN3 5-0 = 011111      | $((156R - 62R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN3 5-0 = 100000      | $((156R - 64R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN3 5-0 = 100001      | $((156R - 66R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN3 5-0 = 100010      | $((156R - 68R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN3 5-0 = 100011      | $((156R - 70R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN3 5-0 = 100100      | $((156R - 72R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN3 5-0 = 100101      | $((156R - 74R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN3 5-0 = 100110      | $((156R - 76R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN3 5-0 = 100111      | $((156R - 78R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN3 5-0 = 101000      | $((156R - 80R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN3 5-0 = 101001      | $((156R - 82R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN3 5-0 = 101010      | $((156R - 84R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN3 5-0 = 101011      | $((156R - 86R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN3 5-0 = 101100      | $((156R - 88R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN3 5-0 = 101101      | $((156R - 90R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN3 5-0 = 101110      | $((156R - 92R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN3 5-0 = 101111      | $((156R - 94R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN3 5-0 = 110000      | $((156R - 96R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN3 5-0 = 110001      | $((156R - 98R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN3 5-0 = 110010      | $((156R - 100R) / 450R) * (VSNR - VGSN) + VGSN$ |
|                   | VRN3 5-0 = 110011      | $((156R - 102R) / 450R) * (VSNR - VGSN) + VGSN$ |
|                   | VRN3 5-0 = 110100      | $((156R - 104R) / 450R) * (VSNR - VGSN) + VGSN$ |
|                   | VRN3 5-0 = 110101      | $((156R - 106R) / 450R) * (VSNR - VGSN) + VGSN$ |
|                   | VRN3 5-0 = 110110      | $((156R - 108R) / 450R) * (VSNR - VGSN) + VGSN$ |
|                   | VRN3 5-0 = 110111      | $((156R - 110R) / 450R) * (VSNR - VGSN) + VGSN$ |
|                   | VRN3 5-0 = 111000      | $((156R - 112R) / 450R) * (VSNR - VGSN) + VGSN$ |
|                   | VRN3 5-0 = 111001      | $((156R - 114R) / 450R) * (VSNR - VGSN) + VGSN$ |
|                   | VRN3 5-0 = 111010      | $((156R - 116R) / 450R) * (VSNR - VGSN) + VGSN$ |
|                   | VRN3 5-0 = 111011      | $((156R - 118R) / 450R) * (VSNR - VGSN) + VGSN$ |
|                   | VRN3 5-0 = 111100      | $((156R - 120R) / 450R) * (VSNR - VGSN) + VGSN$ |
|                   | VRN3 5-0 = 111101      | $((156R - 122R) / 450R) * (VSNR - VGSN) + VGSN$ |
|                   | VRN3 5-0 = 111110      | $((156R - 124R) / 450R) * (VSNR - VGSN) + VGSN$ |
|                   | VRN3 5-0 = 111111      | $((156R - 126R) / 450R) * (VSNR - VGSN) + VGSN$ |

Table 5.44: VinN14



| Reference voltage | Macro adjustment value | VinN15 formula                                  |
|-------------------|------------------------|-------------------------------------------------|
| VinN15            | VRN4 5-0 = 000000      | $(146R / 450R) * (VSNR - VGSN) + VGSN$          |
|                   | VRN4 5-0 = 000001      | $((146R - 2R) / 450R) * (VSNR - VGSN) + VGSN$   |
|                   | VRN4 5-0 = 000010      | $((146R - 4R) / 450R) * (VSNR - VGSN) + VGSN$   |
|                   | VRN4 5-0 = 000011      | $((146R - 6R) / 450R) * (VSNR - VGSN) + VGSN$   |
|                   | VRN4 5-0 = 000100      | $((146R - 8R) / 450R) * (VSNR - VGSN) + VGSN$   |
|                   | VRN4 5-0 = 000101      | $((146R - 10R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN4 5-0 = 000110      | $((146R - 12R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN4 5-0 = 000111      | $((146R - 14R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN4 5-0 = 001000      | $((146R - 16R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN4 5-0 = 001001      | $((146R - 18R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN4 5-0 = 001010      | $((146R - 20R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN4 5-0 = 001011      | $((146R - 22R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN4 5-0 = 001100      | $((146R - 24R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN4 5-0 = 001101      | $((146R - 26R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN4 5-0 = 001110      | $((146R - 28R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN4 5-0 = 001111      | $((146R - 30R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN4 5-0 = 010000      | $((146R - 32R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN4 5-0 = 010001      | $((146R - 34R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN4 5-0 = 010010      | $((146R - 36R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN4 5-0 = 010011      | $((146R - 38R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN4 5-0 = 010100      | $((146R - 40R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN4 5-0 = 010101      | $((146R - 42R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN4 5-0 = 010110      | $((146R - 44R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN4 5-0 = 010111      | $((146R - 46R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN4 5-0 = 011000      | $((146R - 48R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN4 5-0 = 011001      | $((146R - 50R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN4 5-0 = 011010      | $((146R - 52R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN4 5-0 = 011011      | $((146R - 54R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN4 5-0 = 011100      | $((146R - 56R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN4 5-0 = 011101      | $((146R - 58R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN4 5-0 = 011110      | $((146R - 60R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN4 5-0 = 011111      | $((146R - 62R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN4 5-0 = 100000      | $((146R - 64R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN4 5-0 = 100001      | $((146R - 66R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN4 5-0 = 100010      | $((146R - 68R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN4 5-0 = 100011      | $((146R - 70R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN4 5-0 = 100100      | $((146R - 72R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN4 5-0 = 100101      | $((146R - 74R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN4 5-0 = 100110      | $((146R - 76R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN4 5-0 = 100111      | $((146R - 78R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN4 5-0 = 101000      | $((146R - 80R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN4 5-0 = 101001      | $((146R - 82R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN4 5-0 = 101010      | $((146R - 84R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN4 5-0 = 101011      | $((146R - 86R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN4 5-0 = 101100      | $((146R - 88R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN4 5-0 = 101101      | $((146R - 90R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN4 5-0 = 101110      | $((146R - 92R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN4 5-0 = 101111      | $((146R - 94R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN4 5-0 = 110000      | $((146R - 96R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN4 5-0 = 110001      | $((146R - 98R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN4 5-0 = 110010      | $((146R - 100R) / 450R) * (VSNR - VGSN) + VGSN$ |
|                   | VRN4 5-0 = 110011      | $((146R - 102R) / 450R) * (VSNR - VGSN) + VGSN$ |
|                   | VRN4 5-0 = 110100      | $((146R - 104R) / 450R) * (VSNR - VGSN) + VGSN$ |
|                   | VRN4 5-0 = 110101      | $((146R - 106R) / 450R) * (VSNR - VGSN) + VGSN$ |
|                   | VRN4 5-0 = 110110      | $((146R - 108R) / 450R) * (VSNR - VGSN) + VGSN$ |
|                   | VRN4 5-0 = 110111      | $((146R - 110R) / 450R) * (VSNR - VGSN) + VGSN$ |
|                   | VRN4 5-0 = 111000      | $((146R - 112R) / 450R) * (VSNR - VGSN) + VGSN$ |
|                   | VRN4 5-0 = 111001      | $((146R - 114R) / 450R) * (VSNR - VGSN) + VGSN$ |
|                   | VRN4 5-0 = 111010      | $((146R - 116R) / 450R) * (VSNR - VGSN) + VGSN$ |
|                   | VRN4 5-0 = 111011      | $((146R - 118R) / 450R) * (VSNR - VGSN) + VGSN$ |
|                   | VRN4 5-0 = 111100      | $((146R - 120R) / 450R) * (VSNR - VGSN) + VGSN$ |
|                   | VRN4 5-0 = 111101      | $((146R - 122R) / 450R) * (VSNR - VGSN) + VGSN$ |
|                   | VRN4 5-0 = 111110      | $((146R - 124R) / 450R) * (VSNR - VGSN) + VGSN$ |
|                   | VRN4 5-0 = 111111      | $((146R - 126R) / 450R) * (VSNR - VGSN) + VGSN$ |

Table 5.45: VinN15

| Reference voltage | Macro adjustment value | VinN16 formula                                  |
|-------------------|------------------------|-------------------------------------------------|
| VinN16            | VRN5 5-0 = 000000      | $(144R / 450R) * (VSNR - VGSN) + VGSN$          |
|                   | VRN5 5-0 = 000001      | $((144R - 2R) / 450R) * (VSNR - VGSN) + VGSN$   |
|                   | VRN5 5-0 = 000010      | $((144R - 4R) / 450R) * (VSNR - VGSN) + VGSN$   |
|                   | VRN5 5-0 = 000011      | $((144R - 6R) / 450R) * (VSNR - VGSN) + VGSN$   |
|                   | VRN5 5-0 = 000100      | $((144R - 8R) / 450R) * (VSNR - VGSN) + VGSN$   |
|                   | VRN5 5-0 = 000101      | $((144R - 10R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN5 5-0 = 000110      | $((144R - 12R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN5 5-0 = 000111      | $((144R - 14R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN5 5-0 = 001000      | $((144R - 16R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN5 5-0 = 001001      | $((144R - 18R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN5 5-0 = 001010      | $((144R - 20R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN5 5-0 = 001011      | $((144R - 22R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN5 5-0 = 001100      | $((144R - 24R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN5 5-0 = 001101      | $((144R - 26R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN5 5-0 = 001110      | $((144R - 28R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN5 5-0 = 001111      | $((144R - 30R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN5 5-0 = 010000      | $((144R - 32R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN5 5-0 = 010001      | $((144R - 34R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN5 5-0 = 010010      | $((144R - 36R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN5 5-0 = 010011      | $((144R - 38R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN5 5-0 = 010100      | $((144R - 40R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN5 5-0 = 010101      | $((144R - 42R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN5 5-0 = 010110      | $((144R - 44R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN5 5-0 = 010111      | $((144R - 46R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN5 5-0 = 011000      | $((144R - 48R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN5 5-0 = 011001      | $((144R - 50R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN5 5-0 = 011010      | $((144R - 52R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN5 5-0 = 011011      | $((144R - 54R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN5 5-0 = 011100      | $((144R - 56R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN5 5-0 = 011101      | $((144R - 58R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN5 5-0 = 011110      | $((144R - 60R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN5 5-0 = 011111      | $((144R - 62R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN5 5-0 = 100000      | $((144R - 64R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN5 5-0 = 100001      | $((144R - 66R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN5 5-0 = 100010      | $((144R - 68R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN5 5-0 = 100011      | $((144R - 70R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN5 5-0 = 100100      | $((144R - 72R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN5 5-0 = 100101      | $((144R - 74R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN5 5-0 = 100110      | $((144R - 76R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN5 5-0 = 100111      | $((144R - 78R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN5 5-0 = 101000      | $((144R - 80R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN5 5-0 = 101001      | $((144R - 82R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN5 5-0 = 101010      | $((144R - 84R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN5 5-0 = 101011      | $((144R - 86R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN5 5-0 = 101100      | $((144R - 88R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN5 5-0 = 101101      | $((144R - 90R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN5 5-0 = 101110      | $((144R - 92R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN5 5-0 = 101111      | $((144R - 94R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN5 5-0 = 110000      | $((144R - 96R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN5 5-0 = 110001      | $((144R - 98R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | VRN5 5-0 = 110010      | $((144R - 100R) / 450R) * (VSNR - VGSN) + VGSN$ |
|                   | VRN5 5-0 = 110011      | $((144R - 102R) / 450R) * (VSNR - VGSN) + VGSN$ |
|                   | VRN5 5-0 = 110100      | $((144R - 104R) / 450R) * (VSNR - VGSN) + VGSN$ |
|                   | VRN5 5-0 = 110101      | $((144R - 106R) / 450R) * (VSNR - VGSN) + VGSN$ |
|                   | VRN5 5-0 = 110110      | $((144R - 108R) / 450R) * (VSNR - VGSN) + VGSN$ |
|                   | VRN5 5-0 = 110111      | $((144R - 110R) / 450R) * (VSNR - VGSN) + VGSN$ |
|                   | VRN5 5-0 = 111000      | $((144R - 112R) / 450R) * (VSNR - VGSN) + VGSN$ |
|                   | VRN5 5-0 = 111001      | $((144R - 114R) / 450R) * (VSNR - VGSN) + VGSN$ |
|                   | VRN5 5-0 = 111010      | $((144R - 116R) / 450R) * (VSNR - VGSN) + VGSN$ |
|                   | VRN5 5-0 = 111011      | $((144R - 118R) / 450R) * (VSNR - VGSN) + VGSN$ |
|                   | VRN5 5-0 = 111100      | $((144R - 120R) / 450R) * (VSNR - VGSN) + VGSN$ |
|                   | VRN5 5-0 = 111101      | $((144R - 122R) / 450R) * (VSNR - VGSN) + VGSN$ |
|                   | VRN5 5-0 = 111110      | $((144R - 124R) / 450R) * (VSNR - VGSN) + VGSN$ |
|                   | VRN5 5-0 = 111111      | VGSN                                            |

Table 5.46: VinN16

| Reference voltage | Macro adjustment value | VinN5 formula                                   |
|-------------------|------------------------|-------------------------------------------------|
| VinN5             | PRN0 6-0 = 0000000     | $(350R / 450R) (VSNR - VGSN) + VGSN$            |
|                   | PRN0 6-0 = 0000001     | $((350R - 2R) / 450R) * (VSNR - VGSN) + VGSN$   |
|                   | PRN0 6-0 = 0000010     | $((350R - 4R) / 450R) * (VSNR - VGSN) + VGSN$   |
|                   | PRN0 6-0 = 0000011     | $((350R - 6R) / 450R) * (VSNR - VGSN) + VGSN$   |
|                   | PRN0 6-0 = 0000100     | $((350R - 8R) / 450R) * (VSNR - VGSN) + VGSN$   |
|                   | PRN0 6-0 = 0000101     | $((350R - 10R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | PRN0 6-0 = 0000110     | $((350R - 12R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | PRN0 6-0 = 0000111     | $((350R - 14R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | PRN0 6-0 = 0001000     | $((350R - 16R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | PRN0 6-0 = 0001001     | $((350R - 18R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | PRN0 6-0 = 0001010     | $((350R - 20R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | PRN0 6-0 = 0001011     | $((350R - 22R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | PRN0 6-0 = 0001100     | $((350R - 24R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | PRN0 6-0 = 0001101     | $((350R - 26R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | PRN0 6-0 = 0001110     | $((350R - 28R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | PRN0 6-0 = 0001111     | $((350R - 30R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | PRN0 6-0 = 0010000     | $((350R - 32R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | PRN0 6-0 = 0010001     | $((350R - 34R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | PRN0 6-0 = 0010010     | $((350R - 36R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | PRN0 6-0 = 0010011     | $((350R - 38R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | PRN0 6-0 = 0010100     | $((350R - 40R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | PRN0 6-0 = 0010101     | $((350R - 42R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | PRN0 6-0 = 0010110     | $((350R - 44R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | PRN0 6-0 = 0010111     | $((350R - 46R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | PRN0 6-0 = 0011000     | $((350R - 48R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | PRN0 6-0 = 0011001     | $((350R - 50R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | PRN0 6-0 = 0011010     | $((350R - 52R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | PRN0 6-0 = 0011011     | $((350R - 54R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | PRN0 6-0 = 0011100     | $((350R - 56R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | PRN0 6-0 = 0011101     | $((350R - 58R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | PRN0 6-0 = 0011110     | $((350R - 60R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | PRN0 6-0 = 0011111     | $((350R - 62R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | PRN0 6-0 = 0100000     | $((350R - 64R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | PRN0 6-0 = 0100001     | $((350R - 66R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | PRN0 6-0 = 0100010     | $((350R - 68R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | PRN0 6-0 = 0100011     | $((350R - 70R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | PRN0 6-0 = 0100100     | $((350R - 72R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | PRN0 6-0 = 0100101     | $((350R - 74R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | PRN0 6-0 = 0100110     | $((350R - 76R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | PRN0 6-0 = 0100111     | $((350R - 78R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | PRN0 6-0 = 0101000     | $((350R - 80R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | PRN0 6-0 = 0101001     | $((350R - 82R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | PRN0 6-0 = 0101010     | $((350R - 84R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | PRN0 6-0 = 0101011     | $((350R - 86R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | PRN0 6-0 = 0101100     | $((350R - 88R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | PRN0 6-0 = 0101101     | $((350R - 90R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | PRN0 6-0 = 0101110     | $((350R - 92R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | PRN0 6-0 = 0101111     | $((350R - 94R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | PRN0 6-0 = 0110000     | $((350R - 96R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | PRN0 6-0 = 0110001     | $((350R - 98R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | PRN0 6-0 = 0110010     | $((350R - 100R) / 450R) * (VSNR - VGSN) + VGSN$ |
|                   | PRN0 6-0 = 0110011     | $((350R - 102R) / 450R) * (VSNR - VGSN) + VGSN$ |
|                   | PRN0 6-0 = 0110100     | $((350R - 104R) / 450R) * (VSNR - VGSN) + VGSN$ |
|                   | PRN0 6-0 = 0110101     | $((350R - 106R) / 450R) * (VSNR - VGSN) + VGSN$ |
|                   | PRN0 6-0 = 0110110     | $((350R - 108R) / 450R) * (VSNR - VGSN) + VGSN$ |
|                   | PRN0 6-0 = 0110111     | $((350R - 110R) / 450R) * (VSNR - VGSN) + VGSN$ |
|                   | PRN0 6-0 = 0111000     | $((350R - 112R) / 450R) * (VSNR - VGSN) + VGSN$ |
|                   | PRN0 6-0 = 0111001     | $((350R - 114R) / 450R) * (VSNR - VGSN) + VGSN$ |
|                   | PRN0 6-0 = 0111010     | $((350R - 116R) / 450R) * (VSNR - VGSN) + VGSN$ |
|                   | PRN0 6-0 = 0111011     | $((350R - 118R) / 450R) * (VSNR - VGSN) + VGSN$ |
|                   | PRN0 6-0 = 0111100     | $((350R - 120R) / 450R) * (VSNR - VGSN) + VGSN$ |
|                   | PRN0 6-0 = 0111101     | $((350R - 122R) / 450R) * (VSNR - VGSN) + VGSN$ |
|                   | PRN0 6-0 = 0111110     | $((350R - 124R) / 450R) * (VSNR - VGSN) + VGSN$ |
|                   | PRN0 6-0 = 0111111     | $((350R - 126R) / 450R) * (VSNR - VGSN) + VGSN$ |
|                   | PRN0 6-0 = 1000000     | $((350R - 128R) / 450R) * (VSNR - VGSN) + VGSN$ |
|                   | PRN0 6-0 = 1000001     | $((350R - 130R) / 450R) * (VSNR - VGSN) + VGSN$ |
|                   | PRN0 6-0 = 1000010     | $((350R - 132R) / 450R) * (VSNR - VGSN) + VGSN$ |
|                   | PRN0 6-0 = 1000011     | $((350R - 134R) / 450R) * (VSNR - VGSN) + VGSN$ |
|                   | PRN0 6-0 = 1000100     | $((350R - 136R) / 450R) * (VSNR - VGSN) + VGSN$ |



|                    |                                                 |
|--------------------|-------------------------------------------------|
| PRN0 6-0 = 1000101 | $((350R - 138R) / 450R) * (VSNR - VGSN) + VGSN$ |
| PRN0 6-0 = 1000110 | $((350R - 140R) / 450R) * (VSNR - VGSN) + VGSN$ |
| PRN0 6-0 = 1000111 | $((350R - 142R) / 450R) * (VSNR - VGSN) + VGSN$ |
| PRN0 6-0 = 1001000 | $((350R - 144R) / 450R) * (VSNR - VGSN) + VGSN$ |
| PRN0 6-0 = 1001001 | $((350R - 146R) / 450R) * (VSNR - VGSN) + VGSN$ |
| PRN0 6-0 = 1001010 | $((350R - 148R) / 450R) * (VSNR - VGSN) + VGSN$ |
| PRN0 6-0 = 1001011 | $((350R - 150R) / 450R) * (VSNR - VGSN) + VGSN$ |
| PRN0 6-0 = 1001100 | $((350R - 152R) / 450R) * (VSNR - VGSN) + VGSN$ |
| PRN0 6-0 = 1001101 | $((350R - 154R) / 450R) * (VSNR - VGSN) + VGSN$ |
| PRN0 6-0 = 1001110 | $((350R - 156R) / 450R) * (VSNR - VGSN) + VGSN$ |
| PRN0 6-0 = 1001111 | $((350R - 158R) / 450R) * (VSNR - VGSN) + VGSN$ |
| PRN0 6-0 = 1010000 | $((350R - 160R) / 450R) * (VSNR - VGSN) + VGSN$ |
| PRN0 6-0 = 1010001 | $((350R - 162R) / 450R) * (VSNR - VGSN) + VGSN$ |
| PRN0 6-0 = 1010010 | $((350R - 164R) / 450R) * (VSNR - VGSN) + VGSN$ |
| PRN0 6-0 = 1010011 | $((350R - 166R) / 450R) * (VSNR - VGSN) + VGSN$ |
| PRN0 6-0 = 1010100 | $((350R - 168R) / 450R) * (VSNR - VGSN) + VGSN$ |
| PRN0 6-0 = 1010101 | $((350R - 170R) / 450R) * (VSNR - VGSN) + VGSN$ |
| PRN0 6-0 = 1010110 | $((350R - 172R) / 450R) * (VSNR - VGSN) + VGSN$ |
| PRN0 6-0 = 1010111 | $((350R - 174R) / 450R) * (VSNR - VGSN) + VGSN$ |
| PRN0 6-0 = 1011000 | inhibit                                         |
| PRN0 6-0 = 1011001 | inhibit                                         |
| PRN0 6-0 = 1011010 | inhibit                                         |
| PRN0 6-0 = 1011011 | inhibit                                         |
| PRN0 6-0 = 1011100 | inhibit                                         |
| PRN0 6-0 = 1011101 | inhibit                                         |
| PRN0 6-0 = 1011110 | inhibit                                         |
| PRN0 6-0 = 1011111 | inhibit                                         |
| PRN0 6-0 = 1100000 | inhibit                                         |
| PRN0 6-0 = 1100001 | inhibit                                         |
| PRN0 6-0 = 1100010 | inhibit                                         |
| PRN0 6-0 = 1100011 | inhibit                                         |
| PRN0 6-0 = 1100100 | inhibit                                         |
| PRN0 6-0 = 1100101 | inhibit                                         |
| PRN0 6-0 = 1100110 | inhibit                                         |
| PRN0 6-0 = 1100111 | inhibit                                         |
| PRN0 6-0 = 1101000 | inhibit                                         |
| PRN0 6-0 = 1101001 | inhibit                                         |
| PRN0 6-0 = 1101010 | inhibit                                         |
| PRN0 6-0 = 1101011 | inhibit                                         |
| PRN0 6-0 = 1101100 | inhibit                                         |
| PRN0 6-0 = 1101101 | inhibit                                         |
| PRN0 6-0 = 1101110 | inhibit                                         |
| PRN0 6-0 = 1101111 | inhibit                                         |
| PRN0 6-0 = 1110000 | inhibit                                         |
| PRN0 6-0 = 1110001 | inhibit                                         |
| PRN0 6-0 = 1110010 | inhibit                                         |
| PRN0 6-0 = 1110011 | inhibit                                         |
| PRN0 6-0 = 1110100 | inhibit                                         |
| PRN0 6-0 = 1110101 | inhibit                                         |
| PRN0 6-0 = 1110110 | inhibit                                         |
| PRN0 6-0 = 1110111 | inhibit                                         |
| PRN0 6-0 = 1111000 | inhibit                                         |
| PRN0 6-0 = 1111001 | inhibit                                         |
| PRN0 6-0 = 1111010 | inhibit                                         |
| PRN0 6-0 = 1111011 | inhibit                                         |
| PRN0 6-0 = 1111100 | inhibit                                         |
| PRN0 6-0 = 1111101 | inhibit                                         |
| PRN0 6-0 = 1111110 | inhibit                                         |
| PRN0 6-0 = 1111111 | inhibit                                         |

Table 5.47: VinN5

| Reference voltage | Macro adjustment value | VinN11 formula                                  |
|-------------------|------------------------|-------------------------------------------------|
| VinN11            | PRN1 6-0 = 0000000     | $(274R / 450R) (VSNR - VGSN) + VGSN$            |
|                   | PRN1 6-0 = 0000001     | $((274R - 2R) / 450R) * (VSNR - VGSN) + VGSN$   |
|                   | PRN1 6-0 = 0000010     | $((274R - 4R) / 450R) * (VSNR - VGSN) + VGSN$   |
|                   | PRN1 6-0 = 0000011     | $((274R - 6R) / 450R) * (VSNR - VGSN) + VGSN$   |
|                   | PRN1 6-0 = 0000100     | $((274R - 8R) / 450R) * (VSNR - VGSN) + VGSN$   |
|                   | PRN1 6-0 = 0000101     | $((274R - 10R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | PRN1 6-0 = 0000110     | $((274R - 12R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | PRN1 6-0 = 0000111     | $((274R - 14R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | PRN1 6-0 = 0001000     | $((274R - 16R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | PRN1 6-0 = 0001001     | $((274R - 18R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | PRN1 6-0 = 0001010     | $((274R - 20R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | PRN1 6-0 = 0001011     | $((274R - 22R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | PRN1 6-0 = 0001100     | $((274R - 24R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | PRN1 6-0 = 0001101     | $((274R - 26R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | PRN1 6-0 = 0001110     | $((274R - 28R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | PRN1 6-0 = 0001111     | $((274R - 30R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | PRN1 6-0 = 0010000     | $((274R - 32R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | PRN1 6-0 = 0010001     | $((274R - 34R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | PRN1 6-0 = 0010010     | $((274R - 36R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | PRN1 6-0 = 0010011     | $((274R - 38R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | PRN1 6-0 = 0010100     | $((274R - 40R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | PRN1 6-0 = 0010101     | $((274R - 42R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | PRN1 6-0 = 0010110     | $((274R - 44R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | PRN1 6-0 = 0010111     | $((274R - 46R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | PRN1 6-0 = 0011000     | $((274R - 48R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | PRN1 6-0 = 0011001     | $((274R - 50R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | PRN1 6-0 = 0011010     | $((274R - 52R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | PRN1 6-0 = 0011011     | $((274R - 54R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | PRN1 6-0 = 0011100     | $((274R - 56R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | PRN1 6-0 = 0011101     | $((274R - 58R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | PRN1 6-0 = 0011110     | $((274R - 60R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | PRN1 6-0 = 0011111     | $((274R - 62R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | PRN1 6-0 = 0100000     | $((274R - 64R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | PRN1 6-0 = 0100001     | $((274R - 66R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | PRN1 6-0 = 0100010     | $((274R - 68R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | PRN1 6-0 = 0100011     | $((274R - 70R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | PRN1 6-0 = 0100100     | $((274R - 72R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | PRN1 6-0 = 0100101     | $((274R - 74R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | PRN1 6-0 = 0100110     | $((274R - 76R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | PRN1 6-0 = 0100111     | $((274R - 78R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | PRN1 6-0 = 0101000     | $((274R - 80R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | PRN1 6-0 = 0101001     | $((274R - 82R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | PRN1 6-0 = 0101010     | $((274R - 84R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | PRN1 6-0 = 0101011     | $((274R - 86R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | PRN1 6-0 = 0101100     | $((274R - 88R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | PRN1 6-0 = 0101101     | $((274R - 90R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | PRN1 6-0 = 0101110     | $((274R - 92R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | PRN1 6-0 = 0101111     | $((274R - 94R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | PRN1 6-0 = 0110000     | $((274R - 96R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | PRN1 6-0 = 0110001     | $((274R - 98R) / 450R) * (VSNR - VGSN) + VGSN$  |
|                   | PRN1 6-0 = 0110010     | $((274R - 100R) / 450R) * (VSNR - VGSN) + VGSN$ |
|                   | PRN1 6-0 = 0110011     | $((274R - 102R) / 450R) * (VSNR - VGSN) + VGSN$ |
|                   | PRN1 6-0 = 0110100     | $((274R - 104R) / 450R) * (VSNR - VGSN) + VGSN$ |
|                   | PRN1 6-0 = 0110101     | $((274R - 106R) / 450R) * (VSNR - VGSN) + VGSN$ |
|                   | PRN1 6-0 = 0110110     | $((274R - 108R) / 450R) * (VSNR - VGSN) + VGSN$ |
|                   | PRN1 6-0 = 0110111     | $((274R - 110R) / 450R) * (VSNR - VGSN) + VGSN$ |
|                   | PRN1 6-0 = 0111000     | $((274R - 112R) / 450R) * (VSNR - VGSN) + VGSN$ |
|                   | PRN1 6-0 = 0111001     | $((274R - 114R) / 450R) * (VSNR - VGSN) + VGSN$ |
|                   | PRN1 6-0 = 0111010     | $((274R - 116R) / 450R) * (VSNR - VGSN) + VGSN$ |
|                   | PRN1 6-0 = 0111011     | $((274R - 118R) / 450R) * (VSNR - VGSN) + VGSN$ |
|                   | PRN1 6-0 = 0111100     | $((274R - 120R) / 450R) * (VSNR - VGSN) + VGSN$ |
|                   | PRN1 6-0 = 0111101     | $((274R - 122R) / 450R) * (VSNR - VGSN) + VGSN$ |
|                   | PRN1 6-0 = 0111110     | $((274R - 124R) / 450R) * (VSNR - VGSN) + VGSN$ |
|                   | PRN1 6-0 = 0111111     | $((274R - 126R) / 450R) * (VSNR - VGSN) + VGSN$ |
|                   | PRN1 6-0 = 1000000     | $((274R - 128R) / 450R) * (VSNR - VGSN) + VGSN$ |
|                   | PRN1 6-0 = 1000001     | $((274R - 130R) / 450R) * (VSNR - VGSN) + VGSN$ |
|                   | PRN1 6-0 = 1000010     | $((274R - 132R) / 450R) * (VSNR - VGSN) + VGSN$ |
|                   | PRN1 6-0 = 1000011     | $((274R - 134R) / 450R) * (VSNR - VGSN) + VGSN$ |
|                   | PRN1 6-0 = 1000100     | $((274R - 136R) / 450R) * (VSNR - VGSN) + VGSN$ |

|                    |                                                 |
|--------------------|-------------------------------------------------|
| PRN1 6-0 = 1000101 | $((274R - 138R) / 450R) * (VSNR - VGSN) + VGSN$ |
| PRN1 6-0 = 1000110 | $((274R - 140R) / 450R) * (VSNR - VGSN) + VGSN$ |
| PRN1 6-0 = 1000111 | $((274R - 142R) / 450R) * (VSNR - VGSN) + VGSN$ |
| PRN1 6-0 = 1001000 | $((274R - 144R) / 450R) * (VSNR - VGSN) + VGSN$ |
| PRN1 6-0 = 1001001 | $((274R - 146R) / 450R) * (VSNR - VGSN) + VGSN$ |
| PRN1 6-0 = 1001010 | $((274R - 148R) / 450R) * (VSNR - VGSN) + VGSN$ |
| PRN1 6-0 = 1001011 | $((274R - 150R) / 450R) * (VSNR - VGSN) + VGSN$ |
| PRN1 6-0 = 1001100 | $((274R - 152R) / 450R) * (VSNR - VGSN) + VGSN$ |
| PRN1 6-0 = 1001101 | $((274R - 154R) / 450R) * (VSNR - VGSN) + VGSN$ |
| PRN1 6-0 = 1001110 | $((274R - 156R) / 450R) * (VSNR - VGSN) + VGSN$ |
| PRN1 6-0 = 1001111 | $((274R - 158R) / 450R) * (VSNR - VGSN) + VGSN$ |
| PRN1 6-0 = 1010000 | $((274R - 160R) / 450R) * (VSNR - VGSN) + VGSN$ |
| PRN1 6-0 = 1010001 | $((274R - 162R) / 450R) * (VSNR - VGSN) + VGSN$ |
| PRN1 6-0 = 1010010 | $((274R - 164R) / 450R) * (VSNR - VGSN) + VGSN$ |
| PRN1 6-0 = 1010011 | $((274R - 166R) / 450R) * (VSNR - VGSN) + VGSN$ |
| PRN1 6-0 = 1010100 | $((274R - 168R) / 450R) * (VSNR - VGSN) + VGSN$ |
| PRN1 6-0 = 1010101 | $((274R - 170R) / 450R) * (VSNR - VGSN) + VGSN$ |
| PRN1 6-0 = 1010110 | $((274R - 172R) / 450R) * (VSNR - VGSN) + VGSN$ |
| PRN1 6-0 = 1010111 | $((274R - 174R) / 450R) * (VSNR - VGSN) + VGSN$ |
| PRN1 6-0 = 1011000 | inhibit                                         |
| PRN1 6-0 = 1011001 | inhibit                                         |
| PRN1 6-0 = 1011010 | inhibit                                         |
| PRN1 6-0 = 1011011 | inhibit                                         |
| PRN1 6-0 = 1011100 | inhibit                                         |
| PRN1 6-0 = 1011101 | inhibit                                         |
| PRN1 6-0 = 1011110 | inhibit                                         |
| PRN1 6-0 = 1011111 | inhibit                                         |
| PRN1 6-0 = 1100000 | inhibit                                         |
| PRN1 6-0 = 1100001 | inhibit                                         |
| PRN1 6-0 = 1100010 | inhibit                                         |
| PRN1 6-0 = 1100011 | inhibit                                         |
| PRN1 6-0 = 1100100 | inhibit                                         |
| PRN1 6-0 = 1100101 | inhibit                                         |
| PRN1 6-0 = 1100110 | inhibit                                         |
| PRN1 6-0 = 1100111 | inhibit                                         |
| PRN1 6-0 = 1101000 | inhibit                                         |
| PRN1 6-0 = 1101001 | inhibit                                         |
| PRN1 6-0 = 1101010 | inhibit                                         |
| PRN1 6-0 = 1101011 | inhibit                                         |
| PRN1 6-0 = 1101100 | inhibit                                         |
| PRN1 6-0 = 1101101 | inhibit                                         |
| PRN1 6-0 = 1101110 | inhibit                                         |
| PRN1 6-0 = 1101111 | inhibit                                         |
| PRN1 6-0 = 1110000 | inhibit                                         |
| PRN1 6-0 = 1110001 | inhibit                                         |
| PRN1 6-0 = 1110010 | inhibit                                         |
| PRN1 6-0 = 1110011 | inhibit                                         |
| PRN1 6-0 = 1110100 | inhibit                                         |
| PRN1 6-0 = 1110101 | inhibit                                         |
| PRN1 6-0 = 1110110 | inhibit                                         |
| PRN1 6-0 = 1110111 | inhibit                                         |
| PRN1 6-0 = 1111000 | inhibit                                         |
| PRN1 6-0 = 1111001 | inhibit                                         |
| PRN1 6-0 = 1111010 | inhibit                                         |
| PRN1 6-0 = 1111011 | inhibit                                         |
| PRN1 6-0 = 1111100 | inhibit                                         |
| PRN1 6-0 = 1111101 | inhibit                                         |
| PRN1 6-0 = 1111110 | inhibit                                         |
| PRN1 6-0 = 1111111 | inhibit                                         |

Table 5.48: VinN11

| Reference voltage | Macro adjustment value | VinN3 formula                                   |
|-------------------|------------------------|-------------------------------------------------|
| VinN3             | PKN0 4-0 = 00000       | $(47R / 48R) * (VinN2 - VinN5) + VinN5$         |
|                   | PKN0 4-0 = 00001       | $((47R - 1R) / 48R) * (VinN2 - VinN5) + VinN5$  |
|                   | PKN0 4-0 = 00010       | $((47R - 2R) / 48R) * (VinN2 - VinN5) + VinN5$  |
|                   | PKN0 4-0 = 00011       | $((47R - 3R) / 48R) * (VinN2 - VinN5) + VinN5$  |
|                   | PKN0 4-0 = 00100       | $((47R - 4R) / 48R) * (VinN2 - VinN5) + VinN5$  |
|                   | PKN0 4-0 = 00101       | $((47R - 5R) / 48R) * (VinN2 - VinN5) + VinN5$  |
|                   | PKN0 4-0 = 00110       | $((47R - 6R) / 48R) * (VinN2 - VinN5) + VinN5$  |
|                   | PKN0 4-0 = 00111       | $((47R - 7R) / 48R) * (VinN2 - VinN5) + VinN5$  |
|                   | PKN0 4-0 = 01000       | $((47R - 8R) / 48R) * (VinN2 - VinN5) + VinN5$  |
|                   | PKN0 4-0 = 01001       | $((47R - 9R) / 48R) * (VinN2 - VinN5) + VinN5$  |
|                   | PKN0 4-0 = 01010       | $((47R - 10R) / 48R) * (VinN2 - VinN5) + VinN5$ |
|                   | PKN0 4-0 = 01011       | $((47R - 11R) / 48R) * (VinN2 - VinN5) + VinN5$ |
|                   | PKN0 4-0 = 01100       | $((47R - 12R) / 48R) * (VinN2 - VinN5) + VinN5$ |
|                   | PKN0 4-0 = 01101       | $((47R - 13R) / 48R) * (VinN2 - VinN5) + VinN5$ |
|                   | PKN0 4-0 = 01110       | $((47R - 14R) / 48R) * (VinN2 - VinN5) + VinN5$ |
|                   | PKN0 4-0 = 01111       | $((47R - 15R) / 48R) * (VinN2 - VinN5) + VinN5$ |
|                   | PKN0 4-0 = 10000       | $((47R - 16R) / 48R) * (VinN2 - VinN5) + VinN5$ |
|                   | PKN0 4-0 = 10001       | $((47R - 17R) / 48R) * (VinN2 - VinN5) + VinN5$ |
|                   | PKN0 4-0 = 10010       | $((47R - 18R) / 48R) * (VinN2 - VinN5) + VinN5$ |
|                   | PKN0 4-0 = 10011       | $((47R - 19R) / 48R) * (VinN2 - VinN5) + VinN5$ |
|                   | PKN0 4-0 = 10100       | $((47R - 20R) / 48R) * (VinN2 - VinN5) + VinN5$ |
|                   | PKN0 4-0 = 10101       | $((47R - 21R) / 48R) * (VinN2 - VinN5) + VinN5$ |
|                   | PKN0 4-0 = 10110       | $((47R - 22R) / 48R) * (VinN2 - VinN5) + VinN5$ |
|                   | PKN0 4-0 = 10111       | $((47R - 23R) / 48R) * (VinN2 - VinN5) + VinN5$ |
|                   | PKN0 4-0 = 11000       | $((47R - 24R) / 48R) * (VinN2 - VinN5) + VinN5$ |
|                   | PKN0 4-0 = 11001       | $((47R - 25R) / 48R) * (VinN2 - VinN5) + VinN5$ |
|                   | PKN0 4-0 = 11010       | $((47R - 26R) / 48R) * (VinN2 - VinN5) + VinN5$ |
|                   | PKN0 4-0 = 11011       | $((47R - 27R) / 48R) * (VinN2 - VinN5) + VinN5$ |
|                   | PKN0 4-0 = 11100       | $((47R - 28R) / 48R) * (VinN2 - VinN5) + VinN5$ |
|                   | PKN0 4-0 = 11101       | $((47R - 29R) / 48R) * (VinN2 - VinN5) + VinN5$ |
|                   | PKN0 4-0 = 11110       | $((47R - 30R) / 48R) * (VinN2 - VinN5) + VinN5$ |
|                   | PKN0 4-0 = 11111       | $((47R - 31R) / 48R) * (VinN2 - VinN5) + VinN5$ |

Table 5.49: VinN3

| Reference voltage | Macro adjustment value | VinN4 formula                                   |
|-------------------|------------------------|-------------------------------------------------|
| VinN4             | PKN1 4-0 = 00000       | $(32R / 48R) * (VinN2 - VinN5) + VinN5$         |
|                   | PKN1 4-0 = 00001       | $((32R - 1R) / 48R) * (VinN2 - VinN5) + VinN5$  |
|                   | PKN1 4-0 = 00010       | $((32R - 2R) / 48R) * (VinN2 - VinN5) + VinN5$  |
|                   | PKN1 4-0 = 00011       | $((32R - 3R) / 48R) * (VinN2 - VinN5) + VinN5$  |
|                   | PKN1 4-0 = 00100       | $((32R - 4R) / 48R) * (VinN2 - VinN5) + VinN5$  |
|                   | PKN1 4-0 = 00101       | $((32R - 5R) / 48R) * (VinN2 - VinN5) + VinN5$  |
|                   | PKN1 4-0 = 00110       | $((32R - 6R) / 48R) * (VinN2 - VinN5) + VinN5$  |
|                   | PKN1 4-0 = 00111       | $((32R - 7R) / 48R) * (VinN2 - VinN5) + VinN5$  |
|                   | PKN1 4-0 = 01000       | $((32R - 8R) / 48R) * (VinN2 - VinN5) + VinN5$  |
|                   | PKN1 4-0 = 01001       | $((32R - 9R) / 48R) * (VinN2 - VinN5) + VinN5$  |
|                   | PKN1 4-0 = 01010       | $((32R - 10R) / 48R) * (VinN2 - VinN5) + VinN5$ |
|                   | PKN1 4-0 = 01011       | $((32R - 11R) / 48R) * (VinN2 - VinN5) + VinN5$ |
|                   | PKN1 4-0 = 01100       | $((32R - 12R) / 48R) * (VinN2 - VinN5) + VinN5$ |
|                   | PKN1 4-0 = 01101       | $((32R - 13R) / 48R) * (VinN2 - VinN5) + VinN5$ |
|                   | PKN1 4-0 = 01110       | $((32R - 14R) / 48R) * (VinN2 - VinN5) + VinN5$ |
|                   | PKN1 4-0 = 01111       | $((32R - 15R) / 48R) * (VinN2 - VinN5) + VinN5$ |
|                   | PKN1 4-0 = 10000       | $((32R - 16R) / 48R) * (VinN2 - VinN5) + VinN5$ |
|                   | PKN1 4-0 = 10001       | $((32R - 17R) / 48R) * (VinN2 - VinN5) + VinN5$ |
|                   | PKN1 4-0 = 10010       | $((32R - 18R) / 48R) * (VinN2 - VinN5) + VinN5$ |
|                   | PKN1 4-0 = 10011       | $((32R - 19R) / 48R) * (VinN2 - VinN5) + VinN5$ |
|                   | PKN1 4-0 = 10100       | $((32R - 20R) / 48R) * (VinN2 - VinN5) + VinN5$ |
|                   | PKN1 4-0 = 10101       | $((32R - 21R) / 48R) * (VinN2 - VinN5) + VinN5$ |
|                   | PKN1 4-0 = 10110       | $((32R - 22R) / 48R) * (VinN2 - VinN5) + VinN5$ |
|                   | PKN1 4-0 = 10111       | $((32R - 23R) / 48R) * (VinN2 - VinN5) + VinN5$ |
|                   | PKN1 4-0 = 11000       | $((32R - 24R) / 48R) * (VinN2 - VinN5) + VinN5$ |
|                   | PKN1 4-0 = 11001       | $((32R - 25R) / 48R) * (VinN2 - VinN5) + VinN5$ |
|                   | PKN1 4-0 = 11010       | $((32R - 26R) / 48R) * (VinN2 - VinN5) + VinN5$ |
|                   | PKN1 4-0 = 11011       | $((32R - 27R) / 48R) * (VinN2 - VinN5) + VinN5$ |
|                   | PKN1 4-0 = 11100       | $((32R - 28R) / 48R) * (VinN2 - VinN5) + VinN5$ |
|                   | PKN1 4-0 = 11101       | $((32R - 29R) / 48R) * (VinN2 - VinN5) + VinN5$ |
|                   | PKN1 4-0 = 11110       | $((32R - 30R) / 48R) * (VinN2 - VinN5) + VinN5$ |
|                   | PKN1 4-0 = 11111       | $((32R - 31R) / 48R) * (VinN2 - VinN5) + VinN5$ |

Table 5.50: VinN4

| Reference voltage | Macro adjustment value | VinN6 formula                                       |
|-------------------|------------------------|-----------------------------------------------------|
| VinN6             | PKN2 4-0 = 00000       | $(220R / 223R) * (VinN5 - VinN11) + VinN11$         |
|                   | PKN2 4-0 = 00001       | $((220R - 3R) / 223R) * (VinN5 - VinN11) + VinN11$  |
|                   | PKN2 4-0 = 00010       | $((220R - 6R) / 223R) * (VinN5 - VinN11) + VinN11$  |
|                   | PKN2 4-0 = 00011       | $((220R - 9R) / 223R) * (VinN5 - VinN11) + VinN11$  |
|                   | PKN2 4-0 = 00100       | $((220R - 12R) / 223R) * (VinN5 - VinN11) + VinN11$ |
|                   | PKN2 4-0 = 00101       | $((220R - 15R) / 223R) * (VinN5 - VinN11) + VinN11$ |
|                   | PKN2 4-0 = 00110       | $((220R - 18R) / 223R) * (VinN5 - VinN11) + VinN11$ |
|                   | PKN2 4-0 = 00111       | $((220R - 21R) / 223R) * (VinN5 - VinN11) + VinN11$ |
|                   | PKN2 4-0 = 01000       | $((220R - 24R) / 223R) * (VinN5 - VinN11) + VinN11$ |
|                   | PKN2 4-0 = 01001       | $((220R - 27R) / 223R) * (VinN5 - VinN11) + VinN11$ |
|                   | PKN2 4-0 = 01010       | $((220R - 30R) / 223R) * (VinN5 - VinN11) + VinN11$ |
|                   | PKN2 4-0 = 01011       | $((220R - 33R) / 223R) * (VinN5 - VinN11) + VinN11$ |
|                   | PKN2 4-0 = 01100       | $((220R - 36R) / 223R) * (VinN5 - VinN11) + VinN11$ |
|                   | PKN2 4-0 = 01101       | $((220R - 39R) / 223R) * (VinN5 - VinN11) + VinN11$ |
|                   | PKN2 4-0 = 01110       | $((220R - 42R) / 223R) * (VinN5 - VinN11) + VinN11$ |
|                   | PKN2 4-0 = 01111       | $((220R - 45R) / 223R) * (VinN5 - VinN11) + VinN11$ |
|                   | PKN2 4-0 = 10000       | $((220R - 48R) / 223R) * (VinN5 - VinN11) + VinN11$ |
|                   | PKN2 4-0 = 10001       | $((220R - 51R) / 223R) * (VinN5 - VinN11) + VinN11$ |
|                   | PKN2 4-0 = 10010       | $((220R - 54R) / 223R) * (VinN5 - VinN11) + VinN11$ |
|                   | PKN2 4-0 = 10011       | $((220R - 57R) / 223R) * (VinN5 - VinN11) + VinN11$ |
|                   | PKN2 4-0 = 10100       | $((220R - 60R) / 223R) * (VinN5 - VinN11) + VinN11$ |
|                   | PKN2 4-0 = 10101       | $((220R - 63R) / 223R) * (VinN5 - VinN11) + VinN11$ |
|                   | PKN2 4-0 = 10110       | $((220R - 66R) / 223R) * (VinN5 - VinN11) + VinN11$ |
|                   | PKN2 4-0 = 10111       | $((220R - 69R) / 223R) * (VinN5 - VinN11) + VinN11$ |
|                   | PKN2 4-0 = 11000       | $((220R - 72R) / 223R) * (VinN5 - VinN11) + VinN11$ |
|                   | PKN2 4-0 = 11001       | $((220R - 75R) / 223R) * (VinN5 - VinN11) + VinN11$ |
|                   | PKN2 4-0 = 11010       | $((220R - 78R) / 223R) * (VinN5 - VinN11) + VinN11$ |
|                   | PKN2 4-0 = 11011       | $((220R - 81R) / 223R) * (VinN5 - VinN11) + VinN11$ |
|                   | PKN2 4-0 = 11100       | $((220R - 84R) / 223R) * (VinN5 - VinN11) + VinN11$ |
|                   | PKN2 4-0 = 11101       | $((220R - 87R) / 223R) * (VinN5 - VinN11) + VinN11$ |
|                   | PKN2 4-0 = 11110       | $((220R - 90R) / 223R) * (VinN5 - VinN11) + VinN11$ |
|                   | PKN2 4-0 = 11111       | $((220R - 93R) / 223R) * (VinN5 - VinN11) + VinN11$ |

Table 5.51: VinN6



| Reference voltage | Macro adjustment value | VinN7 formula                                       |
|-------------------|------------------------|-----------------------------------------------------|
| VinN7             | PKN3 4-0 = 00000       | $(193R / 223R) * (VinN5 - VinN11) + VinN11$         |
|                   | PKN3 4-0 = 00001       | $((193R - 3R) / 223R) * (VinN5 - VinN11) + VinN11$  |
|                   | PKN3 4-0 = 00010       | $((193R - 6R) / 223R) * (VinN5 - VinN11) + VinN11$  |
|                   | PKN3 4-0 = 00011       | $((193R - 9R) / 223R) * (VinN5 - VinN11) + VinN11$  |
|                   | PKN3 4-0 = 00100       | $((193R - 12R) / 223R) * (VinN5 - VinN11) + VinN11$ |
|                   | PKN3 4-0 = 00101       | $((193R - 15R) / 223R) * (VinN5 - VinN11) + VinN11$ |
|                   | PKN3 4-0 = 00110       | $((193R - 18R) / 223R) * (VinN5 - VinN11) + VinN11$ |
|                   | PKN3 4-0 = 00111       | $((193R - 21R) / 223R) * (VinN5 - VinN11) + VinN11$ |
|                   | PKN3 4-0 = 01000       | $((193R - 24R) / 223R) * (VinN5 - VinN11) + VinN11$ |
|                   | PKN3 4-0 = 01001       | $((193R - 27R) / 223R) * (VinN5 - VinN11) + VinN11$ |
|                   | PKN3 4-0 = 01010       | $((193R - 30R) / 223R) * (VinN5 - VinN11) + VinN11$ |
|                   | PKN3 4-0 = 01011       | $((193R - 33R) / 223R) * (VinN5 - VinN11) + VinN11$ |
|                   | PKN3 4-0 = 01100       | $((193R - 36R) / 223R) * (VinN5 - VinN11) + VinN11$ |
|                   | PKN3 4-0 = 01101       | $((193R - 39R) / 223R) * (VinN5 - VinN11) + VinN11$ |
|                   | PKN3 4-0 = 01110       | $((193R - 42R) / 223R) * (VinN5 - VinN11) + VinN11$ |
|                   | PKN3 4-0 = 01111       | $((193R - 45R) / 223R) * (VinN5 - VinN11) + VinN11$ |
|                   | PKN3 4-0 = 10000       | $((193R - 48R) / 223R) * (VinN5 - VinN11) + VinN11$ |
|                   | PKN3 4-0 = 10001       | $((193R - 51R) / 223R) * (VinN5 - VinN11) + VinN11$ |
|                   | PKN3 4-0 = 10010       | $((193R - 54R) / 223R) * (VinN5 - VinN11) + VinN11$ |
|                   | PKN3 4-0 = 10011       | $((193R - 57R) / 223R) * (VinN5 - VinN11) + VinN11$ |
|                   | PKN3 4-0 = 10100       | $((193R - 60R) / 223R) * (VinN5 - VinN11) + VinN11$ |
|                   | PKN3 4-0 = 10101       | $((193R - 63R) / 223R) * (VinN5 - VinN11) + VinN11$ |
|                   | PKN3 4-0 = 10110       | $((193R - 66R) / 223R) * (VinN5 - VinN11) + VinN11$ |
|                   | PKN3 4-0 = 10111       | $((193R - 69R) / 223R) * (VinN5 - VinN11) + VinN11$ |
|                   | PKN3 4-0 = 11000       | $((193R - 72R) / 223R) * (VinN5 - VinN11) + VinN11$ |
|                   | PKN3 4-0 = 11001       | $((193R - 75R) / 223R) * (VinN5 - VinN11) + VinN11$ |
|                   | PKN3 4-0 = 11010       | $((193R - 78R) / 223R) * (VinN5 - VinN11) + VinN11$ |
|                   | PKN3 4-0 = 11011       | $((193R - 81R) / 223R) * (VinN5 - VinN11) + VinN11$ |
|                   | PKN3 4-0 = 11100       | $((193R - 84R) / 223R) * (VinN5 - VinN11) + VinN11$ |
|                   | PKN3 4-0 = 11101       | $((193R - 87R) / 223R) * (VinN5 - VinN11) + VinN11$ |
|                   | PKN3 4-0 = 11110       | $((193R - 90R) / 223R) * (VinN5 - VinN11) + VinN11$ |
|                   | PKN3 4-0 = 11111       | $((193R - 93R) / 223R) * (VinN5 - VinN11) + VinN11$ |

Table 5.52: VinN7

| Reference voltage | Macro adjustment value | VinN8 formula                                       |
|-------------------|------------------------|-----------------------------------------------------|
| VinN8             | PKN4 4-0 = 00000       | $(158R / 223R) * (VinN5 - VinN11) + VinN11$         |
|                   | PKN4 4-0 = 00001       | $((158R - 3R) / 223R) * (VinN5 - VinN11) + VinN11$  |
|                   | PKN4 4-0 = 00010       | $((158R - 6R) / 223R) * (VinN5 - VinN11) + VinN11$  |
|                   | PKN4 4-0 = 00011       | $((158R - 9R) / 223R) * (VinN5 - VinN11) + VinN11$  |
|                   | PKN4 4-0 = 00100       | $((158R - 12R) / 223R) * (VinN5 - VinN11) + VinN11$ |
|                   | PKN4 4-0 = 00101       | $((158R - 15R) / 223R) * (VinN5 - VinN11) + VinN11$ |
|                   | PKN4 4-0 = 00110       | $((158R - 18R) / 223R) * (VinN5 - VinN11) + VinN11$ |
|                   | PKN4 4-0 = 00111       | $((158R - 21R) / 223R) * (VinN5 - VinN11) + VinN11$ |
|                   | PKN4 4-0 = 01000       | $((158R - 24R) / 223R) * (VinN5 - VinN11) + VinN11$ |
|                   | PKN4 4-0 = 01001       | $((158R - 27R) / 223R) * (VinN5 - VinN11) + VinN11$ |
|                   | PKN4 4-0 = 01010       | $((158R - 30R) / 223R) * (VinN5 - VinN11) + VinN11$ |
|                   | PKN4 4-0 = 01011       | $((158R - 33R) / 223R) * (VinN5 - VinN11) + VinN11$ |
|                   | PKN4 4-0 = 01100       | $((158R - 36R) / 223R) * (VinN5 - VinN11) + VinN11$ |
|                   | PKN4 4-0 = 01101       | $((158R - 39R) / 223R) * (VinN5 - VinN11) + VinN11$ |
|                   | PKN4 4-0 = 01110       | $((158R - 42R) / 223R) * (VinN5 - VinN11) + VinN11$ |
|                   | PKN4 4-0 = 01111       | $((158R - 45R) / 223R) * (VinN5 - VinN11) + VinN11$ |
|                   | PKN4 4-0 = 10000       | $((158R - 48R) / 223R) * (VinN5 - VinN11) + VinN11$ |
|                   | PKN4 4-0 = 10001       | $((158R - 51R) / 223R) * (VinN5 - VinN11) + VinN11$ |
|                   | PKN4 4-0 = 10010       | $((158R - 54R) / 223R) * (VinN5 - VinN11) + VinN11$ |
|                   | PKN4 4-0 = 10011       | $((158R - 57R) / 223R) * (VinN5 - VinN11) + VinN11$ |
|                   | PKN4 4-0 = 10100       | $((158R - 60R) / 223R) * (VinN5 - VinN11) + VinN11$ |
|                   | PKN4 4-0 = 10101       | $((158R - 63R) / 223R) * (VinN5 - VinN11) + VinN11$ |
|                   | PKN4 4-0 = 10110       | $((158R - 66R) / 223R) * (VinN5 - VinN11) + VinN11$ |
|                   | PKN4 4-0 = 10111       | $((158R - 69R) / 223R) * (VinN5 - VinN11) + VinN11$ |
|                   | PKN4 4-0 = 11000       | $((158R - 72R) / 223R) * (VinN5 - VinN11) + VinN11$ |
|                   | PKN4 4-0 = 11001       | $((158R - 75R) / 223R) * (VinN5 - VinN11) + VinN11$ |
|                   | PKN4 4-0 = 11010       | $((158R - 78R) / 223R) * (VinN5 - VinN11) + VinN11$ |
|                   | PKN4 4-0 = 11011       | $((158R - 81R) / 223R) * (VinN5 - VinN11) + VinN11$ |
|                   | PKN4 4-0 = 11100       | $((158R - 84R) / 223R) * (VinN5 - VinN11) + VinN11$ |
|                   | PKN4 4-0 = 11101       | $((158R - 87R) / 223R) * (VinN5 - VinN11) + VinN11$ |
|                   | PKN4 4-0 = 11110       | $((158R - 90R) / 223R) * (VinN5 - VinN11) + VinN11$ |
|                   | PKN4 4-0 = 11111       | $((158R - 93R) / 223R) * (VinN5 - VinN11) + VinN11$ |

Table 5.53: VinN8



| Reference voltage | Macro adjustment value | VinN9 formula                                       |
|-------------------|------------------------|-----------------------------------------------------|
| VinN9             | PKN5 4-0 = 00000       | $(123R / 223R) * (VinN5 - VinN11) + VinN11$         |
|                   | PKN5 4-0 = 00001       | $((123R - 3R) / 223R) * (VinN5 - VinN11) + VinN11$  |
|                   | PKN5 4-0 = 00010       | $((123R - 6R) / 223R) * (VinN5 - VinN11) + VinN11$  |
|                   | PKN5 4-0 = 00011       | $((123R - 9R) / 223R) * (VinN5 - VinN11) + VinN11$  |
|                   | PKN5 4-0 = 00100       | $((123R - 12R) / 223R) * (VinN5 - VinN11) + VinN11$ |
|                   | PKN5 4-0 = 00101       | $((123R - 15R) / 223R) * (VinN5 - VinN11) + VinN11$ |
|                   | PKN5 4-0 = 00110       | $((123R - 18R) / 223R) * (VinN5 - VinN11) + VinN11$ |
|                   | PKN5 4-0 = 00111       | $((123R - 21R) / 223R) * (VinN5 - VinN11) + VinN11$ |
|                   | PKN5 4-0 = 01000       | $((123R - 24R) / 223R) * (VinN5 - VinN11) + VinN11$ |
|                   | PKN5 4-0 = 01001       | $((123R - 27R) / 223R) * (VinN5 - VinN11) + VinN11$ |
|                   | PKN5 4-0 = 01010       | $((123R - 30R) / 223R) * (VinN5 - VinN11) + VinN11$ |
|                   | PKN5 4-0 = 01011       | $((123R - 33R) / 223R) * (VinN5 - VinN11) + VinN11$ |
|                   | PKN5 4-0 = 01100       | $((123R - 36R) / 223R) * (VinN5 - VinN11) + VinN11$ |
|                   | PKN5 4-0 = 01101       | $((123R - 39R) / 223R) * (VinN5 - VinN11) + VinN11$ |
|                   | PKN5 4-0 = 01110       | $((123R - 42R) / 223R) * (VinN5 - VinN11) + VinN11$ |
|                   | PKN5 4-0 = 01111       | $((123R - 45R) / 223R) * (VinN5 - VinN11) + VinN11$ |
|                   | PKN5 4-0 = 10000       | $((123R - 48R) / 223R) * (VinN5 - VinN11) + VinN11$ |
|                   | PKN5 4-0 = 10001       | $((123R - 51R) / 223R) * (VinN5 - VinN11) + VinN11$ |
|                   | PKN5 4-0 = 10010       | $((123R - 54R) / 223R) * (VinN5 - VinN11) + VinN11$ |
|                   | PKN5 4-0 = 10011       | $((123R - 57R) / 223R) * (VinN5 - VinN11) + VinN11$ |
|                   | PKN5 4-0 = 10100       | $((123R - 60R) / 223R) * (VinN5 - VinN11) + VinN11$ |
|                   | PKN5 4-0 = 10101       | $((123R - 63R) / 223R) * (VinN5 - VinN11) + VinN11$ |
|                   | PKN5 4-0 = 10110       | $((123R - 66R) / 223R) * (VinN5 - VinN11) + VinN11$ |
|                   | PKN5 4-0 = 10111       | $((123R - 69R) / 223R) * (VinN5 - VinN11) + VinN11$ |
|                   | PKN5 4-0 = 11000       | $((123R - 72R) / 223R) * (VinN5 - VinN11) + VinN11$ |
|                   | PKN5 4-0 = 11001       | $((123R - 75R) / 223R) * (VinN5 - VinN11) + VinN11$ |
|                   | PKN5 4-0 = 11010       | $((123R - 78R) / 223R) * (VinN5 - VinN11) + VinN11$ |
|                   | PKN5 4-0 = 11011       | $((123R - 81R) / 223R) * (VinN5 - VinN11) + VinN11$ |
|                   | PKN5 4-0 = 11100       | $((123R - 84R) / 223R) * (VinN5 - VinN11) + VinN11$ |
|                   | PKN5 4-0 = 11101       | $((123R - 87R) / 223R) * (VinN5 - VinN11) + VinN11$ |
|                   | PKN5 4-0 = 11110       | $((123R - 90R) / 223R) * (VinN5 - VinN11) + VinN11$ |
|                   | PKN5 4-0 = 11111       | $((123R - 93R) / 223R) * (VinN5 - VinN11) + VinN11$ |

Table 5.54: VinN9

| Reference voltage | Macro adjustment value | VinN10 formula                                     |
|-------------------|------------------------|----------------------------------------------------|
| VinN10            | PKN6 4-0 = 00000       | $(96R / 223R) * (VinN5 - VinN11) + VinN11$         |
|                   | PKN6 4-0 = 00001       | $((96R - 3R) / 223R) * (VinN5 - VinN11) + VinN11$  |
|                   | PKN6 4-0 = 00010       | $((96R - 6R) / 223R) * (VinN5 - VinN11) + VinN11$  |
|                   | PKN6 4-0 = 00011       | $((96R - 9R) / 223R) * (VinN5 - VinN11) + VinN11$  |
|                   | PKN6 4-0 = 00100       | $((96R - 12R) / 223R) * (VinN5 - VinN11) + VinN11$ |
|                   | PKN6 4-0 = 00101       | $((96R - 15R) / 223R) * (VinN5 - VinN11) + VinN11$ |
|                   | PKN6 4-0 = 00110       | $((96R - 18R) / 223R) * (VinN5 - VinN11) + VinN11$ |
|                   | PKN6 4-0 = 00111       | $((96R - 21R) / 223R) * (VinN5 - VinN11) + VinN11$ |
|                   | PKN6 4-0 = 01000       | $((96R - 24R) / 223R) * (VinN5 - VinN11) + VinN11$ |
|                   | PKN6 4-0 = 01001       | $((96R - 27R) / 223R) * (VinN5 - VinN11) + VinN11$ |
|                   | PKN6 4-0 = 01010       | $((96R - 30R) / 223R) * (VinN5 - VinN11) + VinN11$ |
|                   | PKN6 4-0 = 01011       | $((96R - 33R) / 223R) * (VinN5 - VinN11) + VinN11$ |
|                   | PKN6 4-0 = 01100       | $((96R - 36R) / 223R) * (VinN5 - VinN11) + VinN11$ |
|                   | PKN6 4-0 = 01101       | $((96R - 39R) / 223R) * (VinN5 - VinN11) + VinN11$ |
|                   | PKN6 4-0 = 01110       | $((96R - 42R) / 223R) * (VinN5 - VinN11) + VinN11$ |
|                   | PKN6 4-0 = 01111       | $((96R - 45R) / 223R) * (VinN5 - VinN11) + VinN11$ |
|                   | PKN6 4-0 = 10000       | $((96R - 48R) / 223R) * (VinN5 - VinN11) + VinN11$ |
|                   | PKN6 4-0 = 10001       | $((96R - 51R) / 223R) * (VinN5 - VinN11) + VinN11$ |
|                   | PKN6 4-0 = 10010       | $((96R - 54R) / 223R) * (VinN5 - VinN11) + VinN11$ |
|                   | PKN6 4-0 = 10011       | $((96R - 57R) / 223R) * (VinN5 - VinN11) + VinN11$ |
|                   | PKN6 4-0 = 10100       | $((96R - 60R) / 223R) * (VinN5 - VinN11) + VinN11$ |
|                   | PKN6 4-0 = 10101       | $((96R - 63R) / 223R) * (VinN5 - VinN11) + VinN11$ |
|                   | PKN6 4-0 = 10110       | $((96R - 66R) / 223R) * (VinN5 - VinN11) + VinN11$ |
|                   | PKN6 4-0 = 10111       | $((96R - 69R) / 223R) * (VinN5 - VinN11) + VinN11$ |
|                   | PKN6 4-0 = 11000       | $((96R - 72R) / 223R) * (VinN5 - VinN11) + VinN11$ |
|                   | PKN6 4-0 = 11001       | $((96R - 75R) / 223R) * (VinN5 - VinN11) + VinN11$ |
|                   | PKN6 4-0 = 11010       | $((96R - 78R) / 223R) * (VinN5 - VinN11) + VinN11$ |
|                   | PKN6 4-0 = 11011       | $((96R - 81R) / 223R) * (VinN5 - VinN11) + VinN11$ |
|                   | PKN6 4-0 = 11100       | $((96R - 84R) / 223R) * (VinN5 - VinN11) + VinN11$ |
|                   | PKN6 4-0 = 11101       | $((96R - 87R) / 223R) * (VinN5 - VinN11) + VinN11$ |
|                   | PKN6 4-0 = 11110       | $((96R - 90R) / 223R) * (VinN5 - VinN11) + VinN11$ |
|                   | PKN6 4-0 = 11111       | $((96R - 93R) / 223R) * (VinN5 - VinN11) + VinN11$ |

Table 5.55: VinN10

| Reference voltage | Macro adjustment value | VinN12 formula                                     |
|-------------------|------------------------|----------------------------------------------------|
| VinN12            | PKN7 4-0 = 00000       | $(47R / 48R) * (VinN11 - VinN14) + VinN14$         |
|                   | PKN7 4-0 = 00001       | $((47R - 1R) / 48R) * (VinN11 - VinN14) + VinN14$  |
|                   | PKN7 4-0 = 00010       | $((47R - 2R) / 48R) * (VinN11 - VinN14) + VinN14$  |
|                   | PKN7 4-0 = 00011       | $((47R - 3R) / 48R) * (VinN11 - VinN14) + VinN14$  |
|                   | PKN7 4-0 = 00100       | $((47R - 4R) / 48R) * (VinN11 - VinN14) + VinN14$  |
|                   | PKN7 4-0 = 00101       | $((47R - 5R) / 48R) * (VinN11 - VinN14) + VinN14$  |
|                   | PKN7 4-0 = 00110       | $((47R - 6R) / 48R) * (VinN11 - VinN14) + VinN14$  |
|                   | PKN7 4-0 = 00111       | $((47R - 7R) / 48R) * (VinN11 - VinN14) + VinN14$  |
|                   | PKN7 4-0 = 01000       | $((47R - 8R) / 48R) * (VinN11 - VinN14) + VinN14$  |
|                   | PKN7 4-0 = 01001       | $((47R - 9R) / 48R) * (VinN11 - VinN14) + VinN14$  |
|                   | PKN7 4-0 = 01010       | $((47R - 10R) / 48R) * (VinN11 - VinN14) + VinN14$ |
|                   | PKN7 4-0 = 01011       | $((47R - 11R) / 48R) * (VinN11 - VinN14) + VinN14$ |
|                   | PKN7 4-0 = 01100       | $((47R - 12R) / 48R) * (VinN11 - VinN14) + VinN14$ |
|                   | PKN7 4-0 = 01101       | $((47R - 13R) / 48R) * (VinN11 - VinN14) + VinN14$ |
|                   | PKN7 4-0 = 01110       | $((47R - 14R) / 48R) * (VinN11 - VinN14) + VinN14$ |
|                   | PKN7 4-0 = 01111       | $((47R - 15R) / 48R) * (VinN11 - VinN14) + VinN14$ |
|                   | PKN7 4-0 = 10000       | $((47R - 16R) / 48R) * (VinN11 - VinN14) + VinN14$ |
|                   | PKN7 4-0 = 10001       | $((47R - 17R) / 48R) * (VinN11 - VinN14) + VinN14$ |
|                   | PKN7 4-0 = 10010       | $((47R - 18R) / 48R) * (VinN11 - VinN14) + VinN14$ |
|                   | PKN7 4-0 = 10011       | $((47R - 19R) / 48R) * (VinN11 - VinN14) + VinN14$ |
|                   | PKN7 4-0 = 10100       | $((47R - 20R) / 48R) * (VinN11 - VinN14) + VinN14$ |
|                   | PKN7 4-0 = 10101       | $((47R - 21R) / 48R) * (VinN11 - VinN14) + VinN14$ |
|                   | PKN7 4-0 = 10110       | $((47R - 22R) / 48R) * (VinN11 - VinN14) + VinN14$ |
|                   | PKN7 4-0 = 10111       | $((47R - 23R) / 48R) * (VinN11 - VinN14) + VinN14$ |
|                   | PKN7 4-0 = 11000       | $((47R - 24R) / 48R) * (VinN11 - VinN14) + VinN14$ |
|                   | PKN7 4-0 = 11001       | $((47R - 25R) / 48R) * (VinN11 - VinN14) + VinN14$ |
|                   | PKN7 4-0 = 11010       | $((47R - 26R) / 48R) * (VinN11 - VinN14) + VinN14$ |
|                   | PKN7 4-0 = 11011       | $((47R - 27R) / 48R) * (VinN11 - VinN14) + VinN14$ |
|                   | PKN7 4-0 = 11100       | $((47R - 28R) / 48R) * (VinN11 - VinN14) + VinN14$ |
|                   | PKN7 4-0 = 11101       | $((47R - 29R) / 48R) * (VinN11 - VinN14) + VinN14$ |
|                   | PKN7 4-0 = 11110       | $((47R - 30R) / 48R) * (VinN11 - VinN14) + VinN14$ |
|                   | PKN7 4-0 = 11111       | $((47R - 31R) / 48R) * (VinN11 - VinN14) + VinN14$ |

Table 5.56: VinN12

| Reference voltage | Macro adjustment value | VinN13 formula                                     |
|-------------------|------------------------|----------------------------------------------------|
| VinN13            | PKN8 4-0 = 00000       | $(32R / 48R) * (VinN11 - VinN14) + VinN14$         |
|                   | PKN8 4-0 = 00001       | $((32R - 1R) / 48R) * (VinN11 - VinN14) + VinN14$  |
|                   | PKN8 4-0 = 00010       | $((32R - 2R) / 48R) * (VinN11 - VinN14) + VinN14$  |
|                   | PKN8 4-0 = 00011       | $((32R - 3R) / 48R) * (VinN11 - VinN14) + VinN14$  |
|                   | PKN8 4-0 = 00100       | $((32R - 4R) / 48R) * (VinN11 - VinN14) + VinN14$  |
|                   | PKN8 4-0 = 00101       | $((32R - 5R) / 48R) * (VinN11 - VinN14) + VinN14$  |
|                   | PKN8 4-0 = 00110       | $((32R - 6R) / 48R) * (VinN11 - VinN14) + VinN14$  |
|                   | PKN8 4-0 = 00111       | $((32R - 7R) / 48R) * (VinN11 - VinN14) + VinN14$  |
|                   | PKN8 4-0 = 01000       | $((32R - 8R) / 48R) * (VinN11 - VinN14) + VinN14$  |
|                   | PKN8 4-0 = 01001       | $((32R - 9R) / 48R) * (VinN11 - VinN14) + VinN14$  |
|                   | PKN8 4-0 = 01010       | $((32R - 10R) / 48R) * (VinN11 - VinN14) + VinN14$ |
|                   | PKN8 4-0 = 01011       | $((32R - 11R) / 48R) * (VinN11 - VinN14) + VinN14$ |
|                   | PKN8 4-0 = 01100       | $((32R - 12R) / 48R) * (VinN11 - VinN14) + VinN14$ |
|                   | PKN8 4-0 = 01101       | $((32R - 13R) / 48R) * (VinN11 - VinN14) + VinN14$ |
|                   | PKN8 4-0 = 01110       | $((32R - 14R) / 48R) * (VinN11 - VinN14) + VinN14$ |
|                   | PKN8 4-0 = 01111       | $((32R - 15R) / 48R) * (VinN11 - VinN14) + VinN14$ |
|                   | PKN8 4-0 = 10000       | $((32R - 16R) / 48R) * (VinN11 - VinN14) + VinN14$ |
|                   | PKN8 4-0 = 10001       | $((32R - 17R) / 48R) * (VinN11 - VinN14) + VinN14$ |
|                   | PKN8 4-0 = 10010       | $((32R - 18R) / 48R) * (VinN11 - VinN14) + VinN14$ |
|                   | PKN8 4-0 = 10011       | $((32R - 19R) / 48R) * (VinN11 - VinN14) + VinN14$ |
|                   | PKN8 4-0 = 10100       | $((32R - 20R) / 48R) * (VinN11 - VinN14) + VinN14$ |
|                   | PKN8 4-0 = 10101       | $((32R - 21R) / 48R) * (VinN11 - VinN14) + VinN14$ |
|                   | PKN8 4-0 = 10110       | $((32R - 22R) / 48R) * (VinN11 - VinN14) + VinN14$ |
|                   | PKN8 4-0 = 10111       | $((32R - 23R) / 48R) * (VinN11 - VinN14) + VinN14$ |
|                   | PKN8 4-0 = 11000       | $((32R - 24R) / 48R) * (VinN11 - VinN14) + VinN14$ |
|                   | PKN8 4-0 = 11001       | $((32R - 25R) / 48R) * (VinN11 - VinN14) + VinN14$ |
|                   | PKN8 4-0 = 11010       | $((32R - 26R) / 48R) * (VinN11 - VinN14) + VinN14$ |
|                   | PKN8 4-0 = 11011       | $((32R - 27R) / 48R) * (VinN11 - VinN14) + VinN14$ |
|                   | PKN8 4-0 = 11100       | $((32R - 28R) / 48R) * (VinN11 - VinN14) + VinN14$ |
|                   | PKN8 4-0 = 11101       | $((32R - 29R) / 48R) * (VinN11 - VinN14) + VinN14$ |
|                   | PKN8 4-0 = 11110       | $((32R - 30R) / 48R) * (VinN11 - VinN14) + VinN14$ |
|                   | PKN8 4-0 = 11111       | $((32R - 31R) / 48R) * (VinN11 - VinN14) + VinN14$ |

Table 5.57: VinN13

| Grayscale voltage | Formula                                                                                                                                                                                      | Grayscale voltage | Formula                                                                                      |
|-------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|----------------------------------------------------------------------------------------------|
| V0                | VinP0                                                                                                                                                                                        | V16               | CGMP4=0 =VinP5 - (VinP5 - VinP6)*(3R/6R)<br>CGMP4=1 =VinP5 - (VinP5 - VinP6)*(3.5R/6.5R)     |
| V1                | VinP1                                                                                                                                                                                        | V17               | CGMP4=0 =VinP5 - (VinP5 - VinP6)*(4R/6R)<br>CGMP4=1 =VinP5 - (VinP5 - VinP6)*(4.5R/6.5R)     |
| V2                | VinP2                                                                                                                                                                                        | V18               | CGMP4=0 =VinP5 - (VinP5 - VinP6)*(5R/6R)<br>CGMP4=1 =VinP5 - (VinP5 - VinP6)*(5.5R/6.5R)     |
| V3                | VinP3                                                                                                                                                                                        | V19               | VinP6                                                                                        |
| V4                | CGMP0=0 = VinP3 - (VinP3 - VinP4)*(1R/4R)<br>CGMP0=1 = VinP3 - (VinP3 - VinP4)*(3R/9.5R)<br>CGMP0=2 = VinP3 - (VinP3 - VinP4)*(3.5R/9.3R)<br>CGMP0=3 = VinP3 - (VinP3 - VinP4)*(3.5R/10R)    | V20               | VinP6 - (VinP6 - VinP7)*(1R/6R)                                                              |
| V5                | CGMP0=0 = VinP3 - (VinP3 - VinP4)*(2R/4R)<br>CGMP0=1 = VinP3 - (VinP3 - VinP4)*(5.5R/9.5R)<br>CGMP0=2 = VinP3 - (VinP3 - VinP4)*(6R/9.3R)<br>CGMP0=3 = VinP3 - (VinP3 - VinP4)*(6R/10R)      | V21               | VinP6 - (VinP6 - VinP7)*(2R/6R)                                                              |
| V6                | CGMP0=0 = VinP3 - (VinP3 - VinP4)*(3R/4R)<br>CGMP0=1 = VinP3 - (VinP3 - VinP4)*(7.5R/9.5R)<br>CGMP0=2 = VinP3 - (VinP3 - VinP4)*(7.8R/9.3R)<br>CGMP0=3 = VinP3 - (VinP3 - VinP4)*(8R/10R)    | V22               | VinP6 - (VinP6 - VinP7)*(3R/6R)                                                              |
| V7                | VinP4                                                                                                                                                                                        | V23               | VinP6 - (VinP6 - VinP7)*(4R/6R)                                                              |
| V8                | CGMP2=0 = VinP4 - (VinP4 - VinP5)*(1R/6R)<br>CGMP2=1 = VinP4 - (VinP4 - VinP5)*(3R/16R)<br>CGMP2=2 = VinP4 - (VinP4 - VinP5)*(4R/18R)<br>CGMP2=3 = VinP4 - (VinP4 - VinP5)*(4.5R/19.5R)      | V24               | VinP6 - (VinP6 - VinP7)*(5R/6R)                                                              |
| V9                | CGMP2=0 = VinP4 - (VinP4 - VinP5)*(2R/6R)<br>CGMP2=1 = VinP4 - (VinP4 - VinP5)*(6R/16R)<br>CGMP2=2 = VinP4 - (VinP4 - VinP5)*(7R/18R)<br>CGMP2=3 = VinP4 - (VinP4 - VinP5)*(8.5R/19.5R)      | V25               | VinP7                                                                                        |
| V10               | CGMP2=0 = VinP4 - (VinP4 - VinP5)*(3R/6R)<br>CGMP2=1 = VinP4 - (VinP4 - VinP5)*(8.5R/16R)<br>CGMP2=2 = VinP4 - (VinP4 - VinP5)*(10R/18R)<br>CGMP2=3 = VinP4 - (VinP4 - VinP5)*(11.5R/19.5R)  | V26               | VinP7 - (VinP7 - VinP8)*(1R/7.5R)                                                            |
| V11               | CGMP2=0 = VinP4 - (VinP4 - VinP5)*(4R/6R)<br>CGMP2=1 = VinP4 - (VinP4 - VinP5)*(11R/16R)<br>CGMP2=2 = VinP4 - (VinP4 - VinP5)*(13R/18R)<br>CGMP2=3 = VinP4 - (VinP4 - VinP5)*(14.5R/19.5R)   | V27               | VinP7 - (VinP7 - VinP8)*(2R/7.5R)                                                            |
| V12               | CGMP2=0 = VinP4 - (VinP4 - VinP5)*(5R/6R)<br>CGMP2=1 = VinP4 - (VinP4 - VinP5)*(13.5R/16R)<br>CGMP2=2 = VinP4 - (VinP4 - VinP5)*(15.5R/18R)<br>CGMP2=3 = VinP4 - (VinP4 - VinP5)*(17R/19.5R) | V28               | VinP7 - (VinP7 - VinP8)*(3R/7.5R)                                                            |
| V13               | VinP5                                                                                                                                                                                        | V29               | VinP7 - (VinP7 - VinP8)*(4R/7.5R)                                                            |
| V14               | CGMP4=0 =VinP5 - (VinP5 - VinP6)*(1R/6R)<br>CGMP4=1 =VinP5 - (VinP5 - VinP6)*(1.5R/6.5R)                                                                                                     | V30               | VinP7 - (VinP7 - VinP8)*(5R/7.5R)                                                            |
| V15               | CGMP4=0 =VinP5 - (VinP5 - VinP6)*(2R/6R)<br>CGMP4=1 =VinP5 - (VinP5 - VinP6)*(2.5R/6.5R)                                                                                                     | V31               | VinP7 - (VinP7 - VinP8)*(6R/7.5R)                                                            |
|                   |                                                                                                                                                                                              | V32               | VinP8                                                                                        |
|                   |                                                                                                                                                                                              | V33               | VinP8 - (VinP8 - VinP9)*(1R/6R)                                                              |
|                   |                                                                                                                                                                                              | V34               | VinP8 - (VinP8 - VinP9)*(2R/6R)                                                              |
|                   |                                                                                                                                                                                              | V35               | VinP8 - (VinP8 - VinP9)*(3R/6R)                                                              |
|                   |                                                                                                                                                                                              | V36               | VinP8 - (VinP8 - VinP9)*(4R/6R)                                                              |
|                   |                                                                                                                                                                                              | V37               | VinP8 - (VinP8 - VinP9)*(5R/6R)                                                              |
|                   |                                                                                                                                                                                              | V38               | VinP9                                                                                        |
|                   |                                                                                                                                                                                              | V39               | VinP9 - (VinP9 - VinP10)*(1R/6R)                                                             |
|                   |                                                                                                                                                                                              | V40               | VinP9 - (VinP9 - VinP10)*(2R/6R)                                                             |
|                   |                                                                                                                                                                                              | V41               | VinP9 - (VinP9 - VinP10)*(3R/6R)                                                             |
|                   |                                                                                                                                                                                              | V42               | VinP9 - (VinP9 - VinP10)*(4R/6R)                                                             |
|                   |                                                                                                                                                                                              | V43               | VinP9 - (VinP9 - VinP10)*(5R/6R)                                                             |
|                   |                                                                                                                                                                                              | V44               | VinP10                                                                                       |
|                   |                                                                                                                                                                                              | V45               | CGMP5=0 =VinP10 - (VinP10 - VinP11)*(1R/6R)<br>CGMP5=1 =VinP10 - (VinP10 - VinP11)*(1R/6.5R) |
|                   |                                                                                                                                                                                              | V46               | CGMP5=0 =VinP10 - (VinP10 - VinP11)*(2R/6R)<br>CGMP5=1 =VinP10 - (VinP10 - VinP11)*(2R/6.5R) |
|                   |                                                                                                                                                                                              | V47               | CGMP5=0 =VinP10 - (VinP10 - VinP11)*(3R/6R)<br>CGMP5=1 =VinP10 - (VinP10 - VinP11)*(3R/6.5R) |
|                   |                                                                                                                                                                                              | V48               | CGMP5=0 =VinP10 - (VinP10 - VinP11)*(4R/6R)<br>CGMP5=1 =VinP10 - (VinP10 - VinP11)*(4R/6.5R) |
|                   |                                                                                                                                                                                              | V49               | CGMP5=0 =VinP10 - (VinP10 - VinP11)*(5R/6R)<br>CGMP5=1 =VinP10 - (VinP10 - VinP11)*(5R/6.5R) |

| Grayscale voltage | Formula                                           | Grayscale voltage | Formula                                          |
|-------------------|---------------------------------------------------|-------------------|--------------------------------------------------|
| V50               | VinP11                                            | V56               | VinP12                                           |
| V51               | CGMP3=0 = VinP11 - (VinP11 - VinP12)*(1R/6R)      | V57               | CGMP1=0 = VinP12 - (VinP12 - VinP13)*(1R/4R)     |
|                   | CGMP3=1 = VinP11 - (VinP11 - VinP12)*(2.5R/16R)   |                   | CGMP1=1 = VinP12 - (VinP12 - VinP13)*(2R/9.5R)   |
|                   | CGMP3=2 = VinP11 - (VinP11 - VinP12)*(2.5R/18R)   |                   | CGMP1=2 = VinP12 - (VinP12 - VinP13)*(1.5R/9.3R) |
|                   | CGMP3=3 = VinP11 - (VinP11 - VinP12)*(2.5R/19.5R) |                   | CGMP1=3 = VinP12 - (VinP12 - VinP13)*(2R/10R)    |
| V52               | CGMP3=0 = VinP11 - (VinP11 - VinP12)*(2R/6R)      | V58               | CGMP1=0 = VinP12 - (VinP12 - VinP13)*(2R/4R)     |
|                   | CGMP3=1 = VinP11 - (VinP11 - VinP12)*(5R/16R)     |                   | CGMP1=1 = VinP12 - (VinP12 - VinP13)*(4R/9.5R)   |
|                   | CGMP3=2 = VinP11 - (VinP11 - VinP12)*(5R/18R)     |                   | CGMP1=2 = VinP12 - (VinP12 - VinP13)*(3.3R/9.3R) |
|                   | CGMP3=3 = VinP11 - (VinP11 - VinP12)*(5R/19.5R)   |                   | CGMP1=3 = VinP12 - (VinP12 - VinP13)*(4R/10R)    |
| V53               | CGMP3=0 = VinP11 - (VinP11 - VinP12)*(3R/6R)      | V59               | CGMP1=0 = VinP12 - (VinP12 - VinP13)*(3R/4R)     |
|                   | CGMP3=1 = VinP11 - (VinP11 - VinP12)*(7.5R/16R)   |                   | CGMP1=1 = VinP12 - (VinP12 - VinP13)*(6.5R/9.5R) |
|                   | CGMP3=2 = VinP11 - (VinP11 - VinP12)*(8R/18R)     |                   | CGMP1=2 = VinP12 - (VinP12 - VinP13)*(5.8R/9.3R) |
|                   | CGMP3=3 = VinP11 - (VinP11 - VinP12)*(8R/19.5R)   |                   | CGMP1=3 = VinP12 - (VinP12 - VinP13)*(6.5R/10R)  |
| V54               | CGMP3=0 = VinP11 - (VinP11 - VinP12)*(4R/6R)      | V60               | VinP13                                           |
|                   | CGMP3=1 = VinP11 - (VinP11 - VinP12)*(10R/16R)    | V61               | VinP14                                           |
|                   | CGMP3=2 = VinP11 - (VinP11 - VinP12)*(11R/18R)    | V62               | VinP15                                           |
|                   | CGMP3=3 = VinP11 - (VinP11 - VinP12)*(11R/19.5R)  | V63               | VinP16                                           |
| V55               | CGMP3=0 = VinP11 - (VinP11 - VinP12)*(5R/6R)      |                   |                                                  |
|                   | CGMP3=1 = VinP11 - (VinP11 - VinP12)*(13R/16R)    |                   |                                                  |
|                   | CGMP3=2 = VinP11 - (VinP11 - VinP12)*(14R/18R)    |                   |                                                  |
|                   | CGMP3=3 = VinP11 - (VinP11 - VinP12)*(15R/19.5R)  |                   |                                                  |

**Table 5.58: Voltage calculation formula of 64-grayscale voltage (positive polarity)**

| Grayscale voltage | Formula                                                                                                                                                                                      | Grayscale voltage | Formula                                                                                      |
|-------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|----------------------------------------------------------------------------------------------|
| V0                | VinN0                                                                                                                                                                                        | V16               | CGMN4=0 =VinN5 - (VinN5 - VinN6)*(3R/6R)<br>CGMN4=1 =VinN5 - (VinN5 - VinN6)*(3.5R/6.5R)     |
| V1                | VinN1                                                                                                                                                                                        | V17               | CGMN4=0 =VinN5 - (VinN5 - VinN6)*(4R/6R)<br>CGMN4=1 =VinN5 - (VinN5 - VinN6)*(4.5R/6.5R)     |
| V2                | VinN2                                                                                                                                                                                        | V18               | CGMN4=0 =VinN5 - (VinN5 - VinN6)*(5R/6R)<br>CGMN4=1 =VinN5 - (VinN5 - VinN6)*(5.5R/6.5R)     |
| V3                | VinN3                                                                                                                                                                                        | V19               | VinN6                                                                                        |
| V4                | CGMN0=0 = VinN3 - (VinN3 - VinN4)*(1R/4R)<br>CGMN0=1 = VinN3 - (VinN3 - VinN4)*(3R/9.5R)<br>CGMN0=2 = VinN3 - (VinN3 - VinN4)*(3.5R/9.3R)<br>CGMN0=3 = VinN3 - (VinN3 - VinN4)*(3.5R/10R)    | V20               | VinN6 - (VinN6 - VinN7)*(1R/6R)                                                              |
| V5                | CGMN0=0 = VinN3 - (VinN3 - VinN4)*(2R/4R)<br>CGMN0=1 = VinN3 - (VinN3 - VinN4)*(5.5R/9.5R)<br>CGMN0=2 = VinN3 - (VinN3 - VinN4)*(6R/9.3R)<br>CGMN0=3 = VinN3 - (VinN3 - VinN4)*(6R/10R)      | V21               | VinN6 - (VinN6 - VinN7)*(2R/6R)                                                              |
| V6                | CGMN0=0 = VinN3 - (VinN3 - VinN4)*(3R/4R)<br>CGMN0=1 = VinN3 - (VinN3 - VinN4)*(7.5R/9.5R)<br>CGMN0=2 = VinN3 - (VinN3 - VinN4)*(7.8R/9.3R)<br>CGMN0=3 = VinN3 - (VinN3 - VinN4)*(8R/10R)    | V22               | VinN6 - (VinN6 - VinN7)*(3R/6R)                                                              |
| V7                | VinN4                                                                                                                                                                                        | V23               | VinN6 - (VinN6 - VinN7)*(4R/6R)                                                              |
| V8                | CGMN2=0 = VinN4 - (VinN4 - VinN5)*(1R/6R)<br>CGMN2=1 = VinN4 - (VinN4 - VinN5)*(3R/16R)<br>CGMN2=2 = VinN4 - (VinN4 - VinN5)*(4R/18R)<br>CGMN2=3 = VinN4 - (VinN4 - VinN5)*(4.5R/19.5R)      | V24               | VinN6 - (VinN6 - VinN7)*(5R/6R)                                                              |
| V9                | CGMN2=0 = VinN4 - (VinN4 - VinN5)*(2R/6R)<br>CGMN2=1 = VinN4 - (VinN4 - VinN5)*(6R/16R)<br>CGMN2=2 = VinN4 - (VinN4 - VinN5)*(7R/18R)<br>CGMN2=3 = VinN4 - (VinN4 - VinN5)*(8.5R/19.5R)      | V25               | VinP7                                                                                        |
| V10               | CGMN2=0 = VinN4 - (VinN4 - VinN5)*(3R/6R)<br>CGMN2=1 = VinN4 - (VinN4 - VinN5)*(8.5R/16R)<br>CGMN2=2 = VinN4 - (VinN4 - VinN5)*(10R/18R)<br>CGMN2=3 = VinN4 - (VinN4 - VinN5)*(11.5R/19.5R)  | V26               | VinP7 - (VinP7 - VinP8)*(1R/7.5R)                                                            |
| V11               | CGMN2=0 = VinN4 - (VinN4 - VinN5)*(4R/6R)<br>CGMN2=1 = VinN4 - (VinN4 - VinN5)*(11R/16R)<br>CGMN2=2 = VinN4 - (VinN4 - VinN5)*(13R/18R)<br>CGMN2=3 = VinN4 - (VinN4 - VinN5)*(14.5R/19.5R)   | V27               | VinP7 - (VinP7 - VinP8)*(2R/7.5R)                                                            |
| V12               | CGMN2=0 = VinN4 - (VinN4 - VinN5)*(5R/6R)<br>CGMN2=1 = VinN4 - (VinN4 - VinN5)*(13.5R/16R)<br>CGMN2=2 = VinN4 - (VinN4 - VinN5)*(15.5R/18R)<br>CGMN2=3 = VinN4 - (VinN4 - VinN5)*(17R/19.5R) | V28               | VinP7 - (VinP7 - VinP8)*(3R/7.5R)                                                            |
| V13               | VinN5                                                                                                                                                                                        | V29               | VinP7 - (VinP7 - VinP8)*(4R/7.5R)                                                            |
| V14               | CGMN4=0 =VinN5 - (VinN5 - VinN6)*(1R/6R)<br>CGMN4=1 =VinN5 - (VinN5 - VinN6)*(1.5R/6.5R)                                                                                                     | V30               | VinP7 - (VinP7 - VinP8)*(5R/7.5R)                                                            |
| V15               | CGMN4=0 =VinN5 - (VinN5 - VinN6)*(2R/6R)<br>CGMN4=1 =VinN5 - (VinN5 - VinN6)*(2.5R/6.5R)                                                                                                     | V31               | VinP7 - (VinP7 - VinP8)*(6R/7.5R)                                                            |
|                   |                                                                                                                                                                                              | V32               | VinP8                                                                                        |
|                   |                                                                                                                                                                                              | V33               | VinP8 - (VinP8 - VinP9)*(1R/6R)                                                              |
|                   |                                                                                                                                                                                              | V34               | VinP8 - (VinP8 - VinP9)*(2R/6R)                                                              |
|                   |                                                                                                                                                                                              | V35               | VinP8 - (VinP8 - VinP9)*(3R/6R)                                                              |
|                   |                                                                                                                                                                                              | V36               | VinP8 - (VinP8 - VinP9)*(4R/6R)                                                              |
|                   |                                                                                                                                                                                              | V37               | VinP8 - (VinP8 - VinP9)*(5R/6R)                                                              |
|                   |                                                                                                                                                                                              | V38               | VinN9                                                                                        |
|                   |                                                                                                                                                                                              | V39               | VinN9 - (VinN9 - VinN10)*(1R/6R)                                                             |
|                   |                                                                                                                                                                                              | V40               | VinN9 - (VinN9 - VinN10)*(2R/6R)                                                             |
|                   |                                                                                                                                                                                              | V41               | VinN9 - (VinN9 - VinN10)*(3R/6R)                                                             |
|                   |                                                                                                                                                                                              | V42               | VinN9 - (VinN9 - VinN10)*(4R/6R)                                                             |
|                   |                                                                                                                                                                                              | V43               | VinN9 - (VinN9 - VinN10)*(5R/6R)                                                             |
|                   |                                                                                                                                                                                              | V44               | VinN10                                                                                       |
|                   |                                                                                                                                                                                              | V45               | CGMN5=0 =VinN10 - (VinN10 - VinN11)*(1R/6R)<br>CGMN5=1 =VinN10 - (VinN10 - VinN11)*(1R/6.5R) |
|                   |                                                                                                                                                                                              | V46               | CGMN5=0 =VinN10 - (VinN10 - VinN11)*(2R/6R)<br>CGMN5=1 =VinN10 - (VinN10 - VinN11)*(2R/6.5R) |
|                   |                                                                                                                                                                                              | V47               | CGMN5=0 =VinN10 - (VinN10 - VinN11)*(3R/6R)<br>CGMN5=1 =VinN10 - (VinN10 - VinN11)*(3R/6.5R) |
|                   |                                                                                                                                                                                              | V48               | CGMN5=0 =VinN10 - (VinN10 - VinN11)*(4R/6R)<br>CGMN5=1 =VinN10 - (VinN10 - VinN11)*(4R/6.5R) |
|                   |                                                                                                                                                                                              | V49               | CGMN5=0 =VinN10 - (VinN10 - VinN11)*(5R/6R)<br>CGMN5=1 =VinN10 - (VinN10 - VinN11)*(5R/6.5R) |



| Grayscale voltage | Formula                                           | Grayscale voltage | Formula                                          |
|-------------------|---------------------------------------------------|-------------------|--------------------------------------------------|
| V50               | VinN11                                            | V56               | VinN12                                           |
| V51               | CGMN3=0 = VinN11 - (VinN11 - VinN12)*(1R/6R)      | V57               | CGMN1=0 = VinN12 - (VinN12 - VinN13)*(1R/4R)     |
|                   | CGMN3=1 = VinN11 - (VinN11 - VinN12)*(2.5R/16R)   |                   | CGMN1=1 = VinN12 - (VinN12 - VinN13)*(2R/9.5R)   |
|                   | CGMN3=2 = VinN11 - (VinN11 - VinN12)*(2.5R/18R)   |                   | CGMN1=2 = VinN12 - (VinN12 - VinN13)*(1.5R/9.3R) |
|                   | CGMN3=3 = VinN11 - (VinN11 - VinN12)*(2.5R/19.5R) |                   | CGMN1=3 = VinN12 - (VinN12 - VinN13)*(2R/10R)    |
| V52               | CGMN3=0 = VinN11 - (VinN11 - VinN12)*(2R/6R)      | V58               | CGMN1=0 = VinN12 - (VinN12 - VinN13)*(2R/4R)     |
|                   | CGMN3=1 = VinN11 - (VinN11 - VinN12)*(5R/16R)     |                   | CGMN1=1 = VinN12 - (VinN12 - VinN13)*(4R/9.5R)   |
|                   | CGMN3=2 = VinN11 - (VinN11 - VinN12)*(5R/18R)     |                   | CGMN1=2 = VinN12 - (VinN12 - VinN13)*(3.3R/9.3R) |
|                   | CGMN3=3 = VinN11 - (VinN11 - VinN12)*(5R/19.5R)   |                   | CGMN1=3 = VinN12 - (VinN12 - VinN13)*(4R/10R)    |
| V53               | CGMN3=0 = VinN11 - (VinN11 - VinN12)*(3R/6R)      | V59               | CGMN1=0 = VinN12 - (VinN12 - VinN13)*(3R/4R)     |
|                   | CGMN3=1 = VinN11 - (VinN11 - VinN12)*(7.5R/16R)   |                   | CGMN1=1 = VinN12 - (VinN12 - VinN13)*(6.5R/9.5R) |
|                   | CGMN3=2 = VinN11 - (VinN11 - VinN12)*(8R/18R)     |                   | CGMN1=2 = VinN12 - (VinN12 - VinN13)*(5.8R/9.3R) |
|                   | CGMN3=3 = VinN11 - (VinN11 - VinN12)*(8R/19.5R)   |                   | CGMN1=3 = VinN12 - (VinN12 - VinN13)*(6.5R/10R)  |
| V54               | CGMN3=0 = VinN11 - (VinN11 - VinN12)*(4R/6R)      | V60               | VinN13                                           |
|                   | CGMN3=1 = VinN11 - (VinN11 - VinN12)*(10R/16R)    | V61               | VinN14                                           |
|                   | CGMN3=2 = VinN11 - (VinN11 - VinN12)*(11R/18R)    | V62               | VinN15                                           |
|                   | CGMN3=3 = VinN11 - (VinN11 - VinN12)*(11R/19.5R)  | V63               | VinN16                                           |
| V55               | CGMN3=0 = VinN11 - (VinN11 - VinN12)*(5R/6R)      |                   |                                                  |
|                   | CGMN3=1 = VinN11 - (VinN11 - VinN12)*(13R/16R)    |                   |                                                  |
|                   | CGMN3=2 = VinN11 - (VinN11 - VinN12)*(14R/18R)    |                   |                                                  |
|                   | CGMN3=3 = VinN11 - (VinN11 - VinN12)*(15R/19.5R)  |                   |                                                  |

**Table 5.59: Voltage calculation formula of 64-grayscale voltage (negative polarity)**



| Grayscale voltage | Formula                               | Grayscale voltage | Formula                               |
|-------------------|---------------------------------------|-------------------|---------------------------------------|
| VV0               | V0                                    | VV44              | V11                                   |
| VV1               | $V0 - (V0 - V1) \cdot (4R/16R)$       | VV45              | $V11 - (V11 - V12) \cdot (1.6R/6.4R)$ |
| VV2               | $V0 - (V0 - V1) \cdot (8R/16R)$       | VV46              | $V11 - (V11 - V12) \cdot (3.2R/6.4R)$ |
| VV3               | $V0 - (V0 - V1) \cdot (12R/16R)$      | VV47              | $V11 - (V11 - V12) \cdot (4.8R/6.4R)$ |
| VV4               | V1                                    | VV48              | V12                                   |
| VV5               | $V1 - (V1 - V2) \cdot (4R/16R)$       | VV49              | $V12 - (V12 - V13) \cdot (1.6R/6.4R)$ |
| VV6               | $V1 - (V1 - V2) \cdot (8R/16R)$       | VV50              | $V12 - (V12 - V13) \cdot (3.2R/6.4R)$ |
| VV7               | $V1 - (V1 - V2) \cdot (12R/16R)$      | VV51              | $V12 - (V12 - V13) \cdot (4.8R/6.4R)$ |
| VV8               | V2                                    | VV52              | V13                                   |
| VV9               | $V2 - (V2 - V3) \cdot (4R/16R)$       | VV53              | $V13 - (V13 - V14) \cdot (1.6R/6.4R)$ |
| VV10              | $V2 - (V2 - V3) \cdot (8R/16R)$       | VV54              | $V13 - (V13 - V14) \cdot (3.2R/6.4R)$ |
| VV11              | $V2 - (V2 - V3) \cdot (12R/16R)$      | VV55              | $V13 - (V13 - V14) \cdot (4.8R/6.4R)$ |
| VV12              | V3                                    | VV56              | V14                                   |
| VV13              | $V3 - (V3 - V4) \cdot (2R/8R)$        | VV57              | $V14 - (V14 - V15) \cdot (1.6R/6.4R)$ |
| VV14              | $V3 - (V3 - V4) \cdot (4R/8R)$        | VV58              | $V14 - (V14 - V15) \cdot (3.2R/6.4R)$ |
| VV15              | $V3 - (V3 - V4) \cdot (6R/8R)$        | VV59              | $V14 - (V14 - V15) \cdot (4.8R/6.4R)$ |
| VV16              | V4                                    | VV60              | V15                                   |
| VV17              | $V4 - (V4 - V5) \cdot (2R/8R)$        | VV61              | $V15 - (V15 - V16) \cdot (1.6R/6.4R)$ |
| VV18              | $V4 - (V4 - V5) \cdot (4R/8R)$        | VV62              | $V15 - (V15 - V16) \cdot (3.2R/6.4R)$ |
| VV19              | $V4 - (V4 - V5) \cdot (6R/8R)$        | VV63              | $V15 - (V15 - V16) \cdot (4.8R/6.4R)$ |
| VV20              | V5                                    | VV64              | V16                                   |
| VV21              | $V5 - (V5 - V6) \cdot (2R/8R)$        | VV65              | $V16 - (V16 - V17) \cdot (1.6R/6.4R)$ |
| VV22              | $V5 - (V5 - V6) \cdot (4R/8R)$        | VV66              | $V16 - (V16 - V17) \cdot (3.2R/6.4R)$ |
| VV23              | $V5 - (V5 - V6) \cdot (6R/8R)$        | VV67              | $V16 - (V16 - V17) \cdot (4.8R/6.4R)$ |
| VV24              | V6                                    | VV68              | V17                                   |
| VV25              | $V6 - (V6 - V7) \cdot (2R/8R)$        | VV69              | $V17 - (V17 - V18) \cdot (1.6R/6.4R)$ |
| VV26              | $V6 - (V6 - V7) \cdot (4R/8R)$        | VV70              | $V17 - (V17 - V18) \cdot (3.2R/6.4R)$ |
| VV27              | $V6 - (V6 - V7) \cdot (6R/8R)$        | VV71              | $V17 - (V17 - V18) \cdot (4.8R/6.4R)$ |
| VV28              | V7                                    | VV72              | V18                                   |
| VV29              | $V7 - (V7 - V8) \cdot (1.6R/6.4R)$    | VV73              | $V18 - (V18 - V19) \cdot (1.6R/6.4R)$ |
| VV30              | $V7 - (V7 - V8) \cdot (3.2R/6.4R)$    | VV74              | $V18 - (V18 - V19) \cdot (3.2R/6.4R)$ |
| VV31              | $V7 - (V7 - V8) \cdot (4.8R/6.4R)$    | VV75              | $V18 - (V18 - V19) \cdot (4.8R/6.4R)$ |
| VV32              | V8                                    | VV76              | V19                                   |
| VV33              | $V8 - (V8 - V9) \cdot (1.6R/6.4R)$    | VV77              | $V19 - (V19 - V20) \cdot (1.6R/6.4R)$ |
| VV34              | $V8 - (V8 - V9) \cdot (3.2R/6.4R)$    | VV78              | $V19 - (V19 - V20) \cdot (3.2R/6.4R)$ |
| VV35              | $V8 - (V8 - V9) \cdot (4.8R/6.4R)$    | VV79              | $V19 - (V19 - V20) \cdot (4.8R/6.4R)$ |
| VV36              | V9                                    | VV80              | V20                                   |
| VV37              | $V9 - (V9 - V10) \cdot (1.6R/6.4R)$   | VV81              | $V20 - (V20 - V21) \cdot (1.6R/6.4R)$ |
| VV38              | $V9 - (V9 - V10) \cdot (3.2R/6.4R)$   | VV82              | $V20 - (V20 - V21) \cdot (3.2R/6.4R)$ |
| VV39              | $V9 - (V9 - V10) \cdot (4.8R/6.4R)$   | VV83              | $V20 - (V20 - V21) \cdot (4.8R/6.4R)$ |
| VV40              | V10                                   | VV84              | V21                                   |
| VV41              | $V10 - (V10 - V11) \cdot (1.6R/6.4R)$ | VV85              | $V21 - (V21 - V22) \cdot (1.6R/6.4R)$ |
| VV42              | $V10 - (V10 - V11) \cdot (3.2R/6.4R)$ | VV86              | $V21 - (V21 - V22) \cdot (3.2R/6.4R)$ |
| VV43              | $V10 - (V10 - V11) \cdot (4.8R/6.4R)$ | VV87              | $V21 - (V21 - V22) \cdot (4.8R/6.4R)$ |

| Grayscale voltage | Formula                                 | Grayscale voltage | Formula                                |
|-------------------|-----------------------------------------|-------------------|----------------------------------------|
| VV88              | V22                                     | VV132             | $V32 - (V32 - V33) \times (1.6R/6.4R)$ |
| VV89              | $V22 - (V22 - V23) \times (1.6R/6.4R)$  | VV133             | $V32 - (V32 - V33) \times (3.2R/6.4R)$ |
| VV90              | $V22 - (V22 - V23) \times (3.2R/6.4R)$  | VV134             | $V32 - (V32 - V33) \times (4.8R/6.4R)$ |
| VV91              | $V22 - (V22 - V23) \times (4.8R/6.4R)$  | VV135             | V33                                    |
| VV92              | V23                                     | VV136             | $V33 - (V33 - V34) \times (1.6R/6.4R)$ |
| VV93              | $V23 - (V23 - V24) \times (1.6R/6.4R)$  | VV137             | $V33 - (V33 - V34) \times (3.2R/6.4R)$ |
| VV94              | $V23 - (V23 - V24) \times (3.2R/6.4R)$  | VV138             | $V33 - (V33 - V34) \times (4.8R/6.4R)$ |
| VV95              | $V23 - (V23 - V24) \times (4.8R/6.4R)$  | VV139             | V34                                    |
| VV96              | V24                                     | VV140             | $V34 - (V34 - V35) \times (1.6R/6.4R)$ |
| VV97              | $V24 - (V24 - V25) \times (1.6R/6.4R)$  | VV141             | $V34 - (V34 - V35) \times (3.2R/6.4R)$ |
| VV98              | $V24 - (V24 - V25) \times (3.2R/6.4R)$  | VV142             | $V34 - (V34 - V35) \times (4.8R/6.4R)$ |
| VV99              | $V24 - (V24 - V25) \times (4.8R/6.4R)$  | VV143             | V35                                    |
| VV100             | V25                                     | VV144             | $V35 - (V35 - V36) \times (1.6R/6.4R)$ |
| VV101             | $V25 - (V25 - V26) \times (1.6R/6.4R)$  | VV145             | $V35 - (V35 - V36) \times (3.2R/6.4R)$ |
| VV102             | $V25 - (V25 - V26) \times (3.2R/6.4R)$  | VV146             | $V35 - (V35 - V36) \times (4.8R/6.4R)$ |
| VV103             | $V25 - (V25 - V26) \times (4.8R/6.4R)$  | VV147             | V36                                    |
| VV104             | V26                                     | VV148             | $V36 - (V36 - V37) \times (1.6R/6.4R)$ |
| VV105             | $V26 - (V26 - V27) \times (1.6R/6.4R)$  | VV149             | $V36 - (V36 - V37) \times (3.2R/6.4R)$ |
| VV106             | $V26 - (V26 - V27) \times (3.2R/6.4R)$  | VV150             | $V36 - (V36 - V37) \times (4.8R/6.4R)$ |
| VV107             | $V26 - (V26 - V27) \times (4.8R/6.4R)$  | VV151             | V37                                    |
| VV108             | V27                                     | VV152             | $V37 - (V37 - V38) \times (1.6R/6.4R)$ |
| VV109             | $V27 - (V27 - V28) \times (1.6R/6.4R)$  | VV153             | $V37 - (V37 - V38) \times (3.2R/6.4R)$ |
| VV110             | $V27 - (V27 - V28) \times (3.2R/6.4R)$  | VV154             | $V37 - (V37 - V38) \times (4.8R/6.4R)$ |
| VV111             | $V27 - (V27 - V28) \times (4.8R/6.4R)$  | VV155             | V38                                    |
| VV112             | V28                                     | VV156             | $V38 - (V38 - V39) \times (1.6R/6.4R)$ |
| VV113             | $V28 - (V28 - V29) \times (1.6R/6.4R)$  | VV157             | $V38 - (V38 - V39) \times (3.2R/6.4R)$ |
| VV114             | $V28 - (V28 - V29) \times (3.2R/6.4R)$  | VV158             | $V38 - (V38 - V39) \times (4.8R/6.4R)$ |
| VV115             | $V28 - (V28 - V29) \times (4.8R/6.4R)$  | VV159             | V39                                    |
| VV116             | V29                                     | VV160             | $V39 - (V39 - V40) \times (1.6R/6.4R)$ |
| VV117             | $V29 - (V29 - V30) \times (1.6R/6.4R)$  | VV161             | $V39 - (V39 - V40) \times (3.2R/6.4R)$ |
| VV118             | $V29 - (V29 - V30) \times (3.2R/6.4R)$  | VV162             | $V39 - (V39 - V40) \times (4.8R/6.4R)$ |
| VV119             | $V29 - (V29 - V30) \times (4.8R/6.4R)$  | VV163             | V40                                    |
| VV120             | V30                                     | VV164             | $V40 - (V40 - V41) \times (1.6R/6.4R)$ |
| VV121             | $V30 - (V30 - V31) \times (1.6R/6.4R)$  | VV165             | $V40 - (V40 - V41) \times (3.2R/6.4R)$ |
| VV122             | $V30 - (V30 - V31) \times (3.2R/6.4R)$  | VV166             | $V40 - (V40 - V41) \times (4.8R/6.4R)$ |
| VV123             | $V30 - (V30 - V31) \times (4.8R/6.4R)$  | VV167             | V41                                    |
| VV124             | V31                                     | VV168             | $V41 - (V41 - V42) \times (1.6R/6.4R)$ |
| VV125             | $V31 - (V31 - V32) \times (1.6R/11.2R)$ | VV169             | $V41 - (V41 - V42) \times (3.2R/6.4R)$ |
| VV126             | $V31 - (V31 - V32) \times (3.2R/11.2R)$ | VV170             | $V41 - (V41 - V42) \times (4.8R/6.4R)$ |
| VV127             | $V31 - (V31 - V32) \times (4.8R/11.2R)$ | VV171             | V42                                    |
| VV128             | $V31 - (V31 - V32) \times (6.4R/11.2R)$ | VV172             | $V42 - (V42 - V43) \times (1.6R/6.4R)$ |
| VV129             | $V31 - (V31 - V32) \times (8R/11.2R)$   | VV173             | $V42 - (V42 - V43) \times (3.2R/6.4R)$ |
| VV130             | $V31 - (V31 - V32) \times (9.6R/11.2R)$ | VV174             | $V42 - (V42 - V43) \times (4.8R/6.4R)$ |
| VV131             | V32                                     | VV175             | V43                                    |

| Grayscale voltage | Formula                           | Grayscale voltage | Formula                           |
|-------------------|-----------------------------------|-------------------|-----------------------------------|
| VV176             | $V43 - (V43 - V44) * (1.6R/6.4R)$ | VV216             | $V53 - (V53 - V54) * (1.6R/6.4R)$ |
| VV177             | $V43 - (V43 - V44) * (3.2R/6.4R)$ | VV217             | $V53 - (V53 - V54) * (3.2R/6.4R)$ |
| VV178             | $V43 - (V43 - V44) * (4.8R/6.4R)$ | VV218             | $V53 - (V53 - V54) * (4.8R/6.4R)$ |
| VV179             | V44                               | VV219             | V54                               |
| VV180             | $V44 - (V44 - V45) * (1.6R/6.4R)$ | VV220             | $V54 - (V54 - V55) * (1.6R/6.4R)$ |
| VV181             | $V44 - (V44 - V45) * (3.2R/6.4R)$ | VV221             | $V54 - (V54 - V55) * (3.2R/6.4R)$ |
| VV182             | $V44 - (V44 - V45) * (4.8R/6.4R)$ | VV222             | $V54 - (V54 - V55) * (4.8R/6.4R)$ |
| VV183             | V45                               | VV223             | V55                               |
| VV184             | $V45 - (V45 - V46) * (1.6R/6.4R)$ | VV224             | $V55 - (V55 - V56) * (1.6R/6.4R)$ |
| VV185             | $V45 - (V45 - V46) * (3.2R/6.4R)$ | VV225             | $V55 - (V55 - V56) * (3.2R/6.4R)$ |
| VV186             | $V45 - (V45 - V46) * (4.8R/6.4R)$ | VV226             | $V55 - (V55 - V56) * (4.8R/6.4R)$ |
| VV187             | V46                               | VV227             | V56                               |
| VV188             | $V46 - (V46 - V47) * (1.6R/6.4R)$ | VV228             | $V56 - (V56 - V57) * (2R/8R)$     |
| VV189             | $V46 - (V46 - V47) * (3.2R/6.4R)$ | VV229             | $V56 - (V56 - V57) * (4R/8R)$     |
| VV190             | $V46 - (V46 - V47) * (4.8R/6.4R)$ | VV230             | $V56 - (V56 - V57) * (6R/8R)$     |
| VV191             | V47                               | VV231             | V57                               |
| VV192             | $V47 - (V47 - V48) * (1.6R/6.4R)$ | VV232             | $V57 - (V57 - V58) * (2R/8R)$     |
| VV193             | $V47 - (V47 - V48) * (3.2R/6.4R)$ | VV233             | $V57 - (V57 - V58) * (4R/8R)$     |
| VV194             | $V47 - (V47 - V48) * (4.8R/6.4R)$ | VV234             | $V57 - (V57 - V58) * (6R/8R)$     |
| VV195             | V48                               | VV235             | V58                               |
| VV196             | $V48 - (V48 - V49) * (1.6R/6.4R)$ | VV236             | $V58 - (V58 - V59) * (2R/8R)$     |
| VV197             | $V48 - (V48 - V49) * (3.2R/6.4R)$ | VV237             | $V58 - (V58 - V59) * (4R/8R)$     |
| VV198             | $V48 - (V48 - V49) * (4.8R/6.4R)$ | VV238             | $V58 - (V58 - V59) * (6R/8R)$     |
| VV199             | V49                               | VV239             | V59                               |
| VV200             | $V49 - (V49 - V50) * (1.6R/6.4R)$ | VV240             | $V59 - (V59 - V60) * (2R/8R)$     |
| VV201             | $V49 - (V49 - V50) * (3.2R/6.4R)$ | VV241             | $V59 - (V59 - V60) * (4R/8R)$     |
| VV202             | $V49 - (V49 - V50) * (4.8R/6.4R)$ | VV242             | $V59 - (V59 - V60) * (6R/8R)$     |
| VV203             | V50                               | VV243             | V60                               |
| VV204             | $V50 - (V50 - V51) * (1.6R/6.4R)$ | VV244             | $V60 - (V60 - V61) * (4R/16R)$    |
| VV205             | $V50 - (V50 - V51) * (3.2R/6.4R)$ | VV245             | $V60 - (V60 - V61) * (8R/16R)$    |
| VV206             | $V50 - (V50 - V51) * (4.8R/6.4R)$ | VV246             | $V60 - (V60 - V61) * (12R/16R)$   |
| VV207             | V51                               | VV247             | V61                               |
| VV208             | $V51 - (V51 - V52) * (1.6R/6.4R)$ | VV248             | $V61 - (V61 - V62) * (4R/16R)$    |
| VV209             | $V51 - (V51 - V52) * (3.2R/6.4R)$ | VV249             | $V61 - (V61 - V62) * (8R/16R)$    |
| VV210             | $V51 - (V51 - V52) * (4.8R/6.4R)$ | VV250             | $V61 - (V61 - V62) * (12R/16R)$   |
| VV211             | V52                               | VV251             | V62                               |
| VV212             | $V52 - (V52 - V53) * (1.6R/6.4R)$ | VV252             | $V62 - (V62 - V63) * (4R/16R)$    |
| VV213             | $V52 - (V52 - V53) * (3.2R/6.4R)$ | VV253             | $V62 - (V62 - V63) * (8R/16R)$    |
| VV214             | $V52 - (V52 - V53) * (4.8R/6.4R)$ | VV254             | $V62 - (V62 - V63) * (12R/16R)$   |
| VV215             | V53                               | VV255             | V63                               |

Table 5.60: Voltage calculation formula of 256-grayscale voltage (positive/negative polarity)

## 5.13 Characteristics of I/O

### 5.13.1 Output or bi-directional (I/O) pins

| Output or bi-directional pins  | After power on    | After hardware reset | After software reset |
|--------------------------------|-------------------|----------------------|----------------------|
| TE                             | Low               | Low                  | Low                  |
| DB23 to DB0<br>(Output driver) | High-Z (Inactive) | High-Z (Inactive)    | High-Z (Inactive)    |
| SDO                            | High-Z (Inactive) | High-Z (Inactive)    | High-Z (Inactive)    |
| CABC_PWM_OUT                   | Low               | Low                  | Low                  |

Table 5.61 Characteristics of output or bi-directional (I/O) pins

### 5.13.2 Input pins

| Input pins                  | During power on process | After power on | After hardware reset | After software reset | During power off process |
|-----------------------------|-------------------------|----------------|----------------------|----------------------|--------------------------|
| RESX                        | Setion.5.18             | Input valid    | Input valid          | Input valid          | Setion.5.18              |
| CSX                         | Input valid             | Input valid    | Input valid          | Input valid          | Input valid              |
| DCX_SCL                     | Input valid             | Input valid    | Input valid          | Input valid          | Input valid              |
| WRX_DCX                     | Input valid             | Input valid    | Input valid          | Input valid          | Input valid              |
| RDX_E                       | Input valid             | Input valid    | Input valid          | Input valid          | Input valid              |
| DB23 to DB0<br>SDI          | Input valid             | Input valid    | Input valid          | Input valid          | Input valid              |
| HSYNC                       | Input valid             | Input valid    | Input valid          | Input valid          | Input valid              |
| VSXNC                       | Input valid             | Input valid    | Input valid          | Input valid          | Input valid              |
| PCLK                        | Input valid             | Input valid    | Input valid          | Input valid          | Input valid              |
| DE                          | Input valid             | Input valid    | Input valid          | Input valid          | Input valid              |
| OSC, BS3, BS2,<br>BS1, BS0, | Input valid             | Input valid    | Input valid          | Input valid          | Input valid              |
| TEST2-1                     | Low                     | Low            | Low                  | Low                  | Low                      |

Table 5.62 Characteristics of input pins

### 5.14 GIP control signal

HX8369-A02 is a single chip solution for a WVGA GIP (Gate In Panel) type TFT LCD display. There are many GIP/ASG type TFT panels that correspond to different GIP timing. Therefore, the GIP setting must be setup to the correct GIP/ASG timing for the normal display. The GIP timing adjustment is related to register 0xD5h SETGIP.

The GIP control signals (GOUT[1~10]\_L and GOUT[1~10]\_R) is for panel used. The assignment of each panel type is specified on the application note. Regarding the GIP/ASG timing, please refer to HX8369-A02 application note.

Himax Confidential  
Do Not Copy

## 5.15 Sleep Out –command and self-diagnostic functions of the display module

### 5.15.1 Register loading detection

Sleep Out-command (See “Sleep Out (11h)”) is a trigger for an internal function of the display module, which indicates, if the display module loading function of factory default values from OTP (or similar device) to registers of the display controller is working properly. There are compared factory values of the OTP and register values of the display controller by the display controller. If those both values (OTP and register values) are same, there is inverted (=increased by 1) a bit, which is defined in command “Read Display Self-Diagnostic Result (0Fh)” (=RDDSDR) (The used bit of this command is D7). If those both values are not same, this bit (D7) is not inverted (=increased by 1).

The flow chart for this internal function is following:

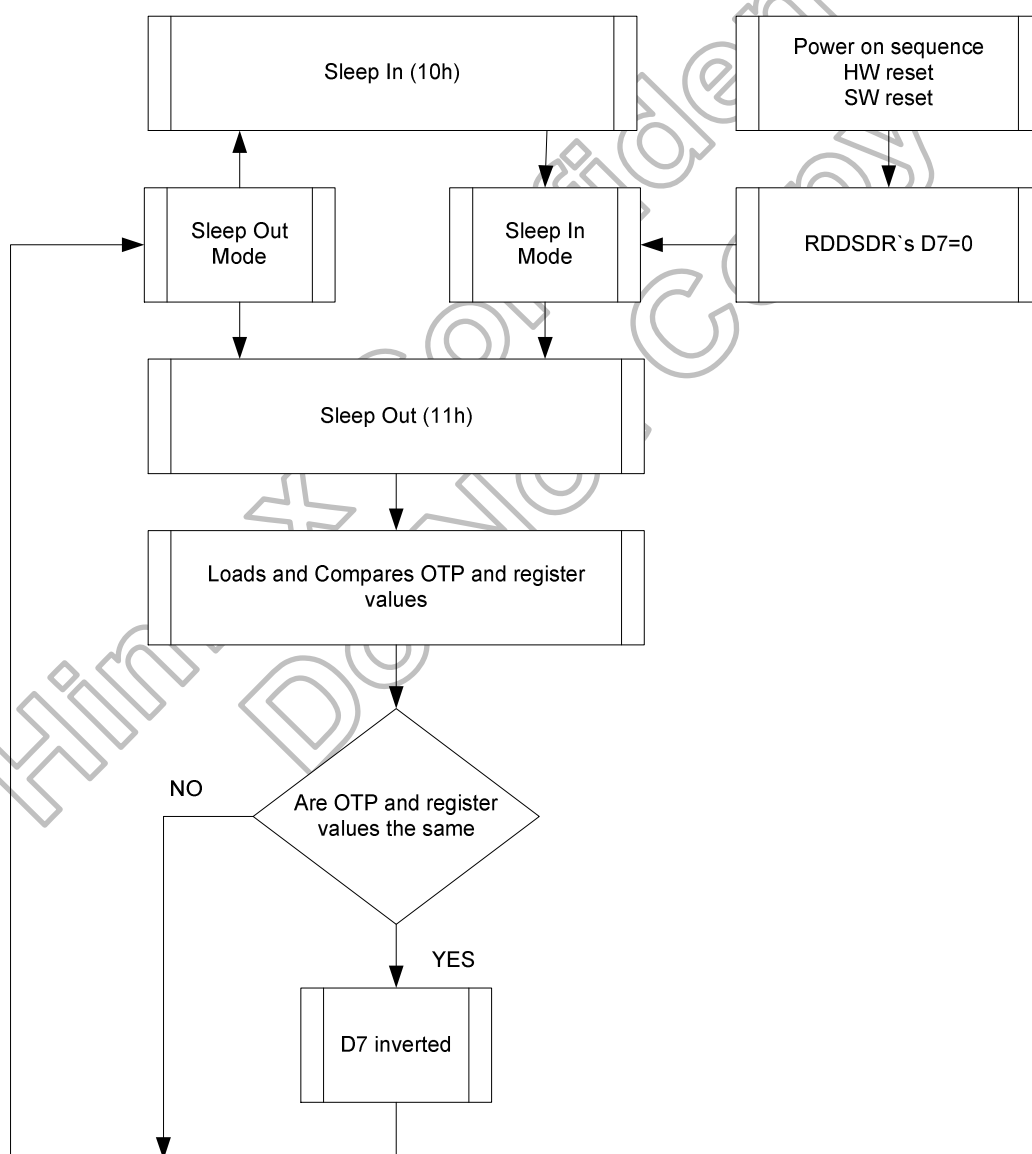


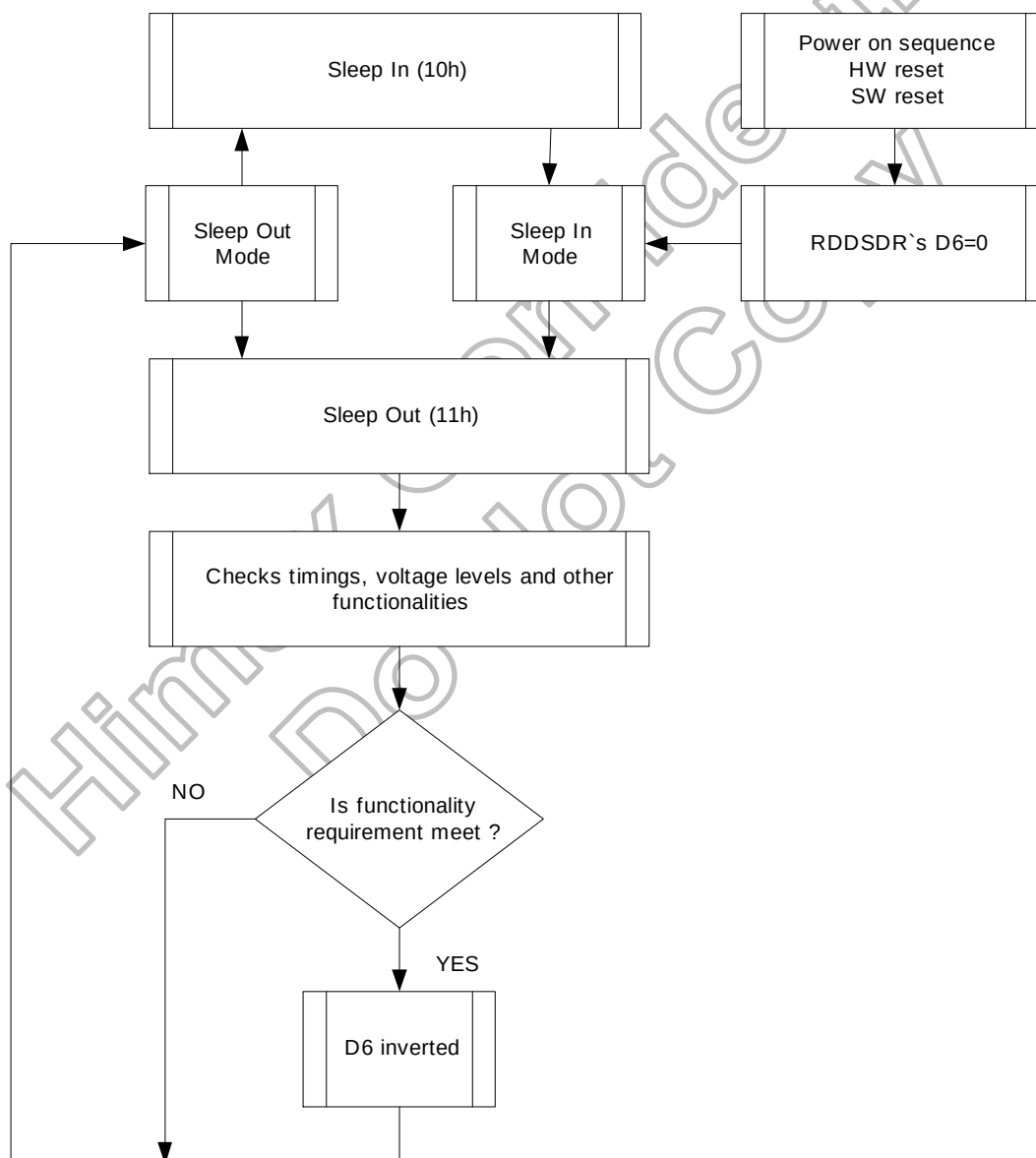
Figure 5.33: Sleep out flow chart–command and self-diagnostic functions



### 5.15.2 Functionality detection

Sleep Out-command (See “Sleep Out (11h)”) is a trigger for an internal function of the display module, which indicates, if the display module is still running and meets functionality requirements.

The internal function (=the display controller) is comparing, if the display module still meets functionality requirements (e.g. booster voltage levels, timings, etc.). If functionality requirement is met, 1 bit will be inverted (=increased by 1), which is defined in command “Read Display Self- Diagnostic Result (0Fh)” (=RDDSDR) (The used bit of this command is D6). If functionality requirement is not the same, this bit (D6) is not inverted (=increased by 1). The flow chart for this internal function is shown as below.



**Note:** There is needed 120msec after Sleep Out -command, when there is changing from Sleep In-mode to Sleep Out -mode, before there is possible to check if Customer's functionality requirements are met and a value of RDDSDR's D6 is valid. Otherwise, there is 5msec delay for D6's value, when Sleep Out -command is sent in Sleep Out -mode.

**Figure 5.34: Sleep out flow chart internal function detection**

## 5.16 Power on/off sequence

VDD1, VDD2 and VDD3 can be applied in any order. VDD1, VDD2 and VDD3 can be powered down in any order. During power off, if LCD is in the Sleep Out mode, VDD1 and VDD2 must be powered down minimum 120msec after RESX has been released. During power off, if LCD is in the Sleep In mode, VDD1, VDD2 and VDD3 can be powered down minimum 0msec after RESX has been released. CSX can be applied at any timing or can be permanently grounded. RESX has priority over CSX. There will be no damage to the display module if the power sequences are not met. There will be no abnormal visible effects on the display panel during the Power On/Off Sequences. There will be no abnormal visible effects on the display between end of Power On Sequence and before receiving Sleep Out command. Also between receiving Sleep In command and Power Off Sequence. If RESX line is not held stable by host during Power On Sequence as defined in Sections 5.16.1 and 5.16.2, then it will be necessary to apply a Hardware Reset (RESX) after Host Power On Sequence is complete to ensure correct operation. Otherwise function is not guaranteed. The power on/off sequence is illustrated below.

Himax Confidential  
Do Not Copy

### 5.16.1 Case 1: RESX line is held high or unstable by host at power on

If RESX line is held high or unstable by the host during power on, then a Hardware Reset must be applied after both VDD1, VDD2 and VDD3 have been applied- otherwise correct functionality is not guaranteed. There is no timing restriction upon this hardware reset.

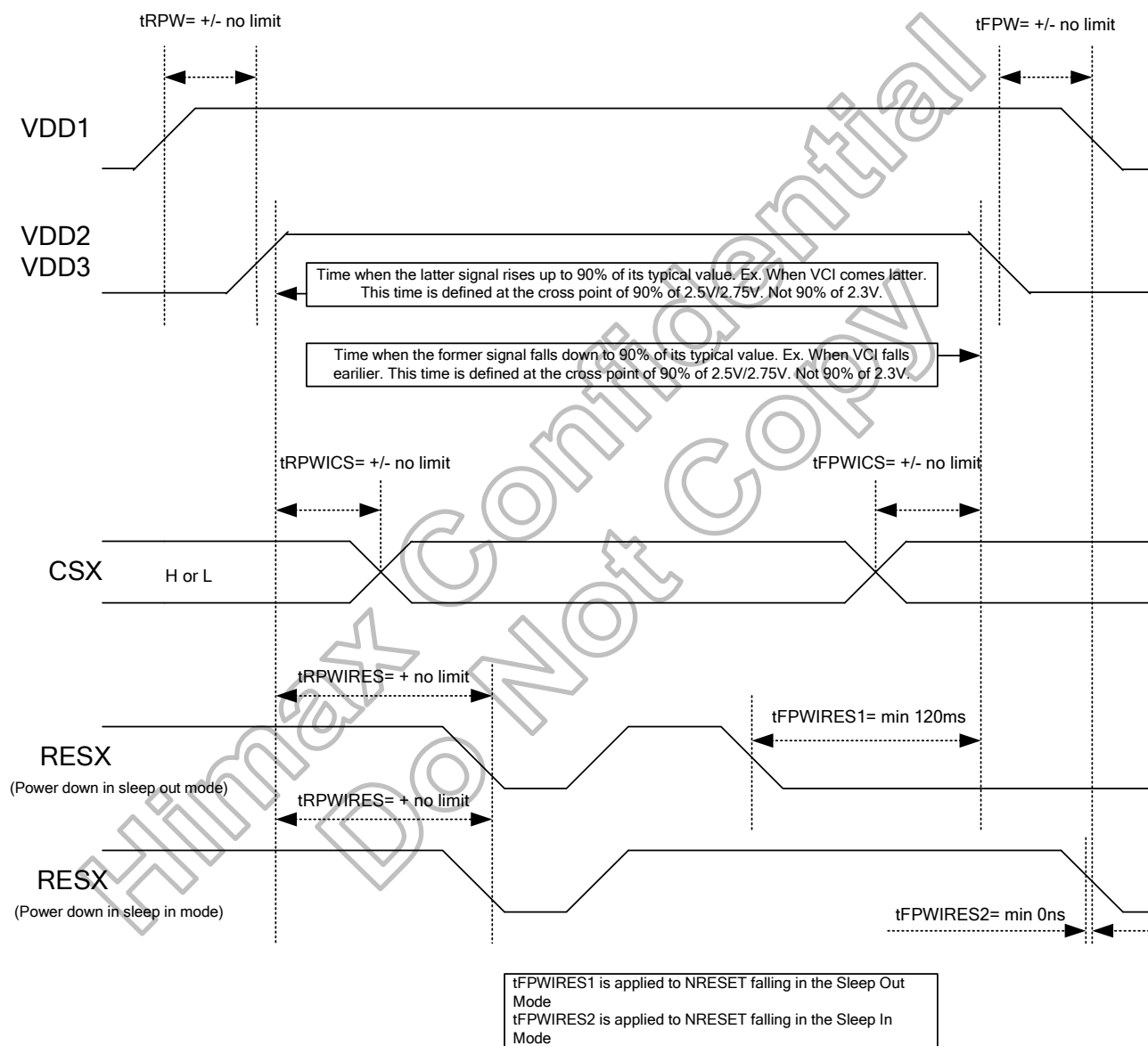


Figure 5.35: Case 1: RESX line is held high or unstable by host at power on

### 5.16.2 Case 2: RESX line is held low by host at power on

If RESX line is held low (and stable) by the host during power on, then the RESX must be held low for minimum 10μsec after both VDD1, VDD2 and VDD3 have been applied.

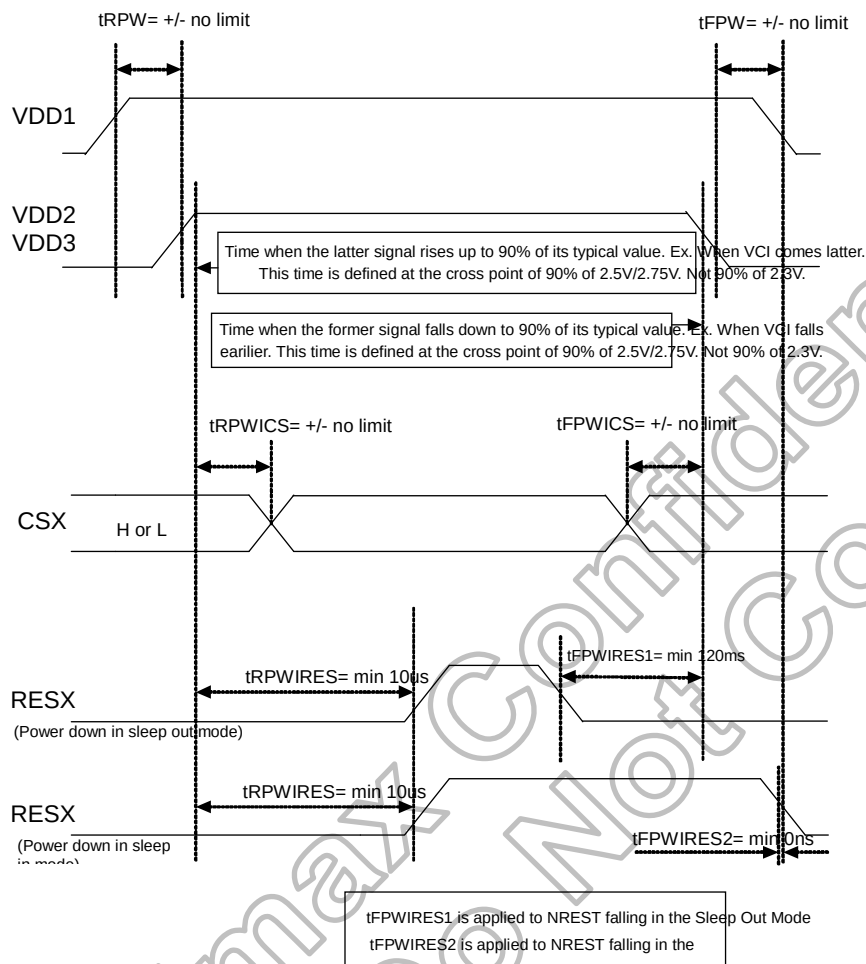
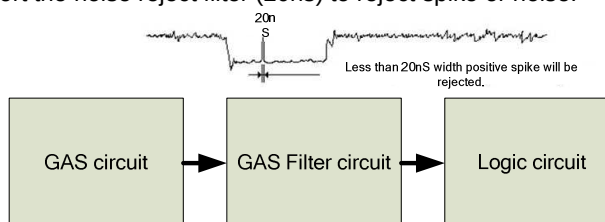


Figure 5.36: Case 2: RESX line is held low by host at power on

### 5.17 Uncontrolled power off

The uncontrolled power off means a situation when e.g. there is removed a battery without the controlled power off sequence. There will not be any damages for the display module or the display module will not cause any damages for the host or lines of the interface. At an uncontrolled power off the display will go blank and there will not be any visible effects within 1 second on the display (blank display) and remains blank until "Power On Sequence" powers it up.

**Note:** HX8369-A02 is support the noise reject filter (20ns) to reject spike or noise.



## 5.18 Content adaptive brightness control (CABC) function

The general block diagram of the CABC and the brightness control is illustrated below:

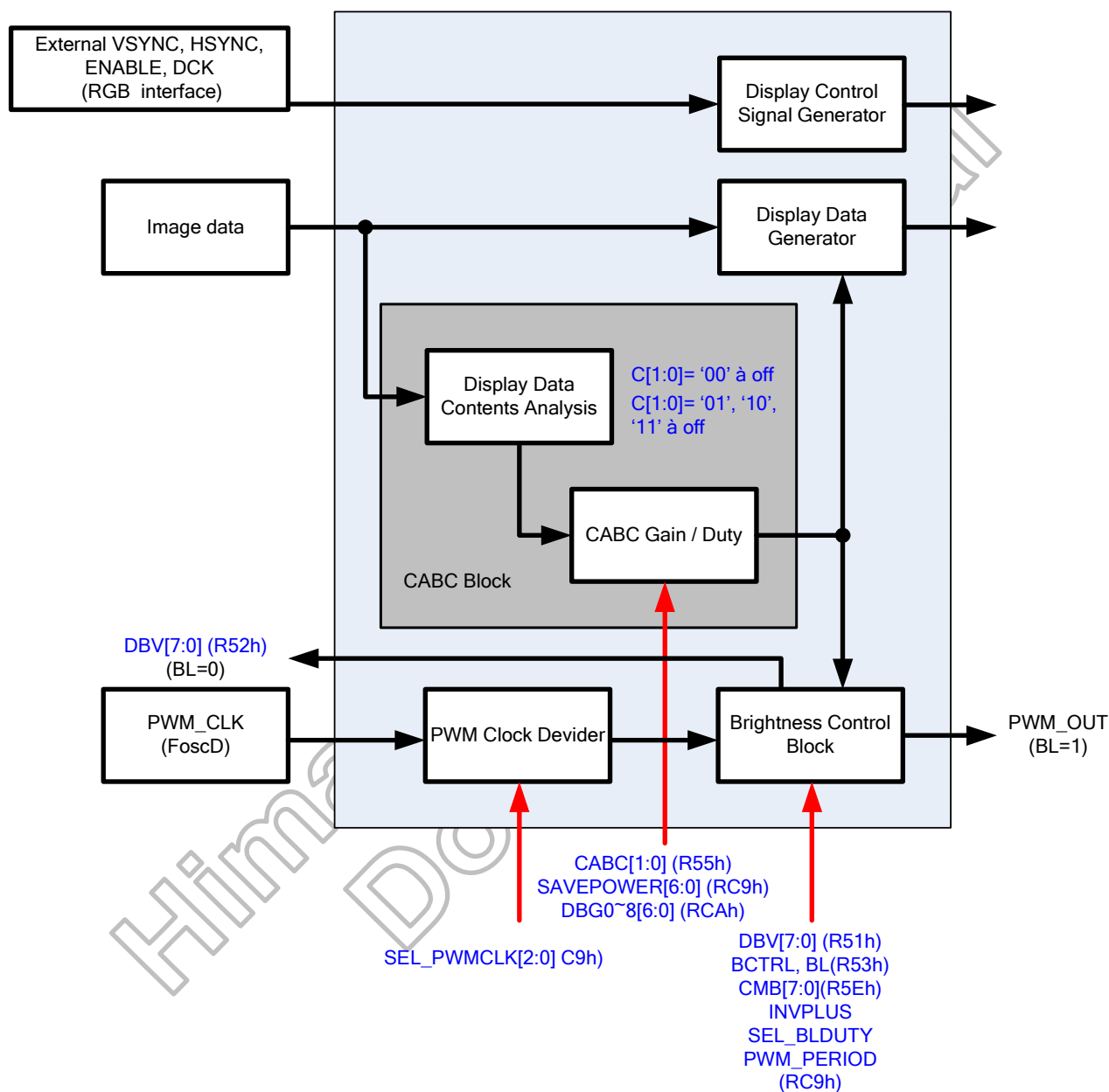
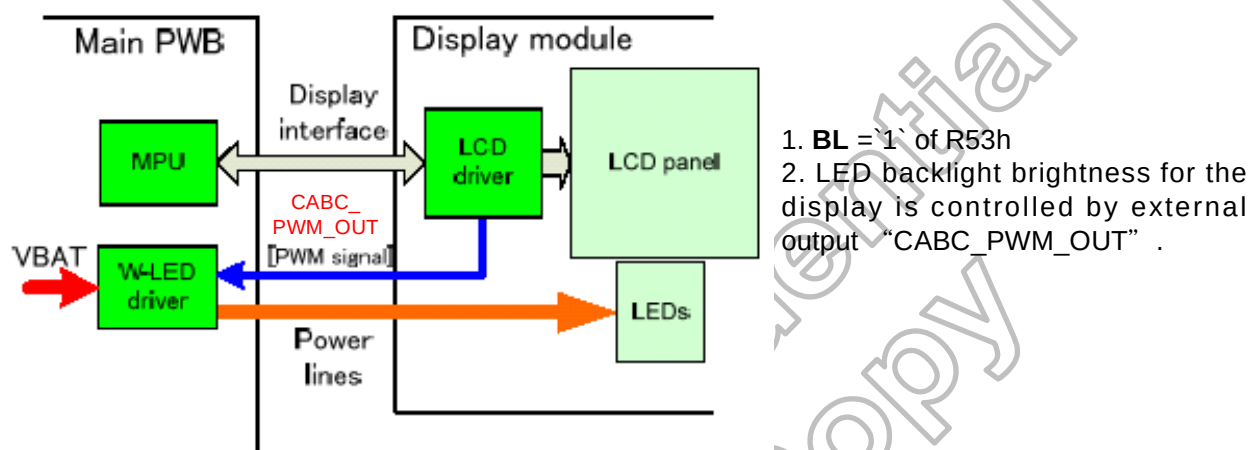


Figure 5.37: CABC block diagram

## 5.18.1 Module architectures

HX8369-A02 can support two module architectures for CABC operation. The BL bit setting of R53h can be used to select used display module architecture. White LED driver circuit for display backlight is located on the main PWB, not in the display module both in architecture I and II.

### • Architecture I



### • Architecture II

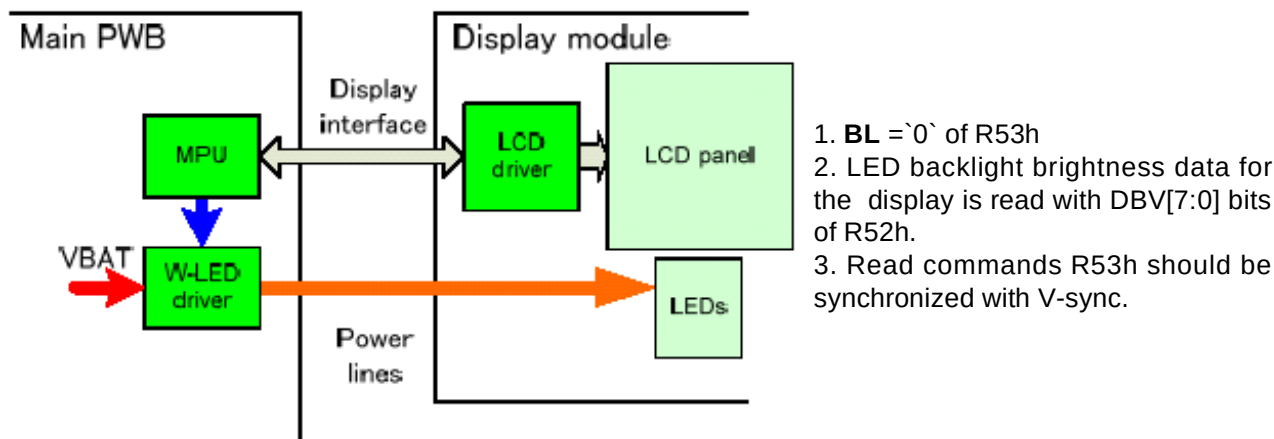


Figure 5.38: Module architecture



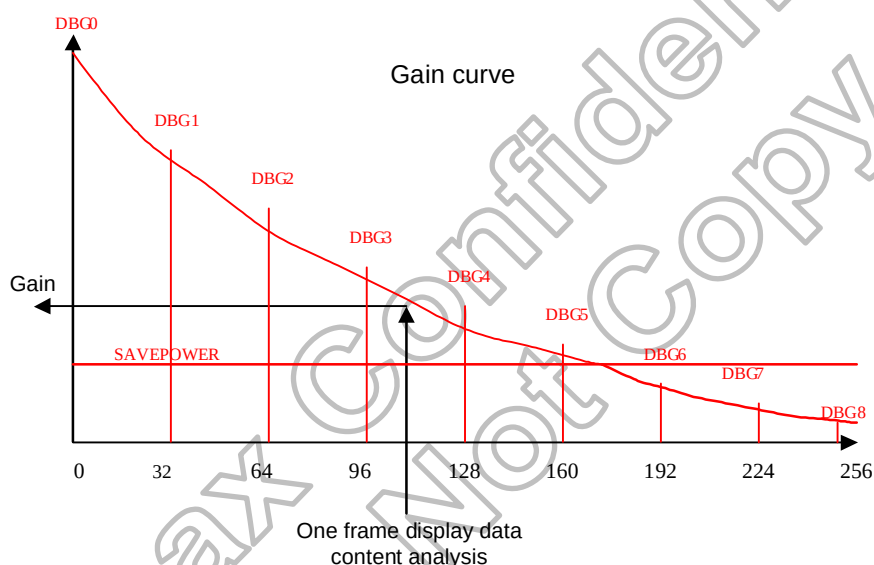
### 5.18.2 CABC block

There are DBG0~8[6:0] register bits in CABC block to define the “CABC gain”/ “CABC duty” table. Every DBGx[6:0] has 33 gain/duty value setting.

After one-frame display data content analysis, LSI will generate one CABC gain / CABC duty value calculated from DBG0~8[6:0] register bits setting (by using interpolated method) for display data generating and for backlight PWM pulse generating.

Please note that the CABC gain / CABC duty value calculated by the LSI is one of the 33 gain/duty value setting in DBGxx[6:0].

Please note that : Duty ( valid level period (LED on) / one complete period)=1/ gain.



**Figure 5.39: CABC gain / CABC duty generation**

For power saving of backlight module, there are SAVEPOWER[6:0] bits to define the “minimum gain”/ “maximum duty” of CABC block output. If the CABC gain / duty after one-frame display data contents analysis is smaller(gain) / larger(duty) than SAVEPOWER[6:0] bits setting, the CABC block will output CABC gain / duty equal to SAVEPOWER[6:0] and ignore the result of display data contents analysis.

### 5.18.3 Brightness control block

There is an external output signal from brightness block, CABC\_PWM\_OUT, to control the LED driver IC in order to control display brightness.

There are resister bits, DBV[7:0] of R51h, for display brightness of manual brightness setting. The CABC\_PWM\_OUT duty is calculated as  $(DBV[7:0])/255 \times \text{CABC duty}$  (generated after one-frame display data content analysis).

For ex: CABC\_PWM\_OUT period=2.95 ms, and DBV[7:0](R51h)='228DEC' and CABC duty is 74%. Then CABC\_PWM\_OUT duty= $(228) / 255 \times 74.42\% \approx 66.54\%$ . Correspond to the CABC\_PWM\_OUT period=2.95 ms, the high-level of CABC\_PWM\_OUT (high effective) = 1.96ms, and the low-level of CABC\_PWM\_OUT =0.99ms.

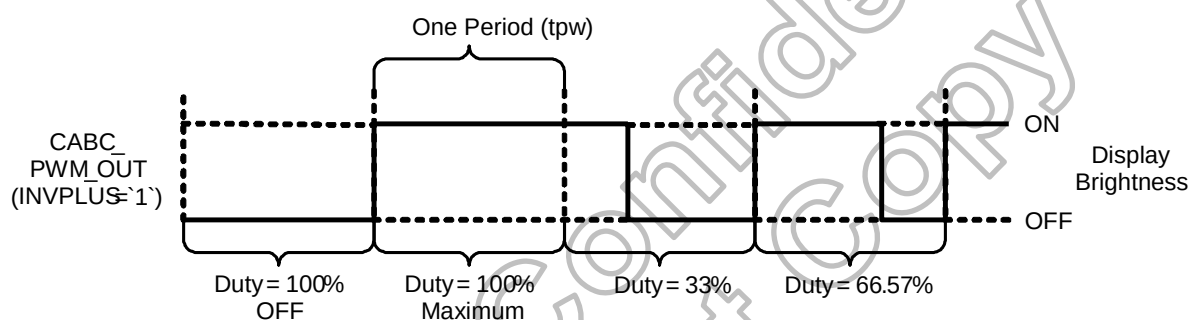


Figure 5.40: CABC\_PWM\_OUT output duty

| Symbol | Parameter   | Min.   | Max. | Unit | Description |
|--------|-------------|--------|------|------|-------------|
| tpw    | Pulse width | 0.0333 | 8.33 | ms   | -           |

Table 5.63 CABC timing table

**Note1:** The signal rise and fall times (tf, tr) are stipulated to be equal to or less than 15ns.

**Note2:** The pulse width range by setting CABC related registers is locate between 0.0333ms to 8.33ms.

When Architecture II module is used (BL='0') with the example below, the CABC\_PWM\_OUT is always output low and the DBV[7:0](R51h) will be read a value as 169DEC ( $((169)/255 \approx 66.27\%)$ ).

#### 5.18.4 Minimum brightness setting of CABC function

CABC function is automatically reduced backlight brightness based on image contents. In the case of the combination with the CABC or manual brightness setting, display brightness is too dark. It must affect to image quality degradation. CABC minimum brightness setting (CMB[7:0] bits of R5Eh) is to avoid too much brightness reduction.

When CABC is active, CABC can not reduce the display brightness to less than CABC minimum brightness setting. Image processing function is worked as normal, even if the brightness can not be changed.

This function does not affect to the other function, manual brightness setting. Manual brightness can be set the display brightness to less than CABC minimum brightness. Smooth transition and dimming function can be worked as normal.

When display brightness is turned off (BCTRL='0' of R53h), CABC minimum brightness setting is ignored. "CMB[7:0], Read CABC minimum brightness (R5Fh)" always read the setting value of "CMB[7:0], Write CABC minimum brightness (R5Eh)"

## 5.19 OTP programing

### 5.19.1 OTP table

| OTP_INDEX (HEX) | Ref. Command   | B7           | B6           | B5           | B4           | B3           | B2           | B1        | B0        |  |
|-----------------|----------------|--------------|--------------|--------------|--------------|--------------|--------------|-----------|-----------|--|
| 00              | SETOSC (B0h)   | NVALID0      | -            | -            | -            | UADJ[3:0]    |              |           |           |  |
| 1B              | SETVCOM (B6h)  | NVALID_VCMF1 | NVALID_VCMF2 | NVALID_VCMF3 | NVALID_VCMB1 | NVALID_VCMB2 | NVALID_VCMB3 | -         | -         |  |
| 1C              |                | VCMC_F1[7:0] |              |              |              |              |              |           |           |  |
| 1D              |                | VCMC_B1[7:0] |              |              |              |              |              |           |           |  |
| 1E              |                | VCMC_F2[7:0] |              |              |              |              |              |           |           |  |
| 1F              |                | VCMC_B2[7:0] |              |              |              |              |              |           |           |  |
| 20              |                | VCMC_F3[7:0] |              |              |              |              |              |           |           |  |
| 21              |                | VCMC_B3[7:0] |              |              |              |              |              |           |           |  |
| 22              | SETID (C3h)    | ID1_1[7:0]   |              |              |              |              |              |           |           |  |
| 23              |                | NVALID_ID1   | ID2_1[6:0]   |              |              |              |              |           |           |  |
| 24              |                | ID3_1[7:0]   |              |              |              |              |              |           |           |  |
| 25              |                | ID1_2[7:0]   |              |              |              |              |              |           |           |  |
| 26              |                | NVALID_ID2   | ID2_2[6:0]   |              |              |              |              |           |           |  |
| 27              |                | ID3_2[7:0]   |              |              |              |              |              |           |           |  |
| 28              |                | ID1_3[7:0]   |              |              |              |              |              |           |           |  |
| 29              |                | NVALID_ID3   | ID2_3[6:0]   |              |              |              |              |           |           |  |
| 2A              |                | ID3_3[7:0]   |              |              |              |              |              |           |           |  |
| 2B              |                | ID1_4[7:0]   |              |              |              |              |              |           |           |  |
| 2C              |                | NVALID_ID4   | ID2_4[6:0]   |              |              |              |              |           |           |  |
| 2D              |                | ID3_4[7:0]   |              |              |              |              |              |           |           |  |
| 2E              |                | ID1_5[7:0]   |              |              |              |              |              |           |           |  |
| 2F              |                | NVALID_ID5   | ID2_5[6:0]   |              |              |              |              |           |           |  |
| 30              |                | ID3_5[7:0]   |              |              |              |              |              |           |           |  |
| 31              | SETPOWER (B1h) | NVALID8      | FS1[2:0]     |              |              | -            | AP[2:0]      |           |           |  |
| 32              |                | -            | -            | -            | -            | BT[3:0]      |              |           |           |  |
| 33              |                | DT[1:0]      |              | -            | -            | DCDIV[3:0]   |              |           |           |  |
| 34              |                | -            | -            | -            | BTP[4:0]     |              |              |           |           |  |
| 35              |                | -            | -            | -            | BTN[4:0]     |              |              |           |           |  |
| 36              |                | VRHP[7:0]    |              |              |              |              |              |           |           |  |
| 37              |                | VRHN[7:0]    |              |              |              |              |              |           |           |  |
| 38              |                |              |              |              |              | VRMP[5:0]    |              |           |           |  |
| 39              |                |              |              |              |              | VRMN[5:0]    |              |           |           |  |
| 3A              |                | -            | -            | DD_TU        | VPNL_EN      | -            | VBS[2:0]     |           |           |  |
| 3B              |                | -            | DC86_DIV3    | DC86_DIV2    | DC86_DIV1    | DC86_DIV0    | XDK1         | XDK0      | AUTO_XDK  |  |
| 3C              |                | -            | DTPS[2:0]    |              |              | -            | DTNS[2:0]    |           |           |  |
| 3D              |                | A_DC[1:0]    |              | A_DTP[2:0]   |              |              | A_DTN[2:0]   |           |           |  |
| 3E              |                | B_DC[1:0]    |              | B_DTP[2:0]   |              |              | B_DTN[2:0]   |           |           |  |
| 3F              |                | C_DC[1:0]    |              | C_DTP[2:0]   |              |              | C_DTN[2:0]   |           |           |  |
| 40              |                | D_DC[1:0]    |              | D_DTP[2:0]   |              |              | D_DTN[2:0]   |           |           |  |
| 41              |                | E_DC[1:0]    |              | E_DTP[2:0]   |              |              | E_DTN[2:0]   |           |           |  |
| 42              | SETCYC (B4h)   | NVALID9      | -            | -            | -            | NW_PE[1:0]   |              | NW[1:0]   |           |  |
| 43              |                | SON[7:0]     |              |              |              |              |              |           |           |  |
| 44              |                | SOFF[7:0]    |              |              |              |              |              |           |           |  |
| 45              |                | EQS[7:0]     |              |              |              |              |              |           |           |  |
| 46              |                | EQON[7:0]    |              |              |              |              |              |           |           |  |
| 47              | SETPANEL (CCh) | NVALID10     | VPL          | HPL          | EPL          | SS_PANEL     | DPL          | REV_PANEL | BGR_PANEL |  |
| 48              | SETDISP (B2h)  | NVALID11     | RES_SEL[2:0] |              |              | RM           | DFR          | DM[1:0]   |           |  |
| 49              |                | BP [7:0]     |              |              |              |              |              |           |           |  |
| 4A              |                | FP [7:0]     |              |              |              |              |              |           |           |  |
| 4B              |                | SAP[3:0]     |              |              |              | -            | -            | -         | -         |  |
| 4C              |                | GEN_ON[7:0]  |              |              |              |              |              |           |           |  |
| 4D              |                | GEN_OFF[7:0] |              |              |              |              |              |           |           |  |
| 4E              |                | RTN[7:0]     |              |              |              |              |              |           |           |  |
| 4F              |                | -            | -            | -            | -            | TEI[3:0]     |              |           |           |  |

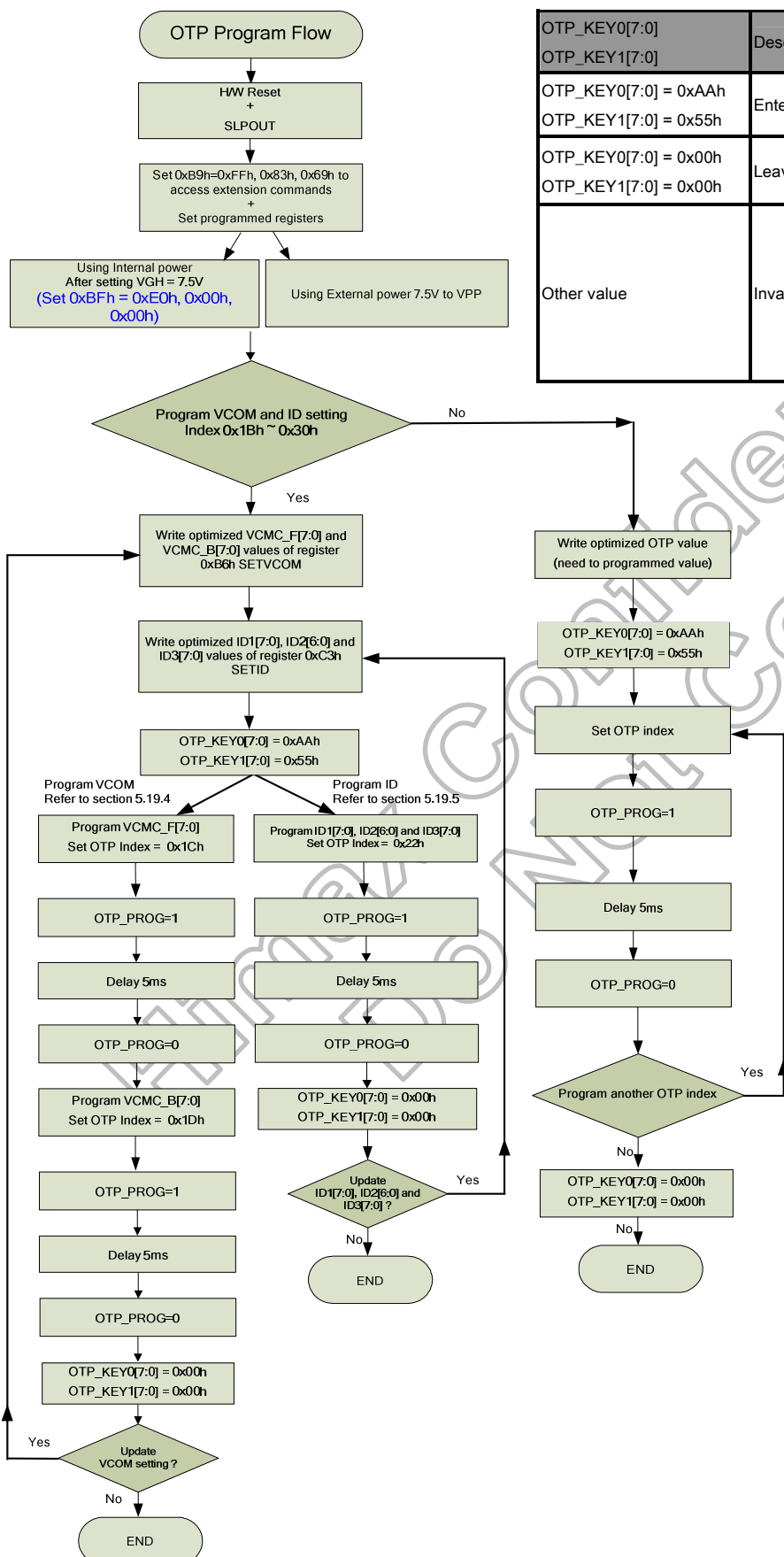
|    |                         |               |          |   |               |   |              |
|----|-------------------------|---------------|----------|---|---------------|---|--------------|
| 50 |                         | -             | -        | - | -             | - | TEP[9:8]     |
| 51 |                         | TEP[7:0]      |          |   |               |   |              |
| 52 |                         | BP_PE [7:0]   |          |   |               |   |              |
| 53 |                         | FP_PE [7:0]   |          |   |               |   |              |
| 54 |                         | RTN_PE[7:0]   |          |   |               |   |              |
| 78 |                         | NVALID_GV0    | -        |   |               |   | G1_VRP0[5:0] |
| 79 |                         | -             | -        |   |               |   | G1_VRP1[5:0] |
| 7A |                         | -             | -        |   |               |   | G1_VRP2[5:0] |
| 7B |                         | -             | -        |   |               |   | G1_VRP3[5:0] |
| 7C |                         | -             | -        |   |               |   | G1_VRP4[5:0] |
| 7D |                         | -             | -        |   |               |   | G1_VRP5[5:0] |
| 7E |                         | -             |          |   |               |   | G1_PRP0[6:0] |
| 7F |                         | -             |          |   |               |   | G1_PRP1[6:0] |
| 80 |                         | G1_CGMP0[1:0] | -        |   |               |   | G1_PKP0[4:0] |
| 81 |                         | G1_CGMP1[1:0] | -        |   |               |   | G1_PKP1[4:0] |
| 82 |                         | G1_CGMP2[1:0] | -        |   |               |   | G1_PKP2[4:0] |
| 83 |                         | G1_CGMP3[1:0] | -        |   |               |   | G1_PKP3[4:0] |
| 84 |                         | G1_CGMP5      | G1_CGMP4 | - |               |   | G1_PKP4[4:0] |
| 85 |                         | -             | -        | - |               |   | G1_PKP5[4:0] |
| 86 |                         | -             | -        | - |               |   | G1_PKP6[4:0] |
| 87 |                         | -             | -        | - |               |   | G1_PKP7[4:0] |
| 88 | SETGAMMA (E0h)<br>(GC0) | -             | -        | - |               |   | G1_PKP8[4:0] |
| 89 |                         | -             | -        |   |               |   | G1_VRN0[5:0] |
| 8A |                         | -             | -        |   |               |   | G1_VRN1[5:0] |
| 8B |                         | -             | -        |   |               |   | G1_VRN2[5:0] |
| 8C |                         | -             | -        |   |               |   | G1_VRN3[5:0] |
| 8D |                         | -             | -        |   |               |   | G1_VRN4[5:0] |
| 8E |                         | -             | -        |   |               |   | G1_VRN5[5:0] |
| 8F |                         | -             |          |   |               |   | G1_PRN0[6:0] |
| 90 |                         | -             |          |   |               |   | G1_PRN1[6:0] |
| 91 |                         | G1_CGMN0[1:0] | -        |   |               |   | G1_PKN0[4:0] |
| 92 |                         | G1_CGMN1[1:0] | -        |   |               |   | G1_PKN1[4:0] |
| 93 |                         | G1_CGMN2[1:0] | -        |   |               |   | G1_PKN2[4:0] |
| 94 |                         | G1_CGMN3[1:0] | -        |   |               |   | G1_PKN3[4:0] |
| 95 |                         | G1_CGMN5      | G1_CGMN4 | - |               |   | G1_PKN4[4:0] |
| 96 |                         | -             | -        | - |               |   | G1_PKN5[4:0] |
| 97 |                         | -             | -        | - |               |   | G1_PKN6[4:0] |
| 98 |                         | -             | -        | - |               |   | G1_PKN7[4:0] |
| 99 |                         | -             | -        | - |               |   | G1_PKN8[4:0] |
| 9A | SETGIP(D5h)             | NVALID13      | -        | - | -             |   | SHR_0[11:8]  |
| 9B |                         | SHR_0[7:0]    |          |   |               |   |              |
| 9C |                         | -             | -        | - | -             |   | SHR_1[11:8]  |
| 9D |                         | SHR_1[7:0]    |          |   |               |   |              |
| 9E |                         | SPD[7:0]      |          |   |               |   |              |
| 9F |                         | CHR[7:0]      |          |   |               |   |              |
| A0 |                         | CON[7:0]      |          |   |               |   |              |
| A1 |                         | COFF[7:0]     |          |   |               |   |              |
| A2 |                         | SHP[3:0]      |          |   | SCP[3:0]      |   |              |
| A3 |                         | CHP[3:0]      |          |   | CCP[3:0]      |   |              |
| A4 |                         | SOS_1[3:0]    |          |   | SOS_0[3:0]    |   |              |
| A5 |                         | SOS_3[3:0]    |          |   | SOS_2[3:0]    |   |              |
| A6 |                         | COS_1[3:0]    |          |   | COS_0[3:0]    |   |              |
| A7 |                         | COS_3[3:0]    |          |   | COS_2[3:0]    |   |              |
| A8 |                         | COS_5[3:0]    |          |   | COS_4[3:0]    |   |              |
| A9 |                         | COS_7[3:0]    |          |   | COS_6[3:0]    |   |              |
| AA |                         | SOS_1_ML[3:0] |          |   | SOS_0_ML[3:0] |   |              |
| AB |                         | SOS_3_ML[3:0] |          |   | SOS_2_ML[3:0] |   |              |
| AC |                         | COS_1_ML[3:0] |          |   | COS_0_ML[3:0] |   |              |
| AD |                         | COS_3_ML[3:0] |          |   | COS_2_ML[3:0] |   |              |

|       |                 |               |   |          |   |   |               |          |        |
|-------|-----------------|---------------|---|----------|---|---|---------------|----------|--------|
| AE    |                 | COS_5_ML[3:0] |   |          |   |   | COS_4_ML[3:0] |          |        |
| AF    |                 | COS_7_ML[3:0] |   |          |   |   | COS_6_ML[3:0] |          |        |
| B0    |                 | -             | - | GTO[5:0] |   |   |               |          |        |
| B1    |                 | GNO[7:0]      |   |          |   |   |               |          |        |
| B2    |                 | EQ_DELAY[7:0] |   |          |   |   |               |          |        |
| B3    | GIP_OPT[7:0]    |               |   |          |   |   |               |          |        |
| 100   | SETDGCLUT (C1h) | NVALID16      | - | -        | - | - | -             | DITH_OPT | DGC_EN |
| 101   |                 | D1[7:0]       |   |          |   |   |               |          |        |
| 102   |                 | D2[7:0]       |   |          |   |   |               |          |        |
| . . . |                 | Dn[7:0]       |   |          |   |   |               |          |        |
| 17D   |                 | D125[7:0]     |   |          |   |   |               |          |        |
| 17E   |                 | D126[7:0]     |   |          |   |   |               |          |        |

Himax Confidential  
Do Not Copy



### 5.19.2 OTP programming flow



| OTP_KEY0[7:0]<br>OTP_KEY1[7:0]                 | Description            | Note                                                                                                                                                                 |
|------------------------------------------------|------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| OTP_KEY0[7:0] = 0xAAh<br>OTP_KEY1[7:0] = 0x55h | Enter OTP program mode |                                                                                                                                                                      |
| OTP_KEY0[7:0] = 0x00h<br>OTP_KEY1[7:0] = 0x00h | Leave OTP program mode |                                                                                                                                                                      |
| Other value                                    | Invalid                | 1. If HX8369-A02 operate on OTP program mode, then keep on OTP program mode.<br>2. If HX8369-A02 operate on non-OTP program mode, then keep on non-OTP program mode. |

Figure 5.41: OTP programming sequence

### 5.19.3 Programming sequence

| Step | Operation                                                                                                                                                                                                                                                                        |
|------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1    | Power on and reset the module.                                                                                                                                                                                                                                                   |
| 2    | SLPOUT and set 0xB9h = 0xFFh, 0x83h, 0x69h to access the extension commands.                                                                                                                                                                                                     |
| 3    | Set VGH power to 7.5V for OTP programming state for using internal power mode.<br>Or using the external power 7.5V to VPP.                                                                                                                                                       |
| 4    | Write optimized values to related registers.                                                                                                                                                                                                                                     |
| 5    | Set OTP_KEY1[7:0] (RE9h)=0xAAh and OTP_KEY1[7:0] (RE9h)=0x55h to enter OTP program mode.                                                                                                                                                                                         |
| 6    | Specify OTP_index, please refer to the OTP table.                                                                                                                                                                                                                                |
| 7    | Set OTP_Mask=0x00h, programming the entire bit of one parameter.                                                                                                                                                                                                                 |
| 8    | Set OTP_PROG=1, Internal register begin write to OTP according to OTP_index.                                                                                                                                                                                                     |
| 9    | Wait 5 ms ( <b>Note 1</b> )                                                                                                                                                                                                                                                      |
| 10   | Set OTP_PROG=0, OTP_index programming action done.                                                                                                                                                                                                                               |
| 11   | Complete programming one parameter to OTP. If continue to programming other parameter, return to step (5). Otherwise, set OTP_KEY1[7:0] (RE9h)=0x00h and OTP_KEY1[7:0] (RE9h)=0x00h to leave OTP program mode and power off the module and remove the external power on VPP pin. |

**Note1:** When do the OTP programming process, it must be added 5ms delay time after setting OTP\_PROG=1.

**Table 5.64: OTP Programming sequence**

## 5.19.4 OTP Programming example of VCOM setting VCMC\_F and VCMC\_B DATA SHEET V01

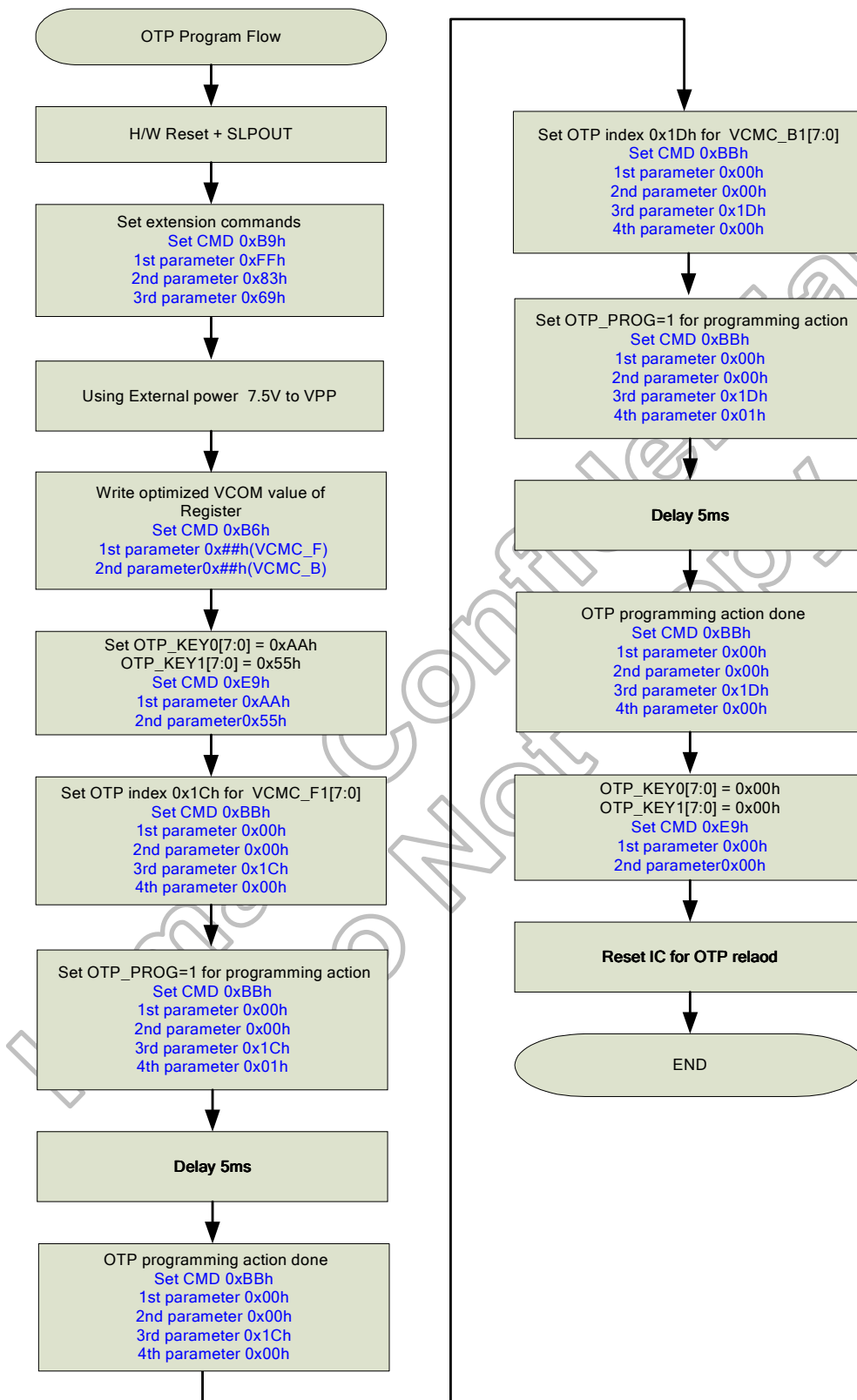


Figure 5.42: OTP programming sequence example 1.

### 5.19.5 OTP Programming example of ID1, ID2 and ID3

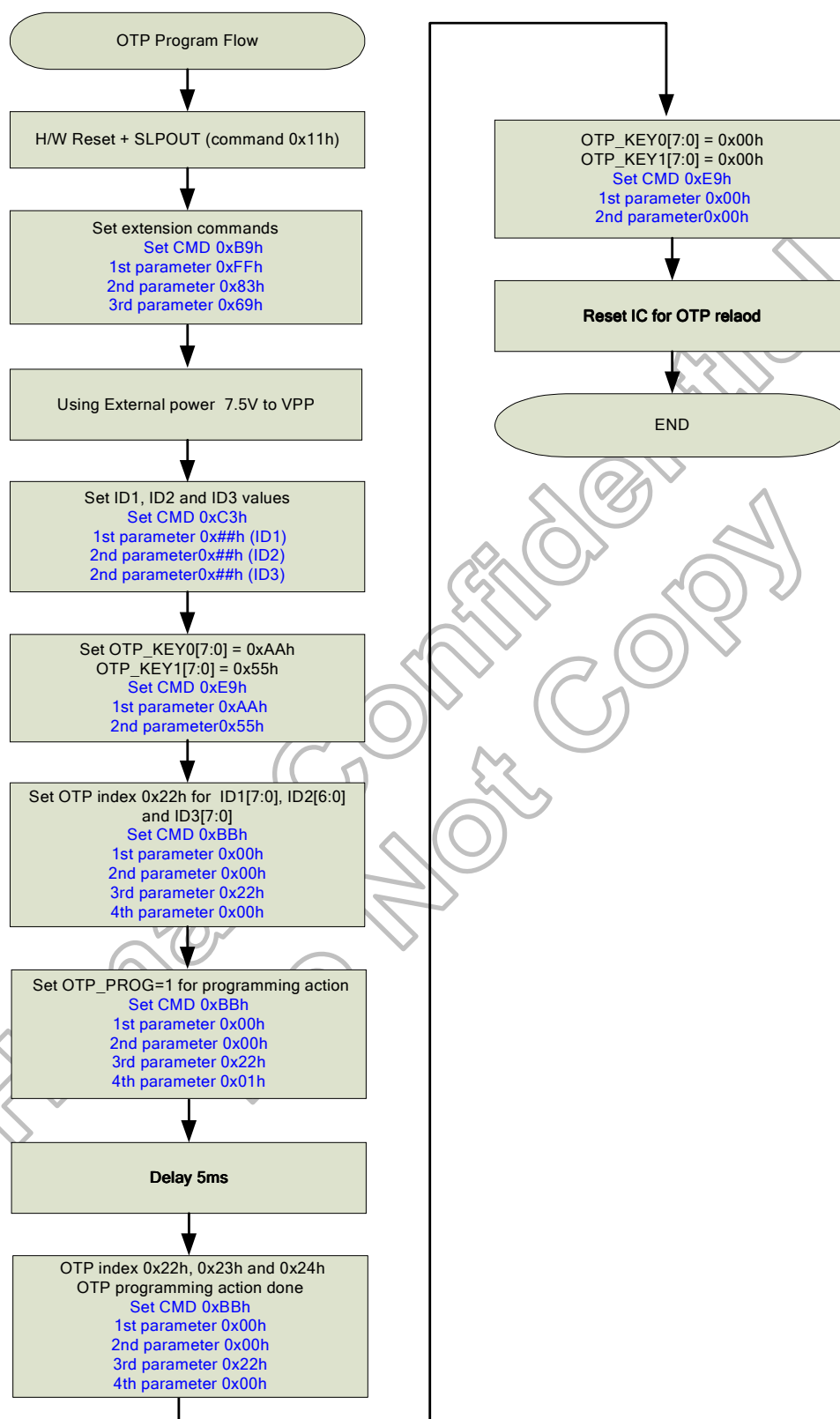
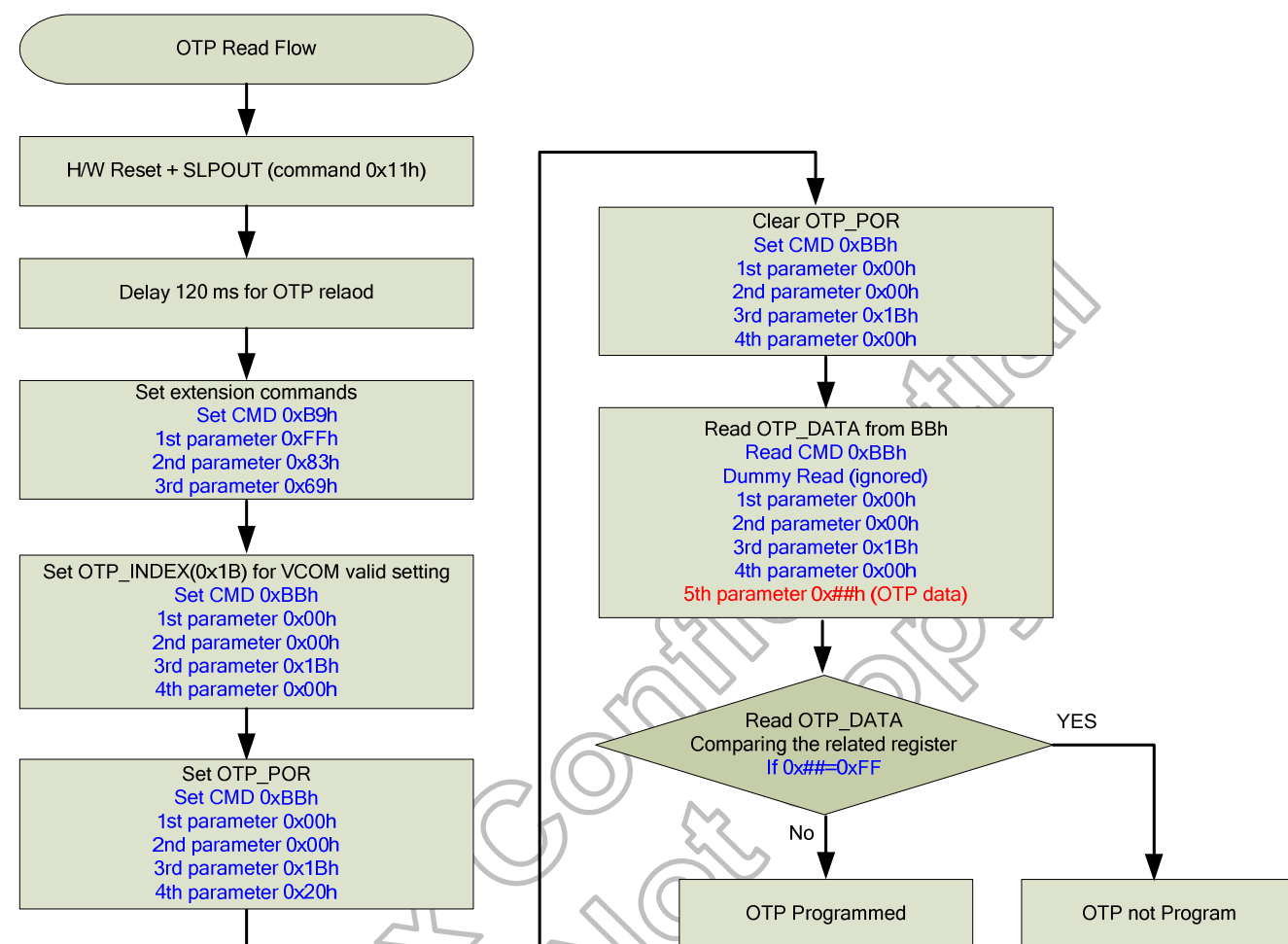


Figure 5.43: OTP programming sequence example 2.

## 5.19.6 OTP read example of 0x1Bh (VCOM setting re-load)



| OTP_index 0x1Bh  | value   | 1 <sup>st</sup> VCOM OTP | 2 <sup>nd</sup> VCOM OTP | 3 <sup>rd</sup> VCOM OTP |
|------------------|---------|--------------------------|--------------------------|--------------------------|
| D7 NVALID_VCMF1  | 1       | 0                        | 0                        | 0                        |
| D6 NVALID_VCMF2  | 1       | 1                        | 0                        | 0                        |
| D5 NVALID_VCMF3  | 1       | 1                        | 1                        | 0                        |
| D4 NVALID_VCMB1  | 1       | 0                        | 0                        | 0                        |
| D3 NVALID_VCMB2  | 1       | 1                        | 0                        | 0                        |
| D2 NVALID_VCMB3  | 1       | 1                        | 1                        | 0                        |
| 0x1Bh value      | 0xFFh   | 0x6Fh                    | 0x27h                    | 0x03h                    |
| Reload OTP index | Default | 0x1Ch and 0x1Dh          | 0x1Eh and 0x1Fh          | 0x20h and 0x21h          |

Figure 5.44: OTP programming sequence index 0x1Bh read flow.

### 5.19.7 OTP read example of VCMC\_F1

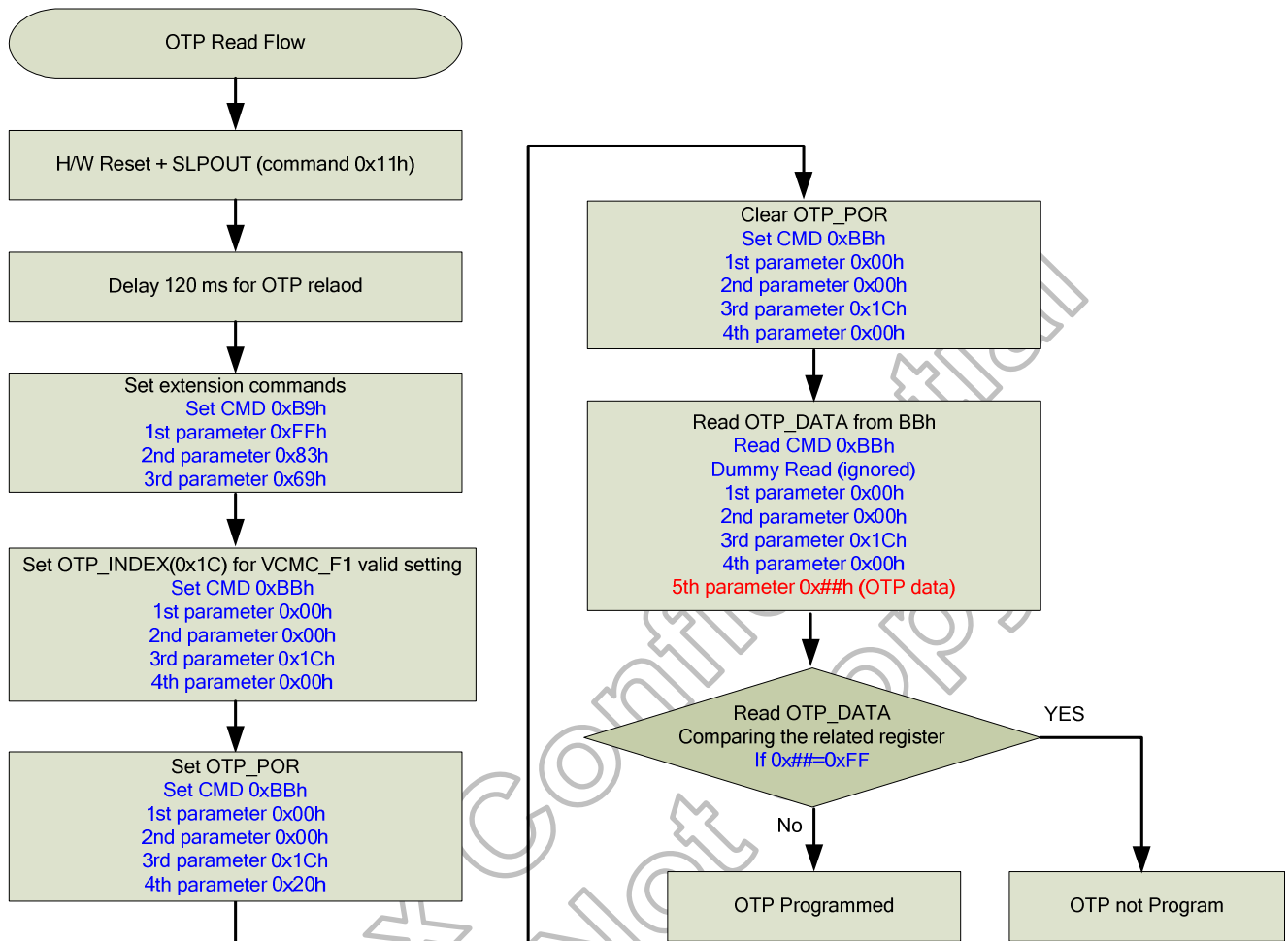


Figure 5.45: OTP programming sequence read flow.



## 6. Command

### 6.1 Command list

#### 6.1.1 Standard command

| (Hex) | Operation code | D/CX | RDX | WRX | D7     | D6 | D5 | D4 | D3 | D2 | D1 | D0 | Function                            | Default (Hex) | RGB |
|-------|----------------|------|-----|-----|--------|----|----|----|----|----|----|----|-------------------------------------|---------------|-----|
| 00    | NOP            | 0    | 1   | ↑   | 0      | 0  | 0  | 0  | 0  | 0  | 0  | 0  | No Operation                        | -             | Yes |
| 01    | SWRESET        | 0    | 1   | ↑   | 0      | 0  | 0  | 0  | 0  | 0  | 0  | 1  | Software Reset                      | -             | Yes |
| 05    | RDNUMPE        | 0    | 1   | ↑   | 0      | 0  | 0  | 0  | 0  | 1  | 0  | 1  | Read Number of DSI Parity Error     | -             | -   |
|       |                | 1    | ↑   | 1   | x      | x  | x  | x  | x  | x  | x  | x  | Dummy read                          | -             | -   |
|       |                | 1    | ↑   | 1   | P[7:0] |    |    |    |    |    |    |    | -                                   | -             | -   |
| 06    | RDRED          | 0    | 1   | ↑   | 0      | 0  | 0  | 0  | 0  | 1  | 1  | 0  | Read Red Colour                     | -             | Yes |
|       |                | 1    | ↑   | 1   | x      | x  | x  | x  | x  | x  | x  | x  | Dummy read                          | -             | -   |
|       |                | 1    | ↑   | 1   | R7     | R6 | R5 | R4 | R3 | R2 | R1 | R0 | xx                                  | -             | -   |
| 07    | RDGREEN        | 0    | 1   | ↑   | 0      | 0  | 0  | 0  | 0  | 1  | 1  | 1  | Read Green Colour                   | -             | Yes |
|       |                | 1    | ↑   | 1   | x      | x  | x  | x  | x  | x  | x  | x  | Dummy read                          | -             | -   |
|       |                | 1    | ↑   | 1   | G7     | G6 | G5 | G4 | G3 | G2 | G1 | G0 | xx                                  | -             | -   |
| 08    | RDBLUE         | 0    | 1   | ↑   | 0      | 0  | 0  | 0  | 1  | 0  | 0  | 0  | Read Blue Colour                    | -             | Yes |
|       |                | 1    | ↑   | 1   | x      | x  | x  | x  | x  | x  | x  | x  | Dummy read                          | -             | -   |
|       |                | 1    | ↑   | 1   | B7     | B6 | B5 | B4 | B3 | B2 | B1 | B0 | xx                                  | -             | -   |
| 0A    | RDDPM          | 0    | 1   | ↑   | 0      | 0  | 0  | 0  | 1  | 0  | 1  | 0  | Read display power mode             | -             | Yes |
|       |                | 1    | ↑   | 1   | x      | x  | x  | x  | x  | x  | x  | x  | Dummy read                          | -             | -   |
|       |                | 1    | ↑   | 1   | D7     | D6 | D5 | D4 | D3 | D2 | 0  | 0  | -                                   | -             | -   |
| 0B    | RDDMADCTL      | 0    | 1   | ↑   | 0      | 0  | 0  | 0  | 1  | 0  | 1  | 1  | Read display MADCTL                 | -             | Yes |
|       |                | 1    | ↑   | 1   | x      | x  | x  | x  | x  | x  | x  | x  | Dummy read                          | -             | -   |
|       |                | 1    | ↑   | 1   | D7     | D6 | D5 | D4 | D3 | D2 | 0  | 0  | -                                   | -             | -   |
| 0C    | RDDCOLMOD      | 0    | 1   | ↑   | 0      | 0  | 0  | 0  | 1  | 1  | 0  | 0  | Read display pixel format           | -             | Yes |
|       |                | 1    | ↑   | 1   | x      | x  | x  | x  | x  | x  | x  | x  | Dummy read                          | -             | -   |
|       |                | 1    | ↑   | 1   | -      | D6 | D5 | D4 | -  | D2 | D1 | D0 | -                                   | -             | -   |
| 0D    | RDDIM          | 0    | 1   | ↑   | 0      | 0  | 0  | 0  | 1  | 1  | 0  | 1  | Read display image mode             | -             | Yes |
|       |                | 1    | ↑   | 1   | x      | x  | x  | x  | x  | x  | x  | x  | Dummy read                          | -             | -   |
|       |                | 1    | ↑   | 1   | D7     | D6 | D5 | 0  | 0  | D2 | D1 | D0 | -                                   | -             | -   |
| 0E    | RDDSM          | 0    | 1   | ↑   | 0      | 0  | 0  | 0  | 1  | 1  | 1  | 0  | Read display signal mode            | -             | Yes |
|       |                | 1    | ↑   | 1   | x      | x  | x  | x  | x  | x  | x  | x  | Dummy read                          | -             | -   |
|       |                | 1    | ↑   | 1   | D7     | D6 | 0  | 0  | 0  | 0  | 0  | 0  | -                                   | -             | -   |
| 0F    | RDDSDR         | 0    | 1   | ↑   | 0      | 0  | 0  | 0  | 1  | 1  | 1  | 1  | Read display self-diagnostic result | -             | Yes |
|       |                | 1    | ↑   | 1   | x      | x  | x  | x  | x  | x  | x  | x  | Dummy read                          | -             | -   |
|       |                | 1    | ↑   | 1   | D7     | D6 | D5 | D4 | 0  | 0  | 0  | 0  | -                                   | -             | -   |

| (Hex) | Operation Code | D/CX | RDX | WRX | D7   | D6   | D5   | D4   | D3   | D2   | D1   | D0   | Function               | Default (Hex) | RGB |
|-------|----------------|------|-----|-----|------|------|------|------|------|------|------|------|------------------------|---------------|-----|
| 10    | SLPIN          | 0    | 1   | ↑   | 0    | 0    | 0    | 1    | 0    | 0    | 0    | 0    | Sleep In               | -             | Yes |
| 11    | SLPOUT         | 0    | 1   | ↑   | 0    | 0    | 0    | 1    | 0    | 0    | 0    | 1    | Sleep Out              | -             | Yes |
| 12    | PTLON          | 0    | 1   | ↑   | 0    | 0    | 0    | 1    | 0    | 0    | 1    | 0    | Partial Mode On        | -             | No  |
| 13    | NORON          | 0    | 1   | ↑   | 0    | 0    | 0    | 1    | 0    | 0    | 1    | 1    | Normal display mode on | -             | No  |
| 20    | INVOFF         | 0    | 1   | ↑   | 0    | 0    | 1    | 0    | 0    | 0    | 0    | 0    | Display inversion off  | -             | No  |
| 21    | INVON          | 0    | 1   | ↑   | 0    | 0    | 1    | 0    | 0    | 0    | 0    | 1    | Display inversion on   | -             | No  |
| 26    | GAMSET         | 0    | 1   | ↑   | 0    | 0    | 1    | 0    | 0    | 1    | 1    | 0    | Gamma set              | -             | Yes |
|       |                | 1    | 1   | ↑   | GC7  | GC6  | GC5  | GC4  | GC3  | GC2  | GC1  | GC0  | -                      | -             | -   |
| 28    | DISPOFF        | 0    | 1   | ↑   | 0    | 0    | 1    | 0    | 1    | 0    | 0    | 0    | Display off            | -             | Yes |
| 29    | DISPON         | 0    | 1   | ↑   | 0    | 0    | 1    | 0    | 1    | 0    | 0    | 1    | Display on             | -             | Yes |
| 2A    | CASET          | 0    | 1   | ↑   | 0    | 0    | 1    | 0    | 1    | 0    | 1    | 0    | Column Address Set     | -             | No  |
|       |                | 1    | 1   | ↑   | SC15 | SC14 | SC13 | SC12 | SC11 | SC10 | SC9  | SC8  | Column address start   | -             | -   |
|       |                | 1    | 1   | ↑   | SC7  | SC6  | SC5  | SC4  | SC3  | SC2  | SC1  | SC0  | Column address start   | -             | -   |
|       |                | 1    | 1   | ↑   | EC15 | EC14 | EC13 | EC12 | EC11 | EC10 | EC9  | EC8  | Column address end     | -             | -   |
|       |                | 1    | 1   | ↑   | EC7  | EC6  | EC5  | EC4  | EC3  | EC2  | EC1  | EC0  | Column address end     | -             | -   |
| 2B    | PASET          | 0    | 1   | ↑   | 0    | 0    | 1    | 0    | 1    | 0    | 1    | 1    | Row address set        | -             | No  |
|       |                | 1    | 1   | ↑   | SP15 | SP14 | SP13 | SP12 | SP11 | SP10 | SP9  | SP8  | Row address start      | -             | -   |
|       |                | 1    | 1   | ↑   | SP7  | SP6  | SP5  | SP4  | SP3  | SP2  | SP1  | SP0  | Row address start      | -             | -   |
|       |                | 1    | 1   | ↑   | EP15 | EP14 | EP13 | EP12 | EP11 | EP10 | EP9  | EP8  | Row address end        | -             | -   |
|       |                | 1    | 1   | ↑   | EP7  | EP6  | EP5  | EP4  | EP3  | EP2  | EP1  | EP0  | Row address end        | -             | -   |
| 2C    | RAMWR          | 0    | 1   | ↑   | 0    | 0    | 1    | 0    | 1    | 1    | 0    | 0    | Memory Write           | -             | No  |
|       |                | 1    | 1   | ↑   | D17  | D16  | D15  | D14  | D13  | D12  | D11  | D10  | Write data             | -             | -   |
|       |                | 1    | 1   | ↑   | Dx7  | Dx6  | Dx5  | Dx4  | Dx3  | Dx2  | Dx1  | Dx0  | Write data             | -             | -   |
|       |                | 1    | 1   | ↑   | Dn7  | Dn6  | Dn5  | Dn4  | Dn3  | Dn2  | Dn1  | Dn0  | Write data             | -             | -   |
| 2D    | RGBSET         | 0    | 1   | ↑   | 0    | 0    | 1    | 0    | 1    | 1    | 0    | 1    | Color Set              | -             | Yes |
|       |                | 1    | 1   | ↑   | R007 | R006 | R005 | R004 | R003 | R002 | R001 | R000 | Red tone               | -             | -   |
|       |                | 1    | 1   | ↑   | Rnn7 | Rnn6 | Rnn5 | Rnn4 | Rnn3 | Rnn2 | Rnn1 | Rnn0 | Red tone               | -             | -   |
|       |                | 1    | 1   | ↑   | R637 | R636 | R635 | R634 | R633 | R632 | R631 | R630 | Red tone               | -             | -   |
|       |                | 1    | 1   | ↑   | G007 | G006 | G005 | G004 | G003 | G002 | G001 | G000 | Green tone             | -             | -   |
|       |                | 1    | 1   | ↑   | Gnn7 | Gnn6 | Gnn5 | Gnn4 | Gnn3 | Gnn2 | Gnn1 | Gnn0 | Green tone             | -             | -   |
|       |                | 1    | 1   | ↑   | G637 | G636 | G635 | G634 | G633 | G632 | G631 | G630 | Green tone             | -             | -   |
|       |                | 1    | 1   | ↑   | B007 | B006 | B005 | B004 | B003 | B002 | B001 | B000 | Blue tone              | -             | -   |
|       |                | 1    | 1   | ↑   | Bnn7 | Bnn6 | Bnn5 | Bnn4 | Bnn3 | Bnn2 | Bnn1 | Bnn0 | Blue tone              | -             | -   |
|       |                | 1    | 1   | ↑   | B637 | B636 | B635 | B634 | B633 | B632 | B631 | B630 | Blue tone              | -             | -   |
| 2E    | RAMRD          | 0    | 1   | ↑   | 0    | 0    | 1    | 0    | 1    | 1    | 1    | 0    | Memory read            | -             | No  |
|       |                | 1    | ↑   | 1   | X    | X    | X    | X    | X    | X    | X    | X    | Dummy read             | -             | -   |
|       |                | 1    | ↑   | 1   | D17  | D16  | D15  | D14  | D13  | D12  | D11  | D10  | Read data              | -             | -   |
|       |                | 1    | ↑   | 1   | Dx7  | Dx6  | Dx5  | Dx4  | Dx3  | Dx2  | Dx1  | Dx0  | Read data              | -             | -   |
|       |                | 1    | ↑   | 1   | Dn7  | Dn6  | Dn5  | Dn4  | Dn3  | Dn2  | Dn1  | Dn0  | -                      | -             | -   |
| 30    | PLTAR          | 0    | 1   | ↑   | 0    | 0    | 1    | 1    | 0    | 0    | 0    | 0    | Partial Area           | -             | No  |
|       |                | 1    | 1   | ↑   | SR15 | SR14 | SR13 | SR12 | SR11 | SR10 | SR9  | SR8  | Start row              | -             | -   |
|       |                | 1    | 1   | ↑   | SR7  | SR6  | SR5  | SR4  | SR3  | SR2  | SR1  | SR0  | Start row              | -             | -   |
|       |                | 1    | 1   | ↑   | ER15 | ER14 | ER13 | ER12 | ER11 | ER10 | ER9  | ER8  | End row                | -             | -   |
|       |                | 1    | 1   | ↑   | ER7  | ER6  | ER5  | ER4  | ER3  | ER2  | ER1  | ER0  | End row                | -             | -   |

| (Hex) | Operation Code | D/CX | RDX | WRX | D7                | D6  | D5    | D4  | D3  | D2  | D1        | D0  | Function                                 | Default (Hex) | RGB |
|-------|----------------|------|-----|-----|-------------------|-----|-------|-----|-----|-----|-----------|-----|------------------------------------------|---------------|-----|
| 33    | VSCRDEF        | 0    | 1   | ↑   | 0                 | 0   | 1     | 1   | 0   | 0   | 1         | 1   | Vertical scrolling definition            | -             | No  |
|       |                | 1    | 1   | ↑   | TFA[15:8]         |     |       |     |     |     |           |     | -                                        | -             | -   |
|       |                | 1    | 1   | ↑   | TFA[7:0]          |     |       |     |     |     |           |     | -                                        | -             | -   |
|       |                | 1    | 1   | ↑   | VSA[15:8]         |     |       |     |     |     |           |     | -                                        | -             | -   |
|       |                | 1    | 1   | ↑   | VSA[7:0]          |     |       |     |     |     |           |     | -                                        | -             | -   |
|       |                | 1    | 1   | ↑   | BFA[15:8]         |     |       |     |     |     |           |     | -                                        | -             | -   |
|       |                | 1    | 1   | ↑   | BFA[7:0]          |     |       |     |     |     |           |     | -                                        | -             | -   |
| 34    | TEOFF          | 0    | 1   | ↑   | 0                 | 0   | 1     | 1   | 0   | 1   | 0         | 0   | Tearing Effect Line OFF                  | -             | No  |
| 35    | TEON           | 0    | 1   | ↑   | 0                 | 0   | 1     | 1   | 0   | 1   | 0         | 1   | Tearing Effect Line ON                   | -             | No  |
|       |                | 1    | 1   | ↑   | X                 | X   | X     | X   | X   | X   | X         | M   | -                                        | -             | -   |
| 36    | MADCTL         | 0    | 1   | ↑   | 0                 | 0   | 1     | 1   | 0   | 1   | 1         | 0   | Memory Access Control                    | -             | Yes |
|       |                | 1    | 1   | ↑   | B7                | B6  | B5    | B4  | B3  | B2  | X         | X   | -                                        | -             | -   |
| 37    | VSCRSADD       | 0    | 1   | ↑   | 0                 | 0   | 1     | 1   | 0   | 1   | 1         | 1   | Vertical scrolling start address         | -             | No  |
|       |                | 1    | 1   | ↑   | VSP[15:8]         |     |       |     |     |     |           |     | -                                        | -             | -   |
|       |                | 1    | 1   | ↑   | VSP[7:0]          |     |       |     |     |     |           |     | -                                        | -             | -   |
| 38    | IDMOFF         | 0    | 1   | ↑   | 0                 | 0   | 1     | 1   | 1   | 0   | 0         | 0   | Idle mode off                            | -             | No  |
| 39    | IDMON          | 0    | 1   | ↑   | 0                 | 0   | 1     | 1   | 1   | 0   | 0         | 1   | Idle mode on                             | -             | No  |
| 3A    | COLMOD         | 0    | 1   | ↑   | 0                 | 0   | 1     | 1   | 1   | 0   | 1         | 0   | -                                        | -             | Yes |
|       |                | 1    | 1   | ↑   | X                 | D6  | D5    | D4  | X   | D2  | D1        | D0  | -                                        | -             | -   |
| 3C    | RAMWRCON       | 0    | 1   | ↑   | 0                 | 0   | 1     | 1   | 1   | 1   | 0         | 0   | Memory write                             | -             | No  |
|       |                | 1    | 1   | ↑   | D17               | D16 | D15   | D14 | D13 | D12 | D11       | D10 | -                                        | -             | -   |
|       |                | 1    | 1   | ↑   | Dx7               | Dx6 | Dx5   | Dx4 | Dx3 | Dx2 | Dx1       | Dx0 | -                                        | -             | -   |
|       |                | 1    | 1   | ↑   | Dn7               | Dn6 | Dn5   | Dn4 | Dn3 | Dn2 | Dn1       | Dn0 | -                                        | -             | -   |
| 3E    | RAMRDCON       | 0    | 1   | ↑   | 0                 | 0   | 1     | 1   | 1   | 1   | 1         | 0   | Memory read                              | -             | No  |
|       |                | 1    | ↑   | 1   | X                 | X   | X     | X   | X   | X   | X         | X   | Dummy read                               | -             | -   |
|       |                | 1    | ↑   | 1   | D17               | D16 | D15   | D14 | D13 | D12 | D11       | D10 | -                                        | -             | -   |
|       |                | 1    | ↑   | 1   | Dx7               | Dx6 | Dx5   | Dx4 | Dx3 | Dx2 | Dx1       | Dx0 | -                                        | -             | -   |
|       |                | 1    | ↑   | 1   | Dn7               | Dn6 | Dn5   | Dn4 | Dn3 | Dn2 | Dn1       | Dn0 | -                                        | -             | -   |
| 44    | TESL           | 0    | 1   | ↑   | 0                 | 1   | 0     | 0   | 0   | 1   | 0         | 0   | TESL                                     | -             | Yes |
|       |                | 1    | 1   | ↑   | TELIN[15:8](8'b0) |     |       |     |     |     |           |     | -                                        | -             | -   |
|       |                | 1    | 1   | ↑   | TELIN[7:0](8'b0)  |     |       |     |     |     |           |     | -                                        | -             | -   |
| 45    | GETSCAN        | 0    | 1   | ↑   | 0                 | 1   | 0     | 0   | 0   | 1   | 0         | 1   | Return the current scanline SLN[15:0]    | -             | No  |
|       |                | 1    | 1   | ↑   | SLN[15:8]         |     |       |     |     |     |           |     | -                                        | -             | -   |
|       |                | 1    | 1   | ↑   | SLN[7:0]          |     |       |     |     |     |           |     | -                                        | -             | -   |
| 51    | WRDISBV        | 0    | 1   | ↑   | 0                 | 1   | 0     | 1   | 0   | 0   | 0         | 1   | Write Display Brightness                 | -             | Yes |
|       |                | 1    | 1   | ↑   | DBV[7:0]          |     |       |     |     |     |           |     | -                                        | -             | -   |
| 52    | RDISBV         | 0    | 1   | ↑   | 0                 | 1   | 0     | 1   | 0   | 0   | 1         | 0   | Read Display Brightness Value            | -             | Yes |
|       |                | 1    | ↑   | 1   | xx                | xx  | xx    | xx  | xx  | xx  | xx        | xx  | Dummy read                               | -             | -   |
|       |                | 1    | ↑   | 1   | DBV[7:0]          |     |       |     |     |     |           |     | -                                        | -             | -   |
| 53    | WRCTRLD        | 0    | 1   | ↑   | 0                 | 1   | 0     | 1   | 0   | 0   | 1         | 1   | Write CTRL Display                       | -             | Yes |
|       |                | 1    | 1   | ↑   | xx                | xx  | BCTRL | xx  | DD  | BL  | xx        | xx  | -                                        | -             | -   |
| 54    | RDCTRLD        | 0    | 1   | ↑   | 0                 | 1   | 0     | 1   | 0   | 0   | 1         | 1   | Read Control Value Display               | -             | Yes |
|       |                | 1    | ↑   | 1   | xx                | xx  | xx    | xx  | xx  | xx  | xx        | xx  | Dummy read                               | -             | -   |
|       |                | 1    | ↑   | 1   | 0                 | 0   | BCTRL | 0   | DD  | BL  | 0         | 0   | -                                        | -             | -   |
| 55    | WRCABC         | 0    | 1   | ↑   | 0                 | 1   | 0     | 1   | 0   | 1   | 0         | 1   | Write Adaptive Brightness Control        | -             | Yes |
|       |                | 1    | 1   | ↑   | xx                | xx  | xx    | xx  | xx  | xx  | CABC[1:0] |     | -                                        | -             | -   |
| 56    | RDCABC         | 0    | 1   | ↑   | 0                 | 1   | 0     | 1   | 0   | 1   | 1         | 0   | Read Adaptive Brightness Control Content | -             | Yes |
|       |                | 1    | ↑   | 1   | XX                | XX  | XX    | XX  | XX  | XX  | XX        | XX  | Dummy read                               | -             | -   |
|       |                | 1    | ↑   | 1   | 0                 | 0   | 0     | 0   | 0   | 0   | C1        | C0  | -                                        | -             | -   |

| (Hex) | Operation Code    | D/CX | RDX | WRX | D7                              | D6 | D5 | D4 | D3 | D2 | D1 | D0 | Function                                                 | Default (Hex) | RGB |
|-------|-------------------|------|-----|-----|---------------------------------|----|----|----|----|----|----|----|----------------------------------------------------------|---------------|-----|
| 5E    | WRCABCMB          | 0    | 1   | ↑   | 0                               | 1  | 0  | 1  | 1  | 1  | 1  | 0  | Write CABC minimum brightness                            | -             | Yes |
|       |                   | 1    | 1   | ↑   | CMB[7:0]                        |    |    |    |    |    |    |    | -                                                        | -             | -   |
| 5F    | RDCABCMB          | 0    | 1   | ↑   | 0                               | 1  | 0  | 1  | 1  | 1  | 1  | 1  | Read CABC minimum brightness                             | -             | Yes |
|       |                   | 1    | ↑   | 1   | -                               | XX | XX | XX | XX | XX | XX | XX | Dummy read                                               | -             | -   |
|       |                   | 1    | ↑   | 1   | CMB[7:0]                        |    |    |    |    |    |    |    | -                                                        | -             | -   |
| 68    | RDABCSDR          | 0    | 1   | ↑   | 0                               | 1  | 1  | 0  | 1  | 0  | 0  | 0  | Read Automatic Brightness Control Self-Diagnostic Result | -             | Yes |
|       |                   | 1    | ↑   | 1   | XX                              | XX | XX | XX | XX | XX | XX | XX | -                                                        | -             | -   |
|       |                   | 1    | ↑   | 1   | D[7:6]                          |    |    |    |    |    |    |    | -                                                        | -             | -   |
| DA    | RDID1             | 0    | ↑   | 1   | 1                               | 1  | 0  | 1  | 1  | 0  | 1  | 0  | Read ID1                                                 | -             | Yes |
|       |                   | 1    | 1   | ↑   | XX                              | XX | XX | XX | XX | XX | XX | XX | Dummy read                                               | -             | -   |
|       |                   | 1    | 1   | ↑   | module's manufacturer[7:0]      |    |    |    |    |    |    |    | -                                                        | -             | -   |
| DB    | RDID2             | 0    | ↑   | 1   | 1                               | 1  | 0  | 1  | 1  | 0  | 1  | 1  | Read ID2                                                 | -             | Yes |
|       |                   | 1    | 1   | ↑   | XX                              | XX | XX | XX | XX | XX | XX | XX | Dummy read                                               | -             | -   |
|       |                   | 1    | 1   | ↑   | LCD module/driver version [6:0] |    |    |    |    |    |    |    | -                                                        | -             | -   |
| DC    | RDID3             | 0    | ↑   | 1   | 1                               | 1  | 0  | 1  | 1  | 1  | 0  | 0  | Read ID3                                                 | -             | Yes |
|       |                   | 1    | 1   | ↑   | XX                              | XX | XX | XX | XX | XX | XX | XX | Dummy read                                               | -             | -   |
|       |                   | 1    | 1   | ↑   | LCD module/driver ID[7:0]       |    |    |    |    |    |    |    | -                                                        | -             | -   |
| A1    | Read_DDB_start    | 0    | 1   | ↑   | 1                               | 0  | 1  | 0  | 0  | 0  | 0  | 1  | Read the DDB from the provided location.                 | -             | Yes |
|       |                   | 1    | ↑   | 1   | XX                              | XX | XX | XX | XX | XX | XX | XX | Dummy read                                               | -             | -   |
|       |                   | 1    | ↑   | 1   | x                               | x  | x  | x  | x  | x  | x  | x  | -                                                        | -             | -   |
|       |                   | 1    | ↑   | 1   | x                               | x  | x  | x  | x  | x  | x  | x  | -                                                        | -             | -   |
|       |                   | 1    | ↑   | 1   | x                               | x  | x  | x  | x  | x  | x  | x  | -                                                        | -             | -   |
| A8    | Read_DDB_continue | 0    | 1   | ↑   | 1                               | 0  | 1  | 0  | 1  | 0  | 0  | 0  | Continue reading the DDB from the last read location.    | -             | Yes |
|       |                   | 1    | ↑   | 1   | XX                              | XX | XX | XX | XX | XX | XX | XX | Dummy read                                               | -             | -   |
|       |                   | 1    | ↑   | 1   | x                               | x  | x  | x  | x  | x  | x  | x  | -                                                        | -             | -   |
|       |                   | 1    | ↑   | 1   | x                               | x  | x  | x  | x  | x  | x  | x  | -                                                        | -             | -   |
|       |                   | 1    | ↑   | 1   | x                               | x  | x  | x  | x  | x  | x  | x  | -                                                        | -             | -   |

**Note:** (1) Undefined commands are treated as NOP (00h) command.

(2) B0h to D8h and E0h to FFh are for factory use of display supplier.

## 6.1.2 User define command list table

User define command list is available only set "SETEXC" command.

| (Hex) | Operation | DCX | RDX       | WRX | D7                                                                                                  | D6           | D5         | D4         | D3         | D2         | D1       | D0                     | Function                            | Default |       |
|-------|-----------|-----|-----------|-----|-----------------------------------------------------------------------------------------------------|--------------|------------|------------|------------|------------|----------|------------------------|-------------------------------------|---------|-------|
|       | Code      |     |           |     |                                                                                                     |              |            |            |            |            |          |                        |                                     | (Hex)   |       |
| B0    | SETOSC    | 0   | 1         | ↑   | 1                                                                                                   | 0            | 1          | 1          | 0          | 0          | 0        | 0                      | Set Internal oscillator             | -       |       |
|       |           | 1   | 1         | ↑   | -                                                                                                   | -            | -          | -          | -          | -          | -        | OSC_EN                 | -                                   | (00h)   |       |
|       |           | 1   | 1         | ↑   | -                                                                                                   | -            | -          | -          | UADJ[3:0]  |            |          |                        | -                                   | (0Bh)   |       |
| B1    | SETPOWER  | 0   | 1         | ↑   | 1                                                                                                   | 0            | 1          | 1          | 0          | 0          | 0        | 1                      | Set power related setting           | -       |       |
|       |           | 1   | 1         | ↑   | VBIAS_EN                                                                                            | VSN_EN       | VSP_EN     | VGL_EN     | VGH_EN     | LVGL_EN    | VDDDN_HZ | STB                    | -                                   | (01h)   |       |
|       |           | 1   | 1         | ↑   | -                                                                                                   | -            | -          | -          | -          | -          | -        | DSTB                   | -                                   | (00h)   |       |
|       |           | 1   | 1         | ↑   | -                                                                                                   | FS1[2:0]     |            |            |            | -          | AP[2:0]  |                        | -                                   | (34h)   |       |
|       |           | 1   | 1         | ↑   | -                                                                                                   | -            | -          | -          | BT[3:0]    |            |          | -                      | (07h)                               |         |       |
|       |           | 1   | 1         | ↑   | DT[1:0]                                                                                             |              |            | -          | DCDIV[3:0] |            |          | -                      | (00h)                               |         |       |
|       |           | 1   | 1         | ↑   | -                                                                                                   | -            | -          | BTP[4:0]   |            |            |          | -                      | (0Eh)                               |         |       |
|       |           | 1   | 1         | ↑   | -                                                                                                   | -            | -          | BTN[4:0]   |            |            |          | -                      | (0Eh)                               |         |       |
|       |           | 1   | 1         | ↑   | VRHP[7:0]                                                                                           |              |            |            |            | -          |          |                        |                                     | -       | (21h) |
|       |           | 1   | 1         | ↑   | VRHN[7:0]                                                                                           |              |            |            |            | -          |          |                        |                                     | -       | (29h) |
|       |           | 1   | 1         | ↑   | -                                                                                                   | -            | VRMP[5:0]  |            |            |            |          | -                      |                                     |         | (19h) |
|       |           | 1   | 1         | ↑   | -                                                                                                   | -            | VRMN[5:0]  |            |            |            |          | -                      |                                     |         | (19h) |
|       |           | 1   | 1         | ↑   | -                                                                                                   | -            | DD_TU      | VPNL_EN    | -          | VBS[2:0]   |          |                        | -                                   | (07h)   |       |
|       |           | 1   | 1         | ↑   | -                                                                                                   | DC86_DIV3    | DC86_DIV2  | DC86_DIV1  | DC86_DIV0  | XDK1       | XDK0     | AUTO_XDK               | -                                   | (22h)   |       |
|       |           | 1   | 1         | ↑   | -                                                                                                   | DTPS[2:0]    |            |            | -          | DTNS[2:0]  |          |                        | -                                   | (01h)   |       |
|       |           | 1   | 1         | ↑   | A_DC[1:0]                                                                                           |              | A_DTP[2:0] |            |            | A_DTN[2:0] |          |                        | -                                   | (E6h)   |       |
|       |           | 1   | 1         | ↑   | B_DC[1:0]                                                                                           |              | B_DTP[2:0] |            |            | B_DTN[2:0] |          |                        | -                                   | (E6h)   |       |
| 1     | 1         | ↑   | C_DC[1:0] |     | C_DTP[2:0]                                                                                          |              |            | C_DTN[2:0] |            |            | -        | (E6h)                  |                                     |         |       |
| 1     | 1         | ↑   | D_DC[1:0] |     | D_DTP[2:0]                                                                                          |              |            | D_DTN[2:0] |            |            | -        | (E6h)                  |                                     |         |       |
| 1     | 1         | ↑   | E_DC[1:0] |     | E_DTP[2:0]                                                                                          |              |            | E_DTN[2:0] |            |            | -        | (E6h)                  |                                     |         |       |
| B2    | SETDISP   | 0   | 1         | ↑   | 1                                                                                                   | 0            | 1          | 1          | 0          | 0          | 1        | 0                      | Set display related register        | -       |       |
|       |           | 1   | 1         | ↑   | -                                                                                                   | -            | -          | -          | -          | -          | D[1:0]   |                        | -                                   | (00h)   |       |
|       |           | 1   | 1         | ↑   | -                                                                                                   | RES_SEL[2:0] |            |            |            | RM         | DFR      | DM[1:0] <sup>(1)</sup> |                                     | -       | (10h) |
|       |           | 1   | 1         | ↑   | BP [7:0]                                                                                            |              |            |            |            | -          |          |                        |                                     | -       | (03h) |
|       |           | 1   | 1         | ↑   | FP [7:0]                                                                                            |              |            |            |            | -          |          |                        |                                     | -       | (03h) |
|       |           | 1   | 1         | ↑   | SAP[3:0]                                                                                            |              |            |            | -          | -          | -        | -                      | -                                   | -       | (70h) |
|       |           | 1   | 1         | ↑   | GEN_ON[7:0]                                                                                         |              |            |            |            | -          |          |                        |                                     | -       | (00h) |
|       |           | 1   | 1         | ↑   | GEN_OFF[7:0]                                                                                        |              |            |            |            | -          |          |                        |                                     | -       | (FFh) |
|       |           | 1   | 1         | ↑   | RTN[7:0]                                                                                            |              |            |            |            | -          |          |                        |                                     | -       | (00h) |
|       |           | 1   | 1         | ↑   | -                                                                                                   | -            | -          | -          | TEI[3:0]   |            |          | -                      | -                                   | (00h)   |       |
|       |           | 1   | 1         | ↑   | -                                                                                                   | -            | -          | -          | -          | -          | TEP[9:8] |                        | -                                   | (00h)   |       |
|       |           | 1   | 1         | ↑   | TEP[7:0]                                                                                            |              |            |            |            | -          |          |                        |                                     | -       | (00h) |
|       |           | 1   | 1         | ↑   | BP_PE [7:0]                                                                                         |              |            |            |            | -          |          |                        |                                     | -       | (03h) |
|       |           | 1   | 1         | ↑   | FP_PE [7:0]                                                                                         |              |            |            |            | -          |          |                        |                                     | -       | (03h) |
|       |           | 1   | 1         | ↑   | RTN_PE[7:0]                                                                                         |              |            |            |            | -          |          |                        |                                     | -       | (03h) |
| 1     | 1         | ↑   | -         | -   | -                                                                                                   | -            | -          | -          | -          | -          | GON      | -                      | (01h)                               |         |       |
| -     | -         | -   | -         | -   | Note: (1) When BS[3:0]=1101, 1110, 1111 DM[1:0] default =11<br>Other condition, DM[1:0] default =00 |              |            |            |            |            |          | -                      | -                                   |         |       |
| B3    | SETRGBIF  | 0   | 1         | ↑   | 1                                                                                                   | 0            | 1          | 1          | 0          | 0          | 1        | 1                      | Set RGB interface related register) | -       |       |
|       |           | 1   | 1         | ↑   | -                                                                                                   | -            | -          | -          | DPL        | HSPL       | VSPL     | EPL                    | -                                   | (01h)   |       |
| B4    | SETCYC    | 0   | 1         | ↑   | 1                                                                                                   | 0            | 1          | 0          | 0          | 1          | 0        | 0                      | Set Display waveform cycles         | -       |       |
|       |           | 1   | 1         | ↑   | -                                                                                                   | -            | -          | -          | NW_PE[1:0] |            | NW[1:0]  |                        | -                                   | (00h)   |       |
|       |           | 1   | 1         | ↑   | SON[7:0]                                                                                            |              |            |            |            | -          |          |                        |                                     | -       | (0Fh) |
|       |           | 1   | 1         | ↑   | SOFF[7:0]                                                                                           |              |            |            |            | -          |          |                        |                                     | -       | (82h) |
|       |           | 1   | 1         | ↑   | EQS[7:0]                                                                                            |              |            |            |            | -          |          |                        |                                     | -       | (0Ch) |
|       |           | 1   | 1         | ↑   | EQON[7:0]                                                                                           |              |            |            |            | -          |          |                        |                                     | -       | (03h) |

|     |                    |   |   |   |                  |                 |           |              |               |             |          |              |                            |                  |           |       |
|-----|--------------------|---|---|---|------------------|-----------------|-----------|--------------|---------------|-------------|----------|--------------|----------------------------|------------------|-----------|-------|
| B6  | SETVCOM<br>(OTPx3) | 0 | 1 | ↑ | 1                | 0               | 1         | 1            | 0             | 1           | 1        | 0            | Set VCOM Voltage           | -                |           |       |
|     |                    | 1 | 1 | ↑ | VCMC_F[7:0]      |                 |           |              |               |             |          |              |                            | -                | (5Eh)     |       |
|     |                    | 1 | 1 | ↑ | VCMC_B[7:0]      |                 |           |              |               |             |          |              |                            |                  | (5Eh)     |       |
| B9  | SETEXTC            | 0 | 1 | ↑ | 1                | 0               | 1         | 1            | 1             | 0           | 0        | 1            | Set extended command set   | -                |           |       |
|     |                    | 1 | 1 | ↑ | EXTC1[7:0]       |                 |           |              |               |             |          |              |                            | -                | (00h/FFh) |       |
|     |                    | 1 | 1 | ↑ | EXTC2[7:0]       |                 |           |              |               |             |          |              |                            | -                | (00h/83h) |       |
|     |                    | 1 | 1 | ↑ | EXTC3[7:0]       |                 |           |              |               |             |          |              |                            | -                | (00h/69h) |       |
| BA  | SETMIPI            | 0 | 1 | ↑ | 1                | 0               | 1         | 1            | 1             | 0           | 1        | 0            | Set MIPI Control           |                  |           |       |
|     |                    | 1 | 1 | ↑ | DPHYCMD0[7:0]    |                 |           |              |               |             |          |              |                            | -                | (00h)     |       |
|     |                    | 1 | 1 | ↑ | DPHYCMD1[7:0]    |                 |           |              |               |             |          |              |                            | -                | (A0h)     |       |
|     |                    | 1 | 1 | ↑ | DPHYCMD2[7:0]    |                 |           |              |               |             |          |              |                            | -                | (C6h)     |       |
|     |                    | 1 | 1 | ↑ | DSICMD0[7:0]     |                 |           |              |               |             |          |              |                            | -                | (00h)     |       |
|     |                    | 1 | 1 | ↑ | DSICMD1[7:0]     |                 |           |              |               |             |          |              |                            | -                | (0Ah)     |       |
|     |                    | 1 | 1 | ↑ | DSICMD2[7:0]     |                 |           |              |               |             |          |              |                            | -                | (00h)     |       |
|     |                    | 1 | 1 | ↑ | DSICMD3[7:0]     |                 |           |              |               |             |          |              |                            | -                | (10h)     |       |
|     |                    | 1 | 1 | ↑ | DPHYOTP0[7:0]    |                 |           |              |               |             |          |              |                            | -                | (30h)     |       |
|     |                    | 1 | 1 | ↑ | DPHYOTP1[7:0]    |                 |           |              |               |             |          |              |                            | -                | (6Fh)     |       |
|     |                    | 1 | 1 | ↑ | DPHYOTP2[7:0]    |                 |           |              |               |             |          |              |                            | -                | (02h)     |       |
|     |                    | 1 | 1 | ↑ | DSIOTP0[7:0]     |                 |           |              |               |             |          |              |                            | -                | (10h)     |       |
|     |                    | 1 | 1 | ↑ | DSIOTP1[7:0]     |                 |           |              |               |             |          |              |                            | -                | (18h)     |       |
| BB  | SETOTP             | 1 | 1 | ↑ | -                | DSI_INITRD_Y    | -         | -            | -             | -           | -        | -            |                            | (40h)            |           |       |
|     |                    | 0 | 1 | ↑ | 1                | 0               | 1         | 1            | 1             | 0           | 1        | 1            | Set OTP                    | -                |           |       |
|     |                    | 1 | 1 | ↑ | OTP_MASK[7:0]    |                 |           |              |               |             |          |              |                            | -                | (00h)     |       |
|     |                    | 1 | 1 | ↑ | -                | -               | -         | -            | -             | -           | -        | OTP_INDEX[8] | -                          | (01h)            |           |       |
|     |                    | 1 | 1 | ↑ | OTP_INDEX[7:0]   |                 |           |              |               |             |          |              |                            | -                | (FFh)     |       |
|     |                    | 1 | 1 | ↑ | OTP_LOAD_DISABLE | OTP_TEST        | OTP_POR   | OTP_PWE      | OTP_PTM[1:0]  |             | VPP_SEL  | OTP_PROG     | -                          | (00h)            |           |       |
| C1  | SETDGLUT           | 1 | 1 | ↑ | OTP_DATA[7:0]    |                 |           |              |               |             |          |              |                            | OTP read / write | (xxh)     |       |
|     |                    | 0 | 1 | ↑ | 1                | 1               | 0         | 0            | 0             | 0           | 0        | 1            | Set DGC LUT                | -                |           |       |
|     |                    | 1 | 1 | ↑ | -                | -               | -         | -            | -             | -           | DITH_OPT | DGC_EN       | -                          | -                |           |       |
|     |                    | 1 | 1 | ↑ | D1[7:0]          |                 |           |              |               |             |          |              |                            | -                | -         |       |
|     |                    | 1 | 1 | ↑ | Dn[7:0]          |                 |           |              |               |             |          |              |                            | -                | -         |       |
| C3  | SETID<br>(OTPx5)   | 1 | 1 | ↑ | D126[7:0]        |                 |           |              |               |             |          |              |                            | -                | -         |       |
|     |                    | 0 | 1 | ↑ | 1                | 1               | 0         | 0            | 0             | 0           | 1        | 1            | Set ID                     | -                |           |       |
|     |                    | 1 | 1 | ↑ | ID1[7:0]         |                 |           |              |               |             |          |              |                            | -                | (00h)     |       |
|     |                    | 1 | 1 | ↑ | 0                | ID2[6:0]        |           |              |               |             |          | -            | (00h)                      |                  |           |       |
| +C9 | SETCABC            | 1 | 1 | ↑ | ID3[7:0]         |                 |           |              |               |             |          |              |                            | -                | (00h)     |       |
|     |                    | 0 | 1 | ↑ | 1                | 1               | 0         | 0            | 1             | 0           | 0        | 1            | Set CABC Control           |                  |           |       |
|     |                    | 1 | 1 | ↑ | -                | -               | EN_DIM_MX | EN_COST_MEAN | EN_COST       | EN_NLN_GAIN | EN_JUDGE | EN_TEMP      |                            | (3Eh)            |           |       |
|     |                    | 1 | 1 | ↑ | CABC_DD          | SAVEPOWER[6:0]  |           |              |               |             |          |              |                            |                  | (00h)     |       |
|     |                    | 1 | 1 | ↑ | MEAN_OFFSET[7:0] |                 |           |              |               |             |          |              |                            |                  | (00h)     |       |
|     |                    | 1 | 1 | ↑ | -                | -               | -         | -            | CABC_FLM[3:0] |             |          |              | (01h)                      |                  |           |       |
|     |                    | 1 | 1 | ↑ | -                | SEL_PWMCLK[2:0] |           |              | SEL_GAIN[1:0] |             | INVPULS  | SEL_BLDUTY   |                            | (2Fh)            |           |       |
|     |                    | 1 | 1 | ↑ | PWM_PERIOD[7:0]  |                 |           |              |               |             |          |              |                            |                  | (2Bh)     |       |
|     |                    | 1 | 1 | ↑ | -                | DIM_FRAME[6:0]  |           |              |               |             |          |              | (1Eh)                      |                  |           |       |
| CC  | SETPANEL           | 1 | 1 | ↑ | CABC_STEP[7:0]   |                 |           |              |               |             |          |              |                            |                  | (1Eh)     |       |
|     |                    | 1 | 1 | ↑ | CABC_CLKEN[7:0]  |                 |           |              |               |             |          |              |                            |                  | (00h)     |       |
|     |                    | 0 | 1 | ↑ | 1                | 1               | 0         | 0            | 1             | 1           | 0        | 0            | Set panel related register |                  |           |       |
| D5  | SETGIP             | 1 | 1 | ↑ | -                | -               | -         | -            | SS_PANEL      | -           | REV_PANE | BGR_PANEL    | -                          | (02h)            |           |       |
|     |                    | 0 | 1 | ↑ | 1                | 1               | 0         | 1            | 0             | 1           | 0        | 1            | SET GIP control            |                  |           |       |
|     |                    | 1 | 1 | ↑ | -                | -               | -         | -            | SHR_0[11:8]   |             |          |              | -                          | (00h)            |           |       |
|     |                    | 1 | 1 | ↑ | SHR_0[7:0]       |                 |           |              |               |             |          |              |                            | -                | (02h)     |       |
|     |                    | 1 | 1 | ↑ | -                | -               | -         | -            | SHR_1[11:8]   |             |          |              | -                          | (00h)            |           |       |
|     |                    | 1 | 1 | ↑ | SHR_1[7:0]       |                 |           |              |               |             |          |              |                            | -                | (01h)     |       |
|     |                    |   | 1 | 1 | ↑                | SPD[7:0]        |           |              |               |             |          |              |                            |                  | -         | (02h) |



|    |                               |   |   |       |               |              |              |              |               |   |   |       |                                 |       |       |
|----|-------------------------------|---|---|-------|---------------|--------------|--------------|--------------|---------------|---|---|-------|---------------------------------|-------|-------|
|    |                               | 1 | 1 | ↑     | CHR[7:0]      |              |              |              |               |   |   | -     | (03h)                           |       |       |
|    |                               | 1 | 1 | ↑     | CON[7:0]      |              |              |              |               |   |   | -     | (20h)                           |       |       |
|    |                               | 1 | 1 | ↑     | COFF[7:0]     |              |              |              |               |   |   | -     | (6Ch)                           |       |       |
|    |                               | 1 | 1 | ↑     | SHP[3:0]      |              |              |              | SCP[3:0]      |   |   | -     | (03h)                           |       |       |
|    |                               | 1 | 1 | ↑     | CHP[3:0]      |              |              |              | CCP[3:0]      |   |   | -     | (03h)                           |       |       |
|    |                               | 1 | 1 | ↑     | SOS_1[3:0]    |              |              |              | SOS_0[3:0]    |   |   | -     | (00h)                           |       |       |
|    |                               | 1 | 1 | ↑     | SOS_3[3:0]    |              |              |              | SOS_2[3:0]    |   |   | -     | (00h)                           |       |       |
|    |                               | 1 | 1 | ↑     | COS_1[3:0]    |              |              |              | COS_0[3:0]    |   |   | -     | (60h)                           |       |       |
|    |                               | 1 | 1 | ↑     | COS_3[3:0]    |              |              |              | COS_2[3:0]    |   |   | -     | (04h)                           |       |       |
|    |                               | 1 | 1 | ↑     | COS_5[3:0]    |              |              |              | COS_4[3:0]    |   |   | -     | (71h)                           |       |       |
|    |                               | 1 | 1 | ↑     | COS_7[3:0]    |              |              |              | COS_6[3:0]    |   |   | -     | (75h)                           |       |       |
|    |                               | 1 | 1 | ↑     | SOS_1_ML[3:0] |              |              |              | SOS_0_ML[3:0] |   |   | -     | (00h)                           |       |       |
|    |                               | 1 | 1 | ↑     | SOS_3_ML[3:0] |              |              |              | SOS_2_ML[3:0] |   |   | -     | (00h)                           |       |       |
|    |                               | 1 | 1 | ↑     | COS_1_ML[3:0] |              |              |              | COS_0_ML[3:0] |   |   | -     | (51h)                           |       |       |
|    |                               | 1 | 1 | ↑     | COS_3_ML[3:0] |              |              |              | COS_2_ML[3:0] |   |   | -     | (57h)                           |       |       |
|    |                               | 1 | 1 | ↑     | COS_5_ML[3:0] |              |              |              | COS_4_ML[3:0] |   |   | -     | (40h)                           |       |       |
|    |                               | 1 | 1 | ↑     | COS_7_ML[3:0] |              |              |              | COS_6_ML[3:0] |   |   | -     | (46h)                           |       |       |
|    |                               | 1 | 1 | ↑     | -             | -            | GTO[5:0]     |              |               |   |   | -     | (01h)                           |       |       |
|    |                               | 1 | 1 | ↑     | GNO[7:0]      |              |              |              |               |   |   | -     | (0Ch)                           |       |       |
|    |                               | 1 | 1 | ↑     | EQ_DELAY[7:0] |              |              |              |               |   |   | -     | (0Ch)                           |       |       |
|    |                               | 1 | 1 | ↑     | GIP_OPT[7:0]  |              |              |              |               |   |   | -     | (00h)                           |       |       |
| D8 | SETTPSNR                      | 0 | 1 | ↑     | 1             | 1            | 0            | 1            | 1             | 0 | 0 | 1     | Set the Temp Senor control      |       |       |
|    |                               | 1 | 1 | ↑     | -             | -            | -            | TSRAW[4:0]   |               |   |   |       | (read only)                     |       |       |
|    |                               | 1 | 1 | ↑     | -             | -            | -            | TS_OS2[4:0]  |               |   |   |       | -                               | (12h) |       |
|    |                               | 1 | 1 | ↑     | BT_P2[3:0]    |              |              |              | BT_P1[3:0]    |   |   | -     | (74h)                           |       |       |
|    |                               | 1 | 1 | ↑     | BT_P4[3:0]    |              |              |              | BT_P3[3:0]    |   |   | -     | (A7h)                           |       |       |
|    |                               | 1 | 1 | ↑     | -             | -            | -            | D0[4:0]      |               |   |   |       | -                               | (0Ch) |       |
|    |                               | 1 | 1 | ↑     | TS_G[2:0]     |              |              | I0[4:0]      |               |   | - | (6Ah) |                                 |       |       |
|    |                               | 1 | 1 | ↑     | -             | TS_OS1[4:3]  |              |              | D1[4:0]       |   |   | -     | (57h)                           |       |       |
|    |                               | 1 | 1 | ↑     | TS_OS1[2:0]   |              |              | I1[4:0]      |               |   | - | (55h) |                                 |       |       |
|    |                               | 1 | 1 | ↑     | PORE          | RER[1:0]     |              | D2[4:0]      |               |   |   |       | -                               | (17h) |       |
| 1  | 1                             | ↑ | - | TF_ON | TSO           | I2[4:0]      |              |              |               |   | - | (55h) |                                 |       |       |
| E0 | SETGAMMA (OTP <sub>x1</sub> ) | 0 | 1 | ↑     | 1             | 1            | 1            | 0            | 0             | 0 | 0 | 0     | Set Gamma Curve Related Setting | -     |       |
|    |                               | 1 | 1 | ↑     | -             | -            | G1_VRP0[5:0] |              |               |   |   |       |                                 | -     | (00h) |
|    |                               | 1 | 1 | ↑     | -             | -            | G1_VRP1[5:0] |              |               |   |   |       |                                 | -     | (18h) |
|    |                               | 1 | 1 | ↑     | -             | -            | G1_VRP2[5:0] |              |               |   |   |       |                                 | -     | (1Fh) |
|    |                               | 1 | 1 | ↑     | -             | -            | G1_VRP3[5:0] |              |               |   |   |       |                                 | -     | (3Fh) |
|    |                               | 1 | 1 | ↑     | -             | -            | G1_VRP4[5:0] |              |               |   |   |       |                                 | -     | (3Fh) |
|    |                               | 1 | 1 | ↑     | -             | -            | G1_VRP5[5:0] |              |               |   |   |       |                                 | -     | (3Fh) |
|    |                               | 1 | 1 | ↑     | -             | G1_PRP0[6:0] |              |              |               |   |   |       | -                               | (33h) |       |
|    |                               | 1 | 1 | ↑     | -             | G1_PRP1[6:0] |              |              |               |   |   |       | -                               | (57h) |       |
|    |                               | 1 | 1 | ↑     | G1_CGMP0[1:0] |              | -            | G1_PKP0[4:0] |               |   |   |       | -                               | (07h) |       |
|    |                               | 1 | 1 | ↑     | G1_CGMP1[1:0] |              | -            | G1_PKP1[4:0] |               |   |   |       | -                               | (0Dh) |       |
|    |                               | 1 | 1 | ↑     | G1_CGMP2[1:0] |              | -            | G1_PKP2[4:0] |               |   |   |       | -                               | (0Fh) |       |
|    |                               | 1 | 1 | ↑     | G1_CGMP3[1:0] |              | -            | G1_PKP3[4:0] |               |   |   |       | -                               | (13h) |       |
|    |                               | 1 | 1 | ↑     | G1_CGMP5      | G1_CGMP4     | -            | G1_PKP4[4:0] |               |   |   |       | -                               | (16h) |       |
|    |                               | 1 | 1 | ↑     | -             | -            | -            | G1_PKP5[4:0] |               |   |   |       | -                               | (14h) |       |
|    |                               | 1 | 1 | ↑     | -             | -            | -            | G1_PKP6[4:0] |               |   |   |       | -                               | (16h) |       |
|    |                               | 1 | 1 | ↑     | -             | -            | -            | G1_PKP7[4:0] |               |   |   |       | -                               | (18h) |       |
|    |                               | 1 | 1 | ↑     | -             | -            | -            | G1_PKP8[4:0] |               |   |   |       | -                               | (1Fh) |       |
|    |                               | 1 | 1 | ↑     | -             | -            | G1_VRN0[5:0] |              |               |   |   |       |                                 | -     | (00h) |
|    |                               | 1 | 1 | ↑     | -             | -            | G1_VRN1[5:0] |              |               |   |   |       |                                 | -     | (18h) |
|    |                               | 1 | 1 | ↑     | -             | -            | G1_VRN2[5:0] |              |               |   |   |       |                                 | -     | (1Fh) |
|    |                               | 1 | 1 | ↑     | -             | -            | G1_VRN3[5:0] |              |               |   |   |       |                                 | -     | (3Fh) |
|    |                               | 1 | 1 | ↑     | -             | -            | G1_VRN4[5:0] |              |               |   |   |       |                                 | -     | (3Fh) |
|    |                               | 1 | 1 | ↑     | -             | -            | G1_VRN5[5:0] |              |               |   |   |       |                                 | -     | (3Fh) |
|    |                               | 1 | 1 | ↑     | -             | G1_PRN0[6:0] |              |              |               |   |   |       | -                               | (33h) |       |
|    |                               | 1 | 1 | ↑     | -             | G1_PRN1[6:0] |              |              |               |   |   |       | -                               | (57h) |       |
|    |                               | 1 | 1 | ↑     | G1_CGMN0[1:0] |              | -            | G1_PKN0[4:0] |               |   |   |       | -                               | (07h) |       |

|    |                     |   |   |   |                |          |   |              |   |   |   |   |                                |   |           |
|----|---------------------|---|---|---|----------------|----------|---|--------------|---|---|---|---|--------------------------------|---|-----------|
|    |                     | 1 | 1 | ↑ | G1_CGMN1[1:0]  |          | - | G1_PKN1[4:0] |   |   |   | - | (0Dh)                          |   |           |
|    |                     | 1 | 1 | ↑ | G1_CGMN2[1:0]  |          | - | G1_PKN2[4:0] |   |   |   | - | (0Fh)                          |   |           |
|    |                     | 1 | 1 | ↑ | G1_CGMN3[1:0]  |          | - | G1_PKN3[4:0] |   |   |   | - | (13h)                          |   |           |
|    |                     | 1 | 1 | ↑ | G1_CGMN5       | G1_CGMN4 | - | G1_PKN4[4:0] |   |   |   | - | (16h)                          |   |           |
|    |                     | 1 | 1 | ↑ | -              | -        | - | G1_PKN5[4:0] |   |   |   | - | (14h)                          |   |           |
|    |                     | 1 | 1 | ↑ | -              | -        | - | G1_PKN6[4:0] |   |   |   | - | (16h)                          |   |           |
|    |                     | 1 | 1 | ↑ | -              | -        | - | G1_PKN7[4:0] |   |   |   | - | (18h)                          |   |           |
|    |                     | 1 | 1 | ↑ | -              | -        | - | G1_PKN8[4:0] |   |   |   | - | (1Fh)                          |   |           |
| E9 | SETOTPKEY           | 0 | 1 | ↑ | 1              | 1        | 1 | 0            | 1 | 0 | 0 | 1 | -                              | - |           |
|    |                     | 1 | 1 | ↑ | OTP_KEY0[7:0]  |          |   |              |   |   |   |   |                                | - | (00h/AAh) |
|    |                     | 1 | 1 | ↑ | OTP_KEY1[7:0]  |          |   |              |   |   |   |   |                                | - | (00h/55h) |
| F4 | GETHXID             | 0 | 1 | ↑ | 1              | 1        | 1 | 1            | 0 | 1 | 0 | 0 | -                              | - |           |
|    |                     | 1 | ↑ | 1 | Himax ID[7:0]  |          |   |              |   |   |   |   |                                | - | (69h)     |
|    |                     | 1 | ↑ | 1 | Version[7:0]   |          |   |              |   |   |   |   |                                | - | (02h)     |
| FD | SETCNCN/<br>GETCNCN | 0 | 1 | ↑ | 1              | 1        | 1 | 1            | 1 | 1 | 0 | 1 | Set/Get<br>Continue<br>Command | - |           |
|    |                     | 1 | 1 | ↑ | WR_CMD_CN[7:0] |          |   |              |   |   |   |   |                                | - | -         |
| FE | SET READ<br>INDEX   | 0 | 1 | ↑ | 1              | 1        | 1 | 1            | 1 | 1 | 1 | 0 | SET READ<br>Command<br>Address | - |           |
|    |                     | 1 | 1 | ↑ | CMD_ADD[7:0]   |          |   |              |   |   |   |   |                                | - | (00h)     |
| FF | GETSPIREAD          | 0 | 1 | ↑ | 1              | 1        | 1 | 1            | 1 | 1 | 1 | 1 | Read<br>Command<br>Data        | - |           |
|    |                     | 1 | ↑ | 1 | CMD_DATA1[7:0] |          |   |              |   |   |   |   |                                | - | -         |
|    |                     | 1 | ↑ | 1 | :              |          |   |              |   |   |   |   |                                | - | -         |
|    |                     | 1 | ↑ | 1 | CMD_DATA1[7:0] |          |   |              |   |   |   |   |                                | - | -         |

## 6.2 Command description

### 6.2.1 NOP (00h)

| 00H                   | NOP (No Operation)                                                                                                                                                                                                         |     |     |        |    |    |              |    |    |    |    |    |     |
|-----------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|-----|--------|----|----|--------------|----|----|----|----|----|-----|
|                       | D/CX                                                                                                                                                                                                                       | RDX | WRX | D15-D8 | D7 | D6 | D5           | D4 | D3 | D2 | D1 | D0 | HEX |
| Command               | 0                                                                                                                                                                                                                          | 1   | ↑   | -      | 0  | 0  | 0            | 0  | 0  | 0  | 0  | 0  | 00  |
| Parameter             | NO PARAMETER                                                                                                                                                                                                               |     |     |        |    |    |              |    |    |    |    |    |     |
| Description           | This command is an empty command; it does not have any effect on the display module. However it can be used to terminate Frame Memory Write or Read as described in RAMWR (Memory Write) and RAMRD (Memory Read) Commands. |     |     |        |    |    |              |    |    |    |    |    |     |
| Restriction           | -                                                                                                                                                                                                                          |     |     |        |    |    |              |    |    |    |    |    |     |
| Register Availability | Status                                                                                                                                                                                                                     |     |     |        |    |    | Availability |    |    |    |    |    |     |
|                       | Normal Mode On, Idle Mode Off, Sleep Out                                                                                                                                                                                   |     |     |        |    |    | Yes          |    |    |    |    |    |     |
|                       | Normal Mode On, Idle Mode On, Sleep Out                                                                                                                                                                                    |     |     |        |    |    | Yes          |    |    |    |    |    |     |
|                       | Partial Mode On, Idle Mode Off, Sleep Out                                                                                                                                                                                  |     |     |        |    |    | Yes          |    |    |    |    |    |     |
|                       | Partial Mode On, Idle Mode On, Sleep Out                                                                                                                                                                                   |     |     |        |    |    | Yes          |    |    |    |    |    |     |
| Default               | N/A                                                                                                                                                                                                                        |     |     |        |    |    |              |    |    |    |    |    |     |
| Flow Chart            | -                                                                                                                                                                                                                          |     |     |        |    |    |              |    |    |    |    |    |     |

## 6.2.2 Software reset (01h)

| 01H                   | SWRESET (Software Reset)                                                                                                                                                                                                                                                                                                                                   |     |     |        |    |              |    |    |    |    |    |    |     |
|-----------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|-----|--------|----|--------------|----|----|----|----|----|----|-----|
|                       | D/CX                                                                                                                                                                                                                                                                                                                                                       | RDX | WRX | D15-D8 | D7 | D6           | D5 | D4 | D3 | D2 | D1 | D0 | HEX |
| Command               | 0                                                                                                                                                                                                                                                                                                                                                          | 1   | ↑   | 1      | 0  | 0            | 0  | 0  | 0  | 0  | 0  | 1  | 01  |
| Parameter             | NO PARAMETER                                                                                                                                                                                                                                                                                                                                               |     |     |        |    |              |    |    |    |    |    |    |     |
| Description           | When the Software Reset command is written, it causes a software reset. It resets the commands and parameters to their S/W Reset default values. (See default tables in each command description.) Note: The Frame Memory contents are unaffected by this command. It will be necessary to wait 5msec before sending new command following software reset. |     |     |        |    |              |    |    |    |    |    |    |     |
| Restriction           | The display module loads all display supplier's factory default values to the registers during this 5msec. If Software Reset is applied during Sleep Out mode, it will be necessary to wait 120msec before sending Sleep out command. Software Reset Command cannot be sent during Sleep Out sequence.                                                     |     |     |        |    |              |    |    |    |    |    |    |     |
| Register Availability | Status                                                                                                                                                                                                                                                                                                                                                     |     |     |        |    | Availability |    |    |    |    |    |    |     |
|                       | Normal Mode On, Idle Mode Off, Sleep Out                                                                                                                                                                                                                                                                                                                   |     |     |        |    | Yes          |    |    |    |    |    |    |     |
|                       | Normal Mode On, Idle Mode On, Sleep Out                                                                                                                                                                                                                                                                                                                    |     |     |        |    | Yes          |    |    |    |    |    |    |     |
|                       | Partial Mode On, Idle Mode Off, Sleep Out                                                                                                                                                                                                                                                                                                                  |     |     |        |    | Yes          |    |    |    |    |    |    |     |
|                       | Partial Mode On, Idle Mode On, Sleep Out                                                                                                                                                                                                                                                                                                                   |     |     |        |    | Yes          |    |    |    |    |    |    |     |
| Default               | N/A                                                                                                                                                                                                                                                                                                                                                        |     |     |        |    |              |    |    |    |    |    |    |     |
| Flow Chart            | <div><div><div>SWRESET</div><div>↓</div><div>Display whole blank screen</div><div>↓</div><div>Set Commands to S/W Default Value</div><div>↓</div><div>Sleep In Mode</div></div><div><div>Legend</div><div>Red and Blue</div><div>Parameter</div><div>Display</div><div>Action</div><div>Mode</div><div>Sequential transfer</div></div></div>               |     |     |        |    |              |    |    |    |    |    |    |     |

### 6.2.3 RDNUMPE: Read number of the parity errors (05h)

| 05H                                       | RDNUMPE (Read Number of the Parity Errors)                                                                                                                                                                                                                                                                                                                                                                          |     |     |        |    |    |    |    |    |    |    |    |            |        |              |                                          |     |                                         |     |                                           |     |                                          |     |
|-------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|-----|--------|----|----|----|----|----|----|----|----|------------|--------|--------------|------------------------------------------|-----|-----------------------------------------|-----|-------------------------------------------|-----|------------------------------------------|-----|
|                                           | D/CX                                                                                                                                                                                                                                                                                                                                                                                                                | RDX | WRX | D15-D8 | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 | HEX        |        |              |                                          |     |                                         |     |                                           |     |                                          |     |
| Command                                   | 0                                                                                                                                                                                                                                                                                                                                                                                                                   | 1   | ↑   | -      | 0  | 0  | 0  | 0  | 0  | 1  | 0  | 1  | 05         |        |              |                                          |     |                                         |     |                                           |     |                                          |     |
| 1 <sup>st</sup> parameter                 | 1                                                                                                                                                                                                                                                                                                                                                                                                                   | ↑   | 1   | -      | x  | x  | x  | x  | x  | x  | x  | x  | Dummy read |        |              |                                          |     |                                         |     |                                           |     |                                          |     |
| 2 <sup>nd</sup> parameter                 | 1                                                                                                                                                                                                                                                                                                                                                                                                                   | ↑   | 1   | -      | P7 | P6 | P5 | P4 | P3 | P2 | P1 | P0 | xx         |        |              |                                          |     |                                         |     |                                           |     |                                          |     |
| Description                               | The first parameter is telling a number of the errors on DSI. The more detailed description of the bits is below.<br>P[6..0] bits are telling a number of the errors.<br>P[7] is set to '1' if there is overflow with P[6..0] bits.<br>P[7..0] bits are set to '0's (as well as RDDSM(0Eh)'s D0 is set '0' at the same time) after there is sent the second parameter information (The read function is completed). |     |     |        |    |    |    |    |    |    |    |    |            |        |              |                                          |     |                                         |     |                                           |     |                                          |     |
| Restriction                               | SETEXTC turn on to enable this command                                                                                                                                                                                                                                                                                                                                                                              |     |     |        |    |    |    |    |    |    |    |    |            |        |              |                                          |     |                                         |     |                                           |     |                                          |     |
| Register Availability                     | <table><tr><th>Status</th><th>Availability</th></tr><tr><td>Normal Mode On, Idle Mode Off, Sleep Out</td><td>Yes</td></tr><tr><td>Normal Mode On, Idle Mode On, Sleep Out</td><td>Yes</td></tr><tr><td>Partial Mode On, Idle Mode Off, Sleep Out</td><td>Yes</td></tr><tr><td>Partial Mode On, Idle Mode On, Sleep Out</td><td>Yes</td></tr></table>                                                                |     |     |        |    |    |    |    |    |    |    |    |            | Status | Availability | Normal Mode On, Idle Mode Off, Sleep Out | Yes | Normal Mode On, Idle Mode On, Sleep Out | Yes | Partial Mode On, Idle Mode Off, Sleep Out | Yes | Partial Mode On, Idle Mode On, Sleep Out | Yes |
| Status                                    | Availability                                                                                                                                                                                                                                                                                                                                                                                                        |     |     |        |    |    |    |    |    |    |    |    |            |        |              |                                          |     |                                         |     |                                           |     |                                          |     |
| Normal Mode On, Idle Mode Off, Sleep Out  | Yes                                                                                                                                                                                                                                                                                                                                                                                                                 |     |     |        |    |    |    |    |    |    |    |    |            |        |              |                                          |     |                                         |     |                                           |     |                                          |     |
| Normal Mode On, Idle Mode On, Sleep Out   | Yes                                                                                                                                                                                                                                                                                                                                                                                                                 |     |     |        |    |    |    |    |    |    |    |    |            |        |              |                                          |     |                                         |     |                                           |     |                                          |     |
| Partial Mode On, Idle Mode Off, Sleep Out | Yes                                                                                                                                                                                                                                                                                                                                                                                                                 |     |     |        |    |    |    |    |    |    |    |    |            |        |              |                                          |     |                                         |     |                                           |     |                                          |     |
| Partial Mode On, Idle Mode On, Sleep Out  | Yes                                                                                                                                                                                                                                                                                                                                                                                                                 |     |     |        |    |    |    |    |    |    |    |    |            |        |              |                                          |     |                                         |     |                                           |     |                                          |     |
| Default                                   | P[7:0] = 0x00h                                                                                                                                                                                                                                                                                                                                                                                                      |     |     |        |    |    |    |    |    |    |    |    |            |        |              |                                          |     |                                         |     |                                           |     |                                          |     |
| Flow Chart                                | <div><div><div>DSI I/F Mode</div><div><div>RDNUMPE<br/>(R05h)</div><div>↓</div><div>Send 1st parameter</div><div>↓</div><div>RDDSM (R0Eh)'s D0 = '0'<br/>P[7:0] = "00"h</div></div><div>Host<br/>Driver</div></div><div><div>Legend</div><div><div>Command</div><div>Parameter</div><div>Display</div><div>Action</div><div>Mode</div><div>Sequential transfer</div></div></div></div>                              |     |     |        |    |    |    |    |    |    |    |    |            |        |              |                                          |     |                                         |     |                                           |     |                                          |     |

## 6.2.4 Get\_red\_channel (06h)

| 06H                       | RDRED (Read Red Colour)                                                                                                                                                                                                                                                                                     |     |     |        |    |    |              |    |    |    |    |    | HEX        |
|---------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|-----|--------|----|----|--------------|----|----|----|----|----|------------|
|                           | D/CX                                                                                                                                                                                                                                                                                                        | RDX | WRX | D15-D8 | D7 | D6 | D5           | D4 | D3 | D2 | D1 | D0 |            |
| Command                   | 0                                                                                                                                                                                                                                                                                                           | 1   | ↑   | -      | 0  | 0  | 0            | 0  | 0  | 1  | 1  | 0  | 06         |
| 1 <sup>st</sup> parameter | 1                                                                                                                                                                                                                                                                                                           | ↑   | 1   | -      | x  | x  | x            | x  | x  | x  | x  | x  | Dummy read |
| 2 <sup>nd</sup> parameter | 1                                                                                                                                                                                                                                                                                                           | ↑   | 1   | -      | R7 | R6 | R5           | R4 | R3 | R2 | R1 | R0 | xx         |
| Description               | The first parameter is telling red colour value of the first pixel of the frame when there is used DPI I/F.<br>16 bit format: R5 is MSB and R1 is LSB. R7, R6 and R0 are set to '0'.<br>18 bit format: R5 is MSB and R0 is LSB. R7 and R6 are set to '0'.                                                   |     |     |        |    |    |              |    |    |    |    |    |            |
| Restriction               | -                                                                                                                                                                                                                                                                                                           |     |     |        |    |    |              |    |    |    |    |    |            |
| Register Availability     | Status                                                                                                                                                                                                                                                                                                      |     |     |        |    |    | Availability |    |    |    |    |    |            |
|                           | Sleep Out                                                                                                                                                                                                                                                                                                   |     |     |        |    |    | Yes          |    |    |    |    |    |            |
| Default                   | R[7:0] = 0x00h                                                                                                                                                                                                                                                                                              |     |     |        |    |    |              |    |    |    |    |    |            |
| Flow Chart                | <div><div><div>Serial I/F Mode</div><div><div>RDBLUE (06h)</div><div>↓</div><div>Send D[7:0]</div></div></div><div>Host<br/>Driver</div><div><div>Legend</div><div><div>Command</div><div>Parameter</div><div>Display</div><div>Action</div><div>Mode</div><div>Sequential transfer</div></div></div></div> |     |     |        |    |    |              |    |    |    |    |    |            |



## 6.2.5 Get\_green\_channel (07h)

| 07H                       | RDGREEN (Read Green Colour)                                                                                                                                                                                                                                                                                                   |     |     |        |    |              |    |    |    |    |    |    |            |
|---------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|-----|--------|----|--------------|----|----|----|----|----|----|------------|
|                           | D/CX                                                                                                                                                                                                                                                                                                                          | RDX | WRX | D15-D8 | D7 | D6           | D5 | D4 | D3 | D2 | D1 | D0 | HEX        |
| Command                   | 0                                                                                                                                                                                                                                                                                                                             | 1   | ↑   | -      | 0  | 0            | 0  | 0  | 0  | 1  | 1  | 1  | 07         |
| 1 <sup>st</sup> parameter | 1                                                                                                                                                                                                                                                                                                                             | ↑   | 1   | -      | x  | x            | x  | x  | x  | x  | x  | x  | Dummy read |
| 2 <sup>nd</sup> parameter | 1                                                                                                                                                                                                                                                                                                                             | ↑   | 1   | -      | G7 | G6           | G5 | G4 | G3 | G2 | G1 | G0 | xx         |
| Description               | The first parameter is telling green colour value of the first pixel of the frame when there is used DPI I/F.<br>16 and 18 bit formats: G5 is MSB and G0 is LSB. G7 and G6 are set to '0'.                                                                                                                                    |     |     |        |    |              |    |    |    |    |    |    |            |
| Restriction               | -                                                                                                                                                                                                                                                                                                                             |     |     |        |    |              |    |    |    |    |    |    |            |
| Register Availability     | Status                                                                                                                                                                                                                                                                                                                        |     |     |        |    | Availability |    |    |    |    |    |    |            |
|                           | Sleep Out                                                                                                                                                                                                                                                                                                                     |     |     |        |    | Yes          |    |    |    |    |    |    |            |
| Default                   | G[7:0] = 0x00h                                                                                                                                                                                                                                                                                                                |     |     |        |    |              |    |    |    |    |    |    |            |
| Flow Chart                | <div><div><div>Serial I/F Mode</div><div><div>RDBLUE (07h)</div><div>↓</div><div>Send D[7:0]</div></div></div><div><div>Host</div><div>Driver</div></div></div> <div><div>Legend</div><div><div>Command</div><div>Parameter</div><div>Display</div><div>Action</div><div>Mode</div><div>Sequential transfer</div></div></div> |     |     |        |    |              |    |    |    |    |    |    |            |

## 6.2.6 Get\_blue\_channel (08h)

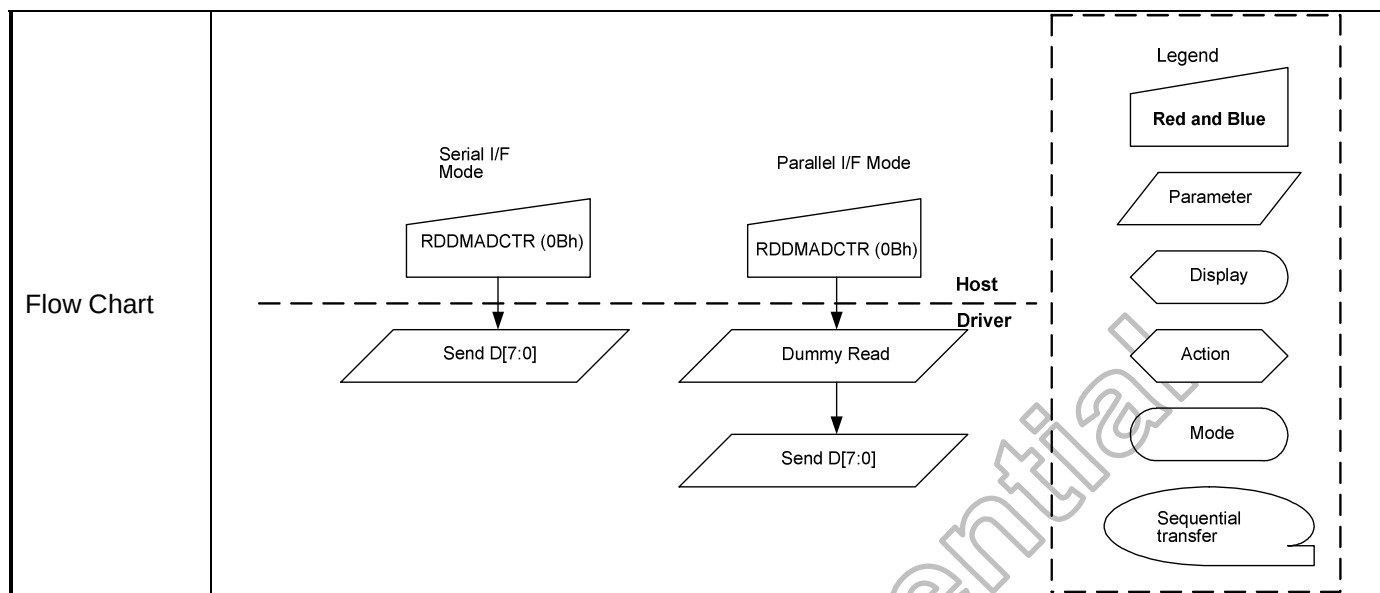
| 08H                       | RDBLUE (Read Blue Colour)                                                                                                                                                                                                                                                                                                     |     |     |        |    |    |    |    |    |    |    |    |            |        |              |           |     |          |     |
|---------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|-----|--------|----|----|----|----|----|----|----|----|------------|--------|--------------|-----------|-----|----------|-----|
|                           | D/CX                                                                                                                                                                                                                                                                                                                          | RDX | WRX | D15-D8 | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 | HEX        |        |              |           |     |          |     |
| Command                   | 0                                                                                                                                                                                                                                                                                                                             | 1   | ↑   | -      | 0  | 0  | 0  | 0  | 1  | 0  | 0  | 0  | 08         |        |              |           |     |          |     |
| 1 <sup>st</sup> parameter | 1                                                                                                                                                                                                                                                                                                                             | ↑   | 1   | -      | x  | x  | x  | x  | x  | x  | x  | x  | Dummy read |        |              |           |     |          |     |
| 2 <sup>nd</sup> parameter | 1                                                                                                                                                                                                                                                                                                                             | ↑   | 1   | -      | B7 | B6 | B5 | B4 | B3 | B2 | B1 | B0 | xx         |        |              |           |     |          |     |
| Description               | The first parameter is telling blue colour value of the first pixel of the frame when there is used DPI I/F.<br>16 bit format: B5 is MSB and B1 is LSB. B7, B6 and B0 are set to '0'.<br>18 bit format: B5 is MSB and B0 is LSB. B7 and B6 are set to '0'.                                                                    |     |     |        |    |    |    |    |    |    |    |    |            |        |              |           |     |          |     |
| Restriction               | -                                                                                                                                                                                                                                                                                                                             |     |     |        |    |    |    |    |    |    |    |    |            |        |              |           |     |          |     |
| Register Availability     | <table><tr><td>Status</td><td>Availability</td></tr><tr><td>Sleep Out</td><td>Yes</td></tr><tr><td>Sleep In</td><td>Yes</td></tr></table>                                                                                                                                                                                     |     |     |        |    |    |    |    |    |    |    |    |            | Status | Availability | Sleep Out | Yes | Sleep In | Yes |
| Status                    | Availability                                                                                                                                                                                                                                                                                                                  |     |     |        |    |    |    |    |    |    |    |    |            |        |              |           |     |          |     |
| Sleep Out                 | Yes                                                                                                                                                                                                                                                                                                                           |     |     |        |    |    |    |    |    |    |    |    |            |        |              |           |     |          |     |
| Sleep In                  | Yes                                                                                                                                                                                                                                                                                                                           |     |     |        |    |    |    |    |    |    |    |    |            |        |              |           |     |          |     |
| Default                   | B[7:0] = 0x00h                                                                                                                                                                                                                                                                                                                |     |     |        |    |    |    |    |    |    |    |    |            |        |              |           |     |          |     |
| Flow Chart                | <div><div><div>Serial I/F Mode</div><div><div>RDBLUE (08h)</div><div>↓</div><div>Send D[7:0]</div></div></div><div><div>Host</div><div>Driver</div></div></div> <div><div>Legend</div><div><div>Command</div><div>Parameter</div><div>Display</div><div>Action</div><div>Mode</div><div>Sequential transfer</div></div></div> |     |     |        |    |    |    |    |    |    |    |    |            |        |              |           |     |          |     |

## 6.2.7 Get\_power\_mode (0Ah)

| 0AH                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | RDDPM (Read Display Power Mode)                                                           |                            |     |        |    |              |    |    |    |    |            |    |            |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------|----------------------------|-----|--------|----|--------------|----|----|----|----|------------|----|------------|
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | D/CX                                                                                      | RDX                        | WRX | D15-D8 | D7 | D6           | D5 | D4 | D3 | D2 | D1         | D0 | HEX        |
| Command                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 0                                                                                         | 1                          | ↑   | -      | 0  | 0            | 0  | 0  | 1  | 0  | 1          | 0  | 0A         |
| 1 <sup>st</sup> parameter                                                                                                                                                                                                                                                                                                                                                                                                                                                   | 1                                                                                         | ↑                          | 1   | -      | x  | x            | x  | x  | x  | x  | x          | x  | Dummy read |
| 2 <sup>nd</sup> parameter                                                                                                                                                                                                                                                                                                                                                                                                                                                   | 1                                                                                         | ↑                          | 1   | -      | D7 | D6           | D5 | D4 | D3 | D2 | 0          | 0  | xx         |
| Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | This command indicates the current status of the display as described in the table below: |                            |     |        |    |              |    |    |    |    |            |    |            |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Bit                                                                                       | Description                |     |        |    |              |    |    |    |    | Comment    |    |            |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | D7                                                                                        | Not Defined                |     |        |    |              |    |    |    |    | Set to '0' |    |            |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | D6                                                                                        | Idle Mode On/Off           |     |        |    |              |    |    |    |    | -          |    |            |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | D5                                                                                        | Partial Mode On/Off        |     |        |    |              |    |    |    |    | -          |    |            |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | D4                                                                                        | Sleep In/Out               |     |        |    |              |    |    |    |    | -          |    |            |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | D3                                                                                        | Display Normal Mode On/Off |     |        |    |              |    |    |    |    | -          |    |            |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | D2                                                                                        | Display On/Off             |     |        |    |              |    |    |    |    | -          |    |            |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | D1                                                                                        | Not Defined                |     |        |    |              |    |    |    |    | Set to '0' |    |            |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | D0                                                                                        | Not Defined                |     |        |    |              |    |    |    |    | Set to '0' |    |            |
| Bits D7 for future use and are set to '0'.<br>Bit D6 – Idle Mode On/Off<br>'0' = Idle Mode Off.<br>'1' = Idle Mode On.<br>Bit D5 – Partial Mode On/Off<br>'0' = Partial Mode Off.<br>'1' = Partial Mode On.<br>Bit D4 – Sleep In/Out<br>'0' = Sleep In Mode.<br>'1' = Sleep Out Mode.<br>Bit D3 – Display Normal Mode On/Off<br>'0' = Display Normal Mode Off.<br>'1' = Display Normal Mode On.<br>Bit D2 – Display On/Off<br>'0' = Display is Off.<br>'1' = Display is On. |                                                                                           |                            |     |        |    |              |    |    |    |    |            |    |            |
| Restrictions                                                                                                                                                                                                                                                                                                                                                                                                                                                                | -                                                                                         |                            |     |        |    |              |    |    |    |    |            |    |            |
| Register Availability                                                                                                                                                                                                                                                                                                                                                                                                                                                       | Status                                                                                    |                            |     |        |    | Availability |    |    |    |    |            |    |            |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Normal Mode On, Idle Mode Off, Sleep Out                                                  |                            |     |        |    | Yes          |    |    |    |    |            |    |            |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Normal Mode On, Idle Mode On, Sleep Out                                                   |                            |     |        |    | Yes          |    |    |    |    |            |    |            |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Partial Mode On, Idle Mode Off, Sleep Out                                                 |                            |     |        |    | Yes          |    |    |    |    |            |    |            |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Partial Mode On, Idle Mode On, Sleep Out                                                  |                            |     |        |    | Yes          |    |    |    |    |            |    |            |
| Default                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | D[7:0] = 0x08h                                                                            |                            |     |        |    |              |    |    |    |    |            |    |            |

## 6.2.8 Read display MADCTL (0Bh)

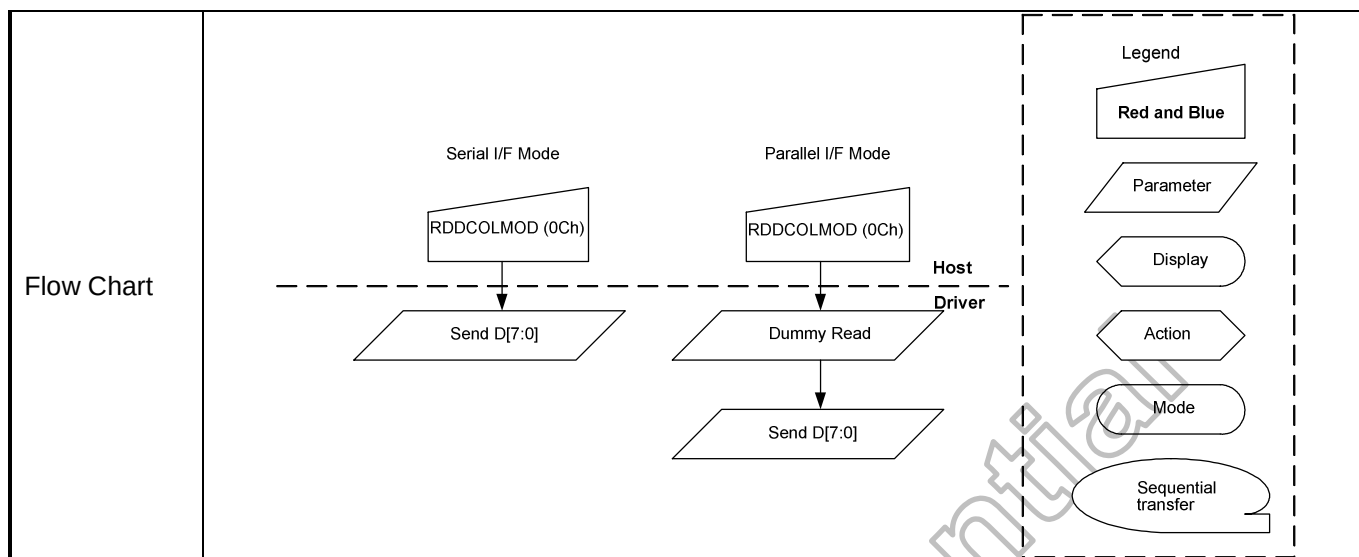
| 0BH                       | RDDMADCTL (Read Display MADCTL)                                                                                                                          |                          |     |        |    |              |    |    |    |    |    |            | HEX        |
|---------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------|-----|--------|----|--------------|----|----|----|----|----|------------|------------|
|                           | D/CX                                                                                                                                                     | RDX                      | WRX | D15-D8 | D7 | D6           | D5 | D4 | D3 | D2 | D1 | D0         |            |
| Command                   | 0                                                                                                                                                        | 1                        | ↑   | -      | 0  | 0            | 0  | 0  | 1  | 0  | 1  | 1          | 0B         |
| 1 <sup>st</sup> parameter | 1                                                                                                                                                        | ↑                        | 1   | -      | x  | x            | x  | x  | x  | x  | x  | x          | Dummy read |
| 2 <sup>nd</sup> parameter | 1                                                                                                                                                        | ↑                        | 1   | -      | D7 | D6           | D5 | D4 | D3 | D2 | 0  | 0          | xx         |
| Description               | This command indicates the current status of the display as described in the table below:                                                                |                          |     |        |    |              |    |    |    |    |    |            |            |
|                           | Bit                                                                                                                                                      | Description              |     |        |    |              |    |    |    |    |    | Comment    |            |
|                           | D7                                                                                                                                                       | Page Address Order       |     |        |    |              |    |    |    |    |    | -          |            |
|                           | D6                                                                                                                                                       | Column Address Order     |     |        |    |              |    |    |    |    |    | -          |            |
|                           | D5                                                                                                                                                       | Page/Column Order        |     |        |    |              |    |    |    |    |    | -          |            |
|                           | D4                                                                                                                                                       | Line Address Order       |     |        |    |              |    |    |    |    |    | -          |            |
|                           | D3                                                                                                                                                       | RGB/BGR Order            |     |        |    |              |    |    |    |    |    | -          |            |
|                           | D2                                                                                                                                                       | Display Data Latch Order |     |        |    |              |    |    |    |    |    | -          |            |
|                           | D1                                                                                                                                                       | Reserved                 |     |        |    |              |    |    |    |    |    | Set to '0' |            |
|                           | D0                                                                                                                                                       | Reserved                 |     |        |    |              |    |    |    |    |    | Set to '0' |            |
|                           | Bit D7 – Page Address Order<br>'0' = Top to Bottom (When MADCTL B7='0').<br>'1' = Bottom to Top (When MADCTL B7='1').                                    |                          |     |        |    |              |    |    |    |    |    |            |            |
|                           | Bit D6 – Column Address Order<br>'0' = Left to Right (When MADCTL B6='0').<br>'1' = Right to Left (When MADCTL B6='1').                                  |                          |     |        |    |              |    |    |    |    |    |            |            |
|                           | Bit D5 – Page/Column Order<br>'0' = Normal (When MADCTL B5='0').<br>'1' = Roration (When MADCTL B5='1').                                                 |                          |     |        |    |              |    |    |    |    |    |            |            |
|                           | Note: For Bits D7 to D5, also refer to Section 5.3 MCU to memory write/read direction.                                                                   |                          |     |        |    |              |    |    |    |    |    |            |            |
|                           | Bit D4 – Line Address Order<br>'0' = LCD Refresh Top to Bottom (When MADCTL B4='0').<br>'1' = LCD Refresh Bottom to Top (When MADCTL B4='1').            |                          |     |        |    |              |    |    |    |    |    |            |            |
|                           | Bit D3 – RGB/BGR Order<br>'0' = RGB (When MADCTL B3='0').<br>'1' = BGR (When MADCTL B3='1').                                                             |                          |     |        |    |              |    |    |    |    |    |            |            |
|                           | Note: For Bits D4 and D3 also refer to Section 6.2.31 Set_address_mode (36h).                                                                            |                          |     |        |    |              |    |    |    |    |    |            |            |
|                           | Bit D2 – Display Data Latch Data Order<br>'0' = LCD Refresh Left to Right (When MADCTL B2='0').<br>'1' = LCD Refresh Right to Left (When MADCTL B2='1'). |                          |     |        |    |              |    |    |    |    |    |            |            |
| Restrictions              | -                                                                                                                                                        |                          |     |        |    |              |    |    |    |    |    |            |            |
| Register Availability     | Status                                                                                                                                                   |                          |     |        |    | Availability |    |    |    |    |    |            |            |
|                           | Normal Mode On, Idle Mode Off, Sleep Out                                                                                                                 |                          |     |        |    | Yes          |    |    |    |    |    |            |            |
|                           | Normal Mode On, Idle Mode On, Sleep Out                                                                                                                  |                          |     |        |    | Yes          |    |    |    |    |    |            |            |
|                           | Partial Mode On, Idle Mode Off, Sleep Out                                                                                                                |                          |     |        |    | Yes          |    |    |    |    |    |            |            |
|                           | Partial Mode On, Idle Mode On, Sleep Out                                                                                                                 |                          |     |        |    | Yes          |    |    |    |    |    |            |            |
|                           | Sleep In or Booster Off                                                                                                                                  |                          |     |        |    | Yes          |    |    |    |    |    |            |            |
| Default                   | D[7:0] = 0x00h                                                                                                                                           |                          |     |        |    |              |    |    |    |    |    |            |            |



Himax Confidential  
Do Not Copy

## 6.2.9 Get\_pixel\_format (0Ch)

| 0CH                       | RDDCOLMOD (Read Display COLMOD)                                                                                                                                                                            |     |                            |        |          |              |          |    |    |    |            |    |            |
|---------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|----------------------------|--------|----------|--------------|----------|----|----|----|------------|----|------------|
|                           | D/CX                                                                                                                                                                                                       | RDX | WRX                        | D15-D8 | D7       | D6           | D5       | D4 | D3 | D2 | D1         | D0 | HEX        |
| Command                   | 0                                                                                                                                                                                                          | 1   | ↑                          | -      | 0        | 0            | 0        | 0  | 1  | 1  | 0          | 0  | 0C         |
| 1 <sup>st</sup> parameter | 1                                                                                                                                                                                                          | ↑   | 1                          | -      | x        | x            | x        | x  | x  | x  | x          | x  | Dummy read |
| 2 <sup>nd</sup> parameter | 1                                                                                                                                                                                                          | ↑   | 1                          | -      | -        | D6           | D5       | D4 | -  | D2 | D1         | D0 | xx         |
| Description               | This command indicates the current status of the display as described in the table below:                                                                                                                  |     |                            |        |          |              |          |    |    |    |            |    |            |
|                           | Bit                                                                                                                                                                                                        |     | Description                |        |          |              |          |    |    |    | Comment    |    |            |
|                           | D7                                                                                                                                                                                                         |     | Reserved                   |        |          |              |          |    |    |    | Set to '0' |    |            |
|                           | D6                                                                                                                                                                                                         |     | DPI Interface Pixel format |        |          |              |          |    |    |    | -          |    |            |
|                           | D5                                                                                                                                                                                                         |     |                            |        |          |              |          |    |    |    | -          |    |            |
|                           | D4                                                                                                                                                                                                         |     |                            |        |          |              |          |    |    |    | -          |    |            |
|                           | D3                                                                                                                                                                                                         |     | Reserved                   |        |          |              |          |    |    |    | Set to '0' |    |            |
|                           | D2                                                                                                                                                                                                         |     | DBI Interface Pixel format |        |          |              |          |    |    |    | -          |    |            |
|                           | D1                                                                                                                                                                                                         |     |                            |        |          |              |          |    |    |    | -          |    |            |
|                           | D0                                                                                                                                                                                                         |     |                            |        |          |              |          |    |    |    | -          |    |            |
|                           | Bits D6, D5, D4 – DPI Interface Colour Pixel Format Definition<br>Bits D2, D1, D0 – DBI Interface Colour Pixel Format Definition.<br>For Setting pixel format, see section 6.2.35 Set_pixel_format (3Ah)". |     |                            |        |          |              |          |    |    |    |            |    |            |
|                           | Interface Colour Format                                                                                                                                                                                    |     | D6<br>D2                   |        | D5<br>D1 |              | D4<br>D0 |    |    |    |            |    |            |
|                           | Not Defined                                                                                                                                                                                                |     | 0                          |        | 0        |              | 0        |    |    |    |            |    |            |
|                           | Not Defined                                                                                                                                                                                                |     | 0                          |        | 0        |              | 1        |    |    |    |            |    |            |
|                           | Not Defined                                                                                                                                                                                                |     | 0                          |        | 1        |              | 0        |    |    |    |            |    |            |
|                           | Not Defined                                                                                                                                                                                                |     | 0                          |        | 1        |              | 1        |    |    |    |            |    |            |
|                           | Not Defined                                                                                                                                                                                                |     | 1                          |        | 0        |              | 0        |    |    |    |            |    |            |
|                           | 16 bit/pixel                                                                                                                                                                                               |     | 1                          |        | 0        |              | 1        |    |    |    |            |    |            |
|                           | 18 bit/pixel                                                                                                                                                                                               |     | 1                          |        | 1        |              | 0        |    |    |    |            |    |            |
|                           | 24 bit/pixel                                                                                                                                                                                               |     | 1                          |        | 1        |              | 1        |    |    |    |            |    |            |
|                           | If a particular interface, either DBI or DPI, is not used then the corresponding bits in the parameter returned from the display module are undefined.                                                     |     |                            |        |          |              |          |    |    |    |            |    |            |
|                           | Restrictions                                                                                                                                                                                               | -   |                            |        |          |              |          |    |    |    |            |    |            |
| Register Availability     | Status                                                                                                                                                                                                     |     |                            |        |          | Availability |          |    |    |    |            |    |            |
|                           | Normal Mode On, Idle Mode Off, Sleep Out                                                                                                                                                                   |     |                            |        |          | Yes          |          |    |    |    |            |    |            |
|                           | Normal Mode On, Idle Mode On, Sleep Out                                                                                                                                                                    |     |                            |        |          | Yes          |          |    |    |    |            |    |            |
|                           | Partial Mode On, Idle Mode Off, Sleep Out                                                                                                                                                                  |     |                            |        |          | Yes          |          |    |    |    |            |    |            |
|                           | Partial Mode On, Idle Mode On, Sleep Out                                                                                                                                                                   |     |                            |        |          | Yes          |          |    |    |    |            |    |            |
|                           | Sleep In or Booster Off                                                                                                                                                                                    |     |                            |        |          | Yes          |          |    |    |    |            |    |            |
| Default                   | D[7:0] = 0x07h                                                                                                                                                                                             |     |                            |        |          |              |          |    |    |    |            |    |            |



Himax Confidential  
Do Not Copy



## 6.2.10 Get\_display\_mode (0Dh)

| 0DH                       | RDDIM (Read Display Image Mode)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |              |     |             |                           |    |    |    |    |    |    |    | HEX        |                      |              |                                          |     |                                         |               |                                           |     |                                          |     |                         |     |   |   |     |               |   |   |   |     |               |   |   |   |     |             |   |   |   |             |             |   |   |   |             |             |   |   |   |             |             |   |   |   |             |
|---------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|-----|-------------|---------------------------|----|----|----|----|----|----|----|------------|----------------------|--------------|------------------------------------------|-----|-----------------------------------------|---------------|-------------------------------------------|-----|------------------------------------------|-----|-------------------------|-----|---|---|-----|---------------|---|---|---|-----|---------------|---|---|---|-----|-------------|---|---|---|-------------|-------------|---|---|---|-------------|-------------|---|---|---|-------------|-------------|---|---|---|-------------|
|                           | D/CX                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | RDX          | WRX | D15-D8      | D7                        | D6 | D5 | D4 | D3 | D2 | D1 | D0 |            |                      |              |                                          |     |                                         |               |                                           |     |                                          |     |                         |     |   |   |     |               |   |   |   |     |               |   |   |   |     |             |   |   |   |             |             |   |   |   |             |             |   |   |   |             |             |   |   |   |             |
| Command                   | 0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 1            | ↑   | -           | 0                         | 0  | 0  | 0  | 1  | 1  | 0  | 1  | 0D         |                      |              |                                          |     |                                         |               |                                           |     |                                          |     |                         |     |   |   |     |               |   |   |   |     |               |   |   |   |     |             |   |   |   |             |             |   |   |   |             |             |   |   |   |             |             |   |   |   |             |
| 1 <sup>st</sup> parameter | 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | ↑            | 1   | -           | x                         | x  | x  | x  | x  | x  | x  | x  | Dummy read |                      |              |                                          |     |                                         |               |                                           |     |                                          |     |                         |     |   |   |     |               |   |   |   |     |               |   |   |   |     |             |   |   |   |             |             |   |   |   |             |             |   |   |   |             |             |   |   |   |             |
| 2 <sup>nd</sup> parameter | 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | ↑            | 1   | -           | D7                        | D6 | D5 | 0  | 0  | D2 | D1 | D0 | xx         |                      |              |                                          |     |                                         |               |                                           |     |                                          |     |                         |     |   |   |     |               |   |   |   |     |               |   |   |   |     |             |   |   |   |             |             |   |   |   |             |             |   |   |   |             |             |   |   |   |             |
| Description               | This command indicates the current status of the display as described in the table below:<br>Bit D7 – Vertical Scrolling On/Off<br>‘0’ = Vertical Scrolling is Off.<br>‘1’ = Vertical Scrolling is On.<br>Bit D6 – Horizontal Scrolling Status<br>This bit is not applicable for this project, so it is set to ‘0’<br>Bit D5 – Inversion On/Off<br>‘0’ = Inversion is Off.<br>‘1’ = Inversion is On.<br>Bit D4, D4 – Reserved<br>Bits D2, D1, D0 – Gamma Curve Selection                                                                                                                                                                                                                                                                                 |              |     |             |                           |    |    |    |    |    |    |    |            |                      |              |                                          |     |                                         |               |                                           |     |                                          |     |                         |     |   |   |     |               |   |   |   |     |               |   |   |   |     |             |   |   |   |             |             |   |   |   |             |             |   |   |   |             |             |   |   |   |             |
|                           | <table><tr><td>Gamma Curve Selected</td><td>D2</td><td>D1</td><td>D0</td><td>Gamma Set (26h) Parameter</td></tr><tr><td>Gamma Curve 1</td><td>0</td><td>0</td><td>0</td><td>GC0</td></tr><tr><td>Gamma Curve 2</td><td>0</td><td>0</td><td>1</td><td>GC1</td></tr><tr><td>Gamma Curve 3</td><td>0</td><td>1</td><td>0</td><td>GC2</td></tr><tr><td>Gamma Curve 4</td><td>0</td><td>1</td><td>1</td><td>GC3</td></tr><tr><td>Not Defined</td><td>1</td><td>0</td><td>0</td><td>Not Defined</td></tr><tr><td>Not Defined</td><td>1</td><td>0</td><td>1</td><td>Not Defined</td></tr><tr><td>Not Defined</td><td>1</td><td>1</td><td>0</td><td>Not Defined</td></tr><tr><td>Not Defined</td><td>1</td><td>1</td><td>1</td><td>Not Defined</td></tr></table> |              |     |             |                           |    |    |    |    |    |    |    |            | Gamma Curve Selected | D2           | D1                                       | D0  | Gamma Set (26h) Parameter               | Gamma Curve 1 | 0                                         | 0   | 0                                        | GC0 | Gamma Curve 2           | 0   | 0 | 1 | GC1 | Gamma Curve 3 | 0 | 1 | 0 | GC2 | Gamma Curve 4 | 0 | 1 | 1 | GC3 | Not Defined | 1 | 0 | 0 | Not Defined | Not Defined | 1 | 0 | 1 | Not Defined | Not Defined | 1 | 1 | 0 | Not Defined | Not Defined | 1 | 1 | 1 | Not Defined |
|                           | Gamma Curve Selected                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | D2           | D1  | D0          | Gamma Set (26h) Parameter |    |    |    |    |    |    |    |            |                      |              |                                          |     |                                         |               |                                           |     |                                          |     |                         |     |   |   |     |               |   |   |   |     |               |   |   |   |     |             |   |   |   |             |             |   |   |   |             |             |   |   |   |             |             |   |   |   |             |
|                           | Gamma Curve 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | 0            | 0   | 0           | GC0                       |    |    |    |    |    |    |    |            |                      |              |                                          |     |                                         |               |                                           |     |                                          |     |                         |     |   |   |     |               |   |   |   |     |               |   |   |   |     |             |   |   |   |             |             |   |   |   |             |             |   |   |   |             |             |   |   |   |             |
|                           | Gamma Curve 2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | 0            | 0   | 1           | GC1                       |    |    |    |    |    |    |    |            |                      |              |                                          |     |                                         |               |                                           |     |                                          |     |                         |     |   |   |     |               |   |   |   |     |               |   |   |   |     |             |   |   |   |             |             |   |   |   |             |             |   |   |   |             |             |   |   |   |             |
|                           | Gamma Curve 3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | 0            | 1   | 0           | GC2                       |    |    |    |    |    |    |    |            |                      |              |                                          |     |                                         |               |                                           |     |                                          |     |                         |     |   |   |     |               |   |   |   |     |               |   |   |   |     |             |   |   |   |             |             |   |   |   |             |             |   |   |   |             |             |   |   |   |             |
|                           | Gamma Curve 4                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | 0            | 1   | 1           | GC3                       |    |    |    |    |    |    |    |            |                      |              |                                          |     |                                         |               |                                           |     |                                          |     |                         |     |   |   |     |               |   |   |   |     |               |   |   |   |     |             |   |   |   |             |             |   |   |   |             |             |   |   |   |             |             |   |   |   |             |
|                           | Not Defined                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | 1            | 0   | 0           | Not Defined               |    |    |    |    |    |    |    |            |                      |              |                                          |     |                                         |               |                                           |     |                                          |     |                         |     |   |   |     |               |   |   |   |     |               |   |   |   |     |             |   |   |   |             |             |   |   |   |             |             |   |   |   |             |             |   |   |   |             |
|                           | Not Defined                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | 1            | 0   | 1           | Not Defined               |    |    |    |    |    |    |    |            |                      |              |                                          |     |                                         |               |                                           |     |                                          |     |                         |     |   |   |     |               |   |   |   |     |               |   |   |   |     |             |   |   |   |             |             |   |   |   |             |             |   |   |   |             |             |   |   |   |             |
|                           | Not Defined                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | 1            | 1   | 0           | Not Defined               |    |    |    |    |    |    |    |            |                      |              |                                          |     |                                         |               |                                           |     |                                          |     |                         |     |   |   |     |               |   |   |   |     |               |   |   |   |     |             |   |   |   |             |             |   |   |   |             |             |   |   |   |             |             |   |   |   |             |
| Not Defined               | 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 1            | 1   | Not Defined |                           |    |    |    |    |    |    |    |            |                      |              |                                          |     |                                         |               |                                           |     |                                          |     |                         |     |   |   |     |               |   |   |   |     |               |   |   |   |     |             |   |   |   |             |             |   |   |   |             |             |   |   |   |             |             |   |   |   |             |
| Restrictions              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |              |     |             |                           |    |    |    |    |    |    |    |            |                      |              |                                          |     |                                         |               |                                           |     |                                          |     |                         |     |   |   |     |               |   |   |   |     |               |   |   |   |     |             |   |   |   |             |             |   |   |   |             |             |   |   |   |             |             |   |   |   |             |
| -                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |              |     |             |                           |    |    |    |    |    |    |    |            |                      |              |                                          |     |                                         |               |                                           |     |                                          |     |                         |     |   |   |     |               |   |   |   |     |               |   |   |   |     |             |   |   |   |             |             |   |   |   |             |             |   |   |   |             |             |   |   |   |             |
| Register Availability     | <table><tr><td>Status</td><td>Availability</td></tr><tr><td>Normal Mode On, Idle Mode Off, Sleep Out</td><td>Yes</td></tr><tr><td>Normal Mode On, Idle Mode On, Sleep Out</td><td>Yes</td></tr><tr><td>Partial Mode On, Idle Mode Off, Sleep Out</td><td>Yes</td></tr><tr><td>Partial Mode On, Idle Mode On, Sleep Out</td><td>Yes</td></tr><tr><td>Sleep In or Booster Off</td><td>Yes</td></tr></table>                                                                                                                                                                                                                                                                                                                                                |              |     |             |                           |    |    |    |    |    |    |    |            | Status               | Availability | Normal Mode On, Idle Mode Off, Sleep Out | Yes | Normal Mode On, Idle Mode On, Sleep Out | Yes           | Partial Mode On, Idle Mode Off, Sleep Out | Yes | Partial Mode On, Idle Mode On, Sleep Out | Yes | Sleep In or Booster Off | Yes |   |   |     |               |   |   |   |     |               |   |   |   |     |             |   |   |   |             |             |   |   |   |             |             |   |   |   |             |             |   |   |   |             |
|                           | Status                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Availability |     |             |                           |    |    |    |    |    |    |    |            |                      |              |                                          |     |                                         |               |                                           |     |                                          |     |                         |     |   |   |     |               |   |   |   |     |               |   |   |   |     |             |   |   |   |             |             |   |   |   |             |             |   |   |   |             |             |   |   |   |             |
|                           | Normal Mode On, Idle Mode Off, Sleep Out                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | Yes          |     |             |                           |    |    |    |    |    |    |    |            |                      |              |                                          |     |                                         |               |                                           |     |                                          |     |                         |     |   |   |     |               |   |   |   |     |               |   |   |   |     |             |   |   |   |             |             |   |   |   |             |             |   |   |   |             |             |   |   |   |             |
|                           | Normal Mode On, Idle Mode On, Sleep Out                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Yes          |     |             |                           |    |    |    |    |    |    |    |            |                      |              |                                          |     |                                         |               |                                           |     |                                          |     |                         |     |   |   |     |               |   |   |   |     |               |   |   |   |     |             |   |   |   |             |             |   |   |   |             |             |   |   |   |             |             |   |   |   |             |
|                           | Partial Mode On, Idle Mode Off, Sleep Out                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | Yes          |     |             |                           |    |    |    |    |    |    |    |            |                      |              |                                          |     |                                         |               |                                           |     |                                          |     |                         |     |   |   |     |               |   |   |   |     |               |   |   |   |     |             |   |   |   |             |             |   |   |   |             |             |   |   |   |             |             |   |   |   |             |
|                           | Partial Mode On, Idle Mode On, Sleep Out                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | Yes          |     |             |                           |    |    |    |    |    |    |    |            |                      |              |                                          |     |                                         |               |                                           |     |                                          |     |                         |     |   |   |     |               |   |   |   |     |               |   |   |   |     |             |   |   |   |             |             |   |   |   |             |             |   |   |   |             |             |   |   |   |             |
| Sleep In or Booster Off   | Yes                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |              |     |             |                           |    |    |    |    |    |    |    |            |                      |              |                                          |     |                                         |               |                                           |     |                                          |     |                         |     |   |   |     |               |   |   |   |     |               |   |   |   |     |             |   |   |   |             |             |   |   |   |             |             |   |   |   |             |             |   |   |   |             |
| Default                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |              |     |             |                           |    |    |    |    |    |    |    |            |                      |              |                                          |     |                                         |               |                                           |     |                                          |     |                         |     |   |   |     |               |   |   |   |     |               |   |   |   |     |             |   |   |   |             |             |   |   |   |             |             |   |   |   |             |             |   |   |   |             |
| D[7:0] = 0x00h            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |              |     |             |                           |    |    |    |    |    |    |    |            |                      |              |                                          |     |                                         |               |                                           |     |                                          |     |                         |     |   |   |     |               |   |   |   |     |               |   |   |   |     |             |   |   |   |             |             |   |   |   |             |             |   |   |   |             |             |   |   |   |             |
| Flow Chart                | <div><div><div>Serial I/F Mode</div><div><div>RDDIM (0Dh)</div><div>Send D[7:0]</div></div></div><div><div>Parallel I/F Mode</div><div><div>RDDIM (0Dh)</div><div>Dummy Read</div><div>Send D[7:0]</div></div></div><div>Host Driver</div></div>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |              |     |             |                           |    |    |    |    |    |    |    |            |                      |              |                                          |     |                                         |               |                                           |     |                                          |     |                         |     |   |   |     |               |   |   |   |     |               |   |   |   |     |             |   |   |   |             |             |   |   |   |             |             |   |   |   |             |             |   |   |   |             |
|                           | <div><div>Legend</div><div><div>Red and Blue</div><div>Parameter</div><div>Display</div><div>Action</div><div>Mode</div><div>Sequential transfer</div></div></div>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |              |     |             |                           |    |    |    |    |    |    |    |            |                      |              |                                          |     |                                         |               |                                           |     |                                          |     |                         |     |   |   |     |               |   |   |   |     |               |   |   |   |     |             |   |   |   |             |             |   |   |   |             |             |   |   |   |             |             |   |   |   |             |

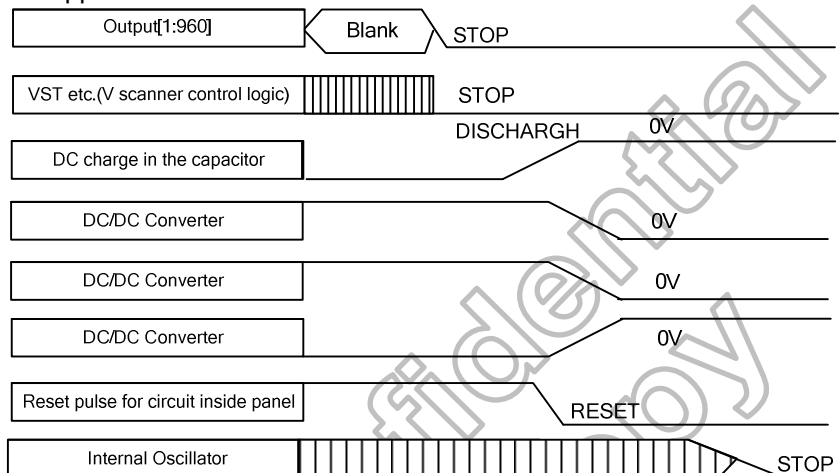
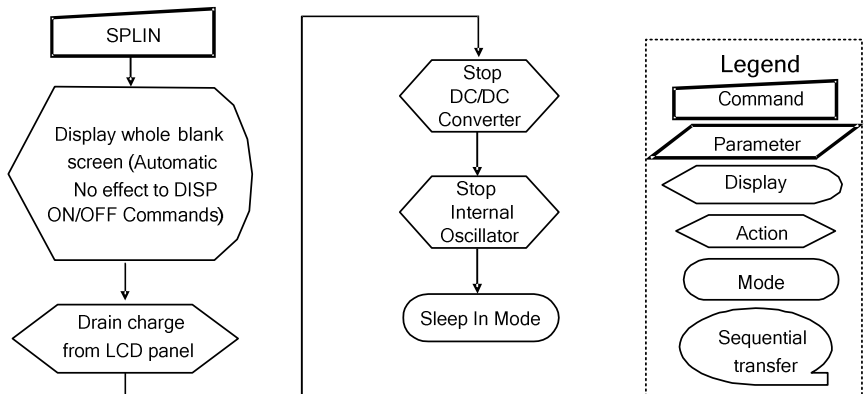
### 6.2.11 Get\_signal\_mode (0Eh)

| 0EH                       | RDDSM (Read Display Signal Mode)                                                                                                                                                                                                                                                                                                                                                   |     |     |        |    |              |    |    |    |    |    |    |            |
|---------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|-----|--------|----|--------------|----|----|----|----|----|----|------------|
|                           | D/CX                                                                                                                                                                                                                                                                                                                                                                               | RDX | WRX | D15-D8 | D7 | D6           | D5 | D4 | D3 | D2 | D1 | D0 | HEX        |
| Command                   | 0                                                                                                                                                                                                                                                                                                                                                                                  | 1   | ↑   | -      | 0  | 0            | 0  | 0  | 1  | 1  | 1  | 0  | 0E         |
| 1 <sup>st</sup> parameter | 1                                                                                                                                                                                                                                                                                                                                                                                  | ↑   | 1   | -      | x  | x            | x  | x  | x  | x  | x  | x  | Dummy read |
| 2 <sup>nd</sup> parameter | 1                                                                                                                                                                                                                                                                                                                                                                                  | ↑   | 1   | -      | D7 | D6           | 0  | 0  | 0  | 0  | 0  | 0  | xx         |
| Description               | This command indicates the current status of the display as described in the table below:<br>Bit D7 – Tearing Effect Line On/Off<br>‘0’ = Tearing Effect Line Off.<br>‘1’ = Tearing Effect On.<br>Bit D6 – Tearing Effect Line Output Mode, see section 5.5.3 for mode definitions.<br>‘0’ = Mode 1.<br>‘1’ = Mode 2.<br>D5 are D0 – are for future use and are set to ‘0’.        |     |     |        |    |              |    |    |    |    |    |    |            |
| Restrictions              | -                                                                                                                                                                                                                                                                                                                                                                                  |     |     |        |    |              |    |    |    |    |    |    |            |
| Register Availability     | Status                                                                                                                                                                                                                                                                                                                                                                             |     |     |        |    | Availability |    |    |    |    |    |    |            |
|                           | Normal Mode On, Idle Mode Off, Sleep Out                                                                                                                                                                                                                                                                                                                                           |     |     |        |    | Yes          |    |    |    |    |    |    |            |
|                           | Normal Mode On, Idle Mode On, Sleep Out                                                                                                                                                                                                                                                                                                                                            |     |     |        |    | Yes          |    |    |    |    |    |    |            |
|                           | Partial Mode On, Idle Mode Off, Sleep Out                                                                                                                                                                                                                                                                                                                                          |     |     |        |    | Yes          |    |    |    |    |    |    |            |
|                           | Partial Mode On, Idle Mode On, Sleep Out                                                                                                                                                                                                                                                                                                                                           |     |     |        |    | Yes          |    |    |    |    |    |    |            |
|                           | Sleep In or Booster Off                                                                                                                                                                                                                                                                                                                                                            |     |     |        |    | Yes          |    |    |    |    |    |    |            |
| Default                   | D[7:0] = 0x00h                                                                                                                                                                                                                                                                                                                                                                     |     |     |        |    |              |    |    |    |    |    |    |            |
| Flow Chart                | <div><div><div>Serial I/F Mode</div><div>RDDSM (0Eh)</div><div>Send D[7:0]</div></div><div><div>Parallel I/F Mode</div><div>RDDSM (0Eh)</div><div>Dummy Read</div><div>Send D[7:0]</div></div><div>Host Driver</div></div> <div><div>Legend</div><div>Red and Blue</div><div>Parameter</div><div>Display</div><div>Action</div><div>Mode</div><div>Sequential transfer</div></div> |     |     |        |    |              |    |    |    |    |    |    |            |

## 6.2.12 Get\_diagnostic\_result (0Fh)

| 0FH                       | RDDSDR (Read Display Self-Diagnostic Result)                                                                                                                                                                                                                                                                                                                                                                                        |     |     |        |    |              |    |    |    |    |    |    |            |
|---------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|-----|--------|----|--------------|----|----|----|----|----|----|------------|
|                           | D/CX                                                                                                                                                                                                                                                                                                                                                                                                                                | RDX | WRX | D15-D8 | D7 | D6           | D5 | D4 | D3 | D2 | D1 | D0 | HEX        |
| Command                   | 0                                                                                                                                                                                                                                                                                                                                                                                                                                   | 1   | ↑   | -      | 0  | 0            | 0  | 0  | 1  | 1  | 1  | 1  | 0F         |
| 1 <sup>st</sup> parameter | 1                                                                                                                                                                                                                                                                                                                                                                                                                                   | ↑   | 1   | -      | x  | x            | x  | x  | x  | x  | x  | x  | Dummy read |
| 2 <sup>nd</sup> parameter | 1                                                                                                                                                                                                                                                                                                                                                                                                                                   | 1   | 1   | -      | D7 | D6           | D5 | D4 | 0  | 0  | 0  | 0  | xx         |
| Description               | The display module returns the self-diagnostic results following a Sleep Out command. See section 5.15 for a description of the status results.<br>Bit D7 – Register Loading Detection<br>Bit D6 – Functionality Detection<br>Bit D5 – Chip Attachment Detection<br>Set to '0' if feature unimplemented.<br>Bit D4 – Display Glass Break Detection<br>Set to '0' if feature unimplemented.<br>Bits D[3:0] – Reserved<br>Set to '0'. |     |     |        |    |              |    |    |    |    |    |    |            |
| Restrictions              | -                                                                                                                                                                                                                                                                                                                                                                                                                                   |     |     |        |    |              |    |    |    |    |    |    |            |
| Register Availability     | Status                                                                                                                                                                                                                                                                                                                                                                                                                              |     |     |        |    | Availability |    |    |    |    |    |    |            |
|                           | Normal Mode On, Idle Mode Off, Sleep Out                                                                                                                                                                                                                                                                                                                                                                                            |     |     |        |    | Yes          |    |    |    |    |    |    |            |
|                           | Normal Mode On, Idle Mode On, Sleep Out                                                                                                                                                                                                                                                                                                                                                                                             |     |     |        |    | Yes          |    |    |    |    |    |    |            |
|                           | Partial Mode On, Idle Mode Off, Sleep Out                                                                                                                                                                                                                                                                                                                                                                                           |     |     |        |    | Yes          |    |    |    |    |    |    |            |
|                           | Partial Mode On, Idle Mode On, Sleep Out                                                                                                                                                                                                                                                                                                                                                                                            |     |     |        |    | Yes          |    |    |    |    |    |    |            |
|                           | Sleep In or Booster Off                                                                                                                                                                                                                                                                                                                                                                                                             |     |     |        |    | Yes          |    |    |    |    |    |    |            |
| Default                   | D[7:0] = 0x00h                                                                                                                                                                                                                                                                                                                                                                                                                      |     |     |        |    |              |    |    |    |    |    |    |            |
| Flow Chart                | <div><div><div>Serial I/F Mode</div><div>RDDSDR (0Fh)</div><div>Send D[7:0]</div></div><div><div>Parallel I/F Mode</div><div>RDDSDR (0Fh)</div><div>Dummy Read</div><div>Send D[7:0]</div></div></div> <div>Host Driver</div> <div><div>Legend</div><div>Red and Blue</div><div>Parameter</div><div>Display</div><div>Action</div><div>Mode</div><div>Sequential transfer</div></div>                                               |     |     |        |    |              |    |    |    |    |    |    |            |

### 6.2.13 Enter\_sleep\_mode (10h)

| 10H                                       | SLPIN (Sleep In)                                                                                                                                                                                                                                                                                                                                                                                                                        |     |     |        |    |    |    |    |    |    |    |    |     |        |              |                                          |     |                                         |     |                                           |     |                                          |     |                         |     |
|-------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|-----|--------|----|----|----|----|----|----|----|----|-----|--------|--------------|------------------------------------------|-----|-----------------------------------------|-----|-------------------------------------------|-----|------------------------------------------|-----|-------------------------|-----|
|                                           | D/CX                                                                                                                                                                                                                                                                                                                                                                                                                                    | RDX | WRX | D15-D8 | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 | HEX |        |              |                                          |     |                                         |     |                                           |     |                                          |     |                         |     |
| Command                                   | 0                                                                                                                                                                                                                                                                                                                                                                                                                                       | 1   | ↑   | -      | 0  | 0  | 0  | 1  | 0  | 0  | 0  | 0  | 10  |        |              |                                          |     |                                         |     |                                           |     |                                          |     |                         |     |
| Parameter                                 | NO PARAMETER                                                                                                                                                                                                                                                                                                                                                                                                                            |     |     |        |    |    |    |    |    |    |    |    |     |        |              |                                          |     |                                         |     |                                           |     |                                          |     |                         |     |
| Description                               | <p>This command causes the LCD module to enter the minimum power consumption mode. In this mode the DC/DC converter is stopped, Internal oscillator is stopped, and panel scanning is stopped.</p>  <p>MCU interface and memory are still working and the memory keeps its contents.</p>                                                              |     |     |        |    |    |    |    |    |    |    |    |     |        |              |                                          |     |                                         |     |                                           |     |                                          |     |                         |     |
| Restriction                               | <p>This command has no effect when module is already in sleep in mode. Sleep In Mode can only be left by the Sleep Out Command (11h). It will be necessary to wait 5msec before sending next command, this is to allow time for the supply voltages and clock circuits to stabilize. It will be necessary to wait 120msec after sending Sleep Out command (when in Sleep In Mode) before Sleep In command can be sent.</p>              |     |     |        |    |    |    |    |    |    |    |    |     |        |              |                                          |     |                                         |     |                                           |     |                                          |     |                         |     |
| Register Availability                     | <table><thead><tr><th>Status</th><th>Availability</th></tr></thead><tbody><tr><td>Normal Mode On, Idle Mode Off, Sleep Out</td><td>Yes</td></tr><tr><td>Normal Mode On, Idle Mode On, Sleep Out</td><td>Yes</td></tr><tr><td>Partial Mode On, Idle Mode Off, Sleep Out</td><td>Yes</td></tr><tr><td>Partial Mode On, Idle Mode On, Sleep Out</td><td>Yes</td></tr><tr><td>Sleep In or Booster Off</td><td>Yes</td></tr></tbody></table> |     |     |        |    |    |    |    |    |    |    |    |     | Status | Availability | Normal Mode On, Idle Mode Off, Sleep Out | Yes | Normal Mode On, Idle Mode On, Sleep Out | Yes | Partial Mode On, Idle Mode Off, Sleep Out | Yes | Partial Mode On, Idle Mode On, Sleep Out | Yes | Sleep In or Booster Off | Yes |
| Status                                    | Availability                                                                                                                                                                                                                                                                                                                                                                                                                            |     |     |        |    |    |    |    |    |    |    |    |     |        |              |                                          |     |                                         |     |                                           |     |                                          |     |                         |     |
| Normal Mode On, Idle Mode Off, Sleep Out  | Yes                                                                                                                                                                                                                                                                                                                                                                                                                                     |     |     |        |    |    |    |    |    |    |    |    |     |        |              |                                          |     |                                         |     |                                           |     |                                          |     |                         |     |
| Normal Mode On, Idle Mode On, Sleep Out   | Yes                                                                                                                                                                                                                                                                                                                                                                                                                                     |     |     |        |    |    |    |    |    |    |    |    |     |        |              |                                          |     |                                         |     |                                           |     |                                          |     |                         |     |
| Partial Mode On, Idle Mode Off, Sleep Out | Yes                                                                                                                                                                                                                                                                                                                                                                                                                                     |     |     |        |    |    |    |    |    |    |    |    |     |        |              |                                          |     |                                         |     |                                           |     |                                          |     |                         |     |
| Partial Mode On, Idle Mode On, Sleep Out  | Yes                                                                                                                                                                                                                                                                                                                                                                                                                                     |     |     |        |    |    |    |    |    |    |    |    |     |        |              |                                          |     |                                         |     |                                           |     |                                          |     |                         |     |
| Sleep In or Booster Off                   | Yes                                                                                                                                                                                                                                                                                                                                                                                                                                     |     |     |        |    |    |    |    |    |    |    |    |     |        |              |                                          |     |                                         |     |                                           |     |                                          |     |                         |     |
| Default                                   | N/A                                                                                                                                                                                                                                                                                                                                                                                                                                     |     |     |        |    |    |    |    |    |    |    |    |     |        |              |                                          |     |                                         |     |                                           |     |                                          |     |                         |     |
| Flow Chart                                | <p>It takes 120msec to get into Sleep In mode after SLPIN command issued.</p>                                                                                                                                                                                                                                                                       |     |     |        |    |    |    |    |    |    |    |    |     |        |              |                                          |     |                                         |     |                                           |     |                                          |     |                         |     |

## 6.2.14 Exit\_sleep\_omde (11h)

| 11H                                       | SLPOUT (Sleep Out)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |     |     |        |    |    |    |    |    |    |    |    |     |        |              |                                          |     |                                         |     |                                           |     |                                          |     |
|-------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|-----|--------|----|----|----|----|----|----|----|----|-----|--------|--------------|------------------------------------------|-----|-----------------------------------------|-----|-------------------------------------------|-----|------------------------------------------|-----|
|                                           | D/CX                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | RDX | WRX | D15-D8 | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 | HEX |        |              |                                          |     |                                         |     |                                           |     |                                          |     |
| Command                                   | 0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | 1   | ↑   | -      | 0  | 0  | 0  | 1  | 0  | 0  | 0  | 1  | 11  |        |              |                                          |     |                                         |     |                                           |     |                                          |     |
| Parameter                                 | NO PARAMETER                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |     |     |        |    |    |    |    |    |    |    |    |     |        |              |                                          |     |                                         |     |                                           |     |                                          |     |
| Description                               | <p>This command turns off sleep mode. In this mode the DC/DC converter is enabled, Internal oscillator is started, and panel scanning is started.</p> <div><div>Out[1:960]</div><div>STOP</div><div>Blank</div><div>Memory contents</div></div> <div><div>VST etc.(V scanner control logic)</div><div>DC charge in the capacitor</div><div>DC:DC converter</div><div>DC:DC converter</div><div>DC:DC converter</div><div>Reset pulse for circuit inside panel</div><div>Internal Oscillator</div><div>0V</div><div>0V</div><div>0V</div><div>0V</div><div>RESET</div><div>STOP</div><div>START</div><div>CHARGE</div></div>                                                                                                                                                                                               |     |     |        |    |    |    |    |    |    |    |    |     |        |              |                                          |     |                                         |     |                                           |     |                                          |     |
| Restriction                               | <p>This command has no effect when module is already in sleep out mode. Sleep Out Mode can only be left by the Sleep In Command (10h). It will be necessary to wait 5msec before sending next command, this is to allow time for the supply voltages and clock circuits to stabilize. The display module loads all display supplier's factory default values to the registers during this 5msec and there cannot be any abnormal visual effect on the display image if factory default and register values are same when this load is done and when the display module is already Sleep Out –mode.</p> <p>The display module is doing self-diagnostic functions during this 5msec. It will be necessary to wait 120msec after sending Sleep In command (when in Sleep Out mode) before Sleep Out command can be sent.</p> |     |     |        |    |    |    |    |    |    |    |    |     |        |              |                                          |     |                                         |     |                                           |     |                                          |     |
| Register Availability                     | <table><thead><tr><th>Status</th><th>Availability</th></tr></thead><tbody><tr><td>Normal Mode On, Idle Mode Off, Sleep Out</td><td>Yes</td></tr><tr><td>Normal Mode On, Idle Mode On, Sleep Out</td><td>Yes</td></tr><tr><td>Partial Mode On, Idle Mode Off, Sleep Out</td><td>Yes</td></tr><tr><td>Partial Mode On, Idle Mode On, Sleep Out</td><td>Yes</td></tr></tbody></table>                                                                                                                                                                                                                                                                                                                                                                                                                                        |     |     |        |    |    |    |    |    |    |    |    |     | Status | Availability | Normal Mode On, Idle Mode Off, Sleep Out | Yes | Normal Mode On, Idle Mode On, Sleep Out | Yes | Partial Mode On, Idle Mode Off, Sleep Out | Yes | Partial Mode On, Idle Mode On, Sleep Out | Yes |
| Status                                    | Availability                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |     |     |        |    |    |    |    |    |    |    |    |     |        |              |                                          |     |                                         |     |                                           |     |                                          |     |
| Normal Mode On, Idle Mode Off, Sleep Out  | Yes                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |     |     |        |    |    |    |    |    |    |    |    |     |        |              |                                          |     |                                         |     |                                           |     |                                          |     |
| Normal Mode On, Idle Mode On, Sleep Out   | Yes                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |     |     |        |    |    |    |    |    |    |    |    |     |        |              |                                          |     |                                         |     |                                           |     |                                          |     |
| Partial Mode On, Idle Mode Off, Sleep Out | Yes                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |     |     |        |    |    |    |    |    |    |    |    |     |        |              |                                          |     |                                         |     |                                           |     |                                          |     |
| Partial Mode On, Idle Mode On, Sleep Out  | Yes                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |     |     |        |    |    |    |    |    |    |    |    |     |        |              |                                          |     |                                         |     |                                           |     |                                          |     |
| Default                                   | N/A                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |     |     |        |    |    |    |    |    |    |    |    |     |        |              |                                          |     |                                         |     |                                           |     |                                          |     |
| Flow Chart                                | <p>It takes 120msec to become Sleep Out mode after SLPOUT command issued.</p> <div><div>SLPOUT</div><div>Start Internal Oscillator</div><div>Start up DC:DC Converter</div><div>Charge Offset voltage for LCD Panel</div><div>Display whole blank screen for 2 frames (Automatic No effect to DISP ON/OFF Commands)</div><div>Display Memory contents In accordance with the current command table settings</div><div>Sleep Out mode</div></div> <div><div>Legend</div><div>Command</div><div>Parameter</div><div>Display</div><div>Action</div><div>Mode</div><div>Sequential transfer</div></div>                                                                                                                                                                                                                       |     |     |        |    |    |    |    |    |    |    |    |     |        |              |                                          |     |                                         |     |                                           |     |                                          |     |

## 6.2.15 Enter\_partial\_mode (12h)

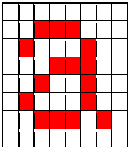
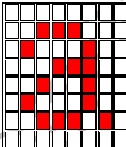
| 12H                   | PTLON (Partial Mode On)                                                                                                                                                                         |     |     |        |    |    |              |    |    |    |    |    |     |
|-----------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|-----|--------|----|----|--------------|----|----|----|----|----|-----|
|                       | D/CX                                                                                                                                                                                            | RDX | WRX | D15-D8 | D7 | D6 | D5           | D4 | D3 | D2 | D1 | D0 | HEX |
| Command               | 0                                                                                                                                                                                               | 1   | ↑   | -      | 0  | 0  | 0            | 1  | 0  | 0  | 1  | 0  | 12  |
| Parameter             | NO PARAMETER                                                                                                                                                                                    |     |     |        |    |    |              |    |    |    |    |    |     |
| Description           | This command turns on partial mode The partial mode window is described by the “Set_partial_area” command (30H). To leave Partial mode, the “Enter_norma_mode” command (13H) should be written. |     |     |        |    |    |              |    |    |    |    |    |     |
| Restrictions          | This command has no effect when Partial mode is active.                                                                                                                                         |     |     |        |    |    |              |    |    |    |    |    |     |
| Register Availability | Status                                                                                                                                                                                          |     |     |        |    |    | Availability |    |    |    |    |    |     |
|                       | Normal Mode On, Idle Mode Off, Sleep Out                                                                                                                                                        |     |     |        |    |    | Yes          |    |    |    |    |    |     |
|                       | Normal Mode On, Idle Mode On, Sleep Out                                                                                                                                                         |     |     |        |    |    | Yes          |    |    |    |    |    |     |
|                       | Partial Mode On, Idle Mode Off, Sleep Out                                                                                                                                                       |     |     |        |    |    | Yes          |    |    |    |    |    |     |
|                       | Partial Mode On, Idle Mode On, Sleep Out                                                                                                                                                        |     |     |        |    |    | Yes          |    |    |    |    |    |     |
|                       | Sleep In or Booster Off                                                                                                                                                                         |     |     |        |    |    | Yes          |    |    |    |    |    |     |
| Default               | N/A                                                                                                                                                                                             |     |     |        |    |    |              |    |    |    |    |    |     |
| Flow Chart            | See Partial Area (30h)                                                                                                                                                                          |     |     |        |    |    |              |    |    |    |    |    |     |

## 6.2.16 Enter\_normal\_mode (13h)

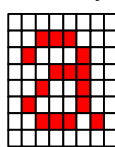
| 13H                   | NORON (Normal Display Mode On)                                                                                   |     |     |        |    |    |    |              |    |    |    |    |     |
|-----------------------|------------------------------------------------------------------------------------------------------------------|-----|-----|--------|----|----|----|--------------|----|----|----|----|-----|
|                       | D/CX                                                                                                             | RDX | WRX | D15-D8 | D7 | D6 | D5 | D4           | D3 | D2 | D1 | D0 | HEX |
| Command               | 0                                                                                                                | 1   | ↑   | -      | 0  | 0  | 0  | 1            | 0  | 0  | 1  | 1  | 13  |
| Parameter             | NO PARAMETER                                                                                                     |     |     |        |    |    |    |              |    |    |    |    |     |
| Description           | This command returns the display to normal mode. Normal display mode is means Partial mode off, Scroll mode Off. |     |     |        |    |    |    |              |    |    |    |    |     |
| Restriction           | This command has no effect when Normal Display mode is active.                                                   |     |     |        |    |    |    |              |    |    |    |    |     |
| Register Availability | Status                                                                                                           |     |     |        |    |    |    | Availability |    |    |    |    |     |
|                       | Normal Mode On, Idle Mode Off, Sleep Out                                                                         |     |     |        |    |    |    | Yes          |    |    |    |    |     |
|                       | Normal Mode On, Idle Mode On, Sleep Out                                                                          |     |     |        |    |    |    | Yes          |    |    |    |    |     |
|                       | Partial Mode On, Idle Mode Off, Sleep Out                                                                        |     |     |        |    |    |    | Yes          |    |    |    |    |     |
|                       | Partial Mode On, Idle Mode On, Sleep Out                                                                         |     |     |        |    |    |    | Yes          |    |    |    |    |     |
|                       | Sleep In or Booster Off                                                                                          |     |     |        |    |    |    | Yes          |    |    |    |    |     |
| Default               | N/A                                                                                                              |     |     |        |    |    |    |              |    |    |    |    |     |
| Flow Chart            | See Partial Area and Vertical Scrolling Definition Descriptions for details of when to use this command.         |     |     |        |    |    |    |              |    |    |    |    |     |



## 6.2.17 Exit\_inversion\_mode (20h)

| 20H                   | INVOFF (Display Inversion Off)                                                                                                                                                                                                                                                                        |     |     |        |    |    |              |    |    |    |    |    |     |
|-----------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|-----|--------|----|----|--------------|----|----|----|----|----|-----|
|                       | D/CX                                                                                                                                                                                                                                                                                                  | RDX | WRX | D15-D8 | D7 | D6 | D5           | D4 | D3 | D2 | D1 | D0 | HEX |
| Command               | 0                                                                                                                                                                                                                                                                                                     | 1   | ↑   | -      | 0  | 0  | 1            | 0  | 0  | 0  | 0  | 0  | 20  |
| Parameter             | No parameter                                                                                                                                                                                                                                                                                          |     |     |        |    |    |              |    |    |    |    |    |     |
| Description           | This command is used to recover from display inversion mode.<br>This command makes no change of contents of frame memory.<br>This command does not change any other status.<br>(Example)                                                                                                              |     |     |        |    |    |              |    |    |    |    |    |     |
|                       | <div><div>Memory</div><div></div><div>(Example)</div><div><div>Display</div><div></div></div></div>                               |     |     |        |    |    |              |    |    |    |    |    |     |
| Restriction           | This command has no effect when module is already in inversion off mode.                                                                                                                                                                                                                              |     |     |        |    |    |              |    |    |    |    |    |     |
| Register Availability | Status                                                                                                                                                                                                                                                                                                |     |     |        |    |    | Availability |    |    |    |    |    |     |
|                       | Normal Mode On, Idle Mode Off, Sleep Out                                                                                                                                                                                                                                                              |     |     |        |    |    | Yes          |    |    |    |    |    |     |
|                       | Normal Mode On, Idle Mode On, Sleep Out                                                                                                                                                                                                                                                               |     |     |        |    |    | Yes          |    |    |    |    |    |     |
|                       | Partial Mode On, Idle Mode Off, Sleep Out                                                                                                                                                                                                                                                             |     |     |        |    |    | Yes          |    |    |    |    |    |     |
|                       | Partial Mode On, Idle Mode On, Sleep Out                                                                                                                                                                                                                                                              |     |     |        |    |    | Yes          |    |    |    |    |    |     |
|                       | Sleep In or Booster Off                                                                                                                                                                                                                                                                               |     |     |        |    |    | Yes          |    |    |    |    |    |     |
| Default               | N/A                                                                                                                                                                                                                                                                                                   |     |     |        |    |    |              |    |    |    |    |    |     |
| Flow Chart            | <div><div><div>Display Inversion On Mode</div><div>↓</div><div>INVOFF</div><div>↓</div><div>Display Inversion OFF Mode</div></div><div><div>Legend</div><div><div>Command</div><div>Parameter</div><div>Display</div><div>Action</div><div>Mode</div><div>Sequential transfer</div></div></div></div> |     |     |        |    |    |              |    |    |    |    |    |     |

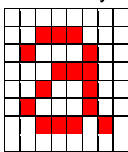
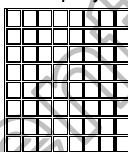
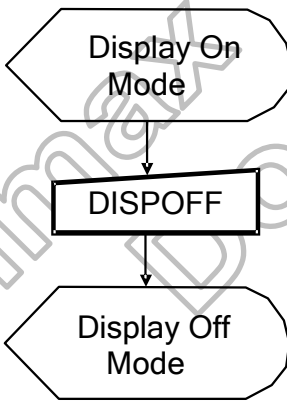
## 6.2.18 Enter\_inversion\_mode (21h)

| 21H                   | INVON (Display Inversion On)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |     |     |        |    |    |              |    |    |    |    |    |     |
|-----------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|-----|--------|----|----|--------------|----|----|----|----|----|-----|
|                       | D/CX                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | RDX | WRX | D15-D8 | D7 | D6 | D5           | D4 | D3 | D2 | D1 | D0 | HEX |
| Command               | 0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | 1   | ↑   | -      | 0  | 0  | 1            | 0  | 0  | 0  | 0  | 1  | 21  |
| Parameter             | NO PARAMETER                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |     |     |        |    |    |              |    |    |    |    |    |     |
| Description           | <p>This command is used to enter into display inversion mode.<br/>This command makes no change of contents of frame memory. Every bit is inverted from the frame memory to the display.<br/>This command does not change any other status.</p> <p>(Example)</p> <div><div>memory</div><div></div><div>→</div><div><div>display</div><div></div></div></div> |     |     |        |    |    |              |    |    |    |    |    |     |
| Restriction           | This command has no effect when module is already in inversion on mode.                                                                                                                                                                                                                                                                                                                                                                                                                                                        |     |     |        |    |    |              |    |    |    |    |    |     |
| Register Availability | Status                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |     |     |        |    |    | Availability |    |    |    |    |    |     |
|                       | Normal Mode On, Idle Mode Off, Sleep Out                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |     |     |        |    |    | Yes          |    |    |    |    |    |     |
|                       | Normal Mode On, Idle Mode On, Sleep Out                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |     |     |        |    |    | Yes          |    |    |    |    |    |     |
|                       | Partial Mode On, Idle Mode Off, Sleep Out                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |     |     |        |    |    | Yes          |    |    |    |    |    |     |
|                       | Partial Mode On, Idle Mode On, Sleep Out                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |     |     |        |    |    | Yes          |    |    |    |    |    |     |
|                       | Sleep In or Booster Off                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |     |     |        |    |    | Yes          |    |    |    |    |    |     |
| Default               | N/A                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |     |     |        |    |    |              |    |    |    |    |    |     |
| Flow Chart            | <div><div><div>Display Inversion OFF Mode</div><div>↓</div><div>INVON</div><div>↓</div><div>Display Inversion ON Mode</div></div><div><div>Legend</div><div><div>Command</div><div>Parameter</div><div>Display</div><div>Action</div><div>Mode</div><div>Sequential transfer</div></div></div></div>                                                                                                                                                                                                                           |     |     |        |    |    |              |    |    |    |    |    |     |

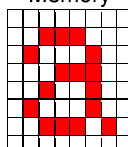
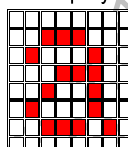
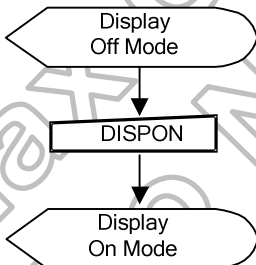
### 6.2.19 Set\_gamma\_curve (26h)

| 26H                                          | GAMSET (Gamma Set)                                                                                                                                                                                                                                                                                   |     |     |           |     |     |                |     |     |     |     |     |       |
|----------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|-----|-----------|-----|-----|----------------|-----|-----|-----|-----|-----|-------|
|                                              | D/CX                                                                                                                                                                                                                                                                                                 | RDX | WRX | D15-D8    | D7  | D6  | D5             | D4  | D3  | D2  | D1  | D0  | HEX   |
| Command                                      | 0                                                                                                                                                                                                                                                                                                    | 1   | ↑   | -         | 0   | 0   | 1              | 0   | 0   | 1   | 1   | 0   | 26    |
| Parameter                                    | 1                                                                                                                                                                                                                                                                                                    | 1   | ↑   | -         | GC7 | GC6 | GC5            | GC4 | GC3 | GC2 | GC1 | GC0 | 1..08 |
| Description                                  | This command is used to select the desired Gamma curve for the current display. A maximum of 4 fixed gamma curves can be selected. The curves are defined in Curve Correction Power Supply Circuit. The curve is selected by setting the appropriate bit in the parameter as described in the Table: |     |     |           |     |     |                |     |     |     |     |     |       |
|                                              | GC[7..0]                                                                                                                                                                                                                                                                                             |     |     | Parameter |     |     | Curve selected |     |     |     |     |     |       |
|                                              | 01h                                                                                                                                                                                                                                                                                                  |     |     | GC0       |     |     | Gamma Curve 1  |     |     |     |     |     |       |
|                                              | 02h                                                                                                                                                                                                                                                                                                  |     |     | GC1       |     |     | Gamma Curve 2  |     |     |     |     |     |       |
|                                              | 04h                                                                                                                                                                                                                                                                                                  |     |     | GC2       |     |     | Gamma Curve 3  |     |     |     |     |     |       |
|                                              | 08h                                                                                                                                                                                                                                                                                                  |     |     | GC3       |     |     | Gamma Curve 4  |     |     |     |     |     |       |
| <b>Note:</b> All other values are undefined. |                                                                                                                                                                                                                                                                                                      |     |     |           |     |     |                |     |     |     |     |     |       |
| Restriction                                  | Values of GC[7..0] not shown in table above are invalid and will not change the current selected Gamma curve until valid value is received.                                                                                                                                                          |     |     |           |     |     |                |     |     |     |     |     |       |
| Register Availability                        | Status                                                                                                                                                                                                                                                                                               |     |     |           |     |     | Availability   |     |     |     |     |     |       |
|                                              | Normal Mode On, Idle Mode Off, Sleep Out                                                                                                                                                                                                                                                             |     |     |           |     |     | Yes            |     |     |     |     |     |       |
|                                              | Normal Mode On, Idle Mode On, Sleep Out                                                                                                                                                                                                                                                              |     |     |           |     |     | Yes            |     |     |     |     |     |       |
|                                              | Partial Mode On, Idle Mode Off, Sleep Out                                                                                                                                                                                                                                                            |     |     |           |     |     | Yes            |     |     |     |     |     |       |
|                                              | Partial Mode On, Idle Mode On, Sleep Out                                                                                                                                                                                                                                                             |     |     |           |     |     | Yes            |     |     |     |     |     |       |
| Default                                      | GC[7:0] = 0x01h                                                                                                                                                                                                                                                                                      |     |     |           |     |     |                |     |     |     |     |     |       |
| Flow Chart                                   | <div><div><div>GAMSET</div><div>↓</div><div>GC [7:0]</div><div>↓</div><div>New Gamma Curve Loaded</div></div><div><div>Legend</div><div>Command</div><div>Parameter</div><div>Display</div><div>Action</div><div>Mode</div><div>Sequential transfer</div></div></div>                                |     |     |           |     |     |                |     |     |     |     |     |       |

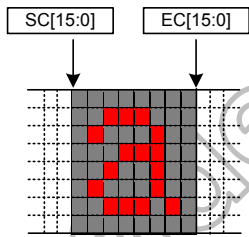
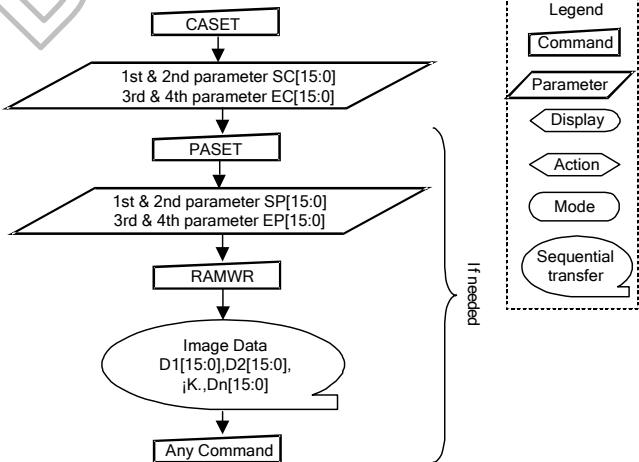
## 6.2.20 Set\_display\_off (28h)

| 28H                   | DISPOFF (Display Off)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |     |     |        |    |    |              |    |    |    |    |    |     |
|-----------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|-----|--------|----|----|--------------|----|----|----|----|----|-----|
|                       | D/CX                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | RDX | WRX | D15-D8 | D7 | D6 | D5           | D4 | D3 | D2 | D1 | D0 | HEX |
| Command               | 0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | 1   | ↑   | -      | 0  | 0  | 1            | 0  | 1  | 0  | 0  | 0  | 28  |
| Parameter             | NO PARAMETER                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |     |     |        |    |    |              |    |    |    |    |    |     |
| Description           | <p>This command is used to enter into DISPLAY OFF mode. In this mode, the output from Frame Memory is disabled and blank page inserted.</p> <p>This command makes no change of contents of frame memory.</p> <p>This command does not change any other status.</p> <p>There will be no abnormal visible effect on the display.</p> <p style="text-align: center;">Example</p> <div style="display: flex; align-items: center; justify-content: center;"><div style="text-align: center;"><p>Memory</p></div><div style="margin: 0 20px; font-size: 2em;">➔</div><div style="text-align: center;"><p>Display</p></div></div>                                                                                                                                                                                                                                |     |     |        |    |    |              |    |    |    |    |    |     |
| Restriction           | This command has no effect when module is already in display off mode.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |     |     |        |    |    |              |    |    |    |    |    |     |
| Register Availability | Status                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |     |     |        |    |    | Availability |    |    |    |    |    |     |
|                       | Normal Mode On, Idle Mode Off, Sleep Out                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |     |     |        |    |    | Yes          |    |    |    |    |    |     |
|                       | Normal Mode On, Idle Mode On, Sleep Out                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |     |     |        |    |    | Yes          |    |    |    |    |    |     |
|                       | Partial Mode On, Idle Mode Off, Sleep Out                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |     |     |        |    |    | Yes          |    |    |    |    |    |     |
|                       | Partial Mode On, Idle Mode On, Sleep Out                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |     |     |        |    |    | Yes          |    |    |    |    |    |     |
|                       | Sleep In or Booster Off                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |     |     |        |    |    | Yes          |    |    |    |    |    |     |
| Default               | N/A                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |     |     |        |    |    |              |    |    |    |    |    |     |
| Flow Chart            | <div style="display: flex; align-items: center; justify-content: center;"><div style="text-align: center;"><pre>graph TD; A{{Display On Mode}} --&gt; B[DISPOFF]; B --&gt; C{{Display Off Mode}}</pre></div><div style="margin-left: 20px;"><div style="border: 1px dashed black; padding: 10px;"><p><b>Legend</b></p><div style="display: flex; flex-direction: column; align-items: center;"><div style="border: 1px solid black; padding: 5px; margin-bottom: 5px;">Command</div><div style="border: 1px solid black; padding: 5px; margin-bottom: 5px;">Parameter</div><div style="border: 1px solid black; padding: 5px; margin-bottom: 5px;">Display</div><div style="border: 1px solid black; padding: 5px; margin-bottom: 5px;">Action</div><div style="border: 1px solid black; padding: 5px; margin-bottom: 5px;">Mode</div><div style="border: 1px solid black; padding: 5px;">Sequential transfer</div></div></div></div></div> |     |     |        |    |    |              |    |    |    |    |    |     |

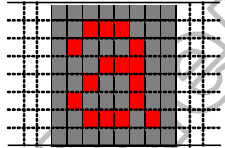
## 6.2.21 Set\_display\_on (29h)

| 29H                     | DISPON (Display On)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |     |     |        |    |     |              |    |    |    |    |    |     |
|-------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|-----|--------|----|-----|--------------|----|----|----|----|----|-----|
|                         | D/CX                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | RDX | WRX | D15-D8 | D7 | D6  | D5           | D4 | D3 | D2 | D1 | D0 | HEX |
| Command                 | 0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | 1   | ↑   | -      | 0  | 0   | 1            | 0  | 1  | 0  | 0  | 1  | 29  |
| Parameter               | NO PARAMETER                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |     |     |        |    |     |              |    |    |    |    |    |     |
| Description             | <p>This command is used to recover from DISPLAY OFF mode. Output from the Frame Memory is enabled.</p> <p>This command makes no change of contents of frame memory.</p> <p>This command does not change any other status.</p> <p>(Example)</p> <div><div><p>Memory</p></div><div></div><div><p>Display</p></div></div> |     |     |        |    |     |              |    |    |    |    |    |     |
|                         | Restriction                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |     |     |        |    |     |              |    |    |    |    |    |     |
| Register Availability   | This command has no effect when module is already in display on mode.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |     |     |        |    |     |              |    |    |    |    |    |     |
|                         | Status                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |     |     |        |    |     | Availability |    |    |    |    |    |     |
|                         | Normal Mode On, Idle Mode Off, Sleep Out                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |     |     |        |    |     | Yes          |    |    |    |    |    |     |
|                         | Normal Mode On, Idle Mode On, Sleep Out                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |     |     |        |    |     | Yes          |    |    |    |    |    |     |
|                         | Partial Mode On, Idle Mode Off, Sleep Out                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |     |     |        |    |     | Yes          |    |    |    |    |    |     |
|                         | Partial Mode On, Idle Mode On, Sleep Out                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |     |     |        |    |     | Yes          |    |    |    |    |    |     |
| Sleep In or Booster Off |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |     |     |        |    | Yes |              |    |    |    |    |    |     |
| Default                 | N/A                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |     |     |        |    |     |              |    |    |    |    |    |     |
| Flow Chart              | <div><div></div><div><p>Legend</p><div><p>Command</p></div><div><p>Parameter</p></div><div><p>Display</p></div><div><p>Action</p></div><div><p>Mode</p></div><div><p>Sequential transfer</p></div></div></div>                                                                                                                                                                                                                                                                          |     |     |        |    |     |              |    |    |    |    |    |     |

## 6.2.22 Set\_column\_address (2Ah)

| 2AH                                       | CASET (Column Address Set)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |     |     |        |      |      |      |      |      |      |     |     |        |        |              |                                          |     |                                         |     |                                           |     |                                          |     |                         |     |
|-------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|-----|--------|------|------|------|------|------|------|-----|-----|--------|--------|--------------|------------------------------------------|-----|-----------------------------------------|-----|-------------------------------------------|-----|------------------------------------------|-----|-------------------------|-----|
|                                           | D/CX                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | RDX | WRX | D15-D8 | D7   | D6   | D5   | D4   | D3   | D2   | D1  | D0  | HEX    |        |              |                                          |     |                                         |     |                                           |     |                                          |     |                         |     |
| Command                                   | 0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | 1   | ↑   | -      | 0    | 0    | 1    | 0    | 1    | 0    | 1   | 0   | 2A     |        |              |                                          |     |                                         |     |                                           |     |                                          |     |                         |     |
| 1 <sup>st</sup> parameter                 | 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | 1   | ↑   | -      | SC15 | SC14 | SC13 | SC12 | SC11 | SC10 | SC9 | SC8 | 00..   |        |              |                                          |     |                                         |     |                                           |     |                                          |     |                         |     |
| 2 <sup>nd</sup> parameter                 | 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | 1   | ↑   | -      | SC7  | SC6  | SC5  | SC4  | SC3  | SC2  | SC1 | SC0 | Note 1 |        |              |                                          |     |                                         |     |                                           |     |                                          |     |                         |     |
| 3 <sup>rd</sup> parameter                 | 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | 1   | ↑   | -      | EC15 | EC14 | EC13 | EC12 | EC11 | EC10 | EC9 | EC8 | 00 ..  |        |              |                                          |     |                                         |     |                                           |     |                                          |     |                         |     |
| 4 <sup>th</sup> parameter                 | 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | 1   | ↑   | -      | EC7  | EC6  | EC5  | EC4  | EC3  | EC2  | EC1 | EC0 | Note 1 |        |              |                                          |     |                                         |     |                                           |     |                                          |     |                         |     |
| Description                               | <p>This command is used to define area of frame memory where MCU can access.<br/>This command makes no change on the other driver status.<br/>The values of SC[15:0] and EC[15:0] are referred when RAMWR command comes. Each value represents one column line in the Frame Memory.</p> <p>(Example)</p>                                                                                                                                       |     |     |        |      |      |      |      |      |      |     |     |        |        |              |                                          |     |                                         |     |                                           |     |                                          |     |                         |     |
| Restriction                               | <p>SC[15:0] always must be equal to or less than EC[15:0]<br/>Note 1: When SC[15:0] or EC[15:0] is greater than horizontal line (when MADCTL's B5=0) or vertical line (when MADCTL's B5=1), data of out of range will be ignored.</p>                                                                                                                                                                                                                                                                                            |     |     |        |      |      |      |      |      |      |     |     |        |        |              |                                          |     |                                         |     |                                           |     |                                          |     |                         |     |
| Register Availability                     | <table><tr><th>Status</th><th>Availability</th></tr><tr><td>Normal Mode On, Idle Mode Off, Sleep Out</td><td>Yes</td></tr><tr><td>Normal Mode On, Idle Mode On, Sleep Out</td><td>Yes</td></tr><tr><td>Partial Mode On, Idle Mode Off, Sleep Out</td><td>Yes</td></tr><tr><td>Partial Mode On, Idle Mode On, Sleep Out</td><td>Yes</td></tr><tr><td>Sleep In or Booster Off</td><td>Yes</td></tr></table>                                                                                                                        |     |     |        |      |      |      |      |      |      |     |     |        | Status | Availability | Normal Mode On, Idle Mode Off, Sleep Out | Yes | Normal Mode On, Idle Mode On, Sleep Out | Yes | Partial Mode On, Idle Mode Off, Sleep Out | Yes | Partial Mode On, Idle Mode On, Sleep Out | Yes | Sleep In or Booster Off | Yes |
| Status                                    | Availability                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |     |     |        |      |      |      |      |      |      |     |     |        |        |              |                                          |     |                                         |     |                                           |     |                                          |     |                         |     |
| Normal Mode On, Idle Mode Off, Sleep Out  | Yes                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |     |     |        |      |      |      |      |      |      |     |     |        |        |              |                                          |     |                                         |     |                                           |     |                                          |     |                         |     |
| Normal Mode On, Idle Mode On, Sleep Out   | Yes                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |     |     |        |      |      |      |      |      |      |     |     |        |        |              |                                          |     |                                         |     |                                           |     |                                          |     |                         |     |
| Partial Mode On, Idle Mode Off, Sleep Out | Yes                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |     |     |        |      |      |      |      |      |      |     |     |        |        |              |                                          |     |                                         |     |                                           |     |                                          |     |                         |     |
| Partial Mode On, Idle Mode On, Sleep Out  | Yes                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |     |     |        |      |      |      |      |      |      |     |     |        |        |              |                                          |     |                                         |     |                                           |     |                                          |     |                         |     |
| Sleep In or Booster Off                   | Yes                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |     |     |        |      |      |      |      |      |      |     |     |        |        |              |                                          |     |                                         |     |                                           |     |                                          |     |                         |     |
| Default                                   | <p>RES_SEL[2:0]=000, Resoulution 480RGBx864: SC[15:0] = 0x0000h, EC[15:0] = 0x01DFh<br/>RES_SEL[2:0]=001, Resoulution 480RGBx854: SC[15:0] = 0x0000h, EC[15:0] = 0x01DFh<br/>RES_SEL[2:0]=010, Resoulution 480RGBx800: SC[15:0] = 0x0000h, EC[15:0] = 0x01DFh<br/>RES_SEL[2:0]=011, Resoulution 480RGBx640: SC[15:0] = 0x0000h, EC[15:0] = 0x01DFh<br/>RES_SEL[2:0]=100, Resoulution 360RGBx640: SC[15:0] = 0x0000h, EC[15:0] = 0x0167h<br/>RES_SEL[2:0]=101, Resoulution 480RGBx720: SC[15:0] = 0x0000h, EC[15:0] = 0x01DFh</p> |     |     |        |      |      |      |      |      |      |     |     |        |        |              |                                          |     |                                         |     |                                           |     |                                          |     |                         |     |
| Flow Chart                                |                                                                                                                                                                                                                                                                                                                                                                                                                                              |     |     |        |      |      |      |      |      |      |     |     |        |        |              |                                          |     |                                         |     |                                           |     |                                          |     |                         |     |

### 6.2.23 Set\_page\_address (2BH)

| 2BH                       | PASET (Page Address Set)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |     |     |        |      |      |              |      |      |      |     |     |                 |
|---------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|-----|--------|------|------|--------------|------|------|------|-----|-----|-----------------|
|                           | D/CX                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | RDX | WRX | D15-D8 | D7   | D6   | D5           | D4   | D3   | D2   | D1  | D0  | HEX             |
| Command                   | 0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | 1   | ↑   | -      | 0    | 0    | 1            | 0    | 1    | 0    | 1   | 1   | 2B              |
| 1 <sup>st</sup> parameter | 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | 1   | ↑   | -      | SP15 | SP14 | SP13         | SP12 | SP11 | SP10 | SP9 | SP8 | 00 ..           |
| 2 <sup>nd</sup> parameter | 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | 1   | ↑   | -      | SP7  | SP6  | SP5          | SP4  | SP3  | SP2  | SP1 | SP0 | Note 1          |
| 3 <sup>rd</sup> parameter | 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | 1   | ↑   | -      | EP15 | EP14 | EP13         | EP12 | EP11 | EP10 | EP9 | EP8 | 00 ..<br>Note 1 |
| 4 <sup>th</sup> parameter | 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | 1   | ↑   | -      | EP7  | EP6  | EP5          | EP4  | EP3  | EP2  | EP1 | EP0 |                 |
| Description               | <p>This command is used to define area of frame memory where MCU can access.<br/>This command makes no change on the other driver status.<br/>The values of SP[15:0] and EP[15:0] are referred when RAMWR command comes.<br/>Each value represents one Page line in the Frame Memory.</p> <p>(Example)</p> <div><div>SP[15:0]</div><div>EP[15:0]</div></div>                                                                                                                                                                               |     |     |        |      |      |              |      |      |      |     |     |                 |
| Restriction               | SP[15:0] always must be equal to or less than EP[15:0]<br>Note 1: When SP[15:0] or EP[15:0] is greater than vertical line (When MADCTL's B5=0) or horizontal line (When MADCTL's B5=1), data of out of range will be ignored.                                                                                                                                                                                                                                                                                                                                                                                                |     |     |        |      |      |              |      |      |      |     |     |                 |
| Register Availability     | Status                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |     |     |        |      |      | Availability |      |      |      |     |     |                 |
|                           | Normal Mode On, Idle Mode Off, Sleep Out                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |     |     |        |      |      | Yes          |      |      |      |     |     |                 |
|                           | Normal Mode On, Idle Mode On, Sleep Out                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |     |     |        |      |      | Yes          |      |      |      |     |     |                 |
|                           | Partial Mode On, Idle Mode Off, Sleep Out                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |     |     |        |      |      | Yes          |      |      |      |     |     |                 |
|                           | Partial Mode On, Idle Mode On, Sleep Out                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |     |     |        |      |      | Yes          |      |      |      |     |     |                 |
| Default                   | RES_SEL[2:0]=000, Resoultion 480RGBx864: SP[15:0] = 0x0000h, EP[15:0] = 0x035Fh<br>RES_SEL[2:0]=001, Resoultion 480RGBx854: SP[15:0] = 0x0000h, EP[15:0] = 0x0355h<br>RES_SEL[2:0]=010, Resoultion 480RGBx800: SP[15:0] = 0x0000h, EP[15:0] = 0x031Fh<br>RES_SEL[2:0]=011, Resoultion 480RGBx640: SP[15:0] = 0x0000h, EP[15:0] = 0x027Fh<br>RES_SEL[2:0]=100, Resoultion 360RGBx640: SP[15:0] = 0x0000h, EP[15:0] = 0x027Fh<br>RES_SEL[2:0]=101, Resoultion 480RGBx720: SP[15:0] = 0x0000h, EP[15:0] = 0x02CFh                                                                                                               |     |     |        |      |      |              |      |      |      |     |     |                 |
| Flow Chart                | <div><div><div>CASET</div><div>1<sup>st</sup> &amp; 2<sup>nd</sup> parameter SC [15:0]<br/>3<sup>rd</sup> &amp; 4<sup>th</sup> parameter EC [15:0]</div><div>RASET</div><div>1<sup>st</sup> &amp; 2<sup>nd</sup> parameter SP [15:0]<br/>3<sup>rd</sup> &amp; 4<sup>th</sup> parameter EP [15:0]</div><div>RAMWR</div><div>Image Data<br/>D1[17:0], D2[17:0],<br/>..., Dn[17:0]</div><div>Any Command</div></div><div><div>IF Needed</div><div>IF Needed</div></div><div><div>Legend</div><div>Command</div><div>Parameter</div><div>Display</div><div>Action</div><div>Mode</div><div>Sequential transfer</div></div></div> |     |     |        |      |      |              |      |      |      |     |     |                 |



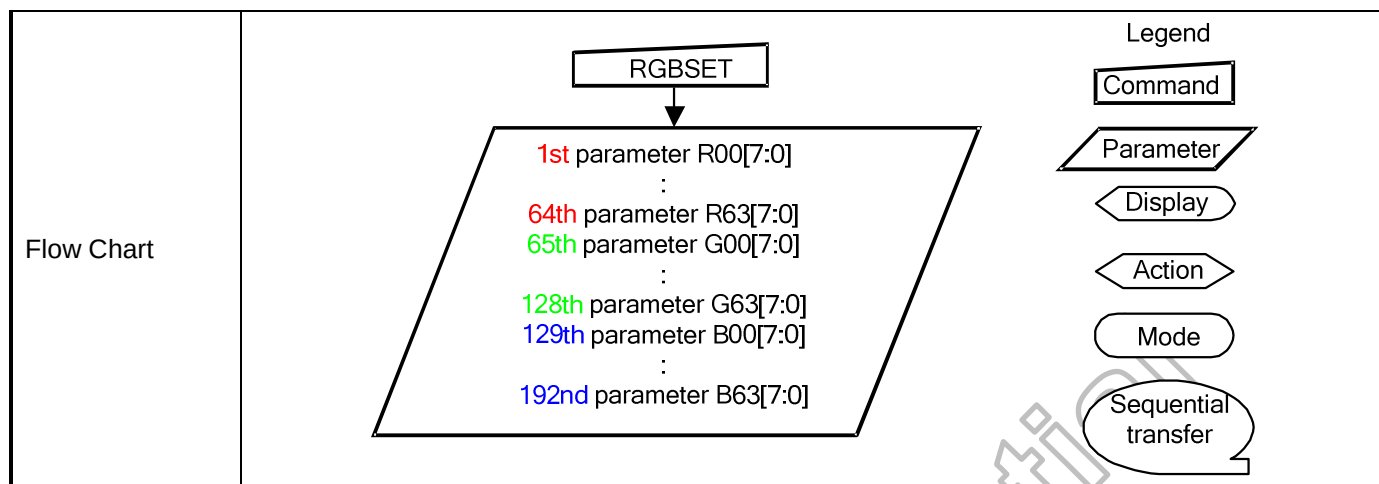
## 6.2.24 Write\_memory\_start (2Ch)

| 2CH                       | RAMWR (Memory Write)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |     |     |        |     |     |              |     |     |     |     |     |        |
|---------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|-----|--------|-----|-----|--------------|-----|-----|-----|-----|-----|--------|
|                           | D/CX                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | RDX | WRX | D15-D8 | D7  | D6  | D5           | D4  | D3  | D2  | D1  | D0  | HEX    |
| Command                   | 0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | 1   | ↑   | -      | 0   | 0   | 1            | 0   | 1   | 1   | 0   | 0   | 2C     |
| 1 <sup>st</sup> parameter | 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | 1   | ↑   | -      | D17 | D16 | D15          | D14 | D13 | D12 | D11 | D10 | 00..FF |
| :                         | 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | 1   | ↑   | -      | Dx7 | Dx6 | Dx5          | Dx4 | Dx3 | Dx2 | Dx1 | Dx0 | 00..FF |
| N <sup>th</sup> parameter | 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | 1   | ↑   | -      | Dn7 | Dn6 | Dn5          | Dn4 | Dn3 | Dn2 | Dn1 | Dn0 | 00..FF |
| Description               | <p>This command transfers image data from the host processor to the display module's frame memory starting at the pixel location specified by preceding set_column_address and set_page_address commands.</p> <p>The column and page registers are reset to the Start Column (SC) and Start Page (SP), respectively.</p> <p>Pixel Data 1 is stored in frame memory at (SC, SP). The column register is then incremented and pixels are written to the frame memory until the column register equals the End Column (EC) value. The column register is then reset to SC and the page register is incremented. Pixels are written to the frame memory until the page register equals the End Page (EP) value or the host processor sends another command.</p> <p>If the number of pixels exceeds (EC – SC + 1) * (EP – SP + 1) the extra pixels are ignored.</p> |     |     |        |     |     |              |     |     |     |     |     |        |
| Restriction               | In all colour modes, there is no restriction on length of parameters.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |     |     |        |     |     |              |     |     |     |     |     |        |
| Register Availability     | Status                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |     |     |        |     |     | Availability |     |     |     |     |     |        |
|                           | Normal Mode On, Idle Mode Off, Sleep Out                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |     |     |        |     |     | Yes          |     |     |     |     |     |        |
|                           | Normal Mode On, Idle Mode On, Sleep Out                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |     |     |        |     |     | Yes          |     |     |     |     |     |        |
|                           | Partial Mode On, Idle Mode Off, Sleep Out                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |     |     |        |     |     | Yes          |     |     |     |     |     |        |
|                           | Partial Mode On, Idle Mode On, Sleep Out                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |     |     |        |     |     | Yes          |     |     |     |     |     |        |
| Default                   | Contents of memory is set randomly and not cleared.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |     |     |        |     |     |              |     |     |     |     |     |        |
| Flow Chart                | <div><div><div>RAMWR</div><div>↓</div><div>Image Data<br/>D1[7:0],D2[7:0],<br/>...,Dn[7:0]</div><div>↓</div><div>Any Command</div></div><div><div>Legend</div><div>Command</div><div>Parameter</div><div>Display</div><div>Action</div><div>Mode</div><div>Sequential transfer</div></div></div>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |     |     |        |     |     |              |     |     |     |     |     |        |

## 6.2.25 Colour Set (2Dh)

| 2DH                         | COLSET (Colour Set)                                                                                                                                                                                                                                                                                                                                                                                 |                  |                     |          |                     |                     |      |      |      |      |      |      |        |
|-----------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------|---------------------|----------|---------------------|---------------------|------|------|------|------|------|------|--------|
|                             | DNC                                                                                                                                                                                                                                                                                                                                                                                                 | NRD              | NWR                 | D8~D15   | D7                  | D6                  | D5   | D4   | D3   | D2   | D1   | D0   | HEX    |
| Command                     | 0                                                                                                                                                                                                                                                                                                                                                                                                   | 1                | ↑                   | -        | 0                   | 0                   | 1    | 0    | 1    | 1    | 0    | 1    | 2D     |
| 1 <sup>st</sup> parameter   | 1                                                                                                                                                                                                                                                                                                                                                                                                   | 1                | ↑                   | -        | R007                | R006                | R005 | R004 | R003 | R002 | R001 | R000 | 00..FF |
| :                           | 1                                                                                                                                                                                                                                                                                                                                                                                                   | 1                | ↑                   | -        | Rnn7                | Rnn6                | Rnn5 | Rnn4 | Rnn3 | Rnn2 | Rnn1 | Rnn0 | 00..FF |
| 64 <sup>th</sup> parameter  | 1                                                                                                                                                                                                                                                                                                                                                                                                   | 1                | ↑                   | -        | R637                | R636                | R635 | R634 | R633 | R632 | R631 | R630 | 00..FF |
| 65 <sup>th</sup> parameter  | 1                                                                                                                                                                                                                                                                                                                                                                                                   | 1                | ↑                   | -        | G007                | G006                | G005 | G004 | G003 | G002 | G001 | G000 | 00..FF |
| :                           | 1                                                                                                                                                                                                                                                                                                                                                                                                   | 1                | ↑                   | -        | Gnn7                | Gnn6                | Gnn5 | Gnn4 | Gnn3 | Gnn2 | Gnn1 | Gnn0 | 00..FF |
| 128 <sup>th</sup> parameter | 1                                                                                                                                                                                                                                                                                                                                                                                                   | 1                | ↑                   | -        | G637                | G636                | G635 | G634 | G633 | G632 | G631 | G630 | 00..FF |
| 129 <sup>th</sup> parameter | 1                                                                                                                                                                                                                                                                                                                                                                                                   | 1                | ↑                   | -        | B007                | B006                | B005 | B004 | B003 | B002 | B001 | B000 | 00..FF |
| :                           | 1                                                                                                                                                                                                                                                                                                                                                                                                   | 1                | ↑                   | -        | Bnn7                | Bnn6                | Bnn5 | Bnn4 | Bnn3 | Bnn2 | Bnn1 | Bnn0 | 00..FF |
| 192 <sup>nd</sup> parameter | 1                                                                                                                                                                                                                                                                                                                                                                                                   | 1                | ↑                   | -        | B637                | B636                | B635 | B634 | B633 | B632 | B631 | B630 | 00..FF |
| Description                 | This command is used to define the LUT for 18bit to 24bit, 16bit-to-24bit colour depth conversions colour depth conversions. 192bytes must be written to the LUT regardless of the colour mode. This command has no effect on other commands/parameters and Contents of frame memory. Visible change takes effect next time the Frame Memory is written to.                                         |                  |                     |          |                     |                     |      |      |      |      |      |      |        |
| Restriction                 | This command is needed to be set in write_data for RGB 5-6-5 (65K colours) and RGB 6-6-6 (262K colours) pixel format.<br>The default for command Colour Set (2Dh) is 0x00h. The colour depth conversion must be followed the below tables.<br>Once write data is RGB 5-6-5 (65K colours), the set pixel format 0x3A=0x05h command must be set and using the 16bit-to-24bit colour depth conversion. |                  |                     |          |                     |                     |      |      |      |      |      |      |        |
|                             | R-G-B=5-6-5                                                                                                                                                                                                                                                                                                                                                                                         | RGBSET parameter | 24- bit /pixel mode | LUT      | 24-bit /pixel value | Input 16-bit /pixel |      |      |      |      |      |      |        |
|                             | R                                                                                                                                                                                                                                                                                                                                                                                                   | 1                | R00[7:0]            | 00000000 | 00000               |                     |      |      |      |      |      |      |        |
|                             |                                                                                                                                                                                                                                                                                                                                                                                                     | 2                | R01[7:0]            | 00001000 | 00001               |                     |      |      |      |      |      |      |        |
|                             |                                                                                                                                                                                                                                                                                                                                                                                                     | 3                | R02[7:0]            | 00010000 | 00010               |                     |      |      |      |      |      |      |        |
|                             |                                                                                                                                                                                                                                                                                                                                                                                                     | ..               | ..                  | ..       | ..                  |                     |      |      |      |      |      |      |        |
|                             |                                                                                                                                                                                                                                                                                                                                                                                                     | ..               | ..                  | ..       | ..                  |                     |      |      |      |      |      |      |        |
|                             |                                                                                                                                                                                                                                                                                                                                                                                                     | 30               | R29[7:0]            | 11101111 | 11101               |                     |      |      |      |      |      |      |        |
|                             |                                                                                                                                                                                                                                                                                                                                                                                                     | 31               | R30[7:0]            | 11110111 | 11110               |                     |      |      |      |      |      |      |        |
|                             |                                                                                                                                                                                                                                                                                                                                                                                                     | 32               | R31[7:0]            | 11111111 | 11111               |                     |      |      |      |      |      |      |        |
|                             |                                                                                                                                                                                                                                                                                                                                                                                                     | 33               | Not Used            | Not Used | Not Used            |                     |      |      |      |      |      |      |        |
|                             |                                                                                                                                                                                                                                                                                                                                                                                                     | 34               |                     |          |                     |                     |      |      |      |      |      |      |        |
|                             |                                                                                                                                                                                                                                                                                                                                                                                                     | 35               |                     |          |                     |                     |      |      |      |      |      |      |        |
|                             |                                                                                                                                                                                                                                                                                                                                                                                                     | ..               |                     |          |                     |                     |      |      |      |      |      |      |        |
|                             |                                                                                                                                                                                                                                                                                                                                                                                                     | ..               |                     |          |                     |                     |      |      |      |      |      |      |        |
|                             |                                                                                                                                                                                                                                                                                                                                                                                                     | 62               |                     |          |                     |                     |      |      |      |      |      |      |        |
|                             |                                                                                                                                                                                                                                                                                                                                                                                                     | 63               |                     |          |                     |                     |      |      |      |      |      |      |        |
|                             |                                                                                                                                                                                                                                                                                                                                                                                                     | 64               |                     |          |                     |                     |      |      |      |      |      |      |        |
|                             | G                                                                                                                                                                                                                                                                                                                                                                                                   | 65               | G00[7:0]            | 00000000 | 000000              |                     |      |      |      |      |      |      |        |
|                             |                                                                                                                                                                                                                                                                                                                                                                                                     | 66               | G01[7:0]            | 00000100 | 000001              |                     |      |      |      |      |      |      |        |
|                             |                                                                                                                                                                                                                                                                                                                                                                                                     | 67               | G02[7:0]            | 00001000 | 000010              |                     |      |      |      |      |      |      |        |
|                             |                                                                                                                                                                                                                                                                                                                                                                                                     | ..               | ..                  | ..       | ..                  |                     |      |      |      |      |      |      |        |
|                             |                                                                                                                                                                                                                                                                                                                                                                                                     | ..               | ..                  | ..       | ..                  |                     |      |      |      |      |      |      |        |
|                             |                                                                                                                                                                                                                                                                                                                                                                                                     | 126              | G61[7:0]            | 11110111 | 111101              |                     |      |      |      |      |      |      |        |
|                             |                                                                                                                                                                                                                                                                                                                                                                                                     | 127              | G62[7:0]            | 11111011 | 111110              |                     |      |      |      |      |      |      |        |
|                             |                                                                                                                                                                                                                                                                                                                                                                                                     | 128              | G63[7:0]            | 11111111 | 111111              |                     |      |      |      |      |      |      |        |
|                             | B                                                                                                                                                                                                                                                                                                                                                                                                   | 129              | B00[7:0]            | 00000000 | 00000               |                     |      |      |      |      |      |      |        |
| 130                         |                                                                                                                                                                                                                                                                                                                                                                                                     | B01[7:0]         | 00001000            | 00001    |                     |                     |      |      |      |      |      |      |        |
| 131                         |                                                                                                                                                                                                                                                                                                                                                                                                     | B02[7:0]         | 00010000            | 00010    |                     |                     |      |      |      |      |      |      |        |
| ..                          |                                                                                                                                                                                                                                                                                                                                                                                                     | ..               | ..                  | ..       |                     |                     |      |      |      |      |      |      |        |
| ..                          |                                                                                                                                                                                                                                                                                                                                                                                                     | ..               | ..                  | ..       |                     |                     |      |      |      |      |      |      |        |
| 158                         |                                                                                                                                                                                                                                                                                                                                                                                                     | B29[7:0]         | 11101111            | 11101    |                     |                     |      |      |      |      |      |      |        |
| 159                         |                                                                                                                                                                                                                                                                                                                                                                                                     | B30[7:0]         | 11110111            | 11110    |                     |                     |      |      |      |      |      |      |        |
| 160                         |                                                                                                                                                                                                                                                                                                                                                                                                     | B31[7:0]         | 11111111            | 11111    |                     |                     |      |      |      |      |      |      |        |
| 161                         |                                                                                                                                                                                                                                                                                                                                                                                                     | Not Used         | Not Used            | Not Used |                     |                     |      |      |      |      |      |      |        |
| 162                         |                                                                                                                                                                                                                                                                                                                                                                                                     |                  |                     |          |                     |                     |      |      |      |      |      |      |        |
| 163                         |                                                                                                                                                                                                                                                                                                                                                                                                     |                  |                     |          |                     |                     |      |      |      |      |      |      |        |

|                                                                                                                                                       |                                           |                  |                     |                                                      |                     |  |
|-------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------|------------------|---------------------|------------------------------------------------------|---------------------|--|
|                                                                                                                                                       |                                           | ..               |                     |                                                      |                     |  |
|                                                                                                                                                       |                                           | ..               |                     |                                                      |                     |  |
|                                                                                                                                                       |                                           | 190              |                     |                                                      |                     |  |
|                                                                                                                                                       |                                           | 191              |                     |                                                      |                     |  |
|                                                                                                                                                       |                                           | 192              |                     |                                                      |                     |  |
| Once write data is RGB 5-6-5 (65K colours), the set pixel format 0x3A=0x06h command must be set and using the 18bit-to-24bit colour depth conversion. |                                           |                  |                     |                                                      |                     |  |
|                                                                                                                                                       | R-G-B=6-6-6                               | RGBSET parameter | 24- bit /pixel mode | LUT 24-bit /pixel value                              | Input 18-bit /pixel |  |
| R                                                                                                                                                     | 1                                         |                  | R00[7:0]            | 00000000                                             | 000000              |  |
|                                                                                                                                                       | 2                                         |                  | R01[7:0]            | 00000100                                             | 000001              |  |
|                                                                                                                                                       | 3                                         |                  | R02[7:0]            | 00001000                                             | 000010              |  |
|                                                                                                                                                       | ..                                        |                  | ..                  | ..                                                   | ..                  |  |
|                                                                                                                                                       | ..                                        |                  | ..                  | ..                                                   | ..                  |  |
|                                                                                                                                                       | 62                                        |                  | R61[7:0]            | 11110111                                             | 111101              |  |
|                                                                                                                                                       | 63                                        |                  | R62[7:0]            | 11111011                                             | 111110              |  |
|                                                                                                                                                       | 64                                        |                  | R63[7:0]            | 11111111                                             | 111111              |  |
| G                                                                                                                                                     | 65                                        |                  | G00[7:0]            | 00000000                                             | 000000              |  |
|                                                                                                                                                       | 66                                        |                  | G01[7:0]            | 00000100                                             | 000001              |  |
|                                                                                                                                                       | 67                                        |                  | G02[7:0]            | 00001000                                             | 000010              |  |
|                                                                                                                                                       | ..                                        |                  | ..                  | ..                                                   | ..                  |  |
|                                                                                                                                                       | ..                                        |                  | ..                  | ..                                                   | ..                  |  |
|                                                                                                                                                       | 126                                       |                  | G61[7:0]            | 11110111                                             | 111101              |  |
|                                                                                                                                                       | 127                                       |                  | G62[7:0]            | 11111011                                             | 111110              |  |
|                                                                                                                                                       | 128                                       |                  | G63[7:0]            | 11111111                                             | 111111              |  |
| B                                                                                                                                                     | 129                                       |                  | B00[7:0]            | 00000000                                             | 000000              |  |
|                                                                                                                                                       | 130                                       |                  | B01[7:0]            | 00000100                                             | 000001              |  |
|                                                                                                                                                       | 131                                       |                  | B02[7:0]            | 00001000                                             | 000010              |  |
|                                                                                                                                                       | ..                                        |                  | ..                  | ..                                                   | ..                  |  |
|                                                                                                                                                       | ..                                        |                  | ..                  | ..                                                   | ..                  |  |
|                                                                                                                                                       | 190                                       |                  | B61[7:0]            | 11110111                                             | 111101              |  |
|                                                                                                                                                       | 191                                       |                  | B62[7:0]            | 11111011                                             | 111110              |  |
|                                                                                                                                                       | 192                                       |                  | B63[7:0]            | 11111111                                             | 111111              |  |
| Register Availability                                                                                                                                 | Status                                    |                  |                     | Availability                                         |                     |  |
|                                                                                                                                                       | Normal Mode On, Idle Mode Off, Sleep Out  |                  |                     | Yes                                                  |                     |  |
|                                                                                                                                                       | Normal Mode On, Idle Mode On, Sleep Out   |                  |                     | Yes                                                  |                     |  |
|                                                                                                                                                       | Partial Mode On, Idle Mode Off, Sleep Out |                  |                     | Yes                                                  |                     |  |
|                                                                                                                                                       | Partial Mode On, Idle Mode On, Sleep Out  |                  |                     | Yes                                                  |                     |  |
|                                                                                                                                                       | Sleep In or Booster Off                   |                  |                     | Yes                                                  |                     |  |
| Default                                                                                                                                               | Status                                    |                  |                     | Default value                                        |                     |  |
|                                                                                                                                                       | SW Reset                                  |                  |                     | Contents of the look-up table protected              |                     |  |
|                                                                                                                                                       | H/W Reset                                 |                  |                     | R00[7:0]~R63[7:0] =0x00h                             |                     |  |
|                                                                                                                                                       |                                           |                  |                     | G00[7:0]~G63[7:0] =0x00h<br>B00[7:0]~B63[7:0] =0x00h |                     |  |

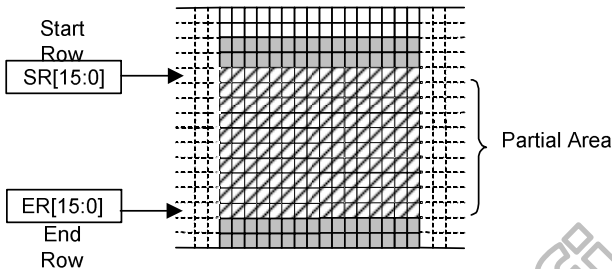
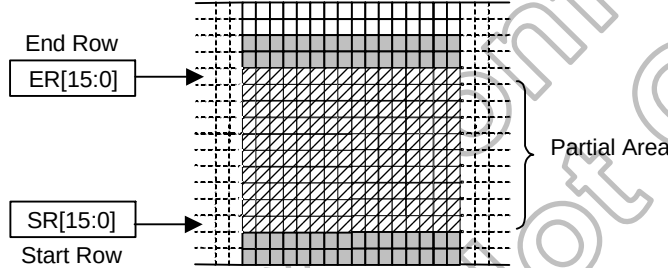
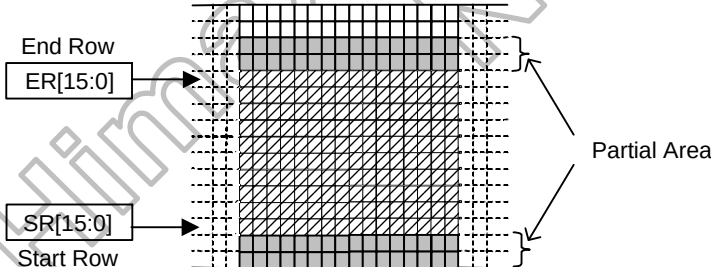


Himax Confidential  
Do Not Copy

## 6.2.26 Raed\_memory\_start (2Eh)

| 2EH                                       | RAMRD (Memory Read)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |     |     |        |     |     |     |     |     |     |     |     |            |        |              |                                          |     |                                         |     |                                           |     |                                          |     |                         |     |
|-------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|-----|--------|-----|-----|-----|-----|-----|-----|-----|-----|------------|--------|--------------|------------------------------------------|-----|-----------------------------------------|-----|-------------------------------------------|-----|------------------------------------------|-----|-------------------------|-----|
|                                           | D/CX                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | RDX | WRX | D15-D8 | D7  | D6  | D5  | D4  | D3  | D2  | D1  | D0  | HEX        |        |              |                                          |     |                                         |     |                                           |     |                                          |     |                         |     |
| Command                                   | 0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | 1   | ↑   | -      | 0   | 0   | 1   | 0   | 1   | 1   | 1   | 0   | 2E         |        |              |                                          |     |                                         |     |                                           |     |                                          |     |                         |     |
| 1 <sup>st</sup> parameter                 | 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | ↑   | 1   | -      | X   | X   | X   | X   | X   | X   | X   | X   | Dummy read |        |              |                                          |     |                                         |     |                                           |     |                                          |     |                         |     |
| 2 <sup>nd</sup> parameter                 | 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | ↑   | 1   | -      | D17 | D16 | D15 | D14 | D13 | D12 | D11 | D10 | 00..FF     |        |              |                                          |     |                                         |     |                                           |     |                                          |     |                         |     |
| :                                         | 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | ↑   | 1   | -      | Dx7 | Dx6 | Dx5 | Dx4 | Dx3 | Dx2 | Dx1 | Dx0 | 00..FF     |        |              |                                          |     |                                         |     |                                           |     |                                          |     |                         |     |
| (n+1) <sup>th</sup> parameter             | 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | ↑   | 1   | -      | Dn7 | Dn6 | Dn5 | Dn4 | Dn3 | Dn2 | Dn1 | Dn0 | 00..FF     |        |              |                                          |     |                                         |     |                                           |     |                                          |     |                         |     |
| Description                               | <p>This command transfers image data from the display module's frame memory to the host processor starting at the pixel location specified by preceding set_column_address and set_page_address commands.</p> <p>The column and page registers are reset to the Start Column (SC) and Start Page (SP), respectively. Pixels are read from frame memory at (SC, SP). The column register is then incremented and pixels read from the frame memory until the column register equals the End Column (EC) value. The column register is then reset to SC and the page register is incremented.</p> <p>Pixels are read from the frame memory until the page register equals the End Page (EP) value or the host processor sends another command.</p> |     |     |        |     |     |     |     |     |     |     |     |            |        |              |                                          |     |                                         |     |                                           |     |                                          |     |                         |     |
| Restriction                               | In all colour modes, the Frame Read is always 24bit so there is no restriction on length of parameters.<br>Note – Memory Read is only possible via the Parallel Interface.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |     |     |        |     |     |     |     |     |     |     |     |            |        |              |                                          |     |                                         |     |                                           |     |                                          |     |                         |     |
| Register Availability                     | <table><tr><th>Status</th><th>Availability</th></tr><tr><td>Normal Mode On, Idle Mode Off, Sleep Out</td><td>Yes</td></tr><tr><td>Normal Mode On, Idle Mode On, Sleep Out</td><td>Yes</td></tr><tr><td>Partial Mode On, Idle Mode Off, Sleep Out</td><td>Yes</td></tr><tr><td>Partial Mode On, Idle Mode On, Sleep Out</td><td>Yes</td></tr><tr><td>Sleep In or Booster Off</td><td>Yes</td></tr></table>                                                                                                                                                                                                                                                                                                                                        |     |     |        |     |     |     |     |     |     |     |     |            | Status | Availability | Normal Mode On, Idle Mode Off, Sleep Out | Yes | Normal Mode On, Idle Mode On, Sleep Out | Yes | Partial Mode On, Idle Mode Off, Sleep Out | Yes | Partial Mode On, Idle Mode On, Sleep Out | Yes | Sleep In or Booster Off | Yes |
| Status                                    | Availability                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |     |     |        |     |     |     |     |     |     |     |     |            |        |              |                                          |     |                                         |     |                                           |     |                                          |     |                         |     |
| Normal Mode On, Idle Mode Off, Sleep Out  | Yes                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |     |     |        |     |     |     |     |     |     |     |     |            |        |              |                                          |     |                                         |     |                                           |     |                                          |     |                         |     |
| Normal Mode On, Idle Mode On, Sleep Out   | Yes                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |     |     |        |     |     |     |     |     |     |     |     |            |        |              |                                          |     |                                         |     |                                           |     |                                          |     |                         |     |
| Partial Mode On, Idle Mode Off, Sleep Out | Yes                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |     |     |        |     |     |     |     |     |     |     |     |            |        |              |                                          |     |                                         |     |                                           |     |                                          |     |                         |     |
| Partial Mode On, Idle Mode On, Sleep Out  | Yes                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |     |     |        |     |     |     |     |     |     |     |     |            |        |              |                                          |     |                                         |     |                                           |     |                                          |     |                         |     |
| Sleep In or Booster Off                   | Yes                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |     |     |        |     |     |     |     |     |     |     |     |            |        |              |                                          |     |                                         |     |                                           |     |                                          |     |                         |     |
| Default                                   | Contents of memory is set randomly and not cleared.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |     |     |        |     |     |     |     |     |     |     |     |            |        |              |                                          |     |                                         |     |                                           |     |                                          |     |                         |     |
| Flow Chart                                | <div><div><div>RAMRD</div><div>Dummy</div><div>Image Data<br/>D1[7:0],D2[7:0],<br/>...,Dn[7:0]</div><div>Any Command</div></div><div><div>Legend</div><div>Command</div><div>Parameter</div><div>Display</div><div>Action</div><div>Mode</div><div>Sequential transfer</div></div></div>                                                                                                                                                                                                                                                                                                                                                                                                                                                         |     |     |        |     |     |     |     |     |     |     |     |            |        |              |                                          |     |                                         |     |                                           |     |                                          |     |                         |     |

## 6.2.27 Set\_partial\_area (30h)

| 30H                                                                                  | PLTAR (Partial Area)                                                                                                                                                                                                                                                                                            |     |     |        |      |      |              |      |      |      |     |     |     |
|--------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|-----|--------|------|------|--------------|------|------|------|-----|-----|-----|
|                                                                                      | D/CX                                                                                                                                                                                                                                                                                                            | RDX | WRX | D15-D8 | D7   | D6   | D5           | D4   | D3   | D2   | D1  | D0  | HEX |
| Command                                                                              | 0                                                                                                                                                                                                                                                                                                               | 1   | ↑   | -      | 0    | 0    | 1            | 1    | 0    | 0    | 0   | 0   | 30  |
| 1 <sup>st</sup> parameter                                                            | 1                                                                                                                                                                                                                                                                                                               | 1   | ↑   | -      | SR15 | SR14 | SR13         | SR12 | SR11 | SR10 | SR9 | SR8 | xx  |
| 2 <sup>nd</sup> parameter                                                            | 1                                                                                                                                                                                                                                                                                                               | 1   | ↑   | -      | SR7  | SR6  | SR5          | SR4  | SR3  | SR2  | SR1 | SR0 | xx  |
| 3 <sup>rd</sup> parameter                                                            | 1                                                                                                                                                                                                                                                                                                               | 1   | ↑   | -      | ER15 | ER14 | ER13         | ER12 | ER11 | ER10 | ER9 | ER8 | xx  |
| 4 <sup>th</sup> parameter                                                            | 1                                                                                                                                                                                                                                                                                                               | 1   | ↑   | -      | ER7  | ER6  | ER5          | ER4  | ER3  | ER2  | ER1 | ER0 | xx  |
| Description                                                                          | This command defines the partial mode's display area. There are 4 parameters associated with this command, the first defines the Start Row (SR) and the second the End Row (ER), as illustrated in the figures below. SR and ER refer to the Frame Memory Line Pointer. If End Row>Start Row when MADCTL B4=0:- |     |     |        |      |      |              |      |      |      |     |     |     |
|                                                                                      |                                                                                                                                                                                                                                |     |     |        |      |      |              |      |      |      |     |     |     |
|                                                                                      | If End Row>Start Row when MADCTL B4=1:-                                                                                                                                                                                                                                                                         |     |     |        |      |      |              |      |      |      |     |     |     |
|                                                                                      |                                                                                                                                                                                                                               |     |     |        |      |      |              |      |      |      |     |     |     |
|                                                                                      | If End Row<Start Row when MADCTL B4=0:-                                                                                                                                                                                                                                                                         |     |     |        |      |      |              |      |      |      |     |     |     |
|  |                                                                                                                                                                                                                                                                                                                 |     |     |        |      |      |              |      |      |      |     |     |     |
| If End Row = Start Row then the Partial Area will be one row deep.                   |                                                                                                                                                                                                                                                                                                                 |     |     |        |      |      |              |      |      |      |     |     |     |
| Restriction                                                                          | SR[15..0] and ER[15..0] cannot be greater than horizontal line number.                                                                                                                                                                                                                                          |     |     |        |      |      |              |      |      |      |     |     |     |
| Register Availability                                                                | Status                                                                                                                                                                                                                                                                                                          |     |     |        |      |      | Availability |      |      |      |     |     |     |
|                                                                                      | Normal Mode On, Idle Mode Off, Sleep Out                                                                                                                                                                                                                                                                        |     |     |        |      |      | Yes          |      |      |      |     |     |     |
|                                                                                      | Normal Mode On, Idle Mode On, Sleep Out                                                                                                                                                                                                                                                                         |     |     |        |      |      | Yes          |      |      |      |     |     |     |
|                                                                                      | Partial Mode On, Idle Mode Off, Sleep Out                                                                                                                                                                                                                                                                       |     |     |        |      |      | Yes          |      |      |      |     |     |     |
|                                                                                      | Partial Mode On, Idle Mode On, Sleep Out                                                                                                                                                                                                                                                                        |     |     |        |      |      | Yes          |      |      |      |     |     |     |
|                                                                                      | Sleep In or Booster Off                                                                                                                                                                                                                                                                                         |     |     |        |      |      | Yes          |      |      |      |     |     |     |

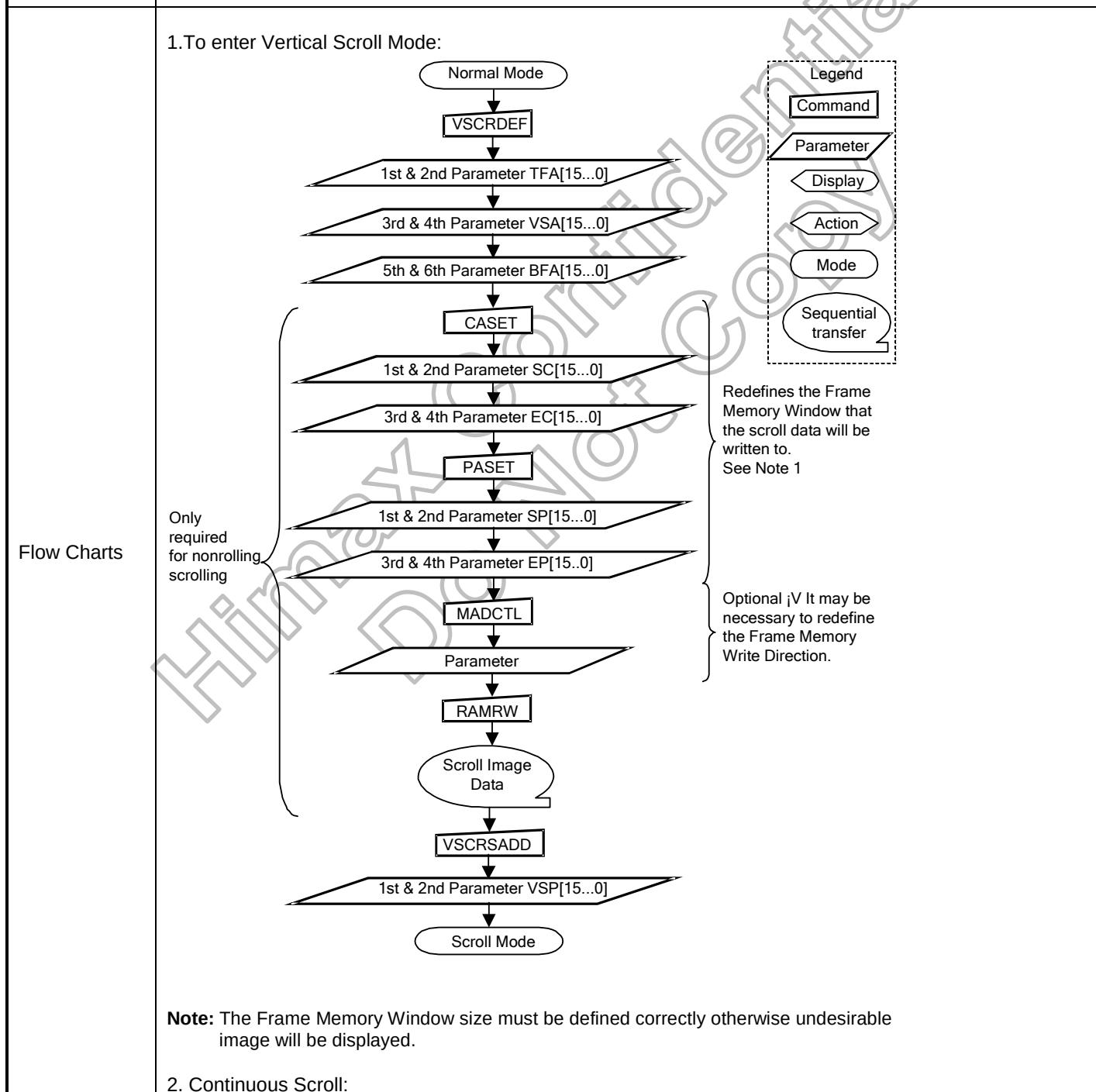
|            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Default    | <p>RES_SEL[2:0]=000, Resoulution 480RGBx864: SR[15:0] = 0x0000h, ER[15:0] = 0x035Fh<br/> RES_SEL[2:0]=001, Resoulution 480RGBx854: SR[15:0] = 0x0000h, ER[15:0] = 0x0355h<br/> RES_SEL[2:0]=010, Resoulution 480RGBx800: SR[15:0] = 0x0000h, ER[15:0] = 0x031Fh<br/> RES_SEL[2:0]=011, Resoulution 480RGBx640: SR[15:0] = 0x0000h, ER[15:0] = 0x027Fh<br/> RES_SEL[2:0]=100, Resoulution 360RGBx640: SR[15:0] = 0x0000h, ER[15:0] = 0x027Fh<br/> RES_SEL[2:0]=101, Resoulution 480RGBx720: SR[15:0] = 0x0000h, ER[15:0] = 0x02CFh</p>                                                                                                                                                                                                                                               |
| Flow Chart | <p>1. To Enter Partial Mode:-</p> <pre> graph TD     PLTAR[PLTAR] --&gt; SR[/SR[15...0]/]     SR --&gt; ER[/ER[15...0]/]     ER --&gt; PTLON[PTLON]     PTLON --&gt; PM([Partial Mode])     </pre> <p>2. To Leave Partial Mode</p> <pre> graph TD     PM([Partial Mode]) --&gt; DISPOFF[DISPOFF]     DISPOFF --&gt; NORON[NORON]     NORON --&gt; PMOFF([Partial Mode OFF])     PMOFF --&gt; RAMRW[RAMRW]     RAMRW --&gt; ID[/Image Data<br/>D1[17:0], D2[17:0],<br/>..., Dn[15:0]/]     ID --&gt; DISPON[DISPON]     </pre> <p>(Optional)<br/>To prevent<br/>Tearing Effect<br/>Image displayed</p> <p><b>Legend</b></p> <ul style="list-style-type: none"> <li>Command</li> <li>Parameter</li> <li>Display</li> <li>Action</li> <li>Mode</li> <li>Sequential transfer</li> </ul> |

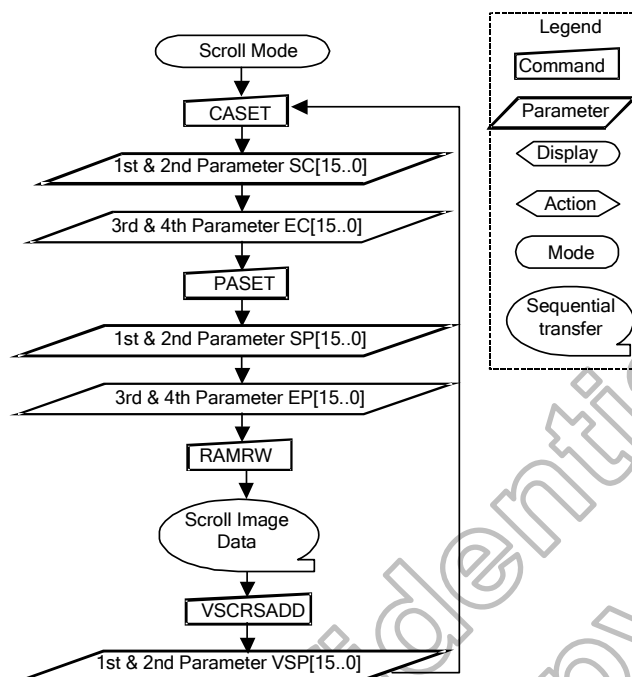


## 6.2.28 Set\_scroll\_area (33h)

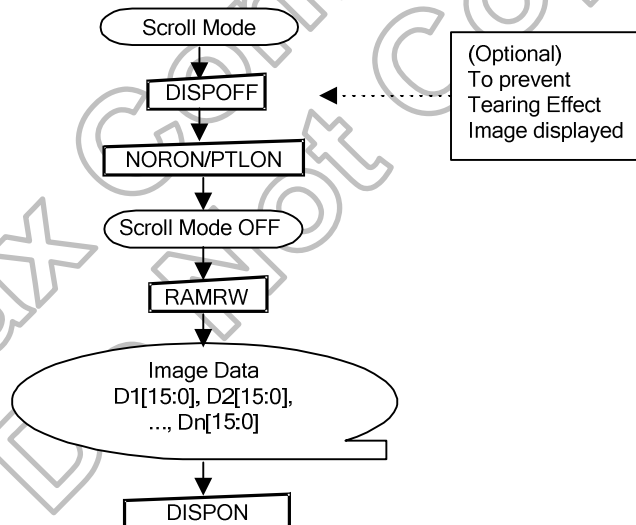
| 33H                       | VSCRDEF (Vertical Scrolling Definition)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |     |     |        |       |       |              |       |       |       |      |      |     |
|---------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|-----|--------|-------|-------|--------------|-------|-------|-------|------|------|-----|
|                           | D/CX                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | RDX | WRX | D15-D8 | D7    | D6    | D5           | D4    | D3    | D2    | D1   | D0   | HEX |
| Command                   | 0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | 1   | ↑   | -      | 0     | 0     | 1            | 1     | 0     | 0     | 1    | 1    | 33  |
| 1 <sup>st</sup> parameter | 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | 1   | ↑   | -      | TFA15 | TFA14 | TFA13        | TFA12 | TFA11 | TFA10 | TFA9 | TFA8 | XX  |
| 2 <sup>nd</sup> parameter | 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | 1   | ↑   | -      | TFA7  | TFA 6 | TFA 5        | TFA 4 | TFA 3 | TFA 2 | TFA1 | TFA0 | XX  |
| 3 <sup>rd</sup> parameter | 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | 1   | ↑   | -      | VSA15 | VSA14 | VSA13        | VSA12 | VSA11 | VSA10 | VSA9 | VSA8 | XX  |
| 4 <sup>th</sup> parameter | 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | 1   | ↑   | -      | VSA7  | VSA 6 | VSA 5        | VSA 4 | VSA 3 | VSA 2 | VSA1 | VSA0 | XX  |
| 5 <sup>th</sup> parameter | 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | 1   | ↑   | -      | BFA15 | BFA14 | BFA13        | BFA12 | BFA11 | BFA10 | BFA9 | BFA8 | XX  |
| 6 <sup>th</sup> parameter | 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | 1   | ↑   | -      | BFA7  | BFA 6 | BFA 5        | BFA 4 | BFA 3 | BFA 2 | BFA1 | BFA0 | XX  |
| Description               | <p>This command defines the Vertical Scrolling Area of the display. When MADCTL B4=0, the 1<sup>st</sup> &amp; 2<sup>nd</sup> parameter TFA[15..0] describes the Top Fixed Area (in No. of lines from top of the Frame Memory and Display). The 3<sup>rd</sup> &amp; 4<sup>th</sup> parameter VSA[15..0] describes the height of the Vertical Scrolling Area (in No. of lines of the Frame Memory [not the display] from the Vertical Scrolling Start Address). The first line read from Frame Memory appears immediately after the bottom most line of the Top Fixed Area. The 5<sup>th</sup> &amp; 6<sup>th</sup> parameter BFA[15..0] describes the Bottom Fixed Area (in No. of lines from Bottom of the Frame Memory and Display). TFA, VSA and BFA refer to the Frame Memory Line Pointer.</p> <p>When MADCTL B4=1</p> <p>The 1<sup>st</sup> &amp; 2<sup>nd</sup> parameter TFA[15..0] describes the Top Fixed Area (in No. of lines from bottom of the Frame Memory and Display). The 3<sup>rd</sup> &amp; 4<sup>th</sup> parameter VSA[15..0] describes the height of the Vertical Scrolling Area (in No. of lines of the Frame Memory [not the display] from the Vertical Scrolling Start Address). The first line read from Frame Memory appears immediately after the top most line of the Top Fixed Area. The 5<sup>th</sup> &amp; 6<sup>th</sup> parameter BFA[15..0] describes the Bottom Fixed Area (in No. of lines from Top of the Frame Memory and Display).</p> |     |     |        |       |       |              |       |       |       |      |      |     |
| Restriction               | The condition is (TFA+VSA+BFA)= Vertical line number, otherwise Scrolling mode is undefined. In Vertical Scroll Mode, MADCTL B5 should be set to '0' – this only affects the Frame Memory Write.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |     |     |        |       |       |              |       |       |       |      |      |     |
| Register Availability     | Status                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |     |     |        |       |       | Availability |       |       |       |      |      |     |
|                           | Normal Mode On, Idle Mode Off, Sleep Out                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |     |     |        |       |       | Yes          |       |       |       |      |      |     |
|                           | Normal Mode On, Idle Mode On, Sleep Out                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |     |     |        |       |       | Yes          |       |       |       |      |      |     |
|                           | Partial Mode On, Idle Mode Off, Sleep Out                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |     |     |        |       |       | Yes          |       |       |       |      |      |     |
|                           | Partial Mode On, Idle Mode On, Sleep Out                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |     |     |        |       |       | Yes          |       |       |       |      |      |     |
|                           | Sleep In or Booster Off                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |     |     |        |       |       | Yes          |       |       |       |      |      |     |

| Default | Status                       | Default value       |                     |                     |
|---------|------------------------------|---------------------|---------------------|---------------------|
|         | RES_SEL[2:0]=000, 480RGBx864 | TFA[15..0]= 0x0000h | VSA[15..0]= 0x0360h | BFA[15..0]= 0x0000h |
|         | RES_SEL[2:0]=001, 480RGBx854 | TFA[15..0]= 0x0000h | VSA[15..0]= 0x0356h | BFA[15..0]= 0x0000h |
|         | RES_SEL[2:0]=010, 480RGBx800 | TFA[15..0]= 0x0000h | VSA[15..0]= 0x0320h | BFA[15..0]= 0x0000h |
|         | RES_SEL[2:0]=011, 480RGBx640 | TFA[15..0]= 0x0000h | VSA[15..0]= 0x0280h | BFA[15..0]= 0x0000h |
|         | RES_SEL[2:0]=100, 360RGBx640 | TFA[15..0]= 0x0000h | VSA[15..0]= 0x0280h | BFA[15..0]= 0x0000h |
|         | RES_SEL[2:0]=101, 480RGBx640 | TFA[15..0]= 0x0000h | VSA[15..0]= 0x02D0h | BFA[15..0]= 0x0000h |





### 3. To Leave Vertical Scroll Mode:

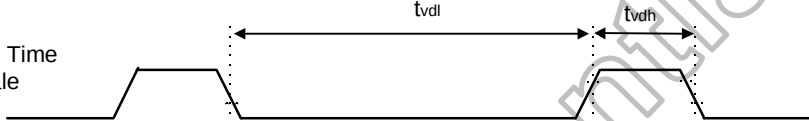
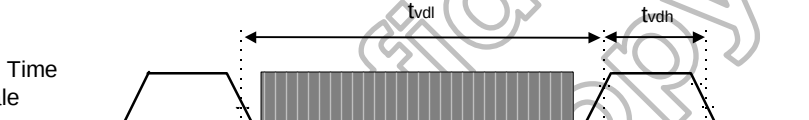


**Note:** Scroll Mode can be left by both the Normal Display Mode On (13h) and Partial Mode On (12h) commands.

## 6.2.29 Tearing effect line off (34h)

| 34H                   | TEOFF (Tearing Effect Line OFF)                                                                                                                                                                                                                   |     |     |        |    |    |    |              |    |    |    |    |     |  |
|-----------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|-----|--------|----|----|----|--------------|----|----|----|----|-----|--|
|                       | D/CX                                                                                                                                                                                                                                              | RDX | WRX | D15-D8 | D7 | D6 | D5 | D4           | D3 | D2 | D1 | D0 | HEX |  |
| Command               | 0                                                                                                                                                                                                                                                 | 1   | ↑   | -      | 0  | 0  | 1  | 1            | 0  | 1  | 0  | 0  | 34  |  |
| Parameter             | NO PARAMETER                                                                                                                                                                                                                                      |     |     |        |    |    |    |              |    |    |    |    |     |  |
| Description           | This command is used to turn OFF (Active Low) the Tearing Effect output signal from the TE signal line.                                                                                                                                           |     |     |        |    |    |    |              |    |    |    |    |     |  |
| Restriction           | This command has no effect when Tearing Effect output is already OFF.                                                                                                                                                                             |     |     |        |    |    |    |              |    |    |    |    |     |  |
| Register Availability | Status                                                                                                                                                                                                                                            |     |     |        |    |    |    | Availability |    |    |    |    |     |  |
|                       | Normal Mode On, Idle Mode Off, Sleep Out                                                                                                                                                                                                          |     |     |        |    |    |    | Yes          |    |    |    |    |     |  |
|                       | Normal Mode On, Idle Mode On, Sleep Out                                                                                                                                                                                                           |     |     |        |    |    |    | Yes          |    |    |    |    |     |  |
|                       | Partial Mode On, Idle Mode Off, Sleep Out                                                                                                                                                                                                         |     |     |        |    |    |    | Yes          |    |    |    |    |     |  |
|                       | Partial Mode On, Idle Mode On, Sleep Out                                                                                                                                                                                                          |     |     |        |    |    |    | Yes          |    |    |    |    |     |  |
|                       | Sleep In or Booster Off                                                                                                                                                                                                                           |     |     |        |    |    |    | Yes          |    |    |    |    |     |  |
| Default               | OFF                                                                                                                                                                                                                                               |     |     |        |    |    |    |              |    |    |    |    |     |  |
| Flow Chart            | <div><div><div>TE Line Output ON</div><div>TEOFF</div><div>TE Line Output OFF</div></div><div><div>Legend</div><div>Command</div><div>Parameter</div><div>Display</div><div>Action</div><div>Mode</div><div>Sequential transfer</div></div></div> |     |     |        |    |    |    |              |    |    |    |    |     |  |

### 6.2.30 Set\_tear\_on (35h)

| 35H                                       | TEON (Tearing Effect Line ON)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                                                                                                                                                                                                                                                                                                                                      |              |        |    |    |    |    |    |    |    |    |     |  |        |              |                                          |     |                                         |     |                                           |     |                                          |     |
|-------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|--------|----|----|----|----|----|----|----|----|-----|--|--------|--------------|------------------------------------------|-----|-----------------------------------------|-----|-------------------------------------------|-----|------------------------------------------|-----|
|                                           | D/CX                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | RDX                                                                                                                                                                                                                                                                                                                                                  | WRX          | D15-D8 | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 | HEX |  |        |              |                                          |     |                                         |     |                                           |     |                                          |     |
| Command                                   | 0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | 1                                                                                                                                                                                                                                                                                                                                                    | ↑            | -      | 0  | 0  | 1  | 1  | 0  | 1  | 0  | 1  | 35  |  |        |              |                                          |     |                                         |     |                                           |     |                                          |     |
| Parameter                                 | 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | 1                                                                                                                                                                                                                                                                                                                                                    | ↑            | -      | X  | X  | X  | X  | X  | X  | X  | M  | xx  |  |        |              |                                          |     |                                         |     |                                           |     |                                          |     |
| Description                               | <p>This command is used to turn ON the Tearing Effect output signal from the TE signal line. This output is not affected by changing MADCTL bit B4.</p> <p>The Tearing Effect Line On has one parameter which describes the mode of the Tearing Effect Output Line. (X=Don't Care).</p> <p>When M=0:</p> <p>The Tearing Effect Output line consists of V-Blanking information only:</p> <div><p>Vertical Time Scale</p></div> <p>When M=1:</p> <p>The Tearing Effect Output Line consists of both V-Blanking and H-Blanking information:</p> <div><p>Vertical Time Scale</p></div> <p><b>Note:</b> During Sleep In Mode with Tearing Effect Line On, Tearing Effect Output pin will be active Low.</p> |                                                                                                                                                                                                                                                                                                                                                      |              |        |    |    |    |    |    |    |    |    |     |  |        |              |                                          |     |                                         |     |                                           |     |                                          |     |
|                                           | Restriction                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | This command has no effect when Tearing Effect output is already ON.                                                                                                                                                                                                                                                                                 |              |        |    |    |    |    |    |    |    |    |     |  |        |              |                                          |     |                                         |     |                                           |     |                                          |     |
|                                           | Register Availability                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | <table><tr><th>Status</th><th>Availability</th></tr><tr><td>Normal Mode On, Idle Mode Off, Sleep Out</td><td>Yes</td></tr><tr><td>Normal Mode On, Idle Mode On, Sleep Out</td><td>Yes</td></tr><tr><td>Partial Mode On, Idle Mode Off, Sleep Out</td><td>Yes</td></tr><tr><td>Partial Mode On, Idle Mode On, Sleep Out</td><td>Yes</td></tr></table> |              |        |    |    |    |    |    |    |    |    |     |  | Status | Availability | Normal Mode On, Idle Mode Off, Sleep Out | Yes | Normal Mode On, Idle Mode On, Sleep Out | Yes | Partial Mode On, Idle Mode Off, Sleep Out | Yes | Partial Mode On, Idle Mode On, Sleep Out | Yes |
|                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | Status                                                                                                                                                                                                                                                                                                                                               | Availability |        |    |    |    |    |    |    |    |    |     |  |        |              |                                          |     |                                         |     |                                           |     |                                          |     |
| Normal Mode On, Idle Mode Off, Sleep Out  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | Yes                                                                                                                                                                                                                                                                                                                                                  |              |        |    |    |    |    |    |    |    |    |     |  |        |              |                                          |     |                                         |     |                                           |     |                                          |     |
| Normal Mode On, Idle Mode On, Sleep Out   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | Yes                                                                                                                                                                                                                                                                                                                                                  |              |        |    |    |    |    |    |    |    |    |     |  |        |              |                                          |     |                                         |     |                                           |     |                                          |     |
| Partial Mode On, Idle Mode Off, Sleep Out |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | Yes                                                                                                                                                                                                                                                                                                                                                  |              |        |    |    |    |    |    |    |    |    |     |  |        |              |                                          |     |                                         |     |                                           |     |                                          |     |
| Partial Mode On, Idle Mode On, Sleep Out  | Yes                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                                                                                                                                                                                                                                                                                                      |              |        |    |    |    |    |    |    |    |    |     |  |        |              |                                          |     |                                         |     |                                           |     |                                          |     |
| Default                                   | OFF                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                                                                                                                                                                                                                                                                                                      |              |        |    |    |    |    |    |    |    |    |     |  |        |              |                                          |     |                                         |     |                                           |     |                                          |     |
| Flow Chart                                | <div><p>TE Line Output OFF</p><p>↓</p><p>TEON</p><p>↓</p><p>M</p><p>↓</p><p>TE Line Output ON</p></div> <div><p>Legend</p><ul style="list-style-type: none"><li>Command</li><li>Parameter</li><li>Display</li><li>Action</li><li>Mode</li><li>Sequential transfer</li></ul></div>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                                                                                                                                                                                                                                      |              |        |    |    |    |    |    |    |    |    |     |  |        |              |                                          |     |                                         |     |                                           |     |                                          |     |

## 6.2.31 Set\_address\_mode (36h)

| 36H                                                                                                                                                                                                                                                                                                                                                             | MADCTL (Memory Access Control)                                                                                                                                                                                                                                                                                                |                            |     |        |    |    |    |    |    |    |    |                                                                                          |     |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------|-----|--------|----|----|----|----|----|----|----|------------------------------------------------------------------------------------------|-----|
|                                                                                                                                                                                                                                                                                                                                                                 | D/CX                                                                                                                                                                                                                                                                                                                          | RDX                        | WRX | D15-D8 | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0                                                                                       | HEX |
| Command                                                                                                                                                                                                                                                                                                                                                         | 0                                                                                                                                                                                                                                                                                                                             | 1                          | ↑   | -      | 0  | 0  | 1  | 1  | 0  | 1  | 1  | 0                                                                                        | 36  |
| 1 <sup>st</sup> parameter                                                                                                                                                                                                                                                                                                                                       | 1                                                                                                                                                                                                                                                                                                                             | 1                          | ↑   | -      | B7 | B6 | B5 | B4 | B3 | B2 | X  | X                                                                                        | XX  |
| Description                                                                                                                                                                                                                                                                                                                                                     | This command defines read/write scanning direction of frame memory.<br>This command makes no change on the other driver status.                                                                                                                                                                                               |                            |     |        |    |    |    |    |    |    |    |                                                                                          |     |
|                                                                                                                                                                                                                                                                                                                                                                 | Bit Assignment                                                                                                                                                                                                                                                                                                                |                            |     |        |    |    |    |    |    |    |    |                                                                                          |     |
|                                                                                                                                                                                                                                                                                                                                                                 | BIT                                                                                                                                                                                                                                                                                                                           | NAME                       |     |        |    |    |    |    |    |    |    | DESCRIPTION                                                                              |     |
|                                                                                                                                                                                                                                                                                                                                                                 | B7                                                                                                                                                                                                                                                                                                                            | PAGE ADDRESS ORDER (MY)    |     |        |    |    |    |    |    |    |    | These 3 bits controls MCU to memory write/read direction.                                |     |
|                                                                                                                                                                                                                                                                                                                                                                 | B6                                                                                                                                                                                                                                                                                                                            | COLUMN ADDRESS ORDER (MX)  |     |        |    |    |    |    |    |    |    |                                                                                          |     |
|                                                                                                                                                                                                                                                                                                                                                                 | B5                                                                                                                                                                                                                                                                                                                            | PAGE/COLUMN SELECTION (MV) |     |        |    |    |    |    |    |    |    |                                                                                          |     |
|                                                                                                                                                                                                                                                                                                                                                                 | B4                                                                                                                                                                                                                                                                                                                            | Vertical ORDER (ML)        |     |        |    |    |    |    |    |    |    | LCD vertical refresh direction control                                                   |     |
|                                                                                                                                                                                                                                                                                                                                                                 | B3                                                                                                                                                                                                                                                                                                                            | RGB-BGR ORDER (BGR)        |     |        |    |    |    |    |    |    |    | Colour selector switch control<br>(0=RGB colour filter panel, 1=BGR colour filter panel) |     |
|                                                                                                                                                                                                                                                                                                                                                                 | B2                                                                                                                                                                                                                                                                                                                            | Horizontal ORDER (SS)      |     |        |    |    |    |    |    |    |    | LCD horizontal refresh direction control                                                 |     |
|                                                                                                                                                                                                                                                                                                                                                                 | <div>ML - Vertical Updating order</div> <div>ML=0</div> <div>Top-Left (0,0) Memory (Example) Display</div> <div>Sent First (1)<br/>Sent 2nd<br/>Sent 3rd<br/>Sent last (864)</div> <div>ML=1</div> <div>Top-Left (0,0) Memory (Example) Display</div> <div>Sent last (864)<br/>Sent 3rd<br/>Sent 2nd<br/>Sent First (1)</div> |                            |     |        |    |    |    |    |    |    |    |                                                                                          |     |
| <div>RGB-BGR Order</div> <div>B3=0</div> <div>Driver IC RGB SIG1 SIG2 ..... SIG480</div> <div>LCD panel RGB RGB RGB ..... RGB</div> <div>B3=1</div> <div>Driver IC BGR SIG1 SIG2 ..... SIG480</div> <div>LCD panel BGR BGR BGR ..... BGR</div>                                                                                                                  |                                                                                                                                                                                                                                                                                                                               |                            |     |        |    |    |    |    |    |    |    |                                                                                          |     |
| <div>SS - Horizontal Updating order</div> <div>SS=0</div> <div>Top-Left (0,0) Display</div> <div>Sent First (1)<br/>Sent 2nd<br/>Sent 3rd<br/>Sent last (480)</div> <div>Top-Left (0,0) Memory</div> <div>SS=1</div> <div>Top-Left (0,0) Display</div> <div>Sent last (480)<br/>Sent 3rd<br/>Sent 2nd<br/>Sent First (1)</div> <div>Top-Left (0,0) Memory</div> |                                                                                                                                                                                                                                                                                                                               |                            |     |        |    |    |    |    |    |    |    |                                                                                          |     |
| Note: Top-Left (0,0) means a physical memory location.<br>Bit D1 – Switching Between Segment Output and RAM<br>Bit D0 – Switching Between Common Output and RAM                                                                                                                                                                                                 |                                                                                                                                                                                                                                                                                                                               |                            |     |        |    |    |    |    |    |    |    |                                                                                          |     |
| Restriction                                                                                                                                                                                                                                                                                                                                                     | -                                                                                                                                                                                                                                                                                                                             |                            |     |        |    |    |    |    |    |    |    |                                                                                          |     |

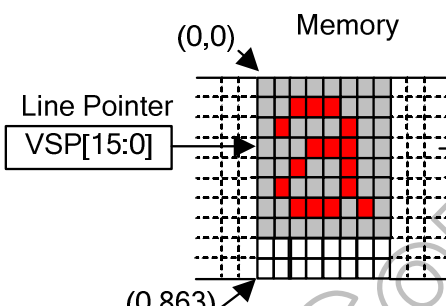
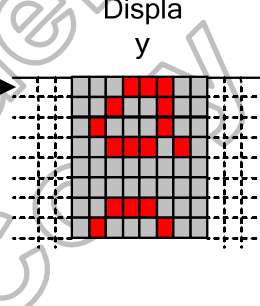
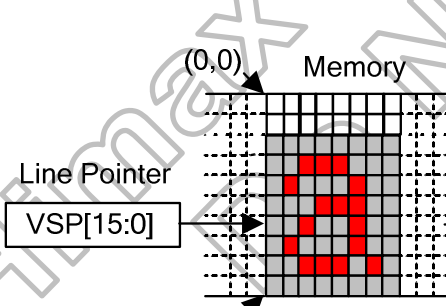
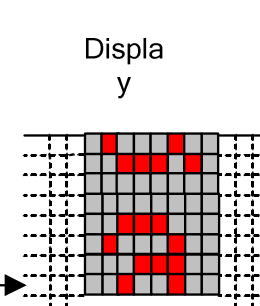
|                       |                                           |  |              |
|-----------------------|-------------------------------------------|--|--------------|
| Register Availability | Status                                    |  | Availability |
|                       | Normal Mode On, Idle Mode Off, Sleep Out  |  | Yes          |
|                       | Normal Mode On, Idle Mode On, Sleep Out   |  | Yes          |
|                       | Partial Mode On, Idle Mode Off, Sleep Out |  | Yes          |
|                       | Partial Mode On, Idle Mode On, Sleep Out  |  | Yes          |
|                       | Sleep In or Booster Off                   |  | Yes          |

|         |                   |                                         |               |  |
|---------|-------------------|-----------------------------------------|---------------|--|
| Default | Status            |                                         | Default value |  |
|         | Power On Sequence | B7=0,B6=0,B5=0,B4=0,B3=0,B2=0,B1=0,B0=0 |               |  |
|         | S/W Reset         | No Change                               |               |  |

|            |                                                                         |  |                                                                                                                                                     |
|------------|-------------------------------------------------------------------------|--|-----------------------------------------------------------------------------------------------------------------------------------------------------|
| Flow Chart | <div><div>MADCTL</div><div>↓</div><div>1st parameter B[7:0]</div></div> |  | <div>Legend</div> <div><div>Command</div><div>Parameter</div><div>Display</div><div>Action</div><div>Mode</div><div>Sequential transfer</div></div> |
|------------|-------------------------------------------------------------------------|--|-----------------------------------------------------------------------------------------------------------------------------------------------------|



### 6.2.32 Set\_scroll\_start (37h)

| 37H                       | VSCRSADD (Vertical Scrolling Start Address)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |     |     |        |           |           |              |           |           |           |          |          |            |   |   |   |   |     |     |     |     |     |     |     |     |     |     |     |   |   |   |   |
|---------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|-----|--------|-----------|-----------|--------------|-----------|-----------|-----------|----------|----------|------------|---|---|---|---|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|---|---|---|---|
|                           | D/CX                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | RDX | WRX | D15-D8 | D7        | D6        | D5           | D4        | D3        | D2        | D1       | D0       | HEX        |   |   |   |   |     |     |     |     |     |     |     |     |     |     |     |   |   |   |   |
| Command                   | 0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | 1   | ↑   | -      | 0         | 0         | 1            | 1         | 0         | 1         | 1        | 1        | 37         |   |   |   |   |     |     |     |     |     |     |     |     |     |     |     |   |   |   |   |
| 1 <sup>st</sup> parameter | 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | 1   | ↑   | -      | VSP<br>15 | VSP<br>14 | VSP<br>13    | VSP<br>12 | VSP<br>11 | VSP<br>10 | VSP<br>9 | VSP<br>8 | 00,<br>13F |   |   |   |   |     |     |     |     |     |     |     |     |     |     |     |   |   |   |   |
| 2 <sup>nd</sup> parameter | 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | 1   | ↑   | -      | VSP<br>7  | VSP<br>6  | VSP<br>5     | VSP<br>4  | VSP<br>3  | VSP<br>2  | VSP<br>1 | VSP<br>0 |            |   |   |   |   |     |     |     |     |     |     |     |     |     |     |     |   |   |   |   |
| Description               | <p>This command is used together with Vertical Scrolling Definition (33h). These two commands describe the scrolling area and the scrolling mode. The Vertical Scrolling Start Address command has one parameter which describes the address of the line in the Frame Memory that will be written as the first line after the last line of the Top Fixed Area on the display as illustrated below:-</p> <p>When MADCTL B4=0</p> <p>Example:</p> <p>When Top Fixed Area = Bottom Fixed Area = 00, Vertical Scrolling Area = 864(DM=10) and</p> <p>(Example)</p> <div><div><p>(0,0)</p><p>Memory</p><p>Line Pointer</p><p>VSP[15:0]</p></div><div><p>Pointer (B4=0)</p><table><tr><td>0</td></tr><tr><td>1</td></tr><tr><td>2</td></tr><tr><td>3</td></tr><tr><td>...</td></tr><tr><td>...</td></tr><tr><td>...</td></tr><tr><td>862</td></tr><tr><td>863</td></tr></table></div><div><p>Display</p></div></div> <p>When MADCTL B4=1</p> <p>Example:</p> <p>When Top Fixed Area = Bottom Fixed Area = 00, Vertical Scrolling Area = 320(DM=10) and</p> <p>(Example)</p> <div><div><p>(0,0)</p><p>Memory</p><p>Line Pointer</p><p>VSP[15:0]</p></div><div><p>Pointer (B4=1)</p><table><tr><td>863</td></tr><tr><td>862</td></tr><tr><td>...</td></tr><tr><td>...</td></tr><tr><td>...</td></tr><tr><td>...</td></tr><tr><td>3</td></tr><tr><td>2</td></tr><tr><td>1</td></tr><tr><td>0</td></tr></table></div><div><p>Display</p></div></div> |     |     |        |           |           |              |           |           |           |          |          |            | 0 | 1 | 2 | 3 | ... | ... | ... | 862 | 863 | 863 | 862 | ... | ... | ... | ... | 3 | 2 | 1 | 0 |
|                           | 0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |     |     |        |           |           |              |           |           |           |          |          |            |   |   |   |   |     |     |     |     |     |     |     |     |     |     |     |   |   |   |   |
| 1                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |     |     |        |           |           |              |           |           |           |          |          |            |   |   |   |   |     |     |     |     |     |     |     |     |     |     |     |   |   |   |   |
| 2                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |     |     |        |           |           |              |           |           |           |          |          |            |   |   |   |   |     |     |     |     |     |     |     |     |     |     |     |   |   |   |   |
| 3                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |     |     |        |           |           |              |           |           |           |          |          |            |   |   |   |   |     |     |     |     |     |     |     |     |     |     |     |   |   |   |   |
| ...                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |     |     |        |           |           |              |           |           |           |          |          |            |   |   |   |   |     |     |     |     |     |     |     |     |     |     |     |   |   |   |   |
| ...                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |     |     |        |           |           |              |           |           |           |          |          |            |   |   |   |   |     |     |     |     |     |     |     |     |     |     |     |   |   |   |   |
| ...                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |     |     |        |           |           |              |           |           |           |          |          |            |   |   |   |   |     |     |     |     |     |     |     |     |     |     |     |   |   |   |   |
| 862                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |     |     |        |           |           |              |           |           |           |          |          |            |   |   |   |   |     |     |     |     |     |     |     |     |     |     |     |   |   |   |   |
| 863                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |     |     |        |           |           |              |           |           |           |          |          |            |   |   |   |   |     |     |     |     |     |     |     |     |     |     |     |   |   |   |   |
| 863                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |     |     |        |           |           |              |           |           |           |          |          |            |   |   |   |   |     |     |     |     |     |     |     |     |     |     |     |   |   |   |   |
| 862                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |     |     |        |           |           |              |           |           |           |          |          |            |   |   |   |   |     |     |     |     |     |     |     |     |     |     |     |   |   |   |   |
| ...                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |     |     |        |           |           |              |           |           |           |          |          |            |   |   |   |   |     |     |     |     |     |     |     |     |     |     |     |   |   |   |   |
| ...                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |     |     |        |           |           |              |           |           |           |          |          |            |   |   |   |   |     |     |     |     |     |     |     |     |     |     |     |   |   |   |   |
| ...                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |     |     |        |           |           |              |           |           |           |          |          |            |   |   |   |   |     |     |     |     |     |     |     |     |     |     |     |   |   |   |   |
| ...                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |     |     |        |           |           |              |           |           |           |          |          |            |   |   |   |   |     |     |     |     |     |     |     |     |     |     |     |   |   |   |   |
| 3                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |     |     |        |           |           |              |           |           |           |          |          |            |   |   |   |   |     |     |     |     |     |     |     |     |     |     |     |   |   |   |   |
| 2                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |     |     |        |           |           |              |           |           |           |          |          |            |   |   |   |   |     |     |     |     |     |     |     |     |     |     |     |   |   |   |   |
| 1                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |     |     |        |           |           |              |           |           |           |          |          |            |   |   |   |   |     |     |     |     |     |     |     |     |     |     |     |   |   |   |   |
| 0                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |     |     |        |           |           |              |           |           |           |          |          |            |   |   |   |   |     |     |     |     |     |     |     |     |     |     |     |   |   |   |   |
| Restriction               | <p>Since the value of the Vertical Scrolling Start Address is absolute (with reference to the Frame Memory), it must not enter the fixed area (defined by Vertical Scrolling Definition (33h) – otherwise undesirable image will be displayed on the Panel.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |     |     |        |           |           |              |           |           |           |          |          |            |   |   |   |   |     |     |     |     |     |     |     |     |     |     |     |   |   |   |   |
| Register Availability     | Status                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |     |     |        |           |           | Availability |           |           |           |          |          |            |   |   |   |   |     |     |     |     |     |     |     |     |     |     |     |   |   |   |   |
|                           | Normal Mode On, Idle Mode Off, Sleep Out                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |     |     |        |           |           | Yes          |           |           |           |          |          |            |   |   |   |   |     |     |     |     |     |     |     |     |     |     |     |   |   |   |   |
|                           | Normal Mode On, Idle Mode On, Sleep Out                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |     |     |        |           |           | Yes          |           |           |           |          |          |            |   |   |   |   |     |     |     |     |     |     |     |     |     |     |     |   |   |   |   |
|                           | Partial Mode On, Idle Mode Off, Sleep Out                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |     |     |        |           |           | No           |           |           |           |          |          |            |   |   |   |   |     |     |     |     |     |     |     |     |     |     |     |   |   |   |   |
|                           | Partial Mode On, Idle Mode On, Sleep Out                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |     |     |        |           |           | No           |           |           |           |          |          |            |   |   |   |   |     |     |     |     |     |     |     |     |     |     |     |   |   |   |   |
| Default                   | VSP[15:0]= 0x0000h                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |     |     |        |           |           |              |           |           |           |          |          |            |   |   |   |   |     |     |     |     |     |     |     |     |     |     |     |   |   |   |   |
| Flow Chart                | See Vertical Scrolling Definition (33h) description.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |     |     |        |           |           |              |           |           |           |          |          |            |   |   |   |   |     |     |     |     |     |     |     |     |     |     |     |   |   |   |   |

## 6.2.33 Idle mode off (38h)

| 38H                   | IDMOFF (Idle mode off)                                                                                                                                                                                                                                           |     |     |        |    |    |              |    |    |    |    |    |     |
|-----------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|-----|--------|----|----|--------------|----|----|----|----|----|-----|
|                       | D/CX                                                                                                                                                                                                                                                             | RDX | WRX | D15-D8 | D7 | D6 | D5           | D4 | D3 | D2 | D1 | D0 | HEX |
| Command               | 0                                                                                                                                                                                                                                                                | 1   | ↑   | -      | 0  | 0  | 1            | 1  | 1  | 0  | 0  | 0  | 38  |
| Parameter             | NO PARAMETER                                                                                                                                                                                                                                                     |     |     |        |    |    |              |    |    |    |    |    |     |
| Description           | This command is used to recover from Idle mode on. In the idle off mode, LCD can display maximum 16.7M colours.                                                                                                                                                  |     |     |        |    |    |              |    |    |    |    |    |     |
| Restriction           | This command has no effect when module is already in idle off mode.                                                                                                                                                                                              |     |     |        |    |    |              |    |    |    |    |    |     |
| Register Availability | Status                                                                                                                                                                                                                                                           |     |     |        |    |    | Availability |    |    |    |    |    |     |
|                       | Normal Mode On, Idle Mode Off, Sleep Out                                                                                                                                                                                                                         |     |     |        |    |    | Yes          |    |    |    |    |    |     |
|                       | Normal Mode On, Idle Mode On, Sleep Out                                                                                                                                                                                                                          |     |     |        |    |    | Yes          |    |    |    |    |    |     |
|                       | Partial Mode On, Idle Mode Off, Sleep Out                                                                                                                                                                                                                        |     |     |        |    |    | Yes          |    |    |    |    |    |     |
|                       | Partial Mode On, Idle Mode On, Sleep Out                                                                                                                                                                                                                         |     |     |        |    |    | Yes          |    |    |    |    |    |     |
| Default               | Idle mode is OFF.                                                                                                                                                                                                                                                |     |     |        |    |    |              |    |    |    |    |    |     |
| Flow Chart            | <div><div><div>Idle on mode</div><div>↓</div><div>IDMOFF</div><div>↓</div><div>Idle off mode</div></div><div><div>Legend</div><div>Command</div><div>Parameter</div><div>Display</div><div>Action</div><div>Mode</div><div>Sequential transfer</div></div></div> |     |     |        |    |    |              |    |    |    |    |    |     |

### 6.2.34 Enter\_Idle\_mode (39h)

| 39H                   | IDMON (Idle mode on)                                                                                                                                                                                                                                            |         |     |        |        |         |              |    |        |         |    |    |     |
|-----------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------|-----|--------|--------|---------|--------------|----|--------|---------|----|----|-----|
|                       | D/CX                                                                                                                                                                                                                                                            | RDX     | WRX | D15-D8 | D7     | D6      | D5           | D4 | D3     | D2      | D1 | D0 | HEX |
| Command               | 0                                                                                                                                                                                                                                                               | 1       | ↑   | -      | 0      | 0       | 1            | 1  | 1      | 0       | 0  | 1  | 39  |
| Parameter             | NO PARAMETER                                                                                                                                                                                                                                                    |         |     |        |        |         |              |    |        |         |    |    |     |
| Description           | This command is used to enter into Idle mode on. In the idle on mode, colour expression is reduced. The primary and the secondary colours using MSB of each R, G and B in the Frame Memory, 8 colour depth data is displayed.                                   |         |     |        |        |         |              |    |        |         |    |    |     |
|                       | <div>(Example)</div> <div><div>Memory</div></div> <div>→</div> <div><div>Display</div></div> |         |     |        |        |         |              |    |        |         |    |    |     |
|                       | Memory contents vs. Display Colour                                                                                                                                                                                                                              |         |     |        |        |         |              |    |        |         |    |    |     |
|                       |                                                                                                                                                                                                                                                                 | R7 - R0 |     |        |        | G7 - G0 |              |    |        | B7 - B0 |    |    |     |
|                       | Black                                                                                                                                                                                                                                                           | 0XXXXX  |     |        |        | 0XXXXX  |              |    |        | 0XXXXX  |    |    |     |
| Blue                  | 0XXXXX                                                                                                                                                                                                                                                          |         |     |        | 0XXXXX |         |              |    | 1XXXXX |         |    |    |     |
| Red                   | 1XXXXX                                                                                                                                                                                                                                                          |         |     |        | 0XXXXX |         |              |    | 0XXXXX |         |    |    |     |
| Magent                | 1XXXXX                                                                                                                                                                                                                                                          |         |     |        | 0XXXXX |         |              |    | 1XXXXX |         |    |    |     |
| Green                 | 0XXXXX                                                                                                                                                                                                                                                          |         |     |        | 1XXXXX |         |              |    | 0XXXXX |         |    |    |     |
| Cyan                  | 0XXXXX                                                                                                                                                                                                                                                          |         |     |        | 1XXXXX |         |              |    | 1XXXXX |         |    |    |     |
| Yellow                | 1XXXXX                                                                                                                                                                                                                                                          |         |     |        | 1XXXXX |         |              |    | 0XXXXX |         |    |    |     |
| White                 | 1XXXXX                                                                                                                                                                                                                                                          |         |     |        | 1XXXXX |         |              |    | 1XXXXX |         |    |    |     |
|                       | X=don't care                                                                                                                                                                                                                                                    |         |     |        |        |         |              |    |        |         |    |    |     |
| Restriction           | This command has no effect when module is already in idle on mode.                                                                                                                                                                                              |         |     |        |        |         |              |    |        |         |    |    |     |
| Register Availability | Status                                                                                                                                                                                                                                                          |         |     |        |        |         | Availability |    |        |         |    |    |     |
|                       | Normal Mode On, Idle Mode Off, Sleep Out                                                                                                                                                                                                                        |         |     |        |        |         | Yes          |    |        |         |    |    |     |
|                       | Normal Mode On, Idle Mode On, Sleep Out                                                                                                                                                                                                                         |         |     |        |        |         | Yes          |    |        |         |    |    |     |
|                       | Partial Mode On, Idle Mode Off, Sleep Out                                                                                                                                                                                                                       |         |     |        |        |         | Yes          |    |        |         |    |    |     |
|                       | Partial Mode On, Idle Mode On, Sleep Out                                                                                                                                                                                                                        |         |     |        |        |         | Yes          |    |        |         |    |    |     |
|                       | Sleep In or Booster Off                                                                                                                                                                                                                                         |         |     |        |        |         | Yes          |    |        |         |    |    |     |
| Default               | Idle mode is OFF.                                                                                                                                                                                                                                               |         |     |        |        |         |              |    |        |         |    |    |     |
| Flow Chart            | <div><div>Idle off mode</div><div>↓</div><div>IDMON</div><div>↓</div><div>Idle on mode</div></div>                                                                                                                                                              |         |     |        |        |         |              |    |        |         |    |    |     |
|                       | <div>Legend</div> <div><div>Command</div><div>Parameter</div><div>Display</div><div>Action</div><div>Mode</div><div>Sequential transfer</div></div>                                                                                                             |         |     |        |        |         |              |    |        |         |    |    |     |

### 6.2.35 Set\_pixel\_format (3Ah)

| 3A H                                                                                                                                              | COLMOD (Interface Pixel Format)                                                                                                                                                                                                                                                                                       |     |     |        |    |               |    |       |    |    |    |    |     |
|---------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|-----|--------|----|---------------|----|-------|----|----|----|----|-----|
|                                                                                                                                                   | D/CX                                                                                                                                                                                                                                                                                                                  | RDX | WRX | D15-D8 | D7 | D6            | D5 | D4    | D3 | D2 | D1 | D0 | HEX |
| Command                                                                                                                                           | 0                                                                                                                                                                                                                                                                                                                     | 1   | ↑   | -      | 0  | 0             | 1  | 1     | 1  | 0  | 1  | 0  | 3A  |
| 1 <sup>st</sup> parameter                                                                                                                         | 1                                                                                                                                                                                                                                                                                                                     | 1   | ↑   | -      | X  | D6            | D5 | D4    | X  | D2 | D1 | D0 | XX  |
| Description                                                                                                                                       | This command is used to define the format of RGB picture data.<br>D6~D4 : DPI Pixel format Definition.<br>D2~D0 : DBI Pixel format Definition.<br>The formats are shown in the table:                                                                                                                                 |     |     |        |    |               |    |       |    |    |    |    |     |
|                                                                                                                                                   | Pixel Format                                                                                                                                                                                                                                                                                                          |     |     | D6/D2  |    | D5/D1         |    | D4/D0 |    |    |    |    |     |
|                                                                                                                                                   | Not Defined                                                                                                                                                                                                                                                                                                           |     |     | 0      |    | 0             |    | 0     |    |    |    |    |     |
|                                                                                                                                                   | Not Defined                                                                                                                                                                                                                                                                                                           |     |     | 0      |    | 0             |    | 1     |    |    |    |    |     |
|                                                                                                                                                   | Not Defined                                                                                                                                                                                                                                                                                                           |     |     | 0      |    | 1             |    | 0     |    |    |    |    |     |
|                                                                                                                                                   | Not Defined                                                                                                                                                                                                                                                                                                           |     |     | 0      |    | 1             |    | 1     |    |    |    |    |     |
|                                                                                                                                                   | Not Defined                                                                                                                                                                                                                                                                                                           |     |     | 1      |    | 0             |    | 0     |    |    |    |    |     |
|                                                                                                                                                   | 16 Bit/Pixel                                                                                                                                                                                                                                                                                                          |     |     | 1      |    | 0             |    | 1     |    |    |    |    |     |
|                                                                                                                                                   | 18 Bit/Pixel                                                                                                                                                                                                                                                                                                          |     |     | 1      |    | 1             |    | 0     |    |    |    |    |     |
|                                                                                                                                                   | 24 Bit/Pixel                                                                                                                                                                                                                                                                                                          |     |     | 1      |    | 1             |    | 1     |    |    |    |    |     |
| If a particular interface, enter DBI or DPI, is not used then the correspondind bits in the parameter returned from the display module undefined. |                                                                                                                                                                                                                                                                                                                       |     |     |        |    |               |    |       |    |    |    |    |     |
| Restriction                                                                                                                                       | There is no visible effect until the Frame Memory is written to.                                                                                                                                                                                                                                                      |     |     |        |    |               |    |       |    |    |    |    |     |
| Register Availability                                                                                                                             | Status                                                                                                                                                                                                                                                                                                                |     |     |        |    | Availability  |    |       |    |    |    |    |     |
|                                                                                                                                                   | Normal Mode On, Idle Mode Off, Sleep Out                                                                                                                                                                                                                                                                              |     |     |        |    | Yes           |    |       |    |    |    |    |     |
|                                                                                                                                                   | Normal Mode On, Idle Mode On, Sleep Out                                                                                                                                                                                                                                                                               |     |     |        |    | Yes           |    |       |    |    |    |    |     |
|                                                                                                                                                   | Partial Mode On, Idle Mode Off, Sleep Out                                                                                                                                                                                                                                                                             |     |     |        |    | Yes           |    |       |    |    |    |    |     |
|                                                                                                                                                   | Partial Mode On, Idle Mode On, Sleep Out                                                                                                                                                                                                                                                                              |     |     |        |    | Yes           |    |       |    |    |    |    |     |
| Default                                                                                                                                           | Status                                                                                                                                                                                                                                                                                                                |     |     |        |    | Default value |    |       |    |    |    |    |     |
|                                                                                                                                                   | Power On Sequence                                                                                                                                                                                                                                                                                                     |     |     |        |    | 24 Bit/Pixel  |    |       |    |    |    |    |     |
| Flow Chart                                                                                                                                        | <div><div><div>n Bit/Pixel Mode</div><div>↓</div><div>Set Pixel Format</div><div>↓</div><div>Parameter</div><div>↓</div><div>New n Bit/Pixel Mode</div></div><div><div>Legend</div><div>Command</div><div>Parameter</div><div>Display</div><div>Action</div><div>Mode</div><div>Sequential transfer</div></div></div> |     |     |        |    |               |    |       |    |    |    |    |     |

### 6.2.36 Write\_memory\_contiune (3Ch)

| 3CH                       | Write_memory contiuene                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |     |     |        |                                    |     |              |     |     |     |     |     |        |
|---------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|-----|--------|------------------------------------|-----|--------------|-----|-----|-----|-----|-----|--------|
|                           | D/CX                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | RDX | WRX | D15-D8 | D7                                 | D6  | D5           | D4  | D3  | D2  | D1  | D0  | HEX    |
| Command                   | 0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | 1   | ↑   | -      | 0                                  | 0   | 1            | 1   | 1   | 1   | 0   | 0   | 3C     |
| 1 <sup>st</sup> parameter | 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | 1   | ↑   | -      | D17                                | D16 | D15          | D14 | D13 | D12 | D11 | D10 | 00..FF |
| :                         | 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | 1   | ↑   | -      | Dx7                                | Dx6 | Dx5          | Dx4 | Dx3 | Dx2 | Dx1 | Dx0 | 00..FF |
| N <sup>th</sup> parameter | 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | 1   | ↑   | -      | Dn7                                | Dn6 | Dn5          | Dn4 | Dn3 | Dn2 | Dn1 | Dn0 | 00..FF |
| Description               | <p>This command transfers image data from the host processor to the display module's frame memory continuing from the pixel location following the previous write_memory_continue or write_memory_start command. Sending any other command can stop frame Write.</p> <p>If set_address_mode B5 = 0:</p> <p>Data is written continuing from the pixel location after the write range of the previous write_memory_start or write_memory_continue. The column register is then incremented and pixels are written to the frame memory until the column register equals the End Column (EC) value. The column register is then reset to SC and the page register is incremented. Pixels are written to the frame memory until the page register equals the End Page (EP) value or the host processor sends another command. If the number of pixels exceeds (EC – SC + 1) * (EP – SP + 1) the extra pixels are ignored.</p> <p>If set_address_mode B5 = 1:</p> <p>Data is written continuing from the pixel location after the write range of the previous write_memory_start or write_memory_continue. The page register is then incremented and pixels are written to the frame memory until the page register equals the End Page (EP) value. The page register is then reset to SP and the column register is incremented. Pixels are written to the frame memory until the column register equals the End column (EC) value or the host processor sends another command. If the number of pixels exceeds (EC – SC + 1) * (EP – SP + 1) the extra pixels are ignored.</p> |     |     |        |                                    |     |              |     |     |     |     |     |        |
| Restriction               | In all colour modes, there is no restriction on length of parameters.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |     |     |        |                                    |     |              |     |     |     |     |     |        |
| Register Availability     | Status                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |     |     |        |                                    |     | Availability |     |     |     |     |     |        |
|                           | Normal Mode On, Idle Mode Off, Sleep Out                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |     |     |        |                                    |     | Yes          |     |     |     |     |     |        |
|                           | Normal Mode On, Idle Mode On, Sleep Out                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |     |     |        |                                    |     | Yes          |     |     |     |     |     |        |
|                           | Partial Mode On, Idle Mode Off, Sleep Out                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |     |     |        |                                    |     | Yes          |     |     |     |     |     |        |
|                           | Partial Mode On, Idle Mode On, Sleep Out                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |     |     |        |                                    |     | Yes          |     |     |     |     |     |        |
| Default                   | Status                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |     |     |        | Default value                      |     |              |     |     |     |     |     |        |
|                           | Power On Sequence                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |     |     |        | Contents of memory is set randomly |     |              |     |     |     |     |     |        |
|                           | S/W Reset                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |     |     |        | Contents of memory is set randomly |     |              |     |     |     |     |     |        |
| Flow Chart                | <div><div>RAMWR</div><div>↓</div><div>Image Data<br/>D1[7:0],D2[7:0],<br/>...,Dn[7:0]</div><div>↓</div><div>Any Command</div></div> <div><div>Legend</div><div>Command</div><div>Parameter</div><div>Display</div><div>Action</div><div>Mode</div><div>Sequential transfer</div></div>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |     |     |        |                                    |     |              |     |     |     |     |     |        |

### 6.2.37 Raed\_memory\_continue (3Eh)

| 3EH                           | Raed_memory_continue                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |     |     |        |                                    |     |              |     |     |     |     |     |            |
|-------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|-----|--------|------------------------------------|-----|--------------|-----|-----|-----|-----|-----|------------|
|                               | D/CX                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | RDX | WRX | D15-D8 | D7                                 | D6  | D5           | D4  | D3  | D2  | D1  | D0  | HEX        |
| Command                       | 0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | 1   | ↑   | -      | 0                                  | 0   | 1            | 1   | 1   | 1   | 1   | 0   | 3E         |
| 1 <sup>st</sup> parameter     | 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | ↑   | 1   | -      | X                                  | X   | X            | X   | X   | X   | X   | X   | Dummy read |
| 2 <sup>nd</sup> parameter     | 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | ↑   | 1   | -      | D17                                | D16 | D15          | D14 | D13 | D12 | D11 | D10 | 00..FF     |
| :                             | 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | ↑   | 1   | -      | Dx7                                | Dx6 | Dx5          | Dx4 | Dx3 | Dx2 | Dx1 | Dx0 | 00..FF     |
| (n+1) <sup>th</sup> parameter | 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | ↑   | 1   | -      | Dn7                                | Dn6 | Dn5          | Dn4 | Dn3 | Dn2 | Dn1 | Dn0 | 00..FF     |
| Description                   | <p>This command transfers image data from the display module's frame memory to the host processor continuing from the location following the previous read_memory_continue or read_memory_start command.</p> <p>If set_address_mode B5=0:</p> <p>Pixels are read continuing from the pixel location after the read range of the previous read_memory_start or read_memory_continue. The column register is then incremented and pixels are read from the frame memory until the column register equals the End Column (EC) value. The column register is then reset to SC and the page register is incremented. Pixels are read from the frame memory until the page register equals the End Page (EP) value or the host processor sends another command.</p> <p>If set_address_mode B5=1:</p> <p>Pixels are read continuing from the pixel location after the read range of the previous read_memory_start or read_memory_continue. The page register is then incremented and pixels are read from the frame memory until the page register equals the End Page (EP) value. The page register is then reset to SP and the column register is incremented. Pixels are read from the frame memory until the column register equals the End Column (EC) value or the host processor sends another command.</p> |     |     |        |                                    |     |              |     |     |     |     |     |            |
| Restriction                   | <p>Regardless of the color mode set in set_pixel_format, the pixel format returned by read_memory_continue is always 24-bit so there is no restriction on the length of data. A read_memory_start should follow a set_column_address, set_page_address or set_address_mode to define the read location. Otherwise, data read with read_memory_continue is undefined.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |     |     |        |                                    |     |              |     |     |     |     |     |            |
| Register Availability         | Status                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |     |     |        |                                    |     | Availability |     |     |     |     |     |            |
|                               | Normal Mode On, Idle Mode Off, Sleep Out                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |     |     |        |                                    |     | Yes          |     |     |     |     |     |            |
|                               | Normal Mode On, Idle Mode On, Sleep Out                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |     |     |        |                                    |     | Yes          |     |     |     |     |     |            |
|                               | Partial Mode On, Idle Mode Off, Sleep Out                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |     |     |        |                                    |     | Yes          |     |     |     |     |     |            |
|                               | Partial Mode On, Idle Mode On, Sleep Out                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |     |     |        |                                    |     | Yes          |     |     |     |     |     |            |
| Default                       | Status                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |     |     |        | Default value                      |     |              |     |     |     |     |     |            |
|                               | Power On Sequence                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |     |     |        | Contents of memory is set randomly |     |              |     |     |     |     |     |            |
| Flow Chart                    | <div><div><div>RAMRD</div><div>Dummy</div><div>Image Data<br/>D1[7:0],D2[7:0],<br/>...,Dn[7:0]</div><div>Any Command</div></div><div><div>Legend</div><div>Command</div><div>Parameter</div><div>Display</div><div>Action</div><div>Mode</div><div>Sequential transfer</div></div></div>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |     |     |        |                                    |     |              |     |     |     |     |     |            |

## 6.2.38 Set tear scan lines (44h)

| 44H                       | TESL (Tear Effect Scan Lines)                                                                                                                                                                           |     |     |        |                    |    |              |    |    |    |    |    |        |
|---------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|-----|--------|--------------------|----|--------------|----|----|----|----|----|--------|
|                           | D/CX                                                                                                                                                                                                    | RDX | WRX | D15-D8 | D7                 | D6 | D5           | D4 | D3 | D2 | D1 | D0 | HEX    |
| Command                   | 0                                                                                                                                                                                                       | 1   | ↑   | -      | 0                  | 1  | 0            | 0  | 0  | 1  | 0  | 0  | 44     |
| 1 <sup>st</sup> parameter | 1                                                                                                                                                                                                       | 1   | ↑   | -      | TELINE[15:8](8'b0) |    |              |    |    |    |    |    | 00..FF |
| 2 <sup>nd</sup> parameter | 1                                                                                                                                                                                                       | 1   | ↑   | -      | TELINE[7:0](8'b0)  |    |              |    |    |    |    |    | 00..FF |
| Description               | This command is turns on the display module's Tearing Effect output signal on the TE signal Line when the display module reacfes line TELINE. The TE signal is not affected by changing MADCTL bit B4.  |     |     |        |                    |    |              |    |    |    |    |    |        |
|                           | The Tearing Effect Line On has one parameter which describes the mode of the Tearing Effect Output Line.                                                                                                |     |     |        |                    |    |              |    |    |    |    |    |        |
|                           | The Tearing Effect Output line consists of V-Blanking information only:                                                                                                                                 |     |     |        |                    |    |              |    |    |    |    |    |        |
|                           | <div><div>Vertical Time Scale</div><div></div></div> <p>Note: That TELINE=0 is equivalent to TEMODE=0. The Tearing Effect Output Line shall be active low when the display module is in Sleep mode.</p> |     |     |        |                    |    |              |    |    |    |    |    |        |
| Restriction               | The command has no effect when Tearing Effect output is already ON.                                                                                                                                     |     |     |        |                    |    |              |    |    |    |    |    |        |
| Register Availability     | Status                                                                                                                                                                                                  |     |     |        |                    |    | Availability |    |    |    |    |    |        |
|                           | Normal Mode On, Idle Mode Off, Sleep Out                                                                                                                                                                |     |     |        |                    |    | Yes          |    |    |    |    |    |        |
|                           | Normal Mode On, Idle Mode On, Sleep Out                                                                                                                                                                 |     |     |        |                    |    | Yes          |    |    |    |    |    |        |
|                           | Partial Mode On, Idle Mode Off, Sleep Out                                                                                                                                                               |     |     |        |                    |    | Yes          |    |    |    |    |    |        |
|                           | Partial Mode On, Idle Mode On, Sleep Out                                                                                                                                                                |     |     |        |                    |    | Yes          |    |    |    |    |    |        |
| Default                   | TELINE[15:0]=0x0000h                                                                                                                                                                                    |     |     |        |                    |    |              |    |    |    |    |    |        |
| Flow Chart                | <div><div>TE Output On or Off</div><div><div><div>set_tear_on</div><div>Line N (LSB)</div><div>Line N (MSB)</div></div></div><div>TE Output On</div></div>                                              |     |     |        |                    |    |              |    |    |    |    |    |        |



### 6.2.39 Get the current scanline(45h)

| 45H                       | GETSCAN (Get the current scanline)                                                                                                                                                                                                                                                                                                        |     |     |        |                 |    |              |    |    |    |    |    |        |
|---------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|-----|--------|-----------------|----|--------------|----|----|----|----|----|--------|
|                           | D/CX                                                                                                                                                                                                                                                                                                                                      | RDX | WRX | D15-D8 | D7              | D6 | D5           | D4 | D3 | D2 | D1 | D0 | HEX    |
| Command                   | 0                                                                                                                                                                                                                                                                                                                                         | 1   | ↑   | -      | 0               | 1  | 0            | 0  | 0  | 1  | 0  | 1  | 45     |
| 1 <sup>st</sup> parameter | 1                                                                                                                                                                                                                                                                                                                                         | 1   | ↑   | -      | SLN[15:8](8'b0) |    |              |    |    |    |    |    | 00..FF |
| 2 <sup>nd</sup> parameter | 1                                                                                                                                                                                                                                                                                                                                         | 1   | ↑   | -      | SLN[7:0](8'b0)  |    |              |    |    |    |    |    | 00..FF |
| Description               | The display module returns the current scanline, N, used to update the display device. The total number of scanlines on a display device is defined as VSYNC + VBP + VACT + VFP. The first scanline is defined as the first line of V Sync and is denoted as Line 0. When in Sleep Mode, the value returned by get_scanline is undefined. |     |     |        |                 |    |              |    |    |    |    |    |        |
| Restriction               | -                                                                                                                                                                                                                                                                                                                                         |     |     |        |                 |    |              |    |    |    |    |    |        |
| Register Availability     | Status                                                                                                                                                                                                                                                                                                                                    |     |     |        |                 |    | Availability |    |    |    |    |    |        |
|                           | Normal Mode On, Idle Mode Off, Sleep Out                                                                                                                                                                                                                                                                                                  |     |     |        |                 |    | Yes          |    |    |    |    |    |        |
|                           | Normal Mode On, Idle Mode On, Sleep Out                                                                                                                                                                                                                                                                                                   |     |     |        |                 |    | Yes          |    |    |    |    |    |        |
|                           | Partial Mode On, Idle Mode Off, Sleep Out                                                                                                                                                                                                                                                                                                 |     |     |        |                 |    | Yes          |    |    |    |    |    |        |
|                           | Partial Mode On, Idle Mode On, Sleep Out                                                                                                                                                                                                                                                                                                  |     |     |        |                 |    | Yes          |    |    |    |    |    |        |
| Default                   | SLN[15:0]= 0x0000h                                                                                                                                                                                                                                                                                                                        |     |     |        |                 |    |              |    |    |    |    |    |        |
| Flow Chart                | <div><div><div>get_scanline</div></div><div>Host Processor</div><div></div><div>scanline MSB</div><div>Display Module</div><div>scanline LSB</div></div>                                                                                                                                                                                  |     |     |        |                 |    |              |    |    |    |    |    |        |

## 6.2.40 Write display brightness (51h)

| 51H                       | WRDISBV (Write Display Brightness)                                                                                                                                                                                                                                                                                                                                                                                                           |     |     |        |          |    |    |    |    |    |    |    |          |        |              |           |     |          |     |
|---------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|-----|--------|----------|----|----|----|----|----|----|----|----------|--------|--------------|-----------|-----|----------|-----|
|                           | D/CX                                                                                                                                                                                                                                                                                                                                                                                                                                         | RDX | WRX | D15-D8 | D7       | D6 | D5 | D4 | D3 | D2 | D1 | D0 | HEX      |        |              |           |     |          |     |
| Command                   | 0                                                                                                                                                                                                                                                                                                                                                                                                                                            | 1   | ↑   | -      | 0        | 1  | 0  | 1  | 0  | 0  | 0  | 1  | 51       |        |              |           |     |          |     |
| 1 <sup>st</sup> parameter | 1                                                                                                                                                                                                                                                                                                                                                                                                                                            | 1   | ↑   | -      | DBV[7:0] |    |    |    |    |    |    |    | 00 .. FF |        |              |           |     |          |     |
| Description               | <p>This command is used to adjust the brightness value of the display. It should be checked what the relationship between this written value and output brightness of the display is. This relationship is defined on the display module specification.</p> <p>In principle relationship is that 00h value means the lowest brightness and FFh value means the highest brightness.</p> <p>See chapter “5.18.3 Brightness Control Block”.</p> |     |     |        |          |    |    |    |    |    |    |    |          |        |              |           |     |          |     |
| Restriction               | -                                                                                                                                                                                                                                                                                                                                                                                                                                            |     |     |        |          |    |    |    |    |    |    |    |          |        |              |           |     |          |     |
| Register Availability     | <table><tr><td>Status</td><td>Availability</td></tr><tr><td>Sleep Out</td><td>Yes</td></tr><tr><td>Sleep In</td><td>Yes</td></tr></table>                                                                                                                                                                                                                                                                                                    |     |     |        |          |    |    |    |    |    |    |    |          | Status | Availability | Sleep Out | Yes | Sleep In | Yes |
| Status                    | Availability                                                                                                                                                                                                                                                                                                                                                                                                                                 |     |     |        |          |    |    |    |    |    |    |    |          |        |              |           |     |          |     |
| Sleep Out                 | Yes                                                                                                                                                                                                                                                                                                                                                                                                                                          |     |     |        |          |    |    |    |    |    |    |    |          |        |              |           |     |          |     |
| Sleep In                  | Yes                                                                                                                                                                                                                                                                                                                                                                                                                                          |     |     |        |          |    |    |    |    |    |    |    |          |        |              |           |     |          |     |
| Default                   | DBV[7:0]= 0x00h                                                                                                                                                                                                                                                                                                                                                                                                                              |     |     |        |          |    |    |    |    |    |    |    |          |        |              |           |     |          |     |
| Flow Chart                | <div><div><div>WRDISBV</div><div>↓</div><div>DBV[7..0]</div><div>↓</div><div>New Display Luminance Value Loaded</div></div><div><div>Legend</div><div>Command</div><div>Parameter</div><div>Display</div><div>Action</div><div>Mode</div><div>Sequential transfer</div></div></div>                                                                                                                                                          |     |     |        |          |    |    |    |    |    |    |    |          |        |              |           |     |          |     |

## 6.2.41 Read display brightness value (52h)

| 52H                       | RDDISBV (Read Display Brightness Value)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |     |     |        |          |    |    |    |    |    |    |    |            |        |              |           |     |          |     |
|---------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|-----|--------|----------|----|----|----|----|----|----|----|------------|--------|--------------|-----------|-----|----------|-----|
|                           | D/CX                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | RDX | WRX | D15-D8 | D7       | D6 | D5 | D4 | D3 | D2 | D1 | D0 | HEX        |        |              |           |     |          |     |
| Command                   | 0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | 1   | ↑   | -      | 0        | 1  | 0  | 1  | 0  | 0  | 1  | 0  | 52         |        |              |           |     |          |     |
| 1 <sup>st</sup> parameter | 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | ↑   | 1   | -      | xx       | xx | xx | xx | xx | xx | xx | xx | Dummy read |        |              |           |     |          |     |
| 2 <sup>nd</sup> parameter | 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | ↑   | 1   | -      | DBV[7:0] |    |    |    |    |    |    | xx |            |        |              |           |     |          |     |
| Description               | <p>This command returns the brightness value of the display.<br/>It should be checked what the relationship between this returned value and output brightness of the display. This relationship is defined on the display modulespecification is.<br/>In principle the relationship is that 00h value means the lowest brightness and FFh value means the highest brightness.<br/>See chapters: “5.18.3 Brightness Control Block”, and “6.2.40 Write Display Brightness (51h)”<br/>DBV[7:0] is reset when display is in sleep-in mode.<br/>DBV[7:0] is ‘0’ when bit BCTRL of “6.2.42 Write CTRL Display (53h)” command is ‘0’.<br/>DBV[7:0] is manual set brightness specified with “6.2.42 Write CTRL Display (53h)” command when bit BCTRL is ‘1’.<br/>When bit BCTRL of “6.2.42 Write CTRL Display (53h)” command is ‘1’ and bit C1/C0 of “6.2.44 Write Content Adaptive Brightness Control (55h)” are ‘0’, DBV[7:0] output is the brightness value specified with “6.2.40 Write Display Brightness (51h)” command.</p> |     |     |        |          |    |    |    |    |    |    |    |            |        |              |           |     |          |     |
| Restriction               | -                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |     |     |        |          |    |    |    |    |    |    |    |            |        |              |           |     |          |     |
| Register Availability     | <table><tr><th>Status</th><th>Availability</th></tr><tr><td>Sleep Out</td><td>Yes</td></tr><tr><td>Sleep In</td><td>Yes</td></tr></table>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |     |     |        |          |    |    |    |    |    |    |    |            | Status | Availability | Sleep Out | Yes | Sleep In | Yes |
| Status                    | Availability                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |     |     |        |          |    |    |    |    |    |    |    |            |        |              |           |     |          |     |
| Sleep Out                 | Yes                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |     |     |        |          |    |    |    |    |    |    |    |            |        |              |           |     |          |     |
| Sleep In                  | Yes                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |     |     |        |          |    |    |    |    |    |    |    |            |        |              |           |     |          |     |
| Default                   | DBV[7:0]= 0x00h                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |     |     |        |          |    |    |    |    |    |    |    |            |        |              |           |     |          |     |
| Flow Chart                | <div><div><div>Serial I/F Mode</div><div>Parallel I/F Mode</div></div><div><div><div>Read RDDISBV</div><div>Send 2<sup>nd</sup> Parameter</div></div><div><div>Read RDDISBV</div><div>Dummy Read</div><div>Send 2<sup>nd</sup> Parameter</div></div></div><div>Host<br/>Display</div><div><div>Legend</div><div><div>Command</div><div>Parameter</div><div>Display</div><div>Action</div><div>Mode</div><div>Sequential transfer</div></div></div></div>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |     |     |        |          |    |    |    |    |    |    |    |            |        |              |           |     |          |     |

## 6.2.42 Write CTRL display (53h)

| 53H                       | WRCTRLD (Write Control Display)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |     |     |        |    |    |       |    |    |    |    |    |          |        |              |           |     |          |     |
|---------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|-----|--------|----|----|-------|----|----|----|----|----|----------|--------|--------------|-----------|-----|----------|-----|
|                           | D/CX                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | RDX | WRX | D15-D8 | D7 | D6 | D5    | D4 | D3 | D2 | D1 | D0 | HEX      |        |              |           |     |          |     |
| Command                   | 0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | 1   | ↑   | -      | 0  | 1  | 0     | 1  | 0  | 0  | 1  | 1  | 53       |        |              |           |     |          |     |
| 1 <sup>st</sup> parameter | 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | 1   | ↑   | -      | xx | xx | BCTRL | xx | DD | BL | xx | xx | 00 .. FF |        |              |           |     |          |     |
| Description               | <p>This command is used to control display brightness.</p> <p>BCTRL: Brightness Control Block On/Off, This bit is always used to switch brightness for display.</p> <p>0 = Off (Brightness registers are 00h, DBV[7..0])</p> <p>1 = On (Brightness registers are active, according to the other parameters.)</p> <p>Display Dimming (DD): (Only for manual brightness setting)</p> <p>DD = 0: Display Dimming is off</p> <p>DD = 1: Display Dimming is on</p> <p>BL: Backlight Control On/Off</p> <p>0 = Off (Completely turn off backlight circuit. Control lines must be low.)</p> <p>1 = On</p> <p>Dimming function is adapted to the brightness registers for display when bit BCTRL is changed at DD=1, e.g. BCTRL: 0 -&gt; 1 or 1-&gt; 0.</p> <p>When BL bit change from “On” to “Off”, backlight is turned off without gradual dimming, even if dimming-on (DD=1) are selected.</p> <p>X = Don't care.</p> |     |     |        |    |    |       |    |    |    |    |    |          |        |              |           |     |          |     |
| Restriction               | -                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |     |     |        |    |    |       |    |    |    |    |    |          |        |              |           |     |          |     |
| Register Availability     | <table><tr><td>Status</td><td>Availability</td></tr><tr><td>Sleep Out</td><td>Yes</td></tr><tr><td>Sleep In</td><td>Yes</td></tr></table>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |     |     |        |    |    |       |    |    |    |    |    |          | Status | Availability | Sleep Out | Yes | Sleep In | Yes |
| Status                    | Availability                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |     |     |        |    |    |       |    |    |    |    |    |          |        |              |           |     |          |     |
| Sleep Out                 | Yes                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |     |     |        |    |    |       |    |    |    |    |    |          |        |              |           |     |          |     |
| Sleep In                  | Yes                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |     |     |        |    |    |       |    |    |    |    |    |          |        |              |           |     |          |     |
| Default                   | D[7:0]= 0x00h                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |     |     |        |    |    |       |    |    |    |    |    |          |        |              |           |     |          |     |
| Flow Chart                | <div><div><div>WRCTRLD</div><div>↓</div><div>BCTRL, DD, BL</div><div>↓</div><div>New Control Value Loaded</div></div><div><div>Legend</div><div>Command</div><div>Parameter</div><div>Display</div><div>Action</div><div>Mode</div><div>Sequential transfer</div></div></div>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |     |     |        |    |    |       |    |    |    |    |    |          |        |              |           |     |          |     |

### 6.2.43 Read CTRL value display (54h)

| 54H                       | RDCTRLD (Read Control Value Display)                                                                                                                                                                                                                                                                                                                                                                                                                          |     |     |        |    |    |       |    |    |    |    |    |     |        |              |           |     |          |     |
|---------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|-----|--------|----|----|-------|----|----|----|----|----|-----|--------|--------------|-----------|-----|----------|-----|
|                           | D/CX                                                                                                                                                                                                                                                                                                                                                                                                                                                          | RDX | WRX | D15-D8 | D7 | D6 | D5    | D4 | D3 | D2 | D1 | D0 | HEX |        |              |           |     |          |     |
| Command                   | 0                                                                                                                                                                                                                                                                                                                                                                                                                                                             | 1   | ↑   | -      | 0  | 1  | 0     | 1  | 0  | 1  | 0  | 0  | 54  |        |              |           |     |          |     |
| 1 <sup>st</sup> parameter | 1                                                                                                                                                                                                                                                                                                                                                                                                                                                             | ↑   | 1   | -      | xx | xx | xx    | xx | xx | xx | xx | xx | xx  |        |              |           |     |          |     |
| 2 <sup>nd</sup> arameter  | 1                                                                                                                                                                                                                                                                                                                                                                                                                                                             | ↑   | 1   | -      | 0  | 0  | BCTRL | 0  | DD | BL | 0  | 0  | xx  |        |              |           |     |          |     |
| Description               | <p>This command returns ambient light and brightness control values, see chapter: “6.2.42 Write CTRL Display (53h)”.</p> <p>BCTRL: Brightness Control Block On/Off, This bit is always used to switch brightness for display.<br/>0 = Off<br/>1 = On</p> <p>Display Dimming (DD):<br/>DD = 0: Display Dimming is off<br/>DD = 1: Display Dimming is on</p> <p>BL: Backlight Control On/Off<br/>0 = Off (completely turn off backlight circuit)<br/>1 = On</p> |     |     |        |    |    |       |    |    |    |    |    |     |        |              |           |     |          |     |
| Restriction               | -                                                                                                                                                                                                                                                                                                                                                                                                                                                             |     |     |        |    |    |       |    |    |    |    |    |     |        |              |           |     |          |     |
| Register Availability     | <table><tr><td>Status</td><td>Availability</td></tr><tr><td>Sleep Out</td><td>Yes</td></tr><tr><td>Sleep In</td><td>Yes</td></tr></table>                                                                                                                                                                                                                                                                                                                     |     |     |        |    |    |       |    |    |    |    |    |     | Status | Availability | Sleep Out | Yes | Sleep In | Yes |
| Status                    | Availability                                                                                                                                                                                                                                                                                                                                                                                                                                                  |     |     |        |    |    |       |    |    |    |    |    |     |        |              |           |     |          |     |
| Sleep Out                 | Yes                                                                                                                                                                                                                                                                                                                                                                                                                                                           |     |     |        |    |    |       |    |    |    |    |    |     |        |              |           |     |          |     |
| Sleep In                  | Yes                                                                                                                                                                                                                                                                                                                                                                                                                                                           |     |     |        |    |    |       |    |    |    |    |    |     |        |              |           |     |          |     |
| Default                   | D[7:0]= 0x00h                                                                                                                                                                                                                                                                                                                                                                                                                                                 |     |     |        |    |    |       |    |    |    |    |    |     |        |              |           |     |          |     |
| Flow Chart                | <div><div><div>Serial I/F Mode</div><div>Read RDCTRLD</div><div>Send 2nd Parameter</div></div><div><div>Parallel I/F Mode</div><div>Read RDCTRLD</div><div>Dummy Read</div><div>Send 2nd Parameter</div></div><div>Host Display</div></div> <div><div>Legend</div><div>Command</div><div>Parameter</div><div>Display</div><div>Action</div><div>Mode</div><div>Sequential transfer</div></div>                                                                |     |     |        |    |    |       |    |    |    |    |    |     |        |              |           |     |          |     |

## 6.2.44 Write content adaptive brightness control (55h)

| 55 H                      | WRCABC (Write Content Adaptive Brightness Control)                                                                                                                                                                                                                                                   |     |     |        |                      |    |    |    |    |    |           |    |     |
|---------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|-----|--------|----------------------|----|----|----|----|----|-----------|----|-----|
|                           | D/CX                                                                                                                                                                                                                                                                                                 | RDX | WRX | D15-D8 | D7                   | D6 | D5 | D4 | D3 | D2 | D1        | D0 | HEX |
| Command                   | 0                                                                                                                                                                                                                                                                                                    | 1   | ↑   | -      | 0                    | 1  | 0  | 1  | 0  | 1  | 0         | 1  | 55  |
| 1 <sup>st</sup> parameter | 1                                                                                                                                                                                                                                                                                                    | 1   | ↑   | -      | xx                   | xx | xx | xx | xx | xx | CABC[1:0] |    | xx  |
| Description               | This command is used to set parameters for image content based adaptive brightness control functionality.<br>There is possible to use 4 different modes for content adaptive image functionality, which are defined on a table below. See chapter “5.18 Content Adaptive Brightness Control (CABC)”. |     |     |        |                      |    |    |    |    |    |           |    |     |
|                           | C1                                                                                                                                                                                                                                                                                                   |     | C0  |        | Function             |    |    |    |    |    |           |    |     |
|                           | 0                                                                                                                                                                                                                                                                                                    |     | 0   |        | Off                  |    |    |    |    |    |           |    |     |
|                           | 0                                                                                                                                                                                                                                                                                                    |     | 1   |        | User Interface Image |    |    |    |    |    |           |    |     |
|                           | 1                                                                                                                                                                                                                                                                                                    |     | 0   |        | Still Picture        |    |    |    |    |    |           |    |     |
|                           | 1                                                                                                                                                                                                                                                                                                    |     | 1   |        | Moving Image         |    |    |    |    |    |           |    |     |
| X = Don't care.           |                                                                                                                                                                                                                                                                                                      |     |     |        |                      |    |    |    |    |    |           |    |     |
| Restriction               |                                                                                                                                                                                                                                                                                                      |     |     |        |                      |    |    |    |    |    |           |    |     |
| Register Availability     | Status                                                                                                                                                                                                                                                                                               |     |     |        | Availability         |    |    |    |    |    |           |    |     |
|                           | Sleep Out                                                                                                                                                                                                                                                                                            |     |     |        | Yes                  |    |    |    |    |    |           |    |     |
|                           | Sleep In                                                                                                                                                                                                                                                                                             |     |     |        | Yes                  |    |    |    |    |    |           |    |     |
| Default                   | CABC[1:0] = 00                                                                                                                                                                                                                                                                                       |     |     |        |                      |    |    |    |    |    |           |    |     |
| Flow Chart                | <div><div><div>WRCABC</div><div>↓</div><div>1st parameter: C[1:0]</div><div>↓</div><div>New Adaptive Image Mode</div></div><div><div>Legend</div><div>Command</div><div>Parameter</div><div>Display</div><div>Action</div><div>Mode</div><div>Sequential transfer</div></div></div>                  |     |     |        |                      |    |    |    |    |    |           |    |     |

## 6.2.45 Read content adaptive brightness control (56h)

| 56H                       | RDCABC (Read Content Adaptive Brightness Control)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                      |     |        |    |    |    |    |    |    |    |    |            |        |              |           |     |          |     |   |   |                      |   |   |               |   |   |              |
|---------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------|-----|--------|----|----|----|----|----|----|----|----|------------|--------|--------------|-----------|-----|----------|-----|---|---|----------------------|---|---|---------------|---|---|--------------|
|                           | D/CX                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | RDX                  | WRX | D15-D8 | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 | HEX        |        |              |           |     |          |     |   |   |                      |   |   |               |   |   |              |
| Command                   | 0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | 1                    | ↑   | -      | 0  | 1  | 0  | 1  | 0  | 1  | 1  | 0  | 56         |        |              |           |     |          |     |   |   |                      |   |   |               |   |   |              |
| 1 <sup>st</sup> parameter | 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | ↑                    | 1   | -      | XX | XX | XX | XX | XX | XX | XX | XX | Dummy read |        |              |           |     |          |     |   |   |                      |   |   |               |   |   |              |
| 2 <sup>nd</sup> parameter | 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | ↑                    | 1   | -      | 0  | 0  | 0  | 0  | 0  | 0  | C1 | C0 | xx         |        |              |           |     |          |     |   |   |                      |   |   |               |   |   |              |
| Description               | <p>This command is used to set parameters for image content based adaptive brightness control functionality.</p> <p>There is possible to use 4 different modes for content adaptive image functionality, which are defined on a table below. See chapter “5.18 Content Adaptive Brightness Control (CABC)”.</p> <table><tr><th>C1</th><th>C0</th><th>Function</th></tr><tr><td>0</td><td>0</td><td>Off</td></tr><tr><td>0</td><td>1</td><td>User Interface Image</td></tr><tr><td>1</td><td>0</td><td>Still Picture</td></tr><tr><td>1</td><td>1</td><td>Moving Image</td></tr></table> |                      |     |        |    |    |    |    |    |    |    |    |            | C1     | C0           | Function  | 0   | 0        | Off | 0 | 1 | User Interface Image | 1 | 0 | Still Picture | 1 | 1 | Moving Image |
| C1                        | C0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | Function             |     |        |    |    |    |    |    |    |    |    |            |        |              |           |     |          |     |   |   |                      |   |   |               |   |   |              |
| 0                         | 0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | Off                  |     |        |    |    |    |    |    |    |    |    |            |        |              |           |     |          |     |   |   |                      |   |   |               |   |   |              |
| 0                         | 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | User Interface Image |     |        |    |    |    |    |    |    |    |    |            |        |              |           |     |          |     |   |   |                      |   |   |               |   |   |              |
| 1                         | 0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | Still Picture        |     |        |    |    |    |    |    |    |    |    |            |        |              |           |     |          |     |   |   |                      |   |   |               |   |   |              |
| 1                         | 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | Moving Image         |     |        |    |    |    |    |    |    |    |    |            |        |              |           |     |          |     |   |   |                      |   |   |               |   |   |              |
| Restriction               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                      |     |        |    |    |    |    |    |    |    |    |            |        |              |           |     |          |     |   |   |                      |   |   |               |   |   |              |
| Register Availability     | <table><tr><th>Status</th><th>Availability</th></tr><tr><td>Sleep Out</td><td>Yes</td></tr><tr><td>Sleep In</td><td>Yes</td></tr></table>                                                                                                                                                                                                                                                                                                                                                                                                                                               |                      |     |        |    |    |    |    |    |    |    |    |            | Status | Availability | Sleep Out | Yes | Sleep In | Yes |   |   |                      |   |   |               |   |   |              |
| Status                    | Availability                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                      |     |        |    |    |    |    |    |    |    |    |            |        |              |           |     |          |     |   |   |                      |   |   |               |   |   |              |
| Sleep Out                 | Yes                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                      |     |        |    |    |    |    |    |    |    |    |            |        |              |           |     |          |     |   |   |                      |   |   |               |   |   |              |
| Sleep In                  | Yes                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                      |     |        |    |    |    |    |    |    |    |    |            |        |              |           |     |          |     |   |   |                      |   |   |               |   |   |              |
| Default                   | C[1:0] = 00                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                      |     |        |    |    |    |    |    |    |    |    |            |        |              |           |     |          |     |   |   |                      |   |   |               |   |   |              |
| Flow Chart                | <div><div><div><div>Serial I/F Mode</div><div>Read RDCABC</div><div>Send 2<sup>nd</sup> Parameter</div></div><div><div>Parallel I/F Mode</div><div>Read RDCABC</div><div>Dummy Read</div><div>Send 2<sup>nd</sup> Parameter</div></div></div><div><div>Host</div><div>Display</div></div></div> <div><div>Legend</div><div><div>Command</div><div>Parameter</div><div>Display</div><div>Action</div><div>Mode</div><div>Sequential transfer</div></div></div>                                                                                                                           |                      |     |        |    |    |    |    |    |    |    |    |            |        |              |           |     |          |     |   |   |                      |   |   |               |   |   |              |



## 6.2.46 Write CABC minimum brightness (5Eh)

| 5E H                      | WRCABCMB (Write CABC minimum brightness)                                                                                                                                                                                                                                                                 |     |     |        |          |    |    |    |    |    |    |    |          |        |              |           |     |          |     |
|---------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|-----|--------|----------|----|----|----|----|----|----|----|----------|--------|--------------|-----------|-----|----------|-----|
|                           | D/CX                                                                                                                                                                                                                                                                                                     | RDX | WRX | D15-D8 | D7       | D6 | D5 | D4 | D3 | D2 | D1 | D0 | HEX      |        |              |           |     |          |     |
| Command                   | 0                                                                                                                                                                                                                                                                                                        | 1   | ↑   | -      | 0        | 1  | 0  | 1  | 1  | 1  | 1  | 0  | 5E       |        |              |           |     |          |     |
| 1 <sup>st</sup> parameter | 1                                                                                                                                                                                                                                                                                                        | 1   | 1   | -      | CMB[7:0] |    |    |    |    |    |    |    | 00 .. FF |        |              |           |     |          |     |
| Description               | This command is used to set the minimum brightness value of the display for CABC function.<br>In principle relationship is that 00h value means the lowest brightness for CABC and FFh value means the highest brightness for CABC.<br>See chapter “5.18.4 Minimum brightness setting of CABC function”. |     |     |        |          |    |    |    |    |    |    |    |          |        |              |           |     |          |     |
| Restriction               | -                                                                                                                                                                                                                                                                                                        |     |     |        |          |    |    |    |    |    |    |    |          |        |              |           |     |          |     |
| Register Availability     | <table><tr><td>Status</td><td>Availability</td></tr><tr><td>Sleep Out</td><td>Yes</td></tr><tr><td>Sleep In</td><td>Yes</td></tr></table>                                                                                                                                                                |     |     |        |          |    |    |    |    |    |    |    |          | Status | Availability | Sleep Out | Yes | Sleep In | Yes |
| Status                    | Availability                                                                                                                                                                                                                                                                                             |     |     |        |          |    |    |    |    |    |    |    |          |        |              |           |     |          |     |
| Sleep Out                 | Yes                                                                                                                                                                                                                                                                                                      |     |     |        |          |    |    |    |    |    |    |    |          |        |              |           |     |          |     |
| Sleep In                  | Yes                                                                                                                                                                                                                                                                                                      |     |     |        |          |    |    |    |    |    |    |    |          |        |              |           |     |          |     |
| Default                   | CMB[7:0] = 0x00h                                                                                                                                                                                                                                                                                         |     |     |        |          |    |    |    |    |    |    |    |          |        |              |           |     |          |     |
| Flow Chart                | <div><div><div>WRCABCMB</div><div>CMB[7..0]</div><div>New Display Luminance Value Loaded</div></div><div><div>Legend</div><div>Command</div><div>Parameter</div><div>Display</div><div>Action</div><div>Mode</div><div>Sequential transfer</div></div></div>                                             |     |     |        |          |    |    |    |    |    |    |    |          |        |              |           |     |          |     |

## 6.2.47 Read CABC minimum brightness (5Fh)

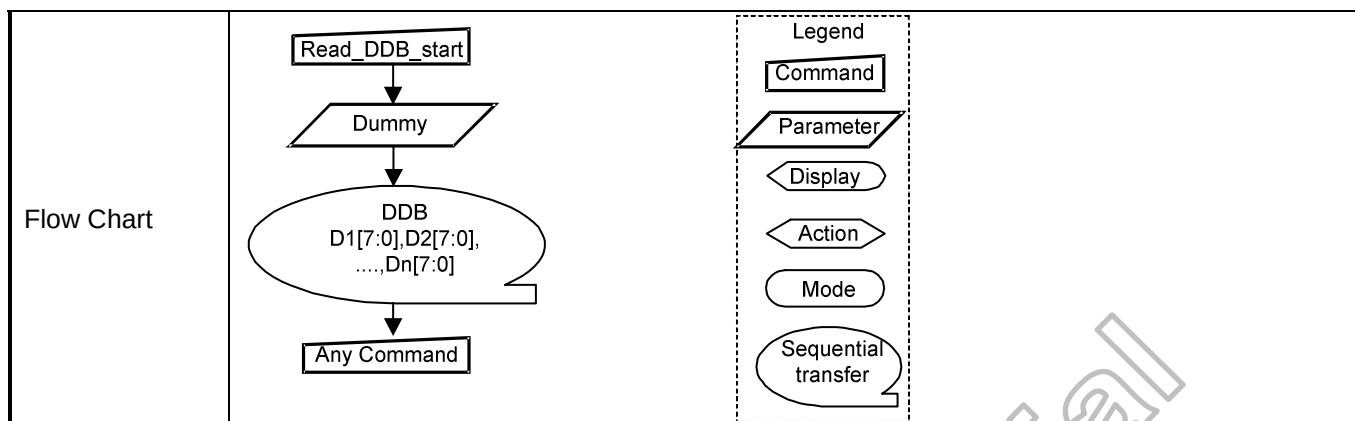
| 5FH                       | RDCABCMB (Read CABC minimum brightness)                                                                                                                                                                                                                                                                                                                                                                                           |     |     |        |          |    |    |    |    |    |    |    |     |        |              |           |     |          |     |
|---------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|-----|--------|----------|----|----|----|----|----|----|----|-----|--------|--------------|-----------|-----|----------|-----|
|                           | D/CX                                                                                                                                                                                                                                                                                                                                                                                                                              | RDX | WRX | D15-D8 | D7       | D6 | D5 | D4 | D3 | D2 | D1 | D0 | HEX |        |              |           |     |          |     |
| Command                   | 0                                                                                                                                                                                                                                                                                                                                                                                                                                 | 1   | ↑   | -      | 0        | 1  | 0  | 1  | 1  | 1  | 1  | 1  | 5F  |        |              |           |     |          |     |
| 1 <sup>st</sup> parameter | 1                                                                                                                                                                                                                                                                                                                                                                                                                                 | ↑   | 1   | -      | XX       | XX | XX | XX | XX | XX | XX | XX | XX  |        |              |           |     |          |     |
| 2 <sup>nd</sup> parameter | 1                                                                                                                                                                                                                                                                                                                                                                                                                                 | ↑   | 1   | -      | CMB[7:0] |    |    |    |    |    |    | XX |     |        |              |           |     |          |     |
| Description               | This command returns the minimum brightness value of CABC function.<br>In principle the relationship is that 00h value means the lowest brightness and FFh value means the highest brightness.<br>See chapter “5.18.4 Minimum brightness setting of CABC function”.<br>CMB[7:0] is CABC minimum brightness specified with “6.2.46 Write CABC minimum brightness (5Eh)” command.                                                   |     |     |        |          |    |    |    |    |    |    |    |     |        |              |           |     |          |     |
| Restriction               | -                                                                                                                                                                                                                                                                                                                                                                                                                                 |     |     |        |          |    |    |    |    |    |    |    |     |        |              |           |     |          |     |
| Register Availability     | <table><tr><td>Status</td><td>Availability</td></tr><tr><td>Sleep Out</td><td>Yes</td></tr><tr><td>Sleep In</td><td>Yes</td></tr></table>                                                                                                                                                                                                                                                                                         |     |     |        |          |    |    |    |    |    |    |    |     | Status | Availability | Sleep Out | Yes | Sleep In | Yes |
| Status                    | Availability                                                                                                                                                                                                                                                                                                                                                                                                                      |     |     |        |          |    |    |    |    |    |    |    |     |        |              |           |     |          |     |
| Sleep Out                 | Yes                                                                                                                                                                                                                                                                                                                                                                                                                               |     |     |        |          |    |    |    |    |    |    |    |     |        |              |           |     |          |     |
| Sleep In                  | Yes                                                                                                                                                                                                                                                                                                                                                                                                                               |     |     |        |          |    |    |    |    |    |    |    |     |        |              |           |     |          |     |
| Default                   | CMB[7:0] = 0x00h                                                                                                                                                                                                                                                                                                                                                                                                                  |     |     |        |          |    |    |    |    |    |    |    |     |        |              |           |     |          |     |
| Flow Chart                | <div><div><div>Serial I/F Mode</div><div>Read RDCABCMB</div><div>Send 2<sup>nd</sup> Parameter</div></div><div><div>Parallel I/F Mode</div><div>Read RDCABCMB</div><div>Dummy Read</div><div>Send 2<sup>nd</sup> Parameter</div></div><div>Host Display</div></div> <div><div>Legend</div><div><div>Command</div><div>Parameter</div><div>Display</div><div>Action</div><div>Mode</div><div>Sequential transfer</div></div></div> |     |     |        |          |    |    |    |    |    |    |    |     |        |              |           |     |          |     |

## 6.2.48 Read automatic brightness control self-diagnostic result (68h)

| 68H                       | RDABCSDR (Read Automatic Brightness Control Self-Diagnostic Result)                                                                                                                                                                                                                                                                                                                                                                                                                                 |     |     |        |        |    |    |    |    |    |    |    |     |        |              |           |     |          |     |
|---------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|-----|--------|--------|----|----|----|----|----|----|----|-----|--------|--------------|-----------|-----|----------|-----|
|                           | D/CX                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | RDX | WRX | D15-D8 | D7     | D6 | D5 | D4 | D3 | D2 | D1 | D0 | HEX |        |              |           |     |          |     |
| Command                   | 0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | 1   | ↑   | -      | 0      | 1  | 1  | 0  | 1  | 0  | 0  | 0  | 68  |        |              |           |     |          |     |
| 1 <sup>st</sup> parameter | 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | ↑   | 1   | -      | xx     | xx | xx | xx | xx | xx | xx | xx | xx  |        |              |           |     |          |     |
| 2 <sup>nd</sup> parameter | 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | ↑   | 1   | -      | D[7:6] |    | 0  | 0  | 0  | 0  | 0  | 0  | xx  |        |              |           |     |          |     |
| Description               | <p>This command indicates the status of the display self-diagnostic results for automatic brightness control after Sleep Out -command as described in the table below:</p> <ul style="list-style-type: none"><li>● Bit D7 – Register Loading Detection<br/>See section “5.15.1 Register loading Detection”.</li><li>● Bit D6 – Functionality Detection<br/>See section “5.15.2 Functionality Detection “.</li><li>● Bits D5, D4, D3, D2, D1 and D0 are for future use and are set to '0'.</li></ul> |     |     |        |        |    |    |    |    |    |    |    |     |        |              |           |     |          |     |
| Restriction               | -                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |     |     |        |        |    |    |    |    |    |    |    |     |        |              |           |     |          |     |
| Register Availability     | <table><tr><td>Status</td><td>Availability</td></tr><tr><td>Sleep Out</td><td>Yes</td></tr><tr><td>Sleep In</td><td>Yes</td></tr></table>                                                                                                                                                                                                                                                                                                                                                           |     |     |        |        |    |    |    |    |    |    |    |     | Status | Availability | Sleep Out | Yes | Sleep In | Yes |
| Status                    | Availability                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |     |     |        |        |    |    |    |    |    |    |    |     |        |              |           |     |          |     |
| Sleep Out                 | Yes                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |     |     |        |        |    |    |    |    |    |    |    |     |        |              |           |     |          |     |
| Sleep In                  | Yes                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |     |     |        |        |    |    |    |    |    |    |    |     |        |              |           |     |          |     |
| Default                   | D[7:0] = 0x00h                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |     |     |        |        |    |    |    |    |    |    |    |     |        |              |           |     |          |     |
| Flow Chart                | <div><div><div>Serial I/F Mode</div><div>Read RDABCSDR</div><div>Send 2<sup>nd</sup>Parameter</div></div><div><div>Parallel I/F Mode</div><div>Read RDABCSDR</div><div>Dummy Read</div><div>Send 2<sup>nd</sup>Parameter</div></div><div><div>Host</div><div>Display</div></div></div> <div><div>Legend</div><div>Command</div><div>Parameter</div><div>Display</div><div>Action</div><div>Mode</div><div>Sequential transfer</div></div>                                                           |     |     |        |        |    |    |    |    |    |    |    |     |        |              |           |     |          |     |

## 6.2.49 Read\_DDB\_start (A1h)

| A1H                       | Read_DDB_start                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |     |     |        |    |    |              |    |    |    |    |    |            |
|---------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|-----|--------|----|----|--------------|----|----|----|----|----|------------|
|                           | D/CX                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | RDX | WRX | D15-D8 | D7 | D6 | D5           | D4 | D3 | D2 | D1 | D0 | HEX        |
| Command                   | 0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | 1   | ↑   | -      | 1  | 0  | 1            | 0  | 0  | 0  | 0  | 1  | A1         |
| 1 <sup>st</sup> parameter | 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | ↑   | 1   | -      | x  | x  | x            | x  | x  | x  | x  | X  | Dummy read |
| 2 <sup>nd</sup> parameter | 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | ↑   | 1   | -      | x  | x  | x            | x  | x  | x  | x  | x  | xx         |
| :                         | 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | ↑   | 1   | -      | x  | x  | x            | x  | x  | x  | x  | x  | xx         |
| N <sup>th</sup> parameter | 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | ↑   | 1   | -      | x  | x  | x            | x  | x  | x  | x  | x  | xx         |
| Description               | <p>This command reads identifying and descriptive information from the peripheral. This information is organized in the Device Descriptor Block (DDB) stored on the peripheral. The response to this command returns a sequence of bytes that may be any length up to 64K bytes. Note that the returned sequence of bytes does not necessarily correspond to the entire DDB; it may be a portion of a larger block of data.</p> <p>The format of returned data is as follows:</p> <p>Parameter 2: LS (least significant) byte of Supplier ID. Supplier ID is a unique value assigned to each peripheral supplier by the MIPI organization.</p> <p>Parameter 3: MS (most significant) byte of Supplier ID.</p> <p>Parameter 4: LS (least significant) byte of Supplier Elective Data. This is a byte of information that is determined by the supplier. It could include model number or revision information, for example.</p> <p>Parameter 5: MS (most significant) byte of Supplier Elective Data</p> <p>Parameter 6: single-byte <i>Escape or Exit Code</i> (EEC). The code is interpreted as follows:</p> <ul style="list-style-type: none"><li>- FFh - Exit code – there is no more data in the Descriptor Block</li><li>- 00h - Escape code – there is supplier-proprietary data in the Descriptor Block (does not conform to any MIPI standard)</li><li>- Any other value – there is DDB data in the Descriptor Block. The format and interpretation of this data is documented in <i>MIPI Alliance Standard for Device Descriptor Block (DDB)</i>.</li></ul> <p>DDBs may contain many more data fields providing information about the peripheral.</p> <p>In a DSI system, read activity takes the form of two separate transactions across the bus: first the read command read_DDB_start from host processor to peripheral, which includes the bus turn-around token.</p> <p>The peripheral then takes control of the bus and returns the requested data. The peripheral response to read_DDB_start is a Long Packet type, so its length may be up to 64K bytes unless limited by a previous set_max_return_size command.</p> <p>The response to a read_DDB_start command always starts at the beginning of the Device Descriptor Block. After receiving the first packet and processing the returned DDB data, the host processor may initiate a read_DDB_continue command to access the next portion of the DDB. A read_DDB_continue command begins the next read at the location following the last byte of the previous data read from the DDB.</p> <p>Subsequent read_DDB_continue commands can be used to read a DDB or supplier-proprietary block of arbitrary size. There is, however, no obligation to read the entire block. The host processor may choose to stop reading after completion of any read_DDB_xxx command.</p> |     |     |        |    |    |              |    |    |    |    |    |            |
| Restrictions              | -                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |     |     |        |    |    |              |    |    |    |    |    |            |
| Register Availability     | Status                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |     |     |        |    |    | Availability |    |    |    |    |    |            |
|                           | Normal Mode On, Idle Mode Off, Sleep Out                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |     |     |        |    |    | Yes          |    |    |    |    |    |            |
|                           | Normal Mode On, Idle Mode On, Sleep Out                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |     |     |        |    |    | Yes          |    |    |    |    |    |            |
|                           | Partial Mode On, Idle Mode Off, Sleep Out                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |     |     |        |    |    | Yes          |    |    |    |    |    |            |
|                           | Partial Mode On, Idle Mode On, Sleep Out                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |     |     |        |    |    | Yes          |    |    |    |    |    |            |
| Default                   | D[7:0] = 0x00h                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |     |     |        |    |    |              |    |    |    |    |    |            |



Himax Confidential  
Do Not Copy

## 6.2.50 Read\_DDB\_continue (A8h)

| A8H                       | Read_DDB_continue                                                                                                                                                                                                                                                                                                                 |     |     |        |    |    |              |    |    |    |    |    |            |
|---------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|-----|--------|----|----|--------------|----|----|----|----|----|------------|
|                           | D/CX                                                                                                                                                                                                                                                                                                                              | RDX | WRX | D15-D8 | D7 | D6 | D5           | D4 | D3 | D2 | D1 | D0 | HEX        |
| Command                   | 0                                                                                                                                                                                                                                                                                                                                 | 1   | ↑   | -      | 1  | 0  | 1            | 0  | 1  | 0  | 0  | 0  | A8         |
| 1 <sup>st</sup> parameter | 1                                                                                                                                                                                                                                                                                                                                 | ↑   | 1   | -      | x  | x  | x            | x  | x  | x  | x  | x  | Dummy read |
| 2 <sup>nd</sup> parameter | 1                                                                                                                                                                                                                                                                                                                                 | ↑   | 1   | -      | x  | x  | x            | x  | x  | x  | x  | x  | xx         |
| :                         | 1                                                                                                                                                                                                                                                                                                                                 | ↑   | 1   | -      | x  | x  | x            | x  | x  | x  | x  | x  | xx         |
| N <sup>th</sup> parameter | 1                                                                                                                                                                                                                                                                                                                                 | ↑   | 1   | -      | x  | x  | x            | x  | x  | x  | x  | x  | xx         |
| Description               | A read_DDB_start command should be executed at least once before a read_DDB_continue command to define the read location. Otherwise, data read with a read_DDB_continue command is undefined.                                                                                                                                     |     |     |        |    |    |              |    |    |    |    |    |            |
| Restrictions              | -                                                                                                                                                                                                                                                                                                                                 |     |     |        |    |    |              |    |    |    |    |    |            |
| Register Availability     | Status                                                                                                                                                                                                                                                                                                                            |     |     |        |    |    | Availability |    |    |    |    |    |            |
|                           | Normal Mode On, Idle Mode Off, Sleep Out                                                                                                                                                                                                                                                                                          |     |     |        |    |    | Yes          |    |    |    |    |    |            |
|                           | Normal Mode On, Idle Mode On, Sleep Out                                                                                                                                                                                                                                                                                           |     |     |        |    |    | Yes          |    |    |    |    |    |            |
|                           | Partial Mode On, Idle Mode Off, Sleep Out                                                                                                                                                                                                                                                                                         |     |     |        |    |    | Yes          |    |    |    |    |    |            |
|                           | Partial Mode On, Idle Mode On, Sleep Out                                                                                                                                                                                                                                                                                          |     |     |        |    |    | Yes          |    |    |    |    |    |            |
| Default                   | D[7:0] = 0x00h                                                                                                                                                                                                                                                                                                                    |     |     |        |    |    |              |    |    |    |    |    |            |
| Flow Chart                | <div><div><div>Read_DDB_continue</div><div>↓</div><div>Dummy</div><div>↓</div><div>DDB<br/>D1[7:0],D2[7:0],<br/>...,Dn[7:0]</div><div>↓</div><div>Any Command</div></div><div><div>Legend</div><div>Command</div><div>Parameter</div><div>Display</div><div>Action</div><div>Mode</div><div>Sequential transfer</div></div></div> |     |     |        |    |    |              |    |    |    |    |    |            |

## 6.2.51 Read ID1 (DAh)

| DAH                       | RDID1 (Read ID1)                                                                                                                                                                                                                                                                                                                                                        |     |     |        |                            |    |                    |    |    |    |    |    |     |
|---------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|-----|--------|----------------------------|----|--------------------|----|----|----|----|----|-----|
|                           | DNC                                                                                                                                                                                                                                                                                                                                                                     | NRD | NWR | D15~D8 | D7                         | D6 | D5                 | D4 | D3 | D2 | D1 | D0 | HEX |
| Command                   | 0                                                                                                                                                                                                                                                                                                                                                                       | 1   | ↑   | -      | 1                          | 1  | 0                  | 1  | 1  | 0  | 1  | 0  | DA  |
| 1 <sup>st</sup> parameter | 1                                                                                                                                                                                                                                                                                                                                                                       | ↑   | 1   | -      | -                          | -  | -                  | -  | -  | -  | -  | -  | -   |
| 2 <sup>nd</sup> parameter | 1                                                                                                                                                                                                                                                                                                                                                                       | ↑   | 1   | -      | module's manufacturer[7:0] |    |                    |    |    |    |    |    | xx  |
| Description               | This read byte identifies the LCD module's manufacturer. It is specified by display supplier and for xx is defined as xxHEX.                                                                                                                                                                                                                                            |     |     |        |                            |    |                    |    |    |    |    |    |     |
| Restriction               | -                                                                                                                                                                                                                                                                                                                                                                       |     |     |        |                            |    |                    |    |    |    |    |    |     |
| Register Availability     | Status                                                                                                                                                                                                                                                                                                                                                                  |     |     |        |                            |    | Availability       |    |    |    |    |    |     |
|                           | Normal Mode On, Idle Mode Off, Sleep Out                                                                                                                                                                                                                                                                                                                                |     |     |        |                            |    | Yes                |    |    |    |    |    |     |
|                           | Normal Mode On, Idle Mode On, Sleep Out                                                                                                                                                                                                                                                                                                                                 |     |     |        |                            |    | Yes                |    |    |    |    |    |     |
|                           | Partial Mode On, Idle Mode Off, Sleep Out                                                                                                                                                                                                                                                                                                                               |     |     |        |                            |    | Yes                |    |    |    |    |    |     |
|                           | Partial Mode On, Idle Mode On, Sleep Out                                                                                                                                                                                                                                                                                                                                |     |     |        |                            |    | Yes                |    |    |    |    |    |     |
|                           | Sleep In or Booster Off                                                                                                                                                                                                                                                                                                                                                 |     |     |        |                            |    | Yes                |    |    |    |    |    |     |
| Default                   | Default value                                                                                                                                                                                                                                                                                                                                                           |     |     |        |                            |    | OTP value          |    |    |    |    |    |     |
|                           | ID1[7:0]=0x00h                                                                                                                                                                                                                                                                                                                                                          |     |     |        |                            |    | Define by customer |    |    |    |    |    |     |
| Flow Chart                | <div><div><div>Serial I/F Mode<br/>(P/SX=Low)</div><div><div>Read ID1</div><div>↓</div><div>Send 2<sup>nd</sup> parameter</div></div></div><div><div>Parallel I/F Mode<br/>(P/SX=High)</div><div><div>Read ID1</div><div>↓</div><div>Dummy Read</div><div>↓</div><div>Send 2<sup>nd</sup> Parameter</div></div></div><div><div>Host</div><div>Display</div></div></div> |     |     |        |                            |    |                    |    |    |    |    |    |     |
|                           | <div><div>Legend</div><div><div>Command</div><div>Parameter</div><div>Display</div><div>Action</div><div>Mode</div><div>Sequential transfer</div></div></div>                                                                                                                                                                                                           |     |     |        |                            |    |                    |    |    |    |    |    |     |



## 6.2.52 Read ID2 (DBh)

| DBH                       | RDID2 (Read ID2)                                                                                                                                                                                                                                                                                                                                                                                                                           |     |     |         |    |                                 |                    |         |    |    |    |    |     |
|---------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|-----|---------|----|---------------------------------|--------------------|---------|----|----|----|----|-----|
|                           | DNC                                                                                                                                                                                                                                                                                                                                                                                                                                        | NRD | NWR | D15~D8  | D7 | D6                              | D5                 | D4      | D3 | D2 | D1 | D0 | HEX |
| Command                   | 0                                                                                                                                                                                                                                                                                                                                                                                                                                          | 1   | ↑   | -       | 1  | 1                               | 0                  | 1       | 1  | 0  | 1  | 1  | DB  |
| 1 <sup>st</sup> parameter | 1                                                                                                                                                                                                                                                                                                                                                                                                                                          | ↑   | 1   | -       | xx | xx                              | xx                 | xx      | xx | xx | xx | xx | xx  |
| 2 <sup>nd</sup> parameter | 1                                                                                                                                                                                                                                                                                                                                                                                                                                          | ↑   | 1   | -       | -  | LCD module/driver version [6:0] |                    |         |    |    |    |    | -   |
| Description               | This read byte is used to track the LCD module/driver version. It is defined by display supplier and changes each time a revision is made to the display, material or construction specifications. See Table:                                                                                                                                                                                                                              |     |     |         |    |                                 |                    |         |    |    |    |    |     |
|                           | ID Byte Value V[7:0]                                                                                                                                                                                                                                                                                                                                                                                                                       |     |     | Version |    |                                 |                    | Changes |    |    |    |    |     |
|                           | 80h                                                                                                                                                                                                                                                                                                                                                                                                                                        |     |     |         |    |                                 |                    |         |    |    |    |    |     |
|                           | 81h                                                                                                                                                                                                                                                                                                                                                                                                                                        |     |     |         |    |                                 |                    |         |    |    |    |    |     |
|                           | 82h                                                                                                                                                                                                                                                                                                                                                                                                                                        |     |     |         |    |                                 |                    |         |    |    |    |    |     |
|                           | 83h                                                                                                                                                                                                                                                                                                                                                                                                                                        |     |     |         |    |                                 |                    |         |    |    |    |    |     |
|                           | 84h                                                                                                                                                                                                                                                                                                                                                                                                                                        |     |     |         |    |                                 |                    |         |    |    |    |    |     |
|                           | 85h                                                                                                                                                                                                                                                                                                                                                                                                                                        |     |     |         |    |                                 |                    |         |    |    |    |    |     |
|                           | X= Don't care                                                                                                                                                                                                                                                                                                                                                                                                                              |     |     |         |    |                                 |                    |         |    |    |    |    |     |
|                           | Restrictions                                                                                                                                                                                                                                                                                                                                                                                                                               | -   |     |         |    |                                 |                    |         |    |    |    |    |     |
| Register Availability     | Status                                                                                                                                                                                                                                                                                                                                                                                                                                     |     |     |         |    |                                 | Availability       |         |    |    |    |    |     |
|                           | Normal Mode On, Idle Mode Off, Sleep Out                                                                                                                                                                                                                                                                                                                                                                                                   |     |     |         |    |                                 | Yes                |         |    |    |    |    |     |
|                           | Normal Mode On, Idle Mode On, Sleep Out                                                                                                                                                                                                                                                                                                                                                                                                    |     |     |         |    |                                 | Yes                |         |    |    |    |    |     |
|                           | Partial Mode On, Idle Mode Off, Sleep Out                                                                                                                                                                                                                                                                                                                                                                                                  |     |     |         |    |                                 | Yes                |         |    |    |    |    |     |
|                           | Partial Mode On, Idle Mode On, Sleep Out                                                                                                                                                                                                                                                                                                                                                                                                   |     |     |         |    |                                 | Yes                |         |    |    |    |    |     |
|                           | Sleep In or Booster Off                                                                                                                                                                                                                                                                                                                                                                                                                    |     |     |         |    |                                 | Yes                |         |    |    |    |    |     |
| Default                   | Default value                                                                                                                                                                                                                                                                                                                                                                                                                              |     |     |         |    |                                 | OTP value          |         |    |    |    |    |     |
|                           | ID2[6:0]=0x00h                                                                                                                                                                                                                                                                                                                                                                                                                             |     |     |         |    |                                 | Define by customer |         |    |    |    |    |     |
| Flow Chart                | <div><div><div>Serial I/F Mode<br/>(P/SX=Low)</div><div>Read ID2</div><div>Send 2<sup>nd</sup> parameter</div></div><div><div>Parallel I/F Mode<br/>(P/SX=High)</div><div>Read ID2</div><div>Dummy Read</div><div>Send 2<sup>nd</sup> parameter</div></div><div>Host Display</div><div><div>Legend</div><div>Command</div><div>Parameter</div><div>Display</div><div>Action</div><div>Mode</div><div>Sequential transfer</div></div></div> |     |     |         |    |                                 |                    |         |    |    |    |    |     |

### 6.2.53 Read ID3 (DCh)

| DCH                       | RDID3 (Read ID3)                                                                                                                                                                                                                                                                         |     |     |        |                           |    |                    |    |    |    |    |    |     |
|---------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|-----|--------|---------------------------|----|--------------------|----|----|----|----|----|-----|
|                           | DNC                                                                                                                                                                                                                                                                                      | NRD | NWR | D15~D8 | D7                        | D6 | D5                 | D4 | D3 | D2 | D1 | D0 | HEX |
| Command                   | 0                                                                                                                                                                                                                                                                                        | 1   | ↑   | -      | 1                         | 1  | 0                  | 1  | 1  | 1  | 0  | 0  | DC  |
| 1 <sup>st</sup> parameter | 1                                                                                                                                                                                                                                                                                        | ↑   | 1   | -      | xx                        | xx | xx                 | xx | xx | xx | xx | xx | xx  |
| 2 <sup>nd</sup> parameter | 1                                                                                                                                                                                                                                                                                        | ↑   | 1   | -      | LCD module/driver ID[7:0] |    |                    |    |    |    |    | xx |     |
| Description               | This read byte identifies the LCD module/driver. It is specified by display supplier and for this LCD project module is defined as xxHEX.                                                                                                                                                |     |     |        |                           |    |                    |    |    |    |    |    |     |
| Restrictions              | -                                                                                                                                                                                                                                                                                        |     |     |        |                           |    |                    |    |    |    |    |    |     |
| Register Availability     | Status                                                                                                                                                                                                                                                                                   |     |     |        |                           |    | Availability       |    |    |    |    |    |     |
|                           | Normal Mode On, Idle Mode Off, Sleep Out                                                                                                                                                                                                                                                 |     |     |        |                           |    | Yes                |    |    |    |    |    |     |
|                           | Normal Mode On, Idle Mode On, Sleep Out                                                                                                                                                                                                                                                  |     |     |        |                           |    | Yes                |    |    |    |    |    |     |
|                           | Partial Mode On, Idle Mode Off, Sleep Out                                                                                                                                                                                                                                                |     |     |        |                           |    | Yes                |    |    |    |    |    |     |
|                           | Partial Mode On, Idle Mode On, Sleep Out                                                                                                                                                                                                                                                 |     |     |        |                           |    | Yes                |    |    |    |    |    |     |
|                           | Sleep In or Booster Off                                                                                                                                                                                                                                                                  |     |     |        |                           |    | Yes                |    |    |    |    |    |     |
| Default                   | Default value                                                                                                                                                                                                                                                                            |     |     |        |                           |    | OTP value          |    |    |    |    |    |     |
|                           | ID3[7:0]=0x00h                                                                                                                                                                                                                                                                           |     |     |        |                           |    | Define by customer |    |    |    |    |    |     |
| Flow Chart                | <div><div><div>Serial I/F Mode<br/>(P/SX=Low)</div><div>Read ID3</div><div>Send 2<sup>nd</sup> parameter</div></div><div><div>Parallel I/F Mode<br/>(P/SX=High)</div><div>Read ID3</div><div>Dummy Read</div><div>Send 2<sup>nd</sup> parameter</div></div><div>Host Display</div></div> |     |     |        |                           |    |                    |    |    |    |    |    |     |
|                           | <div><div>Legend</div><div>Command</div><div>Parameter</div><div>Display</div><div>Action</div><div>Mode</div><div>Sequential transfer</div></div>                                                                                                                                       |     |     |        |                           |    |                    |    |    |    |    |    |     |

## 6.2.54 SETOSC: Set internal oscillator (B0h)

| B0H                       | SETOSC( Set Internal Oscillator)                                                                                                                                                                       |                                         |     |                 |                               |    |              |           |           |    |    |        |     |
|---------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------|-----|-----------------|-------------------------------|----|--------------|-----------|-----------|----|----|--------|-----|
|                           | DNC                                                                                                                                                                                                    | NRD                                     | NWR | D15~D8          | D7                            | D6 | D5           | D4        | D3        | D2 | D1 | D0     | HEX |
| Command                   | 0                                                                                                                                                                                                      | 1                                       | ↑   | -               | 1                             | 1  | 0            | 1         | 1         | 1  | 0  | 0      | DC  |
| 1 <sup>st</sup> parameter | 1                                                                                                                                                                                                      | 1                                       | ↑   | -               | -                             | -  | -            | -         | -         | -  | -  | OSC_EN | -   |
| 2 <sup>nd</sup> parameter | 1                                                                                                                                                                                                      | 1                                       | ↑   | -               | -                             | -  | -            | -         | UADJ[3:0] |    |    | -      |     |
| Description               | This command is used to set internal oscillator related setting<br><b>OSC_EN</b> : Enable internal oscillator, High active.<br><b>UADJ[3:0]</b> : For User to adjust OSC frequency, default is 15 MHZ. |                                         |     |                 |                               |    |              |           |           |    |    |        |     |
|                           | UADJ                                                                                                                                                                                                   |                                         |     |                 | Internal oscillator frequency |    |              |           |           |    |    |        |     |
|                           | 0                                                                                                                                                                                                      | 0                                       | 0   | 0               | 28.0%                         |    |              |           |           |    |    |        |     |
|                           | 0                                                                                                                                                                                                      | 0                                       | 0   | 1               | 34.8%                         |    |              |           |           |    |    |        |     |
|                           | 0                                                                                                                                                                                                      | 0                                       | 1   | 0               | 41.5%                         |    |              |           |           |    |    |        |     |
|                           | 0                                                                                                                                                                                                      | 0                                       | 1   | 1               | 48.1%                         |    |              |           |           |    |    |        |     |
|                           | 0                                                                                                                                                                                                      | 1                                       | 0   | 0               | 54.7%                         |    |              |           |           |    |    |        |     |
|                           | 0                                                                                                                                                                                                      | 1                                       | 0   | 1               | 61.3%                         |    |              |           |           |    |    |        |     |
|                           | 0                                                                                                                                                                                                      | 1                                       | 1   | 0               | 67.8%                         |    |              |           |           |    |    |        |     |
|                           | 0                                                                                                                                                                                                      | 1                                       | 1   | 1               | 74.4%                         |    |              |           |           |    |    |        |     |
|                           | 1                                                                                                                                                                                                      | 0                                       | 0   | 0               | 80.6%                         |    |              |           |           |    |    |        |     |
|                           | 1                                                                                                                                                                                                      | 0                                       | 0   | 1               | 87.2%                         |    |              |           |           |    |    |        |     |
|                           | 1                                                                                                                                                                                                      | 0                                       | 1   | 0               | 93.5%                         |    |              |           |           |    |    |        |     |
|                           | 1                                                                                                                                                                                                      | 0                                       | 1   | 1               | 100.0%                        |    |              |           |           |    |    |        |     |
|                           | 1                                                                                                                                                                                                      | 1                                       | 0   | 0               | 106.4%                        |    |              |           |           |    |    |        |     |
|                           | 1                                                                                                                                                                                                      | 1                                       | 0   | 1               | 112.7%                        |    |              |           |           |    |    |        |     |
|                           | 1                                                                                                                                                                                                      | 1                                       | 1   | 0               | 119.4%                        |    |              |           |           |    |    |        |     |
|                           | 1                                                                                                                                                                                                      | 1                                       | 1   | 1               | 125.8%                        |    |              |           |           |    |    |        |     |
|                           | Restrictions                                                                                                                                                                                           | SETEXTC turn on to enable this command. |     |                 |                               |    |              |           |           |    |    |        |     |
| Register Availability     | Status                                                                                                                                                                                                 |                                         |     |                 |                               |    | Availability |           |           |    |    |        |     |
|                           | Normal Mode On, Idle Mode Off, Sleep Out                                                                                                                                                               |                                         |     |                 |                               |    | Yes          |           |           |    |    |        |     |
|                           | Normal Mode On, Idle Mode On, Sleep Out                                                                                                                                                                |                                         |     |                 |                               |    | Yes          |           |           |    |    |        |     |
|                           | Partial Mode On, Idle Mode Off, Sleep Out                                                                                                                                                              |                                         |     |                 |                               |    | Yes          |           |           |    |    |        |     |
|                           | Partial Mode On, Idle Mode On, Sleep Out                                                                                                                                                               |                                         |     |                 |                               |    | Yes          |           |           |    |    |        |     |
| Default                   | Status                                                                                                                                                                                                 |                                         |     | Default value   |                               |    |              | OTP value |           |    |    |        |     |
|                           | Power On Sequence                                                                                                                                                                                      |                                         |     | OSC_EN=0,       |                               |    |              | UADJ[3:0] |           |    |    |        |     |
|                           | S/W Reset<br>H/W Reset                                                                                                                                                                                 |                                         |     | UADJ[3:0]= 1011 |                               |    |              |           |           |    |    |        |     |

## 6.2.55 SETPOWER: Set power (B1h)

| B1H                                                                                                                                               | SETPOWER( Set power related setting)                                                                                                                                                                                                                                                                                                             |                                |     |        |              |               |            |            |            |             |              |      |        |                                      |                                |     |     |    |    |
|---------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------|-----|--------|--------------|---------------|------------|------------|------------|-------------|--------------|------|--------|--------------------------------------|--------------------------------|-----|-----|----|----|
|                                                                                                                                                   | DNC                                                                                                                                                                                                                                                                                                                                              | NRD                            | NWR | D15~D8 | D7           | D6            | D5         | D4         | D3         | D2          | D1           | D0   | HEX    |                                      |                                |     |     |    |    |
| Command                                                                                                                                           | 0                                                                                                                                                                                                                                                                                                                                                | 1                              | ↑   | -      | 1            | 0             | 1          | 1          | 0          | 0           | 0            | 1    | B1     |                                      |                                |     |     |    |    |
| 1 <sup>st</sup> parameter                                                                                                                         | 1                                                                                                                                                                                                                                                                                                                                                | 1                              | ↑   | -      | VBIA<br>S_EN | VSN_<br>EN    | VSP_<br>EN | VGL_<br>EN | VGH_<br>EN | LVGL_<br>EN | VDDD<br>N_HZ | STB  | -      |                                      |                                |     |     |    |    |
| 2 <sup>nd</sup> parameter                                                                                                                         | 1                                                                                                                                                                                                                                                                                                                                                | 1                              | ↑   | -      | -            | -             | -          | -          | -          | -           | -            | DSTB | -      |                                      |                                |     |     |    |    |
| 3 <sup>rd</sup> parameter                                                                                                                         | 1                                                                                                                                                                                                                                                                                                                                                | 1                              | ↑   | -      | -            | FS1[2:0]      |            |            | -          | AP[2:0]     |              |      | -      |                                      |                                |     |     |    |    |
| 4 <sup>th</sup> parameter                                                                                                                         | 1                                                                                                                                                                                                                                                                                                                                                | 1                              | ↑   | -      | -            | -             | -          | -          | BT[3:0]    |             |              | -    | -      |                                      |                                |     |     |    |    |
| 5 <sup>th</sup> parameter                                                                                                                         | 1                                                                                                                                                                                                                                                                                                                                                | 1                              | ↑   | -      | DT[1:0]      |               | -          | -          | DCDIV[3:0] |             |              | -    | -      |                                      |                                |     |     |    |    |
| 6 <sup>th</sup> parameter                                                                                                                         | 1                                                                                                                                                                                                                                                                                                                                                | 1                              | ↑   | -      | -            | -             | -          | BTP[4:0]   |            |             | -            | -    | -      |                                      |                                |     |     |    |    |
| 7 <sup>th</sup> parameter                                                                                                                         | 1                                                                                                                                                                                                                                                                                                                                                | 1                              | ↑   | -      | -            | -             | -          | BTN[4:0]   |            |             | -            | -    | -      |                                      |                                |     |     |    |    |
| 8 <sup>th</sup> parameter                                                                                                                         | 1                                                                                                                                                                                                                                                                                                                                                | 1                              | ↑   | -      | VRHP[7:0]    |               |            |            |            |             | -            | -    | -      |                                      |                                |     |     |    |    |
| 9 <sup>th</sup> parameter                                                                                                                         | 1                                                                                                                                                                                                                                                                                                                                                | 1                              | ↑   | -      | VRHN[7:0]    |               |            |            |            |             | -            | -    | -      |                                      |                                |     |     |    |    |
| 10 <sup>th</sup> parameter                                                                                                                        | 1                                                                                                                                                                                                                                                                                                                                                | 1                              | ↑   | -      | -            | -             | VRMP[5:0]  |            |            | -           | -            | -    | -      |                                      |                                |     |     |    |    |
| 11 <sup>th</sup> parameter                                                                                                                        | 1                                                                                                                                                                                                                                                                                                                                                | 1                              | ↑   | -      | -            | -             | VRMN[5:0]  |            |            | -           | -            | -    | -      |                                      |                                |     |     |    |    |
| 12 <sup>th</sup> parameter                                                                                                                        | 1                                                                                                                                                                                                                                                                                                                                                | 1                              | ↑   | -      | -            | -             | DD_TU      | VPNL<br>EN | -          | VBS[2:0]    |              |      | -      |                                      |                                |     |     |    |    |
| 13 <sup>th</sup> parameter                                                                                                                        | 1                                                                                                                                                                                                                                                                                                                                                | 1                              | ↑   | -      | -            | DC86_DIV[3:0] |            |            | XDK1       | XDK0        | AUTO<br>XDK  | -    | -      |                                      |                                |     |     |    |    |
| 14 <sup>th</sup> parameter                                                                                                                        | 1                                                                                                                                                                                                                                                                                                                                                | 1                              | ↑   | -      | -            | DTPS[2:0]     |            |            | -          | DTNS[2:0]   |              |      | -      |                                      |                                |     |     |    |    |
| 15 <sup>th</sup> parameter                                                                                                                        | 1                                                                                                                                                                                                                                                                                                                                                | 1                              | ↑   | -      | A_DC[1:0]    |               | A_DTP[2:0] |            |            | A_DTN[2:0]  |              |      | -      |                                      |                                |     |     |    |    |
| 16 <sup>th</sup> parameter                                                                                                                        | 1                                                                                                                                                                                                                                                                                                                                                | 1                              | ↑   | -      | B_DC[1:0]    |               | B_DTP[2:0] |            |            | B_DTN[2:0]  |              |      | -      |                                      |                                |     |     |    |    |
| 17 <sup>th</sup> parameter                                                                                                                        | 1                                                                                                                                                                                                                                                                                                                                                | 1                              | ↑   | -      | C_DC[1:0]    |               | C_DTP[2:0] |            |            | C_DTN[2:0]  |              |      | -      |                                      |                                |     |     |    |    |
| 18 <sup>th</sup> parameter                                                                                                                        | 1                                                                                                                                                                                                                                                                                                                                                | 1                              | ↑   | -      | D_DC[1:0]    |               | D_DTP[2:0] |            |            | D_DTN[2:0]  |              |      | -      |                                      |                                |     |     |    |    |
| 19 <sup>th</sup> parameter                                                                                                                        | 1                                                                                                                                                                                                                                                                                                                                                | 1                              | ↑   | -      | E_DC[1:0]    |               | E_DTP[2:0] |            |            | E_DTN[2:0]  |              |      | -      |                                      |                                |     |     |    |    |
| Description                                                                                                                                       | This command is used to set related setting of power.                                                                                                                                                                                                                                                                                            |                                |     |        |              |               |            |            |            |             |              |      |        |                                      |                                |     |     |    |    |
|                                                                                                                                                   | <b>DSTB:</b> When DSTB = “1”, the HX8369-A02 into the deep_standby mode, where all display operation stops, suspend all the internal operations including the internal R-C oscillator. During the standby mode, only the following process can be executed.                                                                                      |                                |     |        |              |               |            |            |            |             |              |      |        |                                      |                                |     |     |    |    |
|                                                                                                                                                   | 1. Exit the Standby mode (DSTB = “0”)                                                                                                                                                                                                                                                                                                            |                                |     |        |              |               |            |            |            |             |              |      |        |                                      |                                |     |     |    |    |
|                                                                                                                                                   | In the deep standby mode, the GRAM data and register content may be lost. For preventing this, they have to reset again after the deep standby mode cancel.                                                                                                                                                                                      |                                |     |        |              |               |            |            |            |             |              |      |        |                                      |                                |     |     |    |    |
|                                                                                                                                                   | <b>STB:</b> When SLP = “1”, the HX8369-A02 enters the standby mode, where all display operation stops, suspend all the internal operations. But the internal R-C oscillator stop or not is determined by OSC_EN bit. To minimize the standby power, please set OSC_EN to 0. During the standby mode, only the following process can be executed. |                                |     |        |              |               |            |            |            |             |              |      |        |                                      |                                |     |     |    |    |
|                                                                                                                                                   | a. Exit the Standby (Sleep) mode (SLP = “0”)<br>b. Enable or disable the oscillation<br>c. Software reset                                                                                                                                                                                                                                        |                                |     |        |              |               |            |            |            |             |              |      |        |                                      |                                |     |     |    |    |
|                                                                                                                                                   | <b>VSP_EN:</b> ON/OFF the operation of VSP circuit.                                                                                                                                                                                                                                                                                              |                                |     |        |              |               |            |            |            |             |              |      |        |                                      |                                |     |     |    |    |
|                                                                                                                                                   | <table><tr><td>VSP_EN</td><td>Operation of VSP DC/DC circuit</td></tr><tr><td>0</td><td>OFF</td></tr><tr><td>1</td><td>ON</td></tr></table>                                                                                                                                                                                                      |                                |     |        |              |               |            |            |            |             |              |      |        | VSP_EN                               | Operation of VSP DC/DC circuit | 0   | OFF | 1  | ON |
|                                                                                                                                                   | VSP_EN                                                                                                                                                                                                                                                                                                                                           | Operation of VSP DC/DC circuit |     |        |              |               |            |            |            |             |              |      |        |                                      |                                |     |     |    |    |
|                                                                                                                                                   | 0                                                                                                                                                                                                                                                                                                                                                | OFF                            |     |        |              |               |            |            |            |             |              |      |        |                                      |                                |     |     |    |    |
| 1                                                                                                                                                 | ON                                                                                                                                                                                                                                                                                                                                               |                                |     |        |              |               |            |            |            |             |              |      |        |                                      |                                |     |     |    |    |
| <b>VSN_EN:</b> ON/OFF the operation of VSN circuit.                                                                                               |                                                                                                                                                                                                                                                                                                                                                  |                                |     |        |              |               |            |            |            |             |              |      |        |                                      |                                |     |     |    |    |
| <table><tr><td>VSN_EN</td><td>Operation of VSN DC/DC circuit</td></tr><tr><td>0</td><td>OFF</td></tr><tr><td>1</td><td>ON</td></tr></table>       |                                                                                                                                                                                                                                                                                                                                                  |                                |     |        |              |               |            |            |            |             |              |      | VSN_EN | Operation of VSN DC/DC circuit       | 0                              | OFF | 1   | ON |    |
| VSN_EN                                                                                                                                            | Operation of VSN DC/DC circuit                                                                                                                                                                                                                                                                                                                   |                                |     |        |              |               |            |            |            |             |              |      |        |                                      |                                |     |     |    |    |
| 0                                                                                                                                                 | OFF                                                                                                                                                                                                                                                                                                                                              |                                |     |        |              |               |            |            |            |             |              |      |        |                                      |                                |     |     |    |    |
| 1                                                                                                                                                 | ON                                                                                                                                                                                                                                                                                                                                               |                                |     |        |              |               |            |            |            |             |              |      |        |                                      |                                |     |     |    |    |
| <b>VGH_EN:</b> ON/OFF the operation of VGH charge bump circuit.                                                                                   |                                                                                                                                                                                                                                                                                                                                                  |                                |     |        |              |               |            |            |            |             |              |      |        |                                      |                                |     |     |    |    |
| <table><tr><td>VGH_EN</td><td>Operation of VGH charge bump circuit</td></tr><tr><td>0</td><td>OFF</td></tr><tr><td>1</td><td>ON</td></tr></table> |                                                                                                                                                                                                                                                                                                                                                  |                                |     |        |              |               |            |            |            |             |              |      | VGH_EN | Operation of VGH charge bump circuit | 0                              | OFF | 1   | ON |    |
| VGH_EN                                                                                                                                            | Operation of VGH charge bump circuit                                                                                                                                                                                                                                                                                                             |                                |     |        |              |               |            |            |            |             |              |      |        |                                      |                                |     |     |    |    |
| 0                                                                                                                                                 | OFF                                                                                                                                                                                                                                                                                                                                              |                                |     |        |              |               |            |            |            |             |              |      |        |                                      |                                |     |     |    |    |
| 1                                                                                                                                                 | ON                                                                                                                                                                                                                                                                                                                                               |                                |     |        |              |               |            |            |            |             |              |      |        |                                      |                                |     |     |    |    |

| VGL_EN | Operation of VGL charge bump circuit |
|--------|--------------------------------------|
| 0      | OFF                                  |
| 1      | ON                                   |

**LVGL\_EN** : ON/OFF the operation of LVGL charge bump circuit.

| LVGL_EN | Operation of LVGL charge bump circuit |
|---------|---------------------------------------|
| 0       | OFF                                   |
| 1       | ON                                    |

| BT3 | BT2 | BT1 | BT0 | VGH                     | VGL                 |
|-----|-----|-----|-----|-------------------------|---------------------|
| 0   | 0   | 0   | 0   | $2*(VSP-VSN)$           | $VDDDN-1*(VSP-VSN)$ |
| 0   | 0   | 0   | 1   | $2*(VSP-VSN)$           | $-1*(VSP-VSN)$      |
| 0   | 0   | 1   | 0   | $2*(VSP-VSN)$           | $VDD3-1*(VSP-VSN)$  |
| 0   | 0   | 1   | 1   | $(VSP-VSN)+(VDD3-VSN)$  | $VDDDN-1*(VSP-VSN)$ |
| 0   | 1   | 0   | 0   | $(VSP-VSN)+(VDD3-VSN)$  | $-1*(VSP-VSN)$      |
| 0   | 1   | 0   | 1   | $(VSP-VSN)+(VDD3-VSN)$  | $VDD3-1*(VSP-VSN)$  |
| 0   | 1   | 1   | 0   | $(VSP-VSN)+(VSP-VSSD)$  | $VDDDN-1*(VSP-VSN)$ |
| 0   | 1   | 1   | 1   | $(VSP-VSN)+(VSP-VSSD)$  | $-1*(VSP-VSN)$      |
| 1   | 0   | 0   | 0   | $(VSP-VSN)+(VSP-VSSD)$  | $VDD3-1*(VSP-VSN)$  |
| 1   | 0   | 0   | 1   | $(VDD3-VSN)+(VSP-VSSD)$ | $VDDDN-1*(VSP-VSN)$ |
| 1   | 0   | 1   | 0   | $(VDD3-VSN)+(VSP-VSSD)$ | $-1*(VSP-VSN)$      |
| 1   | 0   | 1   | 1   | $(VDD3-VSN)+(VSP-VSSD)$ | $VDD3-1*(VSP-VSN)$  |
| 1   | 1   | 0   | 0   | $(VSP-VSN)$             | $VDDDN-1*(VSP-VSN)$ |
| 1   | 1   | 0   | 1   | $(VSP-VSN)$             | $-1*(VSP-VSN)$      |
| 1   | 1   | 1   | 0   | $(VSP-VSN)$             | $VDD3-1*(VSP-VSN)$  |
| 1   | 1   | 1   | 1   | $2*(VSP-VSSD)$          | $-2*(VSP-VSSD)$     |

**FS1[2:0]**: Set the operating frequency of the step-up circuit for VGH and VGL voltage generation.

| FS12 | FS11 | FS10 | Operation Frequency of Step-up Circuit |
|------|------|------|----------------------------------------|
| 0    | 0    | 0    | Inhibit                                |
| 0    | 0    | 1    | Fosc/64                                |
| 0    | 1    | 0    | Fosc/128                               |
| 0    | 1    | 1    | Fosc/256                               |
| 1    | 0    | 0    | Fosc/512                               |
| 1    | 0    | 1    | Fosc/1024                              |
| 1    | 1    | 0    | Fosc/2048                              |
| 1    | 1    | 1    | Fosc/4096                              |

**VDDDN\_HZ**: Choose external or internal VDDDN power.

VDDDN\_HZ=0, VDDDN= -2.5V.

VDDDN\_HZ=1, VDDDN output HZ. (For external VDDDN.)

**DCDIV[3:0]**: Set the normal operate frequency of DC/DC converter circuit during normal mode.

**For PFM circuit**: Set the operate frequency of DC/DC converter circuit for PFM design.

(PCCS[1:0]=00, PCCS[1:0]=01, PCCS[1:0]=10)

| DCDIV3 | DCDIV2 | DCDIV1 | DCDIV0 | Normal operate frequency of DC/DC converter |
|--------|--------|--------|--------|---------------------------------------------|
| 0      | 0      | 0      | 0      | Fosc / 1                                    |
| 0      | 0      | 0      | 1      | Fosc / 2                                    |
| 0      | 0      | 1      | 0      | Fosc / 3                                    |
| 0      | 0      | 1      | 1      | Fosc / 4                                    |
| 0      | 1      | 0      | 0      | Fosc / 5                                    |
| 0      | 1      | 0      | 1      | Fosc / 6                                    |
| 0      | 1      | 1      | 0      | Fosc / 7                                    |
| 0      | 1      | 1      | 1      | Fosc / 8                                    |
| 1      | 0      | 0      | 0      | Fosc / 1                                    |
| 1      | 0      | 0      | 1      | Fosc / 2                                    |
| 1      | 0      | 1      | 0      | Fosc / 3                                    |
| 1      | 0      | 1      | 1      | Fosc / 4                                    |
| 1      | 1      | 0      | 0      | Fosc / 5                                    |
| 1      | 1      | 0      | 1      | Fosc / 6                                    |
| 1      | 1      | 1      | 0      | Fosc / 7                                    |

|   |   |   |   |          |
|---|---|---|---|----------|
| 1 | 1 | 1 | 1 | Fosc / 8 |
|---|---|---|---|----------|

**DT[1:0]:** Delay time of power on and power off sequence.

| DT1 | DT0 | Delay time of power on and power off sequence on (ms) |
|-----|-----|-------------------------------------------------------|
| 0   | 0   | 5ms                                                   |
| 0   | 1   | 10ms                                                  |
| 1   | 0   | 15ms                                                  |
| 1   | 1   | 20ms                                                  |

**DTPS[2:0]:** Set the soft start operating duty cycle of DC/DC circuit. (PFM DC/DC circuit).  
1 duty cycle = 1 M clock

| DTPS2 | DTPS1 | DTPS0 | soft start operating duty cycle of DC/DC circuit circuit |
|-------|-------|-------|----------------------------------------------------------|
| 0     | 0     | 0     | 1                                                        |
| 0     | 0     | 1     | 2                                                        |
| 0     | 1     | 0     | 3                                                        |
| 0     | 1     | 1     | 4                                                        |
| 1     | 0     | 0     | 5                                                        |
| 1     | 0     | 1     | 6                                                        |
| 1     | 1     | 0     | 7                                                        |
| 1     | 1     | 1     | 8                                                        |

**DTNS[2:0]:** Set the soft start operating duty cycle of DC/DC circuit. (PFM DC/DC circuit).  
1 duty cycle = 1 M clock

| DTNS2 | DTNS1 | DTNS0 | soft start operating duty cycle of DC/DC circuit circuit |
|-------|-------|-------|----------------------------------------------------------|
| 0     | 0     | 0     | 1                                                        |
| 0     | 0     | 1     | 2                                                        |
| 0     | 1     | 0     | 3                                                        |
| 0     | 1     | 1     | 4                                                        |
| 1     | 0     | 0     | 5                                                        |
| 1     | 0     | 1     | 6                                                        |
| 1     | 1     | 0     | 7                                                        |
| 1     | 1     | 1     | 8                                                        |

**BTP[4:0]:** Switch the output factor for DC/DC circuit for VSP voltage generation. The LCD drive voltage level VSP can be selected according to the characteristic of liquid crystal which panel used.

| BTP4 | BTP3 | BTP2 | BTP1 | BTP0 | VSP  |
|------|------|------|------|------|------|
| 0    | 0    | 0    | 0    | 0    | 3.01 |
| 0    | 0    | 0    | 0    | 1    | 3.15 |
| 0    | 0    | 0    | 1    | 0    | 3.29 |
| 0    | 0    | 0    | 1    | 1    | 3.46 |
| 0    | 0    | 1    | 0    | 0    | 3.60 |
| 0    | 0    | 1    | 0    | 1    | 3.74 |
| 0    | 0    | 1    | 1    | 0    | 3.91 |
| 0    | 0    | 1    | 1    | 1    | 4.05 |
| 0    | 1    | 0    | 0    | 0    | 4.19 |
| 0    | 1    | 0    | 0    | 1    | 4.36 |
| 0    | 1    | 0    | 1    | 0    | 4.50 |
| 0    | 1    | 0    | 1    | 1    | 4.64 |
| 0    | 1    | 1    | 0    | 0    | 4.81 |
| 0    | 1    | 1    | 0    | 1    | 4.95 |
| 0    | 1    | 1    | 1    | 0    | 5.09 |
| 0    | 1    | 1    | 1    | 1    | 5.26 |
| 1    | 0    | 0    | 0    | 0    | 5.40 |
| 1    | 0    | 0    | 0    | 1    | 5.54 |
| 1    | 0    | 0    | 1    | 0    | 5.71 |

|           |   |   |   |   |         |
|-----------|---|---|---|---|---------|
| 1         | 0 | 0 | 1 | 1 | Inhibit |
| . . . . . |   |   |   |   | Inhibit |
| 1         | 1 | 1 | 1 | 1 | Inhibit |

**BTN[4:0]:** Switch the output factor of DC/DC circuit for VSN voltage generation. The LCD drive voltage level VSN can be selected according to the characteristic of liquid crystal which panel used.

While using PFM type-C or HX5186-A mode (PCCS1-0 = 10, PCCS1-0 = 11), VSN is followed the BTP[4:0] setting.

PFM mode type-C :  $VSN = -VSP + 0.6V$

Using HX5186-A charge Pump mode :  $VSN = -VSP$

**AP[2:0]:** Adjust the amount of fixed current from the fixed current source for the operational amplifier in the power supply circuit. When the amount of fixed current is increased, the LCD driving capacity and the display quality are high, but the current consumption is increased. This is a tradeoff, Adjust the fixed current by considering both the display quality and the current consumption. During no display operation, when AP[2:0] = 000, the current consumption can be reduced by stopping the operations of operational amplifier and step-up circuit.

| AP2 | AP1 | AP0 | Constant Current of Operational Amplifier |
|-----|-----|-----|-------------------------------------------|
| 0   | 0   | 0   | Stop (inhibit)                            |
| 0   | 0   | 1   | 0.5μA                                     |
| 0   | 1   | 0   | 1μA                                       |
| 0   | 1   | 1   | 1.5μA                                     |
| 1   | 0   | 0   | 2μA                                       |
| 1   | 0   | 1   | 2.5μA                                     |
| 1   | 1   | 0   | 3μA                                       |
| 1   | 1   | 1   | 3.5μA                                     |

**VRHP[7:0]:** VSPR regulator output control setting for source data output driving.

| VRHP[7:0] |   |   |   |   |   |   |   | VSPR  |
|-----------|---|---|---|---|---|---|---|-------|
| 0         | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3.488 |
| 0         | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 3.516 |
| 0         | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 3.544 |
| 0         | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 3.572 |
| 0         | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 3.600 |
| 0         | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 3.628 |
| 0         | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 3.656 |
| 0         | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 3.684 |
| 0         | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 3.713 |
| 0         | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 3.741 |
| 0         | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 3.769 |
| 0         | 0 | 0 | 0 | 1 | 0 | 1 | 1 | 3.797 |
| 0         | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 3.825 |
| 0         | 0 | 0 | 0 | 1 | 1 | 0 | 1 | 3.853 |
| 0         | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 3.881 |
| 0         | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 3.909 |
| 0         | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 3.938 |
| 0         | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 3.966 |
| 0         | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 3.994 |
| 0         | 0 | 0 | 1 | 0 | 0 | 1 | 1 | 4.022 |
| 0         | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 4.050 |
| 0         | 0 | 0 | 1 | 0 | 1 | 0 | 1 | 4.078 |
| 0         | 0 | 0 | 1 | 0 | 1 | 1 | 0 | 4.106 |
| 0         | 0 | 0 | 1 | 0 | 1 | 1 | 1 | 4.134 |
| 0         | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 4.163 |
| 0         | 0 | 0 | 1 | 1 | 0 | 0 | 1 | 4.191 |
| 0         | 0 | 0 | 1 | 1 | 0 | 1 | 0 | 4.219 |
| 0         | 0 | 0 | 1 | 1 | 0 | 1 | 1 | 4.247 |
| 0         | 0 | 0 | 1 | 1 | 1 | 0 | 0 | 4.275 |
| 0         | 0 | 0 | 1 | 1 | 1 | 0 | 1 | 4.303 |
| 0         | 0 | 0 | 1 | 1 | 1 | 1 | 0 | 4.331 |
| 0         | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 4.359 |
| 0         | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 4.388 |



|                     |   |   |   |   |   |   |   |         |
|---------------------|---|---|---|---|---|---|---|---------|
| 0                   | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 4.416   |
| 0                   | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 4.444   |
| 0                   | 0 | 1 | 0 | 0 | 0 | 1 | 1 | 4.472   |
| 0                   | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 4.500   |
| 0                   | 0 | 1 | 0 | 0 | 1 | 0 | 1 | 4.528   |
| 0                   | 0 | 1 | 0 | 0 | 1 | 1 | 0 | 4.556   |
| 0                   | 0 | 1 | 0 | 0 | 1 | 1 | 1 | 4.584   |
| 0                   | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 4.613   |
| 0                   | 0 | 1 | 0 | 1 | 0 | 0 | 1 | 4.641   |
| 0                   | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 4.669   |
| 0                   | 0 | 1 | 0 | 1 | 0 | 1 | 1 | 4.697   |
| 0                   | 0 | 1 | 0 | 1 | 1 | 0 | 0 | 4.725   |
| 0                   | 0 | 1 | 0 | 1 | 1 | 0 | 1 | 4.753   |
| 0                   | 0 | 1 | 0 | 1 | 1 | 1 | 0 | 4.781   |
| 0                   | 0 | 1 | 0 | 1 | 1 | 1 | 1 | 4.809   |
| 0                   | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 4.838   |
| 0                   | 0 | 1 | 1 | 0 | 0 | 0 | 1 | 4.866   |
| 0                   | 0 | 1 | 1 | 0 | 0 | 1 | 0 | 4.894   |
| 0                   | 0 | 1 | 1 | 0 | 0 | 1 | 1 | 4.922   |
| 0                   | 0 | 1 | 1 | 0 | 1 | 0 | 0 | 4.950   |
| 0                   | 0 | 1 | 1 | 0 | 1 | 0 | 1 | 4.978   |
| 0                   | 0 | 1 | 1 | 0 | 1 | 1 | 0 | 5.006   |
| 0                   | 0 | 1 | 1 | 0 | 1 | 1 | 1 | 5.034   |
| 0                   | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 5.063   |
| 0                   | 0 | 1 | 1 | 1 | 0 | 0 | 1 | 5.091   |
| 0                   | 0 | 1 | 1 | 1 | 0 | 1 | 0 | 5.119   |
| 00111011 ~ 01111110 |   |   |   |   |   |   |   | Inhibit |
| 0                   | 1 | 1 | 1 | 1 | 1 | 1 | 1 | VSP     |
| 10000000 ~ 11111110 |   |   |   |   |   |   |   | Inhibit |
| 1                   | 1 | 1 | 1 | 1 | 1 | 1 | 1 | HZ      |

**VRHN[7:0]:** VSNR regulator output control setting for source data output driving.

| VRHN[7:0] |   |   |   |   |   |   |   | VSNR   |
|-----------|---|---|---|---|---|---|---|--------|
| 0         | 0 | 0 | 0 | 0 | 0 | 0 | 0 | -3.263 |
| 0         | 0 | 0 | 0 | 0 | 0 | 0 | 1 | -3.291 |
| 0         | 0 | 0 | 0 | 0 | 0 | 1 | 0 | -3.319 |
| 0         | 0 | 0 | 0 | 0 | 0 | 1 | 1 | -3.347 |
| 0         | 0 | 0 | 0 | 0 | 1 | 0 | 0 | -3.375 |
| 0         | 0 | 0 | 0 | 0 | 1 | 0 | 1 | -3.403 |
| 0         | 0 | 0 | 0 | 0 | 1 | 1 | 0 | -3.431 |
| 0         | 0 | 0 | 0 | 0 | 1 | 1 | 1 | -3.459 |
| 0         | 0 | 0 | 0 | 1 | 0 | 0 | 0 | -3.488 |
| 0         | 0 | 0 | 0 | 1 | 0 | 0 | 1 | -3.516 |
| 0         | 0 | 0 | 0 | 1 | 0 | 1 | 0 | -3.544 |
| 0         | 0 | 0 | 0 | 1 | 0 | 1 | 1 | -3.572 |
| 0         | 0 | 0 | 0 | 1 | 1 | 0 | 0 | -3.600 |
| 0         | 0 | 0 | 0 | 1 | 1 | 0 | 1 | -3.628 |
| 0         | 0 | 0 | 0 | 1 | 1 | 1 | 0 | -3.656 |
| 0         | 0 | 0 | 0 | 1 | 1 | 1 | 1 | -3.684 |
| 0         | 0 | 0 | 0 | 1 | 0 | 0 | 0 | -3.713 |
| 0         | 0 | 0 | 0 | 1 | 0 | 0 | 1 | -3.741 |
| 0         | 0 | 0 | 0 | 1 | 0 | 0 | 1 | -3.769 |
| 0         | 0 | 0 | 0 | 1 | 0 | 0 | 1 | -3.797 |
| 0         | 0 | 0 | 0 | 1 | 0 | 1 | 0 | -3.825 |
| 0         | 0 | 0 | 0 | 1 | 0 | 1 | 1 | -3.853 |
| 0         | 0 | 0 | 0 | 1 | 0 | 1 | 1 | -3.881 |
| 0         | 0 | 0 | 0 | 1 | 0 | 1 | 1 | -3.909 |
| 0         | 0 | 0 | 0 | 1 | 1 | 0 | 0 | -3.938 |
| 0         | 0 | 0 | 0 | 1 | 1 | 0 | 0 | -3.966 |
| 0         | 0 | 0 | 0 | 1 | 1 | 0 | 1 | -3.994 |
| 0         | 0 | 0 | 0 | 1 | 1 | 0 | 1 | -4.022 |
| 0         | 0 | 0 | 0 | 1 | 1 | 1 | 0 | -4.050 |
| 0         | 0 | 0 | 0 | 1 | 1 | 1 | 0 | -4.078 |
| 0         | 0 | 0 | 0 | 1 | 1 | 1 | 1 | -4.106 |

|                     |   |   |   |   |   |   |   |         |
|---------------------|---|---|---|---|---|---|---|---------|
| 0                   | 0 | 0 | 1 | 1 | 1 | 1 | 1 | -4.134  |
| 0                   | 0 | 1 | 0 | 0 | 0 | 0 | 0 | -4.163  |
| 0                   | 0 | 1 | 0 | 0 | 0 | 0 | 1 | -4.191  |
| 0                   | 0 | 1 | 0 | 0 | 0 | 1 | 0 | -4.219  |
| 0                   | 0 | 1 | 0 | 0 | 0 | 1 | 1 | -4.247  |
| 0                   | 0 | 1 | 0 | 0 | 1 | 0 | 0 | -4.275  |
| 0                   | 0 | 1 | 0 | 0 | 1 | 0 | 1 | -4.303  |
| 0                   | 0 | 1 | 0 | 0 | 1 | 1 | 0 | -4.331  |
| 0                   | 0 | 1 | 0 | 0 | 1 | 1 | 1 | -4.359  |
| 0                   | 0 | 1 | 0 | 1 | 0 | 0 | 0 | -4.388  |
| 0                   | 0 | 1 | 0 | 1 | 0 | 0 | 1 | -4.416  |
| 0                   | 0 | 1 | 0 | 1 | 0 | 1 | 0 | -4.444  |
| 0                   | 0 | 1 | 0 | 1 | 0 | 1 | 1 | -4.472  |
| 0                   | 0 | 1 | 0 | 1 | 1 | 0 | 0 | -4.500  |
| 0                   | 0 | 1 | 0 | 1 | 1 | 0 | 1 | -4.528  |
| 0                   | 0 | 1 | 0 | 1 | 1 | 1 | 0 | -4.556  |
| 0                   | 0 | 1 | 0 | 1 | 1 | 1 | 1 | -4.584  |
| 0                   | 0 | 1 | 1 | 0 | 0 | 0 | 0 | -4.613  |
| 0                   | 0 | 1 | 1 | 0 | 0 | 0 | 1 | -4.641  |
| 0                   | 0 | 1 | 1 | 0 | 0 | 1 | 0 | -4.669  |
| 0                   | 0 | 1 | 1 | 0 | 0 | 1 | 1 | -4.697  |
| 0                   | 0 | 1 | 1 | 0 | 1 | 0 | 0 | -4.725  |
| 0                   | 0 | 1 | 1 | 0 | 1 | 0 | 1 | -4.753  |
| 0                   | 0 | 1 | 1 | 0 | 1 | 1 | 0 | -4.781  |
| 0                   | 0 | 1 | 1 | 0 | 1 | 1 | 1 | -4.809  |
| 0                   | 0 | 1 | 1 | 1 | 0 | 0 | 0 | -4.838  |
| 0                   | 0 | 1 | 1 | 1 | 0 | 0 | 1 | -4.866  |
| 0                   | 0 | 1 | 1 | 1 | 0 | 1 | 0 | -4.894  |
| 0                   | 0 | 1 | 1 | 1 | 0 | 1 | 1 | -4.922  |
| 0                   | 0 | 1 | 1 | 1 | 1 | 0 | 0 | -4.950  |
| 0                   | 0 | 1 | 1 | 1 | 1 | 0 | 1 | -4.978  |
| 0                   | 0 | 1 | 1 | 1 | 1 | 1 | 0 | -5.006  |
| 0                   | 0 | 1 | 1 | 1 | 1 | 1 | 1 | -5.034  |
| 0                   | 1 | 0 | 0 | 0 | 0 | 0 | 0 | -5.063  |
| 0                   | 1 | 0 | 0 | 0 | 0 | 0 | 1 | -5.091  |
| 0                   | 1 | 0 | 0 | 0 | 0 | 1 | 0 | -5.119  |
| 01000011 ~ 01111110 |   |   |   |   |   |   |   | Inhibit |
| 0                   | 1 | 1 | 1 | 1 | 1 | 1 | 1 | VSN     |
| 10000000 ~ 11111110 |   |   |   |   |   |   |   | Inhibit |
| 1                   | 1 | 1 | 1 | 1 | 1 | 1 | 1 | HZ      |

**VRMP[5:0]:** The positive polarity gamma amplitude voltage setting (VSPR-VGSP).

| VRMP[5:0] |   |   |   |   |   | VSPR-VGSP |
|-----------|---|---|---|---|---|-----------|
| 0         | 0 | 0 | 0 | 0 | 0 | 2.588     |
| 0         | 0 | 0 | 0 | 0 | 1 | 2.644     |
| 0         | 0 | 0 | 0 | 1 | 0 | 2.700     |
| 0         | 0 | 0 | 0 | 1 | 1 | 2.756     |
| 0         | 0 | 0 | 1 | 0 | 0 | 2.813     |
| 0         | 0 | 0 | 1 | 0 | 1 | 2.869     |
| 0         | 0 | 0 | 1 | 1 | 0 | 2.925     |
| 0         | 0 | 0 | 1 | 1 | 1 | 2.981     |
| 0         | 0 | 1 | 0 | 0 | 0 | 3.038     |
| 0         | 0 | 1 | 0 | 0 | 1 | 3.094     |
| 0         | 0 | 1 | 0 | 1 | 0 | 3.150     |
| 0         | 0 | 1 | 0 | 1 | 1 | 3.206     |
| 0         | 0 | 1 | 1 | 0 | 0 | 3.263     |
| 0         | 0 | 1 | 1 | 0 | 1 | 3.319     |
| 0         | 0 | 1 | 1 | 1 | 0 | 3.375     |
| 0         | 0 | 1 | 1 | 1 | 1 | 3.431     |
| 0         | 1 | 0 | 0 | 0 | 0 | 3.488     |
| 0         | 1 | 0 | 0 | 0 | 1 | 3.544     |
| 0         | 1 | 0 | 0 | 1 | 0 | 3.600     |
| 0         | 1 | 0 | 0 | 1 | 1 | 3.656     |
| 0         | 1 | 0 | 1 | 0 | 0 | 3.713     |
| 0         | 1 | 0 | 1 | 0 | 1 | 3.769     |

|           |   |   |   |   |   |                 |
|-----------|---|---|---|---|---|-----------------|
| 0         | 1 | 0 | 1 | 1 | 0 | 3.825           |
| 0         | 1 | 0 | 1 | 1 | 1 | 3.881           |
| 0         | 1 | 1 | 0 | 0 | 0 | 3.938           |
| 0         | 1 | 1 | 0 | 0 | 1 | 3.994           |
| 0         | 1 | 1 | 0 | 1 | 0 | 4.050           |
| 0         | 1 | 1 | 0 | 1 | 1 | 4.106           |
| 0         | 1 | 1 | 1 | 0 | 0 | 4.163           |
| 0         | 1 | 1 | 1 | 0 | 1 | 4.219           |
| 0         | 1 | 1 | 1 | 1 | 0 | 4.275           |
| 0         | 1 | 1 | 1 | 1 | 1 | 4.331           |
| 1         | 0 | 0 | 0 | 0 | 0 | 4.388           |
| 1         | 0 | 0 | 0 | 0 | 1 | 4.444           |
| 1         | 0 | 0 | 0 | 1 | 0 | 4.500           |
| 1         | 0 | 0 | 0 | 1 | 1 | 4.556           |
| 1         | 0 | 0 | 1 | 0 | 0 | 4.613           |
| 1         | 0 | 0 | 1 | 0 | 1 | 4.669           |
| 1         | 0 | 0 | 1 | 1 | 0 | 4.725           |
| 1         | 0 | 0 | 1 | 1 | 1 | 4.781           |
| 1         | 0 | 1 | 0 | 0 | 0 | 4.838           |
| 1         | 0 | 1 | 0 | 0 | 1 | 4.894           |
| 1         | 0 | 1 | 0 | 1 | 0 | 4.950           |
| 1         | 0 | 1 | 0 | 1 | 1 | 5.006           |
| 1         | 0 | 1 | 1 | 0 | 0 | 5.063           |
| 1         | 0 | 1 | 1 | 0 | 1 | 5.119           |
| 1         | 0 | 1 | 1 | 1 | 0 | Inhibit         |
| . . . . . |   |   |   |   |   | Inhibit         |
| 1         | 1 | 1 | 1 | 1 | 0 | Inhibit         |
| 1         | 1 | 1 | 1 | 1 | 1 | VSPR(VGSP=VSSA) |

**VRMN[5:0]:** The negative polarity gamma amplitude voltage setting (VSNR-VGSN).

| VRMN[5:0] |   |   |   |   |   | VSNR-VGSN |
|-----------|---|---|---|---|---|-----------|
| 0         | 0 | 0 | 0 | 0 | 0 | -2.588    |
| 0         | 0 | 0 | 0 | 0 | 1 | -2.644    |
| 0         | 0 | 0 | 0 | 1 | 0 | -2.700    |
| 0         | 0 | 0 | 0 | 1 | 1 | -2.756    |
| 0         | 0 | 0 | 1 | 0 | 0 | -2.813    |
| 0         | 0 | 0 | 1 | 0 | 1 | -2.869    |
| 0         | 0 | 0 | 1 | 1 | 0 | -2.925    |
| 0         | 0 | 0 | 1 | 1 | 1 | -2.981    |
| 0         | 0 | 1 | 0 | 0 | 0 | -3.038    |
| 0         | 0 | 1 | 0 | 0 | 1 | -3.094    |
| 0         | 0 | 1 | 0 | 1 | 0 | -3.150    |
| 0         | 0 | 1 | 0 | 1 | 1 | -3.206    |
| 0         | 0 | 1 | 1 | 0 | 0 | -3.263    |
| 0         | 0 | 1 | 1 | 0 | 1 | -3.319    |
| 0         | 0 | 1 | 1 | 1 | 0 | -3.375    |
| 0         | 0 | 1 | 1 | 1 | 1 | -3.431    |
| 0         | 1 | 0 | 0 | 0 | 0 | -3.488    |
| 0         | 1 | 0 | 0 | 0 | 1 | -3.544    |
| 0         | 1 | 0 | 0 | 1 | 0 | -3.600    |
| 0         | 1 | 0 | 0 | 1 | 1 | -3.656    |
| 0         | 1 | 0 | 1 | 0 | 0 | -3.713    |
| 0         | 1 | 0 | 1 | 0 | 1 | -3.769    |
| 0         | 1 | 0 | 1 | 1 | 0 | -3.825    |
| 0         | 1 | 0 | 1 | 1 | 1 | -3.881    |
| 0         | 1 | 1 | 0 | 0 | 0 | -3.938    |
| 0         | 1 | 1 | 0 | 0 | 1 | -3.994    |
| 0         | 1 | 1 | 0 | 1 | 0 | -4.050    |
| 0         | 1 | 1 | 0 | 1 | 1 | -4.106    |
| 0         | 1 | 1 | 1 | 0 | 0 | -4.163    |
| 0         | 1 | 1 | 1 | 0 | 1 | -4.219    |
| 0         | 1 | 1 | 1 | 1 | 0 | -4.275    |
| 0         | 1 | 1 | 1 | 1 | 1 | -4.331    |
| 1         | 0 | 0 | 0 | 0 | 0 | -4.388    |
| 1         | 0 | 0 | 0 | 0 | 1 | -4.444    |

|           |   |   |   |   |   |                 |
|-----------|---|---|---|---|---|-----------------|
| 1         | 0 | 0 | 0 | 1 | 0 | -4.500          |
| 1         | 0 | 0 | 0 | 1 | 1 | -4.556          |
| 1         | 0 | 0 | 1 | 0 | 0 | -4.613          |
| 1         | 0 | 0 | 1 | 0 | 1 | -4.669          |
| 1         | 0 | 0 | 1 | 1 | 0 | -4.725          |
| 1         | 0 | 0 | 1 | 1 | 1 | -4.781          |
| 1         | 0 | 1 | 0 | 0 | 0 | -4.838          |
| 1         | 0 | 1 | 0 | 0 | 1 | -4.894          |
| 1         | 0 | 1 | 0 | 1 | 0 | -4.950          |
| 1         | 0 | 1 | 0 | 1 | 1 | -5.006          |
| 1         | 0 | 1 | 1 | 0 | 0 | -5.063          |
| 1         | 0 | 1 | 1 | 0 | 1 | -5.119          |
| 1         | 0 | 1 | 1 | 1 | 0 | Inhibit         |
| . . . . . |   |   |   |   |   | Inhibit         |
| 1         | 1 | 1 | 1 | 1 | 0 | Inhibit         |
| 1         | 1 | 1 | 1 | 1 | 1 | VSNR(VGSN=VSSA) |

**VBS[2:0]:** Set the VBIAS level.

| VBS2 | VBS1 | VBS0 | VBIAS   |
|------|------|------|---------|
| 0    | 0    | 0    | Inhibit |
| 0    | 0    | 1    | 4.68    |
| 0    | 1    | 0    | 4.50    |
| 0    | 1    | 1    | 4.32    |
| 1    | 0    | 0    | 4.14    |
| 1    | 0    | 1    | 3.96    |
| 1    | 1    | 0    | 3.78    |
| 1    | 1    | 1    | 3.60    |

**DC86\_DIV[3:0]:** Frequency for Charge Pump Mode (HX5186-A)

| DC86_DIV[3:0] | Frequency - Charge Pump Mode (HX5186-A) |
|---------------|-----------------------------------------|
| 0000          | Fosc/2                                  |
| 0001          | Fosc/4                                  |
| 0010          | Fosc/8                                  |
| 0011          | Fosc/16                                 |
| 0100          | Fosc/24                                 |
| 0101          | Fosc/32                                 |
| 0110          | Fosc/40                                 |
| 0111          | Fosc/48                                 |
| 1000          | Fosc/56                                 |
| 1001          | Fosc/64                                 |
| 1010          | Fosc/72                                 |
| 1011          | Fosc/80                                 |
| 1100          | Fosc/88                                 |
| 1101          | Fosc/96                                 |
| 1110          | Fosc/104                                |
| 1111          | Fosc/112                                |

**XDK[1:0]:** Setting HX5186-A

| XDK[1] | XDK[0] | HX5186-A or Internal-Charge Pump |
|--------|--------|----------------------------------|
| 0      | 0      | X1.5 Pump                        |
| 0      | 1      | x2 Pump                          |
| 1      | 0      | X3 Pump                          |
| 1      | 1      | Inhibited                        |

**AUTO\_XDK:** Auto XDK function enable, when using HX5186-A.

| Auto_XDK=1             | Hx5186-A           |
|------------------------|--------------------|
| VDD3 x 1.5 > VSPtarget | X1.5               |
| VDD3 x 2 > VSPtarget   | X2                 |
| VDD3 x 2 < VSPtarget   | X3                 |
| Auto_XDK=0             | Depend on XDK[2:0] |

**DD\_TU:** In-house function, and not open.

**VPNL\_EN:** Enable VPNL function.

|                       |                                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|-----------------------|---------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Restriction           | SETEXTC turn on to enable this command.     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| Register Availability | Status                                      | Availability                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|                       | Normal Mode On, Idle Mode Off, Sleep Out    | Yes                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|                       | Normal Mode On, Idle Mode On, Sleep Out     | Yes                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|                       | Partial Mode On, Idle Mode Off, Sleep Out   | Yes                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|                       | Partial Mode On, Idle Mode On, Sleep Out    | Yes                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|                       | Sleep In or Booster Off                     | Yes                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| Default               | Status                                      | Default value                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | OTP value                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|                       | Power On Sequence<br>S/W Reset<br>H/W Reset | VBIAS_EN=0, VSN_EN=0,<br>VSP_EN=0,<br>VGL_EN=0, VGH_EN=0, LVGL_EN=0,<br>VDDDN_HZ=0, STB=1, DSTB=0,<br>FS1[2:0]=011, AP[2:0]=100,<br>BT[3:0]=111, DT[1:0]=00,<br>DCDIV[3:0]=0000, BTP[4:0]=01110,<br>BTN[4:0]=01110, VRHP[7:0]=0x21h,<br>VRHN[7:0]=0x29h, VRMP[5:0]=0x19h,<br>VRMN[5:0]=0x19h,<br>DD_TU= 0, VPNL_EN=0,<br>VBS[2:0]=111, DC86_DIV[3:0]=0111,<br>XDK1=0, XDK0=1, AUTO_XDK=0,<br>DTPS[2:0]=000, DTNS[2:0]=001,<br>A_DC[1:0]=11, A_DTP[2:0]=100,<br>A_DTN[2:0]=110,<br>B_DC[1:0]=11, B_DTP[2:0]=100,<br>B_DTN[2:0]=110,<br>C_DC[1:0]=11, C_DTP[2:0]=100,<br>C_DTN[2:0]=110,<br>D_DC[1:0]=11, D_DTP[2:0]=100,<br>D_DTN[2:0]=110,<br>E_DC[1:0]=11, E_DTP[2:0]=100,<br>E_DTN[2:0]=110, | FS1[2:0], AP[2:0], BT[3:0],<br>DT[1:0], DCDIV[3:0],<br>BTP[4:0], BTN[4:0],<br>VRHP[7:0], VRHN[7:0],<br>VRMP[5:0], VRMN[5:0],<br>DD_TU, VPNL_EN,<br>VBS[2:0], DC86_DIV[3:0],<br>XDK1, XDK0, AUTO_XDK,<br>DTPS[2:0], DTNS[2:0],<br>A_DC[1:0], A_DTP[2:0],<br>A_DTN[2:0],<br>B_DC[1:0], B_DTP[2:0],<br>B_DTN[2:0],<br>C_DC[1:0], C_DTP[2:0],<br>C_DTN[2:0],<br>D_DC[1:0], D_DTP[2:0],<br>D_DTN[2:0],<br>E_DC[1:0], E_DTP[2:0],<br>E_DTN[2:0], |

## 6.2.56 SETDISP: Set display related register (B2h)

| B2H                        | SETDISP( Set display related register) |     |     |        |              |              |    |    |         |     |          |     |    | HEX |
|----------------------------|----------------------------------------|-----|-----|--------|--------------|--------------|----|----|---------|-----|----------|-----|----|-----|
|                            | DNC                                    | NRD | NWR | D15~D8 | D7           | D6           | D5 | D4 | D3      | D2  | D1       | D0  |    |     |
| Command                    | 0                                      | 1   | ↑   | -      | 1            | 0            | 1  | 1  | 0       | 0   | 1        | 0   | B2 |     |
| 1 <sup>st</sup> parameter  | 1                                      | 1   | ↑   | -      | -            | -            | -  | -  | -       | -   | D[1:0]   |     |    |     |
| 2 <sup>nd</sup> parameter  | 1                                      | 1   | ↑   | -      | -            | RES_SEL[2:0] |    |    | RM      | DFR | DM[1:0]  |     |    |     |
| 3 <sup>rd</sup> parameter  | 1                                      | 1   | ↑   | -      | BP [7:0]     |              |    |    |         |     |          |     |    |     |
| 4 <sup>th</sup> parameter  | 1                                      | 1   | ↑   | -      | FP [7:0]     |              |    |    |         |     |          |     |    |     |
| 5 <sup>th</sup> parameter  | 1                                      | 1   | ↑   | -      | SAP[3:0]     |              |    | -  | -       | -   | -        |     |    |     |
| 6 <sup>th</sup> parameter  | 1                                      | 1   | ↑   | -      | GEN_ON[7:0]  |              |    |    |         |     |          |     |    |     |
| 7 <sup>th</sup> parameter  | 1                                      | 1   | ↑   | -      | GEN_OFF[7:0] |              |    |    |         |     |          |     |    |     |
| 8 <sup>th</sup> parameter  | 1                                      | 1   | ↑   | -      | RTN[7:0]     |              |    |    |         |     |          |     |    |     |
| 9 <sup>th</sup> parameter  | 1                                      | 1   | ↑   | -      | -            | -            | -  | -  | TE[3:0] |     |          |     |    |     |
| 10 <sup>th</sup> parameter | 1                                      | 1   | ↑   | -      | -            | -            | -  | -  | -       | -   | TEP[9:8] |     |    |     |
| 11 <sup>th</sup> parameter | 1                                      | 1   | ↑   | -      | TEP[7:0]     |              |    |    |         |     |          |     |    |     |
| 12 <sup>th</sup> parameter | 1                                      | 1   | ↑   | -      | BP_PE[7:0]   |              |    |    |         |     |          |     |    |     |
| 13 <sup>th</sup> parameter | 1                                      | 1   | ↑   | -      | FP_PE[7:0]   |              |    |    |         |     |          |     |    |     |
| 14 <sup>th</sup> parameter | 1                                      | 1   | ↑   | -      | RTN_PE[7:0]  |              |    |    |         |     |          |     |    |     |
| 15 <sup>th</sup> parameter | 1                                      | 1   | ↑   | -      | -            | -            | -  | -  | -       | -   | -        | GON |    |     |

This command is used to set display related register D1~0:

| D1 | D0 | Source Output | HX8369-A02 Internal Display Operations |
|----|----|---------------|----------------------------------------|
| 0  | 0  | VSSD          | Halt                                   |
| 0  | 1  | Inhibit       | Inhibit                                |
| 1  | 0  | V255          | Operate                                |
| 1  | 1  | Display       | Operate                                |

**RES\_SEL[2:0]:** Resolution selection.

| RES_SEL 2 | RES_SEL 1 | RES_SEL 0 | Resolution      |
|-----------|-----------|-----------|-----------------|
| 0         | 0         | 0         | 480RGBX864      |
| 0         | 0         | 1         | 480RGBX854      |
| 0         | 1         | 0         | 480RGBX800      |
| 0         | 1         | 1         | 480RGBX640      |
| 1         | 0         | 0         | 360 RGBX640     |
| 1         | 0         | 1         | 480RGBX720      |
| 1         | 1         | 0         | Setting disable |
| 1         | 1         | 1         | Setting disable |

**Description**

**RM** The bit is used to select an interface for the Frame Memory access operation. The Frame Memory is accessed only via the interface defined by RM bit. Because the interface can be selected separately from display operation mode, writing data to the Frame Memory is possible via system interface when RM = 0, even in the DPI display operation.  
RM setting is enabled from the next frame. Wait 1 frame to transfer data after setting.

| RM | Interface for RAM Access |
|----|--------------------------|
| 0  | DBI Interface (CPU)      |
| 1  | DPI Interface (RGB)      |

**DM[1:0]** The bit is used to select display operation mode. The setting allows switching between display operation in synchronization with internal oscillation clock, VSYNC, or DPI signal (VSYNC+HSYNC).  
Note that switching between VSYNC and DPI operation is prohibited.

| DM 1 | DM 0 | Display Mode               |
|------|------|----------------------------|
| 0    | 0    | Internal oscillation clock |
| 0    | 1    | DPI signal (VSYNC+HSYNC)   |
| 1    | 0    | VSYNC signal               |
| 1    | 1    | RGB data bypass GRAM mode  |

**FP[7:0]:** Specify the amount of scan line for front porch (FP).

**BP[7:0] :** Specify the amount of scan line for back porch(BP).

**FP\_PE[7:0]:** Specify the amount of scan line for front porch (FP) on partial idle mode.

**BP\_PE[7:0] :** Specify the amount of scan line for back porch(BP) on partial idle mode.

| FP[7:0] / FP_PE[7:0] | Number of FP Line | Number of BP Line |
|----------------------|-------------------|-------------------|
| BP[7:0] / BP_PE[7:0] |                   |                   |
| 8h'00                | Inhibited         |                   |
| 8h'01                | 3 lines           |                   |
| 8h'02                | 4 lines           |                   |
| 8h'03                | 5 lines           |                   |
| 8h'04                | 6 lines           |                   |
| 8h'05                | 7 lines           |                   |
| . . .                | . . .             |                   |
| 8h'FB                | 253 lines         |                   |
| 8h'FC                | 254 lines         |                   |
| 8h'FD                | 255 lines         |                   |
| 8h'FE                | 256 lines         |                   |
| 8h'FF                | 257 lines         |                   |

| SAP3      | SAP2 | SAP1 | SAP0 | Fixed Current of Operational Amplifier |
|-----------|------|------|------|----------------------------------------|
| 0         | 0    | 0    | 0    | 0.5u                                   |
| 0         | 0    | 0    | 1    | 1u                                     |
| 0         | 0    | 1    | 0    | 1.5u                                   |
| 0         | 0    | 1    | 1    | 2u                                     |
| 0         | 1    | 0    | 0    | 2.5u                                   |
| 0         | 1    | 0    | 1    | 3u                                     |
| 0         | 1    | 1    | 0    | 3.5u                                   |
| 0         | 1    | 1    | 1    | 4u                                     |
| . . . . . |      |      |      |                                        |
| 1         | 1    | 1    | 1    | 8u                                     |

**GEN\_ON[7:0]:** Gamma OP turned on timing and in-house function not open.

**GEN\_OFF[7:0]:** Gamma OP turned off timing and in-house function not open.

**RTN[7:0]:** A cycle time of line width, in-house function not open.

**RTN\_PE[7:0]:** A cycle time of line width on partial idle mode, in-house function not open.

| RTN[7:0]/ RTN_PE[7:0] | Clock per Line           |
|-----------------------|--------------------------|
| 8h'00                 | 275 clocks               |
| 8h'01                 | (275 + 1x2) 277 clocks   |
| 8h'02                 | (275 + 2x2) 279 clocks   |
| 8h'03                 | (275 + 3x2) 281 clocks   |
| . . .                 | . . .                    |
| 8'hFD                 | (275 + 253x2) 781 clocks |
| 8'hFE                 | (275 + 254x2) 783 clocks |
| 8'hFF                 | (275 + 255x2) 785 clocks |

**TEI[3:0]:** Sets the output interval of TE signal according to the display data rewrite cycle and data transfer rate.

| TEI3      | TEI2 | TEI1 | TEI0 | Output Interval |
|-----------|------|------|------|-----------------|
| 0         | 0    | 0    | 0    | 1 frame         |
| 0         | 0    | 0    | 1    | 2 frames        |
| 0         | 0    | 1    | 0    | 3 frames        |
| . . . . . |      |      |      | . .             |
| 1         | 1    | 1    | 0    | 15 frames       |
| 1         | 1    | 1    | 1    | 16 frames       |



**DFR:** The bit is used in the Frame Memory access and Display operation. In-house function and not open.

**TEP[9:0]:** Sets the output position of frame cycle signal. TE can be used as the trigger signal for frame synchronous write operation.

**Make sure the setting restriction  $9'h000 \leq TEP[9:0] \leq BP + \text{Number of Line} + FP$ .**

| TEP[9:0] | Output position |
|----------|-----------------|
| 10'h000  | 0th line        |
| 10'h001  | 1st line        |
| 10'h002  | 2nd line        |
| 10'h003  | 3rd line        |
| ...      | ...             |
| 10'h35D  | 861th line      |
| 10'h35E  | 862th line      |
| 10'h35F  | 863th line      |

**GON:** Controlling the GIP signals On/Off register.

GON =1, the GIP signals are On for normal operation.

GON =0, the GIP signals are OFF and set as GND.

**Restrictions** SETEXTC turn on to enable this command

| Register Availability | Status                                    | Availability |
|-----------------------|-------------------------------------------|--------------|
|                       | Normal Mode On, Idle Mode Off, Sleep Out  | Yes          |
|                       | Normal Mode On, Idle Mode On, Sleep Out   | Yes          |
|                       | Partial Mode On, Idle Mode Off, Sleep Out | Yes          |
|                       | Partial Mode On, Idle Mode On, Sleep Out  | Yes          |

| Default | Status                                      | Default value                                                                                                                                                                                                                                                          | OTP value                                                                                                                                                       |
|---------|---------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------|
|         | Power On Sequence<br>S/W Reset<br>H/W Reset | D[1:0]=00, RES_SEL[2:0]=001,<br>RM=0, DFR=0, DM[1:0]=00<br>BP[7:0]=0x03h, FP[7:0]=0x03h,<br>SAP[3:0]=0111, GEN_ON=0x00h,<br>GEN_OFF=0xFFh,<br>RTN[7:0]=0x00h,<br>TEI[3:0]=0000, TEP[9:0]=0x000h,<br>BP_PE[7:0]=0x03h,<br>FP_PE[7:0]=0x03h,<br>RTN_PE[7:0]=0x00h, GON=1 | RES_SEL[2:0], RM, DFR,<br>DM[1:0] BP[7:0], FP[7:0],<br>SAP[3:0], GEN_ON,<br>GEN_OFF, RTN[7:0],<br>TEI[3:0], TEP[9:0],<br>BP_PE[7:0], FP_PE[7:0],<br>RTN_PE[7:0] |

## 6.2.57 SETRGBIF: Set RGB interface related register (B3h)

| B3H                       | SETRGBIF( Set RGB interface related register)                                                                                                                          |                                         |     |                           |    |    |         |    |     |                   |      |     |     |
|---------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------|-----|---------------------------|----|----|---------|----|-----|-------------------|------|-----|-----|
|                           | DNC                                                                                                                                                                    | NRD                                     | NWR | D15~D8                    | D7 | D6 | D5      | D4 | D3  | D2                | D1   | D0  | HEX |
| Command                   | 0                                                                                                                                                                      | 1                                       | ↑   | -                         | 1  | 0  | 1       | 1  | 0   | 0                 | 1    | 1   | B3  |
| 1 <sup>st</sup> parameter | 1                                                                                                                                                                      | 1                                       | ↑   | -                         | -  | -  | -       | -  | DPL | HSPL              | VSPL | EPL | -   |
| Description               | This command is used to set RGB interface related register.<br><b>EPL:</b> Specify the polarity of DE pin in RGB interface mode.                                       |                                         |     |                           |    |    |         |    |     |                   |      |     |     |
|                           | EPL                                                                                                                                                                    |                                         |     | DE pin                    |    |    | Display |    |     |                   |      |     |     |
|                           | 0                                                                                                                                                                      |                                         |     | 0                         |    |    | Enable  |    |     |                   |      |     |     |
|                           | 0                                                                                                                                                                      |                                         |     | 1                         |    |    | Disable |    |     |                   |      |     |     |
|                           | 1                                                                                                                                                                      |                                         |     | 0                         |    |    | Disable |    |     |                   |      |     |     |
|                           | 1                                                                                                                                                                      |                                         |     | 1                         |    |    | Enable  |    |     |                   |      |     |     |
|                           | <b>VSPL:</b> The polarity of VS pin. When VSPL=0, the VS pin is Low active. When VSPL=1, the VS pin is High active.                                                    |                                         |     |                           |    |    |         |    |     |                   |      |     |     |
|                           | <b>HSPL:</b> The polarity of HS pin. When HSPL=0, the HS pin is Low active. When HSPL=1, the HS pin is High active.                                                    |                                         |     |                           |    |    |         |    |     |                   |      |     |     |
|                           | <b>DPL:</b> The polarity of PCLK pin. When DPL=0, the data is read on the rising edge of PCLK signal. When DPL=1, the data is read on the falling edge of PCLK signal. |                                         |     |                           |    |    |         |    |     |                   |      |     |     |
|                           | Restrictions                                                                                                                                                           | SETEXTC turn on to enable this command. |     |                           |    |    |         |    |     |                   |      |     |     |
| Register Availability     |                                                                                                                                                                        |                                         |     |                           |    |    |         |    |     |                   |      |     |     |
|                           | Status                                                                                                                                                                 |                                         |     |                           |    |    |         |    |     | Availability      |      |     |     |
|                           | Normal Mode On, Idle Mode Off, Sleep Out                                                                                                                               |                                         |     |                           |    |    |         |    |     | Yes               |      |     |     |
|                           | Normal Mode On, Idle Mode On, Sleep Out                                                                                                                                |                                         |     |                           |    |    |         |    |     | Yes               |      |     |     |
|                           | Partial Mode On, Idle Mode Off, Sleep Out                                                                                                                              |                                         |     |                           |    |    |         |    |     | Yes               |      |     |     |
| Default                   |                                                                                                                                                                        |                                         |     |                           |    |    |         |    |     |                   |      |     |     |
|                           | Status                                                                                                                                                                 |                                         |     | Default value             |    |    |         |    |     | OTP value         |      |     |     |
|                           | Power On Sequence                                                                                                                                                      |                                         |     | DPL=0,HSPL=0,VSPL=0,EPL=1 |    |    |         |    |     | DPL,HSPL,VSPL,EPL |      |     |     |
|                           | S/W Reset                                                                                                                                                              |                                         |     |                           |    |    |         |    |     |                   |      |     |     |
| H/W Reset                 |                                                                                                                                                                        |                                         |     |                           |    |    |         |    |     |                   |      |     |     |

## 6.2.58 SETCYC: Set display waveform cycle (B4h)

| B4H                       | SETCYC( Set display waveform cycles) |     |     |        |           |    |    |    |            |    |         |    |     |
|---------------------------|--------------------------------------|-----|-----|--------|-----------|----|----|----|------------|----|---------|----|-----|
|                           | DNC                                  | NRD | NWR | D15~D8 | D7        | D6 | D5 | D4 | D3         | D2 | D1      | D0 | HEX |
| Command                   | 0                                    | 1   | ↑   | -      | 1         | 0  | 1  | 0  | 0          | 1  | 0       | 0  | B4  |
| 1 <sup>st</sup> parameter | 1                                    | 1   | ↑   | -      | -         | -  | -  | -  | NW_PE[1:0] |    | NW[1:0] |    | -   |
| 2 <sup>nd</sup> parameter | 1                                    | 1   | ↑   | -      | SON[7:0]  |    |    |    |            |    |         |    | -   |
| 3 <sup>rd</sup> parameter | 1                                    | 1   | ↑   | -      | SOFF[7:0] |    |    |    |            |    |         |    | -   |
| 4 <sup>th</sup> parameter | 1                                    | 1   | ↑   | -      | EQS[7:0]  |    |    |    |            |    |         |    | -   |
| 5 <sup>th</sup> parameter | 1                                    | 1   | ↑   | -      | EQON[7:0] |    |    |    |            |    |         |    | -   |

This command is used to get setting of display waveform cycles.

**NW[1:0]:** Inversion type setting.

| NW1 | NW0 | Inversion type    |
|-----|-----|-------------------|
| 0   | 0   | Column inversion  |
| 0   | 1   | 1-dot inversion   |
| 1   | 0   | 2-dot inversion   |
| 1   | 1   | Zig-zag inversion |

**NW\_PE[1:0]:** Inversion type setting on partial idle mode.

| NW_PE1 | NW_PE0 | Inversion type    |
|--------|--------|-------------------|
| 0      | 0      | Column inversion  |
| 0      | 1      | 1-dot inversion   |
| 1      | 0      | 2-dot inversion   |
| 1      | 1      | Zig-zag inversion |

**Description**

SON[7:0]: Specify the valid source output start time.

| SON [7:0] |   |   |   |   |   |   |   | Source output start time |
|-----------|---|---|---|---|---|---|---|--------------------------|
| 0         | 0 | 0 | 0 | 0 | 0 | 0 | 0 | Inhibit                  |
| 0         | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 OSC clock cycle        |
| 0         | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 2 OSC clock cycle        |
| 0         | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 3 OSC clock cycle        |
| 0         | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 4 OSC clock cycle        |

|           |   |   |   |   |   |   |   |                     |
|-----------|---|---|---|---|---|---|---|---------------------|
| . . . . . |   |   |   |   |   |   |   | . . . . .           |
| 0         | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 15 OSC clock cycle  |
| . . . . . |   |   |   |   |   |   |   | . . . . .           |
| 1         | 1 | 1 | 1 | 1 | 0 | 1 | 0 | 250 OSC clock cycle |
| 1         | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 251 OSC clock cycle |
| 1         | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 252 OSC clock cycle |
| 1         | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 253 OSC clock cycle |
| 1         | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 254 OSC clock cycle |
| 1         | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 255 OSC clock cycle |

**SOFF[7:0]:** Specify the valid source output end time.

| SOFF [7:0] |   |   |   |   |   |   |   | Source output end time |
|------------|---|---|---|---|---|---|---|------------------------|
| 0          | 0 | 0 | 0 | 0 | 0 | 0 | 0 | Inhibit                |
| 0          | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 OSC clock cycle      |
| 0          | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 2 OSC clock cycle      |
| 0          | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 3 OSC clock cycle      |
| 0          | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 4 OSC clock cycle      |
| . . . . .  |   |   |   |   |   |   |   | . . . . .              |
| 1          | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 130 OSC clock cycle    |
| . . . . .  |   |   |   |   |   |   |   | . . . . .              |
| 1          | 1 | 1 | 1 | 1 | 0 | 1 | 0 | 250 OSC clock cycle    |
| 1          | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 251 OSC clock cycle    |
| 1          | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 252 OSC clock cycle    |
| 1          | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 253 OSC clock cycle    |
| 1          | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 254 OSC clock cycle    |
| 1          | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 255 OSC clock cycle    |

**EQON[7:0]:** Specify the valid Equalize output start time.

(Please note that the EQON[7:0] ≤ EQS[7:0]-1)

| EQON [7:0] |   |   |   |   |   |   |   | Gate output start time |
|------------|---|---|---|---|---|---|---|------------------------|
| 0          | 0 | 0 | 0 | 0 | 0 | 0 | 0 | Inhibit                |
| 0          | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 OSC clock cycle      |
| 0          | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 2 OSC clock cycle      |
| 0          | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 3 OSC clock cycle      |
| 0          | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 4 OSC clock cycle      |
| . . . . .  |   |   |   |   |   |   |   | . . . . .              |
| 0          | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 12 OSC clock cycle     |
| . . . . .  |   |   |   |   |   |   |   | . . . . .              |
| 1          | 1 | 1 | 1 | 1 | 0 | 1 | 0 | 250 OSC clock cycle    |
| 1          | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 251 OSC clock cycle    |
| 1          | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 252 OSC clock cycle    |
| 1          | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 253 OSC clock cycle    |
| 1          | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 254 OSC clock cycle    |
| 1          | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 255 OSC clock cycle    |

**EQS[7:0]:** Specify the Equalize time of source output. (Please note that the EQS[7:0] ≤ SON-1).

| EQS [7:0] |   |   |   |   |   |   |   | Equalize time of source output |
|-----------|---|---|---|---|---|---|---|--------------------------------|
| 0         | 0 | 0 | 0 | 0 | 0 | 0 | 0 | Equalize function off          |
| 0         | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 OSC clock cycle              |
| 0         | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 2 OSC clock cycle              |
| 0         | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 3 OSC clock cycle              |
| 0         | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 4 OSC clock cycle              |
| 0         | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 5 OSC clock cycle              |
| 0         | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 6 OSC clock cycle              |
| . . . . . |   |   |   |   |   |   |   | . . . . .                      |
| 1         | 1 | 1 | 1 | 1 | 0 | 1 | 0 | 250 OSC clock cycle            |
| 1         | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 251 OSC clock cycle            |

|                       |                                             |   |                                                                                                 |   |   |   |                                                                     |   |                     |
|-----------------------|---------------------------------------------|---|-------------------------------------------------------------------------------------------------|---|---|---|---------------------------------------------------------------------|---|---------------------|
|                       | 1                                           | 1 | 1                                                                                               | 1 | 1 | 1 | 0                                                                   | 0 | 252 OSC clock cycle |
|                       | 1                                           | 1 | 1                                                                                               | 1 | 1 | 1 | 0                                                                   | 1 | 253 OSC clock cycle |
|                       | 1                                           | 1 | 1                                                                                               | 1 | 1 | 1 | 1                                                                   | 0 | 254 OSC clock cycle |
|                       | 1                                           | 1 | 1                                                                                               | 1 | 1 | 1 | 1                                                                   | 1 | 255 OSC clock cycle |
| Restrictions          | SETEXTC turn on to enable this command.     |   |                                                                                                 |   |   |   |                                                                     |   |                     |
| Register Availability | Status                                      |   |                                                                                                 |   |   |   | Availability                                                        |   |                     |
|                       | Normal Mode On, Idle Mode Off, Sleep Out    |   |                                                                                                 |   |   |   | Yes                                                                 |   |                     |
|                       | Normal Mode On, Idle Mode On, Sleep Out     |   |                                                                                                 |   |   |   | Yes                                                                 |   |                     |
|                       | Partial Mode On, Idle Mode Off, Sleep Out   |   |                                                                                                 |   |   |   | Yes                                                                 |   |                     |
|                       | Partial Mode On, Idle Mode On, Sleep Out    |   |                                                                                                 |   |   |   | Yes                                                                 |   |                     |
|                       | Sleep In or Booster Off                     |   |                                                                                                 |   |   |   | Yes                                                                 |   |                     |
| Default               | Status                                      |   | Default value                                                                                   |   |   |   | OTP value                                                           |   |                     |
|                       | Power On Sequence<br>S/W Reset<br>H/W Reset |   | NW_PE[1:0]=00,NW[1:0]=00,<br>SON[7:0]=0x0Fh,SOFF[7:0]=0x82h,<br>EQS[7:0]=0x0Ch, EQON[7:0]=0x03h |   |   |   | NW_PE[1:0], NW[1:0],<br>SON[7:0], SOFF[7:0],<br>EQS[7:0], EQON[7:0] |   |                     |

Himax Confidential  
Do Not Copy

## 6.2.59 SETVCOM: Set VCOM voltage (B6h)

| B6 H                      | SETVCOM ( Set VCOM Voltage)                                                      |     |     |        |             |    |    |    |        |          |    |    |     |
|---------------------------|----------------------------------------------------------------------------------|-----|-----|--------|-------------|----|----|----|--------|----------|----|----|-----|
|                           | DNC                                                                              | NRD | NWR | D15~D8 | D7          | D6 | D5 | D4 | D3     | D2       | D1 | D0 | HEX |
| Command                   | 0                                                                                | 1   | ↑   | -      | 1           | 0  | 1  | 1  | 0      | 1        | 1  | 0  | B6  |
| 1 <sup>st</sup> parameter | 1                                                                                | 1   | ↑   | -      | VCMC_F[7:0] |    |    |    |        |          |    |    | -   |
| 2 <sup>nd</sup> parameter | 1                                                                                | 1   | ↑   | -      | VCMC_B[7:0] |    |    |    |        |          |    |    | -   |
| Description               | This command is used to set VCOM Voltage include VCOM Low and VCOM High Voltage. |     |     |        |             |    |    |    |        |          |    |    |     |
|                           | VCMC_F[7:0]: DC VCOM voltage setting for forward scan.                           |     |     |        |             |    |    |    |        |          |    |    |     |
|                           | VCMC_B[7:0]: DC VCOM voltage setting for backward scan.                          |     |     |        |             |    |    |    |        |          |    |    |     |
|                           | VCMC_F[7:0] / VCMC_B[7:0]                                                        |     |     |        |             |    |    |    |        | VCOM (V) |    |    |     |
|                           | D7                                                                               | D6  | D5  | D4     | D3          | D2 | D1 | D0 |        |          |    |    |     |
|                           | 0                                                                                | 0   | 0   | 0      | 0           | 0  | 0  | 0  | -2     |          |    |    |     |
|                           | 0                                                                                | 0   | 0   | 0      | 0           | 0  | 0  | 1  | -1.984 |          |    |    |     |
|                           | 0                                                                                | 0   | 0   | 0      | 0           | 0  | 1  | 0  | -1.968 |          |    |    |     |
|                           | 0                                                                                | 0   | 0   | 0      | 0           | 0  | 1  | 1  | -1.952 |          |    |    |     |
|                           | 0                                                                                | 0   | 0   | 0      | 0           | 1  | 0  | 0  | -1.936 |          |    |    |     |
|                           | 0                                                                                | 0   | 0   | 0      | 0           | 1  | 0  | 1  | -1.92  |          |    |    |     |
|                           | 0                                                                                | 0   | 0   | 0      | 0           | 1  | 1  | 0  | -1.904 |          |    |    |     |
|                           | 0                                                                                | 0   | 0   | 0      | 0           | 1  | 1  | 1  | -1.888 |          |    |    |     |
|                           | 0                                                                                | 0   | 0   | 0      | 1           | 0  | 0  | 0  | -1.872 |          |    |    |     |
|                           | 0                                                                                | 0   | 0   | 0      | 1           | 0  | 0  | 1  | -1.856 |          |    |    |     |
|                           | 0                                                                                | 0   | 0   | 0      | 1           | 0  | 1  | 0  | -1.84  |          |    |    |     |
|                           | 0                                                                                | 0   | 0   | 0      | 1           | 0  | 1  | 1  | -1.824 |          |    |    |     |
|                           | 0                                                                                | 0   | 0   | 0      | 1           | 1  | 0  | 0  | -1.808 |          |    |    |     |
|                           | 0                                                                                | 0   | 0   | 0      | 1           | 1  | 0  | 1  | -1.792 |          |    |    |     |
|                           | 0                                                                                | 0   | 0   | 0      | 1           | 1  | 1  | 0  | -1.776 |          |    |    |     |
|                           | 0                                                                                | 0   | 0   | 0      | 1           | 1  | 1  | 1  | -1.76  |          |    |    |     |
|                           | 0                                                                                | 0   | 0   | 1      | 0           | 0  | 0  | 0  | -1.744 |          |    |    |     |
|                           | 0                                                                                | 0   | 0   | 1      | 0           | 0  | 0  | 1  | -1.728 |          |    |    |     |
|                           | 0                                                                                | 0   | 0   | 1      | 0           | 0  | 1  | 0  | -1.712 |          |    |    |     |
|                           | 0                                                                                | 0   | 0   | 1      | 0           | 0  | 1  | 1  | -1.696 |          |    |    |     |
|                           | 0                                                                                | 0   | 0   | 1      | 0           | 1  | 0  | 0  | -1.68  |          |    |    |     |
|                           | 0                                                                                | 0   | 0   | 1      | 0           | 1  | 0  | 1  | -1.664 |          |    |    |     |
|                           | 0                                                                                | 0   | 0   | 1      | 0           | 1  | 1  | 0  | -1.648 |          |    |    |     |
|                           | 0                                                                                | 0   | 0   | 1      | 0           | 1  | 1  | 1  | -1.632 |          |    |    |     |
|                           | 0                                                                                | 0   | 0   | 1      | 1           | 0  | 0  | 0  | -1.616 |          |    |    |     |
|                           | 0                                                                                | 0   | 0   | 1      | 1           | 0  | 0  | 1  | -1.6   |          |    |    |     |
|                           | 0                                                                                | 0   | 0   | 1      | 1           | 0  | 1  | 0  | -1.584 |          |    |    |     |
|                           | 0                                                                                | 0   | 0   | 1      | 1           | 0  | 1  | 1  | -1.568 |          |    |    |     |
|                           | 0                                                                                | 0   | 0   | 1      | 1           | 1  | 0  | 0  | -1.552 |          |    |    |     |
|                           | 0                                                                                | 0   | 0   | 1      | 1           | 1  | 0  | 1  | -1.536 |          |    |    |     |
|                           | 0                                                                                | 0   | 0   | 1      | 1           | 1  | 1  | 0  | -1.52  |          |    |    |     |
|                           | 0                                                                                | 0   | 0   | 1      | 1           | 1  | 1  | 1  | -1.504 |          |    |    |     |
|                           | 0                                                                                | 0   | 1   | 0      | 0           | 0  | 0  | 0  | -1.488 |          |    |    |     |
|                           | 0                                                                                | 0   | 1   | 0      | 0           | 0  | 0  | 1  | -1.472 |          |    |    |     |
|                           | 0                                                                                | 0   | 1   | 0      | 0           | 0  | 1  | 0  | -1.456 |          |    |    |     |
|                           | 0                                                                                | 0   | 1   | 0      | 0           | 0  | 1  | 1  | -1.44  |          |    |    |     |
|                           | 0                                                                                | 0   | 1   | 0      | 0           | 1  | 0  | 0  | -1.424 |          |    |    |     |
|                           | 0                                                                                | 0   | 1   | 0      | 0           | 1  | 0  | 1  | -1.408 |          |    |    |     |
|                           | 0                                                                                | 0   | 1   | 0      | 0           | 1  | 1  | 0  | -1.392 |          |    |    |     |
|                           | 0                                                                                | 0   | 1   | 0      | 0           | 1  | 1  | 1  | -1.376 |          |    |    |     |
|                           | 0                                                                                | 0   | 1   | 0      | 1           | 0  | 0  | 0  | -1.36  |          |    |    |     |
|                           | 0                                                                                | 0   | 1   | 0      | 1           | 0  | 0  | 1  | -1.344 |          |    |    |     |
|                           | 0                                                                                | 0   | 1   | 0      | 1           | 0  | 1  | 0  | -1.328 |          |    |    |     |
|                           | 0                                                                                | 0   | 1   | 0      | 1           | 0  | 1  | 1  | -1.312 |          |    |    |     |
|                           | 0                                                                                | 0   | 1   | 0      | 1           | 1  | 0  | 0  | -1.296 |          |    |    |     |

|   |   |   |   |   |   |   |   |        |
|---|---|---|---|---|---|---|---|--------|
| 0 | 0 | 1 | 0 | 1 | 1 | 0 | 1 | -1.28  |
| 0 | 0 | 1 | 0 | 1 | 1 | 1 | 0 | -1.264 |
| 0 | 0 | 1 | 0 | 1 | 1 | 1 | 1 | -1.248 |
| 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | -1.232 |
| 0 | 0 | 1 | 1 | 0 | 0 | 0 | 1 | -1.216 |
| 0 | 0 | 1 | 1 | 0 | 0 | 1 | 0 | -1.2   |
| 0 | 0 | 1 | 1 | 0 | 0 | 1 | 1 | -1.184 |
| 0 | 0 | 1 | 1 | 0 | 1 | 0 | 0 | -1.168 |
| 0 | 0 | 1 | 1 | 0 | 1 | 0 | 1 | -1.152 |
| 0 | 0 | 1 | 1 | 0 | 1 | 1 | 0 | -1.136 |
| 0 | 0 | 1 | 1 | 0 | 1 | 1 | 1 | -1.12  |
| 0 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | -1.104 |
| 0 | 0 | 1 | 1 | 1 | 0 | 0 | 1 | -1.088 |
| 0 | 0 | 1 | 1 | 1 | 0 | 1 | 0 | -1.072 |
| 0 | 0 | 1 | 1 | 1 | 0 | 1 | 1 | -1.056 |
| 0 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | -1.04  |
| 0 | 0 | 1 | 1 | 1 | 1 | 0 | 1 | -1.024 |
| 0 | 0 | 1 | 1 | 1 | 1 | 1 | 0 | -1.008 |
| 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | -0.992 |
| 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | -0.976 |
| 0 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | -0.96  |
| 0 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | -0.944 |
| 0 | 1 | 0 | 0 | 0 | 0 | 1 | 1 | -0.928 |
| 0 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | -0.912 |
| 0 | 1 | 0 | 0 | 0 | 1 | 0 | 1 | -0.896 |
| 0 | 1 | 0 | 0 | 0 | 1 | 1 | 0 | -0.88  |
| 0 | 1 | 0 | 0 | 0 | 1 | 1 | 1 | -0.864 |
| 0 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | -0.848 |
| 0 | 1 | 0 | 0 | 1 | 0 | 0 | 1 | -0.832 |
| 0 | 1 | 0 | 0 | 1 | 0 | 1 | 0 | -0.816 |
| 0 | 1 | 0 | 0 | 1 | 0 | 1 | 1 | -0.8   |
| 0 | 1 | 0 | 0 | 1 | 1 | 0 | 0 | -0.784 |
| 0 | 1 | 0 | 0 | 1 | 1 | 0 | 1 | -0.768 |
| 0 | 1 | 0 | 0 | 1 | 1 | 1 | 0 | -0.752 |
| 0 | 1 | 0 | 0 | 1 | 1 | 1 | 1 | -0.736 |
| 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | -0.72  |
| 0 | 1 | 0 | 1 | 0 | 0 | 0 | 1 | -0.704 |
| 0 | 1 | 0 | 1 | 0 | 0 | 1 | 0 | -0.688 |
| 0 | 1 | 0 | 1 | 0 | 0 | 1 | 1 | -0.672 |
| 0 | 1 | 0 | 1 | 0 | 1 | 0 | 0 | -0.656 |
| 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | -0.64  |
| 0 | 1 | 0 | 1 | 0 | 1 | 1 | 0 | -0.624 |
| 0 | 1 | 0 | 1 | 0 | 1 | 1 | 1 | -0.608 |
| 0 | 1 | 0 | 1 | 1 | 0 | 0 | 0 | -0.592 |
| 0 | 1 | 0 | 1 | 1 | 0 | 0 | 1 | -0.576 |
| 0 | 1 | 0 | 1 | 1 | 0 | 1 | 0 | -0.56  |
| 0 | 1 | 0 | 1 | 1 | 0 | 1 | 1 | -0.544 |
| 0 | 1 | 0 | 1 | 1 | 1 | 0 | 0 | -0.528 |
| 0 | 1 | 0 | 1 | 1 | 1 | 0 | 1 | -0.512 |
| 0 | 1 | 0 | 1 | 1 | 1 | 1 | 0 | -0.496 |
| 0 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | -0.48  |
| 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | -0.464 |
| 0 | 1 | 1 | 0 | 0 | 0 | 0 | 1 | -0.448 |
| 0 | 1 | 1 | 0 | 0 | 0 | 1 | 0 | -0.432 |
| 0 | 1 | 1 | 0 | 0 | 0 | 1 | 1 | -0.416 |
| 0 | 1 | 1 | 0 | 0 | 1 | 0 | 0 | -0.4   |
| 0 | 1 | 1 | 0 | 0 | 1 | 0 | 1 | -0.384 |
| 0 | 1 | 1 | 0 | 0 | 1 | 1 | 0 | -0.368 |



|                       |                                           |   |   |                    |   |   |                          |              |         |
|-----------------------|-------------------------------------------|---|---|--------------------|---|---|--------------------------|--------------|---------|
|                       | 0                                         | 1 | 1 | 0                  | 0 | 1 | 1                        | 1            | -0.352  |
|                       | 0                                         | 1 | 1 | 0                  | 1 | 0 | 0                        | 0            | -0.336  |
|                       | 0                                         | 1 | 1 | 0                  | 1 | 0 | 0                        | 1            | -0.32   |
|                       | 0                                         | 1 | 1 | 0                  | 1 | 0 | 1                        | 0            | -0.304  |
|                       | 0                                         | 1 | 1 | 0                  | 1 | 0 | 1                        | 1            | -0.288  |
|                       | 0                                         | 1 | 1 | 0                  | 1 | 1 | 0                        | 0            | -0.272  |
|                       | 0                                         | 1 | 1 | 0                  | 1 | 1 | 0                        | 1            | -0.256  |
|                       | 0                                         | 1 | 1 | 0                  | 1 | 1 | 1                        | 0            | -0.24   |
|                       | 0                                         | 1 | 1 | 0                  | 1 | 1 | 1                        | 1            | -0.224  |
|                       | 0                                         | 1 | 1 | 1                  | 0 | 0 | 0                        | 0            | -0.208  |
|                       | 0                                         | 1 | 1 | 1                  | 0 | 0 | 0                        | 1            | -0.192  |
|                       | 0                                         | 1 | 1 | 1                  | 0 | 0 | 1                        | 0            | -0.176  |
|                       | 0                                         | 1 | 1 | 1                  | 0 | 0 | 1                        | 1            | -0.16   |
|                       | 0                                         | 1 | 1 | 1                  | 0 | 1 | 0                        | 0            | -0.144  |
|                       | 0                                         | 1 | 1 | 1                  | 0 | 1 | 0                        | 1            | -0.128  |
|                       | 0                                         | 1 | 1 | 1                  | 0 | 1 | 1                        | 0            | -0.112  |
|                       | 0                                         | 1 | 1 | 1                  | 0 | 1 | 1                        | 1            | -0.096  |
|                       | 0                                         | 1 | 1 | 1                  | 1 | 0 | 0                        | 0            | -0.08   |
|                       | 0                                         | 1 | 1 | 1                  | 1 | 0 | 0                        | 1            | -0.064  |
|                       | 0                                         | 1 | 1 | 1                  | 1 | 0 | 1                        | 0            | -0.048  |
|                       | 0                                         | 1 | 1 | 1                  | 1 | 0 | 1                        | 1            | -0.032  |
|                       | 0                                         | 1 | 1 | 1                  | 1 | 1 | 0                        | 0            | -0.016  |
|                       | 01111101 ~ 01111101                       |   |   |                    |   |   |                          |              | Inhibit |
|                       | 0                                         | 1 | 1 | 1                  | 1 | 1 | 1                        | 0            | VCOMR   |
|                       | 0                                         | 1 | 1 | 1                  | 1 | 1 | 1                        | 1            | VSSA    |
|                       | 10000000 ~ 11111110                       |   |   |                    |   |   |                          |              | Inhibit |
|                       | 1                                         | 1 | 1 | 1                  | 1 | 1 | 1                        | 1            | HZ      |
| Restrictions          | SETEXTC turn on to enable this command.   |   |   |                    |   |   |                          |              |         |
| Register Availability | Status                                    |   |   |                    |   |   |                          | Availability |         |
|                       | Normal Mode On, Idle Mode Off, Sleep Out  |   |   |                    |   |   |                          | Yes          |         |
|                       | Normal Mode On, Idle Mode On, Sleep Out   |   |   |                    |   |   |                          | Yes          |         |
|                       | Partial Mode On, Idle Mode Off, Sleep Out |   |   |                    |   |   |                          | Yes          |         |
|                       | Partial Mode On, Idle Mode On, Sleep Out  |   |   |                    |   |   |                          | Yes          |         |
|                       | Sleep In or Booster Off                   |   |   |                    |   |   |                          | Yes          |         |
| Default               | Status                                    |   |   | Default value      |   |   | OTP value                |              |         |
|                       | Power On Sequence                         |   |   | VCMC_F[7:0]=0x5Eh, |   |   | VCMC_F[7:0], VCMC_B[7:0] |              |         |
|                       | S/W Reset                                 |   |   | VCMC_B[7:0]=0x5Eh  |   |   |                          |              |         |
| H/W Reset             |                                           |   |   |                    |   |   |                          |              |         |

**6.2.60 SETEXTC: Set extension command (B9h)**

| B9H                       | SETEXTC ( Set extended command set)                             |     |                                                                                                           |        |                                                             |    |              |    |           |    |    |    |     |
|---------------------------|-----------------------------------------------------------------|-----|-----------------------------------------------------------------------------------------------------------|--------|-------------------------------------------------------------|----|--------------|----|-----------|----|----|----|-----|
|                           | DNC                                                             | NRD | NWR                                                                                                       | D15~D8 | D7                                                          | D6 | D5           | D4 | D3        | D2 | D1 | D0 | HEX |
| Command                   | 0                                                               | 1   | ↑                                                                                                         | -      | 1                                                           | 0  | 1            | 1  | 1         | 0  | 0  | 1  | B9  |
| 1 <sup>st</sup> parameter | 1                                                               | 1   | ↑                                                                                                         | -      | EXTC1[7:0](FFh)                                             |    |              |    |           |    |    |    | -   |
| 2 <sup>nd</sup> parameter | 1                                                               | 1   | ↑                                                                                                         | -      | EXTC2[7:0](83h)                                             |    |              |    |           |    |    |    | -   |
| 3 <sup>rd</sup> parameter | 1                                                               | 1   | ↑                                                                                                         | -      | EXTC3[7:0](69h)                                             |    |              |    |           |    |    |    | -   |
| Description               | This command is used to set extended command set access enable. |     |                                                                                                           |        |                                                             |    |              |    |           |    |    |    |     |
|                           | Extend cmd                                                      |     | Command description                                                                                       |        |                                                             |    |              |    |           |    |    |    |     |
|                           | Enable                                                          |     | After command (B0h), must write 3 parameters (ffh,83h,69h) by order                                       |        |                                                             |    |              |    |           |    |    |    |     |
|                           | Disable(default)                                                |     | After command(B0h), write 3 parameters (xxh,xxh,xxh) any value is all right, but can not be (ffh,83h,69h) |        |                                                             |    |              |    |           |    |    |    |     |
| Restrictions              | -                                                               |     |                                                                                                           |        |                                                             |    |              |    |           |    |    |    |     |
| Register Availability     | Status                                                          |     |                                                                                                           |        |                                                             |    | Availability |    |           |    |    |    |     |
|                           | Normal Mode On, Idle Mode Off, Sleep Out                        |     |                                                                                                           |        |                                                             |    | Yes          |    |           |    |    |    |     |
|                           | Normal Mode On, Idle Mode On, Sleep Out                         |     |                                                                                                           |        |                                                             |    | Yes          |    |           |    |    |    |     |
|                           | Partial Mode On, Idle Mode Off, Sleep Out                       |     |                                                                                                           |        |                                                             |    | Yes          |    |           |    |    |    |     |
|                           | Partial Mode On, Idle Mode On, Sleep Out                        |     |                                                                                                           |        |                                                             |    | Yes          |    |           |    |    |    |     |
|                           | Sleep In or Booster Off                                         |     |                                                                                                           |        |                                                             |    | Yes          |    |           |    |    |    |     |
| Default                   | Status                                                          |     |                                                                                                           |        | Default value                                               |    |              |    | OTP value |    |    |    |     |
|                           | Power On Sequence<br>S/W Reset<br>H/W Reset                     |     |                                                                                                           |        | EXTC1[7:0]=0x00h,<br>EXTC2[7:0]=0x00h,<br>EXTC3[7:0]=0x00h, |    |              |    | N/A       |    |    |    |     |
|                           |                                                                 |     |                                                                                                           |        |                                                             |    |              |    |           |    |    |    |     |

### 6.2.61 SETMIPI: (BAh)

| BAH                          | SETMIPI ( Set extended command set)       |     |     |                                                                                                                                                                                          |                           |              |    |                                                                                 |    |    |    |    |     |
|------------------------------|-------------------------------------------|-----|-----|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------|--------------|----|---------------------------------------------------------------------------------|----|----|----|----|-----|
|                              | DNC                                       | NRD | NWR | D15~D8                                                                                                                                                                                   | D7                        | D6           | D5 | D4                                                                              | D3 | D2 | D1 | D0 | HEX |
| Command                      | 0                                         | 1   | ↑   | -                                                                                                                                                                                        | 1                         | 1            | 0  | 0                                                                               | 1  | 0  | 0  | 1  | BA  |
| 1 <sup>st</sup> parameter    | 1                                         | 1   | ↑   | -                                                                                                                                                                                        | DPHYCMD0[7:0]             |              |    |                                                                                 |    |    |    |    | -   |
| 2 <sup>nd</sup> parameter    | 1                                         | 1   | ↑   | -                                                                                                                                                                                        | DPHYCMD1[7:0]             |              |    |                                                                                 |    |    |    |    | -   |
| 3 <sup>rd</sup> parameter    | 1                                         | 1   | ↑   | -                                                                                                                                                                                        | DPHYCMD2[7:0]             |              |    |                                                                                 |    |    |    |    | -   |
| 4 <sup>th</sup> parameter    | 1                                         | 1   | ↑   | -                                                                                                                                                                                        | DSICMD0[7:0]              |              |    |                                                                                 |    |    |    |    | -   |
| 5 <sup>th</sup> parameter    | 1                                         | 1   | ↑   | -                                                                                                                                                                                        | DSICMD1[7:0]              |              |    |                                                                                 |    |    |    |    | -   |
| 6 <sup>th</sup> parameter    | 1                                         | 1   | ↑   | -                                                                                                                                                                                        | DSICMD2[7:0]              |              |    |                                                                                 |    |    |    |    | -   |
| 7 <sup>th</sup> parameter    | 1                                         | 1   | ↑   | -                                                                                                                                                                                        | DSICMD3[7:0]              |              |    |                                                                                 |    |    |    |    | -   |
| 8 <sup>th</sup> parameter    | 1                                         | 1   | ↑   | -                                                                                                                                                                                        | DPHYOTP0[7:0]             |              |    |                                                                                 |    |    |    |    | -   |
| 9 <sup>th</sup> parameter    | 1                                         | 1   | ↑   | -                                                                                                                                                                                        | DPHYOTP1[7:0]             |              |    |                                                                                 |    |    |    |    | -   |
| 10 <sup>th</sup> parameter   | 1                                         | 1   | ↑   | -                                                                                                                                                                                        | DPHYOTP2[7:0]             |              |    |                                                                                 |    |    |    |    | -   |
| 11 <sup>th</sup> parameter   | 1                                         | 1   | ↑   | -                                                                                                                                                                                        | DSIOTP0[7:0]              |              |    |                                                                                 |    |    |    |    | -   |
| 12 <sup>th</sup> parameter   | 1                                         | 1   | ↑   | -                                                                                                                                                                                        | DSIOTP1[7:0]              |              |    |                                                                                 |    |    |    |    | -   |
| 13 <sup>th</sup> parameter   | 1                                         | 1   | ↑   | -                                                                                                                                                                                        | -                         | DSI_INI TRDY | -  | -                                                                               | -  | -  | -  | -  | -   |
| Description                  | In-house function and not open.           |     |     |                                                                                                                                                                                          |                           |              |    |                                                                                 |    |    |    |    |     |
|                              | Command Table                             |     |     |                                                                                                                                                                                          |                           |              |    |                                                                                 |    |    |    |    |     |
|                              | Register Name                             |     |     |                                                                                                                                                                                          | Hardware Setting          |              |    |                                                                                 |    |    |    |    |     |
|                              | DPHYCMD0[7: 0]=0x00h                      |     |     |                                                                                                                                                                                          | Default setting is fixed. |              |    |                                                                                 |    |    |    |    |     |
|                              | DPHYCMD1[7: 0]=0xA0h                      |     |     |                                                                                                                                                                                          | Default setting is fixed. |              |    |                                                                                 |    |    |    |    |     |
|                              | DPHYCMD2[7: 0]=0xC6h                      |     |     |                                                                                                                                                                                          | Default setting is fixed. |              |    |                                                                                 |    |    |    |    |     |
|                              | Register Name                             |     |     |                                                                                                                                                                                          | Hardware Setting          |              |    |                                                                                 |    |    |    |    |     |
|                              | DSICMD0[7: 0]=0x00h                       |     |     |                                                                                                                                                                                          | Default setting is fixed. |              |    |                                                                                 |    |    |    |    |     |
|                              | DSICMD1[7: 0]=0x0Ah                       |     |     |                                                                                                                                                                                          | Default setting is fixed. |              |    |                                                                                 |    |    |    |    |     |
|                              | DSICMD2[7: 0]=0x00h                       |     |     |                                                                                                                                                                                          | Default setting is fixed. |              |    |                                                                                 |    |    |    |    |     |
|                              | DSICMD3[7: 0]=0x10h                       |     |     |                                                                                                                                                                                          | Default setting is fixed. |              |    |                                                                                 |    |    |    |    |     |
|                              | In-house function and not open.           |     |     |                                                                                                                                                                                          |                           |              |    |                                                                                 |    |    |    |    |     |
|                              | OTP Table:                                |     |     |                                                                                                                                                                                          |                           |              |    |                                                                                 |    |    |    |    |     |
|                              | Register Name                             |     |     |                                                                                                                                                                                          | DSI OTP setting           |              |    |                                                                                 |    |    |    |    |     |
| DPHYOTP0[7:0]                |                                           |     |     | Default setting is fixed.                                                                                                                                                                |                           |              |    |                                                                                 |    |    |    |    |     |
| DPHYOTP1[7:0]                |                                           |     |     | Default setting is fixed.                                                                                                                                                                |                           |              |    |                                                                                 |    |    |    |    |     |
| DPHYOTP2[7:0]                |                                           |     |     | Default setting is fixed.                                                                                                                                                                |                           |              |    |                                                                                 |    |    |    |    |     |
| DSI data lane number setting |                                           |     |     |                                                                                                                                                                                          |                           |              |    |                                                                                 |    |    |    |    |     |
| DSIOTP0[7:0] (00)NW0         |                                           |     |     | Data Lane Number                                                                                                                                                                         |                           |              |    |                                                                                 |    |    |    |    |     |
| 0x10h                        |                                           |     |     | One Data Lane Mode                                                                                                                                                                       |                           |              |    |                                                                                 |    |    |    |    |     |
| 0x11h                        |                                           |     |     | Two Data Lane Mode                                                                                                                                                                       |                           |              |    |                                                                                 |    |    |    |    |     |
| Restrictions                 | SETEXTC turn on to enable this command.   |     |     |                                                                                                                                                                                          |                           |              |    |                                                                                 |    |    |    |    |     |
| Register Availability        | Status                                    |     |     |                                                                                                                                                                                          |                           | Availability |    |                                                                                 |    |    |    |    |     |
|                              | Normal Mode On, Idle Mode Off, Sleep Out  |     |     |                                                                                                                                                                                          |                           | Yes          |    |                                                                                 |    |    |    |    |     |
|                              | Normal Mode On, Idle Mode On, Sleep Out   |     |     |                                                                                                                                                                                          |                           | Yes          |    |                                                                                 |    |    |    |    |     |
|                              | Partial Mode On, Idle Mode Off, Sleep Out |     |     |                                                                                                                                                                                          |                           | Yes          |    |                                                                                 |    |    |    |    |     |
|                              | Partial Mode On, Idle Mode On, Sleep Out  |     |     |                                                                                                                                                                                          |                           | Yes          |    |                                                                                 |    |    |    |    |     |
|                              | Sleep In or Booster Off                   |     |     |                                                                                                                                                                                          |                           | Yes          |    |                                                                                 |    |    |    |    |     |
| Default                      | Status                                    |     |     | Default value                                                                                                                                                                            |                           |              |    | OTP value                                                                       |    |    |    |    |     |
|                              | Power On Sequence<br>SW Reset<br>HW Reset |     |     | DPHYCMD0[7:0]=0x00h,<br>DPHYCMD1[7:0]=0xA0h,<br>DPHYCMD2[7:0]=0xC6h,<br>DSICMD0[7:0]=0x00h,<br>DSICMD1[7:0]=0x0Ah,<br>DSICMD2[7:0]=0x00h,<br>DSICMD3[7:0]=0x10h,<br>DPHYOTP0[7:0]=0x30h, |                           |              |    | DPHYOTP0[7:0]<br>DPHYOTP1[7:0]<br>DPHYOTP2[7:0]<br>DSIOTP0[7:0]<br>DSIOTP1[7:0] |    |    |    |    |     |

|  |  |                                                                                                             |  |  |
|--|--|-------------------------------------------------------------------------------------------------------------|--|--|
|  |  | DPHYOTP1[7:0]=0x6Fh,<br>DPHYOTP2[7:0]=0x02h,<br>DSIOTP0[7:0]=0x10h,<br>DSIOTP1[7:0]=0x18h,<br>DSI_INITRDY=1 |  |  |
|--|--|-------------------------------------------------------------------------------------------------------------|--|--|

Himax Confidential  
Do Not Copy

## 6.2.62 SETOTP: Set OTP (BBh)

| BBH                       | SETOTP( Set OTP Related Setting)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                           |     |        |                                                                                                                                                                               |          |         |         |              |         |          |              |    | HEX |  |
|---------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------|-----|--------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|---------|---------|--------------|---------|----------|--------------|----|-----|--|
|                           | DNC                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | NRD                                       | NWR | D15-D8 | D7                                                                                                                                                                            | D6       | D5      | D4      | D3           | D2      | D1       | D0           |    |     |  |
| Command                   | 0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | 1                                         | ↑   | -      | 1                                                                                                                                                                             | 0        | 1       | 1       | 1            | 0       | 1        | 1            | BB |     |  |
| 1 <sup>st</sup> parameter | 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | 1                                         | ↑   | -      | OTP_MASK[7:0] (8'b0)                                                                                                                                                          |          |         |         |              |         |          |              | -  |     |  |
| 2 <sup>nd</sup> parameter | 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | 1                                         | ↑   | -      | -                                                                                                                                                                             | -        | -       | -       | -            | -       | -        | OTP_INDEX[8] | -  |     |  |
| 3 <sup>rd</sup> parameter | 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | 1                                         | ↑   | -      | OTP_INDEX[7:0]                                                                                                                                                                |          |         |         |              |         |          |              | -  |     |  |
| 4 <sup>th</sup> parameter | 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | 1                                         | ↑   | -      | OTP_LOAD_DISABLE                                                                                                                                                              | OTP_TEST | OTP_POR | OTP_PWE | OTP_PTM[1:0] | VPP_SEL | OTP_PROG | -            |    |     |  |
| 5 <sup>th</sup> parameter | 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | 1                                         | ↑   | -      | OTP_DATA[7:0]                                                                                                                                                                 |          |         |         |              |         |          |              | -  |     |  |
| Description               | This command is used to set OTP Related Setting.<br><b>OTP_MASK[7:0]:</b> Bit programming mask, if 1, means this bit can't be programmed.<br><b>OTP_INDEX[8:0]:</b> Set index of OTP table for programming.<br><b>OTP_PWE:</b> OTP program write enable, if 1, means OTP is able to be programmed.<br><b>OTP_PROG:</b> When set to 1, the register content of OTP index is programmed.<br><b>OTP_LOAD_DISABLE:</b> Normally the internal registers are auto-loaded from OTP when the SLPOUT command is received. Nevertheless, if this bit is set to 1, it will disable the auto loading function when the SLPOUT command was received. In general, this bit is used when OTP is not yet programmed.<br><b>OTP_PTM[1:0]:</b> Not open, internal use.<br><b>VPP_SEL:</b> When written to 1, VPP voltage is fed to OTP<br><b>OTP_DATA[7:0]:</b> Read back the OTP index data. |                                           |     |        |                                                                                                                                                                               |          |         |         |              |         |          |              |    |     |  |
|                           | Restrictions                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                           |     |        |                                                                                                                                                                               |          |         |         |              |         |          |              |    |     |  |
|                           | SETEXTC turn on to enable this command.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                           |     |        |                                                                                                                                                                               |          |         |         |              |         |          |              |    |     |  |
|                           | Register Availability                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | Status                                    |     |        |                                                                                                                                                                               |          |         |         | Availability |         |          |              |    |     |  |
|                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Normal Mode On, Idle Mode Off, Sleep Out  |     |        |                                                                                                                                                                               |          |         |         | Yes          |         |          |              |    |     |  |
|                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Normal Mode On, Idle Mode On, Sleep Out   |     |        |                                                                                                                                                                               |          |         |         | Yes          |         |          |              |    |     |  |
|                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Partial Mode On, Idle Mode Off, Sleep Out |     |        |                                                                                                                                                                               |          |         |         | Yes          |         |          |              |    |     |  |
|                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Partial Mode On, Idle Mode On, Sleep Out  |     |        |                                                                                                                                                                               |          |         |         | Yes          |         |          |              |    |     |  |
| Sleep In                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                           |     |        |                                                                                                                                                                               |          | Yes     |         |              |         |          |              |    |     |  |
| Default                   | Status                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                           |     |        | Default value                                                                                                                                                                 |          |         |         | OTP value    |         |          |              |    |     |  |
|                           | Power On Sequence<br>S/W Reset<br>H/W Reset                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                           |     |        | OTP_MASK[7:0]=0x00h,<br>OTP_INDEX[8:0]=0x1FFh,<br>OTP_LOAD_DISABLE=0,<br>OTP_TEST=0, OTP_POR=0,<br>OTP_PWE=0, OTP_PTM[1:0]=00,<br>VPP_SEL=0, OTP_PROG=0,<br>OTP_DATA[7:0]=xxh |          |         |         | N/A          |         |          |              |    |     |  |

## 6.2.63 SETDGCLUT: Set DGC LUT (C1h)

| C1H                                                                                                         | SETDGCLUT ( Set DGC LUT)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |      |      |        |           |      |      |      |      |         |          |        |     |        |              |                          |     |                         |     |                         |     |    |         |                 |      |      |      |      |      |      |      |      |     |                 |      |      |      |      |      |      |      |      |     |                 |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                  |      |      |      |      |      |      |      |      |     |                  |      |      |   |   |   |   |   |   |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                  |      |      |      |      |      |      |      |      |     |                  |      |      |   |   |   |   |   |   |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                   |      |      |      |      |      |      |      |      |     |                   |      |      |      |      |      |      |      |      |     |                   |      |      |      |      |      |      |      |      |     |                   |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                   |      |      |      |      |      |      |      |      |     |                   |      |      |   |   |   |   |   |   |     |
|-------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|------|--------|-----------|------|------|------|------|---------|----------|--------|-----|--------|--------------|--------------------------|-----|-------------------------|-----|-------------------------|-----|----|---------|-----------------|------|------|------|------|------|------|------|------|-----|-----------------|------|------|------|------|------|------|------|------|-----|-----------------|------|------|------|------|------|------|------|------|-----|---|---|---|---|---|---|---|---|---|---|------------------|------|------|------|------|------|------|------|------|-----|------------------|------|------|------|------|------|------|------|------|-----|------------------|------|------|------|------|------|------|------|------|-----|------------------|------|------|------|------|------|------|------|------|-----|---|---|---|---|---|---|---|---|---|---|------------------|------|------|------|------|------|------|------|------|-----|------------------|------|------|---|---|---|---|---|---|-----|------------------|------|------|------|------|------|------|------|------|-----|------------------|------|------|------|------|------|------|------|------|-----|------------------|------|------|------|------|------|------|------|------|-----|---|---|---|---|---|---|---|---|---|---|------------------|------|------|------|------|------|------|------|------|-----|------------------|------|------|------|------|------|------|------|------|-----|------------------|------|------|------|------|------|------|------|------|-----|------------------|------|------|------|------|------|------|------|------|-----|---|---|---|---|---|---|---|---|---|---|------------------|------|------|------|------|------|------|------|------|-----|------------------|------|------|---|---|---|---|---|---|-----|------------------|------|------|------|------|------|------|------|------|-----|------------------|------|------|------|------|------|------|------|------|-----|------------------|------|------|------|------|------|------|------|------|-----|---|---|---|---|---|---|---|---|---|---|-------------------|------|------|------|------|------|------|------|------|-----|-------------------|------|------|------|------|------|------|------|------|-----|-------------------|------|------|------|------|------|------|------|------|-----|-------------------|------|------|------|------|------|------|------|------|-----|---|---|---|---|---|---|---|---|---|---|-------------------|------|------|------|------|------|------|------|------|-----|-------------------|------|------|---|---|---|---|---|---|-----|
|                                                                                                             | DNC                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | NRD  | NWR  | D15-D8 | D7        | D6   | D5   | D4   | D3   | D2      | D1       | D0     | HEX |        |              |                          |     |                         |     |                         |     |    |         |                 |      |      |      |      |      |      |      |      |     |                 |      |      |      |      |      |      |      |      |     |                 |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                  |      |      |      |      |      |      |      |      |     |                  |      |      |   |   |   |   |   |   |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                  |      |      |      |      |      |      |      |      |     |                  |      |      |   |   |   |   |   |   |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                   |      |      |      |      |      |      |      |      |     |                   |      |      |      |      |      |      |      |      |     |                   |      |      |      |      |      |      |      |      |     |                   |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                   |      |      |      |      |      |      |      |      |     |                   |      |      |   |   |   |   |   |   |     |
| Command                                                                                                     | 0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | 1    | ↑    | -      | 1         | 1    | 0    | 0    | 0    | 0       | 0        | 1      | C1  |        |              |                          |     |                         |     |                         |     |    |         |                 |      |      |      |      |      |      |      |      |     |                 |      |      |      |      |      |      |      |      |     |                 |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                  |      |      |      |      |      |      |      |      |     |                  |      |      |   |   |   |   |   |   |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                  |      |      |      |      |      |      |      |      |     |                  |      |      |   |   |   |   |   |   |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                   |      |      |      |      |      |      |      |      |     |                   |      |      |      |      |      |      |      |      |     |                   |      |      |      |      |      |      |      |      |     |                   |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                   |      |      |      |      |      |      |      |      |     |                   |      |      |   |   |   |   |   |   |     |
| 1 <sup>st</sup> parameter                                                                                   | 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | 1    | ↑    | -      | -         | -    | -    | -    | -    | -       | DITH_OPT | DGC_EN | -   |        |              |                          |     |                         |     |                         |     |    |         |                 |      |      |      |      |      |      |      |      |     |                 |      |      |      |      |      |      |      |      |     |                 |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                  |      |      |      |      |      |      |      |      |     |                  |      |      |   |   |   |   |   |   |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                  |      |      |      |      |      |      |      |      |     |                  |      |      |   |   |   |   |   |   |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                   |      |      |      |      |      |      |      |      |     |                   |      |      |      |      |      |      |      |      |     |                   |      |      |      |      |      |      |      |      |     |                   |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                   |      |      |      |      |      |      |      |      |     |                   |      |      |   |   |   |   |   |   |     |
| 2 <sup>nd</sup> parameter                                                                                   | 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | 1    | ↑    | -      | D1[7:0]   |      |      |      |      |         |          |        | -   |        |              |                          |     |                         |     |                         |     |    |         |                 |      |      |      |      |      |      |      |      |     |                 |      |      |      |      |      |      |      |      |     |                 |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                  |      |      |      |      |      |      |      |      |     |                  |      |      |   |   |   |   |   |   |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                  |      |      |      |      |      |      |      |      |     |                  |      |      |   |   |   |   |   |   |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                   |      |      |      |      |      |      |      |      |     |                   |      |      |      |      |      |      |      |      |     |                   |      |      |      |      |      |      |      |      |     |                   |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                   |      |      |      |      |      |      |      |      |     |                   |      |      |   |   |   |   |   |   |     |
| :                                                                                                           | 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | 1    | ↑    | -      | Dn[7:0]   |      |      |      |      |         |          |        | -   |        |              |                          |     |                         |     |                         |     |    |         |                 |      |      |      |      |      |      |      |      |     |                 |      |      |      |      |      |      |      |      |     |                 |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                  |      |      |      |      |      |      |      |      |     |                  |      |      |   |   |   |   |   |   |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                  |      |      |      |      |      |      |      |      |     |                  |      |      |   |   |   |   |   |   |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                   |      |      |      |      |      |      |      |      |     |                   |      |      |      |      |      |      |      |      |     |                   |      |      |      |      |      |      |      |      |     |                   |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                   |      |      |      |      |      |      |      |      |     |                   |      |      |   |   |   |   |   |   |     |
| 127 <sup>th</sup> parameter                                                                                 | 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | 1    | ↑    | -      | D126[7:0] |      |      |      |      |         |          |        | -   |        |              |                          |     |                         |     |                         |     |    |         |                 |      |      |      |      |      |      |      |      |     |                 |      |      |      |      |      |      |      |      |     |                 |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                  |      |      |      |      |      |      |      |      |     |                  |      |      |   |   |   |   |   |   |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                  |      |      |      |      |      |      |      |      |     |                  |      |      |   |   |   |   |   |   |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                   |      |      |      |      |      |      |      |      |     |                   |      |      |      |      |      |      |      |      |     |                   |      |      |      |      |      |      |      |      |     |                   |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                   |      |      |      |      |      |      |      |      |     |                   |      |      |   |   |   |   |   |   |     |
| Description                                                                                                 | This command is used to set DGC LUT.<br><b>DITH_OPT</b> : Not open, internal use.<br><b>DGC_EN</b> : Enable the DGC function<br><b>D1[7:0] ~ D126[7:0]</b> :                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |      |      |        |           |      |      |      |      |         |          |        |     |        |              |                          |     |                         |     |                         |     |    |         |                 |      |      |      |      |      |      |      |      |     |                 |      |      |      |      |      |      |      |      |     |                 |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                  |      |      |      |      |      |      |      |      |     |                  |      |      |   |   |   |   |   |   |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                  |      |      |      |      |      |      |      |      |     |                  |      |      |   |   |   |   |   |   |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                   |      |      |      |      |      |      |      |      |     |                   |      |      |      |      |      |      |      |      |     |                   |      |      |      |      |      |      |      |      |     |                   |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                   |      |      |      |      |      |      |      |      |     |                   |      |      |   |   |   |   |   |   |     |
|                                                                                                             | <table><tr><th>LUT</th><th>D7</th><th>D6</th><th>D5</th><th>D4</th><th>D3</th><th>D2</th><th>D1</th><th>D0</th><th>Default</th></tr><tr><td>1<sup>st</sup></td><td>R009</td><td>R008</td><td>R007</td><td>R006</td><td>R005</td><td>R004</td><td>R003</td><td>R002</td><td>00h</td></tr><tr><td>2<sup>nd</sup></td><td>R019</td><td>R018</td><td>R017</td><td>R016</td><td>R015</td><td>R014</td><td>R013</td><td>R012</td><td>08h</td></tr><tr><td>3<sup>rd</sup></td><td>R029</td><td>R028</td><td>R027</td><td>R026</td><td>R025</td><td>R024</td><td>R023</td><td>R022</td><td>10h</td></tr><tr><td>⋮</td><td>⋮</td><td>⋮</td><td>⋮</td><td>⋮</td><td>⋮</td><td>⋮</td><td>⋮</td><td>⋮</td><td>⋮</td></tr><tr><td>32<sup>rd</sup></td><td>R319</td><td>R318</td><td>R317</td><td>R316</td><td>R315</td><td>R314</td><td>R313</td><td>R312</td><td>F8h</td></tr><tr><td>33<sup>rd</sup></td><td>R329</td><td>R328</td><td>R327</td><td>R326</td><td>R325</td><td>R324</td><td>R323</td><td>R322</td><td>FFh</td></tr><tr><td>34<sup>th</sup></td><td>R001</td><td>R000</td><td>R011</td><td>R010</td><td>R021</td><td>R020</td><td>R031</td><td>R030</td><td>00h</td></tr><tr><td>35<sup>th</sup></td><td>R041</td><td>R040</td><td>R051</td><td>R050</td><td>R061</td><td>R060</td><td>R071</td><td>R070</td><td>00h</td></tr><tr><td>⋮</td><td>⋮</td><td>⋮</td><td>⋮</td><td>⋮</td><td>⋮</td><td>⋮</td><td>⋮</td><td>⋮</td><td>⋮</td></tr><tr><td>41<sup>st</sup></td><td>R281</td><td>R280</td><td>R291</td><td>R290</td><td>R301</td><td>R300</td><td>R311</td><td>R310</td><td>00h</td></tr><tr><td>42<sup>nd</sup></td><td>R321</td><td>R320</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>00h</td></tr><tr><td>43<sup>rd</sup></td><td>G009</td><td>G008</td><td>G007</td><td>G006</td><td>G005</td><td>G004</td><td>G003</td><td>G002</td><td>00h</td></tr><tr><td>44<sup>th</sup></td><td>G019</td><td>G018</td><td>G017</td><td>G016</td><td>G015</td><td>G014</td><td>G013</td><td>G012</td><td>08h</td></tr><tr><td>45<sup>th</sup></td><td>G029</td><td>G028</td><td>G027</td><td>G026</td><td>G025</td><td>G024</td><td>G023</td><td>G022</td><td>10h</td></tr><tr><td>⋮</td><td>⋮</td><td>⋮</td><td>⋮</td><td>⋮</td><td>⋮</td><td>⋮</td><td>⋮</td><td>⋮</td><td>⋮</td></tr><tr><td>74<sup>th</sup></td><td>G319</td><td>G318</td><td>G317</td><td>G316</td><td>G315</td><td>G314</td><td>G313</td><td>G312</td><td>F8h</td></tr><tr><td>75<sup>th</sup></td><td>G329</td><td>G328</td><td>G327</td><td>G326</td><td>G325</td><td>G324</td><td>G323</td><td>G322</td><td>FFh</td></tr><tr><td>76<sup>th</sup></td><td>G001</td><td>G000</td><td>G011</td><td>G010</td><td>G021</td><td>G020</td><td>G031</td><td>G030</td><td>00h</td></tr><tr><td>77<sup>th</sup></td><td>G041</td><td>G040</td><td>G051</td><td>G050</td><td>G061</td><td>G060</td><td>G071</td><td>G070</td><td>00h</td></tr><tr><td>⋮</td><td>⋮</td><td>⋮</td><td>⋮</td><td>⋮</td><td>⋮</td><td>⋮</td><td>⋮</td><td>⋮</td><td>⋮</td></tr><tr><td>83<sup>rd</sup></td><td>G281</td><td>G280</td><td>G291</td><td>G290</td><td>G301</td><td>G300</td><td>G311</td><td>G310</td><td>00h</td></tr><tr><td>84<sup>th</sup></td><td>G321</td><td>G320</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>00h</td></tr><tr><td>85<sup>th</sup></td><td>B009</td><td>B008</td><td>B007</td><td>B006</td><td>B005</td><td>B004</td><td>B003</td><td>B002</td><td>00h</td></tr><tr><td>86<sup>th</sup></td><td>B019</td><td>B018</td><td>B017</td><td>B016</td><td>B015</td><td>B014</td><td>B013</td><td>B012</td><td>08h</td></tr><tr><td>87<sup>th</sup></td><td>B029</td><td>B028</td><td>B027</td><td>B026</td><td>B025</td><td>B024</td><td>B023</td><td>B022</td><td>10h</td></tr><tr><td>⋮</td><td>⋮</td><td>⋮</td><td>⋮</td><td>⋮</td><td>⋮</td><td>⋮</td><td>⋮</td><td>⋮</td><td>⋮</td></tr><tr><td>116<sup>th</sup></td><td>B319</td><td>B318</td><td>B317</td><td>B316</td><td>B315</td><td>B314</td><td>B313</td><td>B312</td><td>F8h</td></tr><tr><td>117<sup>th</sup></td><td>B329</td><td>B328</td><td>B327</td><td>B326</td><td>B325</td><td>B324</td><td>B323</td><td>B322</td><td>FFh</td></tr><tr><td>118<sup>th</sup></td><td>B001</td><td>B000</td><td>B011</td><td>B010</td><td>B021</td><td>B020</td><td>B031</td><td>B030</td><td>00h</td></tr><tr><td>119<sup>th</sup></td><td>B041</td><td>B040</td><td>B051</td><td>B050</td><td>B061</td><td>B060</td><td>B071</td><td>B070</td><td>00h</td></tr><tr><td>⋮</td><td>⋮</td><td>⋮</td><td>⋮</td><td>⋮</td><td>⋮</td><td>⋮</td><td>⋮</td><td>⋮</td><td>⋮</td></tr><tr><td>125<sup>th</sup></td><td>B281</td><td>B280</td><td>B291</td><td>B290</td><td>B301</td><td>B300</td><td>B311</td><td>B310</td><td>00h</td></tr><tr><td>126<sup>th</sup></td><td>B321</td><td>B320</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>00h</td></tr></table> |      |      |        |           |      |      |      |      |         |          |        |     | LUT    | D7           | D6                       | D5  | D4                      | D3  | D2                      | D1  | D0 | Default | 1 <sup>st</sup> | R009 | R008 | R007 | R006 | R005 | R004 | R003 | R002 | 00h | 2 <sup>nd</sup> | R019 | R018 | R017 | R016 | R015 | R014 | R013 | R012 | 08h | 3 <sup>rd</sup> | R029 | R028 | R027 | R026 | R025 | R024 | R023 | R022 | 10h | ⋮ | ⋮ | ⋮ | ⋮ | ⋮ | ⋮ | ⋮ | ⋮ | ⋮ | ⋮ | 32 <sup>rd</sup> | R319 | R318 | R317 | R316 | R315 | R314 | R313 | R312 | F8h | 33 <sup>rd</sup> | R329 | R328 | R327 | R326 | R325 | R324 | R323 | R322 | FFh | 34 <sup>th</sup> | R001 | R000 | R011 | R010 | R021 | R020 | R031 | R030 | 00h | 35 <sup>th</sup> | R041 | R040 | R051 | R050 | R061 | R060 | R071 | R070 | 00h | ⋮ | ⋮ | ⋮ | ⋮ | ⋮ | ⋮ | ⋮ | ⋮ | ⋮ | ⋮ | 41 <sup>st</sup> | R281 | R280 | R291 | R290 | R301 | R300 | R311 | R310 | 00h | 42 <sup>nd</sup> | R321 | R320 | 0 | 0 | 0 | 0 | 0 | 0 | 00h | 43 <sup>rd</sup> | G009 | G008 | G007 | G006 | G005 | G004 | G003 | G002 | 00h | 44 <sup>th</sup> | G019 | G018 | G017 | G016 | G015 | G014 | G013 | G012 | 08h | 45 <sup>th</sup> | G029 | G028 | G027 | G026 | G025 | G024 | G023 | G022 | 10h | ⋮ | ⋮ | ⋮ | ⋮ | ⋮ | ⋮ | ⋮ | ⋮ | ⋮ | ⋮ | 74 <sup>th</sup> | G319 | G318 | G317 | G316 | G315 | G314 | G313 | G312 | F8h | 75 <sup>th</sup> | G329 | G328 | G327 | G326 | G325 | G324 | G323 | G322 | FFh | 76 <sup>th</sup> | G001 | G000 | G011 | G010 | G021 | G020 | G031 | G030 | 00h | 77 <sup>th</sup> | G041 | G040 | G051 | G050 | G061 | G060 | G071 | G070 | 00h | ⋮ | ⋮ | ⋮ | ⋮ | ⋮ | ⋮ | ⋮ | ⋮ | ⋮ | ⋮ | 83 <sup>rd</sup> | G281 | G280 | G291 | G290 | G301 | G300 | G311 | G310 | 00h | 84 <sup>th</sup> | G321 | G320 | 0 | 0 | 0 | 0 | 0 | 0 | 00h | 85 <sup>th</sup> | B009 | B008 | B007 | B006 | B005 | B004 | B003 | B002 | 00h | 86 <sup>th</sup> | B019 | B018 | B017 | B016 | B015 | B014 | B013 | B012 | 08h | 87 <sup>th</sup> | B029 | B028 | B027 | B026 | B025 | B024 | B023 | B022 | 10h | ⋮ | ⋮ | ⋮ | ⋮ | ⋮ | ⋮ | ⋮ | ⋮ | ⋮ | ⋮ | 116 <sup>th</sup> | B319 | B318 | B317 | B316 | B315 | B314 | B313 | B312 | F8h | 117 <sup>th</sup> | B329 | B328 | B327 | B326 | B325 | B324 | B323 | B322 | FFh | 118 <sup>th</sup> | B001 | B000 | B011 | B010 | B021 | B020 | B031 | B030 | 00h | 119 <sup>th</sup> | B041 | B040 | B051 | B050 | B061 | B060 | B071 | B070 | 00h | ⋮ | ⋮ | ⋮ | ⋮ | ⋮ | ⋮ | ⋮ | ⋮ | ⋮ | ⋮ | 125 <sup>th</sup> | B281 | B280 | B291 | B290 | B301 | B300 | B311 | B310 | 00h | 126 <sup>th</sup> | B321 | B320 | 0 | 0 | 0 | 0 | 0 | 0 | 00h |
|                                                                                                             | LUT                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | D7   | D6   | D5     | D4        | D3   | D2   | D1   | D0   | Default |          |        |     |        |              |                          |     |                         |     |                         |     |    |         |                 |      |      |      |      |      |      |      |      |     |                 |      |      |      |      |      |      |      |      |     |                 |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                  |      |      |      |      |      |      |      |      |     |                  |      |      |   |   |   |   |   |   |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                  |      |      |      |      |      |      |      |      |     |                  |      |      |   |   |   |   |   |   |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                   |      |      |      |      |      |      |      |      |     |                   |      |      |      |      |      |      |      |      |     |                   |      |      |      |      |      |      |      |      |     |                   |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                   |      |      |      |      |      |      |      |      |     |                   |      |      |   |   |   |   |   |   |     |
|                                                                                                             | 1 <sup>st</sup>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | R009 | R008 | R007   | R006      | R005 | R004 | R003 | R002 | 00h     |          |        |     |        |              |                          |     |                         |     |                         |     |    |         |                 |      |      |      |      |      |      |      |      |     |                 |      |      |      |      |      |      |      |      |     |                 |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                  |      |      |      |      |      |      |      |      |     |                  |      |      |   |   |   |   |   |   |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                  |      |      |      |      |      |      |      |      |     |                  |      |      |   |   |   |   |   |   |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                   |      |      |      |      |      |      |      |      |     |                   |      |      |      |      |      |      |      |      |     |                   |      |      |      |      |      |      |      |      |     |                   |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                   |      |      |      |      |      |      |      |      |     |                   |      |      |   |   |   |   |   |   |     |
|                                                                                                             | 2 <sup>nd</sup>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | R019 | R018 | R017   | R016      | R015 | R014 | R013 | R012 | 08h     |          |        |     |        |              |                          |     |                         |     |                         |     |    |         |                 |      |      |      |      |      |      |      |      |     |                 |      |      |      |      |      |      |      |      |     |                 |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                  |      |      |      |      |      |      |      |      |     |                  |      |      |   |   |   |   |   |   |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                  |      |      |      |      |      |      |      |      |     |                  |      |      |   |   |   |   |   |   |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                   |      |      |      |      |      |      |      |      |     |                   |      |      |      |      |      |      |      |      |     |                   |      |      |      |      |      |      |      |      |     |                   |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                   |      |      |      |      |      |      |      |      |     |                   |      |      |   |   |   |   |   |   |     |
|                                                                                                             | 3 <sup>rd</sup>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | R029 | R028 | R027   | R026      | R025 | R024 | R023 | R022 | 10h     |          |        |     |        |              |                          |     |                         |     |                         |     |    |         |                 |      |      |      |      |      |      |      |      |     |                 |      |      |      |      |      |      |      |      |     |                 |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                  |      |      |      |      |      |      |      |      |     |                  |      |      |   |   |   |   |   |   |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                  |      |      |      |      |      |      |      |      |     |                  |      |      |   |   |   |   |   |   |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                   |      |      |      |      |      |      |      |      |     |                   |      |      |      |      |      |      |      |      |     |                   |      |      |      |      |      |      |      |      |     |                   |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                   |      |      |      |      |      |      |      |      |     |                   |      |      |   |   |   |   |   |   |     |
|                                                                                                             | ⋮                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | ⋮    | ⋮    | ⋮      | ⋮         | ⋮    | ⋮    | ⋮    | ⋮    | ⋮       |          |        |     |        |              |                          |     |                         |     |                         |     |    |         |                 |      |      |      |      |      |      |      |      |     |                 |      |      |      |      |      |      |      |      |     |                 |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                  |      |      |      |      |      |      |      |      |     |                  |      |      |   |   |   |   |   |   |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                  |      |      |      |      |      |      |      |      |     |                  |      |      |   |   |   |   |   |   |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                   |      |      |      |      |      |      |      |      |     |                   |      |      |      |      |      |      |      |      |     |                   |      |      |      |      |      |      |      |      |     |                   |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                   |      |      |      |      |      |      |      |      |     |                   |      |      |   |   |   |   |   |   |     |
|                                                                                                             | 32 <sup>rd</sup>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | R319 | R318 | R317   | R316      | R315 | R314 | R313 | R312 | F8h     |          |        |     |        |              |                          |     |                         |     |                         |     |    |         |                 |      |      |      |      |      |      |      |      |     |                 |      |      |      |      |      |      |      |      |     |                 |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                  |      |      |      |      |      |      |      |      |     |                  |      |      |   |   |   |   |   |   |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                  |      |      |      |      |      |      |      |      |     |                  |      |      |   |   |   |   |   |   |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                   |      |      |      |      |      |      |      |      |     |                   |      |      |      |      |      |      |      |      |     |                   |      |      |      |      |      |      |      |      |     |                   |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                   |      |      |      |      |      |      |      |      |     |                   |      |      |   |   |   |   |   |   |     |
|                                                                                                             | 33 <sup>rd</sup>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | R329 | R328 | R327   | R326      | R325 | R324 | R323 | R322 | FFh     |          |        |     |        |              |                          |     |                         |     |                         |     |    |         |                 |      |      |      |      |      |      |      |      |     |                 |      |      |      |      |      |      |      |      |     |                 |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                  |      |      |      |      |      |      |      |      |     |                  |      |      |   |   |   |   |   |   |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                  |      |      |      |      |      |      |      |      |     |                  |      |      |   |   |   |   |   |   |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                   |      |      |      |      |      |      |      |      |     |                   |      |      |      |      |      |      |      |      |     |                   |      |      |      |      |      |      |      |      |     |                   |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                   |      |      |      |      |      |      |      |      |     |                   |      |      |   |   |   |   |   |   |     |
|                                                                                                             | 34 <sup>th</sup>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | R001 | R000 | R011   | R010      | R021 | R020 | R031 | R030 | 00h     |          |        |     |        |              |                          |     |                         |     |                         |     |    |         |                 |      |      |      |      |      |      |      |      |     |                 |      |      |      |      |      |      |      |      |     |                 |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                  |      |      |      |      |      |      |      |      |     |                  |      |      |   |   |   |   |   |   |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                  |      |      |      |      |      |      |      |      |     |                  |      |      |   |   |   |   |   |   |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                   |      |      |      |      |      |      |      |      |     |                   |      |      |      |      |      |      |      |      |     |                   |      |      |      |      |      |      |      |      |     |                   |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                   |      |      |      |      |      |      |      |      |     |                   |      |      |   |   |   |   |   |   |     |
|                                                                                                             | 35 <sup>th</sup>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | R041 | R040 | R051   | R050      | R061 | R060 | R071 | R070 | 00h     |          |        |     |        |              |                          |     |                         |     |                         |     |    |         |                 |      |      |      |      |      |      |      |      |     |                 |      |      |      |      |      |      |      |      |     |                 |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                  |      |      |      |      |      |      |      |      |     |                  |      |      |   |   |   |   |   |   |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                  |      |      |      |      |      |      |      |      |     |                  |      |      |   |   |   |   |   |   |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                   |      |      |      |      |      |      |      |      |     |                   |      |      |      |      |      |      |      |      |     |                   |      |      |      |      |      |      |      |      |     |                   |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                   |      |      |      |      |      |      |      |      |     |                   |      |      |   |   |   |   |   |   |     |
|                                                                                                             | ⋮                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | ⋮    | ⋮    | ⋮      | ⋮         | ⋮    | ⋮    | ⋮    | ⋮    | ⋮       |          |        |     |        |              |                          |     |                         |     |                         |     |    |         |                 |      |      |      |      |      |      |      |      |     |                 |      |      |      |      |      |      |      |      |     |                 |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                  |      |      |      |      |      |      |      |      |     |                  |      |      |   |   |   |   |   |   |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                  |      |      |      |      |      |      |      |      |     |                  |      |      |   |   |   |   |   |   |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                   |      |      |      |      |      |      |      |      |     |                   |      |      |      |      |      |      |      |      |     |                   |      |      |      |      |      |      |      |      |     |                   |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                   |      |      |      |      |      |      |      |      |     |                   |      |      |   |   |   |   |   |   |     |
|                                                                                                             | 41 <sup>st</sup>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | R281 | R280 | R291   | R290      | R301 | R300 | R311 | R310 | 00h     |          |        |     |        |              |                          |     |                         |     |                         |     |    |         |                 |      |      |      |      |      |      |      |      |     |                 |      |      |      |      |      |      |      |      |     |                 |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                  |      |      |      |      |      |      |      |      |     |                  |      |      |   |   |   |   |   |   |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                  |      |      |      |      |      |      |      |      |     |                  |      |      |   |   |   |   |   |   |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                   |      |      |      |      |      |      |      |      |     |                   |      |      |      |      |      |      |      |      |     |                   |      |      |      |      |      |      |      |      |     |                   |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                   |      |      |      |      |      |      |      |      |     |                   |      |      |   |   |   |   |   |   |     |
|                                                                                                             | 42 <sup>nd</sup>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | R321 | R320 | 0      | 0         | 0    | 0    | 0    | 0    | 00h     |          |        |     |        |              |                          |     |                         |     |                         |     |    |         |                 |      |      |      |      |      |      |      |      |     |                 |      |      |      |      |      |      |      |      |     |                 |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                  |      |      |      |      |      |      |      |      |     |                  |      |      |   |   |   |   |   |   |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                  |      |      |      |      |      |      |      |      |     |                  |      |      |   |   |   |   |   |   |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                   |      |      |      |      |      |      |      |      |     |                   |      |      |      |      |      |      |      |      |     |                   |      |      |      |      |      |      |      |      |     |                   |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                   |      |      |      |      |      |      |      |      |     |                   |      |      |   |   |   |   |   |   |     |
|                                                                                                             | 43 <sup>rd</sup>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | G009 | G008 | G007   | G006      | G005 | G004 | G003 | G002 | 00h     |          |        |     |        |              |                          |     |                         |     |                         |     |    |         |                 |      |      |      |      |      |      |      |      |     |                 |      |      |      |      |      |      |      |      |     |                 |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                  |      |      |      |      |      |      |      |      |     |                  |      |      |   |   |   |   |   |   |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                  |      |      |      |      |      |      |      |      |     |                  |      |      |   |   |   |   |   |   |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                   |      |      |      |      |      |      |      |      |     |                   |      |      |      |      |      |      |      |      |     |                   |      |      |      |      |      |      |      |      |     |                   |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                   |      |      |      |      |      |      |      |      |     |                   |      |      |   |   |   |   |   |   |     |
|                                                                                                             | 44 <sup>th</sup>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | G019 | G018 | G017   | G016      | G015 | G014 | G013 | G012 | 08h     |          |        |     |        |              |                          |     |                         |     |                         |     |    |         |                 |      |      |      |      |      |      |      |      |     |                 |      |      |      |      |      |      |      |      |     |                 |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                  |      |      |      |      |      |      |      |      |     |                  |      |      |   |   |   |   |   |   |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                  |      |      |      |      |      |      |      |      |     |                  |      |      |   |   |   |   |   |   |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                   |      |      |      |      |      |      |      |      |     |                   |      |      |      |      |      |      |      |      |     |                   |      |      |      |      |      |      |      |      |     |                   |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                   |      |      |      |      |      |      |      |      |     |                   |      |      |   |   |   |   |   |   |     |
|                                                                                                             | 45 <sup>th</sup>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | G029 | G028 | G027   | G026      | G025 | G024 | G023 | G022 | 10h     |          |        |     |        |              |                          |     |                         |     |                         |     |    |         |                 |      |      |      |      |      |      |      |      |     |                 |      |      |      |      |      |      |      |      |     |                 |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                  |      |      |      |      |      |      |      |      |     |                  |      |      |   |   |   |   |   |   |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                  |      |      |      |      |      |      |      |      |     |                  |      |      |   |   |   |   |   |   |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                   |      |      |      |      |      |      |      |      |     |                   |      |      |      |      |      |      |      |      |     |                   |      |      |      |      |      |      |      |      |     |                   |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                   |      |      |      |      |      |      |      |      |     |                   |      |      |   |   |   |   |   |   |     |
|                                                                                                             | ⋮                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | ⋮    | ⋮    | ⋮      | ⋮         | ⋮    | ⋮    | ⋮    | ⋮    | ⋮       |          |        |     |        |              |                          |     |                         |     |                         |     |    |         |                 |      |      |      |      |      |      |      |      |     |                 |      |      |      |      |      |      |      |      |     |                 |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                  |      |      |      |      |      |      |      |      |     |                  |      |      |   |   |   |   |   |   |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                  |      |      |      |      |      |      |      |      |     |                  |      |      |   |   |   |   |   |   |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                   |      |      |      |      |      |      |      |      |     |                   |      |      |      |      |      |      |      |      |     |                   |      |      |      |      |      |      |      |      |     |                   |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                   |      |      |      |      |      |      |      |      |     |                   |      |      |   |   |   |   |   |   |     |
|                                                                                                             | 74 <sup>th</sup>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | G319 | G318 | G317   | G316      | G315 | G314 | G313 | G312 | F8h     |          |        |     |        |              |                          |     |                         |     |                         |     |    |         |                 |      |      |      |      |      |      |      |      |     |                 |      |      |      |      |      |      |      |      |     |                 |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                  |      |      |      |      |      |      |      |      |     |                  |      |      |   |   |   |   |   |   |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                  |      |      |      |      |      |      |      |      |     |                  |      |      |   |   |   |   |   |   |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                   |      |      |      |      |      |      |      |      |     |                   |      |      |      |      |      |      |      |      |     |                   |      |      |      |      |      |      |      |      |     |                   |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                   |      |      |      |      |      |      |      |      |     |                   |      |      |   |   |   |   |   |   |     |
|                                                                                                             | 75 <sup>th</sup>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | G329 | G328 | G327   | G326      | G325 | G324 | G323 | G322 | FFh     |          |        |     |        |              |                          |     |                         |     |                         |     |    |         |                 |      |      |      |      |      |      |      |      |     |                 |      |      |      |      |      |      |      |      |     |                 |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                  |      |      |      |      |      |      |      |      |     |                  |      |      |   |   |   |   |   |   |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                  |      |      |      |      |      |      |      |      |     |                  |      |      |   |   |   |   |   |   |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                   |      |      |      |      |      |      |      |      |     |                   |      |      |      |      |      |      |      |      |     |                   |      |      |      |      |      |      |      |      |     |                   |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                   |      |      |      |      |      |      |      |      |     |                   |      |      |   |   |   |   |   |   |     |
|                                                                                                             | 76 <sup>th</sup>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | G001 | G000 | G011   | G010      | G021 | G020 | G031 | G030 | 00h     |          |        |     |        |              |                          |     |                         |     |                         |     |    |         |                 |      |      |      |      |      |      |      |      |     |                 |      |      |      |      |      |      |      |      |     |                 |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                  |      |      |      |      |      |      |      |      |     |                  |      |      |   |   |   |   |   |   |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                  |      |      |      |      |      |      |      |      |     |                  |      |      |   |   |   |   |   |   |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                   |      |      |      |      |      |      |      |      |     |                   |      |      |      |      |      |      |      |      |     |                   |      |      |      |      |      |      |      |      |     |                   |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                   |      |      |      |      |      |      |      |      |     |                   |      |      |   |   |   |   |   |   |     |
|                                                                                                             | 77 <sup>th</sup>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | G041 | G040 | G051   | G050      | G061 | G060 | G071 | G070 | 00h     |          |        |     |        |              |                          |     |                         |     |                         |     |    |         |                 |      |      |      |      |      |      |      |      |     |                 |      |      |      |      |      |      |      |      |     |                 |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                  |      |      |      |      |      |      |      |      |     |                  |      |      |   |   |   |   |   |   |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                  |      |      |      |      |      |      |      |      |     |                  |      |      |   |   |   |   |   |   |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                   |      |      |      |      |      |      |      |      |     |                   |      |      |      |      |      |      |      |      |     |                   |      |      |      |      |      |      |      |      |     |                   |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                   |      |      |      |      |      |      |      |      |     |                   |      |      |   |   |   |   |   |   |     |
|                                                                                                             | ⋮                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | ⋮    | ⋮    | ⋮      | ⋮         | ⋮    | ⋮    | ⋮    | ⋮    | ⋮       |          |        |     |        |              |                          |     |                         |     |                         |     |    |         |                 |      |      |      |      |      |      |      |      |     |                 |      |      |      |      |      |      |      |      |     |                 |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                  |      |      |      |      |      |      |      |      |     |                  |      |      |   |   |   |   |   |   |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                  |      |      |      |      |      |      |      |      |     |                  |      |      |   |   |   |   |   |   |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                   |      |      |      |      |      |      |      |      |     |                   |      |      |      |      |      |      |      |      |     |                   |      |      |      |      |      |      |      |      |     |                   |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                   |      |      |      |      |      |      |      |      |     |                   |      |      |   |   |   |   |   |   |     |
|                                                                                                             | 83 <sup>rd</sup>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | G281 | G280 | G291   | G290      | G301 | G300 | G311 | G310 | 00h     |          |        |     |        |              |                          |     |                         |     |                         |     |    |         |                 |      |      |      |      |      |      |      |      |     |                 |      |      |      |      |      |      |      |      |     |                 |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                  |      |      |      |      |      |      |      |      |     |                  |      |      |   |   |   |   |   |   |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                  |      |      |      |      |      |      |      |      |     |                  |      |      |   |   |   |   |   |   |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                   |      |      |      |      |      |      |      |      |     |                   |      |      |      |      |      |      |      |      |     |                   |      |      |      |      |      |      |      |      |     |                   |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                   |      |      |      |      |      |      |      |      |     |                   |      |      |   |   |   |   |   |   |     |
|                                                                                                             | 84 <sup>th</sup>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | G321 | G320 | 0      | 0         | 0    | 0    | 0    | 0    | 00h     |          |        |     |        |              |                          |     |                         |     |                         |     |    |         |                 |      |      |      |      |      |      |      |      |     |                 |      |      |      |      |      |      |      |      |     |                 |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                  |      |      |      |      |      |      |      |      |     |                  |      |      |   |   |   |   |   |   |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                  |      |      |      |      |      |      |      |      |     |                  |      |      |   |   |   |   |   |   |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                   |      |      |      |      |      |      |      |      |     |                   |      |      |      |      |      |      |      |      |     |                   |      |      |      |      |      |      |      |      |     |                   |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                   |      |      |      |      |      |      |      |      |     |                   |      |      |   |   |   |   |   |   |     |
|                                                                                                             | 85 <sup>th</sup>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | B009 | B008 | B007   | B006      | B005 | B004 | B003 | B002 | 00h     |          |        |     |        |              |                          |     |                         |     |                         |     |    |         |                 |      |      |      |      |      |      |      |      |     |                 |      |      |      |      |      |      |      |      |     |                 |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                  |      |      |      |      |      |      |      |      |     |                  |      |      |   |   |   |   |   |   |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                  |      |      |      |      |      |      |      |      |     |                  |      |      |   |   |   |   |   |   |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                   |      |      |      |      |      |      |      |      |     |                   |      |      |      |      |      |      |      |      |     |                   |      |      |      |      |      |      |      |      |     |                   |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                   |      |      |      |      |      |      |      |      |     |                   |      |      |   |   |   |   |   |   |     |
|                                                                                                             | 86 <sup>th</sup>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | B019 | B018 | B017   | B016      | B015 | B014 | B013 | B012 | 08h     |          |        |     |        |              |                          |     |                         |     |                         |     |    |         |                 |      |      |      |      |      |      |      |      |     |                 |      |      |      |      |      |      |      |      |     |                 |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                  |      |      |      |      |      |      |      |      |     |                  |      |      |   |   |   |   |   |   |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                  |      |      |      |      |      |      |      |      |     |                  |      |      |   |   |   |   |   |   |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                   |      |      |      |      |      |      |      |      |     |                   |      |      |      |      |      |      |      |      |     |                   |      |      |      |      |      |      |      |      |     |                   |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                   |      |      |      |      |      |      |      |      |     |                   |      |      |   |   |   |   |   |   |     |
| 87 <sup>th</sup>                                                                                            | B029                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | B028 | B027 | B026   | B025      | B024 | B023 | B022 | 10h  |         |          |        |     |        |              |                          |     |                         |     |                         |     |    |         |                 |      |      |      |      |      |      |      |      |     |                 |      |      |      |      |      |      |      |      |     |                 |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                  |      |      |      |      |      |      |      |      |     |                  |      |      |   |   |   |   |   |   |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                  |      |      |      |      |      |      |      |      |     |                  |      |      |   |   |   |   |   |   |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                   |      |      |      |      |      |      |      |      |     |                   |      |      |      |      |      |      |      |      |     |                   |      |      |      |      |      |      |      |      |     |                   |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                   |      |      |      |      |      |      |      |      |     |                   |      |      |   |   |   |   |   |   |     |
| ⋮                                                                                                           | ⋮                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | ⋮    | ⋮    | ⋮      | ⋮         | ⋮    | ⋮    | ⋮    | ⋮    |         |          |        |     |        |              |                          |     |                         |     |                         |     |    |         |                 |      |      |      |      |      |      |      |      |     |                 |      |      |      |      |      |      |      |      |     |                 |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                  |      |      |      |      |      |      |      |      |     |                  |      |      |   |   |   |   |   |   |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                  |      |      |      |      |      |      |      |      |     |                  |      |      |   |   |   |   |   |   |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                   |      |      |      |      |      |      |      |      |     |                   |      |      |      |      |      |      |      |      |     |                   |      |      |      |      |      |      |      |      |     |                   |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                   |      |      |      |      |      |      |      |      |     |                   |      |      |   |   |   |   |   |   |     |
| 116 <sup>th</sup>                                                                                           | B319                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | B318 | B317 | B316   | B315      | B314 | B313 | B312 | F8h  |         |          |        |     |        |              |                          |     |                         |     |                         |     |    |         |                 |      |      |      |      |      |      |      |      |     |                 |      |      |      |      |      |      |      |      |     |                 |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                  |      |      |      |      |      |      |      |      |     |                  |      |      |   |   |   |   |   |   |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                  |      |      |      |      |      |      |      |      |     |                  |      |      |   |   |   |   |   |   |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                   |      |      |      |      |      |      |      |      |     |                   |      |      |      |      |      |      |      |      |     |                   |      |      |      |      |      |      |      |      |     |                   |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                   |      |      |      |      |      |      |      |      |     |                   |      |      |   |   |   |   |   |   |     |
| 117 <sup>th</sup>                                                                                           | B329                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | B328 | B327 | B326   | B325      | B324 | B323 | B322 | FFh  |         |          |        |     |        |              |                          |     |                         |     |                         |     |    |         |                 |      |      |      |      |      |      |      |      |     |                 |      |      |      |      |      |      |      |      |     |                 |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                  |      |      |      |      |      |      |      |      |     |                  |      |      |   |   |   |   |   |   |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                  |      |      |      |      |      |      |      |      |     |                  |      |      |   |   |   |   |   |   |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                   |      |      |      |      |      |      |      |      |     |                   |      |      |      |      |      |      |      |      |     |                   |      |      |      |      |      |      |      |      |     |                   |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                   |      |      |      |      |      |      |      |      |     |                   |      |      |   |   |   |   |   |   |     |
| 118 <sup>th</sup>                                                                                           | B001                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | B000 | B011 | B010   | B021      | B020 | B031 | B030 | 00h  |         |          |        |     |        |              |                          |     |                         |     |                         |     |    |         |                 |      |      |      |      |      |      |      |      |     |                 |      |      |      |      |      |      |      |      |     |                 |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                  |      |      |      |      |      |      |      |      |     |                  |      |      |   |   |   |   |   |   |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                  |      |      |      |      |      |      |      |      |     |                  |      |      |   |   |   |   |   |   |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                   |      |      |      |      |      |      |      |      |     |                   |      |      |      |      |      |      |      |      |     |                   |      |      |      |      |      |      |      |      |     |                   |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                   |      |      |      |      |      |      |      |      |     |                   |      |      |   |   |   |   |   |   |     |
| 119 <sup>th</sup>                                                                                           | B041                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | B040 | B051 | B050   | B061      | B060 | B071 | B070 | 00h  |         |          |        |     |        |              |                          |     |                         |     |                         |     |    |         |                 |      |      |      |      |      |      |      |      |     |                 |      |      |      |      |      |      |      |      |     |                 |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                  |      |      |      |      |      |      |      |      |     |                  |      |      |   |   |   |   |   |   |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                  |      |      |      |      |      |      |      |      |     |                  |      |      |   |   |   |   |   |   |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                   |      |      |      |      |      |      |      |      |     |                   |      |      |      |      |      |      |      |      |     |                   |      |      |      |      |      |      |      |      |     |                   |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                   |      |      |      |      |      |      |      |      |     |                   |      |      |   |   |   |   |   |   |     |
| ⋮                                                                                                           | ⋮                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | ⋮    | ⋮    | ⋮      | ⋮         | ⋮    | ⋮    | ⋮    | ⋮    |         |          |        |     |        |              |                          |     |                         |     |                         |     |    |         |                 |      |      |      |      |      |      |      |      |     |                 |      |      |      |      |      |      |      |      |     |                 |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                  |      |      |      |      |      |      |      |      |     |                  |      |      |   |   |   |   |   |   |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                  |      |      |      |      |      |      |      |      |     |                  |      |      |   |   |   |   |   |   |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                   |      |      |      |      |      |      |      |      |     |                   |      |      |      |      |      |      |      |      |     |                   |      |      |      |      |      |      |      |      |     |                   |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                   |      |      |      |      |      |      |      |      |     |                   |      |      |   |   |   |   |   |   |     |
| 125 <sup>th</sup>                                                                                           | B281                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | B280 | B291 | B290   | B301      | B300 | B311 | B310 | 00h  |         |          |        |     |        |              |                          |     |                         |     |                         |     |    |         |                 |      |      |      |      |      |      |      |      |     |                 |      |      |      |      |      |      |      |      |     |                 |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                  |      |      |      |      |      |      |      |      |     |                  |      |      |   |   |   |   |   |   |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                  |      |      |      |      |      |      |      |      |     |                  |      |      |   |   |   |   |   |   |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                   |      |      |      |      |      |      |      |      |     |                   |      |      |      |      |      |      |      |      |     |                   |      |      |      |      |      |      |      |      |     |                   |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                   |      |      |      |      |      |      |      |      |     |                   |      |      |   |   |   |   |   |   |     |
| 126 <sup>th</sup>                                                                                           | B321                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | B320 | 0    | 0      | 0         | 0    | 0    | 0    | 00h  |         |          |        |     |        |              |                          |     |                         |     |                         |     |    |         |                 |      |      |      |      |      |      |      |      |     |                 |      |      |      |      |      |      |      |      |     |                 |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                  |      |      |      |      |      |      |      |      |     |                  |      |      |   |   |   |   |   |   |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                  |      |      |      |      |      |      |      |      |     |                  |      |      |   |   |   |   |   |   |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                   |      |      |      |      |      |      |      |      |     |                   |      |      |      |      |      |      |      |      |     |                   |      |      |      |      |      |      |      |      |     |                   |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                   |      |      |      |      |      |      |      |      |     |                   |      |      |   |   |   |   |   |   |     |
| Write D1[7:0] (R 1st), D43[7:0] (G 1st) and D85[7:0] (B 1st), but Read is from D1[7:0], D2[7:0] and D3[7:0] |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |      |      |        |           |      |      |      |      |         |          |        |     |        |              |                          |     |                         |     |                         |     |    |         |                 |      |      |      |      |      |      |      |      |     |                 |      |      |      |      |      |      |      |      |     |                 |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                  |      |      |      |      |      |      |      |      |     |                  |      |      |   |   |   |   |   |   |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                  |      |      |      |      |      |      |      |      |     |                  |      |      |   |   |   |   |   |   |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                   |      |      |      |      |      |      |      |      |     |                   |      |      |      |      |      |      |      |      |     |                   |      |      |      |      |      |      |      |      |     |                   |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                   |      |      |      |      |      |      |      |      |     |                   |      |      |   |   |   |   |   |   |     |
| Restrictions                                                                                                | SETEXTC turn on to enable this command.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |      |      |        |           |      |      |      |      |         |          |        |     |        |              |                          |     |                         |     |                         |     |    |         |                 |      |      |      |      |      |      |      |      |     |                 |      |      |      |      |      |      |      |      |     |                 |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                  |      |      |      |      |      |      |      |      |     |                  |      |      |   |   |   |   |   |   |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                  |      |      |      |      |      |      |      |      |     |                  |      |      |   |   |   |   |   |   |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                   |      |      |      |      |      |      |      |      |     |                   |      |      |      |      |      |      |      |      |     |                   |      |      |      |      |      |      |      |      |     |                   |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                   |      |      |      |      |      |      |      |      |     |                   |      |      |   |   |   |   |   |   |     |
| Register Availability                                                                                       | <table><tr><th>Status</th><th>Availability</th></tr><tr><td>Idle Mode Off, Sleep Out</td><td>Yes</td></tr><tr><td>Idle Mode On, Sleep Out</td><td>Yes</td></tr><tr><td>Sleep In or Booster Off</td><td>Yes</td></tr></table>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |      |      |        |           |      |      |      |      |         |          |        |     | Status | Availability | Idle Mode Off, Sleep Out | Yes | Idle Mode On, Sleep Out | Yes | Sleep In or Booster Off | Yes |    |         |                 |      |      |      |      |      |      |      |      |     |                 |      |      |      |      |      |      |      |      |     |                 |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                  |      |      |      |      |      |      |      |      |     |                  |      |      |   |   |   |   |   |   |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                  |      |      |      |      |      |      |      |      |     |                  |      |      |   |   |   |   |   |   |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                   |      |      |      |      |      |      |      |      |     |                   |      |      |      |      |      |      |      |      |     |                   |      |      |      |      |      |      |      |      |     |                   |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                   |      |      |      |      |      |      |      |      |     |                   |      |      |   |   |   |   |   |   |     |
| Status                                                                                                      | Availability                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |      |      |        |           |      |      |      |      |         |          |        |     |        |              |                          |     |                         |     |                         |     |    |         |                 |      |      |      |      |      |      |      |      |     |                 |      |      |      |      |      |      |      |      |     |                 |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                  |      |      |      |      |      |      |      |      |     |                  |      |      |   |   |   |   |   |   |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                  |      |      |      |      |      |      |      |      |     |                  |      |      |   |   |   |   |   |   |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                   |      |      |      |      |      |      |      |      |     |                   |      |      |      |      |      |      |      |      |     |                   |      |      |      |      |      |      |      |      |     |                   |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                   |      |      |      |      |      |      |      |      |     |                   |      |      |   |   |   |   |   |   |     |
| Idle Mode Off, Sleep Out                                                                                    | Yes                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |      |      |        |           |      |      |      |      |         |          |        |     |        |              |                          |     |                         |     |                         |     |    |         |                 |      |      |      |      |      |      |      |      |     |                 |      |      |      |      |      |      |      |      |     |                 |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                  |      |      |      |      |      |      |      |      |     |                  |      |      |   |   |   |   |   |   |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                  |      |      |      |      |      |      |      |      |     |                  |      |      |   |   |   |   |   |   |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                   |      |      |      |      |      |      |      |      |     |                   |      |      |      |      |      |      |      |      |     |                   |      |      |      |      |      |      |      |      |     |                   |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                   |      |      |      |      |      |      |      |      |     |                   |      |      |   |   |   |   |   |   |     |
| Idle Mode On, Sleep Out                                                                                     | Yes                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |      |      |        |           |      |      |      |      |         |          |        |     |        |              |                          |     |                         |     |                         |     |    |         |                 |      |      |      |      |      |      |      |      |     |                 |      |      |      |      |      |      |      |      |     |                 |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                  |      |      |      |      |      |      |      |      |     |                  |      |      |   |   |   |   |   |   |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                  |      |      |      |      |      |      |      |      |     |                  |      |      |   |   |   |   |   |   |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                   |      |      |      |      |      |      |      |      |     |                   |      |      |      |      |      |      |      |      |     |                   |      |      |      |      |      |      |      |      |     |                   |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                   |      |      |      |      |      |      |      |      |     |                   |      |      |   |   |   |   |   |   |     |
| Sleep In or Booster Off                                                                                     | Yes                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |      |      |        |           |      |      |      |      |         |          |        |     |        |              |                          |     |                         |     |                         |     |    |         |                 |      |      |      |      |      |      |      |      |     |                 |      |      |      |      |      |      |      |      |     |                 |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                  |      |      |      |      |      |      |      |      |     |                  |      |      |   |   |   |   |   |   |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                  |      |      |      |      |      |      |      |      |     |                  |      |      |   |   |   |   |   |   |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |                  |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                   |      |      |      |      |      |      |      |      |     |                   |      |      |      |      |      |      |      |      |     |                   |      |      |      |      |      |      |      |      |     |                   |      |      |      |      |      |      |      |      |     |   |   |   |   |   |   |   |   |   |   |                   |      |      |      |      |      |      |      |      |     |                   |      |      |   |   |   |   |   |   |     |

|         | Status                                      | Default value                           | OTP value                               |  |
|---------|---------------------------------------------|-----------------------------------------|-----------------------------------------|--|
|         | Power On Sequence<br>S/W Reset<br>H/W Reset | DITH_OPT<br>DGC_EN<br>D1[7:0]~D126[7:0] | DITH_OPT<br>DGC_EN<br>D1[7:0]~D126[7:0] |  |
| Default |                                             |                                         |                                         |  |

Himax Confidential  
Do Not Copy



## 6.2.64 SETID: Set ID (C3h)

| C3H                       | SETID ( Set ID)                                          |     |                 |                 |          |          |                              |    |    |    |    |    |     |
|---------------------------|----------------------------------------------------------|-----|-----------------|-----------------|----------|----------|------------------------------|----|----|----|----|----|-----|
|                           | DNC                                                      | NRD | NWR             | D15-D8          | D7       | D6       | D5                           | D4 | D3 | D2 | D1 | D0 | HEX |
| Command                   | 0                                                        | 1   | ↑               | -               | 1        | 1        | 0                            | 0  | 0  | 0  | 1  | 1  | C3  |
| 1 <sup>st</sup> parameter | 1                                                        | 1   | ↑               | -               | ID1[7:0] |          |                              |    |    |    |    |    | -   |
| 2 <sup>nd</sup> parameter | 1                                                        | 1   | ↑               | -               | 0        | ID2[6:0] |                              |    |    |    |    |    | -   |
| 3 <sup>rd</sup> parameter | 1                                                        | 1   | ↑               | -               | ID3[7:0] |          |                              |    |    |    |    |    | -   |
| Description               | This command is used to set ID (RDAh, RDBh, RDCh) value. |     |                 |                 |          |          |                              |    |    |    |    |    |     |
| Restrictions              | SETEXTC turn on to enable this command.                  |     |                 |                 |          |          |                              |    |    |    |    |    |     |
| Register Availability     | Status                                                   |     |                 |                 |          |          | Availability                 |    |    |    |    |    |     |
|                           | Normal Mode On, Idle Mode Off, Sleep Out                 |     |                 |                 |          |          | Yes                          |    |    |    |    |    |     |
|                           | Normal Mode On, Idle Mode On, Sleep Out                  |     |                 |                 |          |          | Yes                          |    |    |    |    |    |     |
|                           | Partial Mode On, Idle Mode Off, Sleep Out                |     |                 |                 |          |          | Yes                          |    |    |    |    |    |     |
|                           | Partial Mode On, Idle Mode On, Sleep Out                 |     |                 |                 |          |          | Yes                          |    |    |    |    |    |     |
|                           | Sleep In                                                 |     |                 |                 |          |          | Yes                          |    |    |    |    |    |     |
| Default                   | Status                                                   |     |                 | Default value   |          |          | OTP value                    |    |    |    |    |    |     |
|                           | Power On Sequence                                        |     |                 | ID1[7:0]=0x00h, |          |          | ID1[7:0], ID2[6:0], ID3[7:0] |    |    |    |    |    |     |
|                           | S/W Reset                                                |     |                 | ID2[6:0]=0x00h, |          |          |                              |    |    |    |    |    |     |
| H/W Reset                 |                                                          |     | ID3[7:0]=0x00h, |                 |          |          |                              |    |    |    |    |    |     |

## 6.2.65 SETCABC: Set CABC Control (C9h)

| C9H                                                            | SETCABC (Set CABC Control)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |     |     |                          |                  |                 |                    |                     |               |                     |              |                   |     |                 |  |  |                          |   |   |   |             |   |   |   |             |   |   |   |             |   |   |   |             |   |   |   |              |   |   |   |              |   |   |   |              |   |   |   |               |
|----------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|-----|--------------------------|------------------|-----------------|--------------------|---------------------|---------------|---------------------|--------------|-------------------|-----|-----------------|--|--|--------------------------|---|---|---|-------------|---|---|---|-------------|---|---|---|-------------|---|---|---|-------------|---|---|---|--------------|---|---|---|--------------|---|---|---|--------------|---|---|---|---------------|
|                                                                | DNC                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | NRD | NWR | D15-D8                   | D7               | D6              | D5                 | D4                  | D3            | D2                  | D1           | D0                | HEX |                 |  |  |                          |   |   |   |             |   |   |   |             |   |   |   |             |   |   |   |             |   |   |   |              |   |   |   |              |   |   |   |              |   |   |   |               |
| Command                                                        | 0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 1   | ↑   | -                        | 1                | 1               | 0                  | 0                   | 1             | 0                   | 0            | 1                 | C9  |                 |  |  |                          |   |   |   |             |   |   |   |             |   |   |   |             |   |   |   |             |   |   |   |              |   |   |   |              |   |   |   |              |   |   |   |               |
| 1 <sup>st</sup> parameter                                      | 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 1   | ↑   | -                        | -                | -               | EN_DI<br>M_MI<br>X | EN_C<br>OST<br>MEAN | EN_C<br>OST   | EN_N<br>LN_G<br>AIN | EN_J<br>UDGE | EN_T<br>EMP       | -   |                 |  |  |                          |   |   |   |             |   |   |   |             |   |   |   |             |   |   |   |             |   |   |   |              |   |   |   |              |   |   |   |              |   |   |   |               |
| 2 <sup>nd</sup> parameter                                      | 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 1   | ↑   | -                        | CABC<br>_DD      | SAVEPOWER[6:0]  |                    |                     |               |                     |              |                   | -   |                 |  |  |                          |   |   |   |             |   |   |   |             |   |   |   |             |   |   |   |             |   |   |   |              |   |   |   |              |   |   |   |              |   |   |   |               |
| 3 <sup>rd</sup> parameter                                      | 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 1   | ↑   | -                        | MEAN_OFFSET[7:0] |                 |                    |                     |               |                     |              | -                 |     |                 |  |  |                          |   |   |   |             |   |   |   |             |   |   |   |             |   |   |   |             |   |   |   |              |   |   |   |              |   |   |   |              |   |   |   |               |
| 4 <sup>th</sup> parameter                                      | 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 1   | ↑   | -                        | -                | -               | -                  | -                   | CABC_FLM[3:0] |                     |              |                   | -   |                 |  |  |                          |   |   |   |             |   |   |   |             |   |   |   |             |   |   |   |             |   |   |   |              |   |   |   |              |   |   |   |              |   |   |   |               |
| 5 <sup>th</sup> parameter                                      | 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 1   | ↑   | -                        | -                | SEL_PWMCLK[2:0] |                    |                     | SEL_GAIN[1:0] |                     | INVP<br>ULS  | SEL<br>BLDU<br>TY | -   |                 |  |  |                          |   |   |   |             |   |   |   |             |   |   |   |             |   |   |   |             |   |   |   |              |   |   |   |              |   |   |   |              |   |   |   |               |
| 6 <sup>th</sup> parameter                                      | 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 1   | ↑   | -                        | PWM_PERIOD[7:0]  |                 |                    |                     |               |                     |              | -                 |     |                 |  |  |                          |   |   |   |             |   |   |   |             |   |   |   |             |   |   |   |             |   |   |   |              |   |   |   |              |   |   |   |              |   |   |   |               |
| 7 <sup>th</sup> parameter                                      | 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 1   | ↑   | -                        | -                | DIM_FRAME[6:0]  |                    |                     |               |                     |              |                   | -   |                 |  |  |                          |   |   |   |             |   |   |   |             |   |   |   |             |   |   |   |             |   |   |   |              |   |   |   |              |   |   |   |              |   |   |   |               |
| 8 <sup>th</sup> parameter                                      | 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 1   | ↑   | -                        | CABC_STEP[7:0]   |                 |                    |                     |               |                     |              | -                 |     |                 |  |  |                          |   |   |   |             |   |   |   |             |   |   |   |             |   |   |   |             |   |   |   |              |   |   |   |              |   |   |   |              |   |   |   |               |
| 9 <sup>th</sup> parameter                                      | 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 1   | ↑   | -                        | CABC_CLKEN[7:0]  |                 |                    |                     |               |                     |              | -                 |     |                 |  |  |                          |   |   |   |             |   |   |   |             |   |   |   |             |   |   |   |             |   |   |   |              |   |   |   |              |   |   |   |              |   |   |   |               |
| Description                                                    | This command is used to set CABC function.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |     |     |                          |                  |                 |                    |                     |               |                     |              |                   |     |                 |  |  |                          |   |   |   |             |   |   |   |             |   |   |   |             |   |   |   |             |   |   |   |              |   |   |   |              |   |   |   |              |   |   |   |               |
|                                                                | <b>INVPULS:</b> The backlight PWM output polarity select.<br>‘0’, The backlight PWM output is low level active.<br>‘1’, The backlight PWM output is high level active.                                                                                                                                                                                                                                                                                                                                                                                                                                                   |     |     |                          |                  |                 |                    |                     |               |                     |              |                   |     |                 |  |  |                          |   |   |   |             |   |   |   |             |   |   |   |             |   |   |   |             |   |   |   |              |   |   |   |              |   |   |   |              |   |   |   |               |
|                                                                | <b>SEL_BLDUTY :</b> The backlight PWM output duty on/off control when CABC operated.<br>‘0’, The backlight PWM output duty is 100%.<br>‘1’, The backlight PWM output duty is calculated from CABC operation.                                                                                                                                                                                                                                                                                                                                                                                                             |     |     |                          |                  |                 |                    |                     |               |                     |              |                   |     |                 |  |  |                          |   |   |   |             |   |   |   |             |   |   |   |             |   |   |   |             |   |   |   |              |   |   |   |              |   |   |   |              |   |   |   |               |
|                                                                | <b>SEL_PWMCLK[2:0] :</b> Internal PWM_CLK divider for CABC clock.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |     |     |                          |                  |                 |                    |                     |               |                     |              |                   |     |                 |  |  |                          |   |   |   |             |   |   |   |             |   |   |   |             |   |   |   |             |   |   |   |              |   |   |   |              |   |   |   |              |   |   |   |               |
|                                                                | <table><thead><tr><th colspan="3">SEL_PWMCLK[2:0]</th><th>Brightness Control Clock</th></tr></thead><tbody><tr><td>0</td><td>0</td><td>0</td><td>PWM_CLK / 1</td></tr><tr><td>0</td><td>0</td><td>1</td><td>PWM_CLK / 2</td></tr><tr><td>0</td><td>1</td><td>0</td><td>PWM_CLK / 4</td></tr><tr><td>0</td><td>1</td><td>1</td><td>PWM_CLK / 8</td></tr><tr><td>1</td><td>0</td><td>0</td><td>PWM_CLK / 16</td></tr><tr><td>1</td><td>0</td><td>1</td><td>PWM_CLK / 32</td></tr><tr><td>1</td><td>1</td><td>0</td><td>PWM_CLK / 64</td></tr><tr><td>1</td><td>1</td><td>1</td><td>PWM_CLK / 128</td></tr></tbody></table> |     |     |                          |                  |                 |                    |                     |               |                     |              |                   |     | SEL_PWMCLK[2:0] |  |  | Brightness Control Clock | 0 | 0 | 0 | PWM_CLK / 1 | 0 | 0 | 1 | PWM_CLK / 2 | 0 | 1 | 0 | PWM_CLK / 4 | 0 | 1 | 1 | PWM_CLK / 8 | 1 | 0 | 0 | PWM_CLK / 16 | 1 | 0 | 1 | PWM_CLK / 32 | 1 | 1 | 0 | PWM_CLK / 64 | 1 | 1 | 1 | PWM_CLK / 128 |
|                                                                | SEL_PWMCLK[2:0]                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |     |     | Brightness Control Clock |                  |                 |                    |                     |               |                     |              |                   |     |                 |  |  |                          |   |   |   |             |   |   |   |             |   |   |   |             |   |   |   |             |   |   |   |              |   |   |   |              |   |   |   |              |   |   |   |               |
|                                                                | 0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 0   | 0   | PWM_CLK / 1              |                  |                 |                    |                     |               |                     |              |                   |     |                 |  |  |                          |   |   |   |             |   |   |   |             |   |   |   |             |   |   |   |             |   |   |   |              |   |   |   |              |   |   |   |              |   |   |   |               |
|                                                                | 0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 0   | 1   | PWM_CLK / 2              |                  |                 |                    |                     |               |                     |              |                   |     |                 |  |  |                          |   |   |   |             |   |   |   |             |   |   |   |             |   |   |   |             |   |   |   |              |   |   |   |              |   |   |   |              |   |   |   |               |
|                                                                | 0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 1   | 0   | PWM_CLK / 4              |                  |                 |                    |                     |               |                     |              |                   |     |                 |  |  |                          |   |   |   |             |   |   |   |             |   |   |   |             |   |   |   |             |   |   |   |              |   |   |   |              |   |   |   |              |   |   |   |               |
|                                                                | 0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 1   | 1   | PWM_CLK / 8              |                  |                 |                    |                     |               |                     |              |                   |     |                 |  |  |                          |   |   |   |             |   |   |   |             |   |   |   |             |   |   |   |             |   |   |   |              |   |   |   |              |   |   |   |              |   |   |   |               |
|                                                                | 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 0   | 0   | PWM_CLK / 16             |                  |                 |                    |                     |               |                     |              |                   |     |                 |  |  |                          |   |   |   |             |   |   |   |             |   |   |   |             |   |   |   |             |   |   |   |              |   |   |   |              |   |   |   |              |   |   |   |               |
|                                                                | 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 0   | 1   | PWM_CLK / 32             |                  |                 |                    |                     |               |                     |              |                   |     |                 |  |  |                          |   |   |   |             |   |   |   |             |   |   |   |             |   |   |   |             |   |   |   |              |   |   |   |              |   |   |   |              |   |   |   |               |
|                                                                | 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 1   | 0   | PWM_CLK / 64             |                  |                 |                    |                     |               |                     |              |                   |     |                 |  |  |                          |   |   |   |             |   |   |   |             |   |   |   |             |   |   |   |             |   |   |   |              |   |   |   |              |   |   |   |              |   |   |   |               |
|                                                                | 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 1   | 1   | PWM_CLK / 128            |                  |                 |                    |                     |               |                     |              |                   |     |                 |  |  |                          |   |   |   |             |   |   |   |             |   |   |   |             |   |   |   |             |   |   |   |              |   |   |   |              |   |   |   |              |   |   |   |               |
|                                                                | <b>SEL_GAIN[1:0]:</b> CABC gain select. Internal use and not Open. Please set to “11”.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |     |     |                          |                  |                 |                    |                     |               |                     |              |                   |     |                 |  |  |                          |   |   |   |             |   |   |   |             |   |   |   |             |   |   |   |             |   |   |   |              |   |   |   |              |   |   |   |              |   |   |   |               |
|                                                                | <b>PWM_PERIOD[7:0] :</b> The backlight PWM output period setting.<br>Backlight PWM output period<br>= 1 / (PWM_CLK / clock divider (SEL_PWMCLK[2:0] )) x (255x(PWM_PERIOD[7:0])).                                                                                                                                                                                                                                                                                                                                                                                                                                        |     |     |                          |                  |                 |                    |                     |               |                     |              |                   |     |                 |  |  |                          |   |   |   |             |   |   |   |             |   |   |   |             |   |   |   |             |   |   |   |              |   |   |   |              |   |   |   |              |   |   |   |               |
|                                                                | <b>SAVEPOWER[6:0] :</b> Minimum CABC gain / maximum CABC duty output select.<br>To define the minimum gain or maximum duty of CABC block output.<br>If not used, please set to"0000000".                                                                                                                                                                                                                                                                                                                                                                                                                                 |     |     |                          |                  |                 |                    |                     |               |                     |              |                   |     |                 |  |  |                          |   |   |   |             |   |   |   |             |   |   |   |             |   |   |   |             |   |   |   |              |   |   |   |              |   |   |   |              |   |   |   |               |
| <b>CABC_DD:</b> Internal use and not open.                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |     |     |                          |                  |                 |                    |                     |               |                     |              |                   |     |                 |  |  |                          |   |   |   |             |   |   |   |             |   |   |   |             |   |   |   |             |   |   |   |              |   |   |   |              |   |   |   |              |   |   |   |               |
| <b>MEAN_OFFSET[7:0]:</b> Internal use, not open.               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |     |     |                          |                  |                 |                    |                     |               |                     |              |                   |     |                 |  |  |                          |   |   |   |             |   |   |   |             |   |   |   |             |   |   |   |             |   |   |   |              |   |   |   |              |   |   |   |              |   |   |   |               |
| <b>CABC_FLM[3:0]:</b> CABC dimming frame number for each step. |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |     |     |                          |                  |                 |                    |                     |               |                     |              |                   |     |                 |  |  |                          |   |   |   |             |   |   |   |             |   |   |   |             |   |   |   |             |   |   |   |              |   |   |   |              |   |   |   |              |   |   |   |               |
| <b>CABC_STEP[7:0]:</b> Internal use and not open.              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |     |     |                          |                  |                 |                    |                     |               |                     |              |                   |     |                 |  |  |                          |   |   |   |             |   |   |   |             |   |   |   |             |   |   |   |             |   |   |   |              |   |   |   |              |   |   |   |              |   |   |   |               |
| <b>CABC_CLKEN[7:0]:</b> Internal use and not open.             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |     |     |                          |                  |                 |                    |                     |               |                     |              |                   |     |                 |  |  |                          |   |   |   |             |   |   |   |             |   |   |   |             |   |   |   |             |   |   |   |              |   |   |   |              |   |   |   |              |   |   |   |               |

|                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                                                                               |
|-----------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------|
|                       | <p><b>DIM_FRAME[6:0]:</b> Manual brightness setting dimming period.</p> <p><b>EN_DIM_MIX:</b> Internal use and not open. Please set to "1".</p> <p><b>EN_COST_MAIN:</b> Internal use and not open. Please set to "1".</p> <p><b>EN_COST:</b> Internal use and not open. Please set to "1".</p> <p><b>EN_NLN_GAIN:</b> Internal use and not open. Please set to "1".</p> <p><b>EN_JUDGE:</b> Internal use and not open. Please set to "1".</p> <p><b>EN_TEMP:</b> Internal use and not open. Please set to "0".</p> |                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                                                                               |
| Restrictions          | SETEXTC turn on to enable this command.                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                                                                               |
| Register Availability | Status                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                                                                                                                                                                                                                                                                                                               | Availability                                                                                                                                  |
|                       | Normal Mode On, Idle Mode Off, Sleep Out                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                                                                                                                                                                                                                                                                                                                                                                               | Yes                                                                                                                                           |
|                       | Normal Mode On, Idle Mode On, Sleep Out                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                                                                                                                                                                                                                                                                                                                                                               | Yes                                                                                                                                           |
|                       | Partial Mode On, Idle Mode Off, Sleep Out                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                                                                                                                                                                                                                                                                               | Yes                                                                                                                                           |
|                       | Partial Mode On, Idle Mode On, Sleep Out                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                                                                                                                                                                                                                                                                                                                                                                               | Yes                                                                                                                                           |
|                       | Sleep In                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                                                                                                                                                                                                                                                                                                                                                                               | Yes                                                                                                                                           |
| Default               | Status                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Default value                                                                                                                                                                                                                                                                                                                                                                                 | OTP value                                                                                                                                     |
|                       | Power On Sequence<br>S/W Reset<br>H/W Reset                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | EN_DIM_MIX =1,<br>EN_COST_MEAN =1,<br>EN_COST =1,<br>EN_NLN_GAIN =1,<br>EN_JUDGE =1,<br>EN_TEMP =0,<br>CABCD_DD =0,<br>SAVEPOWER[6:0] =0x00h<br>MEAN_OFFSET[7:0] =0x00h<br>CABCD_FLM[3:0] = 0001,<br>SEL_PWMCLK[2:0] =010,<br>SEL_GAIN[1:0] =11,<br>INVPULS =1,<br>SEL_BLDUTY =1,<br>PWM_PERIOD[7:0] =0x2Bh,<br>DIM_FRAME[6:0] =0x1Eh,<br>CABCD_STEP[7:0] =0x1Eh,<br>CABCD_CLKEBN[7:0] =0x00h | SEL_PWMCLK[2:0],<br>SEL_GAIN[1:0],<br>INVPULS,<br>SEL_BLDUTY,<br>PWM_PERIOD[7:0],<br>DIM_FRAME[6:0],<br>CABCD_STEP[7:0],<br>CABCD_CLKEBN[7:0] |

## 6.2.66 SETPANEL (CCh)

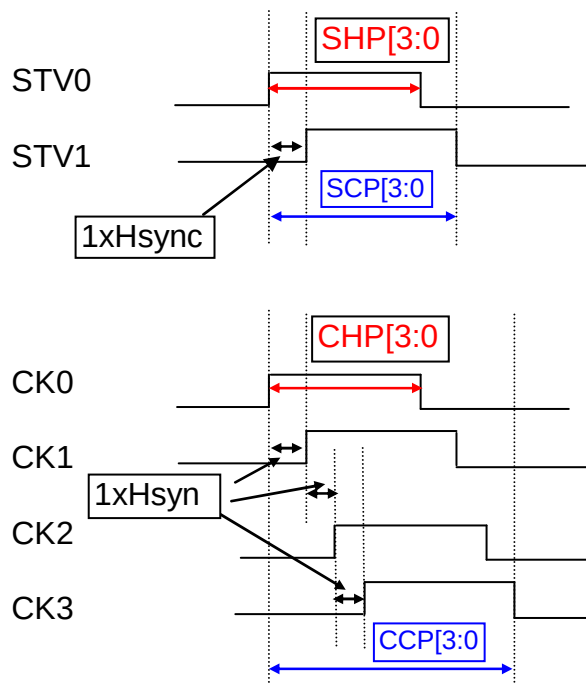
| CCH                       | SETPANEL( Set panel related register)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |     |     |        |               |    |    |    |                     |    |           |           |     |
|---------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|-----|--------|---------------|----|----|----|---------------------|----|-----------|-----------|-----|
|                           | DNC                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | NRD | NWR | D15-D8 | D7            | D6 | D5 | D4 | D3                  | D2 | D1        | D0        | HEX |
| Command                   | 0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 1   | ↑   | -      | 1             | 1  | 0  | 0  | 1                   | 1  | 0         | 0         | CC  |
| 1 <sup>st</sup> parameter | 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 1   | ↑   | -      | -             | -  | -  | -  | SS_PANEL            | -  | REV_PANEL | BGR_PANEL | -   |
| Description0              | <p>This command is used to set setting of panel related register and make panel module meets below spec from viewpoint of user</p> <p><b>BGR_PANEL:</b> The order of &lt;R&gt;&lt;G&gt;&lt;B&gt; dot color for module supplier, default value is stored in OTP. If color filter of panel is &lt;B&gt;&lt;G&gt;&lt;R&gt; type, setting BGR_PANEL = 1, if color filter of panel is &lt;R&gt;&lt;G&gt;&lt;B&gt; type, setting BGR_PANEL = 0. This bit is to make panel module look like a &lt;R&gt;&lt;G&gt;&lt;B&gt; type panel form the user viewpoint.</p> <p><b>SS_PANEL:</b> Specify the shift direction of source driver output. When SS_PANEL = 0, the shift direction from S1 to S1440 When SS_PANEL = 1, the shift direction from S1440 to S1.</p> <p><b>REV_PANEL:</b> Select the inversion of the display of all characters and graphics. This setting allows the display of the same data on both normally-white and normally-black panels.</p> <p>REV_PANEL = 0 normal-white panel<br/>REV_PANEL = 1 normal-black panel</p> |     |     |        |               |    |    |    |                     |    |           |           |     |
| Restrictions              | SETEXTC turn on to enable this command                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |     |     |        |               |    |    |    |                     |    |           |           |     |
| Register Availability     | Status                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |     |     |        |               |    |    |    | Availability        |    |           |           |     |
|                           | Normal Mode On, Idle Mode Off, Sleep Out                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |     |     |        |               |    |    |    | Yes                 |    |           |           |     |
|                           | Normal Mode On, Idle Mode On, Sleep Out                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |     |     |        |               |    |    |    | Yes                 |    |           |           |     |
|                           | Partial Mode On, Idle Mode Off, Sleep Out                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |     |     |        |               |    |    |    | Yes                 |    |           |           |     |
|                           | Partial Mode On, Idle Mode On, Sleep Out                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |     |     |        |               |    |    |    | Yes                 |    |           |           |     |
|                           | Sleep In                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |     |     |        |               |    |    |    | Yes                 |    |           |           |     |
| Default                   | Status                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |     |     |        | Default value |    |    |    | OTP value           |    |           |           |     |
|                           | Power On Sequence                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |     |     |        | SS_PANEL=0,   |    |    |    | SS_PANEL, REV_PANE, |    |           |           |     |
|                           | S/W Reset                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |     |     |        | REV_PANE=1,   |    |    |    | BGR_PANEL           |    |           |           |     |
|                           | H/W Reset                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |     |     |        | BGR_PANEL=0   |    |    |    |                     |    |           |           |     |

## 6.2.67 SETGIP (D5h)

| D5H                        | SETGIP |     |     |        |               |    |    |          |               |    |    |    | HEX |
|----------------------------|--------|-----|-----|--------|---------------|----|----|----------|---------------|----|----|----|-----|
|                            | DNC    | NRD | NWR | D15-D8 | D7            | D6 | D5 | D4       | D3            | D2 | D1 | D0 |     |
| Command                    | 0      | 1   | ↑   | -      | 1             | 1  | 0  | 1        | 0             | 1  | 0  | 1  | D5  |
| 1 <sup>st</sup> parameter  | 1      | 1   | ↑   | -      | -             | -  | -  | -        | SHR_0[11:8]   |    |    |    | -   |
| 2 <sup>nd</sup> parameter  | 1      | 1   | ↑   | -      | SHR_0[7:0]    |    |    |          |               |    |    |    | -   |
| 3 <sup>rd</sup> parameter  | 1      | 1   | ↑   | -      | -             | -  | -  | -        | SHR_1[11:8]   |    |    |    | -   |
| 4 <sup>th</sup> parameter  | 1      | 1   | ↑   | -      | SHR_1[7:0]    |    |    |          |               |    |    |    | -   |
| 5 <sup>th</sup> parameter  | 1      | 1   | ↑   | -      | SPD[7:0]      |    |    |          |               |    |    |    | -   |
| 6 <sup>th</sup> parameter  | 1      | 1   | ↑   | -      | CHR[7:0]      |    |    |          |               |    |    |    | -   |
| 7 <sup>th</sup> parameter  | 1      | 1   | ↑   | -      | CON[7:0]      |    |    |          |               |    |    |    | -   |
| 8 <sup>th</sup> parameter  | 1      | 1   | ↑   | -      | COFF[7:0]     |    |    |          |               |    |    |    | -   |
| 9 <sup>th</sup> parameter  | 1      | 1   | ↑   | -      | SHP[3:0]      |    |    |          | SCP[3:0]      |    |    |    | -   |
| 10 <sup>th</sup> parameter | 1      | 1   | ↑   | -      | CHP[3:0]      |    |    |          | CCP[3:0]      |    |    |    | -   |
| 11 <sup>th</sup> parameter | 1      | 1   | ↑   | -      | SOS_1[4:0]    |    |    |          | SOS_0[3:0]    |    |    |    | -   |
| 12 <sup>th</sup> parameter | 1      | 1   | ↑   | -      | SOS_3[4:0]    |    |    |          | SOS_2[3:0]    |    |    |    | -   |
| 13 <sup>th</sup> parameter | 1      | 1   | ↑   | -      | COS_1[4:0]    |    |    |          | COS_0[3:0]    |    |    |    | -   |
| 14 <sup>th</sup> parameter | 1      | 1   | ↑   | -      | COS_3[4:0]    |    |    |          | COS_2[3:0]    |    |    |    | -   |
| 15 <sup>th</sup> parameter | 1      | 1   | ↑   | -      | COS_5[4:0]    |    |    |          | COS_4[3:0]    |    |    |    | -   |
| 16 <sup>th</sup> parameter | 1      | 1   | ↑   | -      | COS_7[4:0]    |    |    |          | COS_6[3:0]    |    |    |    | -   |
| 17 <sup>th</sup> parameter | 1      | 1   | ↑   | -      | SOS_1_ML[3:0] |    |    |          | SOS_0_ML[3:0] |    |    |    | -   |
| 18 <sup>th</sup> parameter | 1      | 1   | ↑   | -      | SOS_3_ML[3:0] |    |    |          | SOS_2_ML[3:0] |    |    |    | -   |
| 19 <sup>th</sup> parameter | 1      | 1   | ↑   | -      | COS_1_ML[3:0] |    |    |          | COS_0_ML[3:0] |    |    |    | -   |
| 20 <sup>th</sup> parameter | 1      | 1   | ↑   | -      | COS_3_ML[3:0] |    |    |          | COS_2_ML[3:0] |    |    |    | -   |
| 21 <sup>th</sup> parameter | 1      | 1   | ↑   | -      | COS_5_ML[3:0] |    |    |          | COS_4_ML[3:0] |    |    |    | -   |
| 22 <sup>th</sup> parameter | 1      | 1   | ↑   | -      | COS_7_ML[3:0] |    |    |          | COS_6_ML[3:0] |    |    |    | -   |
| 23 <sup>th</sup> parameter | 1      | 1   | ↑   | -      | -             | -  | -  | GTO[5:0] |               |    |    | -  | -   |
| 24 <sup>th</sup> parameter | 1      | 1   | ↑   | -      | GNO[7:0]      |    |    |          |               |    |    |    | -   |
| 25 <sup>th</sup> parameter | 1      | 1   | ↑   | -      | EQ_DELAY[7:0] |    |    |          |               |    |    |    | -   |
| 26 <sup>th</sup> parameter | 1      | 1   | ↑   | -      | GIP_OPT[7:0]  |    |    |          |               |    |    |    | -   |

This command is used for GIP timing output control.

The diagram illustrates the timing of various signals relative to VSYNC and HSYNC. VSYNC is a single pulse. HSYNC is a periodic signal. The diagram shows the timing of several parameters: SHR[11:0] (start of horizontal sync), SPD[7:0] (start of data), SHP[3:0] (start of high pulse), SCP[3:0] (start of cycle of start pulse), CHP[3:0] (start of high pulse), CCP[3:0] (start of cycle of start pulse), SOS\_1[4:0] (start of subpixel), SOS\_3[4:0] (start of subpixel), COS\_1[4:0] (start of color), COS\_3[4:0] (start of color), COS\_5[4:0] (start of color), COS\_7[4:0] (start of color), SOS\_1\_ML[3:0] (start of subpixel), SOS\_3\_ML[3:0] (start of subpixel), COS\_1\_ML[3:0] (start of color), COS\_3\_ML[3:0] (start of color), COS\_5\_ML[3:0] (start of color), COS\_7\_ML[3:0] (start of color), GTO[5:0] (start of gate), GNO[7:0] (start of gate), EQ\_DELAY[7:0] (equivalent delay), and GIP\_OPT[7:0] (GIP option). The diagram also shows the timing of the high pulse and the cycle of start pulse for each parameter.



SHR\_0[11:0]:STV\_0 Hsync Rise

| SHR_0[11:0] | Start Pulse 0 Output delay |
|-------------|----------------------------|
| 0x000h      | 0 x HSYNC                  |
| 0x001h      | 1 x HSYNC                  |
| 0x002h      | 2 x HSYNC                  |
| 0x003h      | 3 x HSYNC                  |
| 0x004h      | 4 x HSYNC                  |
| 0x005h      | 5 x HSYNC                  |
| . . . . .   |                            |
| 0xFFEh      | 4094 x HSYNC               |
| 0xFFFh      | 4095 x HSYNC               |

SHR\_1[11:0]:STV\_1 Hsync Rise

| SHR_1[11:0] | Start Pulse 1 Output delay |
|-------------|----------------------------|
| 0x000h      | 0 x HSYNC                  |
| 0x001h      | 1 x HSYNC                  |
| 0x002h      | 2 x HSYNC                  |
| 0x003h      | 3 x HSYNC                  |
| 0x004h      | 4 x HSYNC                  |
| 0x005h      | 5 x HSYNC                  |
| . . . . .   |                            |
| 0xFFEh      | 4094 x HSYNC               |
| 0xFFFh      | 4095 x HSYNC               |

SPD[7:0]: STV Pulse Delay

| SPD[7:0]  | Start Pulse Output delay |
|-----------|--------------------------|
| 0x00h     | 0 x OSC CLK              |
| 0x01h     | 1 x OSC CLK              |
| 0x02h     | 2 x OSC CLK              |
| 0x03h     | 3 x OSC CLK              |
| 0x04h     | 4 x OSC CLK              |
| 0x05h     | 5 x OSC CLK              |
| . . . . . |                          |
| 0xFEh     | 254 x OSC CLK            |
| 0xFFh     | 255 x OSC CLK            |

## CHR[7:0]: CK Hsync Rise

| CHR[7:0]  | Start Pulse 1 Output delay |
|-----------|----------------------------|
| 0x00h     | 0 x HSYNC                  |
| 0x01h     | 1 x HSYNC                  |
| 0x02h     | 2 x HSYNC                  |
| 0x03h     | 3 x HSYNC                  |
| 0x004h    | 4 x HSYNC                  |
| 0x005h    | 5 x HSYNC                  |
| . . . . . |                            |
| 0xFEh     | 254 x HSYNC                |
| 0xFFh     | 255 x HSYNC                |

## CON[7:0]: CK Pulse Delay

| CON[7:0]  | CK Pulse Output delay |
|-----------|-----------------------|
| 0x00h     | 0 x OSC CLK           |
| 0x01h     | 1 x OSC CLK           |
| 0x02h     | 2 x OSC CLK           |
| 0x03h     | 3 x OSC CLK           |
| 0x04h     | 4 x OSC CLK           |
| 0x05h     | 5 x OSC CLK           |
| . . . . . |                       |
| 0xFEh     | 254 x OSC CLK         |
| 0xFFh     | 255 x OSC CLK         |

Note: Avoid CON[7:0] OSC LCK width > 1-line width

## COFF[7:0]: CK Pulse width

| COFF[7:0] | CK Pulse Output |
|-----------|-----------------|
| 0x00h     | Inhibit         |
| 0x01h     | 1 x OSC CLK     |
| 0x02h     | 2 x OSC CLK     |
| 0x03h     | 3 x OSC CLK     |
| 0x04h     | 4 x OSC CLK     |
| 0x05h     | 5 x OSC CLK     |
| . . . . . |                 |
| 0xFEh     | 254 x OSC CLK   |
| 0xFFh     | 255 x OSC CLK   |

Note: COFF[7:0] value must bigger than CON[7:0] value

## SHP[3:0]: Width of STV High pulse

| SHP3      | SHP2 | SHP1 | SHP0 | Start Pulse Width |
|-----------|------|------|------|-------------------|
| 0         | 0    | 0    | 0    | 1 x HSYNC         |
| 0         | 0    | 0    | 1    | 2 x HSYNC         |
| 0         | 0    | 1    | 0    | 3 x HSYNC         |
| 0         | 0    | 1    | 1    | 4 x HSYNC         |
| 0         | 1    | 0    | 0    | 5 x HSYNC         |
| 0         | 1    | 0    | 1    | 6 x HSYNC         |
| . . . . . |      |      |      |                   |
| 1         | 1    | 1    | 0    | 15 x HSYNC        |
| 1         | 1    | 1    | 1    | 16 x HSYNC        |

## SCP[3:0]: A Cycle of STV pulse

| SCP3 | SCP2 | SCP1 | SCP0 | Start Pulse cycle |
|------|------|------|------|-------------------|
| 0    | 0    | 0    | 0    | 1 x HSYNC         |
| 0    | 0    | 0    | 1    | 2 x HSYNC         |
| 0    | 0    | 1    | 0    | 3 x HSYNC         |
| 0    | 0    | 1    | 1    | 4 x HSYNC         |
| 0    | 1    | 0    | 0    | 5 x HSYNC         |
| 0    | 1    | 0    | 1    | 6 x HSYNC         |



|           |   |   |   |            |
|-----------|---|---|---|------------|
| . . . . . |   |   |   |            |
| 1         | 1 | 1 | 0 | 15 x HSYNC |
| 1         | 1 | 1 | 1 | 16 x HSYNC |

CHP[3:0]: Width of CK High pulse

| CHP3      | CHP2 | CHP1 | CHP0 | CK Pulse Width |
|-----------|------|------|------|----------------|
| 0         | 0    | 0    | 0    | 1 x HSYNC      |
| 0         | 0    | 0    | 1    | 2 x HSYNC      |
| 0         | 0    | 1    | 0    | 3 x HSYNC      |
| 0         | 0    | 1    | 1    | 4 x HSYNC      |
| 0         | 1    | 0    | 0    | 5 x HSYNC      |
| 0         | 1    | 0    | 1    | 6 x HSYNC      |
| . . . . . |      |      |      |                |
| 1         | 1    | 1    | 0    | 15 x HSYNC     |
| 1         | 1    | 1    | 1    | 16 x HSYNC     |

CCP[3:0]: A Cycle of CK pulse

| CCP3      | CCP2 | CCP1 | CCP0 | CK Pulse cycle |
|-----------|------|------|------|----------------|
| 0         | 0    | 0    | 0    | 1 x HSYNC      |
| 0         | 0    | 0    | 1    | 2 x HSYNC      |
| 0         | 0    | 1    | 0    | 3 x HSYNC      |
| 0         | 0    | 1    | 1    | 4 x HSYNC      |
| 0         | 1    | 0    | 0    | 5 x HSYNC      |
| 0         | 1    | 0    | 1    | 6 x HSYNC      |
| . . . . . |      |      |      |                |
| 1         | 1    | 1    | 0    | 15 x HSYNC     |
| 1         | 1    | 1    | 1    | 16 x HSYNC     |

SOS\_0[3:0] for CGOUT9\_L pulse selector

SOS\_1[3:0] for CGOUT10\_L pulse selector

SOS\_2[3:0] for CGOUT9\_R pulse selector

SOS\_3[3:0] for CGOUT10\_R pulse selector

| SOS_0/1/2/3[3] | SOS_0/1/2/3[2] | SOS_0/1/2/3[1] | SOS_0/1/2/3[0] | Signal Type |
|----------------|----------------|----------------|----------------|-------------|
| 0              | 0              | 0              | 0              | STV-0       |
| 0              | 0              | 0              | 1              | STV-1       |
| 0              | 0              | 1              | 0              | STV-2       |
| 0              | 0              | 1              | 1              | STV-3       |
| 0              | 1              | 0              | 0              | CK-0        |
| 0              | 1              | 0              | 1              | CK-1        |
| 0              | 1              | 1              | 0              | CK-2        |
| 0              | 1              | 1              | 1              | CK-3        |
| 1              | 0              | 0              | 0              | CK-4        |
| 1              | 0              | 0              | 1              | CK-5        |
| 1              | 0              | 1              | 0              | CK-6        |
| 1              | 0              | 1              | 1              | CK-7        |
| 1              | 1              | 0              | 0              | Inhibit     |
| 1              | 1              | 0              | 1              | Inhibit     |
| 1              | 1              | 1              | 0              | Inhibit     |
| 1              | 1              | 1              | 1              | Inhibit     |

COS\_0[3:0] for CGOUT5L pulse selector

COS\_1[3:0] for CGOUT6L pulse selector

COS\_2[3:0] for CGOUT7L pulse selector

COS\_3[3:0] for CGOUT8L pulse selector

COS\_4[3:0] for CGOUT5R pulse selector

COS\_5[3:0] for CGOUT6R pulse selector

COS\_6[3:0] for CGOUT7R pulse selector

COS\_7[3:0] for CGOUT8R pulse selector

| COS_0-7[3] | COS_0-7[2] | COS_0-7[1] | COS_0-7[0] | Signal Type |
|------------|------------|------------|------------|-------------|
| 0          | 0          | 0          | 0          | STV-0       |
| 0          | 0          | 0          | 1          | STV-1       |
| 0          | 0          | 1          | 0          | STV-2       |
| 0          | 0          | 1          | 1          | STV-3       |
| 0          | 1          | 0          | 0          | CK-0        |
| 0          | 1          | 0          | 1          | CK-1        |
| 0          | 1          | 1          | 0          | CK-2        |
| 0          | 1          | 1          | 1          | CK-3        |
| 1          | 0          | 0          | 0          | CK-4        |
| 1          | 0          | 0          | 1          | CK-5        |
| 1          | 0          | 1          | 0          | CK-6        |
| 1          | 0          | 1          | 1          | CK-7        |
| 1          | 1          | 0          | 0          | Inhibit     |
| 1          | 1          | 0          | 1          | Inhibit     |
| 1          | 1          | 1          | 0          | Inhibit     |
| 1          | 1          | 1          | 1          | Inhibit     |

Once the R36h ML=1 the STV gate control signals are referred to the below registers:

SOS\_0\_ML[3:0] for CGOUT9\_L pulse selector

SOS\_1\_ML[3:0] for CGOUT10\_L pulse selector

SOS\_2\_ML[3:0] for CGOUT9\_R pulse selector

SOS\_3\_ML[3:0] for CGOUT10\_R pulse selector

| SOS_0-3_ML[3] | SOS_0-3_ML[2] | SOS_0-3_ML[1] | SOS_0-3_ML[0] | Signal Type |
|---------------|---------------|---------------|---------------|-------------|
| 0             | 0             | 0             | 0             | STV-0       |
| 0             | 0             | 0             | 1             | STV-1       |
| 0             | 0             | 1             | 0             | STV-2       |
| 0             | 0             | 1             | 1             | STV-3       |
| 0             | 1             | 0             | 0             | CK-0        |
| 0             | 1             | 0             | 1             | CK-1        |
| 0             | 1             | 1             | 0             | CK-2        |
| 0             | 1             | 1             | 1             | CK-3        |
| 1             | 0             | 0             | 0             | CK-4        |
| 1             | 0             | 0             | 1             | CK-5        |
| 1             | 0             | 1             | 0             | CK-6        |
| 1             | 0             | 1             | 1             | CK-7        |
| 1             | 1             | 0             | 0             | Inhibit     |
| 1             | 1             | 0             | 1             | Inhibit     |
| 1             | 1             | 1             | 0             | Inhibit     |
| 1             | 1             | 1             | 1             | Inhibit     |

Once the R36h ML=1 the CK gate control signals are referred to the below registers:

COS\_0\_ML[3:0] for CGOUT5L pulse selector

COS\_1\_ML[3:0] for CGOUT6L pulse selector

COS\_2\_ML[3:0] for CGOUT7L pulse selector

COS\_3\_ML[3:0] for CGOUT8L pulse selector

COS\_4\_ML[3:0] for CGOUT5R pulse selector

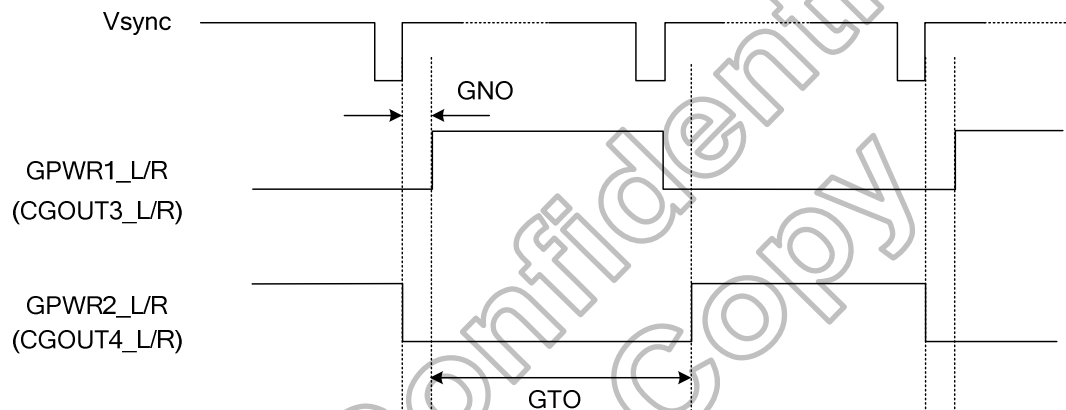
COS\_5\_ML[3:0] for CGOUT6R pulse selector

COS\_6\_ML[3:0] for CGOUT7R pulse selector

COS\_7\_ML[3:0] for CGOUT8R pulse selector

| COS_0-7_ML[3] | COS_0-7_ML[2] | COS_0-7_ML[1] | COS_0-7_ML[0] | Signal Type |
|---------------|---------------|---------------|---------------|-------------|
| 0             | 0             | 0             | 0             | STV-0       |
| 0             | 0             | 0             | 1             | STV-1       |
| 0             | 0             | 1             | 0             | STV-2       |
| 0             | 0             | 1             | 1             | STV-3       |
| 0             | 1             | 0             | 0             | CK-0        |

|   |   |   |   |         |
|---|---|---|---|---------|
| 0 | 1 | 0 | 1 | CK-1    |
| 0 | 1 | 1 | 0 | CK-2    |
| 0 | 1 | 1 | 1 | CK-3    |
| 1 | 0 | 0 | 0 | CK-4    |
| 1 | 0 | 0 | 1 | CK-5    |
| 1 | 0 | 1 | 0 | CK-6    |
| 1 | 0 | 1 | 1 | CK-7    |
| 1 | 1 | 0 | 0 | Inhibit |
| 1 | 1 | 0 | 1 | Inhibit |
| 1 | 1 | 1 | 0 | Inhibit |
| 1 | 1 | 1 | 1 | Inhibit |



| GTO[5:0] | GPWR toggle frequency |
|----------|-----------------------|
| 6'h00    | 64 x Frame            |
| 6'h01    | 1 x Frame             |
| 6'h02    | 2 x Frame             |
| 6'h03    | 3 x Frame             |
| ...      | ...                   |
| 6'h3D    | 61 x Frame            |
| 6'h3E    | 62 x Frame            |
| 6'h3F    | 63 x Frame            |

| GNO[7:0] | GPWR non-overlap timing |
|----------|-------------------------|
| 8'h00    | 0                       |
| 8'h01    | 1 x OSC CLK             |
| 8'h02    | 2 x OSC CLK             |
| 8'h03    | 3 x OSC CLK             |
| ...      | ...                     |
| 8'hFD    | 253 x OSC CLK           |
| 8'hFE    | 254 x OSC CLK           |
| 8'hFF    | 255 x OSC CLK           |

EQ\_DELAY[7:0] is in-house function not open.

GIP\_OPT[7:3] is in-hose function and not open.

GIP\_OPT[2] is stv\_2\_time, In order to meet 2 STV pulses for BP and FP separately. It is the function of controlling the STV-0 and STV-1 pulses in the begin of a frame, and controlling the STV-2 and STV-3 pulses in the end of a frame. The pulses STV-2 and STV-3 started in position are determined by SHR\_1[11:0].

GIP\_OPT[1] is stv\_gated, CK will be off while STV on.

GIP\_OPT[0] is toggle\_en, CK will toggle while porch duration.

|         | Status                                      | Default value                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | OTP value                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|---------|---------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Default | Power On Sequence<br>S/W Reset<br>H/W Reset | SHR_0[11:0]= 0x02h<br>SHR_1[11:0]= 0x01h<br>SPD[7:0]= 0x02h<br>CHR[7:0]= 0x03h<br>CON[7:0]= 0x20h<br>COFF[7:0]= 0x6Cg<br>SCP[3:0]= 0x03h<br>SHP[3:0]= 0x00h<br>CCP[3:0]= 0x03h<br>CHP[3:0]= 0x00h<br>SOS_0[3:0]= 0x00h<br>SOS_1[3:0]= 0x00h<br>SOS_2[3:0]= 0x00h<br>SOS_3[3:0]= 0x00h<br>COS_0[3:0]= 0x00h<br>COS_1[3:0]= 0x06h<br>COS_2[3:0]= 0x04h<br>COS_3[3:0]= 0x00h<br>COS_4[3:0]= 0x01h<br>COS_5[3:0]= 0x07h<br>COS_6[3:0]= 0x05h<br>COS_7[3:0]= 0x07h<br>SOS_0_ML[3:0]= 0x00h<br>SOS_1_ML[3:0]= 0x00h<br>SOS_2_ML[3:0]= 0x00h<br>SOS_3_ML[3:0]= 0x00h<br>COS_0_ML[3:0]= 0x01h<br>COS_1_ML[3:0]= 0x05h<br>COS_2_ML[3:0]= 0x07h<br>COS_3_ML[3:0]= 0x05h<br>COS_4_ML[3:0]= 0x00h<br>COS_5_ML[3:0]= 0x04h<br>COS_6_ML[3:0]= 0x06h<br>COS_7_ML[3:0]= 0x04h<br>GTO[5:0]= 0x01h<br>GNO[7:0]= 0x0Ch<br>EQ_DELAY[7:0]= 0x0Ch<br>GIP_OPT[7:0]= 0x00h | SHR_0[11:0], SHR_1[11:0]<br>SPD[7:0], CHR[7:0]<br>CON[7:0], COFF[7:0]<br>SCP[3:0], SHP[3:0]<br>CCP[3:0], CHP[3:0]<br>SOS_0[3:0], SOS_1[3:0]<br>SOS_2[3:0], SOS_3[3:0]<br>COS_0[3:0], COS_1[3:0]<br>COS_2[3:0], COS_3[3:0]<br>COS_4[3:0], COS_5[3:0]<br>COS_6[3:0], COS_7[3:0]<br>SOS_0_ML[3:0]<br>SOS_1_ML[3:0]<br>SOS_2_ML[3:0]<br>SOS_3_ML[3:0]<br>COS_0_ML[3:0]<br>COS_1_ML[3:0]<br>COS_2_ML[3:0]<br>COS_3_ML[3:0]<br>COS_4_ML[3:0]<br>COS_5_ML[3:0]<br>COS_6_ML[3:0]<br>COS_7_ML[3:0]<br>GTO[5:0], GNO[7:0]<br>EQ_DELAY[7:0]<br>GIP_OPT[7:0] |

## 6.2.68 SETGAMMA: Set gamma curve related setting (E0h)

| E0H                        | SETGAMMAR ( Set Gamma Curve Related Setting ) |                   |             |                                                 |                                                                                                               |              |              |              |    |    |    |    |     |
|----------------------------|-----------------------------------------------|-------------------|-------------|-------------------------------------------------|---------------------------------------------------------------------------------------------------------------|--------------|--------------|--------------|----|----|----|----|-----|
|                            | DNC                                           | NRD               | NWR         | D15-D8                                          | D7                                                                                                            | D6           | D5           | D4           | D3 | D2 | D1 | D0 | HEX |
| Command                    | 0                                             | 1                 | ↑           | -                                               | 1                                                                                                             | 1            | 1            | 0            | 0  | 0  | 0  | 0  | E0  |
| 1 <sup>st</sup> parameter  | 1                                             | 1                 | ↑           | -                                               | -                                                                                                             | -            | G1_VRP0[5:0] |              |    |    |    |    | -   |
| 2 <sup>nd</sup> parameter  | 1                                             | 1                 | ↑           | -                                               | -                                                                                                             | -            | G1_VRP1[5:0] |              |    |    |    |    | -   |
| 3 <sup>rd</sup> Parameter  | 1                                             | 1                 | ↑           | -                                               | -                                                                                                             | -            | G1_VRP2[5:0] |              |    |    |    |    | -   |
| 4 <sup>th</sup> Parameter  | 1                                             | 1                 | ↑           | -                                               | -                                                                                                             | -            | G1_VRP3[5:0] |              |    |    |    |    | -   |
| 5 <sup>th</sup> Parameter  | 1                                             | 1                 | ↑           | -                                               | -                                                                                                             | -            | G1_VRP4[5:0] |              |    |    |    |    | -   |
| 6 <sup>th</sup> Parameter  | 1                                             | 1                 | ↑           | -                                               | -                                                                                                             | -            | G1_VRP5[5:0] |              |    |    |    |    | -   |
| 7 <sup>th</sup> Parameter  | 1                                             | 1                 | ↑           | -                                               | -                                                                                                             | G1_PRP0[6:0] |              |              |    |    |    | -  |     |
| 8 <sup>th</sup> Parameter  | 1                                             | 1                 | ↑           | -                                               | -                                                                                                             | G1_PRP1[6:0] |              |              |    |    |    | -  |     |
| 9 <sup>th</sup> Parameter  | 1                                             | 1                 | ↑           | -                                               | G1_CGMP0<br>[1:0]                                                                                             |              | -            | G1_PKP0[4:0] |    |    |    |    | -   |
| 10 <sup>th</sup> Parameter | 1                                             | 1                 | ↑           | -                                               | G1_CGMP1<br>[1:0]                                                                                             |              | -            | G1_PKP1[4:0] |    |    |    |    | -   |
| 11 <sup>th</sup> Parameter | 1                                             | 1                 | ↑           | -                                               | G1_CGMP2<br>[1:0]                                                                                             |              | -            | G1_PKP2[4:0] |    |    |    |    | -   |
| 12 <sup>th</sup> Parameter | 1                                             | 1                 | ↑           | -                                               | G1_CGMP3<br>[1:0]                                                                                             |              | -            | G1_PKP3[4:0] |    |    |    |    | -   |
| 13 <sup>th</sup> Parameter | 1                                             | 1                 | ↑           | -                                               | G1_CGMP5                                                                                                      | G1_CGMP4     | -            | G1_PKP4[4:0] |    |    |    |    | -   |
| 14 <sup>th</sup> Parameter | 1                                             | 1                 | ↑           | -                                               | -                                                                                                             | -            | -            | G1_PKP5[4:0] |    |    |    |    | -   |
| 15 <sup>th</sup> Parameter | 1                                             | 1                 | ↑           | -                                               | -                                                                                                             | -            | -            | G1_PKP6[4:0] |    |    |    |    | -   |
| 16 <sup>th</sup> Parameter | 1                                             | 1                 | ↑           | -                                               | -                                                                                                             | -            | -            | G1_PKP7[4:0] |    |    |    |    | -   |
| 17 <sup>th</sup> Parameter | 1                                             | 1                 | ↑           | -                                               | -                                                                                                             | -            | -            | G1_PKP8[4:0] |    |    |    |    | -   |
| 18 <sup>th</sup> Parameter | 1                                             | 1                 | ↑           | -                                               | -                                                                                                             | -            | G1_VRN0[5:0] |              |    |    |    | -  |     |
| 19 <sup>th</sup> Parameter | 1                                             | 1                 | ↑           | -                                               | -                                                                                                             | -            | G1_VRN1[5:0] |              |    |    |    | -  |     |
| 20 <sup>th</sup> Parameter | 1                                             | 1                 | ↑           | -                                               | -                                                                                                             | -            | G1_VRN2[5:0] |              |    |    |    | -  |     |
| 21 <sup>th</sup> Parameter | 1                                             | 1                 | ↑           | -                                               | -                                                                                                             | -            | G1_VRN3[5:0] |              |    |    |    | -  |     |
| 22 <sup>th</sup> Parameter | 1                                             | 1                 | ↑           | -                                               | -                                                                                                             | -            | G1_VRN4[5:0] |              |    |    |    | -  |     |
| 23 <sup>th</sup> Parameter | 1                                             | 1                 | ↑           | -                                               | -                                                                                                             | -            | G1_VRN5[5:0] |              |    |    |    | -  |     |
| 24 <sup>th</sup> Parameter | 1                                             | 1                 | ↑           | -                                               | -                                                                                                             | G1_PRN0[6:0] |              |              |    |    |    | -  |     |
| 25 <sup>th</sup> Parameter | 1                                             | 1                 | ↑           | -                                               | -                                                                                                             | G1_PRN1[6:0] |              |              |    |    |    | -  |     |
| 26 <sup>th</sup> Parameter | 1                                             | 1                 | ↑           | -                                               | G1_CGMN0<br>[1:0]                                                                                             |              | -            | G1_PKN0[4:0] |    |    |    |    | -   |
| 27 <sup>th</sup> Parameter | 1                                             | 1                 | ↑           | -                                               | G1_CGMN1<br>[1:0]                                                                                             |              | -            | G1_PKN1[4:0] |    |    |    |    | -   |
| 28 <sup>th</sup> Parameter | 1                                             | 1                 | ↑           | -                                               | G1_CGMN2<br>[1:0]                                                                                             |              | -            | G1_PKN2[4:0] |    |    |    |    | -   |
| 29 <sup>th</sup> Parameter | 1                                             | 1                 | ↑           | -                                               | G1_CGMN3<br>[1:0]                                                                                             |              | -            | G1_PKN3[4:0] |    |    |    |    | -   |
| 30 <sup>th</sup> Parameter | 1                                             | 1                 | ↑           | -                                               | G1_CGMN5                                                                                                      | G1_CGMN4     | -            | G1_PKN4[4:0] |    |    |    |    | -   |
| 31 <sup>th</sup> Parameter | 1                                             | 1                 | ↑           | -                                               | -                                                                                                             | -            | -            | G1_PKN5[4:0] |    |    |    |    | -   |
| 32 <sup>th</sup> Parameter | 1                                             | 1                 | ↑           | -                                               | -                                                                                                             | -            | -            | G1_PKN6[4:0] |    |    |    |    | -   |
| 33 <sup>th</sup> Parameter | 1                                             | 1                 | ↑           | -                                               | -                                                                                                             | -            | -            | G1_PKN7[4:0] |    |    |    |    | -   |
| 34 <sup>th</sup> Parameter | 1                                             | 1                 | ↑           | -                                               | -                                                                                                             | -            | -            | G1_PKN8[4:0] |    |    |    |    | -   |
| Description                | Register Groups                               | Positive Polarity |             | Negative Polarity                               |                                                                                                               | Description  |              |              |    |    |    |    |     |
|                            | Center Adjustment                             | G1_PRP0 6-0       | G1_PRN0 6-0 |                                                 | Variable resistor (PRP/N0) for center adjustment                                                              |              |              |              |    |    |    |    |     |
|                            |                                               | G1_PRP1 6-0       | G1_PRN1 6-0 |                                                 | Variable resistor (PRP/N1)for center adjustment                                                               |              |              |              |    |    |    |    |     |
|                            | Macro Adjustment                              | G1_PKP0 4-0       | G1_PKN0 4-0 |                                                 | 32-to-1 selector (voltage level of grayscale 3)                                                               |              |              |              |    |    |    |    |     |
|                            |                                               | G1_PKP1 4-0       | G1_PKN1 4-0 |                                                 | 32-to-1 selector (voltage level of grayscale 7)                                                               |              |              |              |    |    |    |    |     |
|                            |                                               | G1_PKP2 4-0       | G1_PKN2 4-0 |                                                 | 32-to-1 selector (voltage level of grayscale 19)                                                              |              |              |              |    |    |    |    |     |
|                            |                                               | G1_PKP3 4-0       | G1_PKN3 4-0 |                                                 | 32-to-1 selector (voltage level of grayscale 25)                                                              |              |              |              |    |    |    |    |     |
|                            |                                               | G1_PKP4 4-0       | G1_PKN4 4-0 |                                                 | 32-to-1 selector (voltage level of grayscale 32 for positive polarity and grayscale 31 for negative polarity) |              |              |              |    |    |    |    |     |
|                            |                                               | G1_PKP5 4-0       | G1_PKN5 4-0 |                                                 | 32-to-1 selector (voltage level of grayscale 38)                                                              |              |              |              |    |    |    |    |     |
|                            |                                               | G1_PKP6 4-0       | G1_PKN6 4-0 |                                                 | 32-to-1 selector (voltage level of grayscale 44)                                                              |              |              |              |    |    |    |    |     |
|                            |                                               | G1_PKP7 4-0       | G1_PKN7 4-0 |                                                 | 32-to-1 selector (voltage level of grayscale 56)                                                              |              |              |              |    |    |    |    |     |
|                            |                                               | G1_PKP8 4-0       | G1_PKN8 4-0 |                                                 | 32-to-1 selector (voltage level of grayscale 60)                                                              |              |              |              |    |    |    |    |     |
|                            | Offset Adjustment                             | G1_VRP0 5-0       | G1_VRN0 5-0 |                                                 | Variable resistor (VRP/N0)for offset adjustment                                                               |              |              |              |    |    |    |    |     |
|                            |                                               | G1_VRP1 5-0       | G1_VRN1 5-0 |                                                 | Variable resistor (VRP/N1)for offset adjustment                                                               |              |              |              |    |    |    |    |     |
|                            |                                               | G1_VRP2 5-0       | G1_VRN2 5-0 |                                                 | Variable resistor (VRP/N2)for offset adjustment                                                               |              |              |              |    |    |    |    |     |
| G1_VRP3 5-0                |                                               | G1_VRN3 5-0       |             | Variable resistor (VRP/N3)for offset adjustment |                                                                                                               |              |              |              |    |    |    |    |     |

|                                             | <table><tr><td>G1_VRP4 5-0</td><td>G1_VRN4 5-0</td><td>Variable resistor (VRP/N4)for offset adjustment</td></tr><tr><td>G1_VRP5 5-0</td><td>G1_VRN5 5-0</td><td>Variable resistor (VRP/N5)for offset adjustment</td></tr></table>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | G1_VRP4 5-0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | G1_VRN4 5-0   | Variable resistor (VRP/N4)for offset adjustment | G1_VRP5 5-0                                 | G1_VRN5 5-0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | Variable resistor (VRP/N5)for offset adjustment                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                           |     |                                          |     |          |     |
|---------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|-------------------------------------------------|---------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------|-----|------------------------------------------|-----|----------|-----|
| G1_VRP4 5-0                                 | G1_VRN4 5-0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | Variable resistor (VRP/N4)for offset adjustment                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |               |                                                 |                                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                           |     |                                          |     |          |     |
| G1_VRP5 5-0                                 | G1_VRN5 5-0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | Variable resistor (VRP/N5)for offset adjustment                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |               |                                                 |                                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                           |     |                                          |     |          |     |
|                                             | <p><b>G1_CGMP/N0:</b> Select to change gamma resistor stream.</p> <p><b>G1_CGMP/N1:</b> Select to change gamma resistor stream.</p> <p><b>G1_CGMP/N2:</b> Select to change gamma resistor stream.</p> <p><b>G1_CGMP/N3:</b> Select to change gamma resistor stream. Please refer to Figure 5.31.</p> <p><b>G1_CGMP/N4:</b> Select to change gamma resistor stream. Please refer to Figure 5.31.</p> <p><b>G1_CGMP/N5:</b> Select to change gamma resistor stream. Please refer to Figure 5.31.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |               |                                                 |                                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                           |     |                                          |     |          |     |
| Restriction                                 | SETEXTC turn on to enable this command.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |               |                                                 |                                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                           |     |                                          |     |          |     |
| Register Availability                       | <table><tr><th>Status</th><th>Availability</th></tr><tr><td>Normal Mode On, Idle Mode Off, Sleep Out</td><td>Yes</td></tr><tr><td>Normal Mode On, Idle Mode On, Sleep Out</td><td>Yes</td></tr><tr><td>Partial Mode On, Idle Mode Off, Sleep Out</td><td>Yes</td></tr><tr><td>Partial Mode On, Idle Mode On, Sleep Out</td><td>Yes</td></tr><tr><td>Sleep In</td><td>Yes</td></tr></table>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Status                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Availability  | Normal Mode On, Idle Mode Off, Sleep Out        | Yes                                         | Normal Mode On, Idle Mode On, Sleep Out                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Yes                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Partial Mode On, Idle Mode Off, Sleep Out | Yes | Partial Mode On, Idle Mode On, Sleep Out | Yes | Sleep In | Yes |
|                                             | Status                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Availability                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |               |                                                 |                                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                           |     |                                          |     |          |     |
|                                             | Normal Mode On, Idle Mode Off, Sleep Out                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | Yes                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |               |                                                 |                                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                           |     |                                          |     |          |     |
|                                             | Normal Mode On, Idle Mode On, Sleep Out                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Yes                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |               |                                                 |                                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                           |     |                                          |     |          |     |
|                                             | Partial Mode On, Idle Mode Off, Sleep Out                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | Yes                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |               |                                                 |                                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                           |     |                                          |     |          |     |
|                                             | Partial Mode On, Idle Mode On, Sleep Out                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | Yes                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |               |                                                 |                                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                           |     |                                          |     |          |     |
| Sleep In                                    | Yes                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |               |                                                 |                                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                           |     |                                          |     |          |     |
| Default                                     | <table><tr><th>Status</th><th>Default value</th><th>OTP value</th></tr><tr><td>Power On Sequence<br/>S/W Reset<br/>H/W Reset</td><td>G1_VRP0[5:0]=0x00h,<br/>G1_VRP1[5:0]=0x18h,<br/>G1_VRP2[5:0]=0x1Fh,<br/>G1_VRP3[5:0]=0x3Fh,<br/>G1_VRP4[5:0]=0x3Fh,<br/>G1_VRP5[5:0]=0x3Fh,<br/>G1_PRP0[6:0]=0x33h,<br/>G1_PRP1[6:0]=0x57h,<br/>G1_CGMP0[1:0]=00,<br/>G1_CGMP1[1:0]=00,<br/>G1_CGMP2[1:0]=00,<br/>G1_CGMP3[1:0]=00,<br/>G1_CGMP4=0, G1_CGMP5=0,<br/>G1_PKP0[4:0]=0x07h, G1_PKP1[4:0]=0x0Dh,<br/>G1_PKP2[4:0]=0x0Fh, G1_PKP3[4:0]=0x13h,<br/>G1_PKP4[4:0]=0x16h, G1_PKP5[4:0]=0x14h,<br/>G1_PKP6[4:0]=0x16h, G1_PKP7[4:0]=0x18h,<br/>G1_PKP8[4:0]=0x1Fh,<br/>G1_VRN0[5:0]=0x00h,<br/>G1_VRN1[5:0]=0x18h,<br/>G1_VRN2[5:0]=0x1Fh,<br/>G1_VRN3[5:0]=0x3Fh,<br/>G1_VRN4[5:0]=0x3Fh,<br/>G1_VRN5[5:0]=0x3Fh,<br/>G1_PKN0[4:0]=0x07h,<br/>G1_PKN1[4:0]=0x0Dh,<br/>G1_PKN2[4:0]=0x0Fh,<br/>G1_PKN3[4:0]=0x13h,<br/>G1_PKN4[4:0]=0x16h,<br/>G1_PKN5[4:0]=0x14h,<br/>G1_PKN6[4:0]=0x16h,<br/>G1_PKN7[4:0]=0x18h,<br/>G1_PKN8[4:0]=0x1Fh,<br/>G1_CGMN0[1:0]=00,<br/>G1_CGMN1[1:0]=00,<br/>G1_CGMN2[1:0]=00,<br/>G1_CGMN3[1:0]=00,<br/>G1_CGMN4=0, G1_CGMN5=0,</td><td>G1_VRP0[5:0], G1_VRP1[5:0],<br/>G1_VRP2[5:0], G1_VRP3[5:0],<br/>G1_VRP4[5:0], G1_VRP5[5:0],<br/>G1_PRP0[6:0], G1_PRP1[6:0],<br/>G1_CGMP0[1:0], G1_CGMP1[1:0],<br/>G1_CGMP2[1:0], G1_CGMP3[1:0],<br/>G1_CGMP4, G1_CGMP5,<br/>G1_PKP0[4:0], G1_PKP1[4:0],<br/>G1_PKP2[4:0], G1_PKP3[4:0],<br/>G1_PKP4[4:0], G1_PKP5[4:0],<br/>G1_PKP6[4:0], G1_PKP7[4:0],<br/>G1_PKP8[4:0], G1_VRN0[5:0],<br/>G1_VRN1[5:0], G1_VRN2[5:0],<br/>G1_VRN3[5:0], G1_VRN4[5:0],<br/>G1_VRN5[5:0], G1_PKN0[4:0],<br/>G1_PKN1[4:0], G1_PKN2[4:0],<br/>G1_PKN3[4:0], G1_PKN4[4:0],<br/>G1_PKN5[4:0], G1_PKN6[4:0],<br/>G1_PKN7[4:0], G1_PKN8[4:0],<br/>G1_CGMN0[1:0],<br/>G1_CGMN1[1:0],<br/>G1_CGMN2[1:0],<br/>G1_CGMN3[1:0],<br/>G1_CGMN4, G1_CGMN5.</td></tr></table> | Status                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Default value | OTP value                                       | Power On Sequence<br>S/W Reset<br>H/W Reset | G1_VRP0[5:0]=0x00h,<br>G1_VRP1[5:0]=0x18h,<br>G1_VRP2[5:0]=0x1Fh,<br>G1_VRP3[5:0]=0x3Fh,<br>G1_VRP4[5:0]=0x3Fh,<br>G1_VRP5[5:0]=0x3Fh,<br>G1_PRP0[6:0]=0x33h,<br>G1_PRP1[6:0]=0x57h,<br>G1_CGMP0[1:0]=00,<br>G1_CGMP1[1:0]=00,<br>G1_CGMP2[1:0]=00,<br>G1_CGMP3[1:0]=00,<br>G1_CGMP4=0, G1_CGMP5=0,<br>G1_PKP0[4:0]=0x07h, G1_PKP1[4:0]=0x0Dh,<br>G1_PKP2[4:0]=0x0Fh, G1_PKP3[4:0]=0x13h,<br>G1_PKP4[4:0]=0x16h, G1_PKP5[4:0]=0x14h,<br>G1_PKP6[4:0]=0x16h, G1_PKP7[4:0]=0x18h,<br>G1_PKP8[4:0]=0x1Fh,<br>G1_VRN0[5:0]=0x00h,<br>G1_VRN1[5:0]=0x18h,<br>G1_VRN2[5:0]=0x1Fh,<br>G1_VRN3[5:0]=0x3Fh,<br>G1_VRN4[5:0]=0x3Fh,<br>G1_VRN5[5:0]=0x3Fh,<br>G1_PKN0[4:0]=0x07h,<br>G1_PKN1[4:0]=0x0Dh,<br>G1_PKN2[4:0]=0x0Fh,<br>G1_PKN3[4:0]=0x13h,<br>G1_PKN4[4:0]=0x16h,<br>G1_PKN5[4:0]=0x14h,<br>G1_PKN6[4:0]=0x16h,<br>G1_PKN7[4:0]=0x18h,<br>G1_PKN8[4:0]=0x1Fh,<br>G1_CGMN0[1:0]=00,<br>G1_CGMN1[1:0]=00,<br>G1_CGMN2[1:0]=00,<br>G1_CGMN3[1:0]=00,<br>G1_CGMN4=0, G1_CGMN5=0, | G1_VRP0[5:0], G1_VRP1[5:0],<br>G1_VRP2[5:0], G1_VRP3[5:0],<br>G1_VRP4[5:0], G1_VRP5[5:0],<br>G1_PRP0[6:0], G1_PRP1[6:0],<br>G1_CGMP0[1:0], G1_CGMP1[1:0],<br>G1_CGMP2[1:0], G1_CGMP3[1:0],<br>G1_CGMP4, G1_CGMP5,<br>G1_PKP0[4:0], G1_PKP1[4:0],<br>G1_PKP2[4:0], G1_PKP3[4:0],<br>G1_PKP4[4:0], G1_PKP5[4:0],<br>G1_PKP6[4:0], G1_PKP7[4:0],<br>G1_PKP8[4:0], G1_VRN0[5:0],<br>G1_VRN1[5:0], G1_VRN2[5:0],<br>G1_VRN3[5:0], G1_VRN4[5:0],<br>G1_VRN5[5:0], G1_PKN0[4:0],<br>G1_PKN1[4:0], G1_PKN2[4:0],<br>G1_PKN3[4:0], G1_PKN4[4:0],<br>G1_PKN5[4:0], G1_PKN6[4:0],<br>G1_PKN7[4:0], G1_PKN8[4:0],<br>G1_CGMN0[1:0],<br>G1_CGMN1[1:0],<br>G1_CGMN2[1:0],<br>G1_CGMN3[1:0],<br>G1_CGMN4, G1_CGMN5. |                                           |     |                                          |     |          |     |
|                                             | Status                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Default value                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | OTP value     |                                                 |                                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                           |     |                                          |     |          |     |
| Power On Sequence<br>S/W Reset<br>H/W Reset | G1_VRP0[5:0]=0x00h,<br>G1_VRP1[5:0]=0x18h,<br>G1_VRP2[5:0]=0x1Fh,<br>G1_VRP3[5:0]=0x3Fh,<br>G1_VRP4[5:0]=0x3Fh,<br>G1_VRP5[5:0]=0x3Fh,<br>G1_PRP0[6:0]=0x33h,<br>G1_PRP1[6:0]=0x57h,<br>G1_CGMP0[1:0]=00,<br>G1_CGMP1[1:0]=00,<br>G1_CGMP2[1:0]=00,<br>G1_CGMP3[1:0]=00,<br>G1_CGMP4=0, G1_CGMP5=0,<br>G1_PKP0[4:0]=0x07h, G1_PKP1[4:0]=0x0Dh,<br>G1_PKP2[4:0]=0x0Fh, G1_PKP3[4:0]=0x13h,<br>G1_PKP4[4:0]=0x16h, G1_PKP5[4:0]=0x14h,<br>G1_PKP6[4:0]=0x16h, G1_PKP7[4:0]=0x18h,<br>G1_PKP8[4:0]=0x1Fh,<br>G1_VRN0[5:0]=0x00h,<br>G1_VRN1[5:0]=0x18h,<br>G1_VRN2[5:0]=0x1Fh,<br>G1_VRN3[5:0]=0x3Fh,<br>G1_VRN4[5:0]=0x3Fh,<br>G1_VRN5[5:0]=0x3Fh,<br>G1_PKN0[4:0]=0x07h,<br>G1_PKN1[4:0]=0x0Dh,<br>G1_PKN2[4:0]=0x0Fh,<br>G1_PKN3[4:0]=0x13h,<br>G1_PKN4[4:0]=0x16h,<br>G1_PKN5[4:0]=0x14h,<br>G1_PKN6[4:0]=0x16h,<br>G1_PKN7[4:0]=0x18h,<br>G1_PKN8[4:0]=0x1Fh,<br>G1_CGMN0[1:0]=00,<br>G1_CGMN1[1:0]=00,<br>G1_CGMN2[1:0]=00,<br>G1_CGMN3[1:0]=00,<br>G1_CGMN4=0, G1_CGMN5=0,                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | G1_VRP0[5:0], G1_VRP1[5:0],<br>G1_VRP2[5:0], G1_VRP3[5:0],<br>G1_VRP4[5:0], G1_VRP5[5:0],<br>G1_PRP0[6:0], G1_PRP1[6:0],<br>G1_CGMP0[1:0], G1_CGMP1[1:0],<br>G1_CGMP2[1:0], G1_CGMP3[1:0],<br>G1_CGMP4, G1_CGMP5,<br>G1_PKP0[4:0], G1_PKP1[4:0],<br>G1_PKP2[4:0], G1_PKP3[4:0],<br>G1_PKP4[4:0], G1_PKP5[4:0],<br>G1_PKP6[4:0], G1_PKP7[4:0],<br>G1_PKP8[4:0], G1_VRN0[5:0],<br>G1_VRN1[5:0], G1_VRN2[5:0],<br>G1_VRN3[5:0], G1_VRN4[5:0],<br>G1_VRN5[5:0], G1_PKN0[4:0],<br>G1_PKN1[4:0], G1_PKN2[4:0],<br>G1_PKN3[4:0], G1_PKN4[4:0],<br>G1_PKN5[4:0], G1_PKN6[4:0],<br>G1_PKN7[4:0], G1_PKN8[4:0],<br>G1_CGMN0[1:0],<br>G1_CGMN1[1:0],<br>G1_CGMN2[1:0],<br>G1_CGMN3[1:0],<br>G1_CGMN4, G1_CGMN5. |               |                                                 |                                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                           |     |                                          |     |          |     |



**6.2.69 SETOTPKEY (E9h)**

| E9H                       | SETOTPKEY                                                               |     |     |        |                                             |    |    |    |                                                                                                                                                                      |    |    |    |     |
|---------------------------|-------------------------------------------------------------------------|-----|-----|--------|---------------------------------------------|----|----|----|----------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|----|----|-----|
|                           | DNC                                                                     | NRD | NWR | D15-D8 | D7                                          | D6 | D5 | D4 | D3                                                                                                                                                                   | D2 | D1 | D0 | HEX |
| Command                   | 0                                                                       | 1   | ↑   | -      | 1                                           | 1  | 1  | 0  | 1                                                                                                                                                                    | 0  | 0  | 1  | E9  |
| 1 <sup>st</sup> parameter | 1                                                                       | 1   | ↑   | -      | OTP_KEY0[7:0]                               |    |    |    |                                                                                                                                                                      |    |    |    | 00h |
| 2 <sup>nd</sup> parameter | 1                                                                       | 1   | ↑   | -      | OTP_KEY1[7:0]                               |    |    |    |                                                                                                                                                                      |    |    |    | 00h |
| Description               | This command is used to set OTP key to enter or leave OTP program mode. |     |     |        |                                             |    |    |    |                                                                                                                                                                      |    |    |    |     |
|                           | OTP_KEY0[7:0]<br>OTP_KEY1[7:0]                                          |     |     |        | Description                                 |    |    |    | Note                                                                                                                                                                 |    |    |    |     |
|                           | OTP_KEY0[7:0] = 0xAAh<br>OTP_KEY1[7:0] = 0x55h                          |     |     |        | Enter OTP program mode                      |    |    |    |                                                                                                                                                                      |    |    |    |     |
|                           | OTP_KEY0[7:0] = 0x00h<br>OTP_KEY1[7:0] = 0x00h                          |     |     |        | Leave OTP program mode                      |    |    |    |                                                                                                                                                                      |    |    |    |     |
|                           | Other value                                                             |     |     |        | Invalid                                     |    |    |    | 1. If HX8369-A02 operate on OTP program mode, Then keep on OTP program mode.<br>2. If HX8369-A02 operate on non-OTP program mode, Then keep on non-OTP program mode. |    |    |    |     |
| Restrictions              | SETEXTC turn on to enable this command.                                 |     |     |        |                                             |    |    |    |                                                                                                                                                                      |    |    |    |     |
| Register Availability     | Status                                                                  |     |     |        |                                             |    |    |    | Availability                                                                                                                                                         |    |    |    |     |
|                           | Normal Mode On, Idle Mode Off, Sleep Out                                |     |     |        |                                             |    |    |    | Yes                                                                                                                                                                  |    |    |    |     |
|                           | Normal Mode On, Idle Mode On, Sleep Out                                 |     |     |        |                                             |    |    |    | Yes                                                                                                                                                                  |    |    |    |     |
|                           | Partial Mode On, Idle Mode Off, Sleep Out                               |     |     |        |                                             |    |    |    | Yes                                                                                                                                                                  |    |    |    |     |
|                           | Partial Mode On, Idle Mode On, Sleep Out                                |     |     |        |                                             |    |    |    | Yes                                                                                                                                                                  |    |    |    |     |
|                           | Sleep In                                                                |     |     |        |                                             |    |    |    | Yes                                                                                                                                                                  |    |    |    |     |
| Default                   | Status                                                                  |     |     |        | Default value                               |    |    |    | OTP value                                                                                                                                                            |    |    |    |     |
|                           | Power On Sequence<br>S/W Reset<br>H/W Reset                             |     |     |        | OTP_KEY0[7:0]=0x00h,<br>OTP_KEY1[7:0]=0x00h |    |    |    | N/A                                                                                                                                                                  |    |    |    |     |
|                           |                                                                         |     |     |        |                                             |    |    |    |                                                                                                                                                                      |    |    |    |     |



## 6.2.70 GETHXID (F4h)

| F4H                       | GETHXIC                                         |     |     |                       |               |    |              |           |    |    |    |    |     |
|---------------------------|-------------------------------------------------|-----|-----|-----------------------|---------------|----|--------------|-----------|----|----|----|----|-----|
|                           | DNC                                             | NRD | NWR | D15-D8                | D7            | D6 | D5           | D4        | D3 | D2 | D1 | D0 | HEX |
| Command                   | 0                                               | 1   | ↑   | -                     | 1             | 1  | 1            | 1         | 0  | 1  | 0  | 0  | F4  |
| 1 <sup>st</sup> parameter | 1                                               | ↑   | 1   | -                     | Himax ID[7:0] |    |              |           |    |    |    |    | -   |
| Description               | This command is used to get LCD ID and version. |     |     |                       |               |    |              |           |    |    |    |    |     |
| Restrictions              | SETEXTC turn on to enable this command.         |     |     |                       |               |    |              |           |    |    |    |    |     |
| Register Availability     | Status                                          |     |     |                       |               |    | Availability |           |    |    |    |    |     |
|                           | Normal Mode On, Idle Mode Off, Sleep Out        |     |     |                       |               |    | Yes          |           |    |    |    |    |     |
|                           | Normal Mode On, Idle Mode On, Sleep Out         |     |     |                       |               |    | Yes          |           |    |    |    |    |     |
|                           | Partial Mode On, Idle Mode Off, Sleep Out       |     |     |                       |               |    | Yes          |           |    |    |    |    |     |
|                           | Partial Mode On, Idle Mode On, Sleep Out        |     |     |                       |               |    | Yes          |           |    |    |    |    |     |
|                           | Sleep In                                        |     |     |                       |               |    | Yes          |           |    |    |    |    |     |
| Default                   | Status                                          |     |     | Default value         |               |    |              | OTP value |    |    |    |    |     |
|                           | Power On Sequence                               |     |     | Himax ID[7:0] = 0x69h |               |    |              | N/A       |    |    |    |    |     |
|                           | S/W Reset<br>H/W Reset                          |     |     | Version[7:0] = 0x02h  |               |    |              |           |    |    |    |    |     |

### 6.2.71 SETCNCD/GETCNCD (FDh)

| FDH                       | SETCNCD/GETCNCD (Set/Get Continue Command)                                                                                                                          |     |     |        |                |    |    |    |           |    |    |    |     |
|---------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|-----|--------|----------------|----|----|----|-----------|----|----|----|-----|
|                           | DNC                                                                                                                                                                 | NRD | NWR | D15-D8 | D7             | D6 | D5 | D4 | D3        | D2 | D1 | D0 | HEX |
| Command                   | 0                                                                                                                                                                   | 1   | ↑   | -      | 1              | 1  | 1  | 1  | 1         | 1  | 0  | 1  | FD  |
| 1 <sup>st</sup> parameter | 1                                                                                                                                                                   | 1   | ↑   | -      | WR_CMD_CN[7:0] |    |    |    |           |    |    |    | -   |
| Description               | This function is use to instead of Register-Content interface mode.<br>The parameter for SETCNCD will continue to read from the last command address automatically. |     |     |        |                |    |    |    |           |    |    |    |     |
| Restrictions              | SETEXTC turn on to enable this command                                                                                                                              |     |     |        |                |    |    |    |           |    |    |    |     |
| Register Availability     | Status                                                                                                                                                              |     |     |        | Availability   |    |    |    |           |    |    |    |     |
|                           | Idle Mode Off, Sleep Out                                                                                                                                            |     |     |        | Yes            |    |    |    |           |    |    |    |     |
|                           | Idle Mode On, Sleep Out                                                                                                                                             |     |     |        | Yes            |    |    |    |           |    |    |    |     |
|                           | Sleep In or Booster Off                                                                                                                                             |     |     |        | Yes            |    |    |    |           |    |    |    |     |
| Default                   | Status                                                                                                                                                              |     |     |        | Default value  |    |    |    | OTP value |    |    |    |     |
|                           | Power On Sequence                                                                                                                                                   |     |     |        | N/A            |    |    |    | N/A       |    |    |    |     |
|                           | S/W Reset<br>H/W Reset                                                                                                                                              |     |     |        |                |    |    |    |           |    |    |    |     |

## 6.2.72 SET SPI READ INDEX (FEh)

| FEH                       | SET SPI READ INDEX (Set SPI READ Command Address)     |     |     |        |                    |    |    |    |           |    |    |    |     |
|---------------------------|-------------------------------------------------------|-----|-----|--------|--------------------|----|----|----|-----------|----|----|----|-----|
|                           | DNC                                                   | NRD | NWR | D15-D8 | D7                 | D6 | D5 | D4 | D3        | D2 | D1 | D0 | HEX |
| Command                   | 0                                                     | 1   | ↑   | -      | 1                  | 1  | 1  | 1  | 1         | 1  | 1  | 0  | FE  |
| 1 <sup>st</sup> parameter | 1                                                     | 1   | ↑   | -      | CMD_ADD[7:0]       |    |    |    |           |    |    |    | -   |
| Description               | SET SPI READ Command Address for User Define Command. |     |     |        |                    |    |    |    |           |    |    |    |     |
| Restrictions              | SETEXTC turn on to enable this command                |     |     |        |                    |    |    |    |           |    |    |    |     |
| Register Availability     | Status                                                |     |     |        | Availability       |    |    |    |           |    |    |    |     |
|                           | Idle Mode Off, Sleep Out                              |     |     |        | Yes                |    |    |    |           |    |    |    |     |
|                           | Idle Mode On, Sleep Out                               |     |     |        | Yes                |    |    |    |           |    |    |    |     |
| Default                   | Status                                                |     |     |        | Default value      |    |    |    | OTP value |    |    |    |     |
|                           | Power On Sequence                                     |     |     |        | CMD_ADD[7:0]=0x00h |    |    |    | N/A       |    |    |    |     |
|                           | S/W Reset                                             |     |     |        |                    |    |    |    |           |    |    |    |     |
|                           | H/W Reset                                             |     |     |        |                    |    |    |    |           |    |    |    |     |

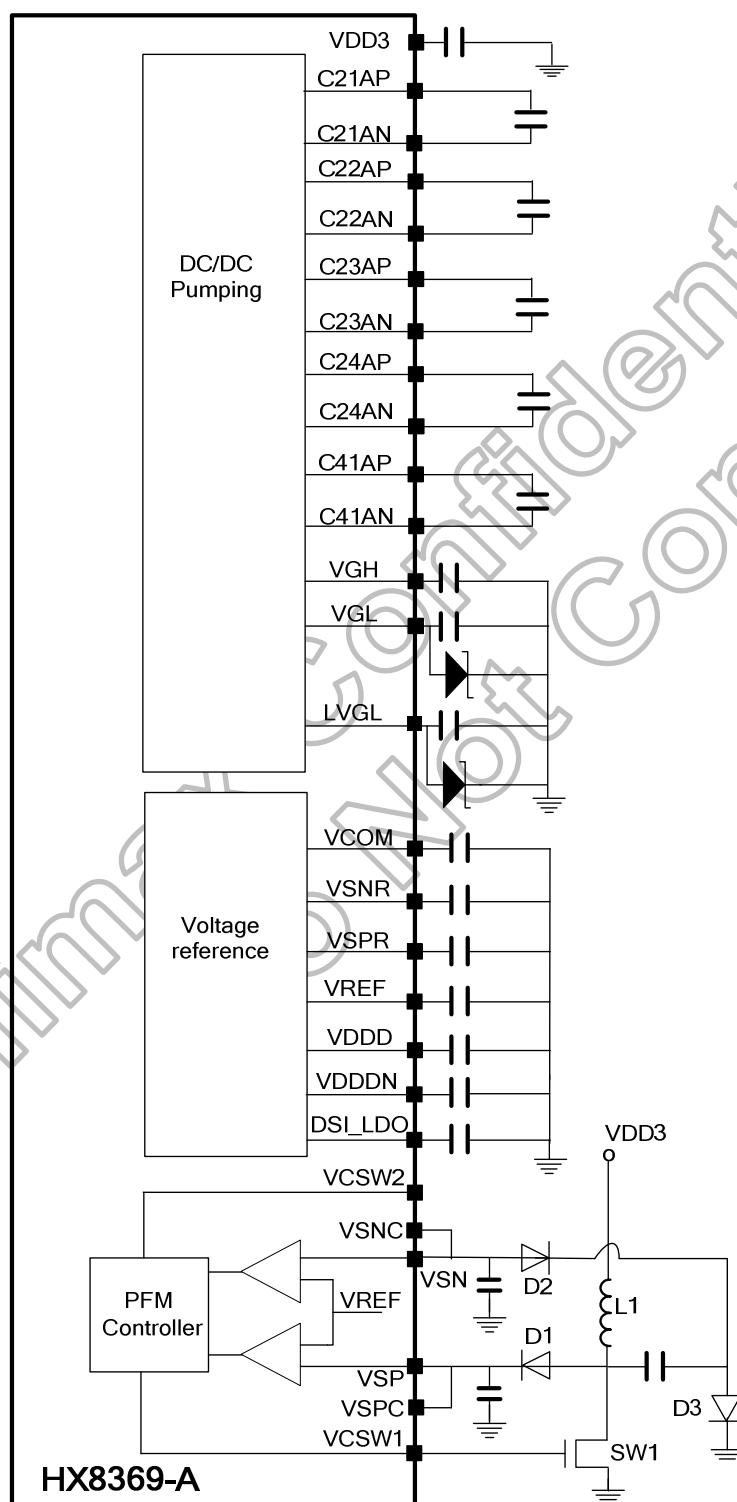
### 6.2.73 GETSPIREAD: Read command data (FFh)

| FFH                       | GETMPUREAD (Read Command Data)                 |     |     |        |                |    |    |    |           |    |    |    |     |
|---------------------------|------------------------------------------------|-----|-----|--------|----------------|----|----|----|-----------|----|----|----|-----|
|                           | DNC                                            | NRD | NWR | D15-D8 | D7             | D6 | D5 | D4 | D3        | D2 | D1 | D0 | HEX |
| Command                   | 0                                              | 1   | ↑   | -      | 1              | 1  | 1  | 1  | 1         | 1  | 1  | 1  | FF  |
| 1 <sup>st</sup> parameter | 1                                              | ↑   | 1   | -      | CMD_DATA1[7:0] |    |    |    |           |    |    |    | -   |
| :                         | 1                                              | ↑   | 1   | -      | :              |    |    |    |           |    |    |    | -   |
| n <sup>th</sup> parameter | 1                                              | ↑   | 1   | -      | CMD_DATAN[7:0] |    |    |    |           |    |    |    | -   |
| Description               | Read SPI Command Data for User Define Command. |     |     |        |                |    |    |    |           |    |    |    |     |
| Restrictions              | SETEXTC turn on to enable this command.        |     |     |        |                |    |    |    |           |    |    |    |     |
| Register Availability     | Status                                         |     |     |        | Availability   |    |    |    |           |    |    |    |     |
|                           | Idle Mode Off, Sleep Out                       |     |     |        | Yes            |    |    |    |           |    |    |    |     |
|                           | Idle Mode On, Sleep Out                        |     |     |        | Yes            |    |    |    |           |    |    |    |     |
|                           | Sleep In or Booster Off                        |     |     |        | Yes            |    |    |    |           |    |    |    |     |
| Default                   | Status                                         |     |     |        | Default value  |    |    |    | OTP value |    |    |    |     |
|                           | Power On Sequence                              |     |     |        | N/A            |    |    |    | N/A       |    |    |    |     |
|                           | S/W Reset                                      |     |     |        |                |    |    |    |           |    |    |    |     |
|                           | H/W Reset                                      |     |     |        |                |    |    |    |           |    |    |    |     |

## 7. Power Supply

### 7.1 Power supply setup

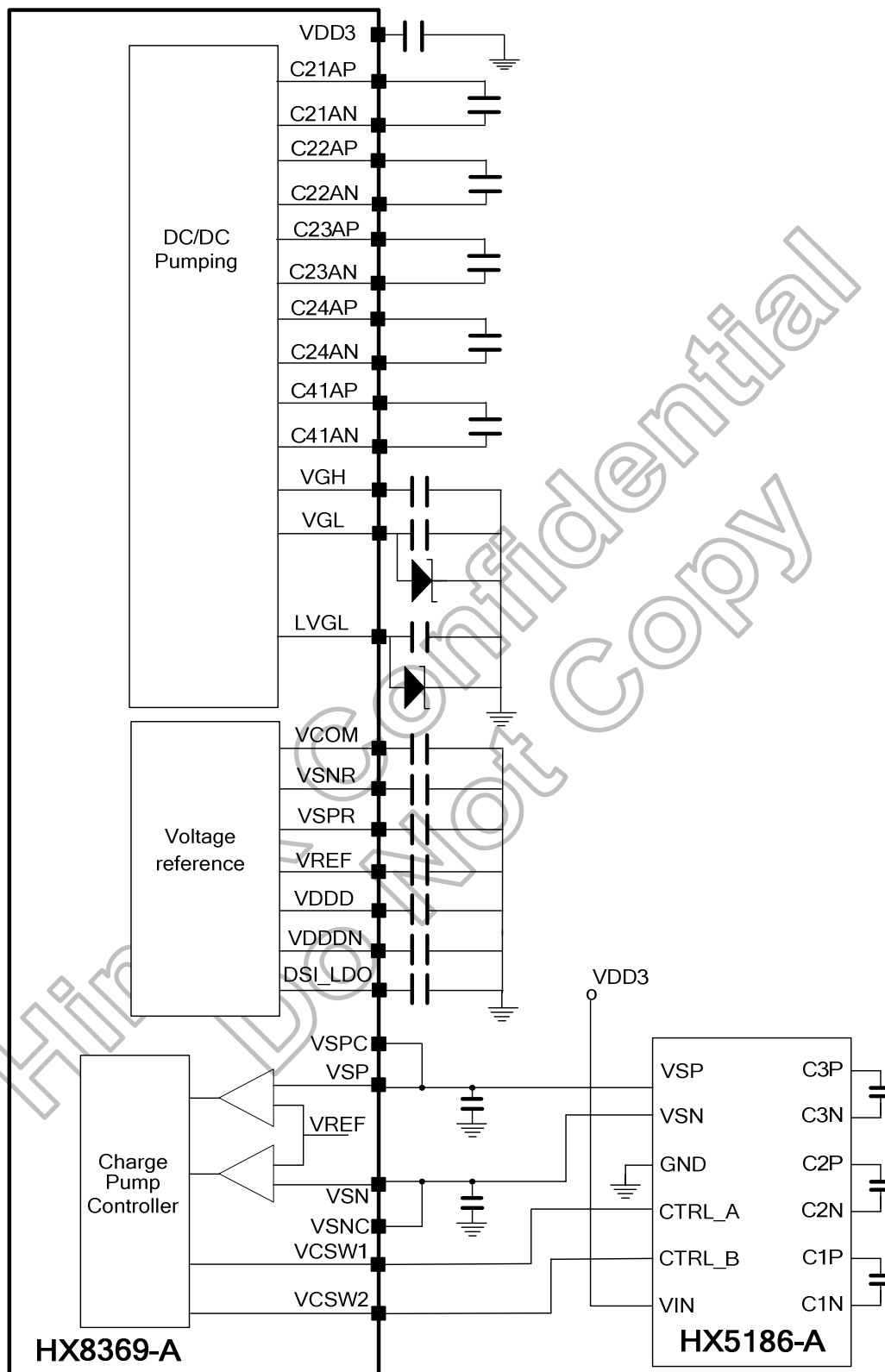
### 7.1.1 Architecture 1 with PFM circuit



**Note:** If not use LVGL, please connect the VGL and LVGL together.

### Figure 7.1: Power supply with PFM circuit

### 7.1.2 Architecture 2 with HX5186-A



**Figure 7.2: Power supply with HX5186-A**

## 7.2 Voltage configuration

The HX8369-A02 has an internal power supply circuit to drive TFTLCD panel. Please set up each voltage output according to the LCD panel.

| Name    | Function                                         | Set up value         | Note                  |
|---------|--------------------------------------------------|----------------------|-----------------------|
| VREF    | Reference voltage from internal band gap circuit | 1.8V                 | -                     |
| VSP     | DC/DC converter circuit output                   | 4.7V ~ 5.5V          | Do not exceed 6 V     |
| VSN     | DC/DC converter circuit output                   | -4.7V ~ -5.5V        | Do not exceed 6V      |
| VSPC    | DC/DC converter circuit output                   | 4.7V ~ 5.5V          | Do not exceed 6 V     |
| VSNC    | DC/DC converter circuit output                   | -4.7V ~ -5.5V        | Do not exceed 6V      |
| VSPR    | Reference voltage for gamma circuit              | 3.5V ~ (VSP - 0.5V)  | Reference register    |
| VSNR    | Reference voltage for gamma circuit              | -3.5V ~ (VSN + 0.5V) | Reference register    |
| VDDDN   | Logic power supply                               | -2.5V                | -                     |
| VGH     | Positive gate driver output voltage level        | +9V ~ +20V           | Depend on VSP and VSN |
| VGL     | Negative gate driver output voltage level        | -6V ~ -13.5V         | Depend on VSP and VSN |
| LVGL    | GIP most negative voltage level                  | VGL-VDD3             | Depend on VSP and VSN |
| VCOM    | VCOM DC voltage                                  | -2V ~ 0V             | -                     |
| DSI_LDO | Analog power for MIPI DSI circuit                | 1.2V ~ 1.3V          | -                     |

| Pad Name      | Connection                                                                   | Typical Component Value                                                  |
|---------------|------------------------------------------------------------------------------|--------------------------------------------------------------------------|
| VCOM          | Connect to Capacitor (Max 6V): VCOM ---(-)----   --- (+)---- VSSA            | 2.2 $\mu$ F                                                              |
| VGH           | Connect to Capacitor (Max 25V): VGH ---(+)--   --- (-)---- VSSA              | 1.0 $\mu$ F                                                              |
| VGL           | Connect to Capacitor (Max 16V): VGL ---(+)--   --- (-)---- VSSA              | 1.0 $\mu$ F                                                              |
|               | Connect to Schottky Diode(VR $\geq$ 30V): VSSA ---(-)----   --- (+)---- VGL  | VF < 0.4V / 20mA @ 25°C, VR $\geq$ 30V<br>(Recommended diode: RB521S-30) |
| C24AP - C24AN | Connect to Capacitor (Max 16V): C24AP ---(+)--   --- (-)----C24AN            | 1.0 $\mu$ F                                                              |
| C23AP - C23AN | Connect to Capacitor (Max 16V): C23AP ---(+)--   --- (-)----C23AN            | 1.0 $\mu$ F                                                              |
| C22AP - C22AN | Connect to Capacitor (Max 16V): C22AP ---(+)--   --- (-)----C22AN            | 1.0 $\mu$ F                                                              |
| C21AP - C21AN | Connect to Capacitor (Max 16V): C21AP ---(+)--   --- (-)----C21AN            | 1.0 $\mu$ F                                                              |
| C41AP - C41AN | Connect to Capacitor (Max 16V): C41AP ---(+)--   --- (-)----C41AN            | 1.0 $\mu$ F                                                              |
| VSPR          | Connect to Capacitor (Max 10V): VSPR ---(+)--   --- (-)----VSSA              | 1.0 $\mu$ F                                                              |
| VSNR          | Connect to Capacitor (Max 10V): VSNR ---(+)--   --- (-)----VSSA              | 1.0 $\mu$ F                                                              |
| VDDD          | Connect to Capacitor (Max 6V): VDDD ---(+)--   --- (-)----VSSA               | 1.0 $\mu$ F                                                              |
| VDDDN         | Connect to Capacitor (Max 6V): VDDDN ---(+)--   --- (-)----VSSA              | 1.0 $\mu$ F                                                              |
| VREF          | Connect to Capacitor (Max 6V): VREF ---(-)----   --- (+)---- VSSA            | 1.0 $\mu$ F                                                              |
| VSP           | Connect to Capacitor (Max 10V):VSP ---(+)--   --- (-)----VSSA                | 2.2 $\mu$ F                                                              |
| VSN           | Connect to Capacitor (Max 10V):VSN ---(+)--   --- (-)----VSSA                | 2.2 $\mu$ F                                                              |
| VDD3          | Connect to Capacitor (Max 10V): VDD3 ---(+)--   --- (-)----VSSA              | 1.0 $\mu$ F                                                              |
| DSI_LDO       | Connect to Capacitor (Max 6V): DSI_LDO ---(+)--   --- (-)----DSI_VSS         | 1.0 $\mu$ F                                                              |
| LVGL          | Connect to Capacitor (Max 16V): LVGL ---(-)----   --- (+)---- VSSA           | 1.0 $\mu$ F                                                              |
|               | Connect to Schottky Diode(VR $\geq$ 30V): VSSA ---(-)----   --- (+)---- LVGL | VF < 0.4V / 20mA @ 25°C, VR $\geq$ 30V<br>(Recommended diode: RB521S-30) |

Table 7.1: Adoptability of component



## 8. Electrical Characteristics

### 8.1 Absolute maximum ratings

The absolute maximum ratings are list on Table 8.1. When used out of the absolute maximum ratings, the LSI may be permanently damaged. Using the LSI within the following electrical characteristics limit is strongly recommended for normal operation. If these electrical characteristic conditions are exceeded during normal operation, the LSI will malfunction and cause poor reliability.

| Item                   | Symbol               | Unit | Value        | Note                    |
|------------------------|----------------------|------|--------------|-------------------------|
| Power Supply Voltage 1 | VDD1~ VSSD           | V    | -0.3 to +3.6 | Note <sup>(1),(2)</sup> |
| Power Supply Voltage 2 | VDD2 ~ VSSA          | V    | -0.3 to +5.5 | Note <sup>(1),(3)</sup> |
| Power Supply Voltage 3 | VDD3 ~ VSSA          | V    | -0.3 to +5.5 | Note <sup>(1),(4)</sup> |
| Power Supply Voltage 4 | DSI_VCC ~<br>DSI_VSS | V    | -0.3 to +3.6 | Note <sup>(1),(5)</sup> |
| Power Supply Voltage 5 | VSP ~ VSSA           | V    | -0.3 to +6.6 | Note <sup>(6)</sup>     |
| Power Supply Voltage 6 | VSSA ~ VSN           | V    | 0 to -6.6    | Note <sup>(7)</sup>     |
| Power Supply Voltage 7 | VGH ~ VSSA           | V    | -0.3 to +25  | Note <sup>(8)</sup>     |
| Power Supply Voltage 8 | VSSA ~ VGL           | V    | 0 to -16     | Note <sup>(9)</sup>     |
| Operating Temperature  | Topr                 | °C   | -40 to +85   | Note <sup>(10)</sup>    |
| Storage Temperature    | Tstg                 | °C   | -55 to +110  | Note <sup>(11)</sup>    |

**Note:** (1) VDD1, VSSD must be maintained.

(2) To make sure  $VDD1 \geq VSSD$ .

(3) To make sure  $VDD2 \geq VSSA$ .

(4) To make sure  $VDD3 \geq VSSA$ .

(5) To make sure  $DSI\_VCC \geq DSI\_VSS$ .

(6) To make sure  $VSP \geq VSSA$ .

(7) To make sure  $VSSA \geq VSN$ .

(8) To make sure  $VGH \geq VSSA$ .

(9) To make sure  $VSSA \geq VGL$ .

$VGH + |VGL| < 32V$

(10) For die and wafer products, specified up to +85°C.

(11) This temperature specifications apply to the TCP package.

**Table 8.1: Absolute maximum rating**

### 8.2 ESD protection level

| Mode             | Test condition     | Criteria | Standard                      |
|------------------|--------------------|----------|-------------------------------|
| Human Body Model | C=100 pF, R=1.5 kΩ | ±2.0KV   | MIL-STD-883F<br>Method 3015.7 |
| Machine Model    | C=200 pF, R=0.0 Ω  | ±200V    | EIA/JEDEC<br>JESD22-A115-A    |

**Table 8.2: ESD protection level**

### 8.3 DC characteristics

(VDD2=2.3 ~ 4.8V, VDD3=2.3 ~ 4.8V, VDD1=1.65~3.3V, T<sub>A</sub>=-40 ~ 85 °C)

| Item                                                                | Symbol                   | Unit | Test Condition                                       | Min.                 | Typ. | Max.                 | Note |
|---------------------------------------------------------------------|--------------------------|------|------------------------------------------------------|----------------------|------|----------------------|------|
| Input high voltage                                                  | V <sub>IH</sub>          | V    | VDD1= 1.65 ~ 3.3V                                    | 0.7 V <sub>DD1</sub> | -    | VDD1                 | V    |
| Input low voltage                                                   | V <sub>IL</sub>          | V    | VDD2= 2.3 ~ 3.3V<br>VDD3= 2.3 ~ 3.3V                 | 0                    | -    | 0.3 V <sub>DD1</sub> | V    |
| VPP                                                                 | V <sub>IH</sub>          | V    | VPP                                                  | 7.25V                | 7.5V | 7.75V                | V    |
|                                                                     | V <sub>IL</sub>          | V    |                                                      |                      |      |                      |      |
| Output high voltage<br>(SDO, CABC_PWM_OUT)                          | V <sub>OH1</sub>         | V    | I <sub>OH</sub> = -1.0 mA                            | 0.8 V <sub>DD1</sub> | -    | VDD1                 | V    |
| Output low voltage<br>(SDO, CABC_PWM_OUT)                           | V <sub>OL1</sub>         | V    | VDD1= 1.65 ~ 2.4V<br>I <sub>OL</sub> = 1.0 mA        | 0                    | -    | 0.2 V <sub>DD1</sub> | V    |
| Logic High level input<br>current                                   | I <sub>IH</sub>          | uA   | VSYNC, HSYNC                                         | -                    | -    | 1                    | uA   |
|                                                                     |                          |      | RESX, DCX_SCL, CSX,<br>RDX_E, WRX_DCX                | -                    | -    | 1                    | uA   |
|                                                                     | I <sub>IHD</sub>         | uA   | DB[23...0], SDI,<br>DCX_SCL                          | -                    | -    | 1                    | uA   |
|                                                                     |                          |      | DB[23...0]                                           | -                    | -    | 1                    | uA   |
| Logic Low level input<br>current                                    | I <sub>IL</sub>          | uA   | VSYNC, HSYNC                                         | -1                   | -    |                      | uA   |
|                                                                     |                          |      | RESX, DCX_SCL, CSX,<br>RDX_E, WRX_DCX                | -1                   | -    |                      | uA   |
|                                                                     | I <sub>ILD</sub>         | uA   | DB[23...0], SDI,<br>DCX_SCL                          | -1                   | -    |                      | uA   |
|                                                                     |                          |      | DB[17...0]                                           | -1                   | -    |                      | uA   |
| Current consumption<br>standby mode<br>(VDD2/VDD3-VSSD)             | I <sub>ST(VDD)</sub>     | uA   | VDD2/VDD3=2.8V,<br>VDD1=1.8V<br>T <sub>A</sub> =25°C | -                    | 30   | 80                   | uA   |
| Current consumption<br>standby mode<br>(VDD1- VSSD)                 | I <sub>ST(VDD1)</sub>    | uA   |                                                      | -                    | 1    | -                    | uA   |
| Current consumption<br>during Deep-standby mode<br>(VDD2/VDD3-VSSD) | I <sub>DP-ST(VDD)</sub>  | uA   |                                                      | -                    | 5    | -                    | uA   |
| Current consumption<br>during Deep-standby mode<br>(VDD1- VSSD)     | I <sub>DP-ST(VDD1)</sub> | uA   |                                                      | -                    | 1    | -                    | uA   |

**Note:** 1. The VPP pin is open on normal mode and in used while OTP programming condition.

2. The GRAM data is eliminated under the Deep standby mode.

**Table 8.3: DC characteristic**

## 8.4 AC characteristics

### 8.4.1 DBI Type A interface characteristics

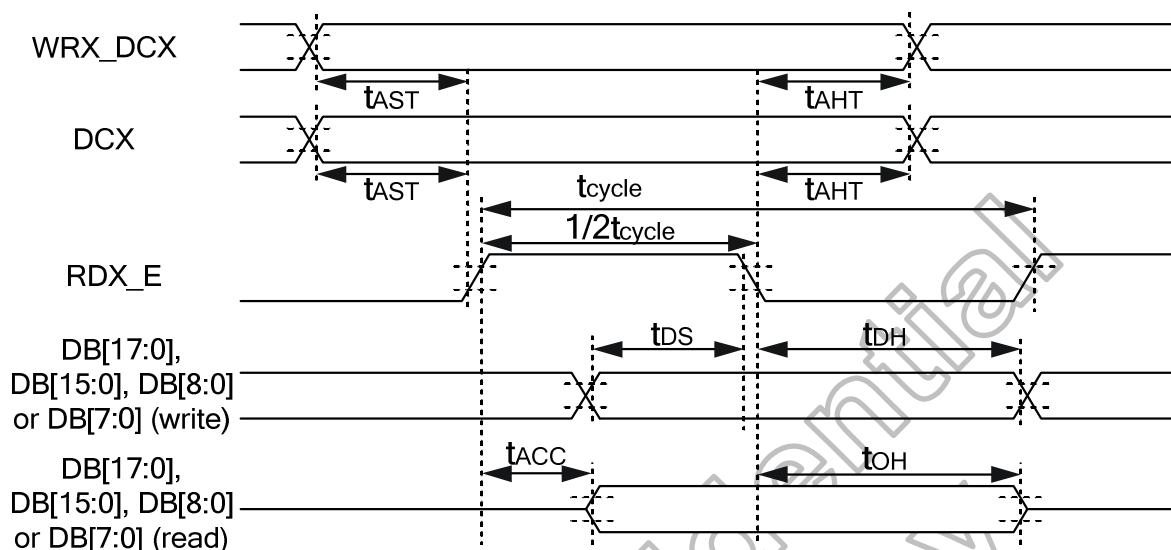


Figure 8.1: DBI Type A interface characteristics(CLK-E mode)

(VSSA=0V, VDD1=1.8V, VDD2=2.8V, VDD3=2.8V, T<sub>A</sub>=25°C)

| Signal                | Symbol                                                                    | Parameter                                                                    | Min.                 | Max.             | Unit | Description                                  |
|-----------------------|---------------------------------------------------------------------------|------------------------------------------------------------------------------|----------------------|------------------|------|----------------------------------------------|
| WRX_DCX<br>or DCX_SCL | t <sub>AST</sub><br>t <sub>AHT</sub>                                      | Address setup time<br>Address hold time (Write/Read)                         | 10<br>10             | -<br>-           | ns   | -                                            |
| CSX or<br>RDX_E       | t <sub>cycle</sub>                                                        | System clock cycle time read register                                        | 100                  | 790              | ns   | -                                            |
|                       |                                                                           | Read GRAM                                                                    | 350                  | 790              | ns   | -                                            |
|                       |                                                                           | Write register                                                               | 100                  | 790              | ns   | -                                            |
|                       |                                                                           | Write GRAM @ SLPOUT                                                          | 33                   | 790              | ns   | -                                            |
|                       |                                                                           | Write GRAM @ SLPIN                                                           | 100                  | 790              | ns   | -                                            |
| DB23-DB0              | t <sub>DS</sub><br>t <sub>DH</sub><br>t <sub>ACC</sub><br>t <sub>OH</sub> | Data setup time<br>Data hold time<br>Read access time<br>Output disable time | 15<br>25<br>10<br>10 | -<br>-<br>-<br>- | ns   | For maximum<br>CL=30pF<br>For minimum CL=8pF |

**Note:** The input signal rise time and fall time (tr, tf) is specified at 15 ns or less.

Logic high and low levels are specified as 30% and 70% of VDD1 for Input signals.

Table 8.4: DBI Type A interface characteristics

## 8.4.2 DBI Type B interface characteristics

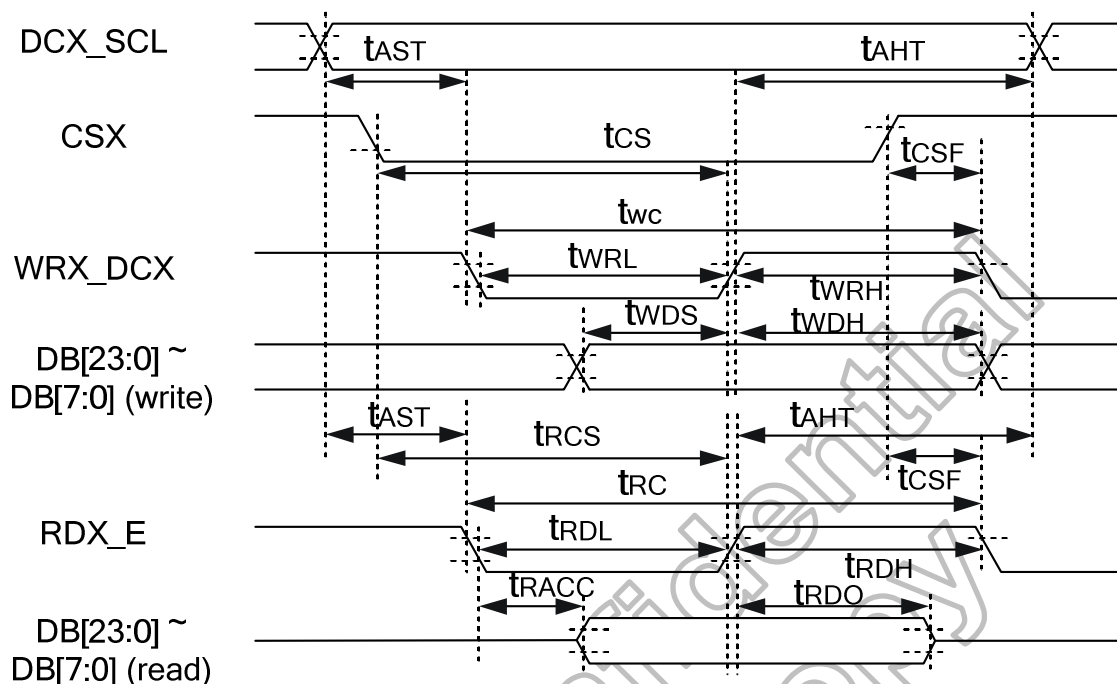


Figure 8.2: DBI Type B interface characteristics

(VSSA=0V, VDD1=1.8V, VDD2=2.8V, VDD3=2.8V, T<sub>A</sub>=25°C)

| Signal   | Symbol                                                                                        | Parameter                                                                                                                                                     | Min.                         | Max.                            | Unit | Description                                                         |
|----------|-----------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------|---------------------------------|------|---------------------------------------------------------------------|
| DCX_SCL  | t <sub>AST</sub><br>t <sub>AHT</sub>                                                          | Address setup time<br>Address hold time (Write/Read)                                                                                                          | 10<br>10                     | -<br>-                          | ns   | -                                                                   |
| CSX      | t <sub>CS</sub><br>t <sub>RCS</sub><br>t <sub>RCSFM</sub><br>t <sub>CSF</sub>                 | Chip select setup time (Write)<br>Chip select setup time (Read ID)<br>Chip Select setup time (Read FM)<br>Chip select wait time (Write/Read)                  | 20<br>45<br>355<br>20        | -<br>-<br>-<br>-                | ns   | -                                                                   |
| WRX_DCX  | t <sub>WC</sub><br>t <sub>WC</sub><br>t <sub>WC</sub><br>t <sub>WRH</sub><br>t <sub>WRL</sub> | Write cycle (write register)<br>Write cycle (write GRAM@SLPOUT)<br>Write cycle (write GRAM@SLPIN)<br>Control pulse "H" duration<br>Control pulse "L" duration | 100<br>33<br>100<br>15<br>15 | 790<br>790<br>790<br>630<br>160 | ns   | -                                                                   |
| RDX_E    | t <sub>RC</sub><br>t <sub>RC</sub><br>t <sub>RDH</sub><br>t <sub>RDL</sub>                    | Read cycle (read register)<br>Read cycle (GRAM)<br>Control pulse "H" duration<br>Control pulse "L" duration                                                   | 100<br>350<br>30<br>20       | 790<br>790<br>630<br>160        | ns   | -                                                                   |
| DB23-DB0 | t <sub>WDS</sub><br>t <sub>WDH</sub><br>t <sub>TRACC</sub><br>t <sub>TRDO</sub>               | Data setup time<br>Data hold time<br>Read access time<br>Output disable time                                                                                  | 15<br>25<br>10<br>10         | -<br>-<br>-<br>-                | ns   | For maximum C <sub>L</sub> =30pF<br>For minimum C <sub>L</sub> =8pF |

**Note:** The input signal rise time and fall time (tr, tf) is specified at 15 ns or less.

Logic high and low levels are specified as 30% and 70% of VDD1 for Input signals.

Table 8.5: DBI Type B interface characteristics

### 8.4.3 DBI Type C interface characteristics

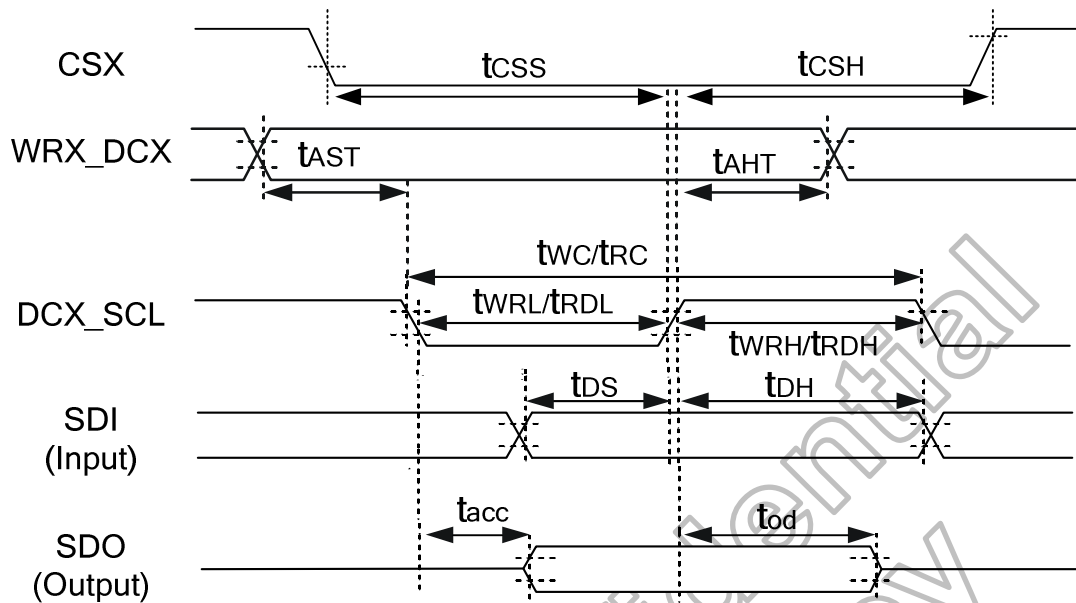


Figure 8.3: DBI Type C interface characteristics

(VSSA=0V, VDD1=1.8V, VDD2=2.8V, VDD3=2.8V,  $T_A = 25^\circ\text{C}$ )

| Signal              | Symbol     | Parameter                      | Min. | Max. | Unit | Description                                                   |
|---------------------|------------|--------------------------------|------|------|------|---------------------------------------------------------------|
| CSX                 | $t_{CSS}$  | Chip select setup time (Write) | 40   | -    | ns   | -                                                             |
|                     | $t_{CSH}$  | Chip select setup time (Read)  | 40   | -    | ns   |                                                               |
| WRX_DCX             | $t_{AST}$  | Address setup time             | 10   | -    | ns   | -                                                             |
|                     | $t_{AHT}$  | Address hold time (Write/Read) | 10   | -    | ns   |                                                               |
| DCX_SCL<br>(Write)  | $t_{WC}$   | Write cycle                    | 100  | -    | ns   | -                                                             |
|                     | $t_{WRH}$  | Control pulse "H" duration     | 40   | -    | ns   |                                                               |
|                     | $t_{WRL}$  | Control pulse "L" duration     | 40   | -    | ns   |                                                               |
| DCX_SCL<br>(Read)   | $t_{RC}$   | Read cycle                     | 150  | -    | ns   | -                                                             |
|                     | $t_{RDH}$  | Control pulse "H" duration     | 60   | -    | ns   |                                                               |
|                     | $t_{RDL}$  | Control pulse "L" duration     | 60   | -    | ns   |                                                               |
| SDI/SDO<br>(Input)  | $t_{DS}$   | Data setup time                | 30   | -    | ns   | For maximum $C_L=30\text{pF}$<br>For minimum $C_L=8\text{pF}$ |
|                     | $t_{dT}$   | Data hold time                 | 30   | -    | ns   |                                                               |
| SDI/SDO<br>(Output) | $t_{RACC}$ | Read access time               | 10   | -    | ns   |                                                               |
|                     | $t_{od}$   | Output disable time            | 10   | 50   | ns   |                                                               |

**Note:** The input signal rise time and fall time ( $t_r$ ,  $t_f$ ) is specified at 15 ns or less.

Logic high and low levels are specified as 30% and 70% of VDD1 for Input signals.

Table 8.6: DBI Type C interface characteristics

## 8.4.4 DPI interface characteristics

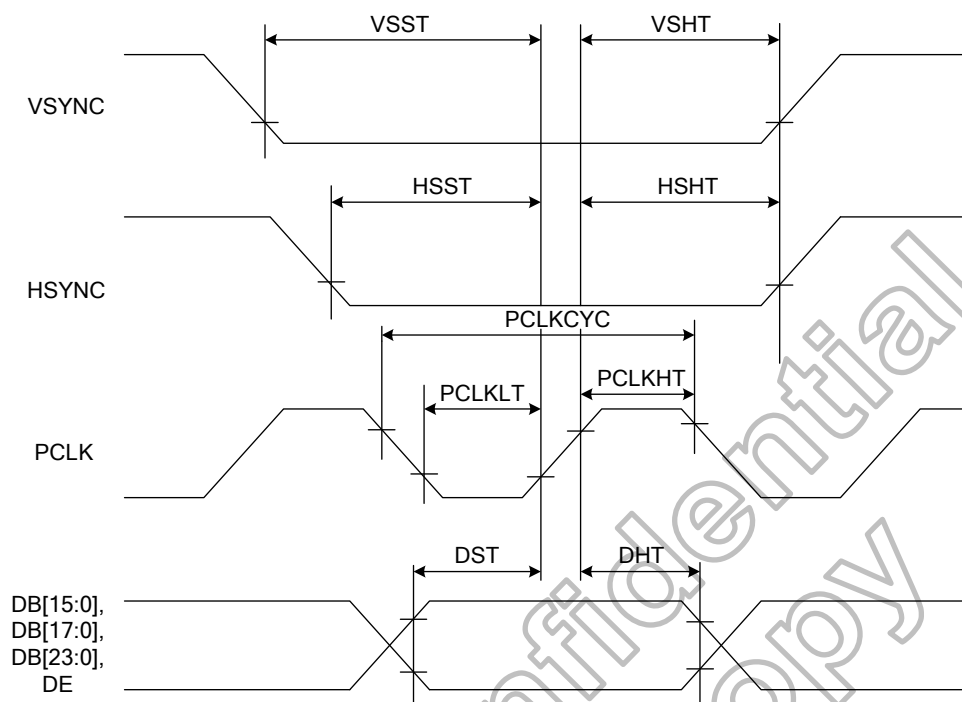


Figure 8.4: DPI interface characteristics

(VSSA=0V, VDD1=1.8V, VDD2=2.8V, VDD3=2.8V, T<sub>A</sub>=25°C)

| Parameter                                 | Symbol            | Condition                       | Min. | Typ. | Max. | Unit |
|-------------------------------------------|-------------------|---------------------------------|------|------|------|------|
| Vertical sync. setup time                 | VSST              | -                               | 5    | -    | -    | ns   |
| Vertical sync. hold time                  | VSHT              | -                               | 5    | -    | -    | ns   |
| Horizontal sync. setup time               | HSST              | -                               | 5    | -    | -    | ns   |
| Horizontal sync. hold time                | HSHT              | -                               | 5    | -    | -    | ns   |
| Pixel clock cycle when RGB I/F is running | PCLKCYC (480x854) | VRR <sup>(3)</sup> = Min. 50 Hz | 21.6 | -    | 34.3 | MHz  |
|                                           |                   | Max. 70 Hz                      | 29.1 | -    | 46.2 | ns   |
|                                           | PCLKCYC (480x800) | VRR <sup>(3)</sup> = Min. 50 Hz | 20.3 | -    | 32.2 | MHz  |
|                                           |                   | Max. 70 Hz                      | 31   | -    | 49.2 | ns   |
|                                           | PCLKCYC (360x640) | VRR <sup>(3)</sup> = Min. 50 Hz | 12.4 | -    | 20.3 | MHz  |
|                                           |                   | Max. 70 Hz                      | 49.2 | -    | 80.6 | ns   |
| Pixel clock low time                      | PCLKLT            | -                               | 5    | -    | -    | ns   |
| Pixel clock high time                     | PCLKHT            | -                               | 5    | -    | -    | ns   |
| Data setup time DB[23:0]                  | DST               | -                               | 5    | -    | -    | ns   |
| Data hold time DB[23:0]                   | DHT               | -                               | 5    | -    | -    | ns   |

**Note:** (1) Signal rise and fall times are equal to or less than 20 ns.

(2) Input signals are measured by 0.30 x VDD1 for low state and 0.70 x VDD1 for high state.

(3) VRR : Vertical Refresh Rate, equal to VSYNC frequency.

Table 8.7: DPI interface characteristics

## Vertical Timings for RGB I/F

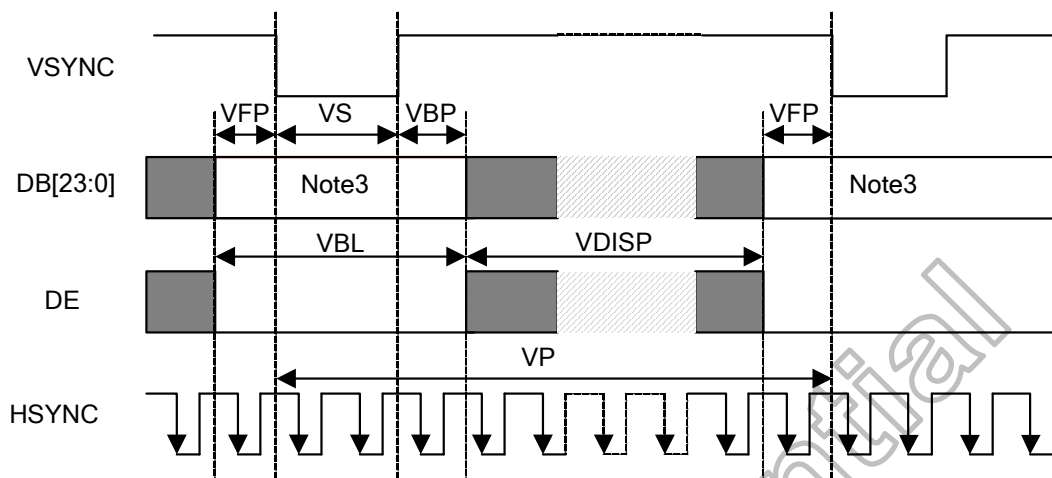


Figure 8.5: Vertical Timings for RGB I/F

(VSSA=0V, VDD1=1.8V, VDD2=2.8V, VDD3=2.8V, T<sub>A</sub>=25°C)

| Item                      | Symbol | Condition          | Min. | Typ. | Max.    | Unit |
|---------------------------|--------|--------------------|------|------|---------|------|
| Vertical cycle            | VP     | Resolution=480x854 | 860  |      |         | Line |
|                           |        | Resolution=480x800 | 806  | -    | -       | Line |
|                           |        | Resolution=360x640 | 646  |      |         | Line |
| Vertical low pulse width  | VS     | -                  | 2    | -    | Note(4) | Line |
| Vertical front porch      | VFP    | -                  | 2    | -    | -       | Line |
| Vertical back porch       | VBP    | -                  | 2    | -    | Note(4) | Line |
| Vertical data start point | -      | VS+VBP             | 4    | -    | Note(4) | Line |
| Vertical blanking period  | VBL    | VS+VBP+VFP         | 6    | -    | -       | Line |
| Vertical active area      |        | VDISP(480x854)     | -    | 854  | -       | Line |
|                           |        | VDISP(480x800)     | -    | 800  |         |      |
|                           |        | VDISP(360x640)     | -    | 640  |         |      |
| Vertical Refresh rate     | VRR    | -                  | 50   | -    | 70      | Hz   |

**Note:** (1) Signal rise and fall times are equal to or less than 20 ns.

(2) Input signals are measured by 0.30 x VDD1 for low state and 0.70 x VDD1 for highstate.

(3) Data lines can be set to "High" or "Low" during blanking time – Don't care.

(4) The VS and VBP pulse width are related to ASG/GIP STV and CKV timing. The STV and CKV must be set at corresponding position for LCD normal display. Also refer to setion 6.2.66 SETGIP.

Table 8.8 Vertical Timings for RGB I/F



# Horizontal Timings for RGB I/F

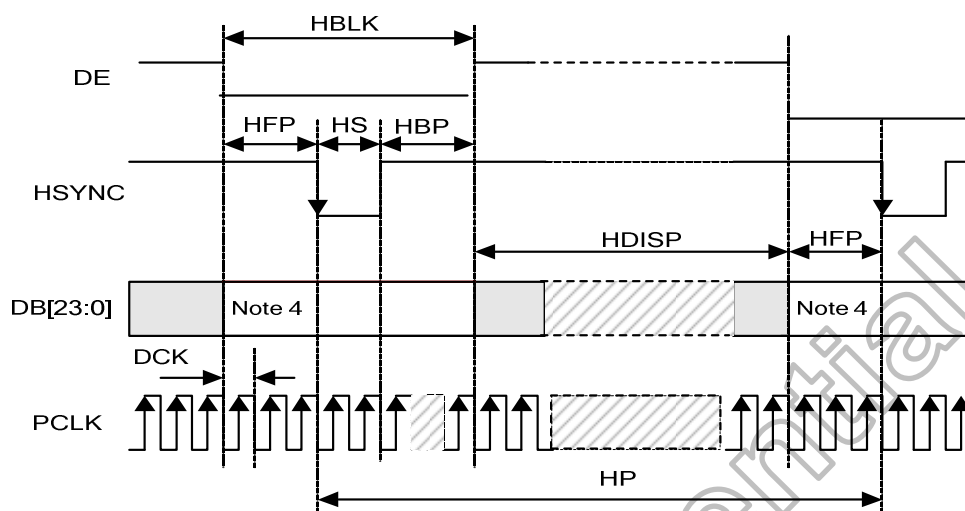


Figure 8.6: Horizontal Timing for RGB I/F

(VSSA=0V, VDD1=1.8V, VDD2=2.8V, VDD3=2.8V, T<sub>A</sub>=25°C)

| Item                                             | Symbol           | Condition          | Min. | Typ. | Max. | Unit |
|--------------------------------------------------|------------------|--------------------|------|------|------|------|
| HS cycle                                         | HP               | Resolution=480x854 | 504  | -    | 568  | DCK  |
|                                                  |                  | Resolution=480x800 | 504  | -    | 568  | DCK  |
|                                                  |                  | Resolution=360x640 | 384  | -    | 448  | DCK  |
| HS low pulse width                               | HS               | -                  | 5    | -    | 78   | DCK  |
| Horizontal back porch                            | HBP              | -                  | 5    | -    | 78   | DCK  |
| Horizontal front porch                           | HFP              | -                  | 5    | -    | 78   | DCK  |
| Horizontal data start point                      | -                | HS+HBP             | 19   | -    | 83   | DCK  |
|                                                  |                  |                    | 700  | -    | -    | ns   |
| Horizontal blanking period                       | HBLK             | HS+HBP+HFP         | 24   | -    | 88   | DCK  |
| Horizontal active area                           | HDISP            | Resolution=480x854 | -    | 480  | -    | DCK  |
|                                                  |                  | Resolution=480x800 | -    | 480  | -    | DCK  |
|                                                  |                  | Resolution=360x640 | -    | 360  | -    | DCK  |
| Pixel clock frequency<br>When RGB I/F is running | DCK<br>(480x854) | VRR = Min. 50 Hz   | 21.6 | -    | 34.3 | MHz  |
|                                                  |                  | - Max. 70 Hz       | 29.1 | -    | 46.2 | ns   |
|                                                  | DCK<br>(480x800) | VRR = Min. 50 Hz   | 20.3 | -    | 32.2 | MHz  |
|                                                  |                  | - Max. 70 Hz       | 31   | -    | 49.2 | ns   |
|                                                  | DCK<br>(360x640) | VRR = Min. 50 Hz   | 12.4 | -    | 20.3 | MHz  |
|                                                  |                  | - Max. 70 Hz       | 49.2 | -    | 80.6 | ns   |

Note:(1) Signal rise and fall times are equal to or less than 20 ns.

(2) Input signals are measured by 0.30 x VDD1 for low state and 0.70 x VDD1 for high state.

(3) HP is multiples of eight DCK.

(4)Data lines can be set to "High" or "Low" during blanking time – Don't care.

Table 8.9 Horizontal Timings for RGB I/F

## 8.4.5 Reset input timing

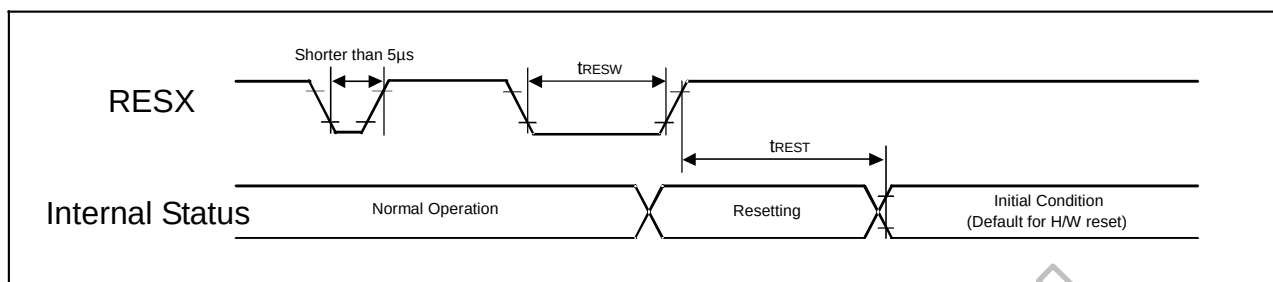


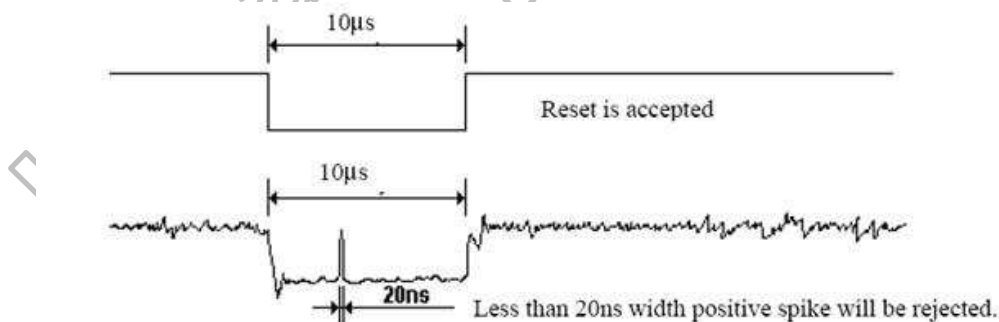
Figure 8.7: Reset input timing

| Symbol     | Parameter                            | Related pins | Min. | Typ. | Max. | Note                                        | Unit |
|------------|--------------------------------------|--------------|------|------|------|---------------------------------------------|------|
| $t_{RESW}$ | Reset low pulse width <sup>(1)</sup> | RESX         | 10   | -    | -    | -                                           | μs   |
| $t_{REST}$ | Reset complete time <sup>(2)</sup>   | -            | 5    | -    | -    | When reset is applied during Sleep In mode  | ms   |
|            |                                      | -            | 120  | -    | -    | When reset is applied during Sleep Out mode | ms   |

**Note:** (1) Spike due to an electrostatic discharge on RESX line does not cause irregular system reset according to the table below.

| RESX Pulse             | Action         |
|------------------------|----------------|
| Shorter than 5 μ       | Reset Rejected |
| Longer than 10 μs      | Reset          |
| Between 5 μs and 10 μs | Reset Start    |

- (2) During the resetting period, the display will be blanked (The display is entering blanking sequence, which maximum time is 120 ms, when Reset Starts in Sleep Out –mode. The display remains the blank state in Sleep In –mode) and then returns to Default condition for H/W reset.
- (3) During Reset Complete Time, ID2 value in OTP will be latched to internal register during this period. This loading is done every time when there is H/W reset complete time ( $t_{REST}$ ) within 5ms after a rising edge of RESX.
- (4) Spike Rejection also applies during a valid reset pulse as shown below:



- (5) When Reset is applied during Sleep In Mode.
- (6) When Reset is applied during Sleep Out Mode.
- (7) It is necessary to wait 5msec after releasing RESX before sending commands. Also Sleep Out command cannot be sent for 120msec.

Table 8.10: Reset timing

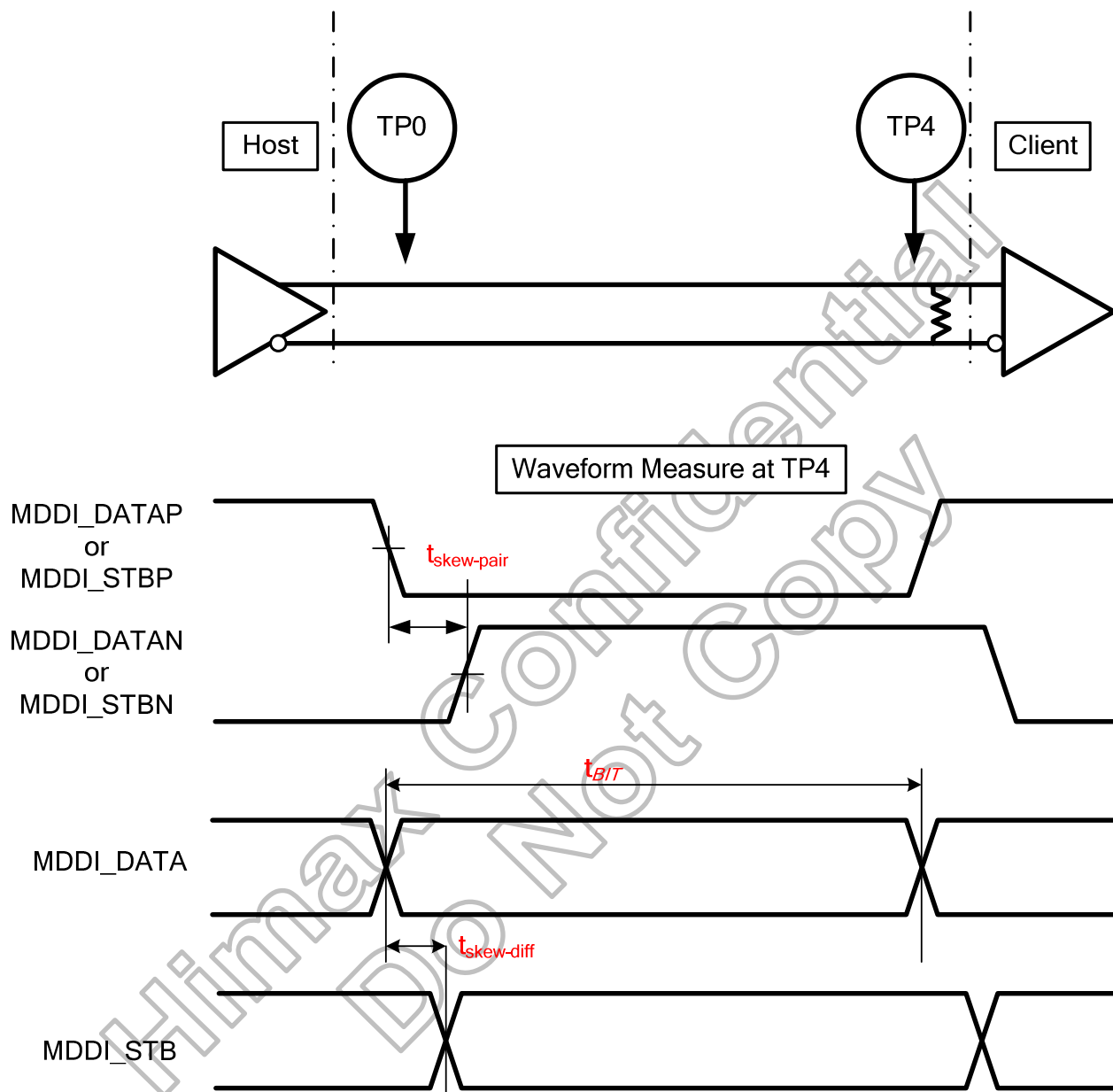
## 8.4.6 MDDI electrical characteristics

### 8.4.6.1 DC characteristic

| Parameter         | Description                                                                                                                                                                      | Min. | Typ. | Max. | Unit |
|-------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|------|------|------|
| $V_{IT+}$         | Receiver differential input high threshold voltage. Above this differential voltage the input signal shall be interpreted as a logic-one level.                                  | -    | 0    | 50   | mV   |
| $V_{IT-}$         | Receiver differential input low threshold voltage. Below this differential voltage the input signal shall be interpreted as a logic-zero level.                                  | -50  | 0    | -    | -    |
| $V_{IT+\_hib}$    | Receiver differential input high threshold voltage (offset for hibernation wake-up). Above this differential voltage the input signal shall be interpreted as a logic-one level. | -    | 100  | 125  | mV   |
| $V_{IT-\_hib}$    | Receiver differential input low threshold voltage (offset for hibernation wake-up). Below this differential voltage the input signal shall be interpreted as a logic-zero level. | 75   | 100  | -    | mV   |
| $V_{Input-Range}$ | Allowable receiver input voltage range with respect to client ground.                                                                                                            | 0.5  | -    | 1.2  | V    |

Himax Confidential  
Do Not Copy

### 8.4.6.2 AC characteristic

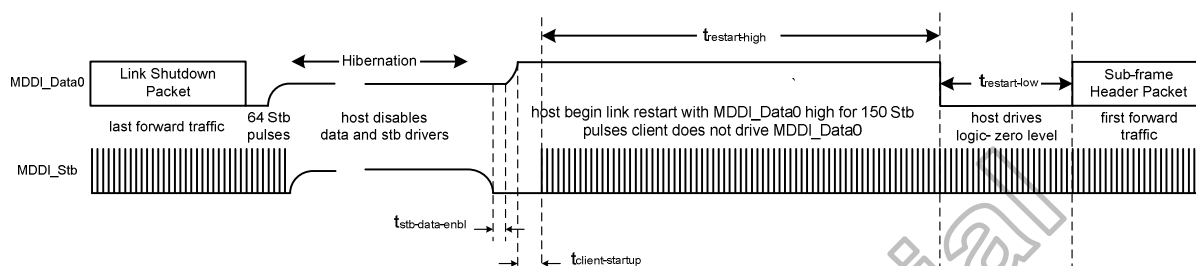


| Parameter              | Description                                                                                                            | Min.                   | Typ. | Max.                  | Unit |
|------------------------|------------------------------------------------------------------------------------------------------------------------|------------------------|------|-----------------------|------|
| $1/t_{\text{BIT}}$     | MDDI operate speed                                                                                                     | 50                     | 350  | 400                   | Mbps |
| $t_{\text{skew-pair}}$ | Skew between positive and negative inputs of the differential receiver of the same differential pair (intra-pair skew) | -0.05                  | 0    | 0.05                  | ns   |
| $t_{\text{skew-diff}}$ | Peak delay skew between one differential pair and any other differential pair                                          | $-0.45 t_{\text{BIT}}$ | 0    | $0.45 t_{\text{BIT}}$ | ns   |
| $t_{\text{Rise-Fall}}$ | Rise/Fall time(20%-80% of swing)                                                                                       | 200                    | -    | Note <sup>(1)</sup>   | ps   |

**Note :** The maximum rise and fall time is either 35% of the interval to transmit one bit on one differential pair or 100 nsec, whichever is smaller.

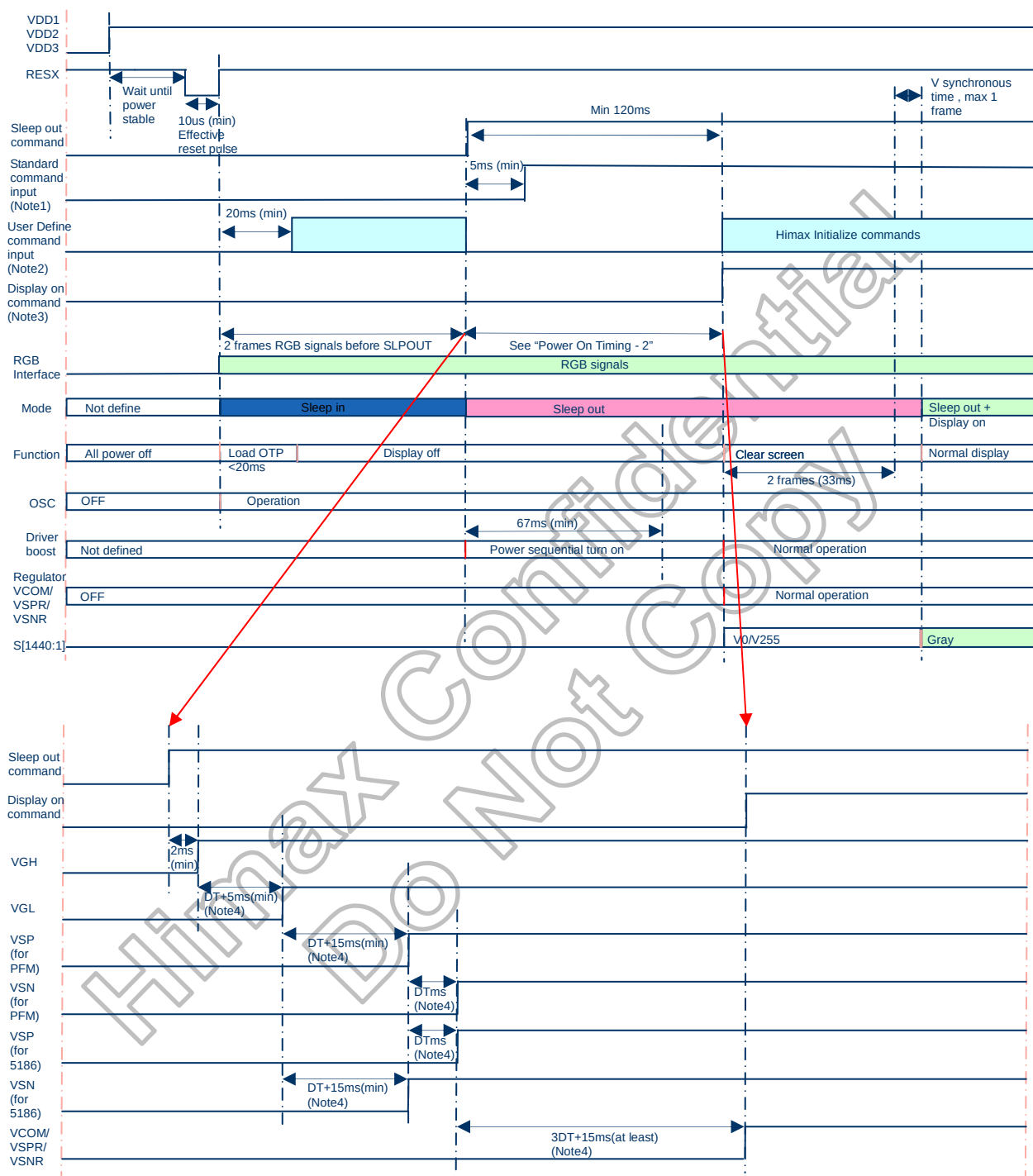
### 8.4.6.3 DC characteristic

#### Host-Initiated Wake-up



| Parameter                   | Description                                                                                  | Min. | Typ. | Max. | Unit            |
|-----------------------------|----------------------------------------------------------------------------------------------|------|------|------|-----------------|
| $t_{\text{restart-high}}$   | Duration of host link restart high pulse                                                     | 140  | 150  | 250  | Stb clock       |
| $t_{\text{restart-low}}$    | Duration of host link restart low pulse                                                      | 50   | 50   | 50   | Stb clock       |
| $t_{\text{stb-data-enbl}}$  | MDDI_Stb completely enabled to MDDI_Data0 enabled                                            | 0    | -    | -    | $\mu\text{sec}$ |
| $t_{\text{client-startup}}$ | Time for host to hold MDDI_Stb at logic-zero level after MDDI_Data0 reaches logic-high level | 200  | -    | -    | nsec            |

### 8.4.7 DPI Interface Power On/Off Timing



**Note1:**  
“Standard” command except “01h” & “10h” command must wait 5ms after “Sleep out” command then can be sent. “01h” & “10h” command must wait 100ms after “Sleep out” command then can be sent.

**Note2:**  
“User Define” command must be sent “B9h” first then other commands can be available.

**Note3:**  
“Display on” command must send after “User Define” command or at the same time.

**Note4:**

DT[1:0]: Delay time of power on and power off sequence on

| DT1 | DT0 | Delay time of power on and power off sequence on |
|-----|-----|--------------------------------------------------|
| 0   | 0   | 5ms                                              |
| 0   | 1   | 10ms                                             |
| 1   | 0   | 15ms                                             |
| 1   | 1   | 20ms                                             |

Default DT=5ms

Figure 8.8 Power On Timing

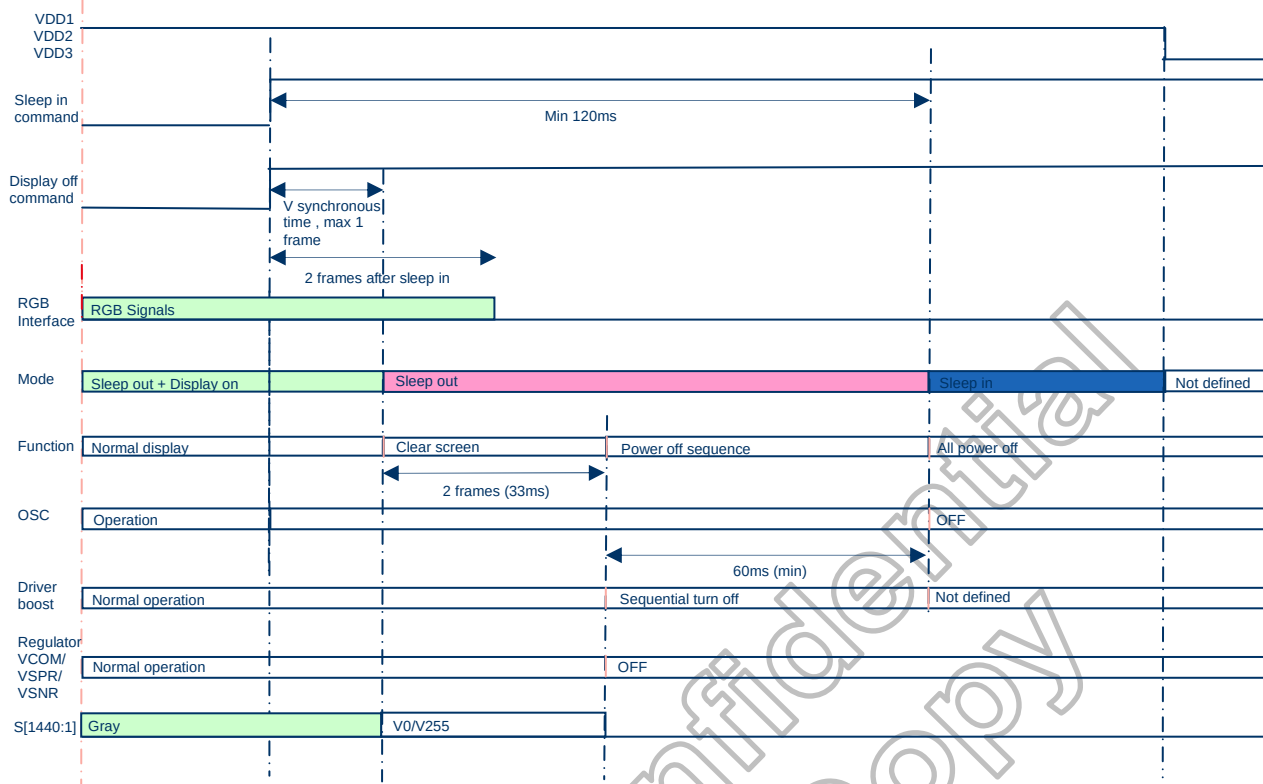


Figure 8.9 Power Off Timing



## 8.4.8 DSI D-PHY electrical characteristics

### 8.4.8.1 The Electrical Characteristics of D-PHY Layer

In general, the DSI - PHY may contain the following electrical functions: High-Speed Receiver (HS-RX), Low Power Transmitter (LP-TX), a Low-Power Receiver (LP-RX), and the Low-Power Contention Detector (LP-CD). Figure 8.10 shows the complete set of electrical functions required for a fully featured PHY transceiver.

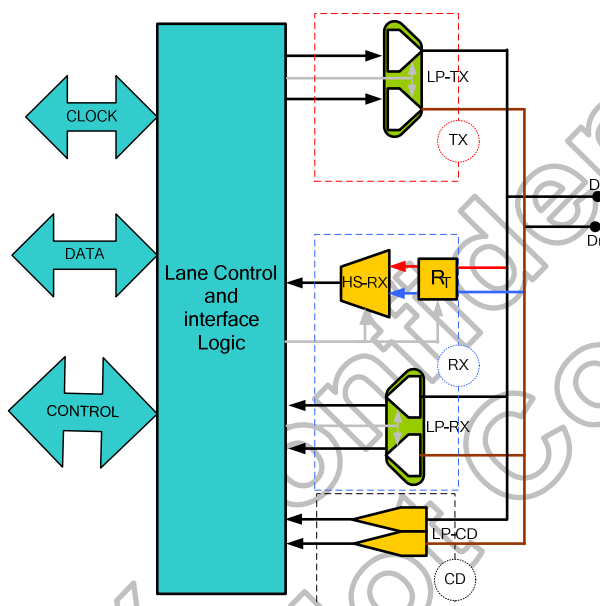


Figure 8.10: Electrical functions of a fully D-PHY transceiver

Where, the HS receiver utilize low-voltage swing differential signaling for signal transmission. The LP transmitter and LP receiver serve as a low power signaling mechanism. The Figure 8.11 shows both the HS and LP signal levels on the left and right sides, respectively.

Because the HS signaling levels are below the LP low-level input threshold, Lane switches between Low-Power and High-Speed mode during normal operation.

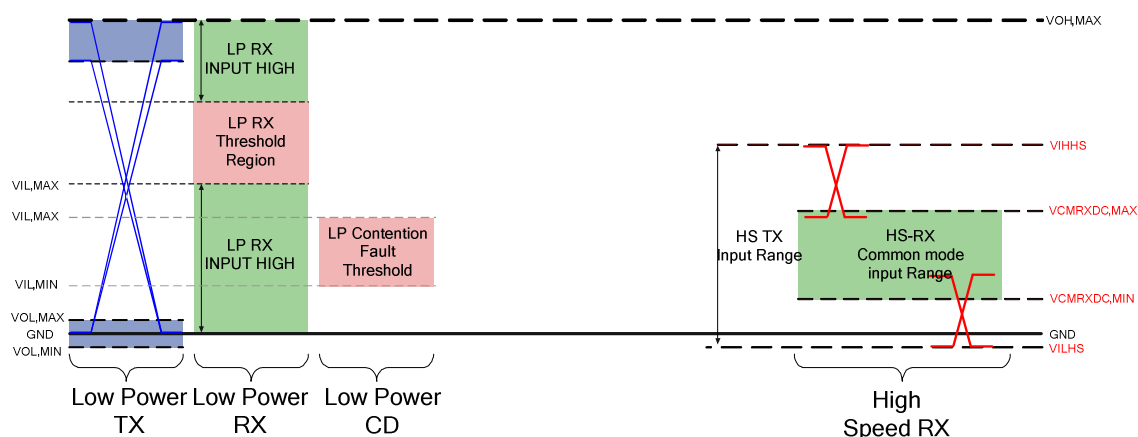


Figure 8.11: Shows both the HS and LP signal levels

### 8.4.8.2 The Electrical Characteristics of Low-Power Transmitter

The Low-Power transmitter shall be a slew-rate controlled push-pull driver. It is used for driving the Lines in all Low-Power operating modes. It is therefore important that the static power consumption of a LP transmitter be as low as possible. Under tables list DC and AC characteristic for LP-TX

| Parameter | Description                | Min | Nom | Max | Units    | Note |
|-----------|----------------------------|-----|-----|-----|----------|------|
| $V_{OL}$  | Thevenin output low level  | -50 |     | 50  | mV       |      |
| $V_{OH}$  | Thevenin output high level | 1.1 | 1.2 | 1.3 | V        |      |
| $Z_{OLP}$ | Output impedance of LP-TX  | 110 |     |     | $\Omega$ | 1    |

Note: Though no maximum value for  $Z_{OLP}$  is specified, the LP transmitter output impedance shall ensure the  $t_{RLP}/t_{FLP}$  specification is met.

**Table 8.11: LP Transmitter DC Specifications**

| Parameter                | Description                                       | Min                                   | Nom | Max | Units | Note       |
|--------------------------|---------------------------------------------------|---------------------------------------|-----|-----|-------|------------|
| $t_{RLP}/t_{FLP}$        | 15%-85% rise time and fall time                   | -                                     | -   | 25  | ns    | 1          |
| $\delta V/\delta t_{SR}$ | Slew rate @ CLOAD = 0pF                           | -                                     | -   | 500 | mV/ns | 1, 3, 5, 6 |
|                          | Slew rate @ CLOAD = 5pF                           | -                                     | -   | 300 | mV/ns | 1, 3, 5, 6 |
|                          | Slew rate @ CLOAD = 20pF                          | -                                     | -   | 250 | mV/ns | 1, 3, 5, 6 |
|                          | Slew rate @ CLOAD = 70pF                          | -                                     | -   | 150 | mV/ns | 1, 3, 5, 6 |
|                          | Slew rate @ CLOAD = 0 to 70pF (Falling Edge Only) | 30                                    | -   | -   | mV/ns | 1, 2, 3    |
|                          | Slew rate @ CLOAD = 0 to 70pF (Rising Edge Only)  | 30                                    | -   | -   | mV/ns | 1, 3, 7    |
|                          | Slew rate @ CLOAD = 0 to 70pF (Rising Edge Only)  | $30 - 0.075 \cdot (V_{O,INST} - 700)$ | -   | -   | mV/ns | 1, 8, 9    |
| $C_{LOAD}$               | Load capacitance                                  | -                                     | -   | 70  | pF    |            |

Note:

1.  $C_{LOAD}$  includes the low-frequency equivalent transmission line capacitance. The capacitance of TX and RX are assumed to always be <10pF. The distributed line capacitance can be up to 50pF for a transmission line with 2ns delay.
2. When the output voltage is between 400 mV and 930 mV.
3. Measured as average across any 50 mV segment of the output signal transition.
4. This parameter value can be lower than  $T_{LPX}$  due to differences in rise vs. fall signal slopes and trip levels and mismatches between Dp and Dn LP transmitters.
5. This value represents a corner point in a piecewise linear curve.
6. When the output voltage is in the range specified by  $V_{PIN(absmax)}$ .
7. When the output voltage is between 400 mV and 700 mV.
8. Where  $V_{O,INST}$  is the instantaneous output voltage,  $V_{DP}$  or  $V_{DN}$ , in millivolts.
9. When the output voltage is between 700 mV and 930 mV.

**Table 8.12: LP Transmitter AC Specifications**

### 8.4.8.3 The Electrical Characteristics of Receiver

This part will contain two parts which High-Speed Receiver and Low-Power Receiver. Because their have differential DC and AC characteristic, describe HS-RX first then describe LP-RX.

### 8.4.8.4 High-Speed Receiver

The HS receiver is a differential line receiver. It contains a switch-able parallel input termination, Z<sub>ID</sub>, between the positive input pin D<sub>p</sub> and the negative input pin D<sub>n</sub>. Under Tables list DC and AC characteristic for HS-RX.

| Parameter           | Description                         | Min | Nom | Max | Units | Note |
|---------------------|-------------------------------------|-----|-----|-----|-------|------|
| V <sub>IDTH</sub>   | Differential input high threshold   |     |     | 70  | mV    |      |
| V <sub>IDTL</sub>   | Differential input low threshold    | -70 |     |     | mV    |      |
| V <sub>ILHS</sub>   | Single-ended input low voltage      | -40 |     |     | mV    | 1    |
| V <sub>IHHS</sub>   | Single-ended input high voltage     |     |     | 460 | mV    | 1    |
| V <sub>CMRXDC</sub> | Common-mode voltage HS receive mode | 70  |     | 330 | mV    | 1, 2 |
| Z <sub>ID</sub>     | Differential input impedance        | 80  | 100 | 125 | Ω     |      |

NOTE:

1. Excluding possible additional RF interference of 100mV peak sine wave beyond 450MHz.
2. This table value includes a ground difference of 50mV between the transmitter and the receiver, the static common-mode level tolerance and variations below 450MHz

**Table 8.13: HS Receiver DC Specifications**

| Parameter              | Description                             | Min | Nom | Max | Units            | Note |
|------------------------|-----------------------------------------|-----|-----|-----|------------------|------|
| ΔV <sub>CMRX(HF)</sub> | Common mode interference beyond 450 MHz |     |     | 100 | mV <sub>PP</sub> | 1    |
| C <sub>CM</sub>        | Common mode termination                 |     |     | 60  | pF               | 2    |

Note:

1. ΔV<sub>CMRX(HF)</sub> is the peak amplitude of a sine wave superimposed on the receiver inputs.
2. For higher bit rates a 14pF capacitor will be needed to meet the common-mode return loss specification.

**Table 8.14: HS Receiver AC Specifications**

### 8.4.8.5 Low-Power Receiver

The low power receiver is an un-terminated, single-ended receiver circuit. The LP receiver is used to detect the Low-Power state on each pin. For high robustness, the LP receiver shall filter out noise pulses and RF interference. It is recommended the implementer optimize the LP receiver design for low power. The LP receiver shall reject any input glitch when the glitch is smaller than eSPIKE. The filter shall allow pulses wider than TMIN to propagate through the LP receiver. The related diagram shows as Figure 8.10 Input Glitch Rejection of Low-Power Receivers. Besides, under tables list DC and AC characteristic for LP-RX.

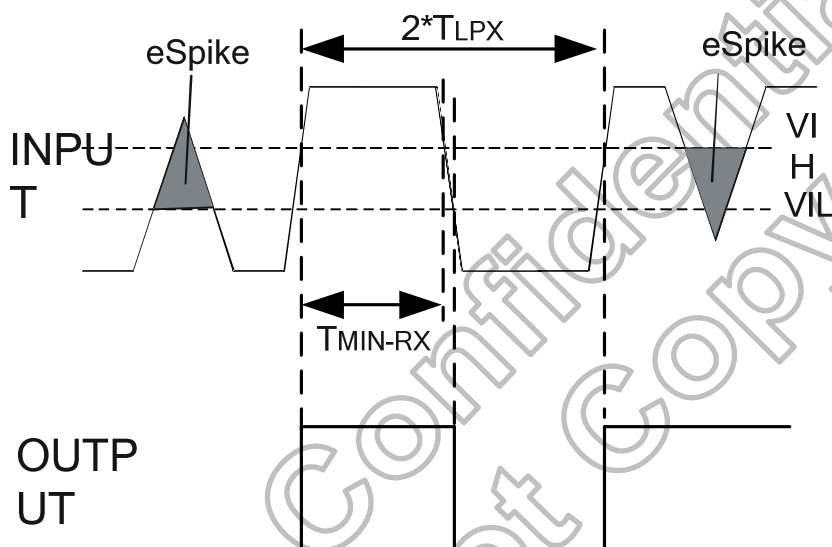


Figure 8.12: Input Glitch Rejections of Low-Power Receivers

| Parameter | Description             | Min | Nom | Max | Units | Note |
|-----------|-------------------------|-----|-----|-----|-------|------|
| $V_{IL}$  | Logic 0 input threshold |     |     | 550 | mV    |      |
| $V_{IH}$  | Logic 1 input threshold | 880 |     |     | mV    |      |

Table 8.15: LP Receiver DC Specifications

| Parameter   | Description                       | Min | Nom | Max | Units | Note    |
|-------------|-----------------------------------|-----|-----|-----|-------|---------|
| $e_{SPIKE}$ | Input pulse rejection             |     |     | 300 | V.ps  | 1, 2, 3 |
| $T_{MIN}$   | Minimum pulse width response      | 20  |     |     | ns    | 4       |
| $V_{INT}$   | Peak-to-peak interference voltage |     |     | 200 | mV    |         |
| $f_{INT}$   | Interference frequency            | 450 |     |     | MHz   |         |

Note:

1. Time-voltage integration of a spike above  $V_{IL}$  when being in LP-0 state or below  $V_{IH}$  when being in LP-1 state
2. An impulse less than this will not change the receiver state.
3. In addition to the required glitch rejection, implementers shall ensure rejection of known RF-interferers.
4. An input pulse greater than this shall toggle the output.

Table 8.16: LP Receiver AC Specifications

#### 8.4.8.6 Line Contention Detection

Contention can be inferred from any of the following conditions:

1. An LP high fault shall be detected when the LP transmitter is driving high.
2. An LP low fault shall be detected when the LP transmitter is driving low.

| Parameter  | Description                  | Min | Nom | Max | Units | Note |
|------------|------------------------------|-----|-----|-----|-------|------|
| $V_{IHCD}$ | Logic 1 contention threshold | 450 |     |     | mV    |      |
| $V_{ILCD}$ | Logic 0 contention threshold |     |     | 200 | mV    |      |

**Table 8.17: Contention Detector DC Specifications**

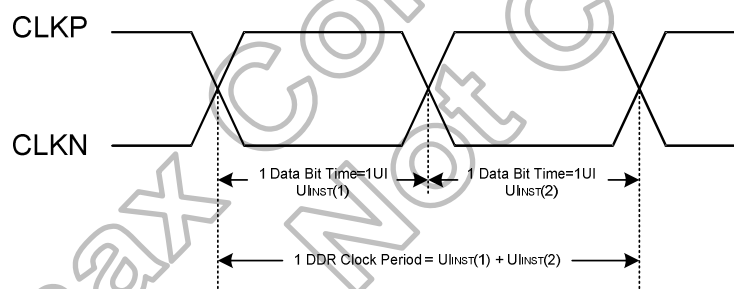
Himax Confidential  
Do Not Copy

### 8.4.8.7 High-Speed Data-Clock Timing

This section specifies the required timings on the high-speed signaling interface independent of the electrical characteristics of the signal. The PHY is a source synchronous interface in the Forward direction. In either the Forward or Reverse signaling modes there shall be only one clock source. In the Reverse direction, Clock is sent in the Forward direction and one of four possible edges is used to launch the data.

The Master side of the Link shall send a differential clock signal to the Slave side to be used for data sampling. This signal shall be a DDR (half-rate) clock and shall have one transition per data bit time. All timing relationships required for correct data sampling are defined relative to the clock transitions. Therefore, implementations may use frequency spreading modulation on the clock to reduce EMI.

The DDR clock signal shall maintain a quadrature phase relationship to the data signal. Data shall be sampled on both the rising and falling edges of the Clock signal. The term “rising edge” means “rising edge of the differential signal, i.e. CLKP – CLKN, and similarly for “falling edge”. Therefore, the period of the Clock signal shall be the sum of two successive instantaneous data bit times.



**Figure 8.13: DDR Clock Definition**

The same clock source is used to generate the DDR Clock and launch the serial data. Since the Clock and Data signals propagate together over a channel of specified skew, the Clock may be used directly to sample the Data lines in the receiver. Such a system can accommodate large instantaneous variations in UI.

The allowed instantaneous UI variation can cause large, instantaneous data rate variations. Therefore, devices shall either accommodate these instantaneous variations with appropriate FIFO logic outside of the PHY or provide an accurate clock source to the Lane Module to eliminate these instantaneous variations.

| Parameter        | Symbol      | Min | Nom | Max  | Unit | Note |
|------------------|-------------|-----|-----|------|------|------|
| UI instantaneous | $UI_{INST}$ | 2   |     | 12.5 | ns   | 1, 2 |

Note:

1. This value corresponds to a maximum 500 Mbps data rate.
2. The minimum UI shall not be violated for any single bit period, i.e., any DDR half cycle within a data burst.

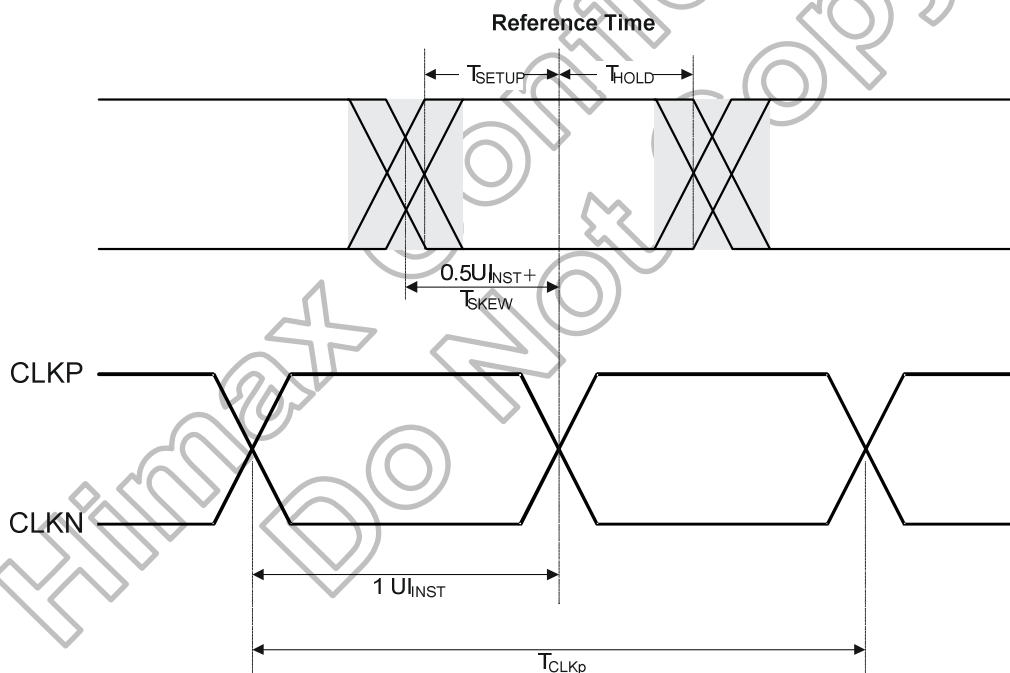
**Table 8.18: HS Data Transmission Timing Parameters**

The timing relationship of the DDR Clock differential signal to the Data differential signal is shown in Figure 8.10. Data is launched in a quadrature relationship to the clock such that the Clock signal edge may be used directly by the receiver to sample the received data.

The transmitter shall ensure that a rising edge of the DDR clock is sent during the first payload bit of a transmission burst such that the first payload bit can be sampled by the receiver on the rising clock edge, the second bit can be sampled on the falling edge, and all following bits can be sampled on alternating rising and falling edges.

All timing values are measured with respect to the actual observed crossing of the Clock differential signal. The effects due to variations in this level are included in the clock to data timing budget.

Receiver input offset and threshold effects shall be accounted as part of the receiver setup and hold parameters.



**Figure 8.14: Data to Clock Timing Definitions**



### 8.4.8.8 Data-Clock Timing Specifications

The Data-Clock timing specifications are shown in Table 8.16. Implementers shall specify a value  $UI_{INST,MIN}$  that represents the minimum instantaneous UI possible within a High-Speed data transfer for a given implementation. Parameters in Table 8.16 are specified as a part of this value. The skew specification,  $TSKEW[TX]$ , is the allowed deviation of the data launch time to the ideal  $\frac{1}{2}UI_{INST}$  displaced quadrature clock edge. The setup and hold times,  $T_{SETUP}[RX]$  and  $T_{HOLD}[RX]$ , respectively, describe the timing relationships between the data and clock signals.  $T_{SETUP}[RX]$  is the minimum time that data shall be present before a rising or falling clock edge and  $T_{HOLD}[RX]$  is the minimum time that data shall remain in its current state after a rising or falling clock edge. The timing budget specifications for a receiver shall represent the minimum variations observable at the receiver for which the receiver will operate at the maximum specified acceptable bit error rate.

The intent in the timing budget is to leave  $0.4*UI_{INST}$ , i.e.  $\pm 0.2*UI_{INST}$  for degradation contributed by the interconnect.

| Parameter                           | Symbol          | Min  | Typ | Max | Unit        | Note |
|-------------------------------------|-----------------|------|-----|-----|-------------|------|
| Data to Clock Setup Time [receiver] | $T_{SETUP}[RX]$ | 0.15 |     |     | $UI_{INST}$ | 1    |
| Clock to Data Hold Time [receiver]  | $T_{HOLD}[RX]$  | 0.15 |     |     | $UI_{INST}$ | 1    |

Note:

1. Total setup and hold window for receiver of  $0.3*UI_{INST}$ .

**Table 8.19: Data to Clock Timing Specifications**

## 9. Layout Recommendation

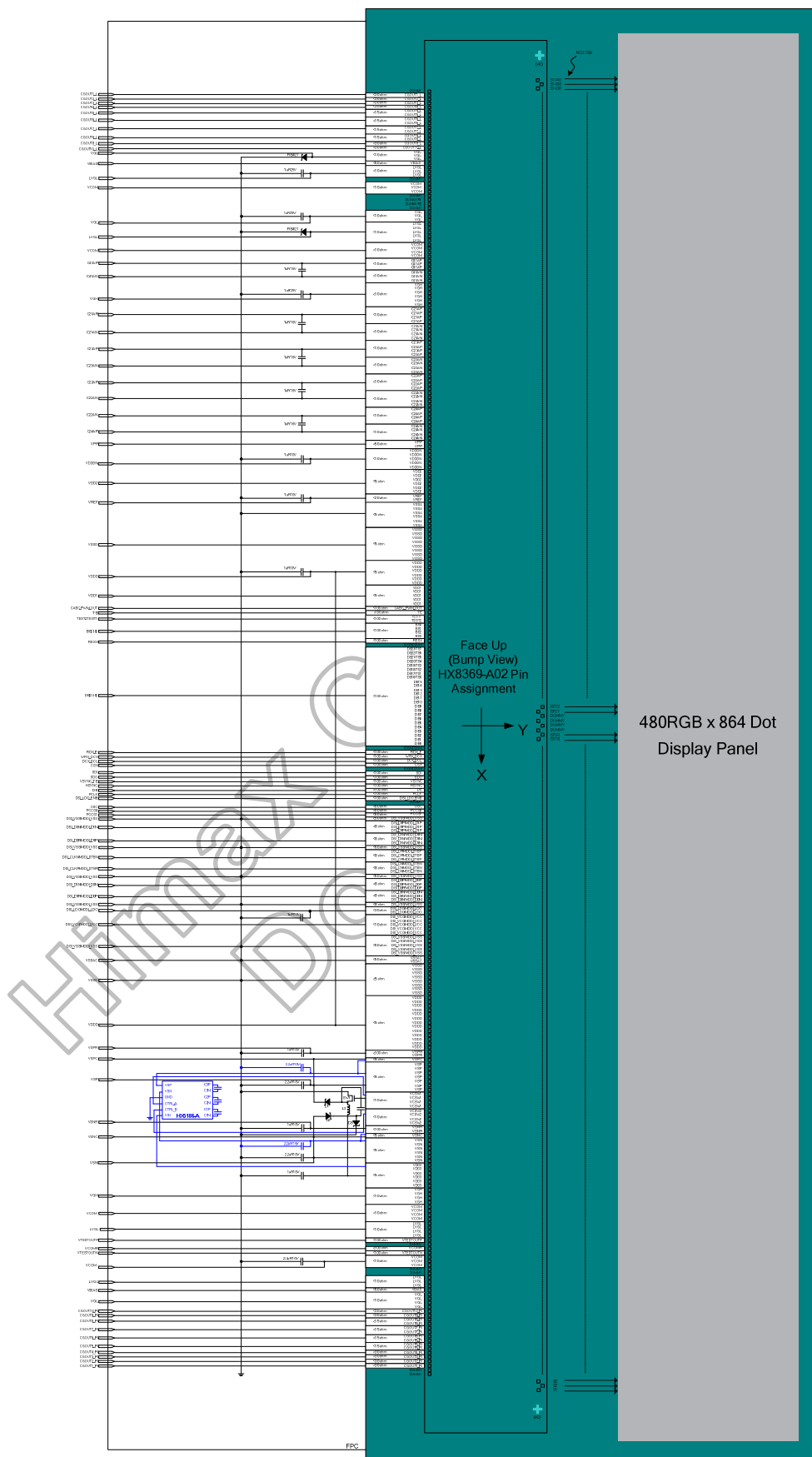


Figure 9.1: Layout recommendation

## 10. Maximum Layout Resistance

| Name                                                           | Type                 | Maximum series resistance | Unit |
|----------------------------------------------------------------|----------------------|---------------------------|------|
| VDD1                                                           | Power supply         | 10                        | Ω    |
| VDD2                                                           | Power supply         | 20                        | Ω    |
| VDD3                                                           | Power supply         | 10                        | Ω    |
| VSSD                                                           | Power supply         | 10                        | Ω    |
| VSSA                                                           | Power supply         | 10                        | Ω    |
| DSI_VCC / MDDI_VCC                                             | Power supply         | 10                        | Ω    |
| DSI_VSS / MDDI_VSS                                             | Power supply         | 10                        | Ω    |
| VSSAC                                                          | Power supply         | 20                        | Ω    |
| VPP                                                            | Input                | 10                        | Ω    |
| PCCS0, PCCS1                                                   | Input                | 50                        | Ω    |
| VCSW1, VCSW2                                                   | Output               | 30                        | Ω    |
| BS[3:0]                                                        | Input                | 100                       | Ω    |
| RDX_E, WRX_DCX, DCX_SCL, CSX, RESX                             | Input                | 100                       | Ω    |
| HSYNC, VSYNC, DE, PCLK                                         | Input                | 100                       | Ω    |
| SDI                                                            | Input                | 100                       | Ω    |
| SDO                                                            | Output               | 100                       | Ω    |
| DB[23:0]                                                       | Output               | 100                       | Ω    |
| CABC_PWM_OUT                                                   | Output               | 100                       | Ω    |
| VCOM                                                           | Output               | 10                        | Ω    |
| DSI_D0P / MDDI_D0P                                             | Input + Output       | 8                         | Ω    |
| DSI_D0N / MDDI_D0N                                             | Input + Output       | 8                         | Ω    |
| DSI_CLKP / MDDI_STBP                                           | Input                | 8                         | Ω    |
| DSI_CLKN / MDDI_STBN                                           | Input                | 8                         | Ω    |
| DSI_D1P / MDDI_D1P                                             | Input                | 8                         | Ω    |
| DSI_D1N / MDDI_D1N                                             | Input                | 8                         | Ω    |
| VDDD                                                           | Capacitor Connection | 5                         | Ω    |
| VDDDN                                                          | Capacitor Connection | 50                        | Ω    |
| VSP, VSN                                                       | Capacitor Connection | 10                        | Ω    |
| VSPC, VSNC                                                     | Capacitor Connection | 50                        | Ω    |
| VSPR, VSNR                                                     | Capacitor Connection | 50                        | Ω    |
| VREF                                                           | Capacitor Connection | 20                        | Ω    |
| VGL, LVGL                                                      | Capacitor Connection | 10                        | Ω    |
| VGH                                                            | Capacitor Connection | 10                        | Ω    |
| DSI_LDO/MDDI_LDO                                               | Capacitor Connection | 20                        | Ω    |
| DSI_LDO_ENB                                                    | Input                | 100                       | Ω    |
| OSC                                                            | Input                | 100                       | Ω    |
| C21AP,C21AN,C22AP,C22AN, C23AP,C23AN,C24AP,C24AN, C41AP,C41AN, | Capacitor Connection | 10                        | Ω    |
| TEST[2:1]                                                      | Input                | 100                       | Ω    |
| TE                                                             | Output               | 100                       | Ω    |
| VTESTOUTP, VTESTOUTN                                           | Output               | 100                       | Ω    |
| VBIAS                                                          | Output               | 50                        | Ω    |
| VCOMR                                                          | Input                | 100                       | Ω    |
| CGOUT1~10_L<br>CGOUT1~10_R                                     | Output               | 30                        | Ω    |

Table 10.1: Maximum layout resistance

## 11. Ordering Information

| Part No.                | Package                                                                                   |
|-------------------------|-------------------------------------------------------------------------------------------|
| HX8369-A02 <u>PDxxx</u> | PD: mean COG<br>xxx: mean chip thickness ( $\mu\text{m}$ ), (default: 250 $\mu\text{m}$ ) |

## 12. Revision History

| Version | Date       | Description of Changes |
|---------|------------|------------------------|
| 01      | 2011/10/20 | 1. New setup           |

Himax Confidential  
Do Not Copy

With collaboration of <https://www.displayfuture.com>