

**Rev.0.11**

# **Data Sheet**

## **S6D04H0**

**-X01**

**-X02**

**MOBILE DISPLAY DRIVER IC**

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## REVISION HISTORY

| Rev.# | Date    | History                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | Author |
|-------|---------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------|
| 0.11  | May `09 | Modify Table8 – add power condition in sleep-in current<br>Modify Table8 – change power condition in LCD source driver output on Resistance<br>Modify Table8 – Operating current1: memory access speed Mhz → fps                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |        |
| 0.10  | Apr `09 | Copyright © 2008 to 2009 update<br>Modify Table8 - AVDD, GVDD add<br>Modify Table4 - DB[17:0] Pin usage comment add<br>Add Minimum NHW[7:0](F2h command)<br>Modify Table110 - HBLK_SRC[2:0]=001, 010 set disable<br>Modify Figure53 - Note added<br>Modify Figure54 - Note added<br>Serial Read at 1para command - Comment added(no dummy read)<br>Add Description - RDCABCMB is valid in case that BCTRL(WRCTRLD 53h)=1<br>Add Note at Table140 - Maximum Rating Voltage should not be exceed 25volt<br>Add restriction at BRMIN command(5Eh command)<br>Modify Table92 - D[1:0] Control at VGL<br>Delete Note - RGB_MODE=0 removed<br>Add Test Key Comment(F0h, F1h command)<br>Modify SEQ1,2,3,4,5 default value(F4h command)<br>Modify MTP Sequence<br>Add Initial sequence - Figure59<br>Modify Timing Diagram – Figure114<br>Add note – Table140 D1 part<br>Modify Table8 – Output voltage deviation GVDD → AVDD |        |
| 0.00  | Oct `08 | 1. Initial Release                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |        |

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# Preface

## About This Data Sheet

This document is to provide a complete data sheet of S6D04H0 IC design.  
It also provides useful information to those who work on a panel module or a set

## IMPORTANT NOTICE

### Precautions against Light

The conductivity of a semiconductor is strongly influenced by electro-magnetic radiation such as visible light, infrared light, ultraviolet light, or gamma radiation. When light is absorbed, electron-hole pairs are generated raising the conductivity of the material, eventually altering the electrical characteristics of the IC. Therefore, if the packages that expose IC's to external light sources, such as COB, COG, TCP, and COF, are used, effective means to shield the IC from the light coming in all directions – top, bottom, and the sides – must be devised. Full observation of the following precautions is strongly recommended.

1. Make sure that the IC and substrate (board or glass) are protected from a stray light.
2. Always test and inspect products under the environment with no light penetration.

## CHAPTER 1

# OVERVIEW

- |                                                                                                                                                                                                                |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <ul style="list-style-type: none"><li>1.1 Introduction</li><li>1.2 Product Options</li><li>1.3 Features</li><li>1.4 Block Diagram</li><li>1.5 Pad Information</li><li>1.6 Description of Signal Pads</li></ul> |
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# 1. OVERVIEW

## 1.1. INTRODUCTION

S6D04H0 is a single-chip display driver IC for a TFT-LCD panel. S6D04H0 has source drivers with built-in memory, gate drivers and power sources. S6D04H0 can support a TFT-LCD panel up to a resolution of 240-RGB x 320-dot graphics with 262k color.

## 1.2. PRODUCT OPTIONS

S6D04H0 may offer more than one option in order to meet customer-specific functions from the customers. Table 1 describes its functions.

**Table 1. List of S6D04H0 Options.**

| Options  | Remarks                     |
|----------|-----------------------------|
| -X01,X02 | Reference Design of S6D04H0 |

### 1.3. FEATURES

S6D04H0 offers the following key features:

- Single chip TFT-LCD controller and driver with Display RAM.
- Display resolution: 240\*RGB(H) \*320(V)
- Display data RAM (frame memory): 240 x 320 x 18-bit = 1,382,400 bits
- Output:
  - Source output
  - Common electrode output
  - Gate output
- Display mode (Color mode)
  - Full color mode (Idle mode off): 262k-color
  - 65k-color
  - Reduce color mode (Idle mode on): 8-color
- MPU Interface:
  - 3-wire 9-bit data serial interface
  - 4-wire 8-bit data serial interface
  - 8 / 9 / 16 / 18bit parallel interface with 80-series MPU
  - 8 / 9 / 16 / 18bit parallel interface with 68-series MPU
  - 6 / 18bit RGB interface
- VSYNC Interface with 80-series MPU
- Display features
  - CABC (MIE2.5G) for saving current consumption
  - Partial display mode
  - Line inversion for low cross talk
- MIPI DCS support
- MIE (Mobile Image Enhancement) function
  - Adaptive luminance/contrast enhancement function
  - Reduce the power consumption of backlight
- On chip
  - DC/DC converter
  - Adjusted VCOM generation
  - Oscillator for display clock generation
  - Timing generation

- Non-Volatile Memory (NVM)
  - 7bits for VCOM adjustment
- Driving Algorithm
  - Line inversion, frame inversion
- Supply voltage range
  - Analog supply voltage range for VCI to VSSA: 2.4V ~ 3.3V
  - I/O supply voltage range for VDD3 to VSS: 1.65V ~ 3.3V
- Output voltage levels
  - Source output voltage range for GVDD to VSSA: 2.46V to 5V
  - Power supply for driver circuit range for AVDD to VSSA: 4.2V to 6.0V
  - Max 6.0V Common electrode output voltage range for VCOM
  - Positive Gate output voltage range for VGH to VSSA: 8.4V to 16.5V (Note 3)
  - Negative Gate output voltage range for VGL to VSSA: -15V to -6.3V (Note 3)
- Lower power consumption, suitable for battery operated systems
- Optimized layout for COG assembly
- Operate temperature range: -40°C to +85°C

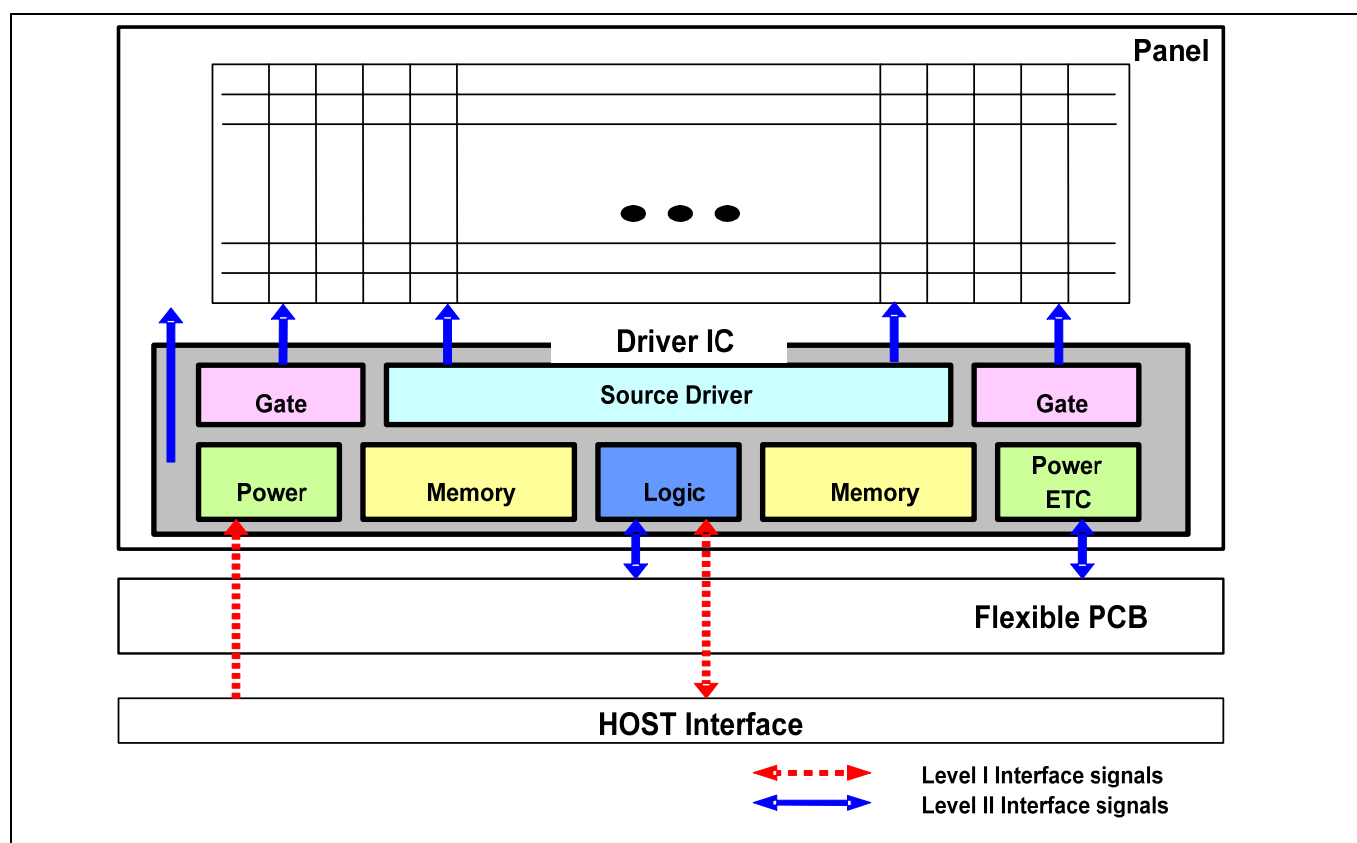
**Note.**

1. Blank display means: Normal White Display = White, Normal Black Display = Black.
2. AVDD Min: When VCI1 = 2.1V, AVDD Max: When VCI1=3.0V
3. |VGH| & |VGL| Min: When VCI1 = 2.1V, |VGL| Max: When VCI1=3.0V, |VGH - VGL| Max: 30.0V
4. |VGH| Max should be lower than or equal to 16.5V in normal operating condition,
5. NVM and EEPROM mean MTP (Multi Time Programmable) in this data sheet.

## 1.4. BLOCK DIAGRAM

### 1.4.1. MODULE LEVEL

Figure 1 shows the block diagram of a mobile display panel module and related interface signals required by set makers and module makers. Level I interface signals are usually required by a set maker who would then request the display module such a function, and Level II interface signals are required by a display module maker for its own purpose.

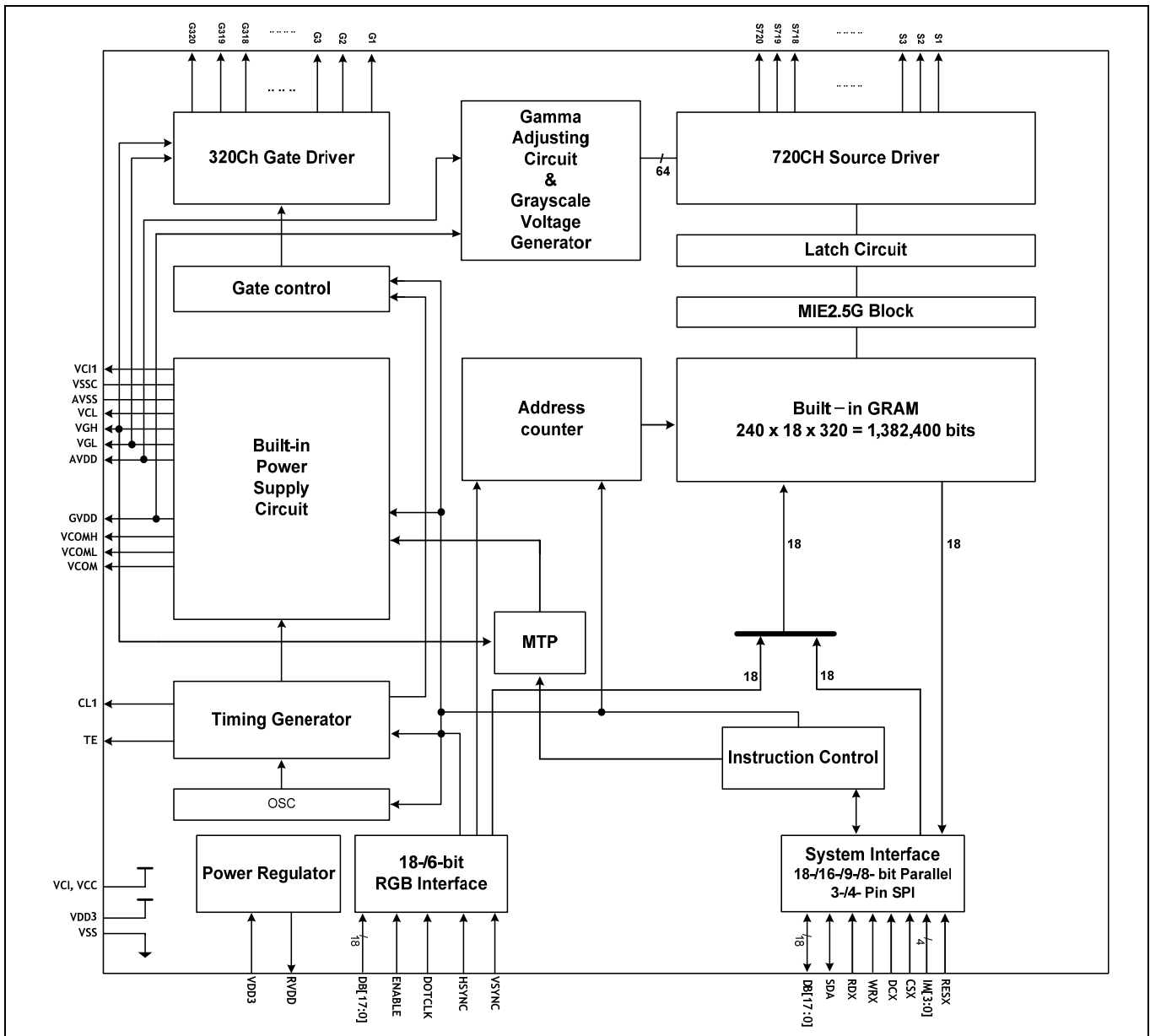


**Figure1.Interface Signal Flow of a Mobile Display Panel Module.**

There are also Level III signals which is for the internal use only for the driver IC itself. These signals may not necessarily be released to the customer since it is designed for a specific manufacturing purpose and are supposed to be hidden to customers.

This data sheet only provide a guideline to Level I and II interface signals since some of specifications related to Level I and II need a margin on IC side and would not be necessarily the same as the one in Level I and II specification even though both uses the same interface signals. This is mainly due to the parasitic and design requirements within the flexible PCB used by a display module maker. IC specification will offer related information among Level I/II on how each interface signals interact each other.

#### 1.4.2. FUNCTIONAL BLOCK DIAGRAM OF THE IC



### Figure2.S6D04H0 Block Diagram

## 1.5. PAD INFORMATION

### 1.5.1. CONFIGURATION OF SIGNAL PADS

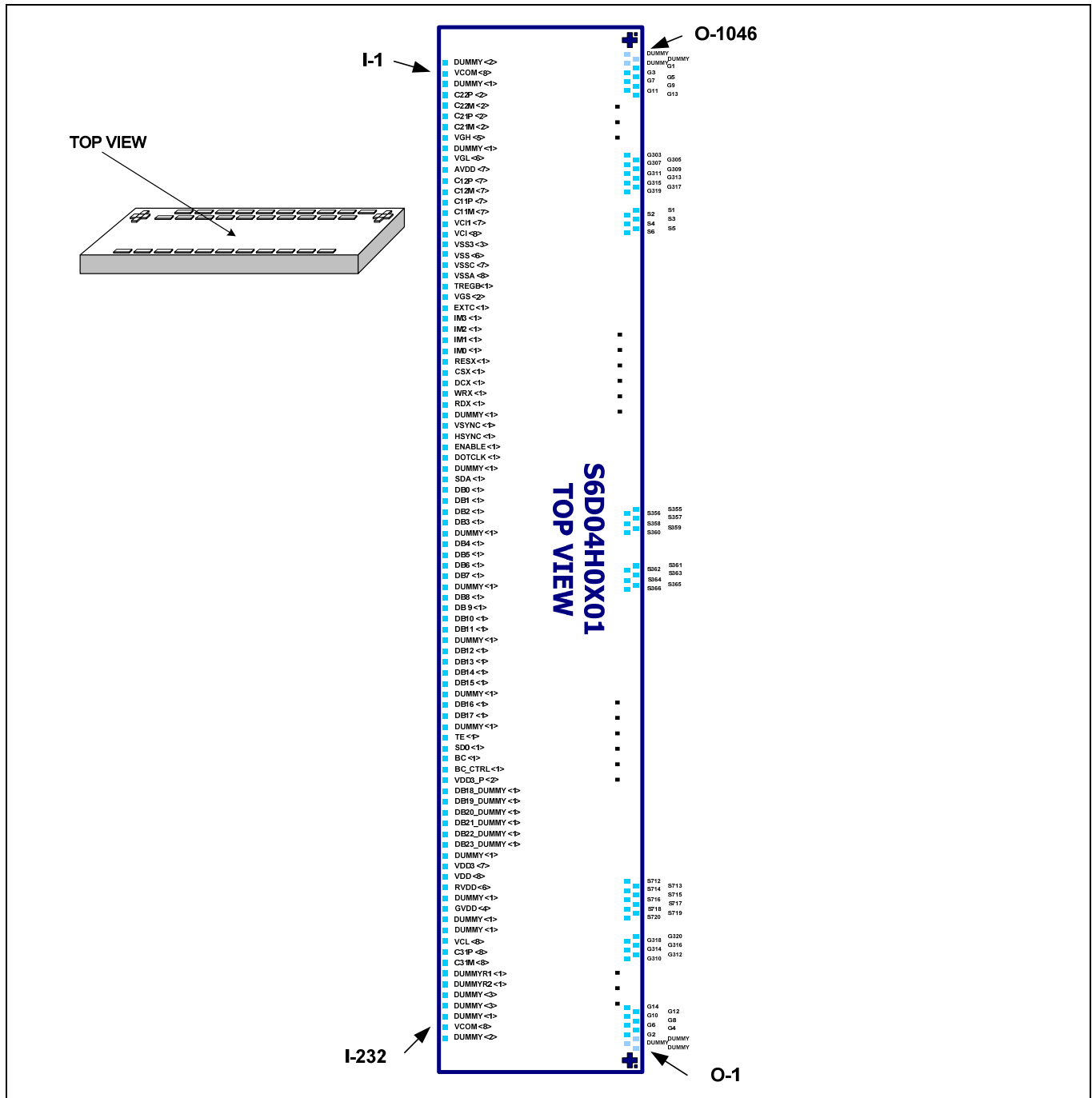


Figure3. S6D04H0 PAD Configuration

Note.

Pattern Surface



## 1.5.2. BUMP INFORMATION

Table 2. Bump Information

| Item                | Pad No.           | Size           |       | Unit |
|---------------------|-------------------|----------------|-------|------|
|                     |                   | X              | Y     |      |
| Chip Size           | -                 | 15260          | 720   | μm   |
| Pad Pitch           | Input Side        | 85 / 72.5 / 60 |       |      |
|                     | Output Side       | 14             |       |      |
| Bumped Pad Top Size | Input Side        | 40±2           | 56±2  |      |
|                     | Output Side       | 14±2           | 104±2 |      |
| Bumped Pad Height   | Height In Wafer   | 15±3           |       |      |
|                     | Tolerance In Chip | Under 2        |       |      |
|                     | Dimple Height     | Under 2        |       |      |
| Chip Thickness      | -                 | 300±10         |       |      |

**Note.**

1. Scribe lane 80um included in this die size
2. Wafer thickness can be varied with the customer's needs.

1.5.3. BUMP DIMENSION

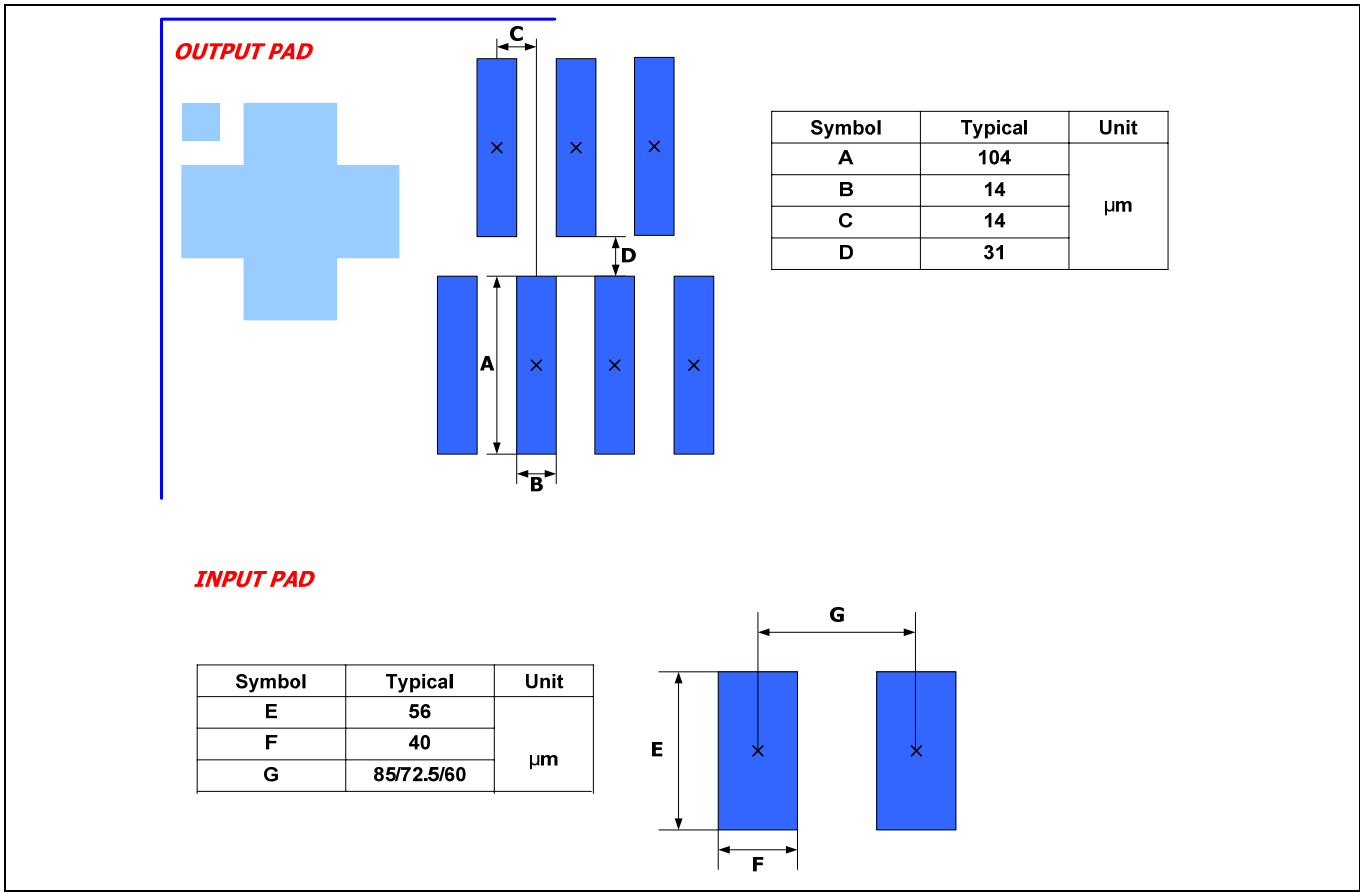


Figure4. Bump Dimension

1.5.4. ALIGN KEY

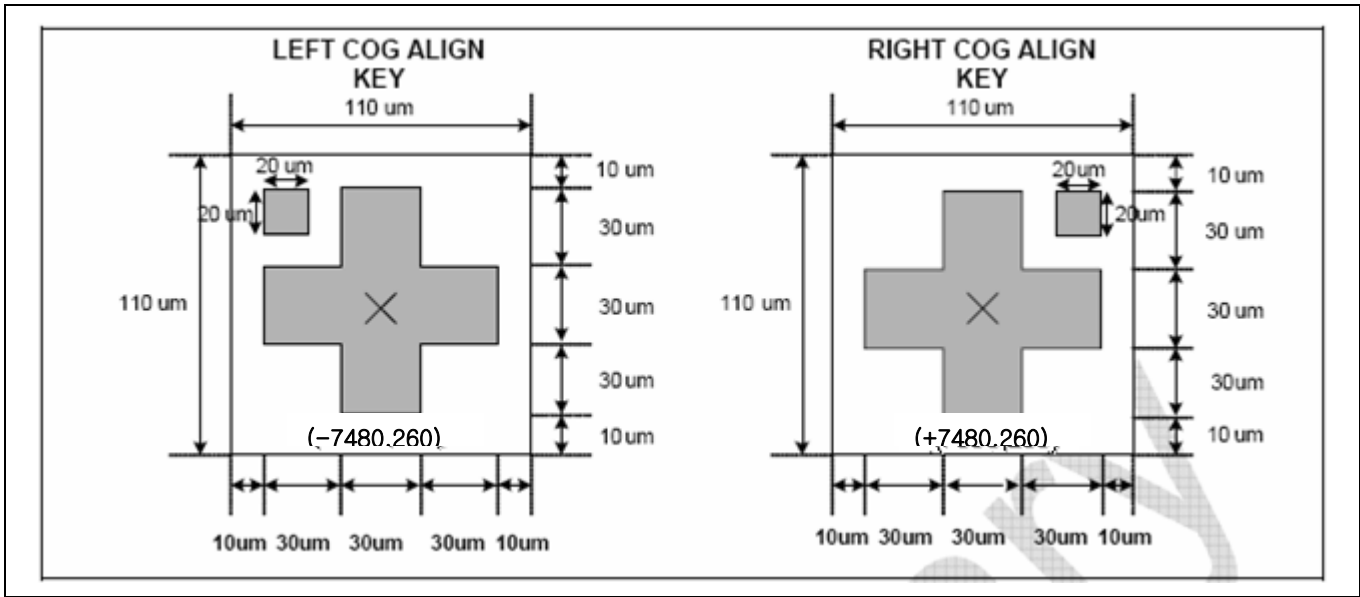


Figure5. COG Align Key Configuration and Coordinate

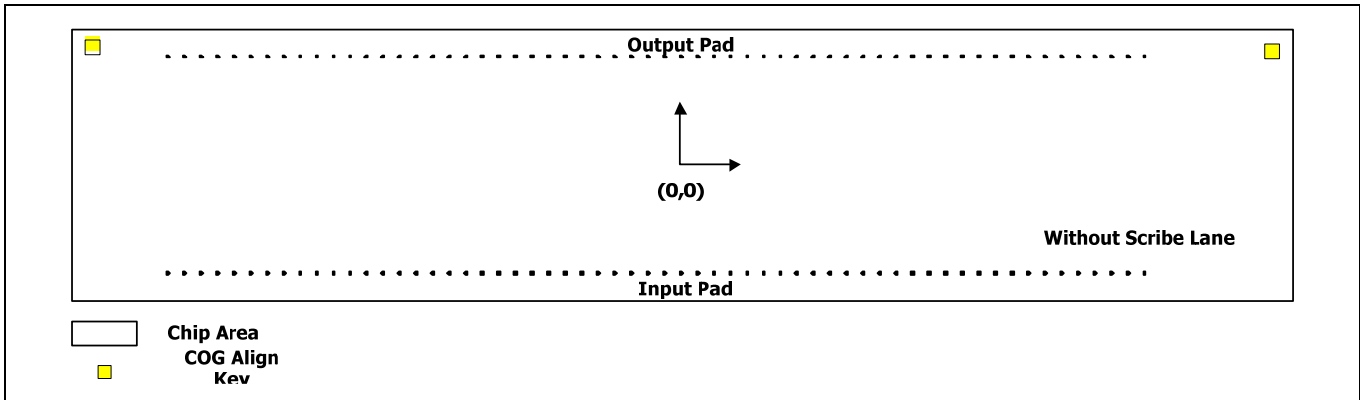


Figure6. COG Align Key Arrangement Layout

## 1.6. DESCRIPTION OF SIGNAL PADS

### 1.6.1. POWER SUPPLY PINS

Table 3. Power Supply Pins

| Symbol | Name              | Description                                                                                                                                |
|--------|-------------------|--------------------------------------------------------------------------------------------------------------------------------------------|
| VDD3   | I/O voltage       | Low voltage power supply for interface logic circuits (1.65 ~ 3.3 V)                                                                       |
| VDD3_P | LED driver Power  | Power supply for LED driver interface. (1.65 ~ 3.3 V)<br>If LED driver is not used, fix this pin at VSS.                                   |
| VCI    | Analog Power      | High voltage power supply for analog circuit blocks (2.4 ~ 3.3 V)                                                                          |
| VDD    | Regulated Voltage | Regulated Low voltage level for interface circuits<br>Connect a capacitor for stabilization.<br>Don't apply any external power to this pad |
| VSS3   | I/O Ground        | System ground level for I/O circuits.                                                                                                      |
| VSS    | Logic Ground      | System ground level for logic blocks                                                                                                       |
| VSSA   | Analog Ground     | System ground level for analog circuit blocks<br>Connect to VSS on the FPC to prevent noise.                                               |
| VSSC   | Analog Ground     | System ground level for analog circuit blocks<br>Connect to VSS on the FPC to prevent noise                                                |

## 1.6.2. INTERFACE LOGIC PINS

Table 4. Interface Logic Pins

| Symbol                                                 | I/O | Description                                                                                                                                                                                                                                                                                                                               |     |     |     |                                       |                         |
|--------------------------------------------------------|-----|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|-----|-----|---------------------------------------|-------------------------|
| IM[3:0]                                                | I   | Selects the MPU interface mode                                                                                                                                                                                                                                                                                                            |     |     |     |                                       |                         |
|                                                        |     | IM3                                                                                                                                                                                                                                                                                                                                       | IM2 | IM1 | IM0 | Interface mode                        | Data pad                |
|                                                        |     | 0                                                                                                                                                                                                                                                                                                                                         | 0   | 0   | 0   | 80 MCU 8-bit Parallel I/F             | DB[7:0]                 |
|                                                        |     | 0                                                                                                                                                                                                                                                                                                                                         | 0   | 0   | 1   | 80 MCU 16-bit Parallel I/F            | DB[15:0]                |
|                                                        |     | 0                                                                                                                                                                                                                                                                                                                                         | 0   | 1   | 0   | 80 MCU 9-bit Parallel I/F             | DB[8:0]                 |
|                                                        |     | 0                                                                                                                                                                                                                                                                                                                                         | 0   | 1   | 1   | 80 MCU 18-bit Parallel I/F            | DB[17:0]                |
|                                                        |     | 0                                                                                                                                                                                                                                                                                                                                         | 1   | 0   | 1   | 3-wire 9-bit data Serial interface I  | SDA : In/Out            |
|                                                        |     | 0                                                                                                                                                                                                                                                                                                                                         | 1   | 1   | 0   | 4-wire 8-bit data Serial interface I  | SDA : In/Out            |
|                                                        |     | 1                                                                                                                                                                                                                                                                                                                                         | 0   | 0   | 0   | 68 MCU 8-bit Parallel I/F             | DB[7:0]                 |
|                                                        |     | 1                                                                                                                                                                                                                                                                                                                                         | 0   | 0   | 1   | 68 MCU 16-bit Parallel I/F            | DB[15:0]                |
|                                                        |     | 1                                                                                                                                                                                                                                                                                                                                         | 0   | 1   | 0   | 68 MCU 9-bit Parallel I/F             | DB[8:0]                 |
|                                                        |     | 1                                                                                                                                                                                                                                                                                                                                         | 0   | 1   | 1   | 68 MCU 18-bit Parallel I/F            | DB[17:0]                |
|                                                        |     | 1                                                                                                                                                                                                                                                                                                                                         | 1   | 0   | 1   | 3-wire 9-bit data Serial interface II | SDI : In /<br>SDO : Out |
|                                                        |     | 1                                                                                                                                                                                                                                                                                                                                         | 1   | 1   | 0   | 4-wire 8-bit data Serial interface II | SDI : In /<br>SDO : Out |
| MPU Parallel interface bus and serial interface select |     |                                                                                                                                                                                                                                                                                                                                           |     |     |     |                                       |                         |
| * : Fix this pin at VDD3 or VSS.                       |     |                                                                                                                                                                                                                                                                                                                                           |     |     |     |                                       |                         |
| RESX                                                   | I   | This signal will reset the device and must be applied to properly initialize the chip.<br>Signal is active low.                                                                                                                                                                                                                           |     |     |     |                                       |                         |
| EXTC                                                   | I   | Select to access Level2 command (“Low” : Leve1 only, “High” : Level1 and Level2”)                                                                                                                                                                                                                                                         |     |     |     |                                       |                         |
| CSX                                                    | I   | Chip select input pin (“Low” enable).<br>This pin can be permanently fixed “Low” in MPU interface mode only.<br>* note1,2                                                                                                                                                                                                                 |     |     |     |                                       |                         |
| DCX (SCL)                                              | I   | This pin is used to select “Data or Command” in the parallel interface or 4-wire 8-bit serial data interface.<br>When DCX = ‘1’, data is selected.<br>When DCX = ‘0’, command is selected.<br>This pin is used serial interface clock in 3-wire 9-bit serial data interface.<br>If not used, this pin should be connected to VDD3 or VSS. |     |     |     |                                       |                         |

| Symbol    | I/O | Description                                                                                                                                                                                                                                                                                               |
|-----------|-----|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| RDX (E)   | I   | This pin is used to "Read Clock" in 80-series parallel interface.<br>This pin is used to "Read / Write Clock" in 68-series parallel interface.<br>If not used, this pin should be connected to VDD3 or VSS.                                                                                               |
| WRX (RWX) | I   | This pin is used to "Write Clock" in 80-series parallel interface.<br>This pin is used to select "Read / Write Operation" in 68-series parallel interface.<br>This pin is used serial interface clock in 4-wire 8-bit serial data interface.<br>If not used, this pin should be connected to VDD3 or VSS. |
| DB[17:0]  | I/O | When RGB I/F, DB[17:0] are used to RGB interface data bus.<br>When MPU I/F, DB[17:0] are used to MPU parallel interface data bus.<br>If not used, fix this pin at VDD3 or VSS.                                                                                                                            |
| SDI / SDA | I/O | When IM[3] : Low, Serial in/out signal.<br>When IM[3] : High, Serial input signal.<br>The data is applied on the rising edge of the SCL signal.<br>If not used, fix this pin at VDD3 or VSS.                                                                                                              |
| SDO       | O   | Serial output signal.<br>The data is outputted on the falling edge of the SCL signal.<br>If not used, open this pin                                                                                                                                                                                       |
| TE        | O   | Tearing effect output pin to synchronize MPU to frame writing, activated by S/W command. When this pin is not activated, this pin is low.<br>If not used, open this pin.                                                                                                                                  |
| DOTCLK    | I   | Pixel clock signal in RGB I/F mode.<br>If not used, fix this pin at VDD3 or VSS.                                                                                                                                                                                                                          |
| VSNC      | I   | Vertical sync. Signal in RGB I/F mode.<br>If not used, fix this pin at VDD3 or VSS.                                                                                                                                                                                                                       |
| HSNC      | I   | Horizontal sync. Signal in RGB I/F mode.<br>If not used, fix this pin at VDD3 or VSS.                                                                                                                                                                                                                     |
| ENABLE    | I   | Data enable signal in RGB I/F mode. If not used, fix this pin at VDD3 or VSS.                                                                                                                                                                                                                             |

**Note.**

1. If CSX is connected to VSS in Parallel interface mode, there will be no abnormal visible effect to the display module.  
Also there will be no restriction on using the Parallel Read/Write protocols, Power On/Off Sequences or other functions.  
Furthermore there will be no influence to the Power Consumption of the display module.
2. When CSX='1', there is no influence to the parallel and serial interface.

## 1.6.3. DRIVER INPUT / OUTPUT PINS

Table 5. Driver Input / Output Pins

| Symbol                   | I/O | Description                                                                                                                                                                                                                                                             |
|--------------------------|-----|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| S1 to S720               | O   | Source driver output pads.                                                                                                                                                                                                                                              |
| G1 to G320               | O   | Gate driver output pads                                                                                                                                                                                                                                                 |
| VCI1                     | O   | An internal reference voltage generated between VCI and VSSA.<br>Reference input voltage for 1st and 3rd step up circuit.                                                                                                                                               |
| AVDD                     | O   | Output voltage of 1st step up circuit (2 x VCI1). Input voltage to 2nd step up circuit.<br>Generated power output pad for source driver block. Connect this pad to the capacitor for stabilization.                                                                     |
| VGH                      | O   | Positive power output of the 2nd step up circuit. Connect a capacitor for stabilization.<br>Gate "ON" level voltage.                                                                                                                                                    |
| VGL                      | O   | Negative power output of the 2nd step up circuit. Connect a capacitor for stabilization.<br>To protect IC against Latch up, connect the cathode of the schottky diode to the VSS pad. And the anode of the schottky diode to the VGL pad. Refer to application circuit. |
| VCL                      | O   | Power supply for generating VCOM low level. 3rd step up circuit output voltage.<br>Connect a capacitor for stabilization.                                                                                                                                               |
| C11P, C11M<br>C12P, C12M | –   | Connect the charge-pumping capacitor for generating AVDD level.                                                                                                                                                                                                         |
| C21P, C21M<br>C22P, C22M | –   | Connect the charge-pumping capacitor for generating VGH, VGL level.                                                                                                                                                                                                     |
| C31P, C31M               | –   | Connect the charge-pumping capacitor for generating VCL level.                                                                                                                                                                                                          |
| GVDD                     | O   | High reference voltage for grayscale voltage generator.<br>Internal register can be used to adjust the voltage.                                                                                                                                                         |
| VGS                      | I   | Low reference voltage for grayscale voltage generator.<br>Connect an external resistor or to system ground.                                                                                                                                                             |
| VCOM                     | O   | Power supply pad for the TFT- display counter electrode.<br>Charge recycling method is used with VCI and VSSA voltage.<br>Connect this pad to the TFT-display counter electrode.                                                                                        |
| BC                       | O   | Output pin for PWM(Pulse Width Modulation) signal of LED driving.<br>If not used, open this pad.                                                                                                                                                                        |
| BC_CTRL                  | O   | Output pin for enabling LED driving.<br>If not used, open this pad.                                                                                                                                                                                                     |

## 1.6.4. TEST PINS

Table 6. Test Pins

| Symbol                        | I/O | Description                                                                                                                                                                                 |
|-------------------------------|-----|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| TREGB                         | I   | Input pads used only for test purpose at IC-side.<br>During normal operation, connect this pad to VSS.                                                                                      |
| DUMMYR1<br>DUMMYR2            | I   | Contact resistance measurement pad. In normal operation, leave this unconnected.<br>These pads are at VSS level. When measuring an ohmic resistance of the contact, do not apply any power. |
| TMODE[3:0]                    | –   | Input pads used only for test purpose at IC-side.<br>During normal operation, leave these pads open.                                                                                        |
| TMUX[2:0]                     | –   | Input pads used only for test purpose at IC-side.<br>During normal operation, leave these pads open.                                                                                        |
| EXCLK                         | –   | Input pads used only for test purpose at IC-side.<br>During normal operation, leave these pads open.                                                                                        |
| DB18_DUMMY<br>~<br>DB23_DUMMY | –   | Input pads used only for test purpose at IC-side.<br>During normal operation, leave these pads open.                                                                                        |
| VCIR_EXIN                     | –   | Input pads used only for test purpose at IC-side.<br>During normal operation, leave these pads open.                                                                                        |
| VGH_DUMMY                     | –   | Input pads used only for test purpose at IC-side.<br>During normal operation, leave these pads open.                                                                                        |
| VGL_DUMMY                     | –   | Input pads used only for test purpose at IC-side.<br>During normal operation, leave these pads open.                                                                                        |
| DUMMY                         | –   | Dummy pin. Leave these pads open.                                                                                                                                                           |



## CHAPTER 2

# ELECTRICAL SPECIFICATION

- 2.1 Absolute Maximum Ratings
- 2.2 DC Electrical Characteristics
- 2.3 AC Characteristics

# 2. ELECTRICAL SPECIFICATIONS

## 2.1. ABSOLUTE MAXIMUM RATINGS

Table 7. Absolute Maximum Ratings

| Item                               | Symbol     | Rating           | Unit |
|------------------------------------|------------|------------------|------|
| Supply voltage for logic block     | VDD – VSS  | –0.3 to +3.3     | V    |
| Supply voltage for I/O block       | VDD3 – VSS | –0.3 to +5.0     | V    |
| Supply voltage for step-up circuit | VCI – VSS  | –0.3 to +5.0     | V    |
| LCD Supply Voltage range           | AVDD – VSS | –0.3 to +6.5     | V    |
|                                    | VGH – VSS  | –0.3 to +22.0    | V    |
|                                    | VSS – VGL  | –0.3 to +22.0    | V    |
|                                    | VSS – VCL  | –0.3 to +5.0     | V    |
|                                    | VGH – VGL  | –0.3 to +33      | V    |
| Input Voltage range                | Vin        | –0.3 to VDD3+0.5 | V    |
| Operating temperature              | Topr       | –40 to +85       | °C   |
| Storage temperature                | Tstg       | –55 to +110      | °C   |

**Note.**

1. The absolute maximum rating is the limit value. When the IC is exposed to the operating environment beyond this range, the IC does not assure normal operations and may be damaged permanently, not be able to be recovered.
2. The operating temperature is the range of device-operating temperature. They do not guarantee chip performance.

## CAUTION

Stresses above these absolute maximum ratings may cause permanent damage. These are stress ratings only and functional operation at these conditions is not implied. Exposure to maximum rating conditions for extended periods may reduce device reliability.

## 2.2. DC ELECTRICAL CHARACTERISTICS

Table 8. DC Electrical Characteristics

| Item                                                             | Symbol                  | Condition                                                         | Min         | Typ | Max         | Unit | Applicable Pin                  |
|------------------------------------------------------------------|-------------------------|-------------------------------------------------------------------|-------------|-----|-------------|------|---------------------------------|
| Power voltage(1)                                                 | VDD3                    |                                                                   | 1.65        | 1.8 | 3.3         | V    | VDD3                            |
| Power voltage(2)                                                 | VCI                     |                                                                   | 2.4         | –   | 3.3         | V    | VCI                             |
| LCD driving voltage                                              | AVDD                    |                                                                   | 4.2         | 5.0 | 6.0         | V    | AVDD                            |
|                                                                  | VGH                     |                                                                   | 8.4         |     | 16.5        | V    | VGH                             |
|                                                                  | VGL                     |                                                                   | –15         |     | –6.3        | V    | VGL                             |
|                                                                  | VGH-VGL                 |                                                                   |             |     | 30.0        | V    | VGH, VGL                        |
|                                                                  | VCL                     |                                                                   | –3          |     | –2.1        | V    | VCL                             |
|                                                                  | VCI-VCL                 |                                                                   |             |     | 6.0         | V    | VCI, VCL                        |
|                                                                  | GVDD                    |                                                                   | 2.46        | 4.5 | 5.0         | V    | GVDD                            |
| High Level Input Voltage                                         | VIH                     |                                                                   | 0.7V<br>DD3 |     | VDD3        | V    | All input pins                  |
| Low Level Input Voltage                                          | VIL                     |                                                                   | 0.0         |     | 0.3V<br>DD3 | V    | All input pins                  |
| High Level Output Voltage                                        | VOH                     | IOH = –0.5mA                                                      | 0.8V<br>DD3 |     | VDD3        | V    | DB[17:0], TE                    |
| Low Level Output Voltage                                         | VOL                     | IOH = +0.5mA                                                      | 0.0         |     | 0.2V<br>DD3 | V    | DB[17:0], TE                    |
| Input Current                                                    | ILI1                    | $GND \leq V_{IN} \leq VDD3$                                       | –1.0        |     | 1.0         | uA   | CSX,RDX,WRX,<br>DB[17:0],& RESX |
| Output voltage deviation<br>(Mean value)<br>AVDD=5.0V, GVDD=4.5V | $\Delta V_o$            | $AVDD-0.8 \leq V_{so}$                                            | –           | –   | $\pm 55$    | mV   | S[1:720]                        |
|                                                                  |                         | $VSS+0.8 < V_{so} < AVDD-0.8$                                     | –           | –   | $\pm 25$    |      |                                 |
|                                                                  |                         | $V_{so} \leq VSS + 0.8$                                           | –           | –   | $\pm 55$    |      |                                 |
| Sleep In Current                                                 | IDD <sub>SI_VDD3</sub>  | VCI=2.8V<br>VDD3=1.8V<br>Ta=25℃                                   | –           | –   | 25          | uA   | VSS                             |
|                                                                  | IDD <sub>SI_VCI</sub>   |                                                                   | –           | –   | 5           | uA   | VSS                             |
| Operating Current 1                                              | IDD <sub>OP1_VDD3</sub> | 30fps memory access<br>(VCI=2.8v,VDD3=1.8v<br>Load=100pf. Ta=25℃) | –           |     | *1.8        | mA   |                                 |
|                                                                  | IDD <sub>OP1_VCI</sub>  | 30fps memory access                                               | –           |     | 8.8         | mA   |                                 |

| Item                                      | Symbol                  | Condition                                                       | Min           | Typ | Max           | Unit | Applicable Pin  |
|-------------------------------------------|-------------------------|-----------------------------------------------------------------|---------------|-----|---------------|------|-----------------|
|                                           |                         | (VCI=2.8v,VDD3=1.8v<br>Load=100pf. Ta=25℃)                      |               |     |               |      |                 |
| Operating Current 2                       | IDD <sub>OP2_VDD3</sub> | Memory Not Access<br>(VCI=2.8v,VDD3=1.8v<br>Load=100pf. Ta=25℃) | –             |     | *500          | uA   |                 |
|                                           | IDD <sub>OP2_VCI</sub>  | Memory Not Access<br>(VCI=2.8v,VDD3=1.8v<br>Load=100pf. Ta=25℃) | –             |     | 8.8           | mA   |                 |
| Internal Oscillator frequency             | Fosc1                   | Frame freq. = 60 Hz<br>Display line = 320<br>Ta = 25℃           | 8.55<br>(8.1) | 9   | 9.45<br>(9.9) | MHz  | *(Ta= All Temp) |
| Step-up output efficiency                 | AVDD                    | ILOAD = 4 mA                                                    | 90            | 95  | –             | %    |                 |
|                                           | VGH                     | ILOAD = 0.1 mA                                                  | 90            | 95  | –             | %    |                 |
|                                           | VGL                     | ILOAD = 0.1 mA                                                  | 90            | 95  | –             | %    |                 |
|                                           | VCL                     | ILOAD = 0.3 mA                                                  | 90            | 95  | –             | %    |                 |
| LCD Gate driver output<br>On resistance   | Ronvgh                  | VGH = 8.4V<br>VGL = 6.3V                                        | –             | –   | 7             | kΩ   |                 |
|                                           | Ronvgl                  |                                                                 | –             | –   | 7             | kΩ   |                 |
| LCD source driver output<br>On resistance | Ronp                    | AVDD = 5.0V<br>VSSA = 0V                                        | –             | –   | 30            | kΩ   |                 |
|                                           | Ronn                    |                                                                 | –             | –   | 30            | kΩ   |                 |
| LCD Binary driver Output<br>On resistance | Ronpb                   | GVDD = 4.5V<br>VSSA = 0V                                        | –             | –   | 300           | kΩ   |                 |
|                                           | Ronnb                   |                                                                 | –             | –   | 300           | kΩ   |                 |

**Note.**

DC Electrical Characteristics(Total): -40℃ to +85℃

Fosc: 25℃

Ivdd: 25℃(no load), 25℃(EDS 100pF load)

\* : Don't applied to MIE function

## 2.3. AC CHARACTERISTICS

### 2.3.1. 80-SERIES 8/ 9/ 16/ 18 BIT PARALLEL INTERFACE

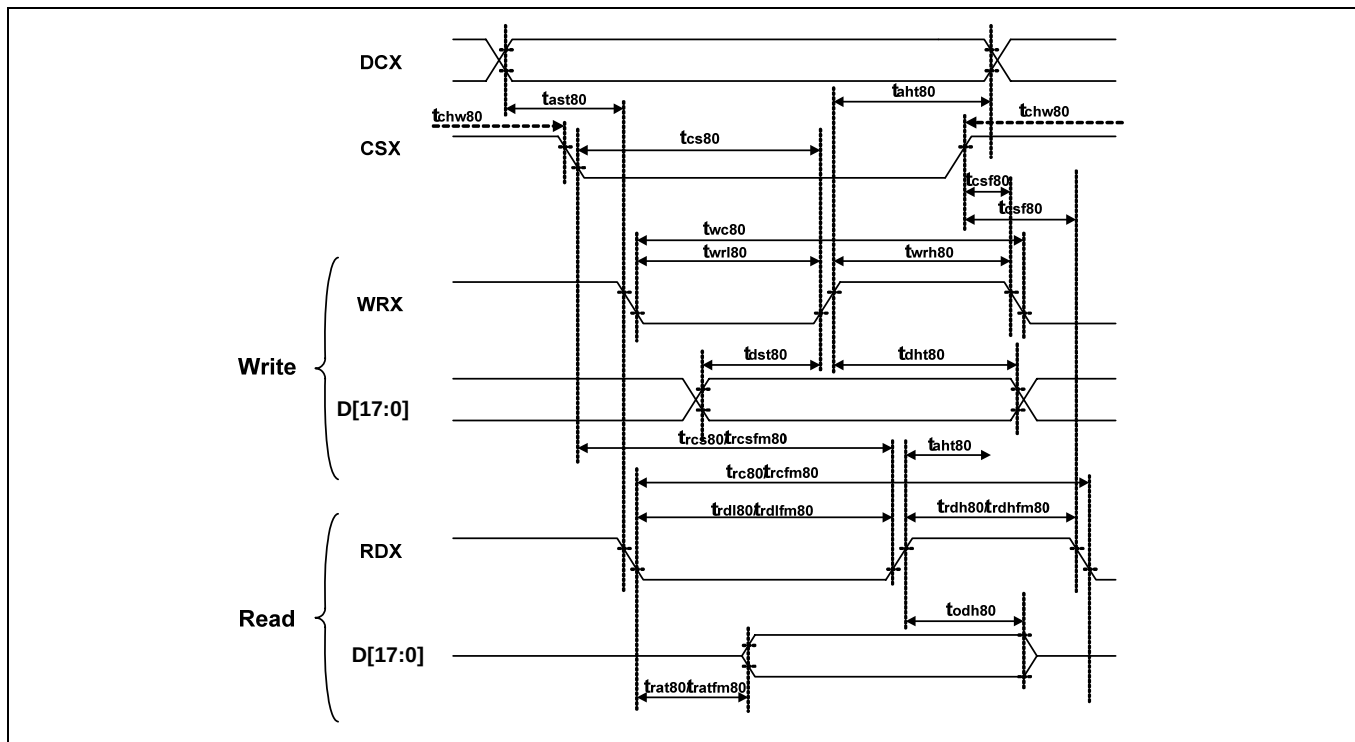


Figure7. 80-Series Parallel Interface

Table 9. AC Characteristics of 80-Series Parallel Interface

| Signal  | Parameter                         | Symbol         | Min | Max | Unit | Description          |
|---------|-----------------------------------|----------------|-----|-----|------|----------------------|
| DCX     | DCX setup time                    | $t_{ast80}$    | 0   | —   | ns   |                      |
|         | DCX hold time                     | $t_{aht80}$    | 10  | —   | ns   |                      |
| CSX     | CSX "H" pulse width               | $t_{ch80}$     | 0   | —   | ns   |                      |
|         | Chip select setup time(write)     | $t_{cs80}$     | 15  | —   | ns   |                      |
|         | Chip select setup time (Read ID)  | $t_{trcs80}$   | 45  | —   | ns   |                      |
|         | Chip select setup time (Read FM)  | $t_{trcsfm80}$ | 355 | —   | ns   |                      |
|         | Chip select wait time(write/read) | $t_{csf80}$    | 10  | —   | ns   |                      |
| WRX     | Write cycle                       | $t_{wc80}$     | 66  | —   | ns   |                      |
|         | Control pulse H duration          | $t_{wrh80}$    | 15  | —   | ns   |                      |
|         | Control pulse L duration          | $t_{wrl80}$    | 15  | —   | ns   |                      |
| RDX(ID) | Read cycle                        | $t_{rc80}$     | 160 | —   | ns   | When read<br>ID data |
|         | Control pulse H duration          | $t_{rdh80}$    | 90  | —   | ns   |                      |

| Signal  | Parameter                | Symbol   | Min | Max | Unit | Description                                           |
|---------|--------------------------|----------|-----|-----|------|-------------------------------------------------------|
|         | Control pulse L duration | trdl80   | 45  | –   | ns   |                                                       |
| RDX(FM) | Read cycle               | trcfm80  | 450 | –   | ns   | When read<br>from frame<br>memory                     |
|         | Control pulse H duration | trdhfm80 | 90  | –   | ns   |                                                       |
|         | Control pulse L duration | trdlfm80 | 355 | –   | ns   |                                                       |
| D[18:0] | Write data setup time    | tdst80   | 10  | –   | ns   | For maximum<br>CL = 30 pF<br>For minimum<br>CL = 8 pF |
|         | Write data hold time     | tdht80   | 10  | –   | ns   |                                                       |
|         | Read access time         | trat80   | –   | 40  | ns   |                                                       |
|         | Read access time (FM)    | tratfm80 | –   | 340 | ns   |                                                       |
|         | Read output disable time | todh80   | 20  | 80  | ns   |                                                       |

**Note.**

Ta = -40 ~+85 °C, VDD3=1.65V~3.3V, VCI=2.4V~3.3V, VSS=0V

## 2.3.2. 68-SERIES 8/ 9/ 16/ 18 BIT PARALLEL INTERFACE

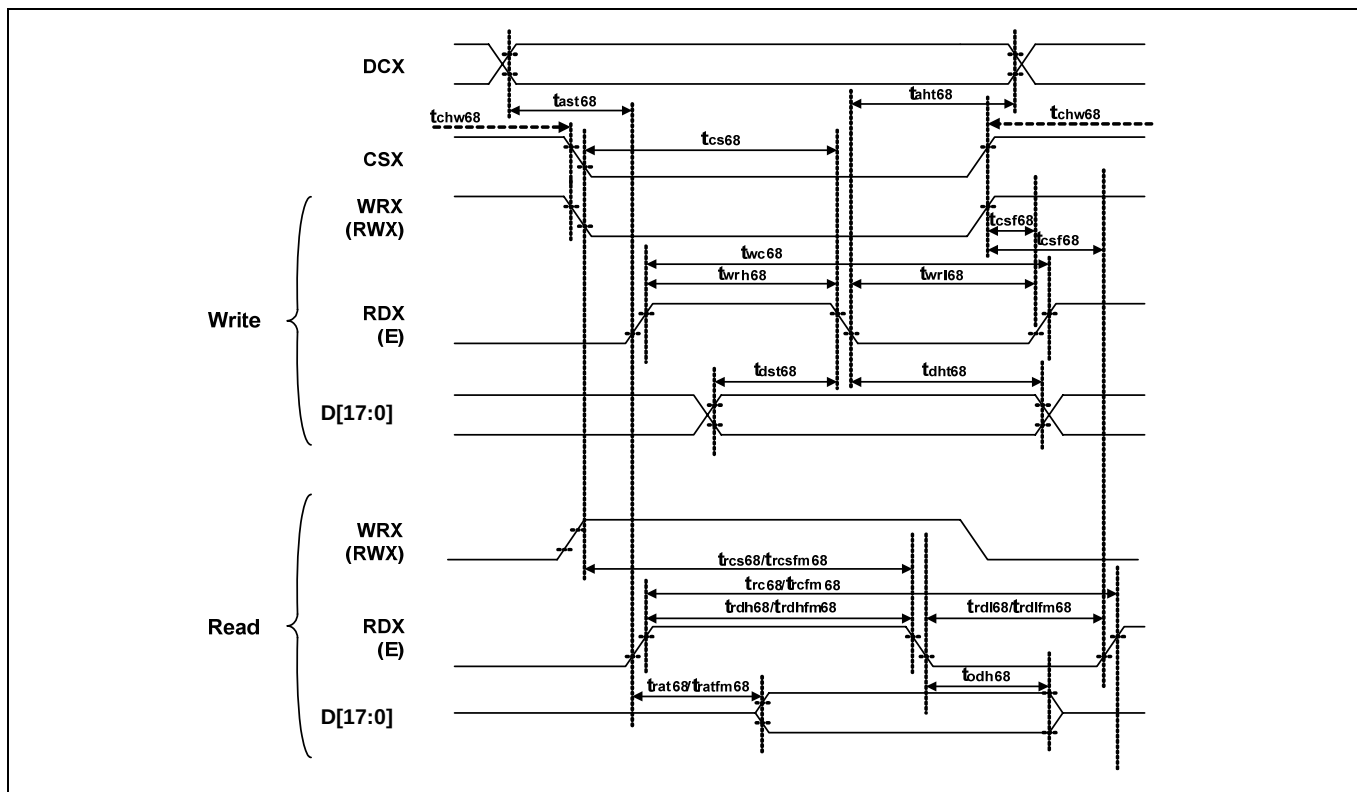


Figure8. 68-Series Parallel Interface

Table 10. AC Characteristics of 68-Series Parallel Interface

| Signal  | Parameter                         | Symbol        | Min | Max | Unit | Description       |
|---------|-----------------------------------|---------------|-----|-----|------|-------------------|
| DCX     | DCX setup time                    | $t_{ast68}$   | 0   | —   | ns   |                   |
|         | DCX hold time                     | $t_{ht68}$    | 10  | —   | ns   |                   |
| CSX     | CSX "H" pulse width               | $t_{chw68}$   | 0   | —   | ns   |                   |
|         | Chip select setup time(write)     | $t_{cs68}$    | 15  | —   | ns   |                   |
|         | Chip select setup time (Read ID)  | $t_{rcs68}$   | 45  | —   | ns   |                   |
|         | Chip select setup time (Read FM)  | $t_{rcsfm68}$ | 355 | —   | ns   |                   |
|         | Chip select wait time(write/read) | $t_{csf68}$   | 10  | —   | ns   |                   |
| WRX     | Write cycle                       | $t_{wc68}$    | 66  | —   | ns   |                   |
|         | Control pulse H duration          | $t_{wrh68}$   | 15  | —   | ns   |                   |
|         | Control pulse L duration          | $t_{wrl68}$   | 15  | —   | ns   |                   |
| RDX(ID) | Read cycle                        | $t_{rc68}$    | 160 | —   | ns   | When read ID data |
|         | Control pulse H duration          | $t_{rdh68}$   | 90  | —   | ns   |                   |

| Signal   | Parameter                | Symbol   | Min | Max | Unit | Description                                           |
|----------|--------------------------|----------|-----|-----|------|-------------------------------------------------------|
|          | Control pulse L duration | trdl68   | 45  | –   | ns   |                                                       |
| RDX(FM)  | Read cycle               | trcfm68  | 450 | –   | ns   | When read<br>from frame<br>memory                     |
|          | Control pulse H duration | trdhfm68 | 355 | –   | ns   |                                                       |
|          | Control pulse L duration | trdlfm68 | 90  | –   | ns   |                                                       |
| DB[23:0] | Write data setup time    | tdst68   | 10  | –   | ns   | For maximum<br>CL = 30 pF<br>For minimum<br>CL = 8 pF |
|          | Write data hold time     | tdht68   | 10  | –   | ns   |                                                       |
|          | Read access time         | trat68   | –   | 40  | ns   |                                                       |
|          | Read access time (FM)    | tratfm68 | –   | 340 | ns   |                                                       |
|          | Read output disable time | todh68   | 20  | 80  | ns   |                                                       |

**Note.**

Ta = -40 ~+85 °C, VDD3=1.65V~3.3V, VCI=2.4V~3.3V, VSS=0V



## 2.3.3. 3-WIRE 9-BIT SERIAL INTERFACE

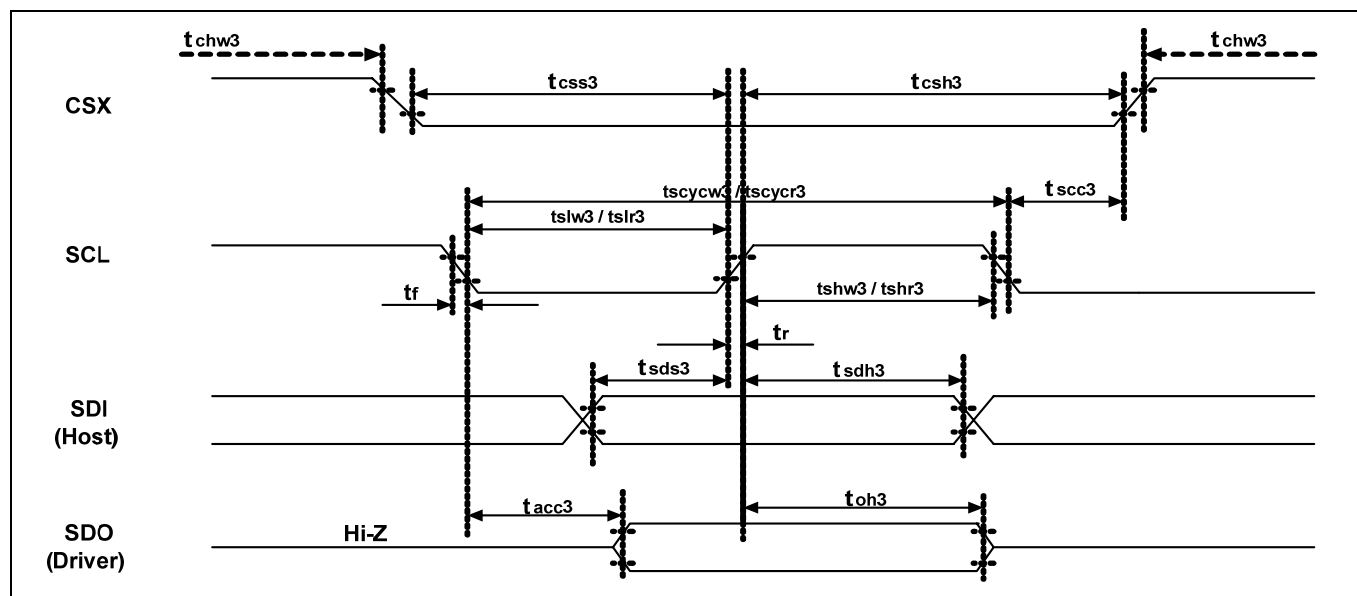


Figure9. 3-Wire 9-Bit Serial Interface

Table 11. AC Characteristics of 3-Wire 9-Bit Serial Interface

| Parameter                  | Symbol | Conditions  | Min | Max | Unit |
|----------------------------|--------|-------------|-----|-----|------|
| Serial Clock Cycle(Write)  | tscw3  | SCL         | 100 | –   | ns   |
| SCL "H" pulse width(Write) | tshw3  | SCL         | 35  | –   | ns   |
| SCL "L" pulse width(Write) | tslw3  | SCL         | 35  | –   | ns   |
| Data setup time(Write)     | tsds3  | SDA         | 30  | –   | ns   |
| Data hold time(Write)      | tsdh3  | SDA         | 30  | –   | ns   |
| Serial Clock Cycle(Read)   | tscyr3 | SCL         | 150 | –   | ns   |
| SCL "H" pulse width(Read)  | tshr3  | SCL         | 60  | –   | ns   |
| SCL "L" pulse width(Read)  | tslr3  | SCL         | 60  | –   | ns   |
| Access time                | tacc3  | SDO (Note2) | 10  | 50  | ns   |
| Output disable time        | toh3   | SDO (Note2) | 15  | 50  | ns   |
| CSX "H" pulse width        | tchw3  | CSX         | 40  | –   | ns   |
| CSX–SCL time               | tcsw3  | CSX(Write)  | 60  | –   | ns   |
|                            | tcshw3 | CSX(Write)  | 65  | –   | ns   |

**Note.**

1.  $T_a = -40 \sim +85 \text{ }^{\circ}\text{C}$ ,  $V_{DD3}=1.65\text{V}\sim 3.3\text{V}$ ,  $V_{CI}=2.4\text{V}\sim 3.3\text{V}$ ,  $V_{SS}=0\text{V}$
2. For maximum  $CL = 30 \text{ pF}$ , for minimum  $CL = 8 \text{ pF}$

## 2.3.4. 4-WIRE 8-BIT SERIAL INTERFACE

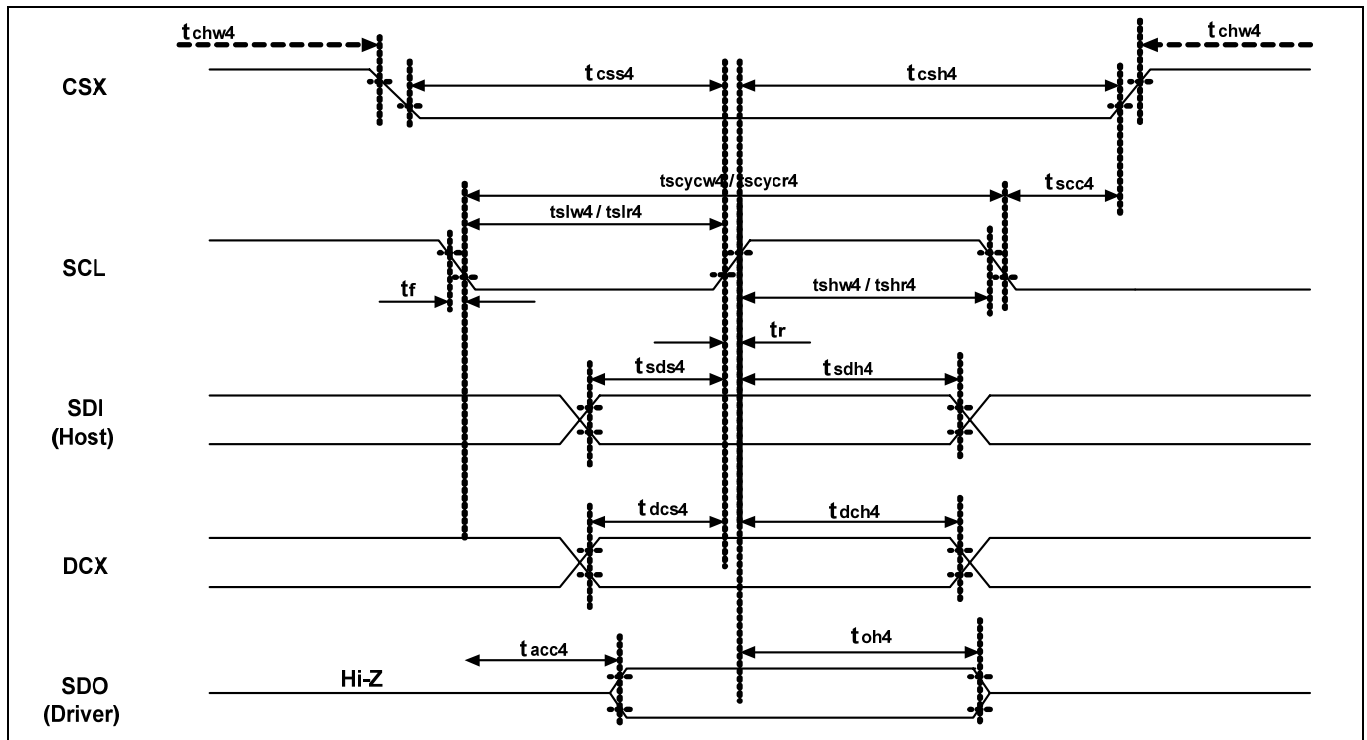


Figure10. 4-Wire 8-Bit Serial Interface

Table 12. AC Characteristics of 4-Wire 8-Bit Serial Interface

| Parameter                  | Symbol       | Conditions  | Min | Max | Unit |
|----------------------------|--------------|-------------|-----|-----|------|
| Serial Clock Cycle(Write)  | $t_{scycw4}$ | SCL         | 100 | –   | ns   |
| SCL "H" pulse width(Write) | $t_{shw4}$   | SCL         | 35  | –   | ns   |
| SCL "L" pulse width(Write) | $t_{slw4}$   | SCL         | 35  | –   | ns   |
| Data setup time(Write)     | $t_{ds4}$    | SDA         | 30  | –   | ns   |
| Data hold time(Write)      | $t_{dh4}$    | SDA         | 30  | –   | ns   |
| DCX setup time             | $t_{dcs4}$   | DCX         | 30  | –   | ns   |
| DCX hold time              | $t_{dch4}$   | DCX         | 30  | –   | ns   |
| Serial Clock Cycle(Read)   | $t_{scycr4}$ | SCL         | 150 | –   | ns   |
| SCL "H" pulse width(Read)  | $t_{shr4}$   | SCL         | 60  | –   | ns   |
| SCL "L" pulse width(Read)  | $t_{slr4}$   | SCL         | 60  | –   | ns   |
| Access time                | $t_{acc4}$   | SDO (Note2) | 10  | 50  | ns   |
| Output disable time        | $t_{oh4}$    | SDO (Note2) | 15  | 50  | ns   |
| CSX "H" pulse width        | $t_{chw4}$   | CSX         | 40  | –   | ns   |

| Parameter           | Symbol | Conditions | Min | Max | Unit |
|---------------------|--------|------------|-----|-----|------|
| CSX–SCL time(Write) | tcsw4  | CSX        | 60  | –   | ns   |
|                     | tcshw4 | CSX        | 65  | –   | ns   |

**Note.**

1. Ta = -40 ~+85 °C, VDD3=1.65V~3.3V, VCI=2.4V~3.3V, VSS=0V
2. Note2. For maximum CL = 30 pF, for minimum CL = 8 pF

## 2.3.5. RGB INTERFACE CHARACTERISTICS

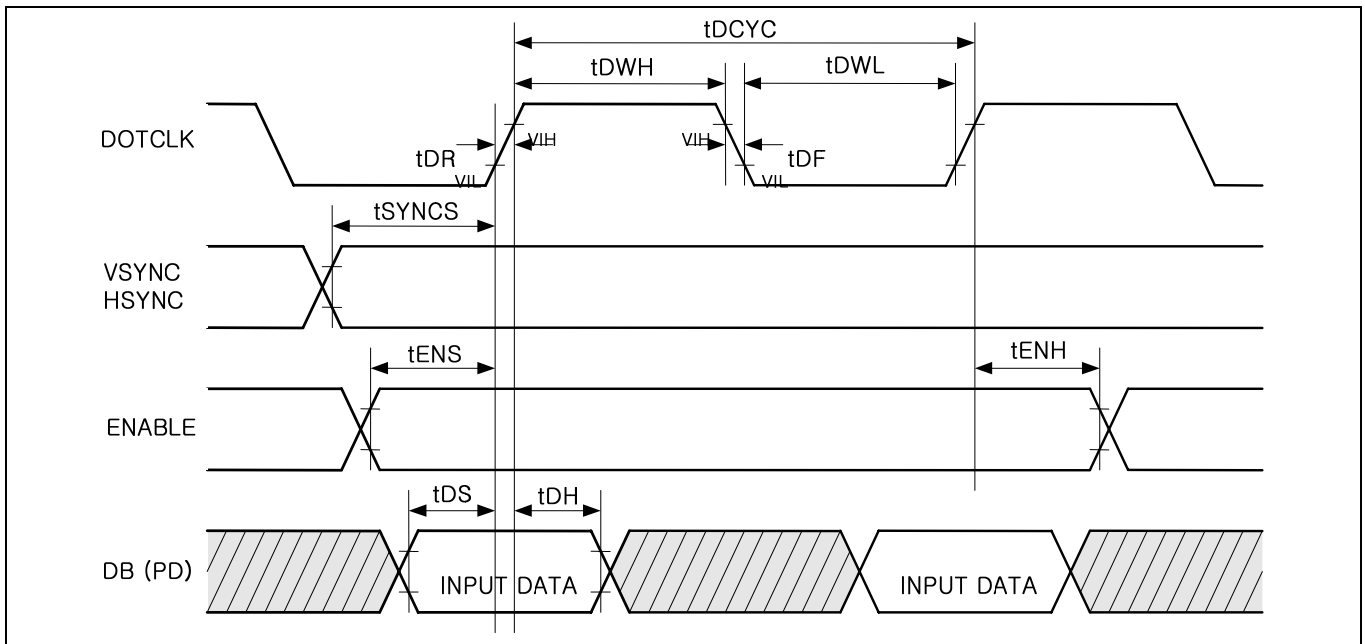


Figure11. RGB Interface

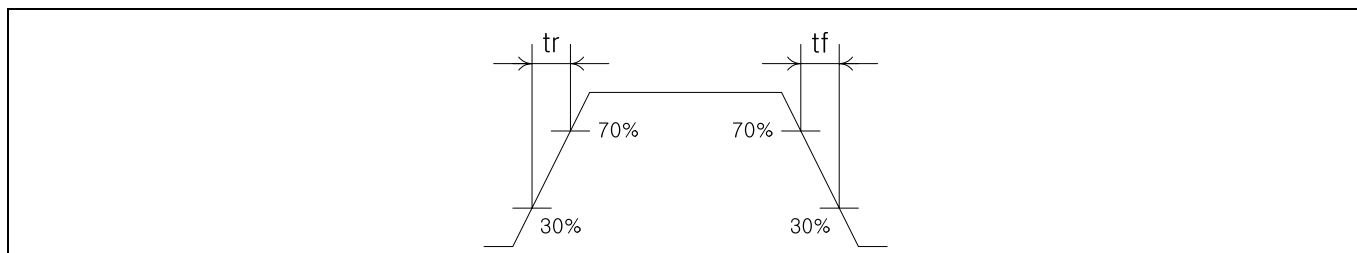
Table 13. RGB Interface AC Characteristics

(Ta = -40 ~ +85 °C, VDD3=1.65V~3.3V, VCI=2.4V~3.3V)

| Parameter         | Description                  | Min | Max | Unit |
|-------------------|------------------------------|-----|-----|------|
| $t_{DCYC}$        | DOTCLK period                | 100 | –   | ns   |
| $t_{DWL}$         | DOTCLK pulse width low       | 50  | –   | ns   |
| $t_{DWH}$         | DOTCLK pulse width high      | 50  | –   | ns   |
| $t_{DR} / t_{DF}$ | DOTCLK rising / falling time | –   | 20  | ns   |
| $t_{SYNCS}$       | VSYNC, HSYNC setup           | 30  | –   | ns   |
| $t_{ENS}$         | ENABLE setup                 | 50  | –   | ns   |
| $t_{ENH}$         | ENABLE hold                  | 50  | –   | ns   |
| $t_{DS}$          | Input Data setup             | 50  | –   | ns   |
| $t_{DH}$          | Input Data hold              | 50  | –   | ns   |

**Note.**

1. VSYNC Low Pulse Width  $\geq 1H$
2. HSYNC Low Pulse Width  $\geq 1$  DOTCLK

**Figure12. Rising and Falling****Note.**

The signal's rise and fall times ( $t_f$ ,  $t_r$ ) are stipulated to be equal to or less than 15ns.

## 2.3.6. TACC, TODH MEASUREMENT CONDITION

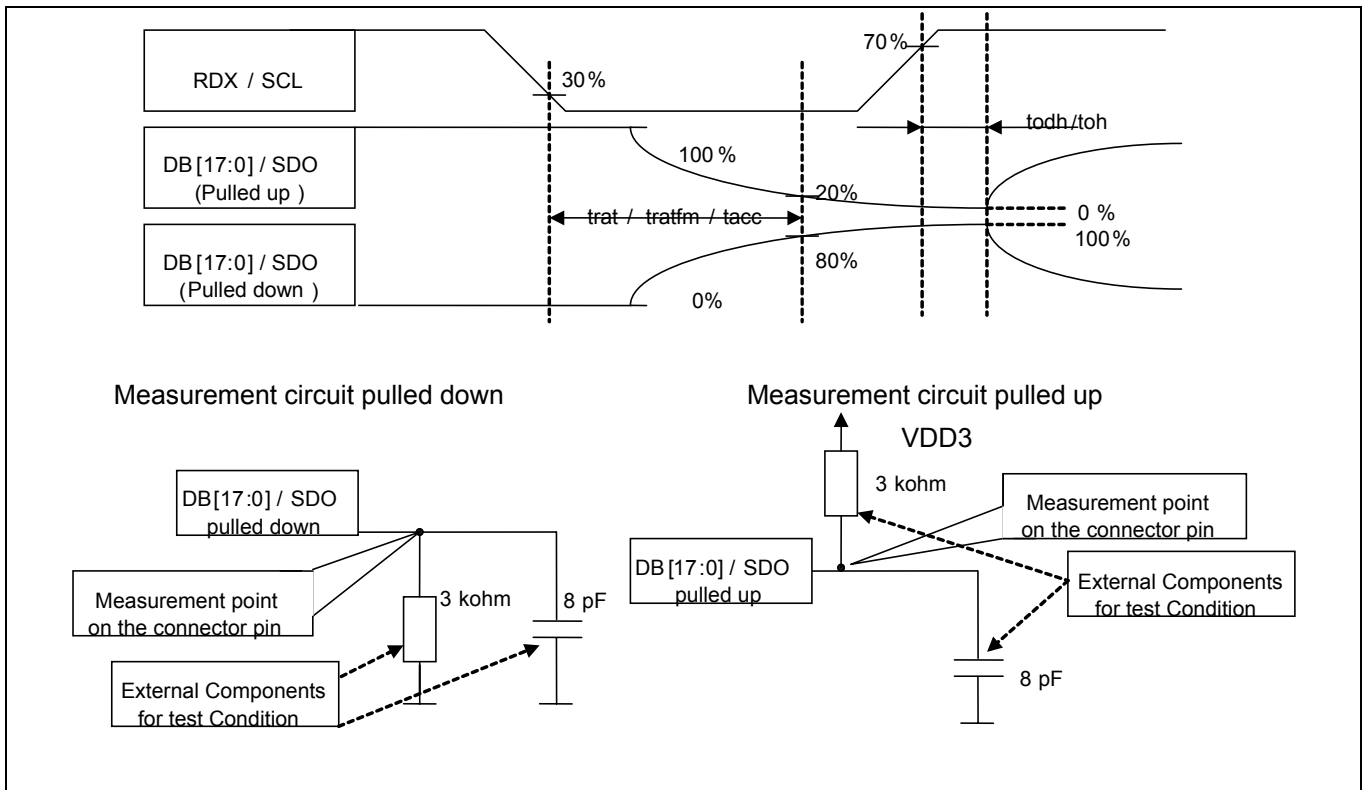


Figure13. Minimum Measurement Condition

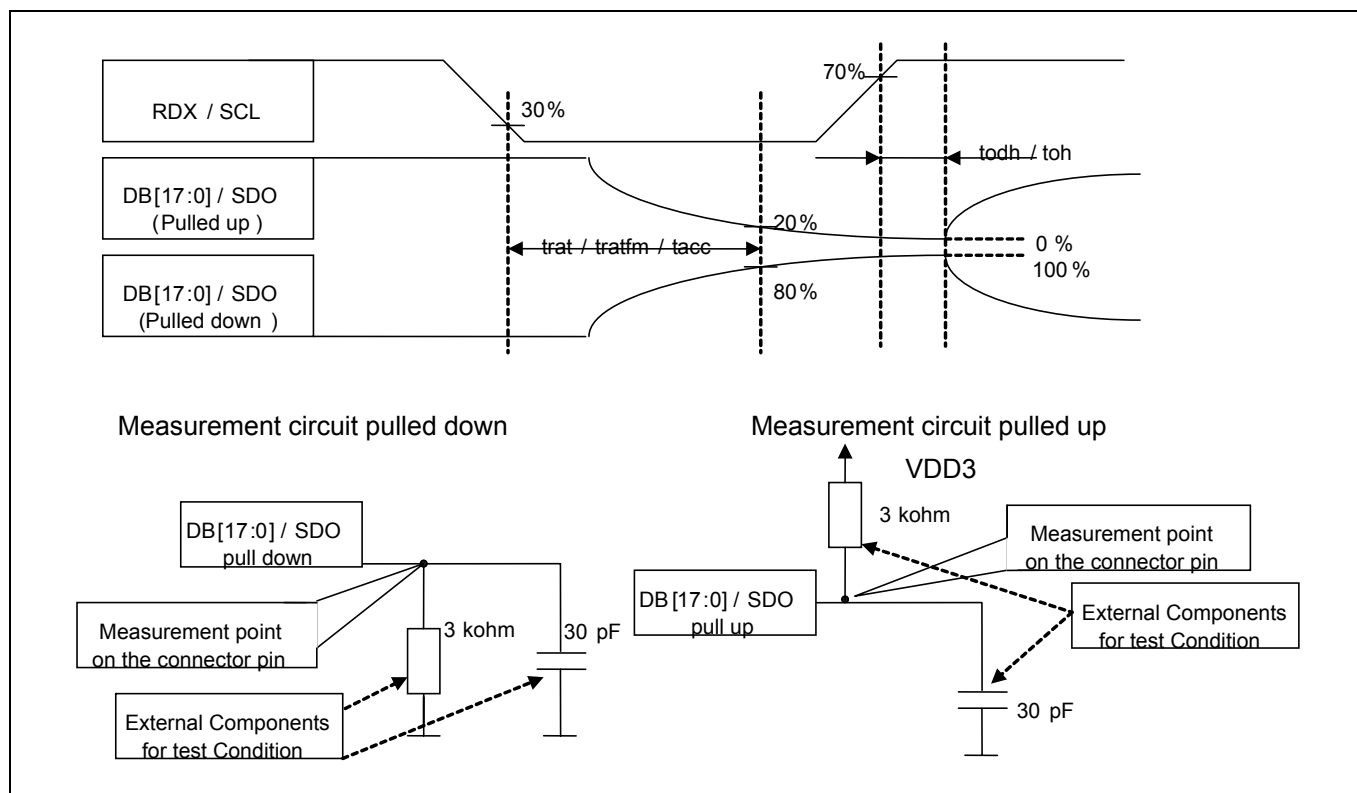


Figure14. Maximum Measurement Condition

## 2.3.7. RESET TIMING

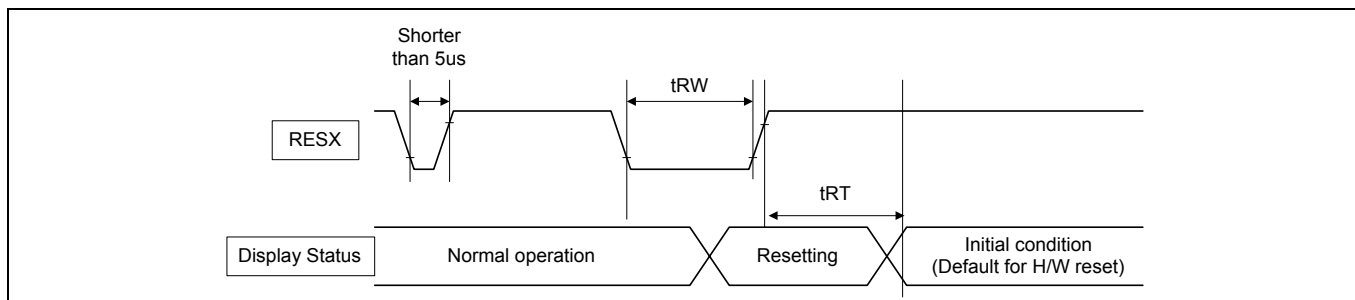


Figure15. Reset Timing

Table 14. Reset Input Timing

| Signal | Symbol | Parameter            | Min | Max             | Unit |
|--------|--------|----------------------|-----|-----------------|------|
| RESX   | tRW    | Reset pulse duration | 10  | –               | us   |
|        | tRT    | Reset cancel         | –   | 5 (note 5)      | ms   |
|        |        |                      | –   | 120 (note 6, 7) | ms   |

**Note.**

1. The reset cancel includes also required time for loading ID bytes, VCOM setting and other settings from EEPROM to registers. This loading is done every time when there is HW reset cancel time (tRT) within 5ms after a rising edge of RESX.
2. Spike due to an electrostatic discharge on RESX line does not cause irregular system reset according to the table below: -

Table 15. Reset Operation According to Resx Pulse Width

| RESX Pulse           | Action         |
|----------------------|----------------|
| Shorter than 5us     | Reset Rejected |
| Longer than 10us     | Reset          |
| Between 5us and 10us | Reset starts   |

3. During the Resetting period, the display will be blanked (The display is entering blanking sequence, which maximum time is 120ms, when Reset Starts in Sleep Out –mode. The display remains the blank state in Sleep In mode.) and then return to Default condition for Hardware Reset.

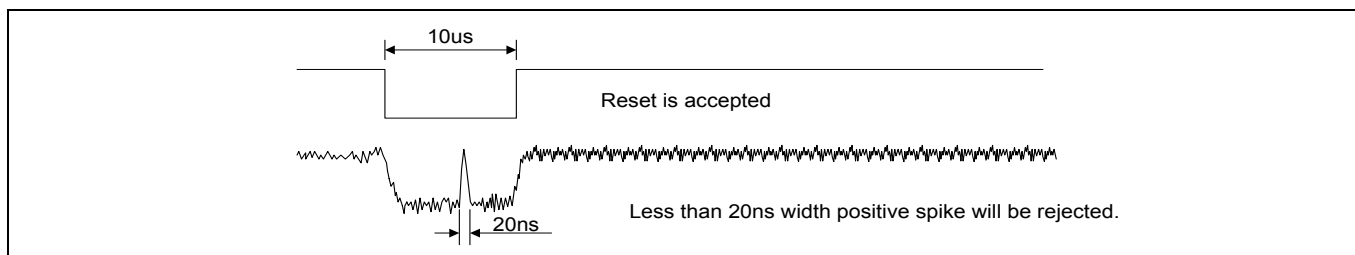


Figure16. Spike Rejection



4. Spike Rejection also applies during a valid reset pulse as shown below:
5. When Reset applied during Sleep In Mode.
6. When Reset 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.

## CHAPTER 3

# INTERFACE

- 3.1 MPU Interface
- 3.2 Interface Description
- 3.3 Display Data Format
- 3.4 RGB Interface
- 3.5 VSYNC Interface

# 3. INTERFACE

## 3.1. MPU INTERFACE

### 3.1.1. INTERFACE TYPE SELECTION

Selection of given interfaces are set by IM[3], IM[2], IM[1], and IM[0] pins as shown below.

**Table 16. Interface Type Selection**

| IM[3] | IM[2] | IM[1] | IM[0] | Interface                    | Description                                     |
|-------|-------|-------|-------|------------------------------|-------------------------------------------------|
| 0     | 0     | 0     | 0     | 80-series 8bit parallel I/F  | 8bit read display data and 8bit read parameter  |
| 0     | 0     | 0     | 1     | 80-series 16bit parallel I/F | 16bit read display data and 8bit read parameter |
| 0     | 0     | 1     | 0     | 80-series 9bit parallel I/F  | 9bit read display data and 8bit read parameter  |
| 0     | 0     | 1     | 1     | 80-series 18bit parallel I/F | 18bit read display data and 8bit read parameter |
| 0     | 1     | 0     | 1     | 3-wire 9bit serial I/F I     | 8bit command and 8 / 24 / 32bit parameter       |
| 0     | 1     | 1     | 0     | 4-wire 8bit serial I/F I     | 8bit command and 8 / 24 / 32bit parameter       |
| 1     | 0     | 0     | 0     | 68-series 8bit parallel I/F  | 8bit read display data and 8bit read parameter  |
| 1     | 0     | 0     | 1     | 68-series 16bit parallel I/F | 16bit read display data and 8bit read parameter |
| 1     | 0     | 1     | 0     | 68-series 9bit parallel I/F  | 9bit read display data and 8bit read parameter  |
| 1     | 0     | 1     | 1     | 68-series 18bit parallel I/F | 18bit read display data and 8bit read parameter |
| 1     | 1     | 0     | 1     | 3-wire 9bit serial I/F II    | 8bit command and 8 / 24 / 32bit parameter       |
| 1     | 1     | 1     | 0     | 4-wire 8bit serial I/F II    | 8bit command and 8 / 24 / 32bit parameter       |

### 3.1.2. PIN DESCRIPTION

MPU interface is changed according to the bus width used. The pin assignment is listed in the table below.

#### 3.1.2.1. 3-Wire 9-bit serial interface I

| Pin Name  | Description                                                                                                  |
|-----------|--------------------------------------------------------------------------------------------------------------|
| CSX       | Chip select signal                                                                                           |
| DCX (SCL) | Clock for serial interface<br>During write mode, the data is latched on the rising edge of DCX (SCL) signal. |
| SDA       | Serial input/output data                                                                                     |
| DB[17:0]  | Display Data of RGB Interface                                                                                |

#### 3.1.2.2. 4-Wire 8-bit serial interface I

| Pin Name  | Description                                                                                                       |
|-----------|-------------------------------------------------------------------------------------------------------------------|
| CSX       | Chip select signal                                                                                                |
| DCX       | Data is regard as a command when DCX is low.<br>Data is regard as a parameter or a display data when DCX is high. |
| WRX (SCL) | Clock for serial interface<br>During write mode, the data is latched on the rising edge of WRX signal.            |
| SDA       | Serial input/output data                                                                                          |
| DB[17:0]  | Display Data of RGB Interface                                                                                     |

#### 3.1.2.3. 3-Wire 9-bit serial interface II

| Pin Name  | Description                                                                                                  |
|-----------|--------------------------------------------------------------------------------------------------------------|
| CSX       | Chip select signal                                                                                           |
| DCX (SCL) | Clock for serial interface<br>During write mode, the data is latched on the rising edge of DCX (SCL) signal. |
| SDA       | Serial input data                                                                                            |
| SDO       | Serial output data                                                                                           |
| DB[17:0]  | Display Data of RGB Interface                                                                                |

## 3.1.2.4. 4-Wire 8-bit serial interface II

| Pin Name  | Description                                                                                                       |
|-----------|-------------------------------------------------------------------------------------------------------------------|
| CSX       | Chip select signal                                                                                                |
| DCX       | Data is regard as a command when DCX is low.<br>Data is regard as a parameter or a display data when DCX is high. |
| WRX (SCL) | Clock for serial interface<br>During write mode, the data is latched on the rising edge of WRX signal.            |
| SDI / SDA | Serial input data                                                                                                 |
| SDO       | Serial output data                                                                                                |
| DB[17:0]  | Display Data of RGB Interface                                                                                     |

## 3.1.2.5. 80-Series parallel interface

| Pin Name  | Description                                                                                                               |                                            |
|-----------|---------------------------------------------------------------------------------------------------------------------------|--------------------------------------------|
| CSX       | Chip select signal                                                                                                        |                                            |
| DCX       | Data bus is regard as a command when DCX is low.<br>Data bus is regard as a parameter or a display data when DCX is high. |                                            |
| RDX (E)   | Clock for read operation. When RDX is low, the data bus held on output state.                                             |                                            |
| WRX (RWX) | Clock for write operation. The data is latched on the rising edge of WRX.                                                 |                                            |
| DB[17:0]  | Data bus                                                                                                                  |                                            |
|           | Interface                                                                                                                 | DB Pins                                    |
|           | 8-bit Parallel Interface                                                                                                  | DB17-DB8 : unused, DB7-DB0 : 8-bit data    |
|           | 16-bit Parallel Interface                                                                                                 | DB17-DB16 : unused, DB15-DB0 : 16-bit data |
|           | 9-bit Parallel Interface                                                                                                  | DB17-DB9 : unused, DB8-DB0 : 9-bit data    |
|           | 18-bit Parallel Interface                                                                                                 | DB17-DB0 : 18-bit data                     |
|           | If not used, fix this pin to VSS.                                                                                         |                                            |

## 3.1.2.6. 68-Series parallel interface

| Pin Name  | Description                                                                                                               |                                           |
|-----------|---------------------------------------------------------------------------------------------------------------------------|-------------------------------------------|
| CSX       | Chip select signal                                                                                                        |                                           |
| DCX       | Data bus is regard as a command when DCX is low.<br>Data bus is regard as a parameter or a display data when DCX is high. |                                           |
| RDX (E)   | Clock for read / write operation                                                                                          |                                           |
| WRX (RWX) | Read / write selection signal (Read: High / Write: Low)                                                                   |                                           |
| DB[17:0]  | Data bus                                                                                                                  |                                           |
|           | Interface                                                                                                                 | DB Pins                                   |
|           | 8-bit Parallel Interface                                                                                                  | DB17-DB8: unused, DB7-DB0 : 8-bit data    |
|           | 16-bit Parallel Interface                                                                                                 | DB17-DB16: unused, DB15-DB0 : 16-bit data |
|           | 9-bit Parallel Interface                                                                                                  | DB17-DB9: unused, DB8-DB0 : 9-bit data    |
|           | 18-bit Parallel Interface                                                                                                 | DB17-DB0: 18-bit data                     |
|           | If not used, fix this pin to VSS.                                                                                         |                                           |

3.1.3. INPUT / OUTPUT PIN ASSIGNMENT

The block diagrams for MPU interface are illustrated below.

3.1.3.1. 3-Wire 9-bit serial interface I

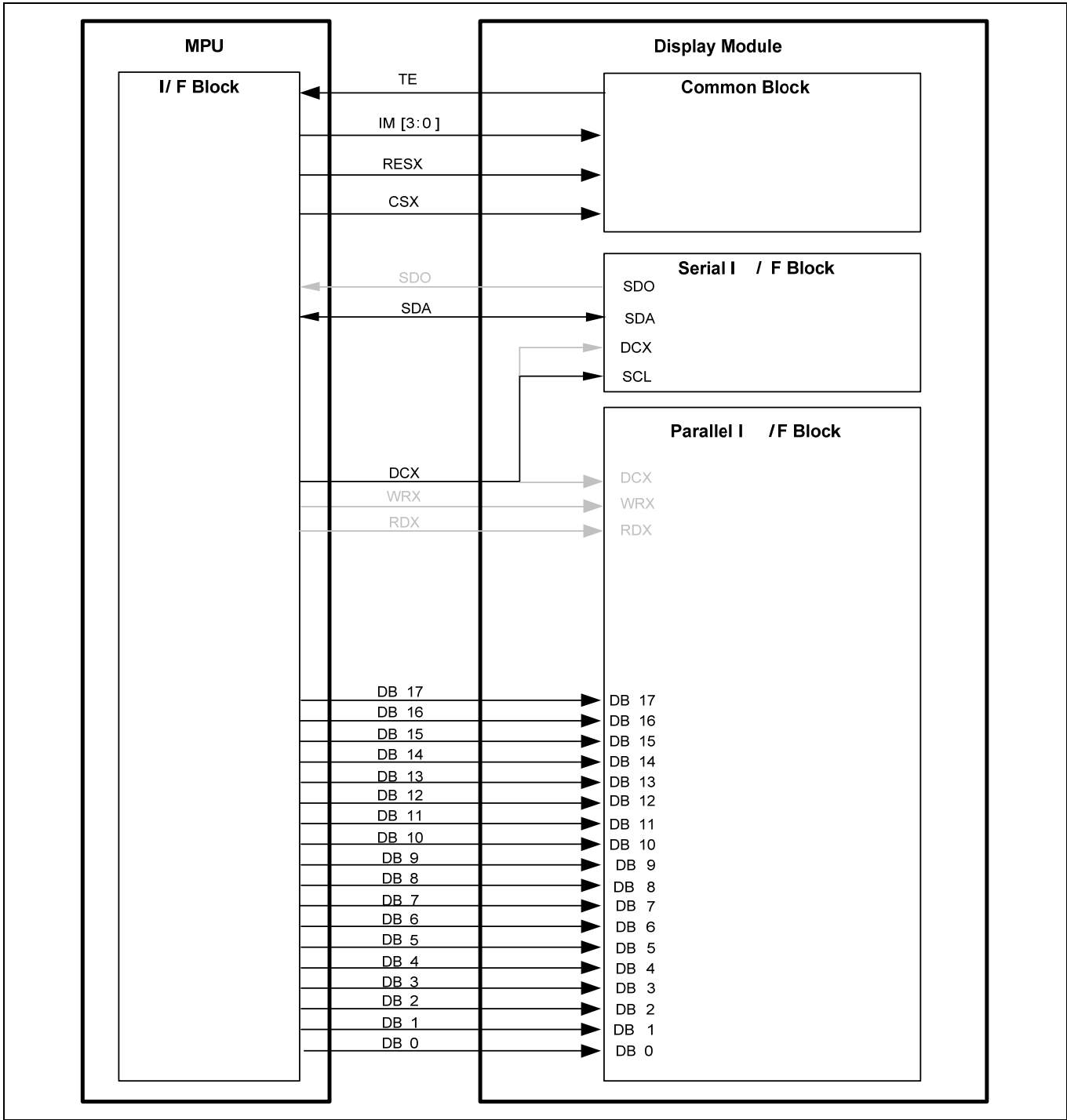


Figure17. 3-Wire 9-Bit Serial Interface I (RGB 18-Bit I/F)

3.1.3.2. 4-Wire 8-bit serial interface I

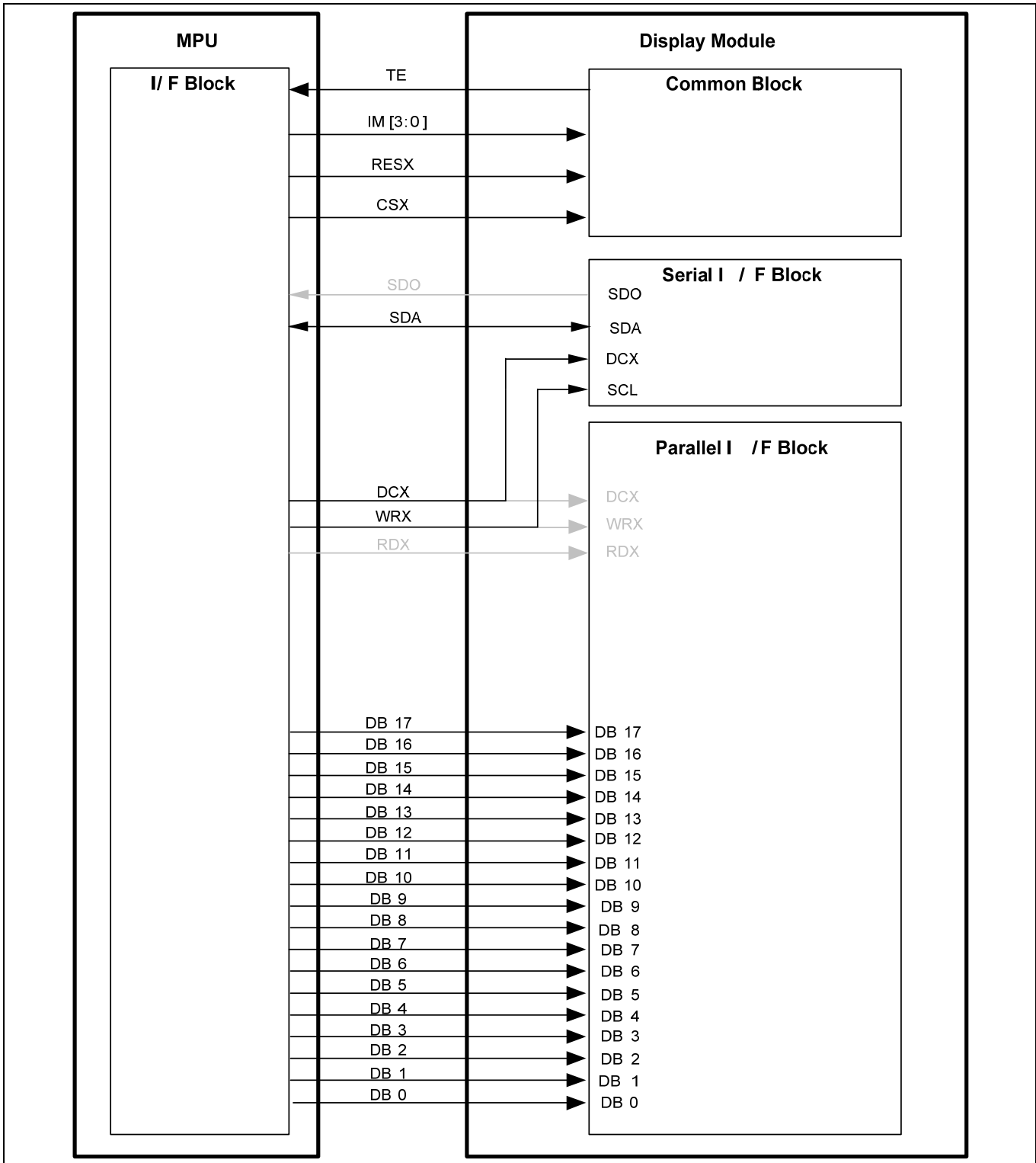


Figure18. 4-Wire 8-Bit Serial Interface I (RGB 18-Bit I/F)



3.1.3.3. 3-Wire 9-bit serial interface II

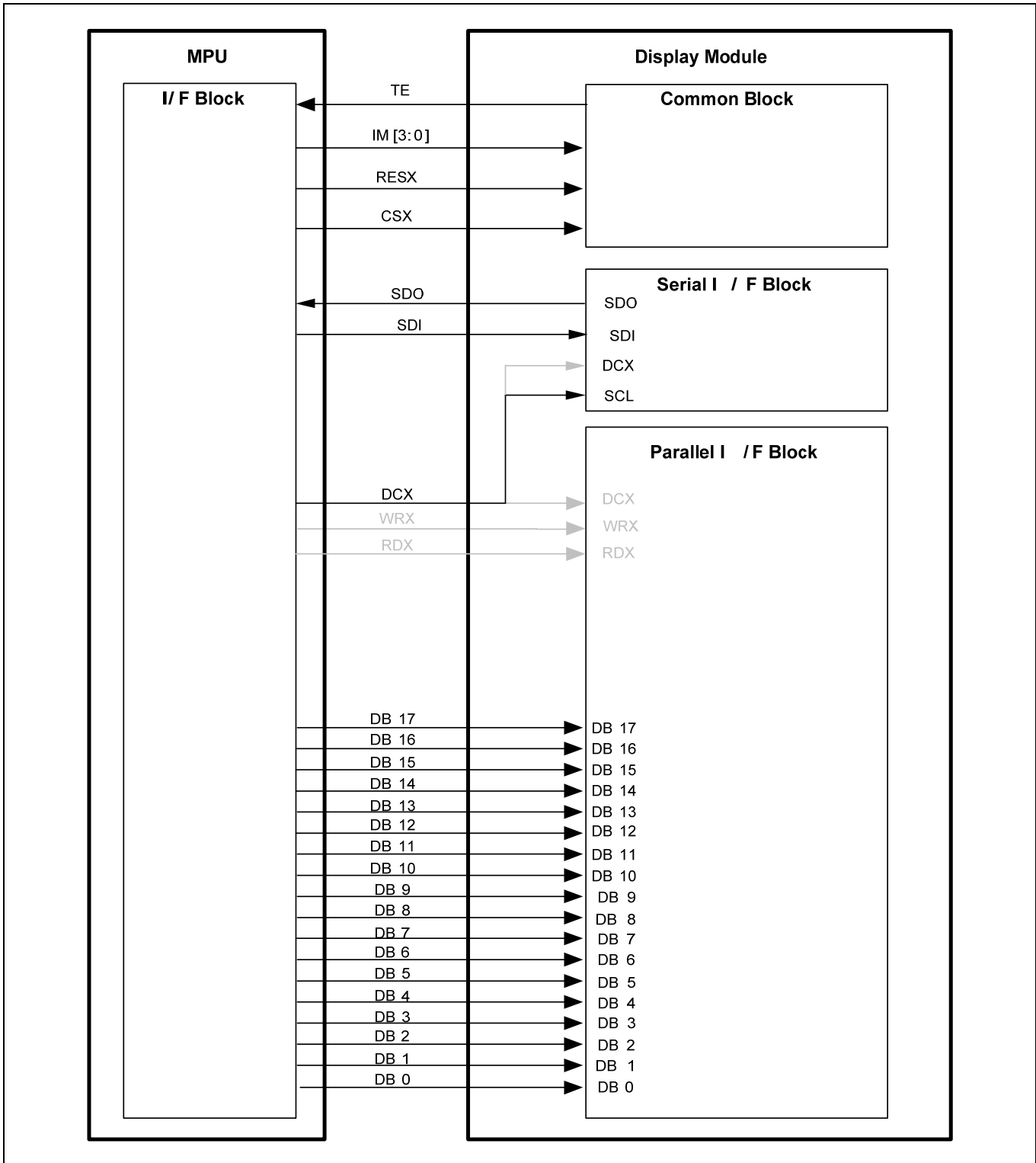


Figure19. 3-Wire 9-Bit Serial Interface II (RGB 18-Bit I/F)

3.1.3.4. 4-Wire 8-bit serial interface II

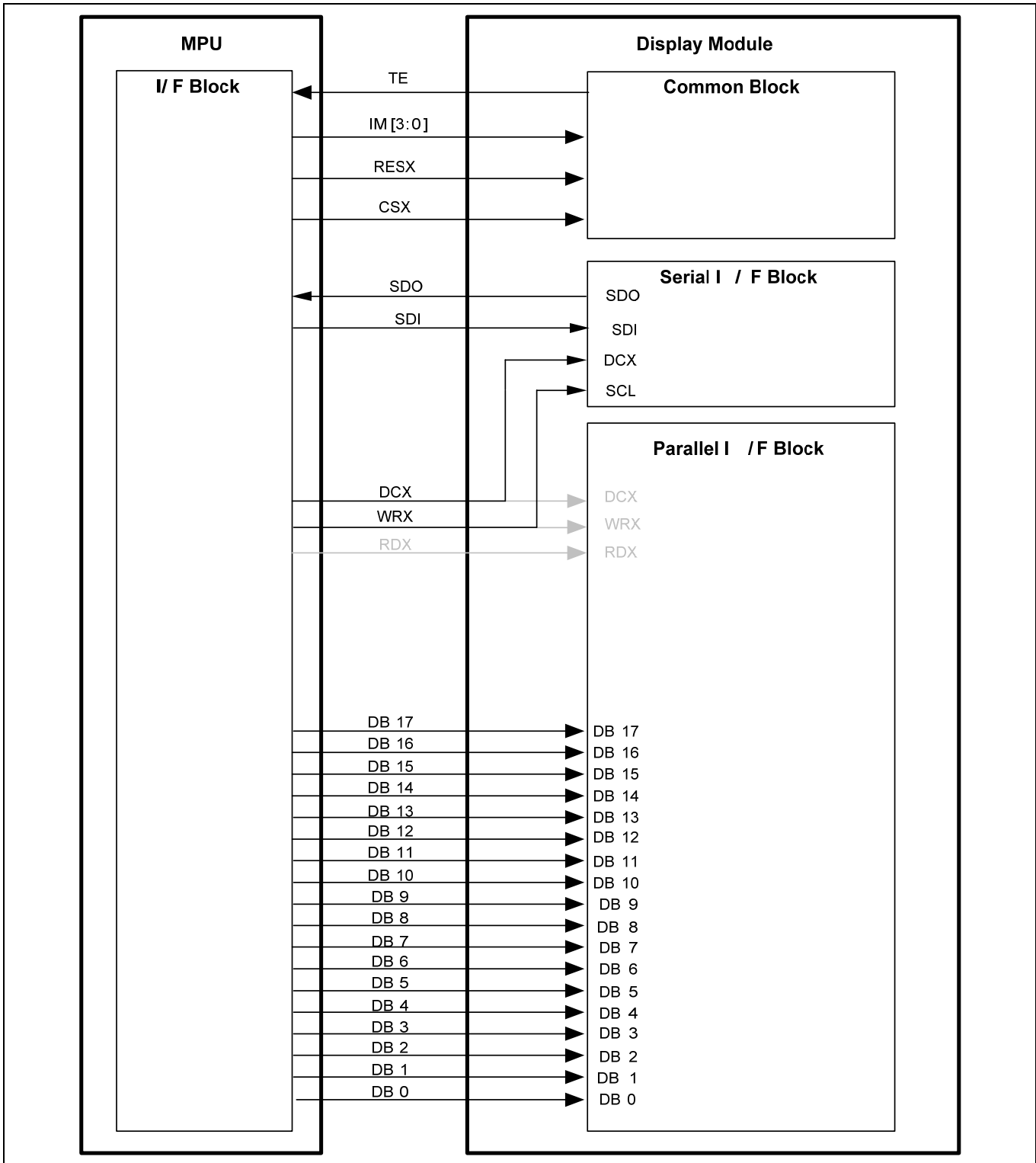


Figure20. 4-Wire 8-Bit Serial Interface II (RGB 18-Bit I/F)

3.1.3.5. 80-Series parallel interface

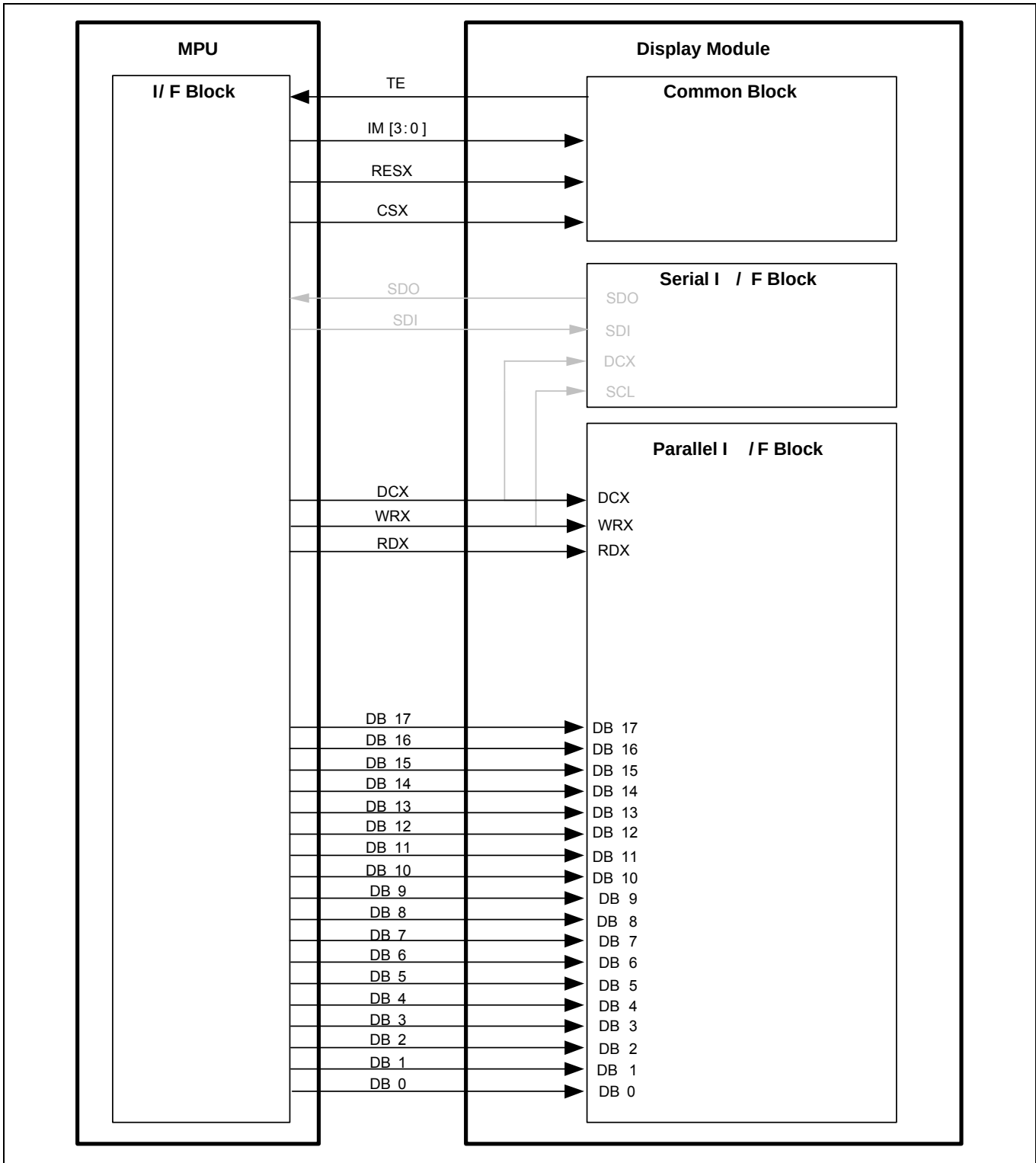


Figure21. 80-Series Parallel Interface

3.1.3.6. 68-Series parallel interface

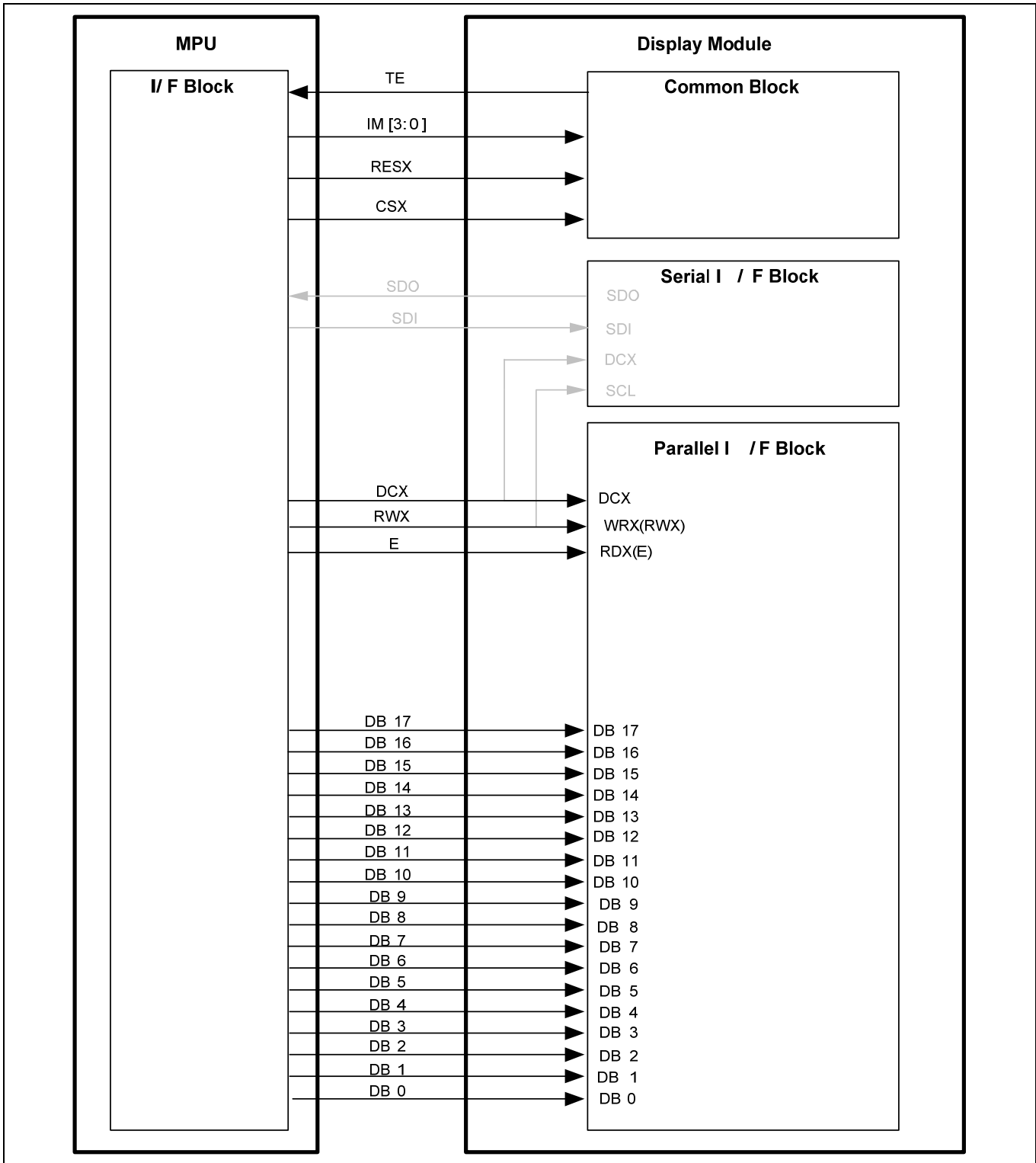


Figure22. 68-Series Parallel Interface

### 3.1.4. 3-WIRE 9-BIT SERIAL INTERFACE

This serial interface is 3-wire 9-bit bi-directional interface for communication between the micro controller and the LCD driver IC. CSX, SCL (DCX), SDA and SDO are used for interface with MPU only, so it can be stopped when no communication is necessary.

#### 3.1.4.1. 3-Wire 9-bit data serial interface write mode

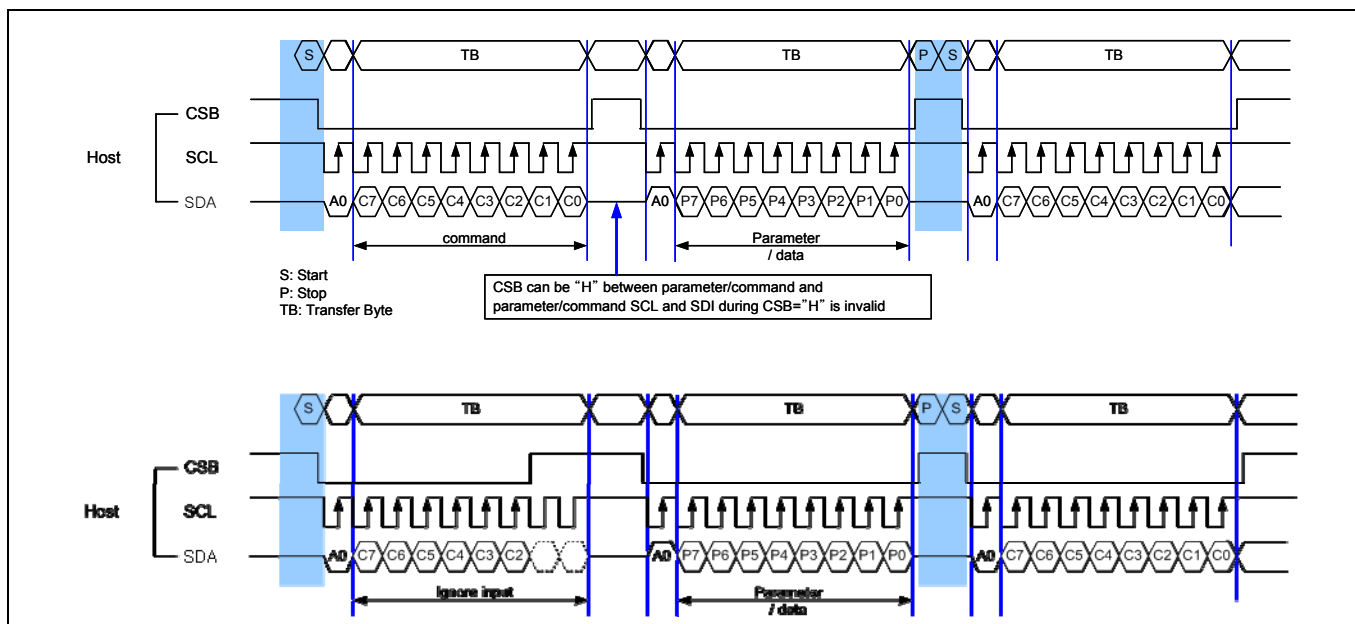


Figure23. 3-Wire 9-Bit Serial Interface I Bus Protocol, Write to Register or Display RAM

#### 3.1.4.2. 3-Wire 9-bit data serial interface read 1-byte mode

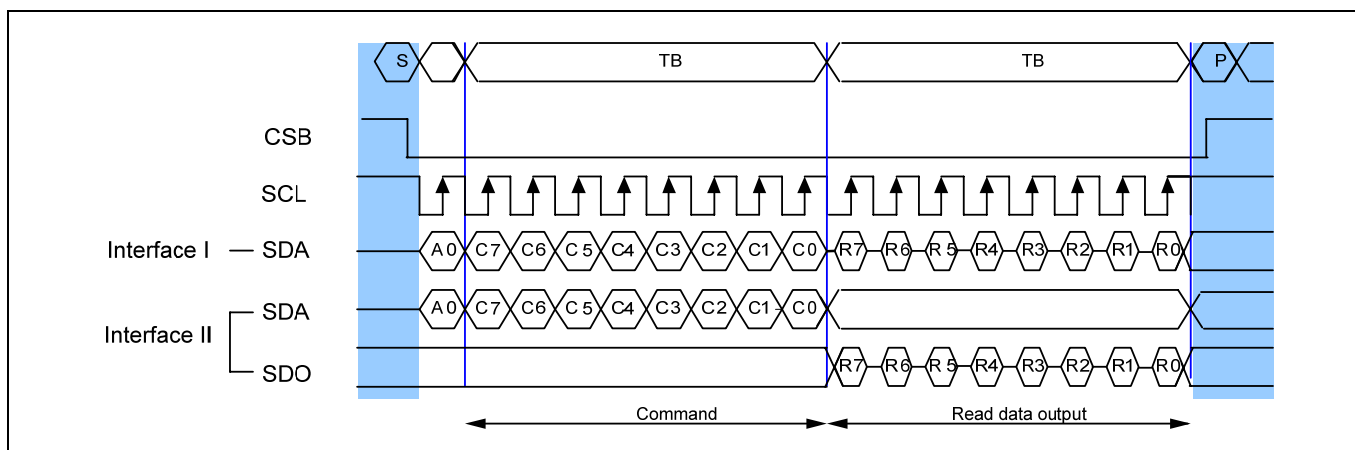


Figure24. 3-Wire 9-Bit Serial Interface I/II Bus Protocol, Read 1-Byte From Register

3.1.4.3. 3-Wire 9-bit data serial interface read multi-byte mode

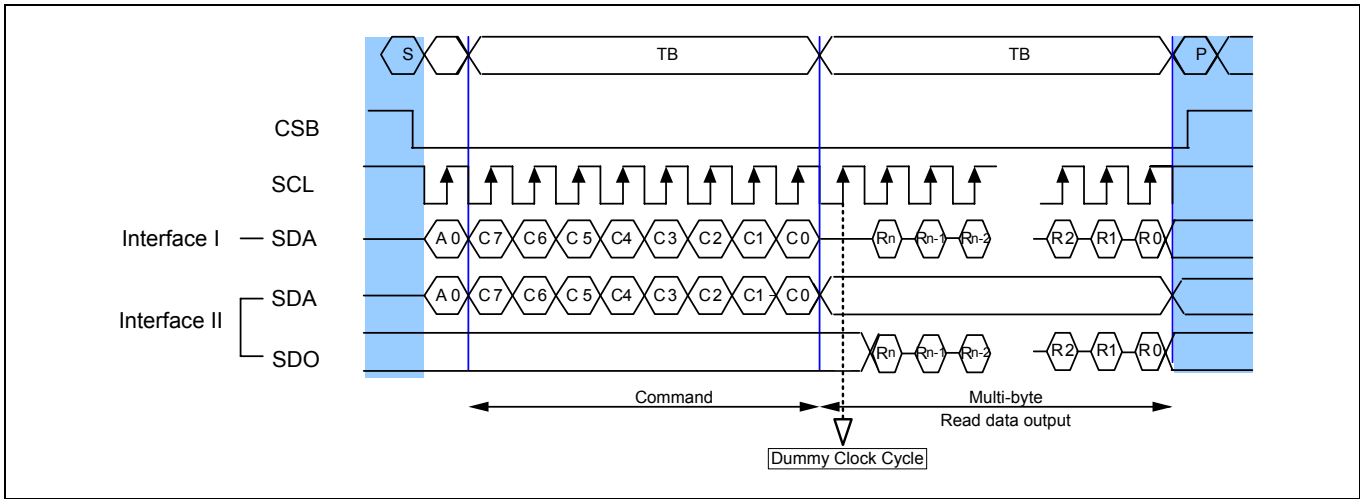


Figure25. 3-Wire 9-Bit Serial Interface I/II Bus Protocol, Read Multi-Byte From Register

### 3.1.5. 4-WIRE 8-BIT SERIAL INTERFACE

This serial interface is 4-wire 8-bit bi-directional interface for communication between the micro controller and the LCD driver IC. CSX, DCX, SCL, SDA and SDO are used for interface with MPU only, so it can be stopped when no communication is necessary.

#### 3.1.5.1. 4-Wire 8-bit data serial interface write mode

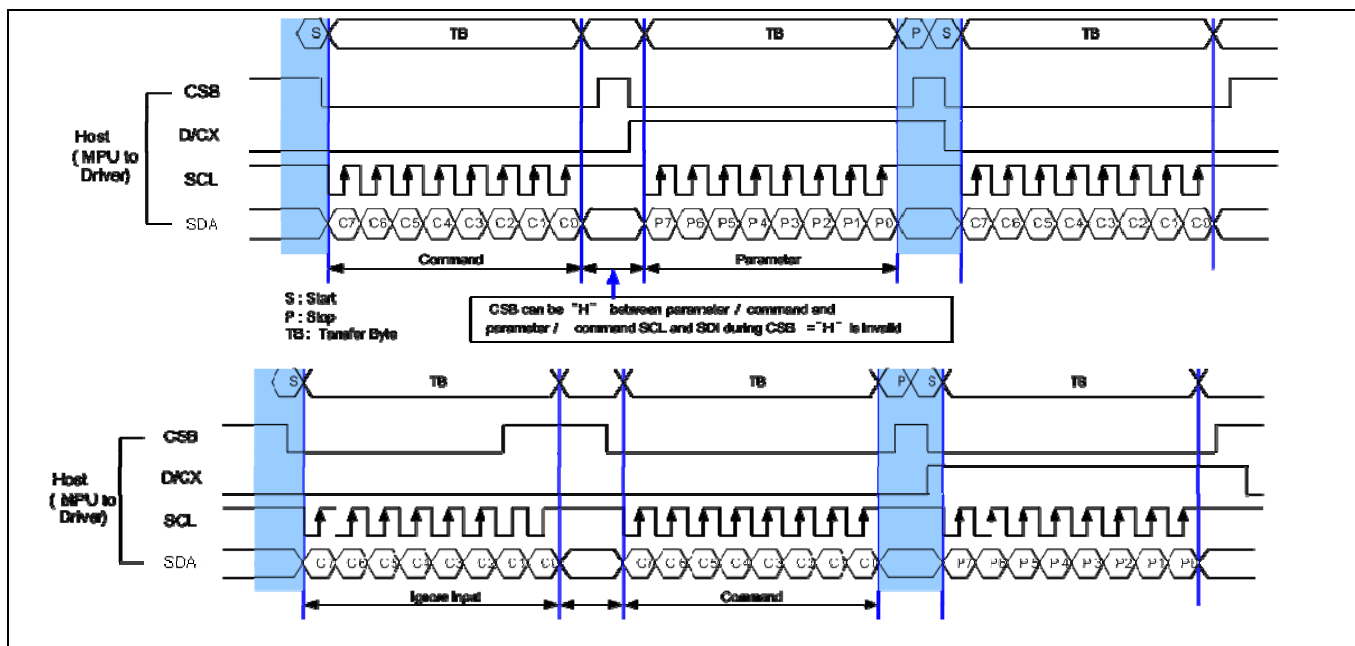


Figure26. 4-Wire 8-Bit Serial Interface I Bus Protocol, Write to Register or Display RAM

#### 3.1.5.2. 4-Wire 8-bit data serial interface read 1-byte mode

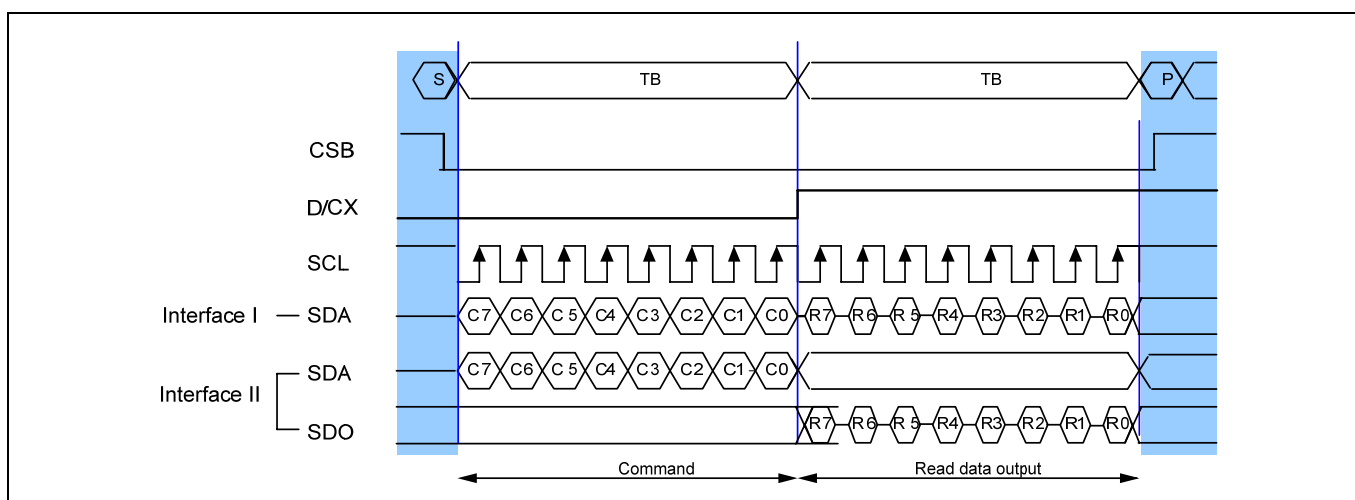


Figure27. 4-Wire 8-Bit Serial Interface I/II Bus Protocol, Read 1-Byte From Register

3.1.5.3. 4-Wire 8-bit data serial interface read multi-byte mode

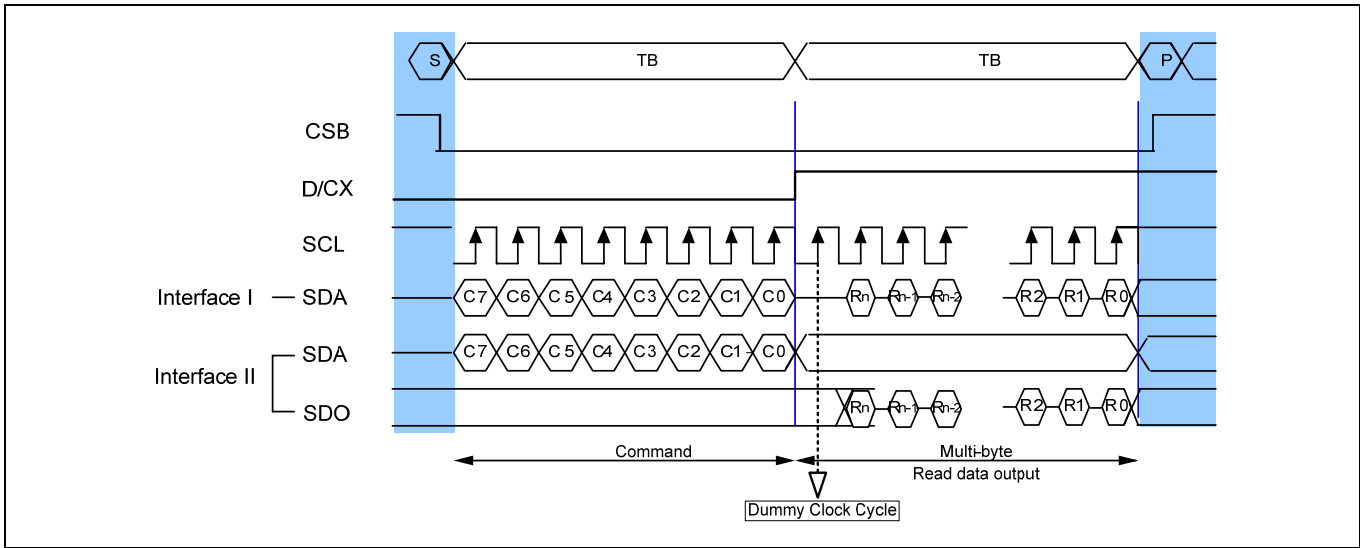


Figure28. 4-Wire 8-Bit Serial Interface I/II Bus Protocol, Read Multi-Byte From Register



### 3.1.6. 80-SERIES PARALLEL INTERFACE

#### 3.1.6.1. 80-series MPU Parallel Interface Write Mode

The write cycle means that the host writes information (command or/and data) to the display via the interface. Each write cycle (WRX high-low-high sequence) consists of 3 control (DCX, RDX, WRX) and data signals (DB[17:0]). DCX bit is a control signal, which tells if the data is a command or a data. The data signals are the command if the control signal is low (=‘0’) and vice versa it is data (=‘1’).

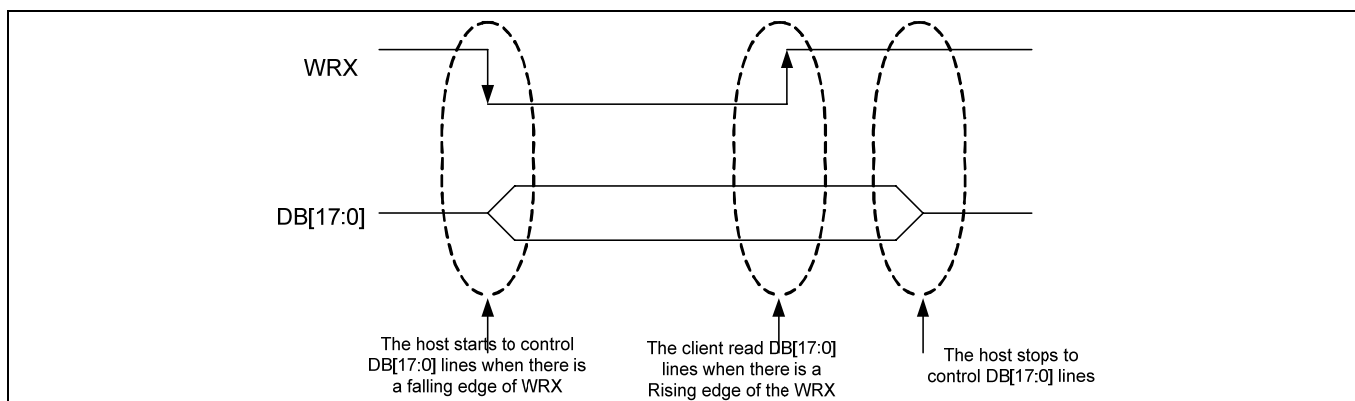


Figure29. 80-Series WRX Protocol

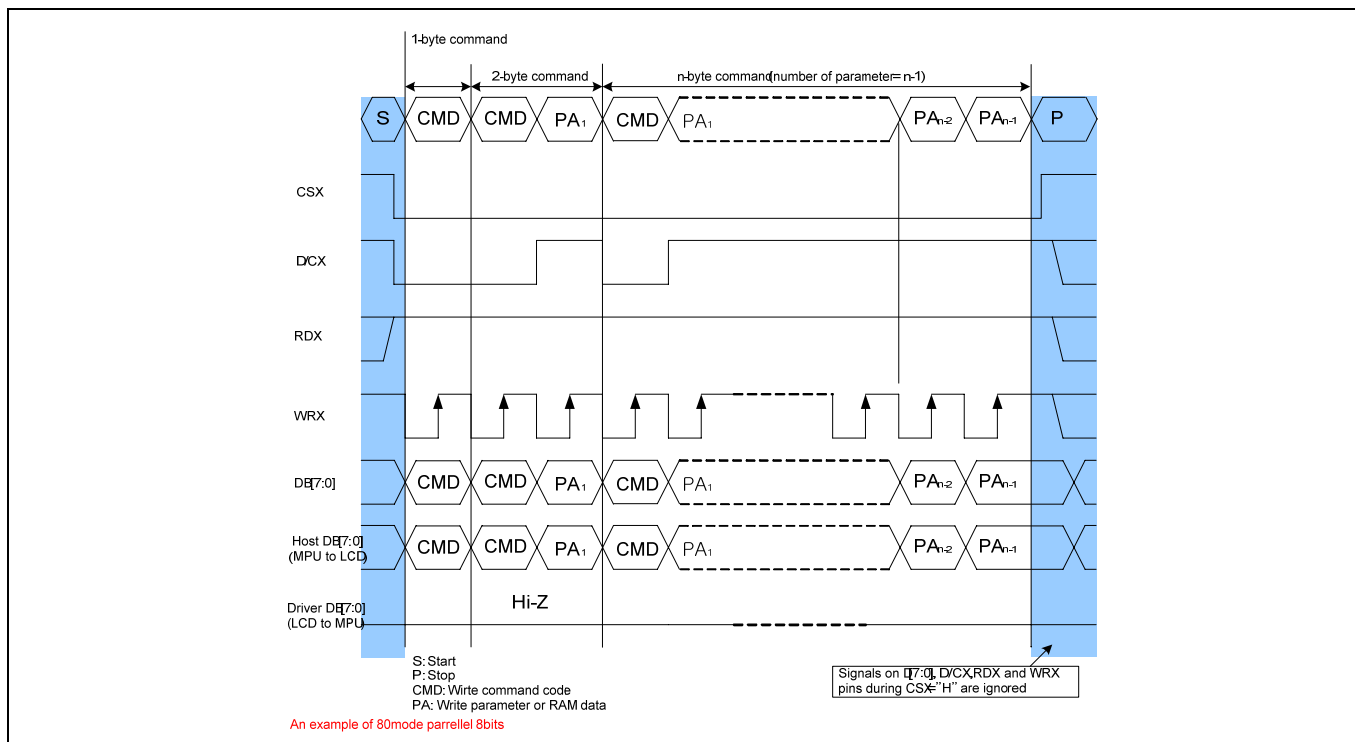
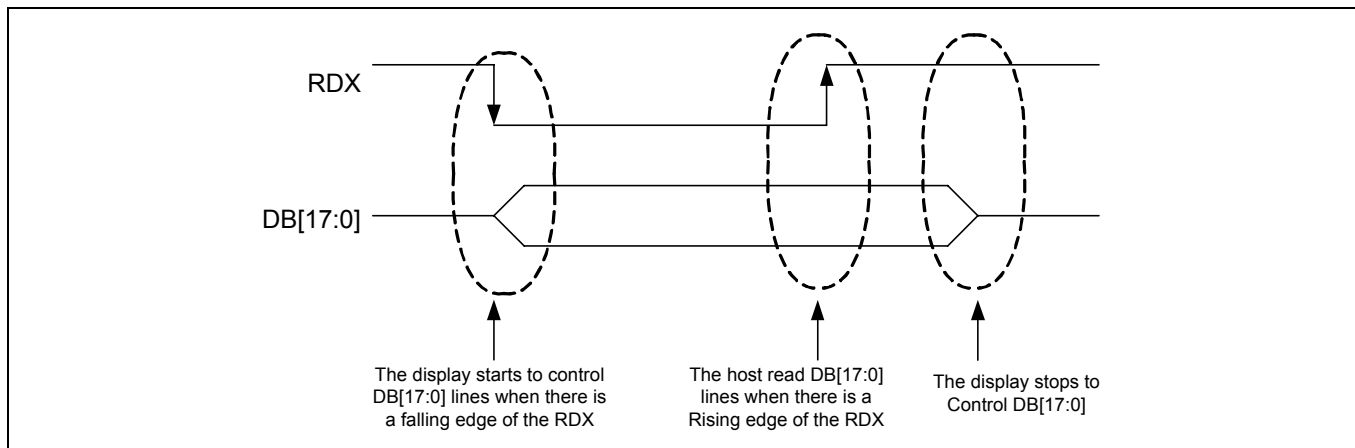


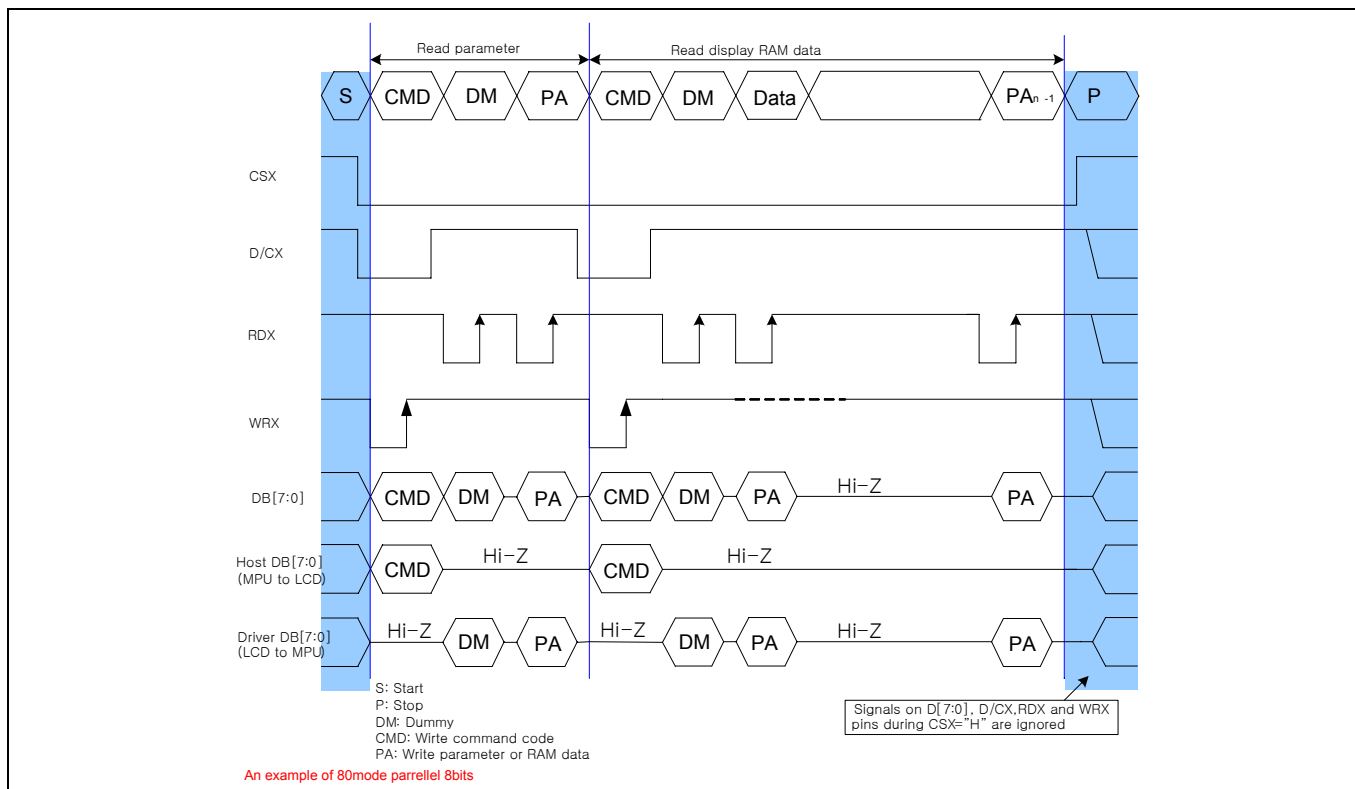
Figure30. 80-Series Parallel Bus Protocol, Write to Register or Display RAM

### 3.1.6.2. 80-Series mpu parallel interface read mode

The read cycle (RDX high-low-high sequence) means that the host reads information from display via interface. The display sends data (DB[17:0]) to the host when there is a falling edge of RDX and the host reads data when there is a rising edge of RDX.



**Figure31. 80-Series RDX Protocol**



**Figure32. 80-Series Parallel Bus Protocol, Read From Register**

## 3.2. INTERFACE DESCRIPTION

The parallel interface of S6D04H0 can communicate with the MPU using max.18 bit bidirectional data bus (DB17 to DB0) to transfer command, parameter and display data. The serial interface uses SDI, SDO for transferring data.

### 3.2.1. BIDIRECTIONAL DATA BUS

The purpose of MPU interface in S6D04H0 is to communicate with the MPU in a direct connection. If the driver IC is not selected as CSX = Low, the data bus (data line) is placed in the high-impedance state to prevent the other driver ICs from adverse effects. When the driver IC is not selected, inputs through the MPU interface (DCX, RDX and WRX) have no effect.

**Table 17. Description OF Data Bus for 80-Series**

| DCX | WRX | RDX | Description                                                                                                           |
|-----|-----|-----|-----------------------------------------------------------------------------------------------------------------------|
| L   | ↑   | H   | Command write<br>Commands are input to DB7 to DB0.                                                                    |
| H   | ↑   | H   | Parameter and display data write<br>Parameters and display data are respectively input to DB7 to DB0 and DB17 to DB0. |
| L   | H   | ↑   | Parameter and display data read<br>Parameters and display data are respectively output to DB7 to DB0 and DB17 to DB0. |
| L   | H   | ↑   | Dummy data is output                                                                                                  |

**Table 18. Description of Data Bus for 68-Series**

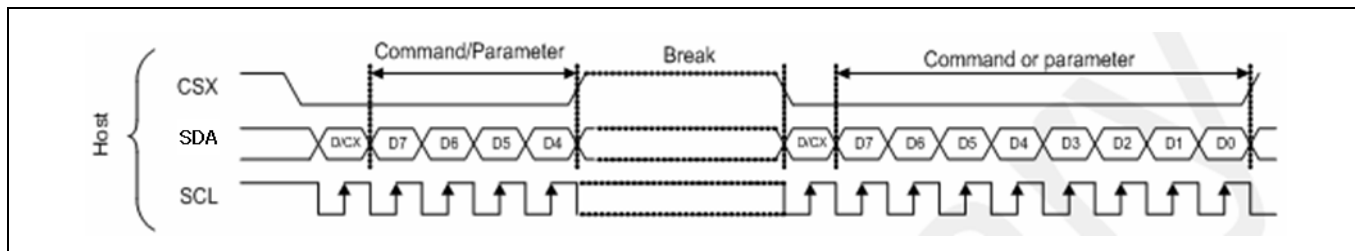
| DCX | WRX<br>(RWX) | RDX<br>(E) | Description                                                                                                           |
|-----|--------------|------------|-----------------------------------------------------------------------------------------------------------------------|
| L   | L            | ↓          | Command write<br>Commands are input to DB7 to DB0.                                                                    |
| H   | L            | ↓          | Parameter and display data write<br>Parameters and display data are respectively input to DB7 to DB0 and DB17 to DB0. |
| L   | H            | ↓          | Parameter and display data read<br>Parameters and display data are respectively output to DB7 to DB0 and DB17 to DB0. |
| L   | H            | ↓          | Dummy data is output                                                                                                  |

While using the parallel interface, the bus width which is used changes depending on the display data format.

When a display data format which uses DB17 to DB8 is selected, it is necessary that DB17 to DB8 are set either HIGH or LOW as input on the MPU side although DB17 to DB8 are ignored when command and parameters are input.

### 3.2.2. DISPLAY MODULE DATA TRANSFER RECOVERY

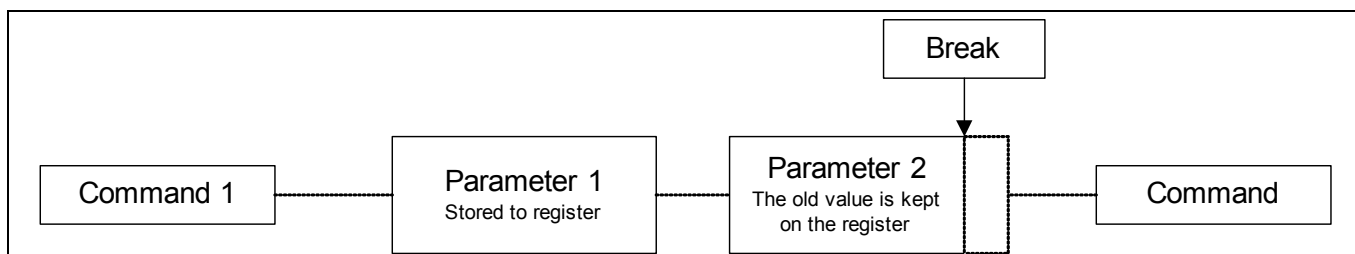
If there is a break in data transmission while transferring a Command, Frame Memory or Multiple Parameter command data, before Bit D0 of the byte has been completed, then the Display Module will reject the previous bits and have reset the interface such that it will be ready to receive the same byte retransmitted when the chip select line (CSX) is next activated. See the following example;



**Figure33. Break During Data Transmission**

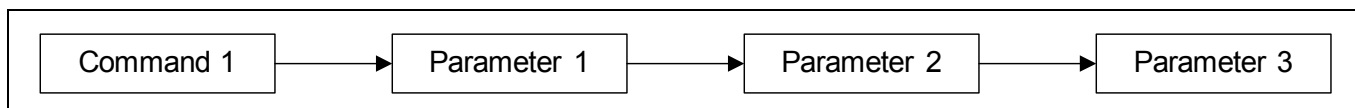
If a 1 or more parameter command is being sent and a break occurs sending before the last parameter of the command and if the host then sends a new command rather than re-transmitting the parameter that was interrupted, then the parameters that were successfully sent are stored and the parameter where the break occurred is rejected. The interface is ready to receive next byte as shown.

#### 3.2.2.1. Break during middle of frame

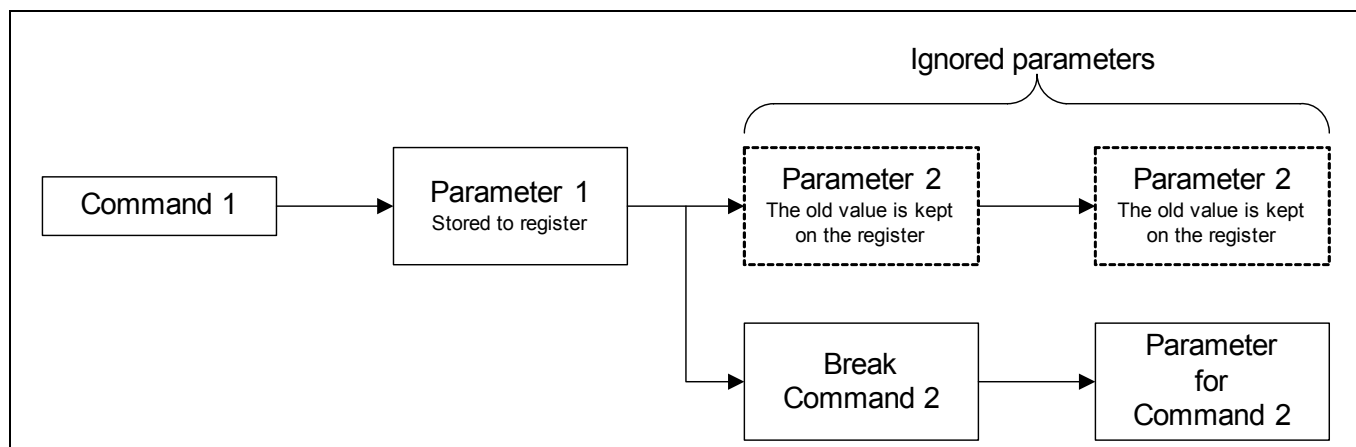


**Figure34. Break During Middle of Frame**

#### 3.2.2.2. Break between frames



**Figure35. Without Break**

**Figure36. With Break****Note.**

Break can be e.g. another command or noise pulse.

### 3.2.3. DISPLAY MODULE DATA TRANSFER PAUSE

It will be possible when transferring a Command, Frame Memory Data or Multiple Data to invoke a pause in the data transmission. If the Chip Select Line is released after a whole byte of a Frame Memory Data or Multiple Parameter has been completed, then the Display Module will wait and continue the Frame Memory Data or Parameter Data Transmission from the point where it was paused. If the Chip Select Line is released after a whole byte of a command has been completed, then the Display Module will receive either the command's parameters (if appropriate) or a new command when the Chip Select Line is next enabled as shown below.

#### 3.2.3.1. Serial interface pause

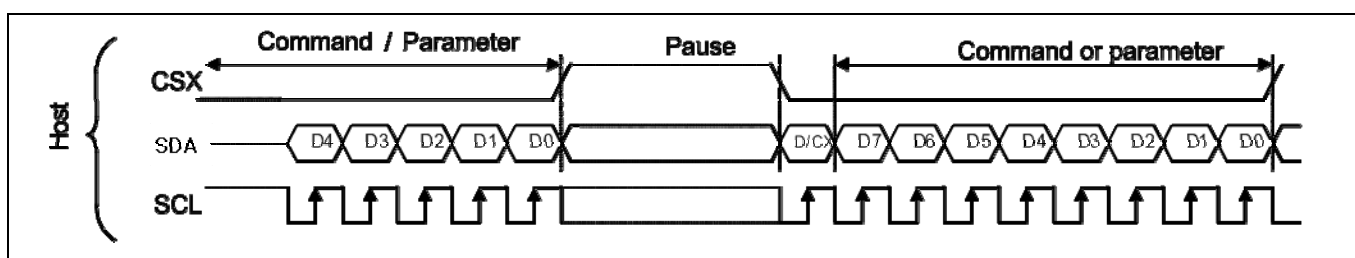


Figure37. Serial Interface Pause

This applies to the following 4 conditions:

1. Command-Pause-Command
2. Command-Pause-Parameter
3. Parameter-Pause-Command
4. Parameter-Pause-Parameter

## 3.2.3.2. Parallel interface pause

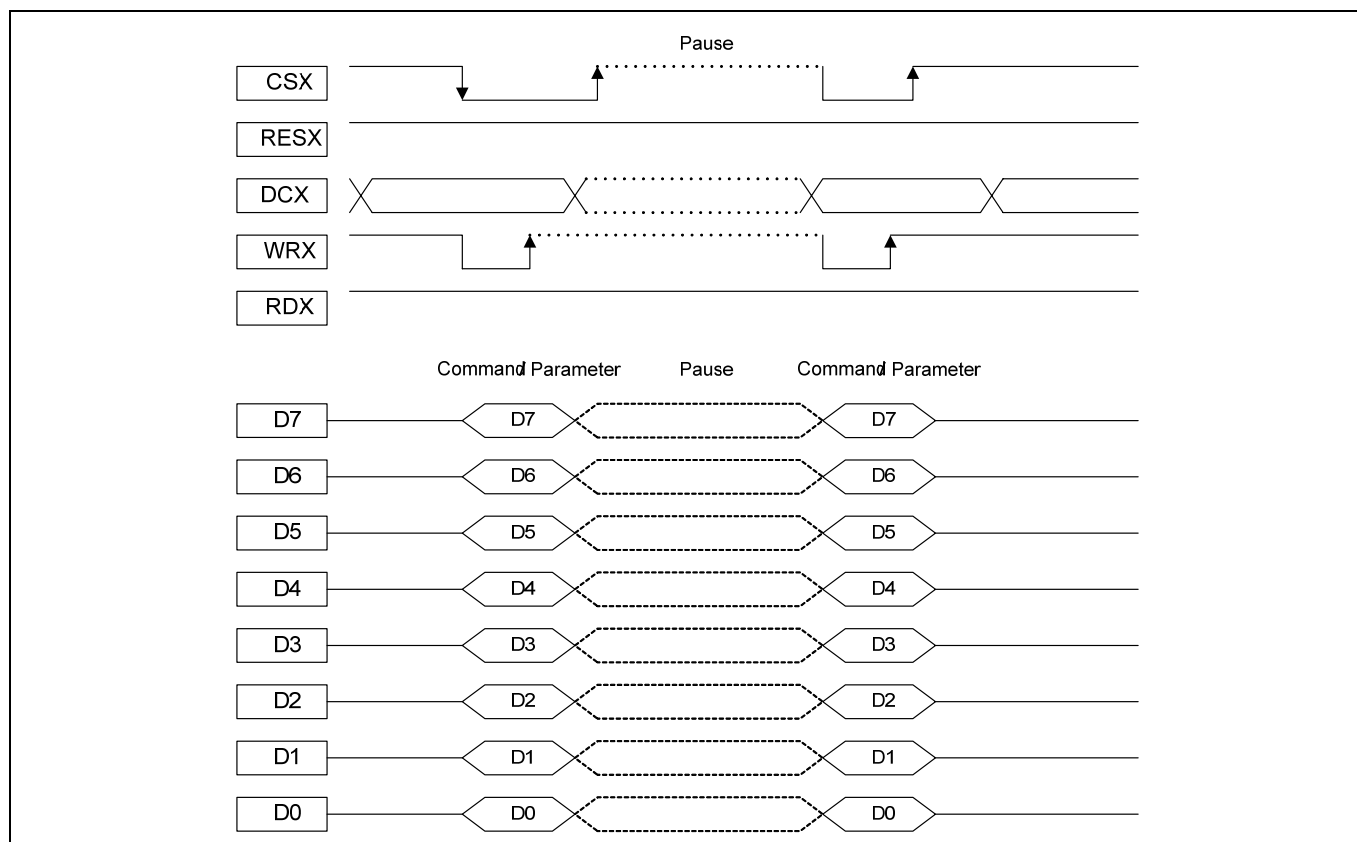


Figure38. Parallel Interface Pause

This applies to the following 4 conditions:

1. Command-Pause-Command
2. Command-Pause-Parameter
3. Parameter-Pause-Command
4. Parameter-Pause-Parameter

3.2.4. DISPLAY MODULE DATA TRANSFER MODES

The module has various color modes for transferring data to the display data RAM. The data format is described for each interface. Data can be downloaded to the Frame Memory by 2 methods.

3.2.4.1. Method I

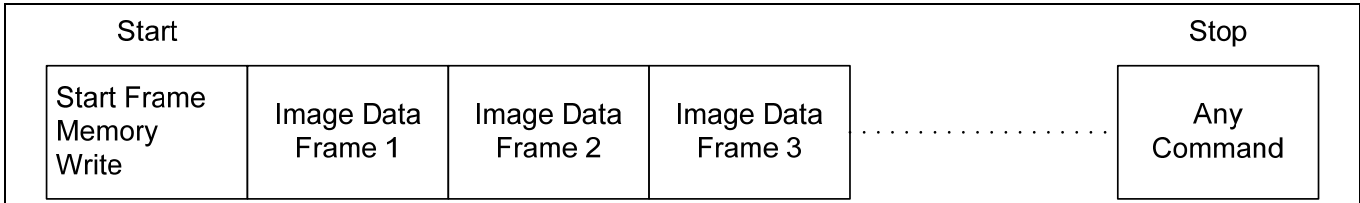


Figure39. Method I of Data Transfer Mode

The Image data is sent to the Frame Memory in successive Frame writes, each time the Frame Memory is filled, the Frame Memory pointer is reset to the start pint and the next Frame is written.

3.2.4.2. Method II

The Image data is sent and at the end of each Frame Memory download, a command is sent to stop Frame Memory Write. Then Start Memory Write command is sent, and a new Frame downloaded.

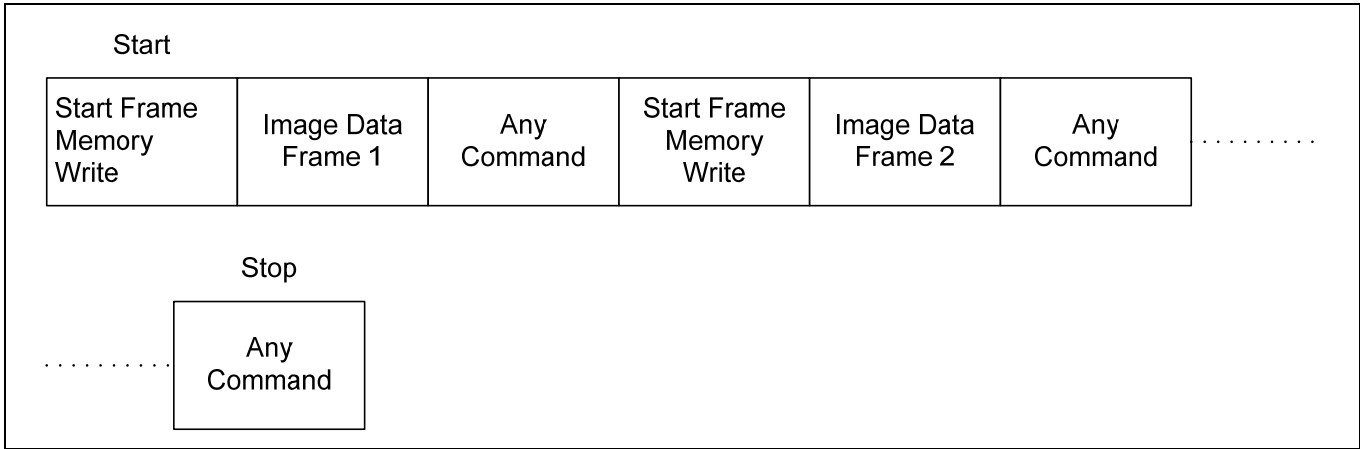


Figure40. Method 2 of Data Transfer Mode

Note.

- 1. These apply to all data transfer color modes on both Serial and Parallel interfaces.
- 2. The Frame Memory can contain both odd and even number of pixels for both Methods. Only complete pixel data will be stored to the Frame Memory.



### 3.3. DISPLAY DATA FORMAT

Various data formats are available in which display data can be written to the display data RAM. It is possible to choose a format suitable for the purpose of use. The data format is determined by a combination of COLMOD and MDT commands.

#### 3.3.1. DISPLAY DATA FORMAT FOR WRITE

Table 19. Display Data Format for Write

| Color Mode                           | Interface(IM[2:0])        |                          |                                                                                     |                          |                        |
|--------------------------------------|---------------------------|--------------------------|-------------------------------------------------------------------------------------|--------------------------|------------------------|
|                                      | 18Bit                     | 9Bit                     | 16Bit                                                                               | 8Bit                     |                        |
|                                      | 011                       | 010                      | 001                                                                                 | 000                      |                        |
| 262k Color<br>(COLMOD[2:0]<br>= 110) | 18bit 666 1/1<br>(MDT=00) | 9bit 666 1/2<br>(MDT=00) | 16bit 666 2/3<br>(MDT=00)                                                           | 6bit 666 1/3<br>(MDT=00) | Expand by IPM<br>Note1 |
|                                      |                           | 6bit 666 1/3<br>(MDT=01) | 12bit 666 1/2<br>(MDT=01)<br>16bit 666 1/2<br>(MDT=10)<br>16bit 666 1/2<br>(MDT=11) |                          |                        |
| 65k Color<br>(COLMOD[2:0]<br>= 101)  | 16bit 565 1/1<br>(MDT=00) | 8bit 565 1/2<br>(MDT=00) | 16bit 565 1/1<br>(MDT=00)                                                           | 8bit 565 1/2<br>(MDT=00) | Expand by IPM<br>Note1 |

**Note.**

1. Display data expand (565 → 666) method is decided by IPM command. In default condition (IPM = "00" ), MSB data are copied to LSB data for expanding. See Figure. 41 and Figure. 42.
2. Registers set related to data format (IPM, MDT) are on the F7H command (Level 2)

Table 20. MDT Description

| MDT[1:0](Value) | Description             |
|-----------------|-------------------------|
| 00              | 1pixel by 1cycle format |
| 01              | 2pixel by 3cycle format |
| 10              | 1pixel by 2cycle format |
| 11              | 1pixel by 3cycle format |

In 65k color mode (16-bit data) data bit should be expanded to 18-bit like below. It will be used “IPM=00”

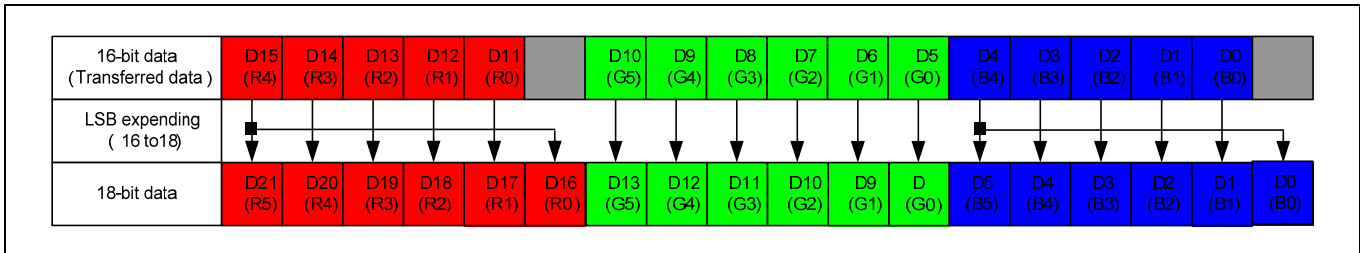


Figure41. Data Expand Method(65K Color Mode)

### 3.3.2. DISPLAY MODULE DATA COLOR CODING(262K COLOR MODE)

For the display data to be accessed in 262k color mode, it is necessary that 262k color mode be selected (B2 to B0: 110) using COLMOD command before writing or reading to or from the display data RAM. In this mode, the display data per pixel comprised of 6 bits for R, 6 bits for G and 6 bits for B is written to the display data RAM. When all of the data for one pixel (RGB) is prepared in the internal register, the MPU writes the data to the display data RAM. When the display data is read from the display data RAM after RAMRD command is issued, 1 byte of dummy read cycle is needed, and the display data is read out to the MPU bus according to the format selected.

#### 3.3.2.1. 8Bit parallel interface for 666 1/3 formats

**Table 21. 8Bit Parallel Interface for 666 1/3 Formats**

| Count | 0  | 1   | 2   | 3   | ... | 718   | 719   | 720   |
|-------|----|-----|-----|-----|-----|-------|-------|-------|
| DCX   | 0  | 1   | 1   | 1   | ... | 1     | 1     | 1     |
| D7    | C7 | 0R5 | 0G5 | 0B5 | ... | 239R5 | 239G5 | 239B5 |
| D6    | C6 | 0R4 | 0G4 | 0B4 | ... | 239R4 | 239G4 | 239B4 |
| D5    | C5 | 0R3 | 0G3 | 0B3 | ... | 239R3 | 239G3 | 239B3 |
| D4    | C4 | 0R2 | 0G2 | 0B2 | ... | 239R2 | 239G2 | 239B2 |
| D3    | C3 | 0R1 | 0G1 | 0B1 | ... | 239R1 | 239G1 | 239B1 |
| D2    | C2 | 0R0 | 0G0 | 0B0 | ... | 239R0 | 239G0 | 239B0 |
| D1    | C1 |     |     |     | ... |       |       |       |
| D0    | C0 |     |     |     | ... |       |       |       |

#### 3.3.2.2. 16Bit parallel interface for 666 2/3 formats(MDT=00)

**Table 22. 16Bit Parallel Interface for 666 2/3 Formats(MDT="00")**

| Count | 0  | 1   | 2   | 3   | ... | 358   | 359   | 360   |
|-------|----|-----|-----|-----|-----|-------|-------|-------|
| DCX   | 0  | 1   | 1   | 1   | ... | 1     | 1     | 1     |
| D15   |    | 0R5 | 0B5 | 1G5 | ... | 238R5 | 238B5 | 239G5 |
| D14   |    | 0R4 | 0B4 | 1G4 | ... | 238R4 | 238B4 | 239G4 |
| D13   |    | 0R3 | 0B3 | 1G3 | ... | 238R3 | 238B3 | 239G3 |
| D12   |    | 0R2 | 0B2 | 1G2 | ... | 238R2 | 238B2 | 239G2 |
| D11   |    | 0R1 | 0B1 | 1G1 | ... | 238R1 | 238B1 | 239G1 |
| D10   |    | 0R0 | 0B0 | 1G0 | ... | 238R0 | 238B0 | 239G0 |
| D9    |    |     |     |     | ... |       |       |       |
| D8    |    |     |     |     | ... |       |       |       |
| D7    | C7 | 0G5 | 1R5 | 1B5 | ... | 238G5 | 239R5 | 239B5 |

| Count | 0  | 1   | 2   | 3   | ... | 358   | 359   | 360   |
|-------|----|-----|-----|-----|-----|-------|-------|-------|
| D6    | C6 | 0G4 | 1R4 | 1B4 | ... | 238G4 | 239R4 | 239B4 |
| D5    | C5 | 0G3 | 1R3 | 1B3 | ... | 238G3 | 239R3 | 239B3 |
| D4    | C4 | 0G2 | 1R2 | 1B2 | ... | 238G2 | 239R2 | 239B2 |
| D3    | C3 | 0G1 | 1R1 | 1B1 | ... | 238G1 | 239R1 | 239B1 |
| D2    | C2 | 0G0 | 1R0 | 1B0 | ... | 238G0 | 239R0 | 239B0 |
| D1    | C1 |     |     |     | ... |       |       |       |
| D0    | C0 |     |     |     | ... |       |       |       |

### 3.3.2.3. 16Bit parallel interface for 666 1/2 formats( MDT = "01")

**Table 23. 16Bit Parallel Interface For 666 1/2 Formats( MDT = "01")**

| Count | 0  | 1   | 2   | 3   | 4   | ... | 479   | 480   |
|-------|----|-----|-----|-----|-----|-----|-------|-------|
| DCX   | 0  | 1   | 1   | 1   | 1   | ... | 1     | 1     |
| D15   |    | 0R5 | 0B5 | 1R5 | 1B5 | ... | 239R5 | 239B5 |
| D14   |    | 0R4 | 0B4 | 1R4 | 1B4 | ... | 239R4 | 239B4 |
| D13   |    | 0R3 | 0B3 | 1R3 | 1B3 | ... | 239R3 | 239B3 |
| D12   |    | 0R2 | 0B2 | 1R2 | 1B2 | ... | 239R2 | 239B2 |
| D11   |    | 0R1 | 0B1 | 1R1 | 1B1 | ... | 239R1 | 239B1 |
| D10   |    | 0R0 | 0B0 | 1R0 | 1B0 | ... | 239R0 | 239B0 |
| D9    |    |     |     |     |     | ... |       |       |
| D8    |    |     |     |     |     | ... |       |       |
| D7    | C7 | 0G5 |     | 1G5 |     | ... | 239G5 |       |
| D6    | C6 | 0G4 |     | 1G4 |     | ... | 239G4 |       |
| D5    | C5 | 0G3 |     | 1G3 |     | ... | 239G3 |       |
| D4    | C4 | 0G2 |     | 1G2 |     | ... | 239G2 |       |
| D3    | C3 | 0G1 |     | 1G1 |     | ... | 239G1 |       |
| D2    | C2 | 0G0 |     | 1G0 |     | ... | 239G0 |       |
| D1    | C1 |     |     |     |     | ... |       |       |
| D0    | C0 |     |     |     |     | ... |       |       |

## 3.3.2.4. 16Bit parallel interface for 666 1/2 formats(MDT = "10")

Table 24. 16Bit Parallel Interface for 666 1/2 Formats(MDT = "10")

| Count | 0  | 1   | 2   | 3   | 4   | ... | 479   | 480   |
|-------|----|-----|-----|-----|-----|-----|-------|-------|
| DCX   | 0  | 1   | 1   | 1   | 1   | ... | 1     | 1     |
| D15   |    | 0R5 | 0B1 | 1R5 | 1B1 | ... | 239R5 | 239B1 |
| D14   |    | 0R4 | 0B0 | 1R4 | 1B0 | ... | 239R4 | 239B0 |
| D13   |    | 0R3 |     | 1R3 |     | ... | 239R3 |       |
| D12   |    | 0R2 |     | 1R2 |     | ... | 239R2 |       |
| D11   |    | 0R1 |     | 1R1 |     | ... | 239R1 |       |
| D10   |    | 0R0 |     | 1R0 |     | ... | 239R0 |       |
| D9    |    | 0G5 |     | 1G5 |     | ... | 239G5 |       |
| D8    |    | 0G4 |     | 1G4 |     | ... | 239G4 |       |
| D7    | C7 | 0G3 |     | 1G3 |     | ... | 239G3 |       |
| D6    | C6 | 0G2 |     | 1G2 |     | ... | 239G2 |       |
| D5    | C5 | 0G1 |     | 1G1 |     | ... | 239G1 |       |
| D4    | C4 | 0G0 |     | 1G0 |     | ... | 239G0 |       |
| D3    | C3 | 0B5 |     | 1B5 |     | ... | 239B5 |       |
| D2    | C2 | 0B4 |     | 1B4 |     | ... | 239B4 |       |
| D1    | C1 | 0B3 |     | 1B3 |     | ... | 239B3 |       |
| D0    | C0 | 0B2 |     | 1B2 |     | ... | 239B2 |       |

## 3.3.2.5. 16Bit parallel interface for 666 1/2 formats(MDT = "11")

Table 25. 16Bit Parallel Interface for 666 1/2 Formats(MDT = "11")

| Count | 0 | 1 | 2   | 3 | 4   | ... | 479 | 480   |
|-------|---|---|-----|---|-----|-----|-----|-------|
| DCX   | 0 | 1 | 1   | 1 | 1   | ... | 1   | 1     |
| D15   |   |   | 0R3 |   | 1R3 | ... |     | 239R3 |
| D14   |   |   | 0R2 |   | 1R2 | ... |     | 239R2 |
| D13   |   |   | 0R1 |   | 1R1 | ... |     | 239R1 |
| D12   |   |   | 0R0 |   | 1R0 | ... |     | 239R0 |
| D11   |   |   | 0G5 |   | 1G5 | ... |     | 239G5 |
| D10   |   |   | 0G4 |   | 1G4 | ... |     | 239G4 |
| D9    |   |   | 0G3 |   | 1G3 | ... |     | 239G3 |
| D8    |   |   | 0G2 |   | 1G2 | ... |     | 239G2 |

| Count | 0  | 1   | 2   | 3   | 4   | ... | 479   | 480   |
|-------|----|-----|-----|-----|-----|-----|-------|-------|
| D7    | C7 |     | 0G1 |     | 1G1 | ... |       | 239G1 |
| D6    | C6 |     | 0G0 |     | 1G0 | ... |       | 239G0 |
| D5    | C5 |     | 0B5 |     | 1B5 | ... |       | 239B5 |
| D4    | C4 |     | 0B4 |     | 1B4 | ... |       | 239B4 |
| D3    | C3 |     | 0B3 |     | 1B3 | ... |       | 239B3 |
| D2    | C2 |     | 0B2 |     | 1B2 | ... |       | 239B2 |
| D1    | C1 | 0R5 | 0B1 | 1R5 | 1B1 | ... | 239R5 | 239B1 |
| D0    | C0 | 0R4 | 0B0 | 1R4 | 1B0 | ... | 239R4 | 239B0 |

## 3.3.2.6. 9Bit parallel interface for 666 1/2 formats

Table 26. 9Bit Parallel Interface for 666 1/2 Formats(MDT = 00)

| Count | 0  | 1   | 2   | 3   | ... | 478   | 479   | 480   |
|-------|----|-----|-----|-----|-----|-------|-------|-------|
| DCX   | 0  | 1   | 1   | 1   | ... | 1     | 1     | 1     |
| D8    |    | 0R5 | 0G2 | 1R5 | ... | 238G2 | 239R5 | 239G2 |
| D7    | C7 | 0R4 | 0G1 | 1R4 | ... | 238G1 | 239R4 | 239G1 |
| D6    | C6 | 0R3 | 0G0 | 1R3 | ... | 238G0 | 239R3 | 239G0 |
| D5    | C5 | 0R2 | 0B5 | 1R2 | ... | 238B5 | 239R2 | 239B5 |
| D4    | C4 | 0R1 | 0B4 | 1R1 | ... | 238B4 | 239R1 | 239B4 |
| D3    | C3 | 0R0 | 0B3 | 1R0 | ... | 238B3 | 239R0 | 239B3 |
| D2    | C2 | 0G5 | 0B2 | 1G5 | ... | 238B2 | 239G5 | 239B2 |
| D1    | C1 | 0G4 | 0B1 | 1G4 | ... | 238B1 | 239G4 | 239B1 |
| D0    | C0 | 0G3 | 0B0 | 1G3 | ... | 238B0 | 239G3 | 239B0 |

Table 27. 9-Bit Parallel Interface for 666 1/3 Formats(MDT = 01)

| Count | 0  | 1   | 2   | 3   | ... | 718   | 719   | 720   |
|-------|----|-----|-----|-----|-----|-------|-------|-------|
| D/CX  | 0  | 1   | 1   | 1   | ... | 1     | 1     | 1     |
| D8    |    |     |     |     | ... |       |       |       |
| D7    | C7 | 0R5 | 0G5 | 0B5 | ... | 239R5 | 239G5 | 239B5 |
| D6    | C6 | 0R4 | 0G4 | 0B4 | ... | 239R4 | 239G5 | 239B4 |
| D5    | C5 | 0R3 | 0G3 | 0B3 | ... | 239R3 | 239G4 | 239B3 |
| D4    | C4 | 0R2 | 0G2 | 0B2 | ... | 239R2 | 239G2 | 239B2 |
| D3    | C3 | 0R1 | 0G1 | 0B1 | ... | 239R1 | 239G1 | 239B1 |
| D2    | C2 | 0R0 | 0G0 | 0B0 | ... | 239R0 | 239G0 | 239B0 |

| Count | 0  | 1 | 2 | 3 | ... | 718 | 719 | 720 |
|-------|----|---|---|---|-----|-----|-----|-----|
| D1    | C1 |   |   |   | ... |     |     |     |
| D0    | C0 |   |   |   | ... |     |     |     |

## 3.3.2.7. 18Bit parallel interface for 666 1/1 formats

Table 28. 18Bit Parallel Interface for 666 1/1 Formats

| Count | 0  | 1   | 2   | ... | 239   | 240   |
|-------|----|-----|-----|-----|-------|-------|
| DCX   | 0  | 1   | 1   | ... | 1     | 1     |
| D17   |    | 0R5 | 1R5 | ... | 238R5 | 239R5 |
| D16   |    | 0R4 | 1R4 | ... | 238R4 | 239R4 |
| D15   |    | 0R3 | 1R3 | ... | 238R3 | 239R3 |
| D14   |    | 0R2 | 1R2 | ... | 238R2 | 239R2 |
| D13   |    | 0R1 | 1R1 | ... | 238R1 | 239R1 |
| D12   |    | 0R0 | 1R0 | ... | 238R0 | 239R0 |
| D11   |    | 0G5 | 1G5 | ... | 238G5 | 239G5 |
| D10   |    | 0G4 | 1G4 | ... | 238G4 | 239G4 |
| D9    |    | 0G3 | 1G3 | ... | 238G3 | 239G3 |
| D8    |    | 0G2 | 1G2 | ... | 238G2 | 239G2 |
| D7    | C7 | 0G1 | 1G1 | ... | 238G1 | 239G1 |
| D6    | C6 | 0G0 | 1G0 | ... | 238G0 | 239G0 |
| D5    | C5 | 0B5 | 1B5 | ... | 238B5 | 239B5 |
| D4    | C4 | 0B4 | 1B4 | ... | 238B4 | 239B4 |
| D3    | C3 | 0B3 | 1B3 | ... | 238B3 | 239B3 |
| D2    | C2 | 0B2 | 1B2 | ... | 238B2 | 239B2 |
| D1    | C1 | 0B1 | 1B1 | ... | 238B1 | 239B1 |
| D0    | C0 | 0B0 | 1B0 | ... | 238B0 | 239B0 |

## 3.3.2.8. 4-Wire 8-bit serial interface for 666 1/3 formats

Table 29. 4-Wire 8-Bit Serial Interface for 666 1/3 Formats

| Count | 0  | 1   | 2   | 3   | ... | 718   | 719   | 720   |
|-------|----|-----|-----|-----|-----|-------|-------|-------|
| DCX   | 0  | 1   | 1   | 1   | ... | 1     | 1     | 1     |
| D7    | C7 | 0R5 | 0G5 | 0B5 | ... | 239R5 | 239G5 | 239B5 |
| D6    | C6 | 0R4 | 0G4 | 0B4 | ... | 239R4 | 239G4 | 239B4 |
| D5    | C5 | 0R3 | 0G3 | 0B3 | ... | 239R3 | 239G3 | 239B3 |

| Count | 0  | 1   | 2   | 3   | ... | 718   | 719   | 720   |
|-------|----|-----|-----|-----|-----|-------|-------|-------|
| D4    | C4 | 0R2 | 0G2 | 0B2 | ... | 239R2 | 239G2 | 239B2 |
| D3    | C3 | 0R1 | 0G1 | 0B1 | ... | 239R1 | 239G1 | 239B1 |
| D2    | C2 | 0R0 | 0G0 | 0B0 | ... | 239R0 | 239G0 | 239B0 |
| D1    | C1 |     |     |     | ... |       |       |       |
| D0    | C0 |     |     |     | ... |       |       |       |

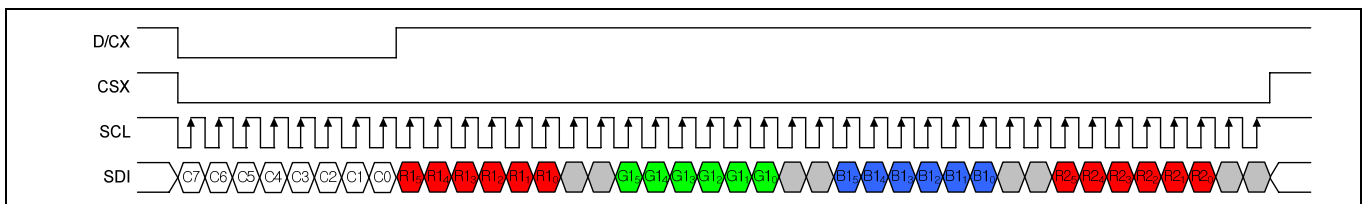


Figure42. 4-Wire 8-Bit Serial Interface for 666 1/3 Formats

## 3.3.2.9. 3-Wire 9-bit serial interface for 666 1/3 formats

Table 30. 3-Wire 9-Bit Serial Interface for 666 1/3 Formats

| Count | 0  | 1   | 2   | 3   | ... | 718   | 719   | 720   |
|-------|----|-----|-----|-----|-----|-------|-------|-------|
| DCX   | 0  | 1   | 1   | 1   | ... | 1     | 1     | 1     |
| D7    | C7 | 0R5 | 0G5 | 0B5 | ... | 239R5 | 239G5 | 239B5 |
| D6    | C6 | 0R4 | 0G4 | 0B4 | ... | 239R4 | 239G4 | 239B4 |
| D5    | C5 | 0R3 | 0G3 | 0B3 | ... | 239R3 | 239G3 | 239B3 |
| D4    | C4 | 0R2 | 0G2 | 0B2 | ... | 239R2 | 239G2 | 239B2 |
| D3    | C3 | 0R1 | 0G1 | 0B1 | ... | 239R1 | 239G1 | 239B1 |
| D2    | C2 | 0R0 | 0G0 | 0B0 | ... | 239R0 | 239G0 | 239B0 |
| D1    | C1 |     |     |     | ... |       |       |       |
| D0    | C0 |     |     |     | ... |       |       |       |

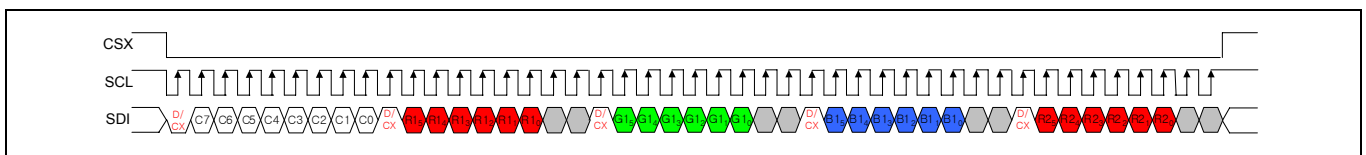


Figure43. 3-Wire 9-Bit Serial Interface for 666 1/3 Formats



### 3.3.3. DISPLAY MODULE DATA COLOR CODING (65K COLOR MODE)

For the display data to be accessed in 65k color mode, it is necessary that 65k color mode be selected (B2 to B0: 101) using COLMOD command before writing or reading to or from the display data RAM. In this mode, the display data per pixel comprised of 5 bits for R, 6 bits for G and 5 bits for B is written to the display data RAM. When all of the data for one pixel (RGB) is prepared in the internal register, the MPU writes the data to the display data RAM. When the display data is read from the display data RAM after RAMRD command is issued, 1 byte of dummy read cycle is needed, and the display data is read out to the MPU bus according to the format selected.

#### 3.3.3.1. 8Bit parallel interface for 565 1/2 formats

**Table 31. 8Bit Parallel Interface for 565 1/2 Formats**

| Count | 0  | 1   | 2   | 3   | 4   | ... | 359   | 480   |
|-------|----|-----|-----|-----|-----|-----|-------|-------|
| DCX   | 0  | 1   | 1   | 1   | 1   | ... | 1     | 1     |
| D7    | C7 | 0R4 | 0G2 | 1R4 | 1G2 | ... | 239R4 | 239G2 |
| D6    | C6 | 0R3 | 0G1 | 1R3 | 1G1 | ... | 239R3 | 239G1 |
| D5    | C5 | 0R2 | 0G0 | 1R2 | 1G0 | ... | 239R2 | 239G0 |
| D4    | C4 | 0R1 | 0B4 | 1R1 | 1B4 | ... | 239R1 | 239B4 |
| D3    | C3 | 0R0 | 0B3 | 1R0 | 1B3 | ... | 239R0 | 239B3 |
| D2    | C2 | 0G5 | 0B2 | 1G5 | 1B2 | ... | 239G5 | 239B2 |
| D1    | C1 | 0G4 | 0B1 | 1G4 | 1B1 | ... | 239G4 | 239B1 |
| D0    | C0 | 0G3 | 0B0 | 1G3 | 1B0 | ... | 239G3 | 239B0 |

#### 3.3.3.2. 16Bit parallel interface for 565 1/1 formats

**Table 32. 16Bit Parallel Interface for 565 1/1 Formats**

| Count | 0  | 1   | 2   | ... | 239   | 240   |
|-------|----|-----|-----|-----|-------|-------|
| DCX   | 0  | 1   | 1   | ... | 1     | 1     |
| D15   |    | 0R4 | 1R4 | ... | 238R4 | 239R4 |
| D14   |    | 0R3 | 1R3 | ... | 238R3 | 239R3 |
| D13   |    | 0R2 | 1R2 | ... | 238R2 | 239R2 |
| D12   |    | 0R1 | 1R1 | ... | 238R1 | 239R1 |
| D11   |    | 0R0 | 1R0 | ... | 238R0 | 239R0 |
| D10   |    | 0G5 | 1G5 | ... | 238G5 | 239G5 |
| D9    |    | 0G4 | 1G4 | ... | 238G4 | 239G4 |
| D8    |    | 0G3 | 1G3 | ... | 238G3 | 239G3 |
| D7    | C7 | 0G2 | 1G2 | ... | 238G2 | 239G2 |

| Count | 0  | 1   | 2   | ... | 239   | 240   |
|-------|----|-----|-----|-----|-------|-------|
| D6    | C6 | 0G1 | 1G1 | ... | 238G1 | 239G1 |
| D5    | C5 | 0G0 | 1G0 | ... | 238G0 | 239G0 |
| D4    | C4 | 0B4 | 1B4 | ... | 238B4 | 239B4 |
| D3    | C3 | 0B3 | 1B3 | ... | 238B3 | 239B3 |
| D2    | C2 | 0B2 | 1B2 | ... | 238B2 | 239B2 |
| D1    | C1 | 0B1 | 1B1 | ... | 238B1 | 239B1 |
| D0    | C0 | 0B0 | 1B0 | ... | 238B0 | 239B0 |

## 3.3.3.3. 9Bit parallel interface for 565 1/2 formats

Table 33. 9Bit Parallel Interface for 565 1/2 Formats

| Count | 0  | 1   | 2   | 3   | 4   | ... | 359   | 480   |
|-------|----|-----|-----|-----|-----|-----|-------|-------|
| DCX   | 0  | 1   | 1   | 1   | 1   | ... | 1     | 1     |
| D8    |    |     |     |     |     | ... |       |       |
| D7    | C7 | 0R4 | 0G2 | 1R4 | 1G2 | ... | 239R4 | 239G2 |
| D6    | C6 | 0R3 | 0G1 | 1R3 | 1G1 | ... | 239R3 | 239G1 |
| D5    | C5 | 0R2 | 0G0 | 1R2 | 1G0 | ... | 239R2 | 239G0 |
| D4    | C4 | 0R1 | 0B4 | 1R1 | 1B4 | ... | 239R1 | 239B4 |
| D3    | C3 | 0R0 | 0B3 | 1R0 | 1B3 | ... | 239R0 | 239B3 |
| D2    | C2 | 0G5 | 0B2 | 1G5 | 1B2 | ... | 239G5 | 239B2 |
| D1    | C1 | 0G4 | 0B1 | 1G4 | 1B1 | ... | 239G4 | 239B1 |
| D0    | C0 | 0G3 | 0B0 | 1G3 | 1B0 | ... | 239G3 | 239B0 |

## 3.3.3.4. 18Bit parallel interface for 565 1/1 formats

Table 34. 18Bit Parallel Interface for 565 1/1 Formats

| Count | 0 | 1   | 2   | ... | 239   | 240   |
|-------|---|-----|-----|-----|-------|-------|
| DCX   | 0 | 1   | 1   | ... | 1     | 1     |
| D17   |   |     |     |     |       |       |
| D16   |   |     |     |     |       |       |
| D15   |   | 0R4 | 1R4 | ... | 238R4 | 239R4 |
| D14   |   | 0R3 | 1R3 | ... | 238R3 | 239R3 |
| D13   |   | 0R2 | 1R2 | ... | 238R2 | 239R2 |
| D12   |   | 0R1 | 1R1 | ... | 238R1 | 239R1 |
| D11   |   | 0R0 | 1R0 | ... | 238R0 | 239R0 |

| Count | 0  | 1   | 2   | ... | 239   | 240   |
|-------|----|-----|-----|-----|-------|-------|
| D10   |    | 0G5 | 1G5 | ... | 238G5 | 239G5 |
| D9    |    | 0G4 | 1G4 | ... | 238G4 | 239G4 |
| D8    |    | 0G3 | 1G3 | ... | 238G3 | 239G3 |
| D7    | C7 | 0G2 | 1G2 | ... | 238G2 | 239G2 |
| D6    | C6 | 0G1 | 1G1 | ... | 238G1 | 239G1 |
| D5    | C5 | 0G0 | 1G0 | ... | 238G0 | 239G0 |
| D4    | C4 | 0B4 | 1B4 | ... | 238B4 | 239B4 |
| D3    | C3 | 0B3 | 1B3 | ... | 238B3 | 239B3 |
| D2    | C2 | 0B2 | 1B2 | ... | 238B2 | 239B2 |
| D1    | C1 | 0B1 | 1B1 | ... | 238B1 | 239B1 |
| D0    | C0 | 0B0 | 1B0 | ... | 238B0 | 239B0 |

3.3.3.5. 4-Wire 8-bit serial interface for 565 1/2 formats

Table 35. 4-Wire 8-Bit Serial Interface for 565 1/2 Formats

| Count | 0  | 1   | 2   | 3   | 4   | ... | 359   | 480   |
|-------|----|-----|-----|-----|-----|-----|-------|-------|
| DCX   | 0  | 1   | 1   | 1   | 1   | ... | 1     | 1     |
| D7    | C7 | 0R4 | 0G2 | 1R4 | 1G2 | ... | 239R4 | 239G2 |
| D6    | C6 | 0R3 | 0G1 | 1R3 | 1G1 | ... | 239R3 | 239G1 |
| D5    | C5 | 0R2 | 0G0 | 1R2 | 1G0 | ... | 239R2 | 239G0 |
| D4    | C4 | 0R1 | 0B4 | 1R1 | 1B4 | ... | 239R1 | 239B4 |
| D3    | C3 | 0R0 | 0B3 | 1R0 | 1B3 | ... | 239R0 | 239B3 |
| D2    | C2 | 0G5 | 0B2 | 1G5 | 1B2 | ... | 239G5 | 239B2 |
| D1    | C1 | 0G4 | 0B1 | 1G4 | 1B1 | ... | 239G4 | 239B1 |
| D0    | C0 | 0G3 | 0B0 | 1G3 | 1B0 | ... | 239G3 | 239B0 |

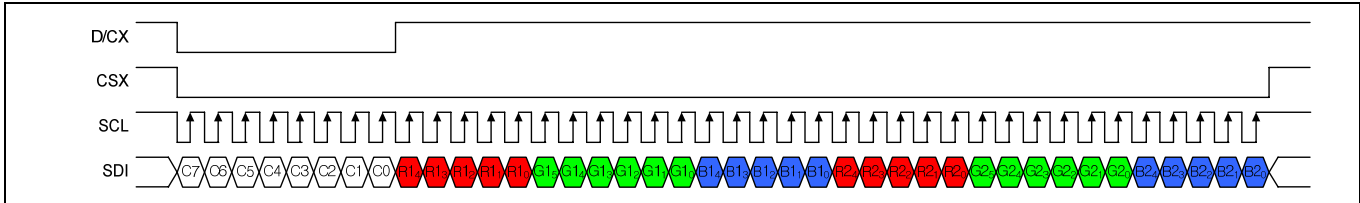


Figure44. 4-Wire 8-Bit Serial Interface for 565 1/2 Formats

3.3.3.6. 3-Wire 9-bit serial interface for 565 1/2 formats

Table 36. 3-Wire 9-Bit Serial Interface for 565 1/2 Formats

| Count | 0  | 1   | 2   | 3   | 4   | ... | 359   | 480   |
|-------|----|-----|-----|-----|-----|-----|-------|-------|
| DCX   | 0  | 1   | 1   | 1   | 1   | ... | 1     | 1     |
| D7    | C7 | 0R4 | 0G2 | 1R4 | 1G2 | ... | 239R4 | 239G2 |
| D6    | C6 | 0R3 | 0G1 | 1R3 | 1G1 | ... | 239R3 | 239G1 |
| D5    | C5 | 0R2 | 0G0 | 1R2 | 1G0 | ... | 239R2 | 239G0 |
| D4    | C4 | 0R1 | 0B4 | 1R1 | 1B4 | ... | 239R1 | 239B4 |
| D3    | C3 | 0R0 | 0B3 | 1R0 | 1B3 | ... | 239R0 | 239B3 |
| D2    | C2 | 0G5 | 0B2 | 1G5 | 1B2 | ... | 239G5 | 239B2 |
| D1    | C1 | 0G4 | 0B1 | 1G4 | 1B1 | ... | 239G4 | 239B1 |
| D0    | C0 | 0G3 | 0B0 | 1G3 | 1B0 | ... | 239G3 | 239B0 |

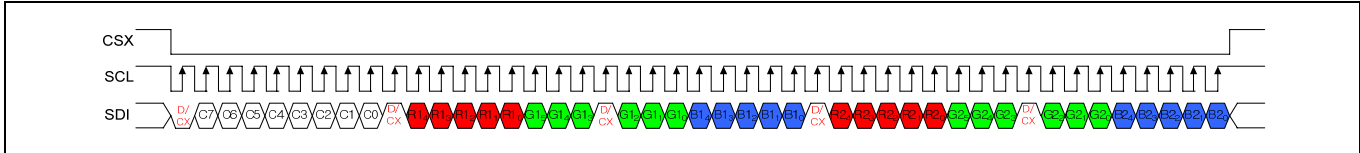


Figure45. 3-Wire 9-Bit Serial Interface for 565 1/2 Formats

### 3.4. RGB INTERFACE

#### 3.4.1. DEFINITION

The module uses 6 or 18-bit parallel RGB interface which includes: VSYNC, HSYNC, ENABLE, DOTCLK, DB[17:0]. The interface is activated after Power On sequence (See section Power On/Off Sequence)

Pixel clock (DOTCLK) is running all the time without stopping and it is used to entering VSYNC, HSYNC, ENABLE and DB[17:0] states when there is a rising edge of the DOTCLK. The DOTCLK can not be used as continues 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 DOTCLK signal.

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 DOTCLK signal.

Data Enable (ENABLE) is used to tell when there is received a RGB information that should be transferred on the display. This is a positive ('1', high) active and its state is read to the display module by a rising edge of the DOTCLK signal.

DB[17:0] are used to tell what is the information of the image that is transferred on the display (When ENABLE= '1' and there is a rising edge of DOTCLK). DB[17:0] can be '0' (low) or '1' (high). These lines are read by a rising edge of the DOTCLK signal.

The DOTCLK cycle is described in the following figure.

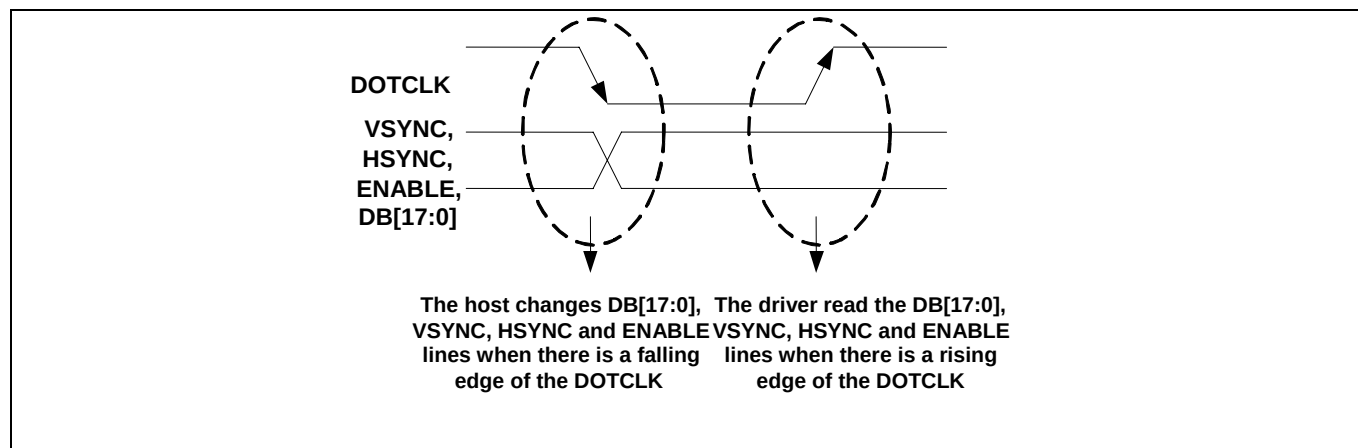


Figure46. DOTCLK Timing

**Note.**

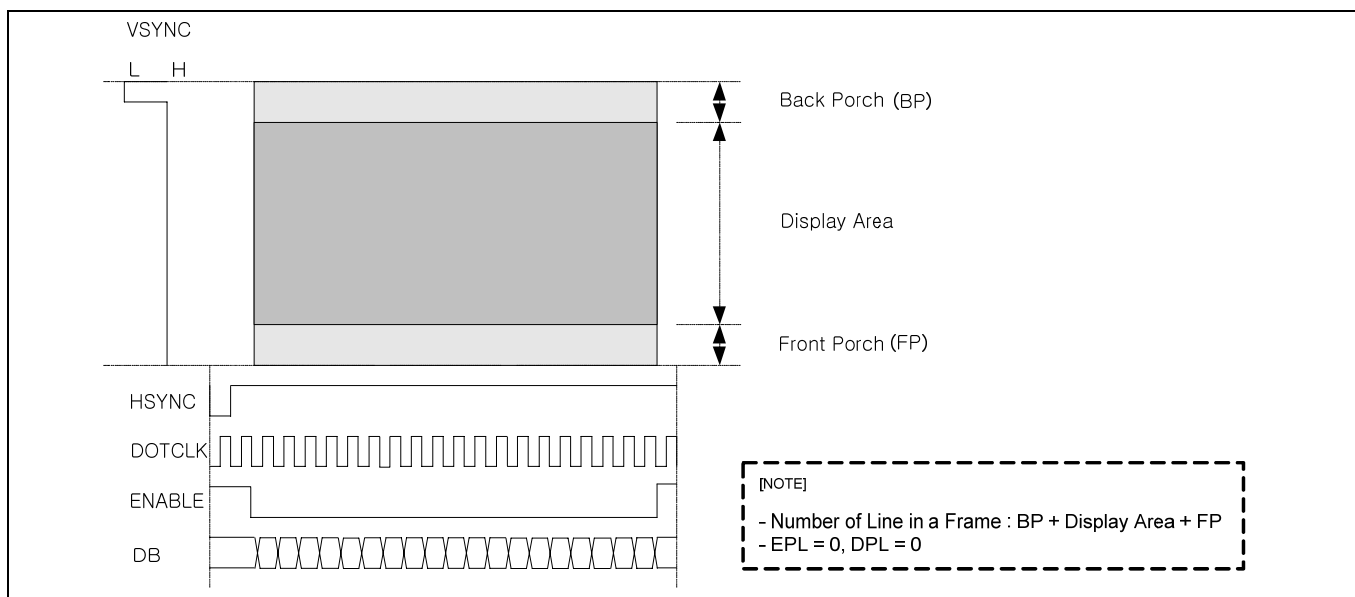
DPL=0 of IFCTL (F7h) command.

### 3.4.2. MOTION PICTURE DISPLAY

S6D04H0 incorporates RGB interface to display motion pictures and GRAM to store data for display.

The RGB interface is performed in synchronization with VSYNC, HSYNC, and DOTCLK.

In the period between the completion of displaying one frame data and the next VSYNC signal, the display status will remain in front porch period.



**Figure47. RGB Interface**

**Note.**

For RGB interface, VSYNC, HSYNC, DOTCLK should be supplied at much higher resolution than that of panel.

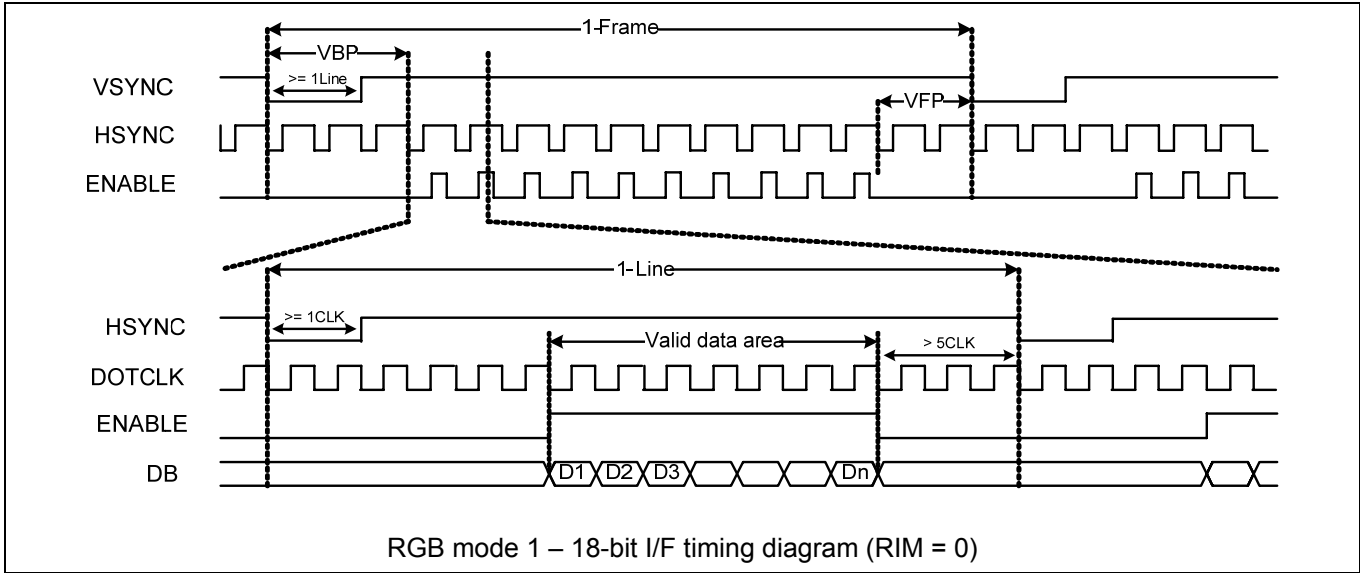
There are five timing conditions for RGB Interface that is determined according to RIM, COLMOD and each condition is described below.

**Table 37. Rgb Interface Mode Selection**

| RIM | COLMOD[6:4] | Color Depth                   |
|-----|-------------|-------------------------------|
| 0   | 110         | 262k-color (1 transfer/pixel) |
|     | 101         | 65k-color (1 transfer/pixel)  |
| 1   | 110         | 262k-color (3 transfer/pixel) |
|     | 101         | 65k-color (3 transfer/pixel)  |

3.4.3. RGB MODE

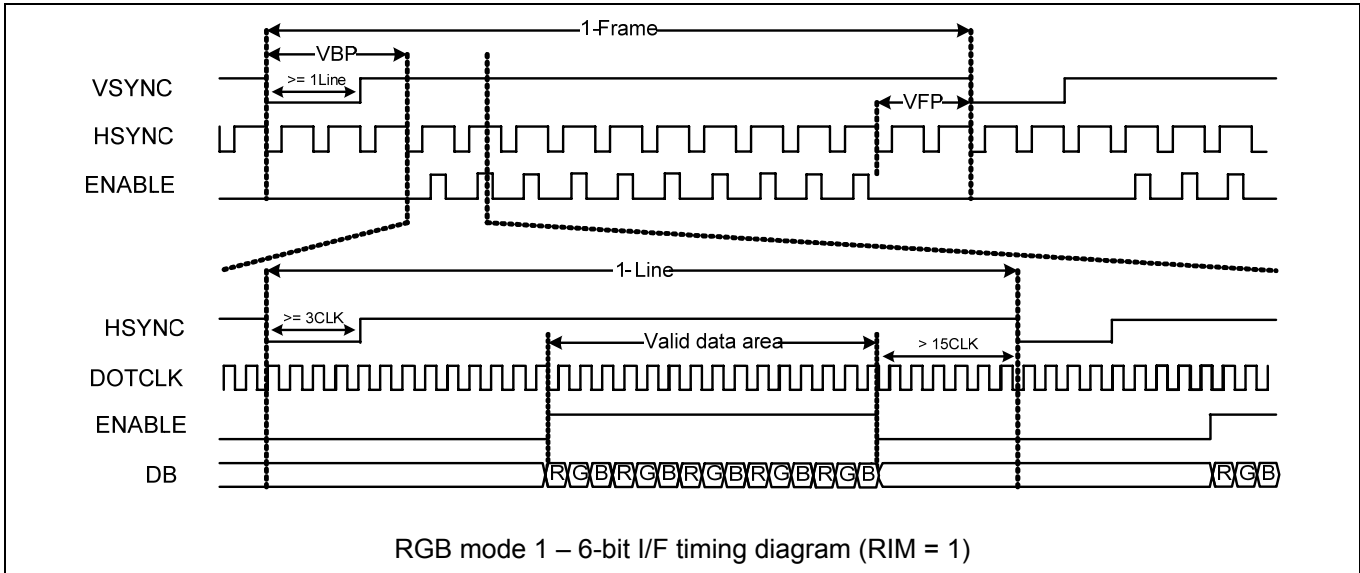
3.4.3.1. RGB Mode – 18-bit I/F



Note.

DPL=0, EPL=1, HPL=0 and VPL=0 of IFCTL (F7h) command.

3.4.3.2. RGB Mode – 6-bit I/F



Note.

DPL=0, EPL=1, HPL=0 and VPL=0 of IFCTL (F7h) command.

### 3.4.4. RGB DISPLAY DATA FORMAT

#### 3.4.4.1. RGB 18-bit I/F – 262k-color

**Table 38. 18-Bit Interface for 666 1/1 Formats**

| Count | 1   | 2   | ... | 239   | 240   |
|-------|-----|-----|-----|-------|-------|
| DB17  | 0R5 | 1R5 | ... | 238R5 | 239R5 |
| DB16  | 0R4 | 1R4 | ... | 238R4 | 239R4 |
| DB15  | 0R3 | 1R3 | ... | 238R3 | 239R3 |
| DB14  | 0R2 | 1R2 | ... | 238R2 | 239R2 |
| DB13  | 0R1 | 1R1 | ... | 238R1 | 239R1 |
| DB12  | 0R0 | 1R0 | ... | 238R0 | 239R0 |
| DB11  | 0G5 | 1G5 | ... | 238G5 | 239G5 |
| DB10  | 0G4 | 1G4 | ... | 238G4 | 239G4 |
| DB9   | 0G3 | 1G3 | ... | 238G3 | 239G3 |
| DB8   | 0G2 | 1G2 | ... | 238G2 | 239G2 |
| DB7   | 0G1 | 1G1 | ... | 238G1 | 239G1 |
| DB6   | 0G0 | 1G0 | ... | 238G0 | 239G0 |
| DB5   | 0B5 | 1B5 | ... | 238B5 | 239B5 |
| DB4   | 0B4 | 1B4 | ... | 238B4 | 239B4 |
| DB3   | 0B3 | 1B3 | ... | 238B3 | 239B3 |
| DB2   | 0B2 | 1B2 | ... | 238B2 | 239B2 |
| DB1   | 0B1 | 1B1 | ... | 238B1 | 239B1 |
| DB0   | 0B0 | 1B0 | ... | 238B0 | 239B0 |

#### 3.4.4.2. RGB 18-Bit I/F – 65k-color

**Table 39. 18-Bit Interface for 565 1/1 Formats**

| Count | 1   | 2   | ... | 239   | 240   |
|-------|-----|-----|-----|-------|-------|
| DB17  |     |     |     |       |       |
| DB16  |     |     |     |       |       |
| DB15  | 0R4 | 1R4 | ... | 238R4 | 239R4 |
| DB14  | 0R3 | 1R3 | ... | 238R3 | 239R3 |
| DB13  | 0R2 | 1R2 | ... | 238R2 | 239R2 |
| DB12  | 0R1 | 1R1 | ... | 238R1 | 239R1 |
| DB11  | 0R0 | 1R0 | ... | 238R0 | 239R0 |
| DB10  | 0G5 | 1G5 | ... | 238G5 | 239G5 |



| Count | 1   | 2   | ... | 239   | 240   |
|-------|-----|-----|-----|-------|-------|
| DB9   | 0G4 | 1G4 | ... | 238G4 | 239G4 |
| DB8   | 0G3 | 1G3 | ... | 238G3 | 239G3 |
| DB7   | 0G2 | 1G2 | ... | 238G2 | 239G2 |
| DB6   | 0G1 | 1G1 | ... | 238G1 | 239G1 |
| DB5   | 0G0 | 1G0 | ... | 238G0 | 239G0 |
| DB4   | 0B4 | 1B4 | ... | 238B4 | 239B4 |
| DB3   | 0B3 | 1B3 | ... | 238B3 | 239B3 |
| DB2   | 0B2 | 1B2 | ... | 238B2 | 239B2 |
| DB1   | 0B1 | 1B1 | ... | 238B1 | 239B1 |
| DB0   | 0B0 | 1B0 | ... | 238B0 | 239B0 |

## 3.4.4.3. RGB 6-Bit I/F – 262k-color

Table 40. 6-Bit Interface Type I for 666 1/3 Formats

| Count | 1   | 2   | 3   | ... | 718   | 719   | 720   |
|-------|-----|-----|-----|-----|-------|-------|-------|
| DB5   | 0R5 | 0G5 | 0B5 | ... | 239R5 | 239G5 | 239B5 |
| DB4   | 0R4 | 0G4 | 0B4 | ... | 239R4 | 239G4 | 239B4 |
| DB3   | 0R3 | 0G3 | 0B3 | ... | 239R3 | 239G3 | 239B3 |
| DB2   | 0R2 | 0G2 | 0B2 | ... | 239R2 | 239G2 | 239B2 |
| DB1   | 0R1 | 0G1 | 0B1 | ... | 239R1 | 239G1 | 239B1 |
| DB0   | 0R0 | 0G0 | 0B0 | ... | 239R0 | 239G0 | 239B0 |

## 3.4.4.4. RGB 6Bit I/F – 65k-color

Table 41. 6-Bit Interface Type I for 565 1/3 Formats

| Count | 1   | 2   | 3   | ... | 718   | 719   | 720   |
|-------|-----|-----|-----|-----|-------|-------|-------|
| DB5   | 0R4 | 0G5 | 0B4 | ... | 239R4 | 239G5 | 239B4 |
| DB4   | 0R3 | 0G4 | 0B3 | ... | 239R3 | 239G4 | 239B3 |
| DB3   | 0R2 | 0G3 | 0B2 | ... | 239R2 | 239G3 | 239B2 |
| DB2   | 0R1 | 0G2 | 0B1 | ... | 239R1 | 239G2 | 239B1 |
| DB1   | 0R0 | 0G1 | 0B0 | ... | 239R0 | 239G1 | 239B0 |
| DB0   |     | 0G0 |     | ... |       | 239G0 |       |

3.4.5. DISPLAY TIMING OF RGB INTERFACE

3.4.5.1. Display timing when rgb data is written at shift register

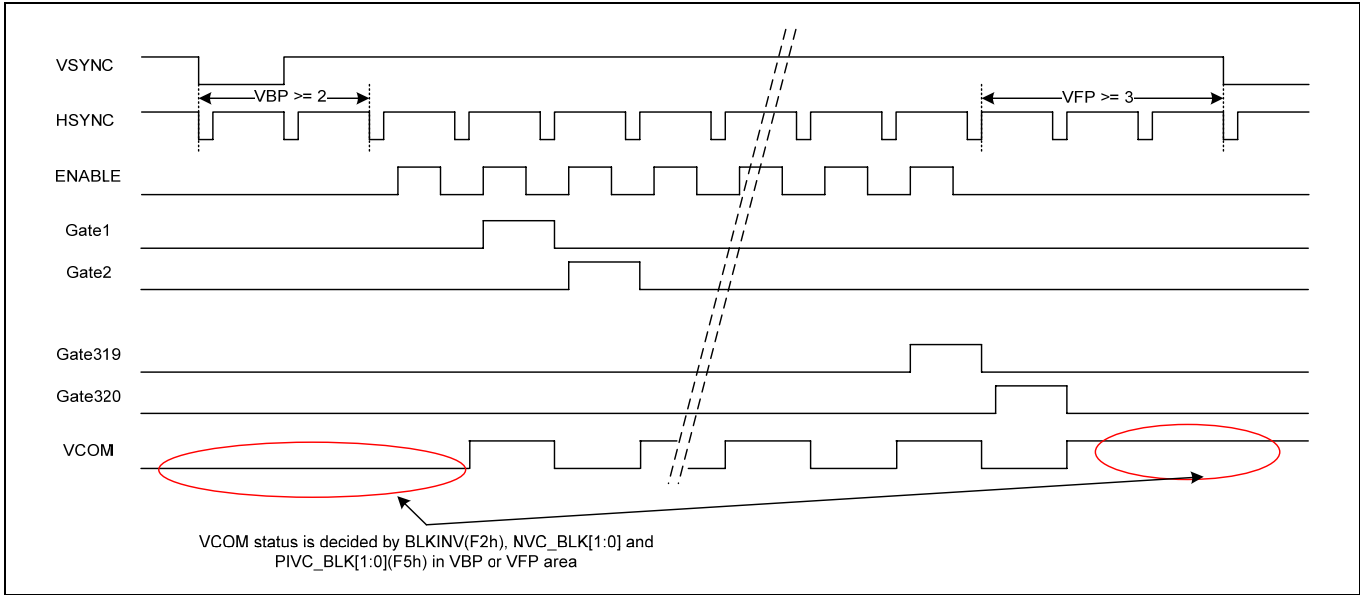


Figure48. Display Timing Diagram When RAM\_ACCS = 0 (F7h)

Note.

When RAM\_ACCS=0, real Vertical Back Porch is VBP + 1 and real Vertical Front Porch is VFP – 1 .

3.4.5.2. Display timing when rgb data is written at memory

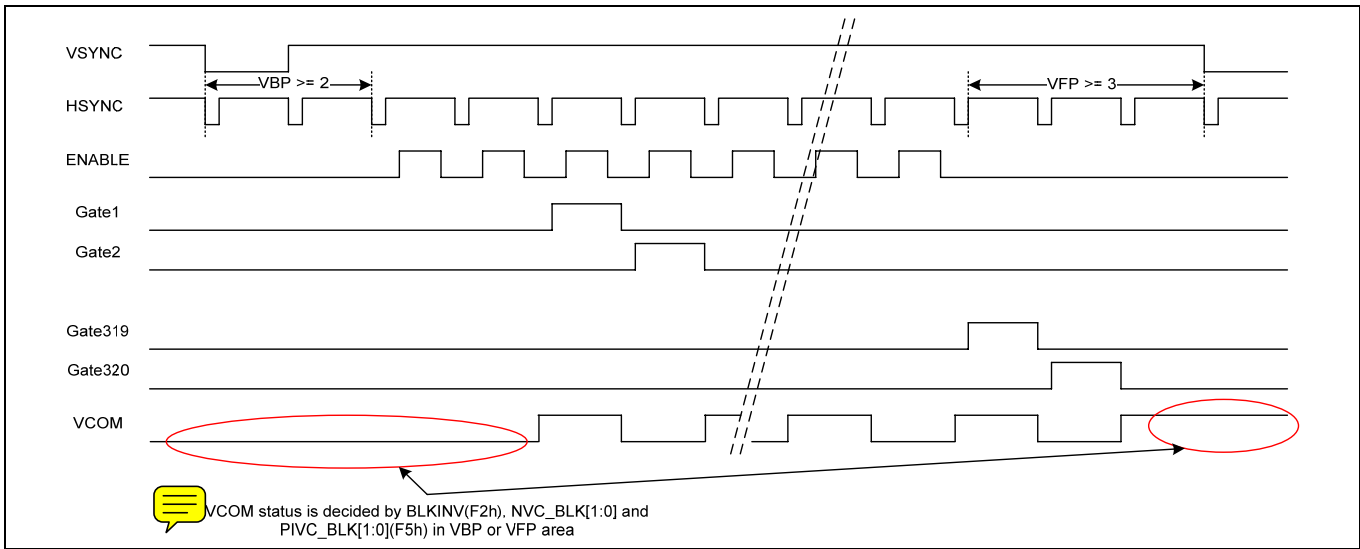


Figure49. Display Timing Diagram When RAM\_ACCS = 1 (F7h)

Note.

When RAM\_ACCS=1, real Vertical Back Porch is VBP + 2 and real Vertical Front Porch is VFP – 2 .

### 3.5. VSYNC INTERFACE

#### 3.5.1. DEFINITION

The S6D04H0 incorporates VSYNC interface, which enables motion pictures to be displayed with only the conventional system interface and the frame synchronization signal (VSYNC). This interface requires minimal changes from the conventional system to display motion pictures.

When DM1-0="10", VSYNC interface is available. In this interface the internal display operation is synchronized with VSYNC. Data for display is written to RAM via the system interface with higher speed than for internal display operation. This method enables tearing-free display of motion pictures with the conventional interface.

Display operation can be achieved by using the internal clock generated by the internal oscillator and the VSYNC input. Because all the data for display is written to RAM, only the data to be rewritten is transferred. This method reduces the amount of data transferred during motion picture display operation.

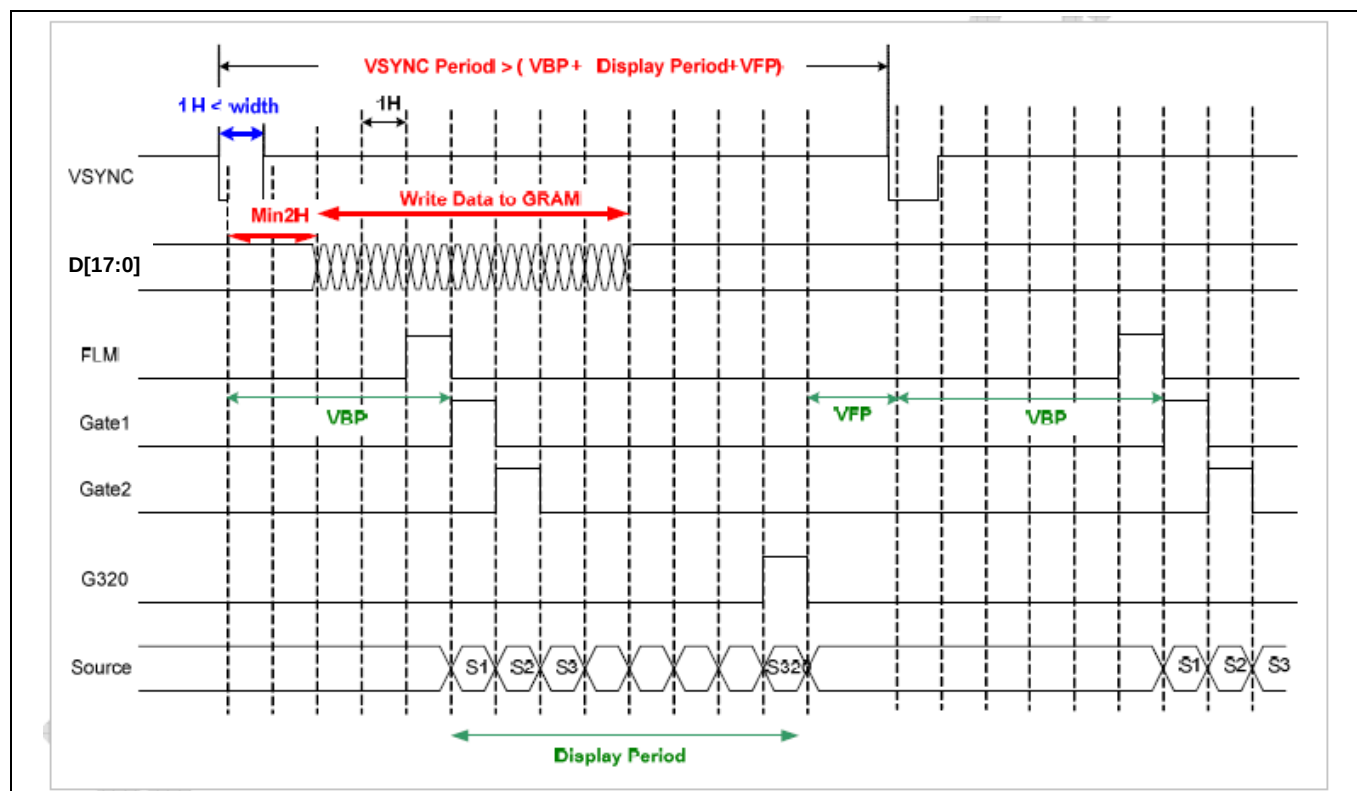


Figure50. Timing Diagram of VSYNC I/F

VSYNC interface requires taking the minimum speed for RAM writing via the system interface and the frequency of the internal clock into consideration. RAM writing should be performed with higher speed than the result

obtained from the calculation shown below. The internal memory writing address counter is reset by VSYNC. So, insure interval time between VSYNC falling and GRAM data writing.

**Note.**

1. VSYNC period should always be constant. If not, some degradation of display such as flicker may occur in LCD system.
2. Display data don't need to be written for every VSYNC period. For example, any system is working under 60Hz frame rate and 30-fps motion picture condition. So being written display data for every other frame would be enough.

### 3.5.2. VSYNC INTERFACE MODE

#### 3.5.2.1. Leading mode.

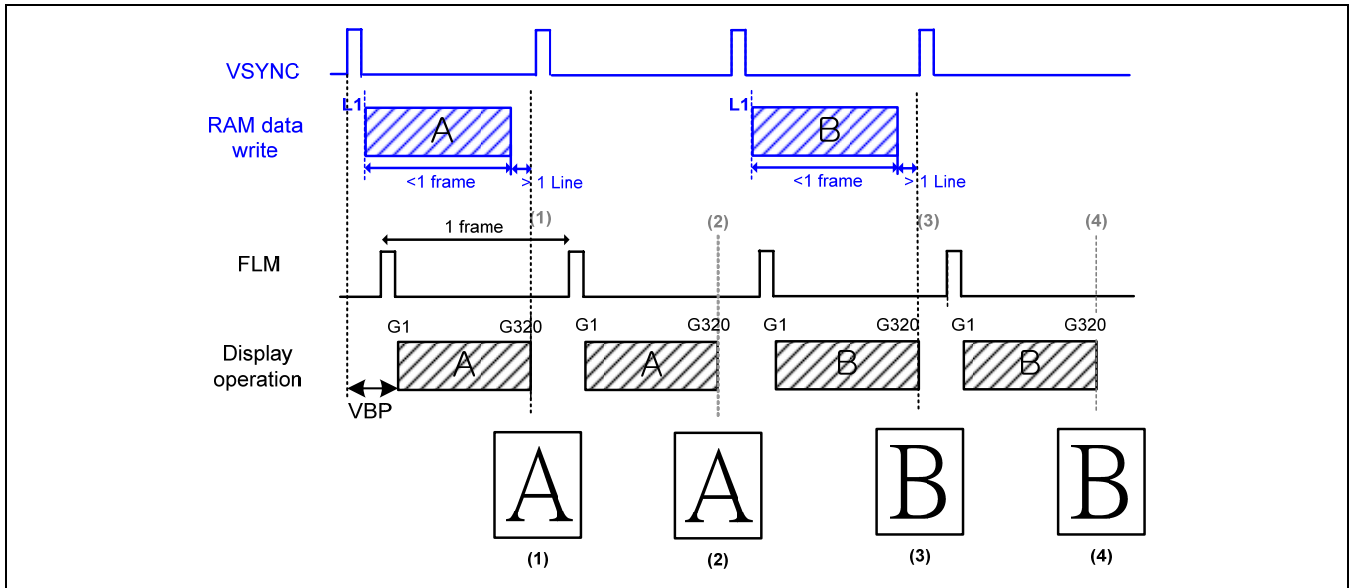


Figure51. Operation for Leading Mode of VSYNC Interface ( $VPL = 1$ )

#### 3.5.2.2. Lagging mode.

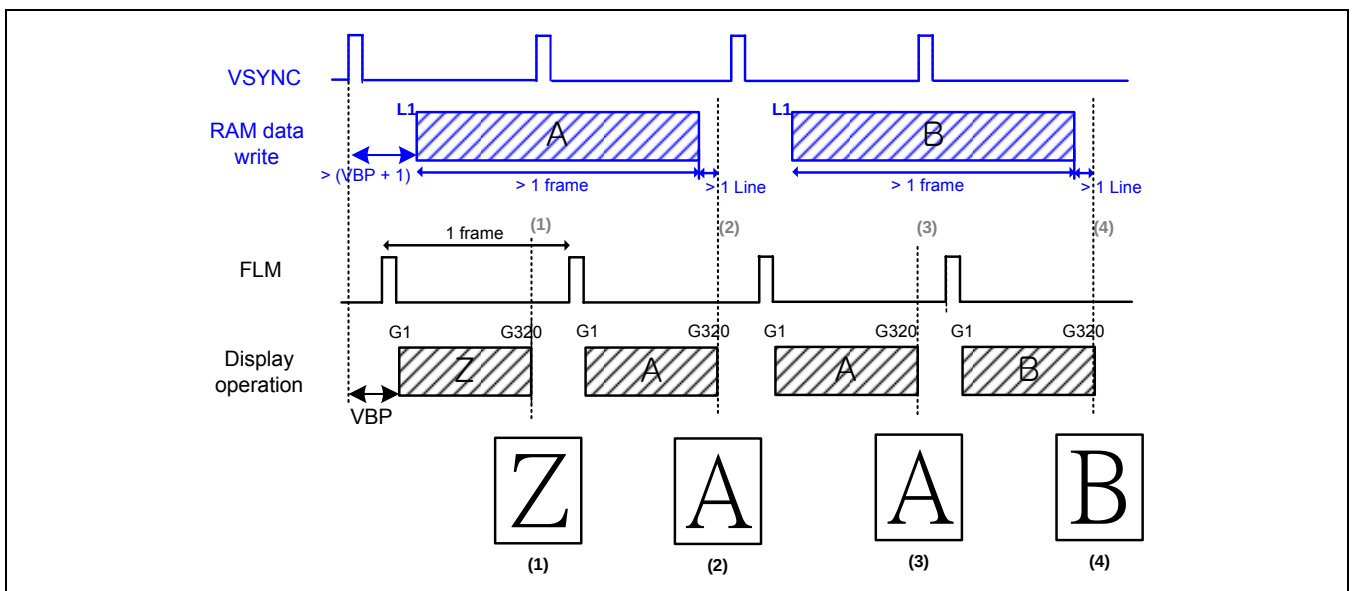


Figure52. Operation for Lagging Mode of VSYNC Interface ( $VPL = 1$ )

---

*Internal clock frequency (fosc) [Hz] = Frame freq. × (Display line (NL) + Front porch (VFP) + Back porch (VBP))*  
*× \*37-Clock × Fluctuation*

*Minimum speed for RAM writing [Hz] > 320 × Display line (NL)*  
*/ {((Back porch (BP) + Display line (NL) – Margin) × 37 Clock) / fosc}*

**Note.**

When RAM writing does not start immediately after the falling edge of VSYNC, the time between the falling edge of VSYNC and the RAM writing start timing must also be considered.

---

An example is shown below.

**3.5.3. EXAMPLE**

|                     |                               |
|---------------------|-------------------------------|
| Display size        | 240RGB × 320 lines            |
| Display line number | 320 lines                     |
| Back/Front porch    | 8 lines / 8 lines (VBP / VFP) |
| Frame Frequency     | 60Hz                          |

Internal clock frequency (fosc) [Hz] = 60 Hz × (320 + 8 + 8) lines × \*37 clock × 1.1 / 0.9 = 694.61 kHz

**Note.**

1. Calculating the internal clock frequency requires considering the fluctuation. In the above case a 10% Fluctuation within the VSYNC period is assumed.
2. The fluctuation includes LSI production variation and air temperature fluctuation. Other fluctuations, including those for the external resistors and the supplied power, are not included in this example. Please keep in mind that a margin for these factors is also needed.  
Minimum speed for RAM writing [Hz] >  $240 \times 320 / \{((14 + 320 - 2) \text{ lines} \times *37 \text{ clock}) / 694.61 \text{ kHz}\} = 4.38 \text{ MHz}$
3. In this case RAM writing starts immediately after the falling edge of VSYNC.
4. The margin for display line should be two lines or more at the completion of RAM writing for one frame.

\* 1H clock (default) = 148 display clock

Note) display clock = oscillator clock /3

## CHAPTER 4

# FUNCTIONAL DESCRIPTION

- 4.1 Power
- 4.2 Source
- 4.3 Display Data RAM
- 4.4 MTP Control
- 4.5 Tearing Effect Output
- 4.6 Sleep Out Command and Self-diagnostic Functions
- 4.7 MIE Function
- 4.8 Deep Standby Mode
- 4.9 Display On/Off Sequence



# 4. FUNCTIONAL DESCRIPTION

## 4.1. POWER

### 4.1.1. POWER ON / OFF SEQUENCE

VDD3 and VCI can be applied in any order.

VDD3 and VCI can be powered down in any order.

During power off, if LCD is in the Sleep Out mode, VCI and VDD3 must be powered down minimum 120msec after RESX has been released.

During power off, if LCD is in the Sleep In mode, VDD3 or VCI 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.

#### Note.

1. There will be no damage to the display module if the power sequences are not met.
2. There will be no abnormal visible effects on the display panel during the Power On/Off Sequences.
3. There will be no abnormal visible effects on the display between the end of Power On Sequence and before the reception of Sleep Out command. Same is the case between receiving Sleep In command and Power Off Sequence.
4. If RESX line is not held stable by host during Power On Sequence as defined in Sections 4.1.1.1, 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 in the next pages.

## 4.1.1.1. 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 VCI and VDD3 have been applied – otherwise, correct functionality is not guaranteed. There is no timing restriction upon this hardware reset.

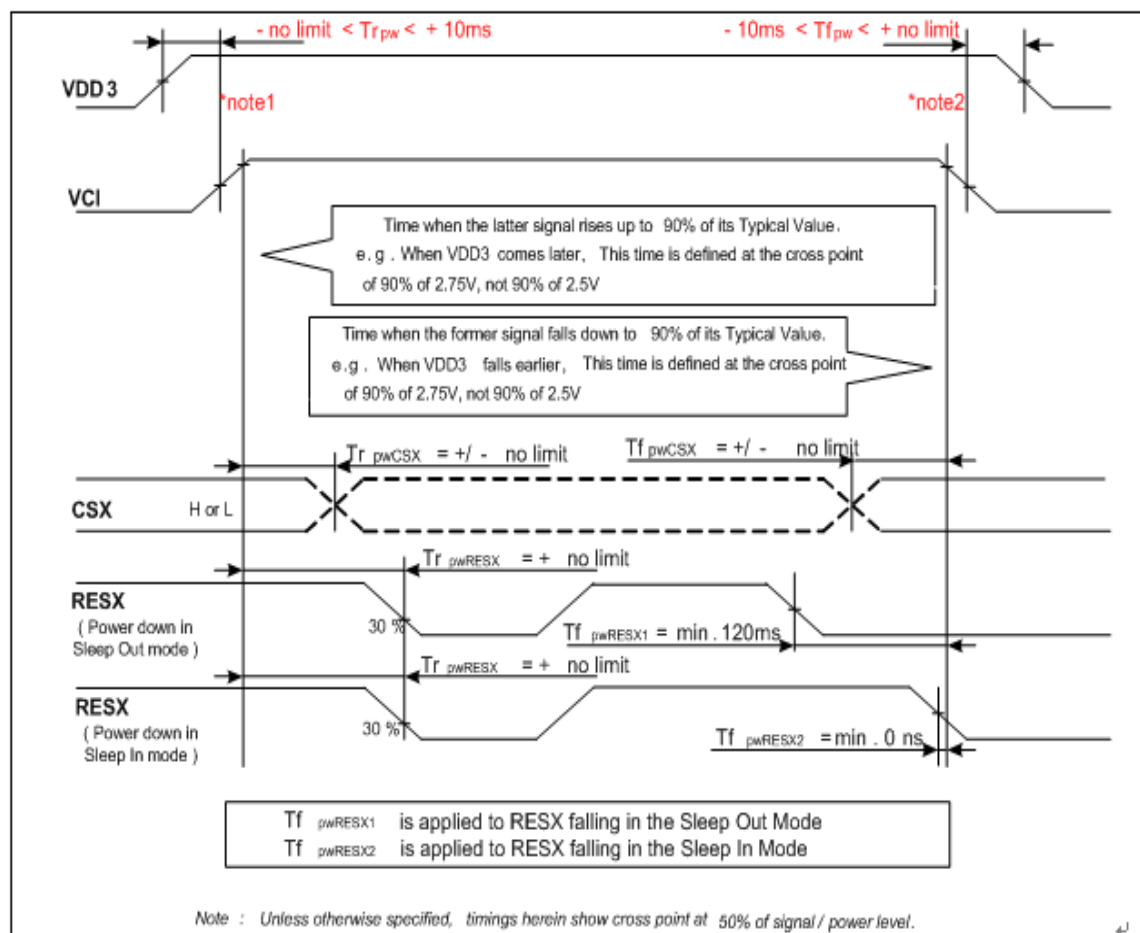


Figure 102 RESX line is held high or unstable by host at power on

Figure53. RESX Line is Held High or Unstable by Host At Power On

Note1. In case that VCI comes first, VDD3 should be applied & settled within 10ms after VCI is applied.

Note2. In case that VCI disappears first, VDD3 should also be turned off within 10ms after VCI is off.

**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 VCI and VDD3 have been applied.

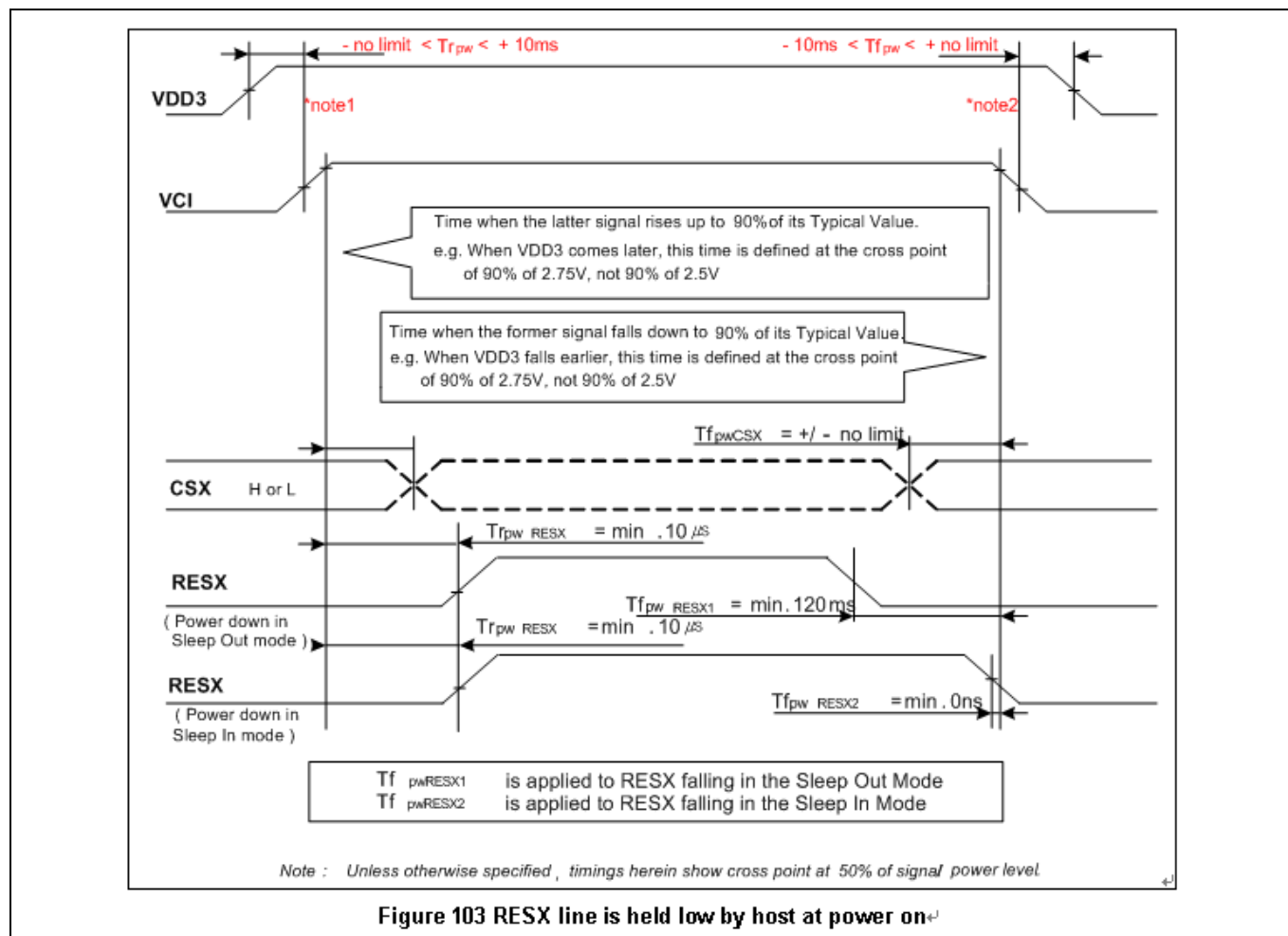


Figure 103 RESX line is held low by host at power on

Figure54. RESX Line is Held Low by Host At Power On

Note1. In case that VCI comes first, VDD3 should be applied & settled within 10ms after VCI is applied.

Note2. In case that VCI disappears first, VDD3 should also be turned off within 10ms after VCI is off.

#### 4.1.2. ABRUPT POWER OFF

The abrupt power-off represents a situation where, for e.g, a battery is removed without the expected 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 abrupt 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.

#### 4.1.3. POWER LEVELS

6 level modes are defined they are in order of Maximum power consumption to Minimum power consumption.

1. Normal Mode On (full display), Idle Mode Off, Sleep Out

In this mode, the display is able to show maximum 262,144 colors.

2. Partial Mode On, Idle Mode Off, Sleep Out

In this mode, part of the display is used with maximum 262,144 colors.

3. Normal Mode On (full display), Idle Mode On, Sleep Out

In this mode, the full display area is used but with 8 colors,

4. Partial Mode On, Idle Mode On, Sleep Out

In this mode, part of the display is used but with 8 colors

5. Sleep In Mode

In this mode, the step up circuit, Internal oscillator and panel driver circuit are stopped. Only the MPU interface and memory works with VDD3 power supply. Contents of the memory are safe.

6. Power Off Mode.

In this mode, both VCI and VDD3 are removed

**Note.**

Transition between modes 1-5 is controllable by MPU commands. Mode 6 is entered only when both Power supplies are removed.

## 4.1.4. POWER FLOW CHART FOR DIFFERENT POWER MODES

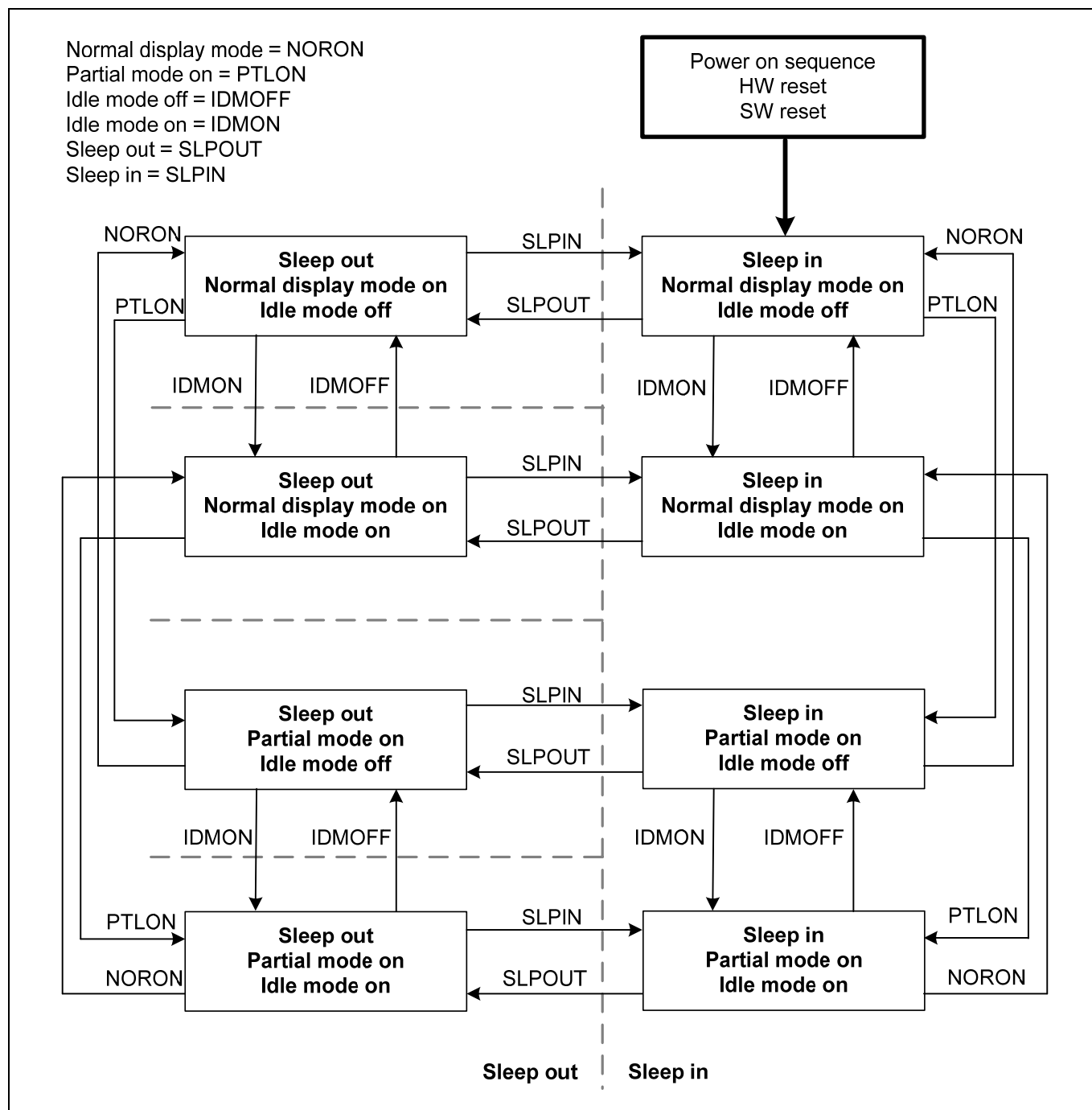


Figure55. Power Flow Chart

## Note.

1. There is no abnormal visual effect when there is a change from one power mode to another power mode.
2. There is no limitation, which is not specified by this spec, when there is a change from one power mode to another power

Mode

## 4.1.5. POWER SUPPLY

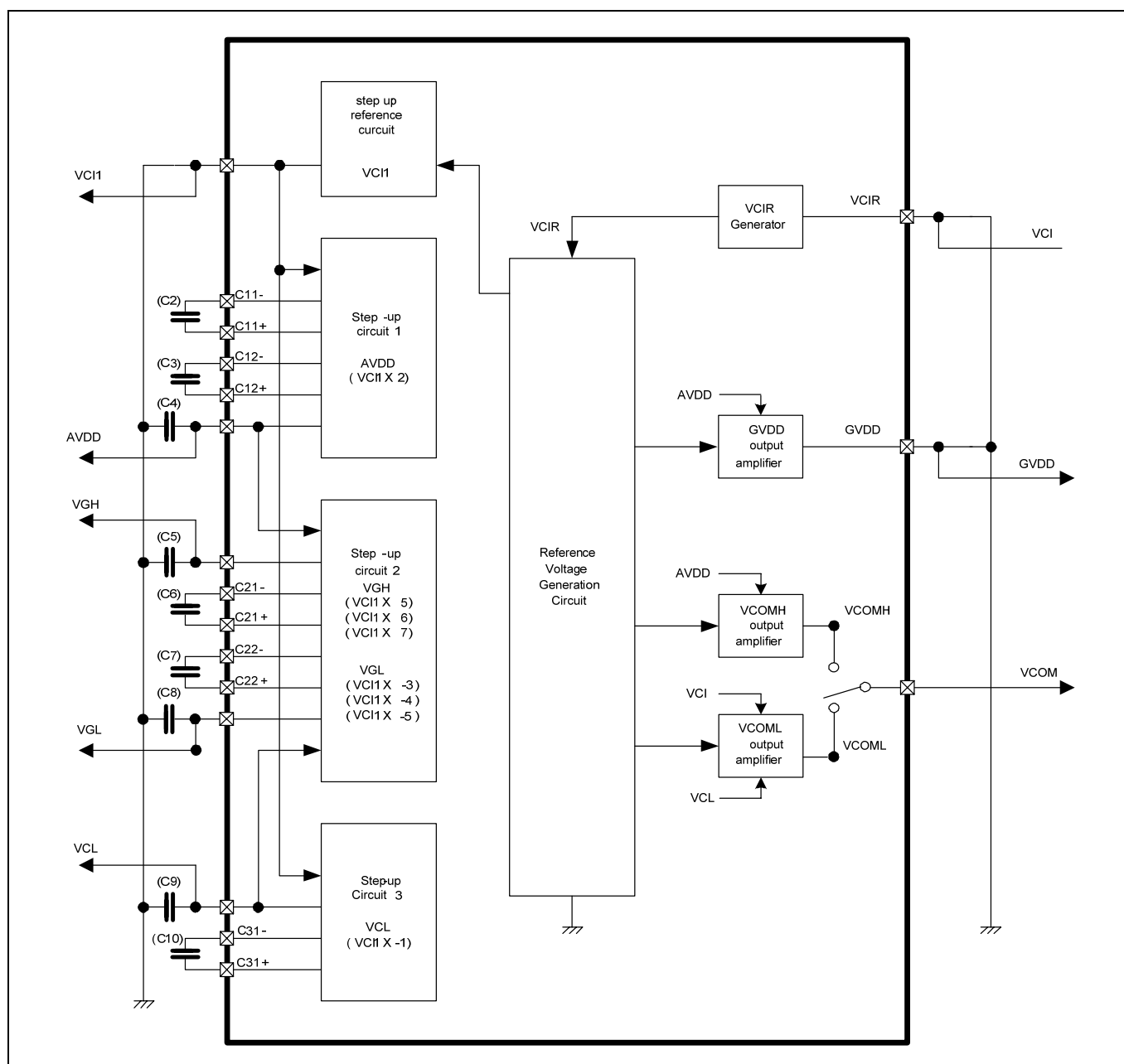


Figure 56. Configuration of the Internal Power-Supply Circuit

The step-up circuits consist of step-up circuits 1 to 3. Step-up circuit 1 doubles the voltage which is supplied to VCI1 for AVDD level, and VCI1 is positively amplified by 5 or 6 or 7 times for VGH level and negatively amplified by 3 or 4 or 5 times for VGL level in step-up circuit 2. Step-up circuit 3 flips the VCI1 level and generates the VCL level. These step-up circuits generate the supply powers of AVDD, VGH, VGL and VCL in sequence after regulation. The regulated GVDD is for the grayscale voltage, another regulated VCOMH and the other regulated

VCOML are for VCOM which is connected to counter electrode of TFT LCD panel, and generate each level depending on that voltage. Connect VCOM to the TFT panel.

#### 4.1.5.1. Pattern diagrams for voltage setting

The following figure shows a pattern diagram for the voltage setting and an example of waveforms.

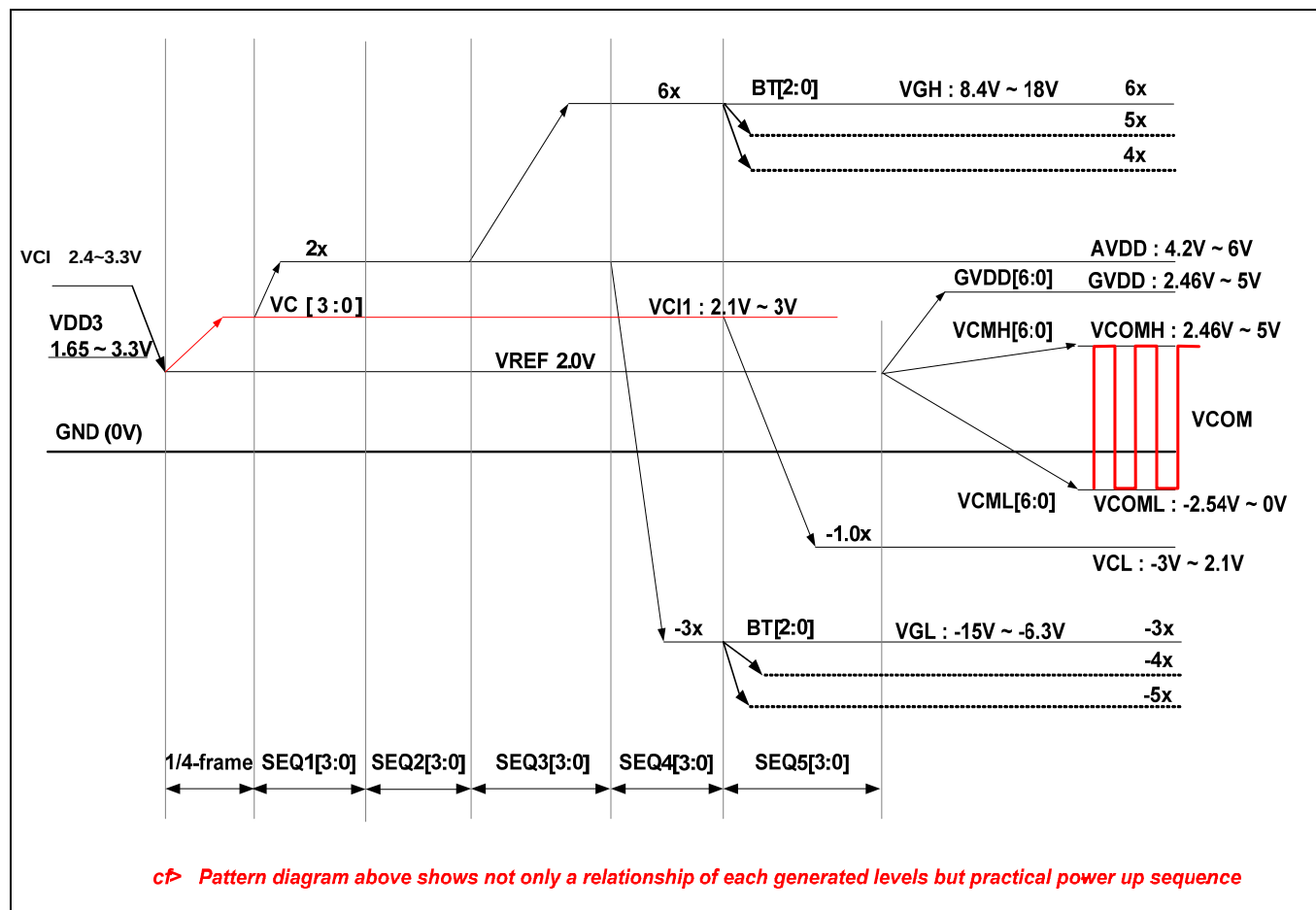


Figure57. Sequence of Power Boosting S6D04H0

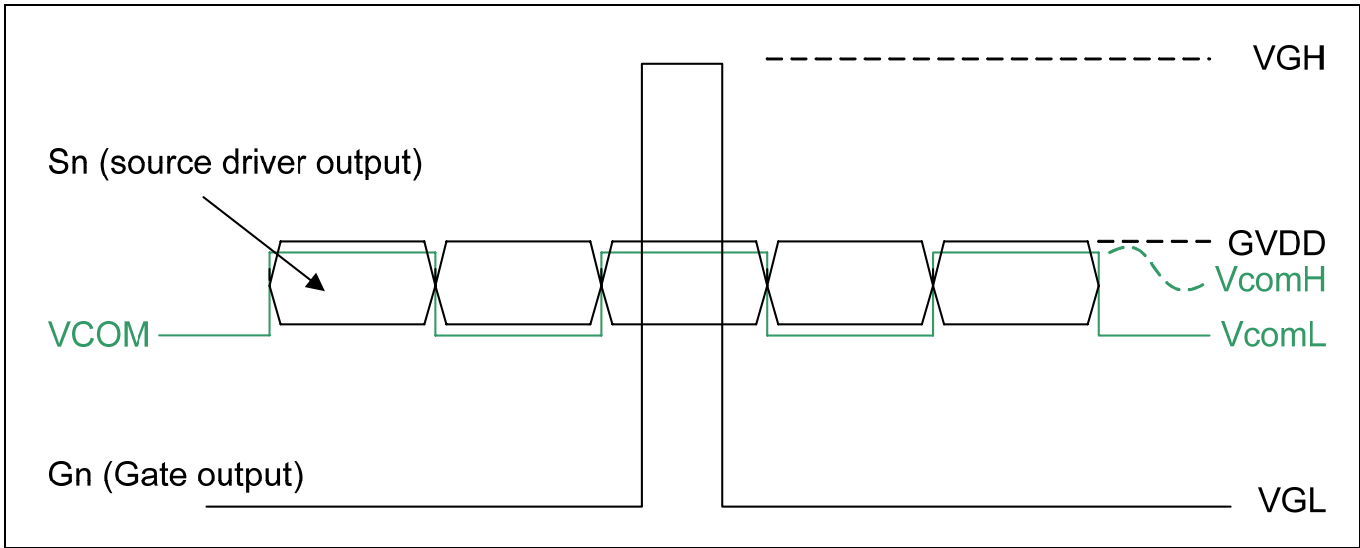


Figure58. Power-Up Pattern Diagram & An Example of Source/VCOM Waveforms



## 4.1.6. SETUP FLOW OF POWER

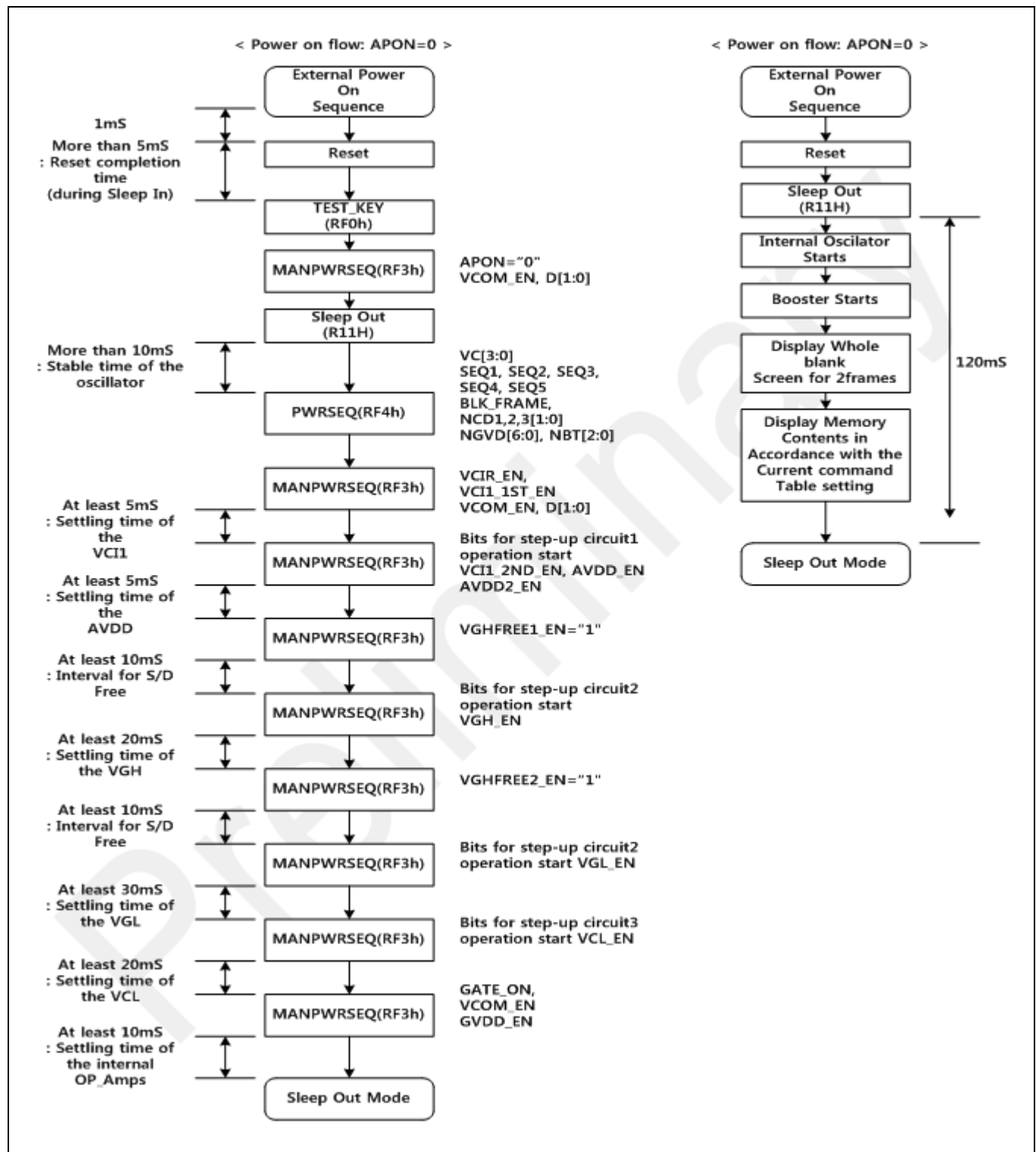


Figure 59. Power-Up Pattern Diagram

## 4.2. SOURCE

### 4.2.1. GAMMA ADJUSTMENT FUNCTION

S6D04H0 provides the gamma adjustment function to display 262,144 colors simultaneously for each R/G/B color. The gamma adjustment executed by the high/ mid/ low level adjustment registers determines 11 grayscale reference levels. Furthermore, since the high-level adjustment register, mid-level adjustment register and the low-level adjustment register have the positive polarities and negative polarities, you can adjust them to match LCD panel and a gamma for each R/G/B color, respectively.

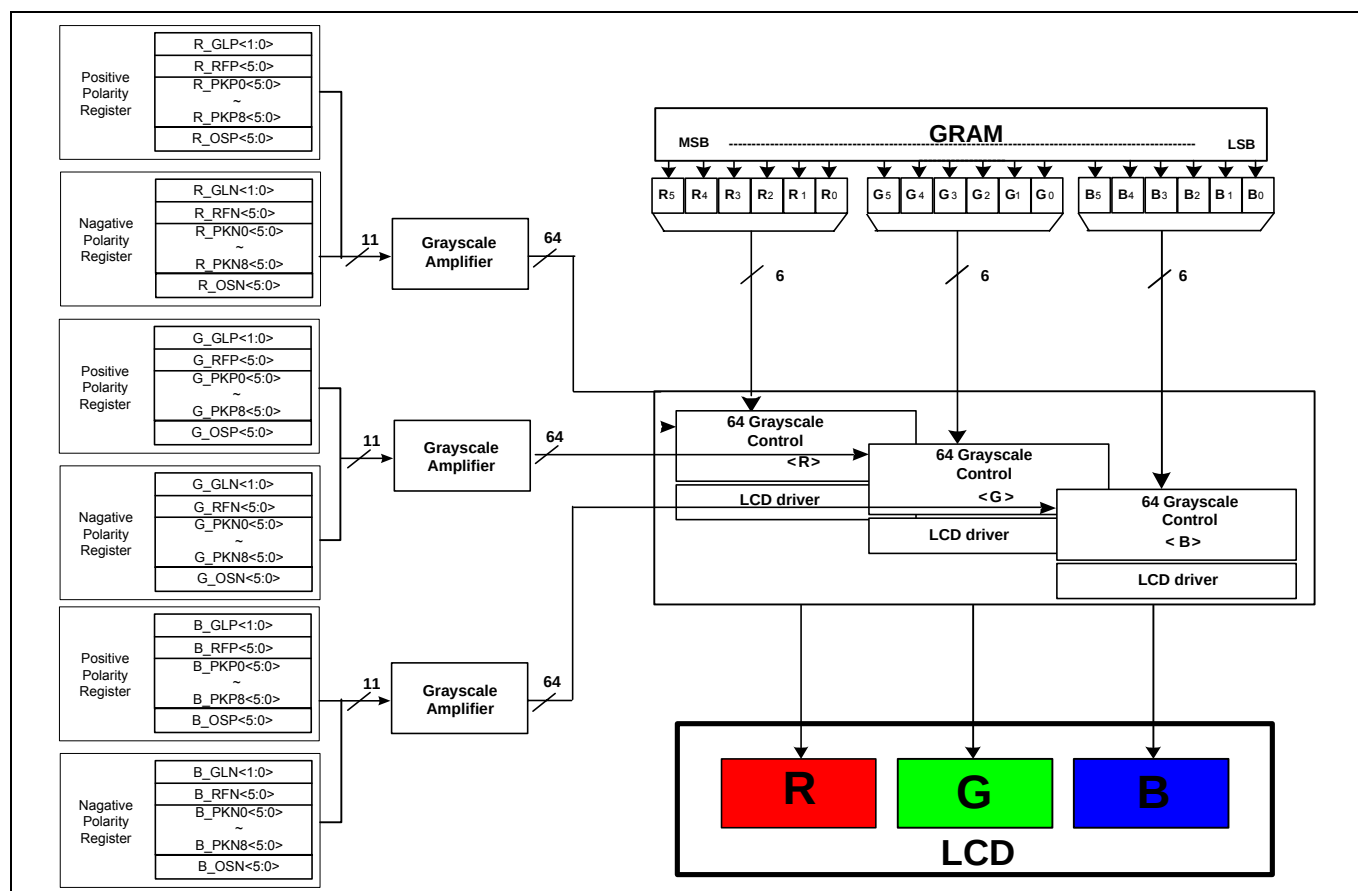


Figure60. Gamma Adjustment Block Diagram

## 4.2.2. GAMMA CURVE

### 4.2.2.1. Gamma curve 1 (GC0)

Gamma Curve 1 (GC0), applies the function.  $y = x^{2.2}$

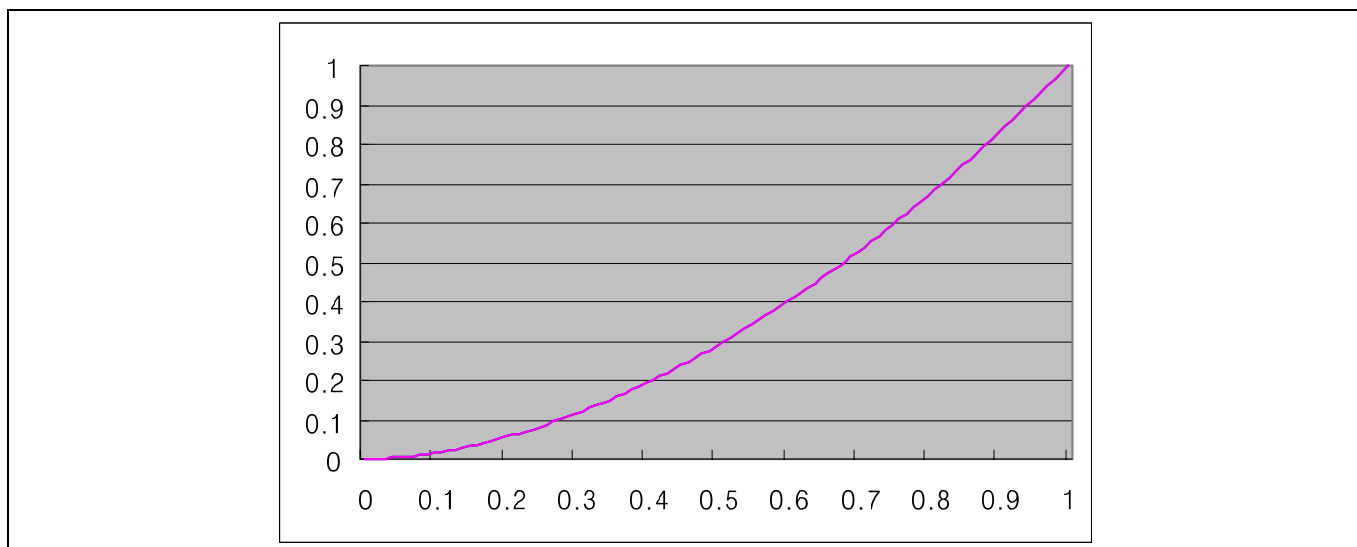


Figure61. Gamma  $y = x^{2.2}$

### 4.2.2.2. Gamma curve 2 (GC1)

Gamma Curve 2 (GC1), applies the function.  $y = x^{1.8}$

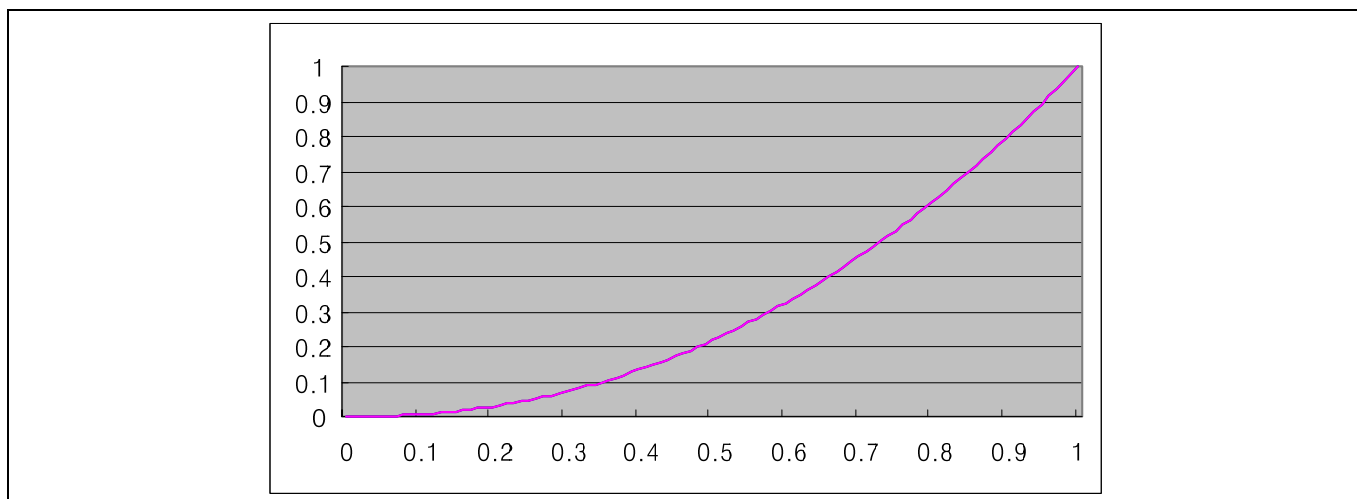


Figure62. Gamma  $y = x^{1.8}$

## 4.2.2.3. Gamma curve 3(GC2)

Gamma Curve 3(GC2), applies the function.  $y = x^{2.5}$

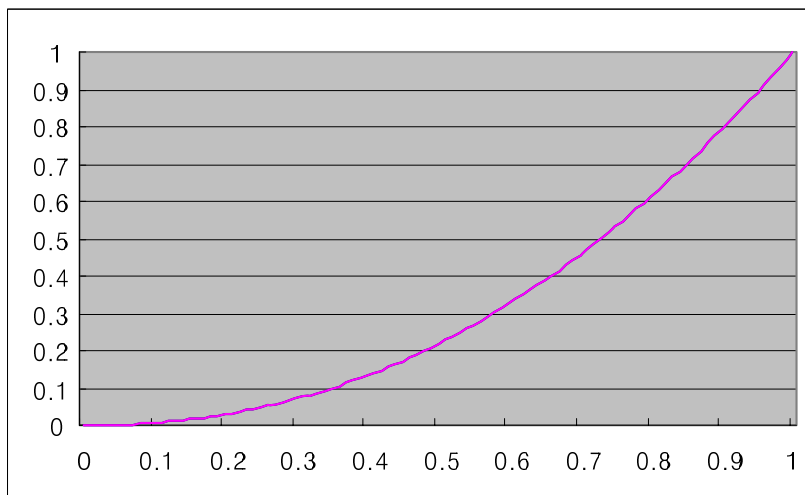


Figure63. Gamma  $y = x^{2.5}$

## 4.2.2.4. Gamma curve 4 (GC3)

Gamma Curve 4 (GC3) is linear, i. e.  $y = x^1$

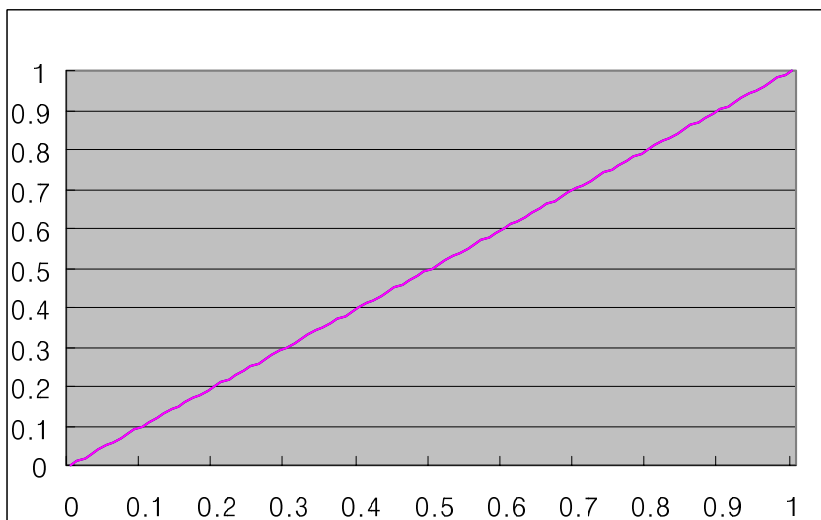
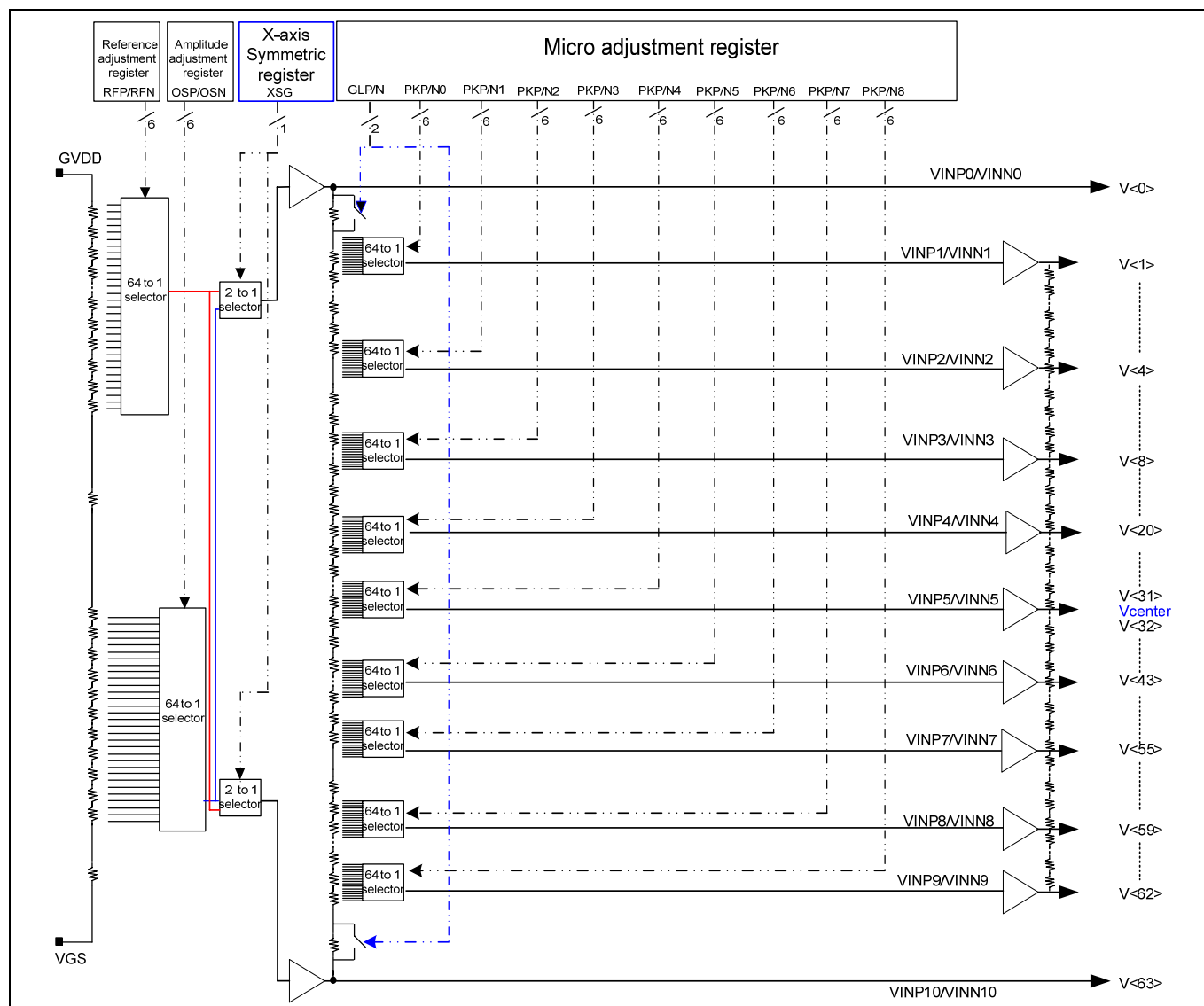


Figure64. Gamma  $y = x^1$

### 4.2.3. STRUCTURE OF GRAYSCALE AMPLIFIER

S6D04H0 provides the gamma adjustment function to display 262,114 colors simultaneously for each R/G/B color. The gamma adjustment executed by the high/ mid/ low level adjustment registers determines 11 grayscale reference levels. Furthermore, since the high-level adjustment register, mid-level adjustment register and the low-level adjustment register have the positive polarities and negative polarities, you can adjust them to match LCD panel and a gamma for each R/G/B color, respectively.



**Figure65. Structure of Grayscale Amplifier**

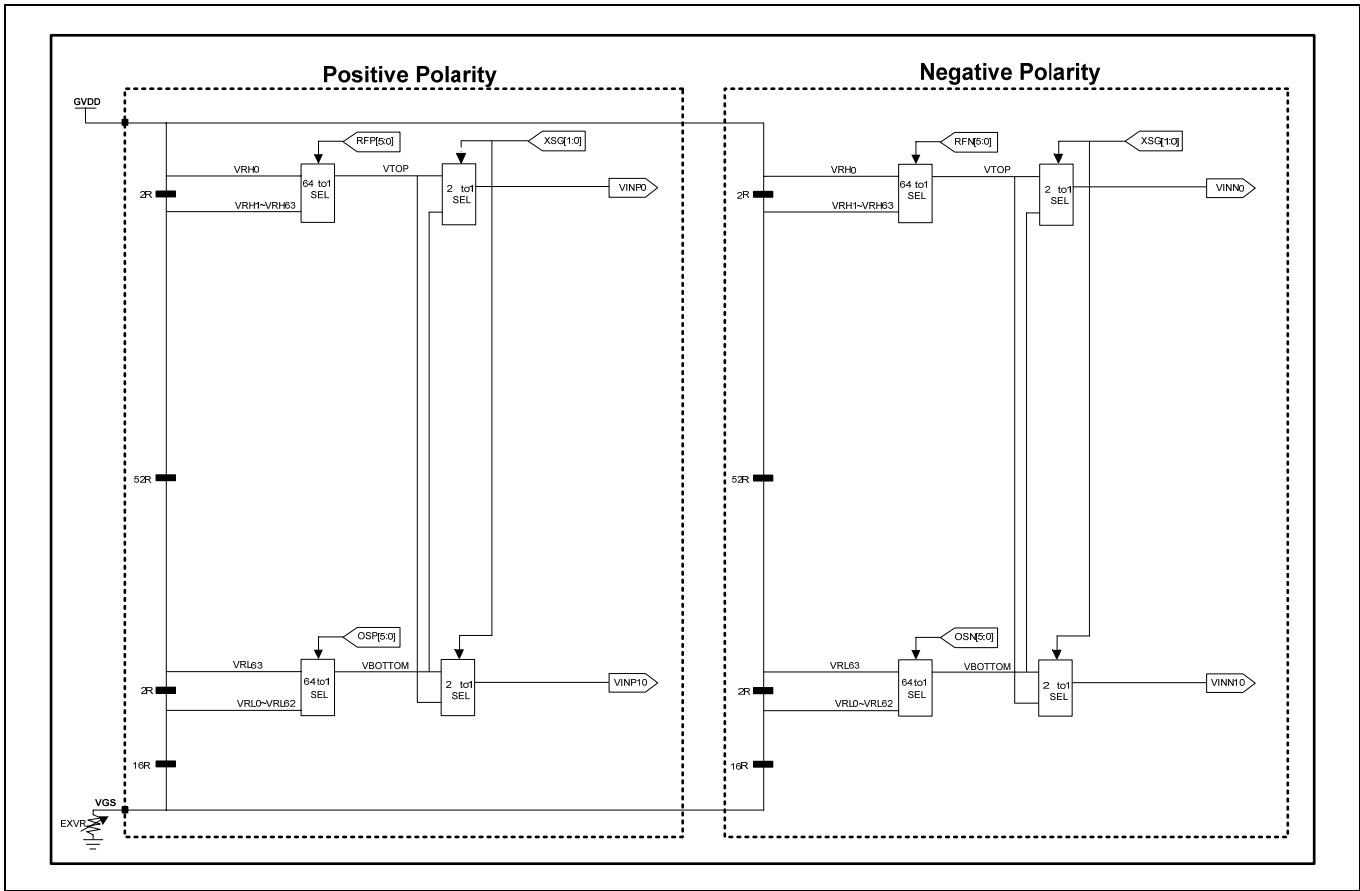


Figure66. Structure of Resistor Ladder Network I

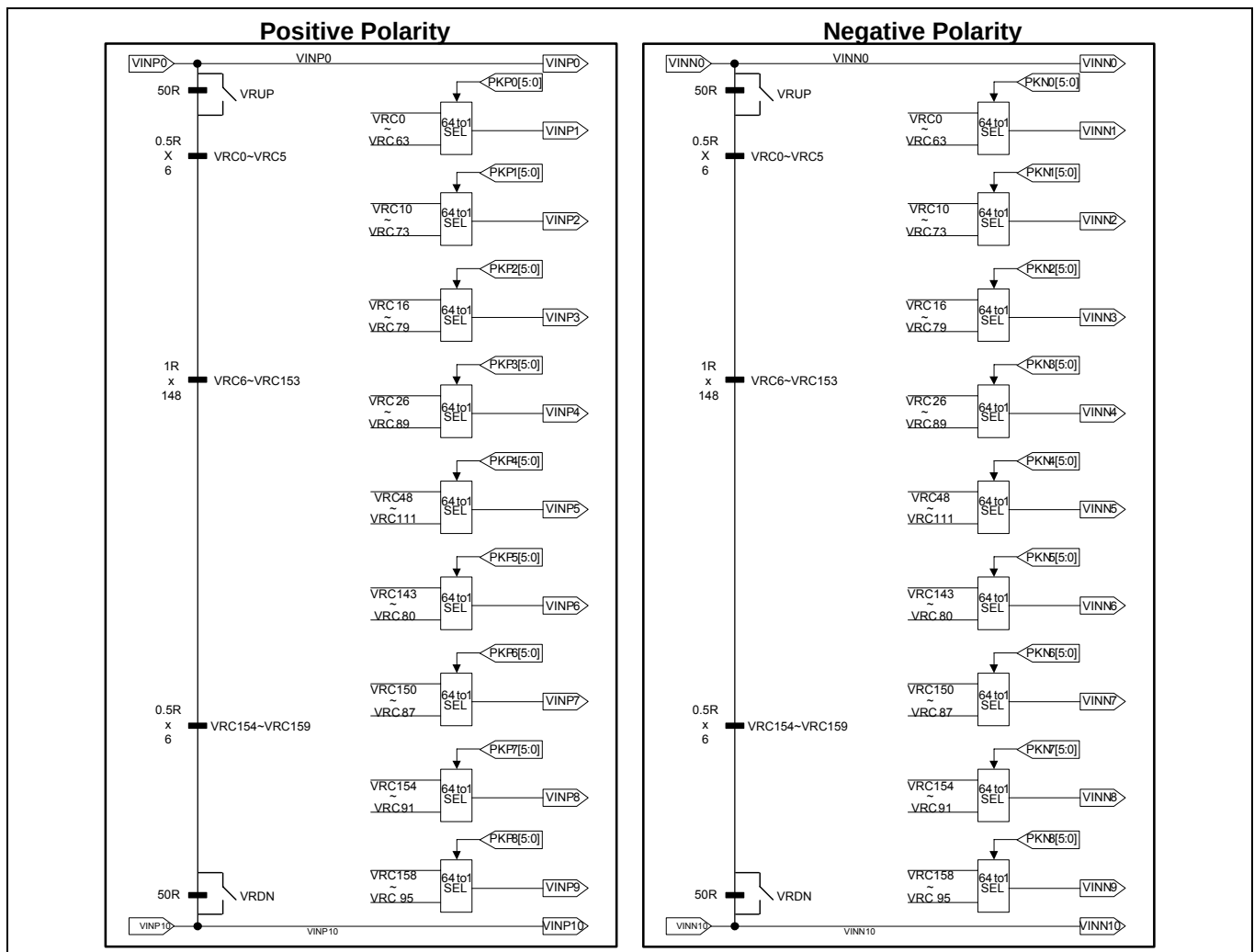


Figure67. Structure of Resistor Ladder Network II

#### 4.2.4. GAMMA ADJUSTMENT REGISTER

This block has registers to set up the grayscale voltage according to the gamma specification of the LCD panel. These registers can independently set up the positive/negative polarities. There are 4 types of register groups to adjust the amplitude on the grayscale characteristics of the grayscale voltage, and R/G/B gamma adjustment registers are separated. The following figures indicate the operation of each adjustment registers.

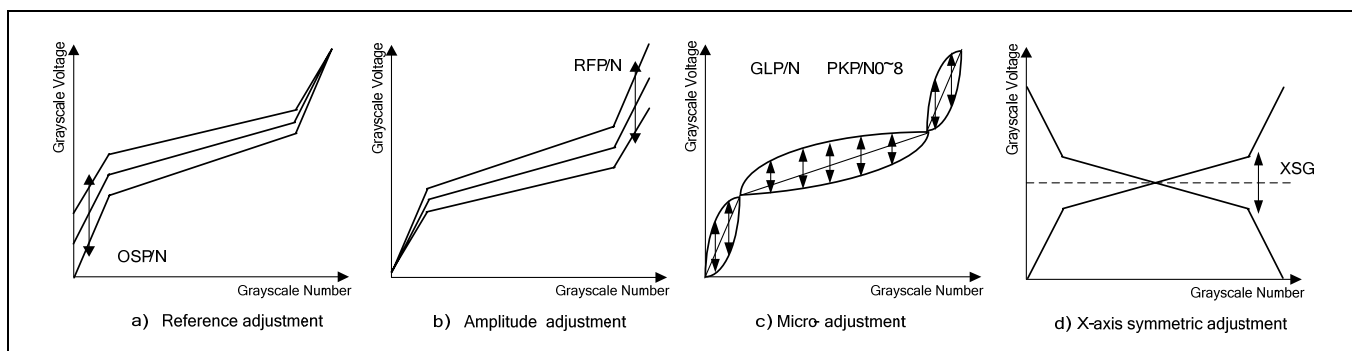


Figure68. The Operation of Adjusting Register

##### 4.2.4.1. Reference adjustment register

The Reference adjustment register is used to adjust the reference of the grayscale voltage. To accomplish the adjustment, it controls the **VINP10/VINN10** voltage level by 64 to 1 selector towards the 64-leveled reference voltage generated from the resistor ladder between GVDD and VGS.

##### 4.2.4.2. Amplitude adjustment register

The Amplitude adjustment register is to adjust the amplitude of the grayscale voltage. To accomplish the adjustment, it controls the **VINP0/VINN0** voltage level by 64 to 1 selector towards the 64-leveled reference voltage generated from the resistor ladder between GVDD and VGS.

##### 4.2.4.3. Micro-adjustment register

The Micro adjustment register is employed to make subtle adjustment to the grayscale voltage level. To accomplish the adjustment, it controls each reference voltage level by the 64 to 1 selector towards the 64-leveled reference voltage generated from the resistor ladder. Also, there is an independent register on the positive/negative polarities as well as other adjustment registers.

##### 4.2.4.4. X-axis symmetric adjustment register

The X-axis symmetric adjustment register is to adjust X-axis symmetric of the grayscale voltage. This register can be detailedly explained with NGF register selection. 1st case; when XSG=0 and NGF=1,  $V_{p<N>} + V_{n<N>} = V_{p<0>} + V_{n<0>}$  and gamma symmetric axis is  $(V_{p<0>} + V_{n<0>})/2$ . 2nd case; when XSG=0 and NGF=0, negative gamma voltage can be changed using negative gamma register value and symmetric axis will be changed according to negative gamma voltage. 3rd case; when XSG=1 and NGF=1,  $V_{p<N>} = V_{n<|63-N|>}$ . 4th



case; when XSG=1 and NGF=0,  $V_{p<N>}+V_{n<N>} \neq V_{p<0>}+V_{n<0>}$  but can have similar value in some degree using both positive and negative gamma registers.

**Table 42. Gamma Adjusting Register**

| Register                    | Positive Polarity | Negative Polarity | Set-up Contents                                                                                                      |
|-----------------------------|-------------------|-------------------|----------------------------------------------------------------------------------------------------------------------|
| Reference adjustment        | OSP[5:0]          | OSN[5:0]          | The voltage of VBOTTOM is selected by the 64 to 1 selector                                                           |
| Amplitude adjustment        | RFP[5:0]          | RFN[5:0]          | The voltage of VTOP is selected by the 64 to 1 selector                                                              |
| X-axis symmetric adjustment | XSG               |                   | The voltage of VINP10/VINN10 is selected by the 2 to 1 selector                                                      |
|                             |                   |                   | The voltage of VINP0/VINN0 is selected by the 2 to 1 selector                                                        |
| Micro adjustment            | GLP[1:0]          | GLN[1:0]          | The voltage of grayscale number from 1 to 62 is adjusted by the variable resistor                                    |
|                             | PKP0[5:0]         | PKN0[5:0]         | The voltage of grayscale number 1 is selected by the 64 to 1 selector                                                |
|                             | PKP1[5:0]         | PKN1[5:0]         | The voltage of grayscale number 4 is selected by the 64 to 1 selector                                                |
|                             | PKP2[5:0]         | PKN2[5:0]         | The voltage of grayscale number 8 is selected by the 64 to 1 selector                                                |
|                             | PKP3[5:0]         | PKN3[5:0]         | The voltage of grayscale number 20 is selected by the 64 to 1 selector                                               |
|                             | PKP4[5:0]         | PKN4[5:0]         | The voltage of grayscale number VC (middle voltage between $v<31>$ and $V<32>$ ) is selected by the 64 to 1 selector |
|                             | PKP5[5:0]         | PKN5[5:0]         | The voltage of grayscale number 43 is selected by the 64 to 1 selector                                               |
|                             | PKP6[5:0]         | PKN6[5:0]         | The voltage of grayscale number 55 is selected by the 64 to 1 selector                                               |
|                             | PKP7[5:0]         | PKN7[5:0]         | The voltage of grayscale number 59 is selected by the 64 to 1 selector                                               |
|                             | PKP8[5:0]         | PKN8[5:0]         | The voltage of grayscale number 62 is selected by the 64 to 1 selector                                               |

#### 4.2.5. RESISTOR LADDER NETWORK / SELECTOR

This block outputs the reference voltage of the grayscale voltage. There are three ladder resistors including the 64 to 1 selector selecting voltage generated by the ladder resistance voltage. Also, there are pins that connect to the external volume resistor. In addition, it allows compensating the dispersion of length between one panel and another.

##### 4.2.5.1. Resistor ladder network 1 / selector

There are 2 adjustments that are for the reference / amplitude adjustment (RFP(N)/ OSP(N)) and micro adjustment (PKP(N)). The voltage level is set by the reference / amplitude adjustment registers and micro adjustments as below.

**Table 43. Amplitude Adjustment**

| Register Value RFP(N) [5:0] | Selected Voltage VTOP | Formula of VTOP                  |
|-----------------------------|-----------------------|----------------------------------|
| 000000                      | VRH0                  | $(320R/320R) * (GVDD-VGS) + VGS$ |
| 000001                      | VRH1                  | $(318R/320R) * (GVDD-VGS) + VGS$ |
| 000010                      | VRH2                  | $(316R/320R) * (GVDD-VGS) + VGS$ |
| 000011                      | VRH3                  | $(314R/320R) * (GVDD-VGS) + VGS$ |
| 000100                      | VRH4                  | $(312R/320R) * (GVDD-VGS) + VGS$ |
| 000101                      | VRH5                  | $(310R/320R) * (GVDD-VGS) + VGS$ |
| 000110                      | VRH6                  | $(308R/320R) * (GVDD-VGS) + VGS$ |
| 000111                      | VRH7                  | $(306R/320R) * (GVDD-VGS) + VGS$ |
| 001000                      | VRH8                  | $(304R/320R) * (GVDD-VGS) + VGS$ |
| 001001                      | VRH9                  | $(302R/320R) * (GVDD-VGS) + VGS$ |
| 001010                      | VRH10                 | $(300R/320R) * (GVDD-VGS) + VGS$ |
| 001011                      | VRH11                 | $(298R/320R) * (GVDD-VGS) + VGS$ |
| 001100                      | VRH12                 | $(296R/320R) * (GVDD-VGS) + VGS$ |
| 001101                      | VRH13                 | $(294R/320R) * (GVDD-VGS) + VGS$ |
| 001110                      | VRH14                 | $(292R/320R) * (GVDD-VGS) + VGS$ |
| 001111                      | VRH15                 | $(290R/320R) * (GVDD-VGS) + VGS$ |
| 010000                      | VRH16                 | $(288R/320R) * (GVDD-VGS) + VGS$ |
| 010001                      | VRH17                 | $(286R/320R) * (GVDD-VGS) + VGS$ |
| 010010                      | VRH18                 | $(284R/320R) * (GVDD-VGS) + VGS$ |
| 010011                      | VRH19                 | $(282R/320R) * (GVDD-VGS) + VGS$ |
| 010100                      | VRH20                 | $(280R/320R) * (GVDD-VGS) + VGS$ |
| 010101                      | VRH21                 | $(278R/320R) * (GVDD-VGS) + VGS$ |

| Register Value RFP(N) [5:0] | Selected Voltage VTOP | Formula of VTOP                  |
|-----------------------------|-----------------------|----------------------------------|
| 010110                      | VRH22                 | $(276R/320R) * (GVDD-VGS) + VGS$ |
| 010111                      | VRH23                 | $(274R/320R) * (GVDD-VGS) + VGS$ |
| 011000                      | VRH24                 | $(272R/320R) * (GVDD-VGS) + VGS$ |
| 011001                      | VRH25                 | $(270R/320R) * (GVDD-VGS) + VGS$ |
| 011010                      | VRH26                 | $(268R/320R) * (GVDD-VGS) + VGS$ |
| 011011                      | VRH27                 | $(266R/320R) * (GVDD-VGS) + VGS$ |
| 011100                      | VRH28                 | $(264R/320R) * (GVDD-VGS) + VGS$ |
| 011101                      | VRH29                 | $(262R/320R) * (GVDD-VGS) + VGS$ |
| 011110                      | VRH30                 | $(260R/320R) * (GVDD-VGS) + VGS$ |
| 011111                      | VRH31                 | $(258R/320R) * (GVDD-VGS) + VGS$ |
| 100000                      | VRH32                 | $(256R/320R) * (GVDD-VGS) + VGS$ |
| 100001                      | VRH33                 | $(254R/320R) * (GVDD-VGS) + VGS$ |
| 100010                      | VRH34                 | $(252R/320R) * (GVDD-VGS) + VGS$ |
| 100011                      | VRH35                 | $(250R/320R) * (GVDD-VGS) + VGS$ |
| 100100                      | VRH36                 | $(248R/320R) * (GVDD-VGS) + VGS$ |
| 100101                      | VRH37                 | $(246R/320R) * (GVDD-VGS) + VGS$ |
| 100110                      | VRH38                 | $(244R/320R) * (GVDD-VGS) + VGS$ |
| 100111                      | VRH39                 | $(242R/320R) * (GVDD-VGS) + VGS$ |
| 101000                      | VRH40                 | $(240R/320R) * (GVDD-VGS) + VGS$ |
| 101001                      | VRH41                 | $(238R/320R) * (GVDD-VGS) + VGS$ |
| 101010                      | VRH42                 | $(236R/320R) * (GVDD-VGS) + VGS$ |
| 101011                      | VRH43                 | $(234R/320R) * (GVDD-VGS) + VGS$ |
| 101100                      | VRH44                 | $(232R/320R) * (GVDD-VGS) + VGS$ |
| 101101                      | VRH45                 | $(230R/320R) * (GVDD-VGS) + VGS$ |
| 101110                      | VRH46                 | $(228R/320R) * (GVDD-VGS) + VGS$ |
| 101111                      | VRH47                 | $(226R/320R) * (GVDD-VGS) + VGS$ |
| 110000                      | VRH48                 | $(224R/320R) * (GVDD-VGS) + VGS$ |
| 110001                      | VRH49                 | $(222R/320R) * (GVDD-VGS) + VGS$ |
| 110010                      | VRH50                 | $(220R/320R) * (GVDD-VGS) + VGS$ |
| 110011                      | VRH51                 | $(218R/320R) * (GVDD-VGS) + VGS$ |
| 110100                      | VRH52                 | $(216R/320R) * (GVDD-VGS) + VGS$ |
| 110101                      | VRH53                 | $(214R/320R) * (GVDD-VGS) + VGS$ |

| Register Value RFP(N) [5:0] | Selected Voltage VTOP | Formula of VTOP                  |
|-----------------------------|-----------------------|----------------------------------|
| 110110                      | VRH54                 | $(212R/320R) * (GVDD-VGS) + VGS$ |
| 110111                      | VRH55                 | $(210R/320R) * (GVDD-VGS) + VGS$ |
| 111000                      | VRH56                 | $(208R/320R) * (GVDD-VGS) + VGS$ |
| 111001                      | VRH57                 | $(206R/320R) * (GVDD-VGS) + VGS$ |
| 111010                      | VRH58                 | $(204R/320R) * (GVDD-VGS) + VGS$ |
| 111011                      | VRH59                 | $(202R/320R) * (GVDD-VGS) + VGS$ |
| 111100                      | VRH60                 | $(200R/320R) * (GVDD-VGS) + VGS$ |
| 111101                      | VRH61                 | $(198R/320R) * (GVDD-VGS) + VGS$ |
| 111110                      | VRH62                 | $(196R/320R) * (GVDD-VGS) + VGS$ |
| 111111                      | VRH63                 | $(194R/320R) * (GVDD-VGS) + VGS$ |

Table 44. Reference Adjustment

| Register Value OSP(N) [5:0] | Selected Voltage VBOTTOM | Formula of VBOTTOM              |
|-----------------------------|--------------------------|---------------------------------|
| 000000                      | VRL0                     | $(16R/320R) * (GVDD-VGS) + VGS$ |
| 000001                      | VRL1                     | $(18R/320R) * (GVDD-VGS) + VGS$ |
| 000010                      | VRL2                     | $(20R/320R) * (GVDD-VGS) + VGS$ |
| 000011                      | VRL3                     | $(22R/320R) * (GVDD-VGS) + VGS$ |
| 000100                      | VRL4                     | $(24R/320R) * (GVDD-VGS) + VGS$ |
| 000101                      | VRL5                     | $(26R/320R) * (GVDD-VGS) + VGS$ |
| 000110                      | VRL6                     | $(28R/320R) * (GVDD-VGS) + VGS$ |
| 000111                      | VRL7                     | $(30R/320R) * (GVDD-VGS) + VGS$ |
| 001000                      | VRL8                     | $(32R/320R) * (GVDD-VGS) + VGS$ |
| 001001                      | VRL9                     | $(34R/320R) * (GVDD-VGS) + VGS$ |
| 001010                      | VRL10                    | $(36R/320R) * (GVDD-VGS) + VGS$ |
| 001011                      | VRL11                    | $(38R/320R) * (GVDD-VGS) + VGS$ |
| 001100                      | VRL12                    | $(40R/320R) * (GVDD-VGS) + VGS$ |
| 001101                      | VRL13                    | $(42R/320R) * (GVDD-VGS) + VGS$ |
| 001110                      | VRL14                    | $(44R/320R) * (GVDD-VGS) + VGS$ |
| 001111                      | VRL15                    | $(46R/320R) * (GVDD-VGS) + VGS$ |
| 010000                      | VRL16                    | $(48R/320R) * (GVDD-VGS) + VGS$ |
| 010001                      | VRL17                    | $(50R/320R) * (GVDD-VGS) + VGS$ |
| 010010                      | VRL18                    | $(52R/320R) * (GVDD-VGS) + VGS$ |
| 010011                      | VRL19                    | $(54R/320R) * (GVDD-VGS) + VGS$ |

| Register Value OSP(N) [5:0] | Selected Voltage VBOTTOM | Formula of VBOTTOM               |
|-----------------------------|--------------------------|----------------------------------|
| 010100                      | VRL20                    | $(56R/320R) * (GVDD-VGS) + VGS$  |
| 010101                      | VRL21                    | $(58R/320R) * (GVDD-VGS) + VGS$  |
| 010110                      | VRL22                    | $(60R/320R) * (GVDD-VGS) + VGS$  |
| 010111                      | VRL23                    | $(62R/320R) * (GVDD-VGS) + VGS$  |
| 011000                      | VRL24                    | $(64R/320R) * (GVDD-VGS) + VGS$  |
| 011001                      | VRL25                    | $(66R/320R) * (GVDD-VGS) + VGS$  |
| 011010                      | VRL26                    | $(68R/320R) * (GVDD-VGS) + VGS$  |
| 011011                      | VRL27                    | $(70R/320R) * (GVDD-VGS) + VGS$  |
| 011100                      | VRL28                    | $(72R/320R) * (GVDD-VGS) + VGS$  |
| 011101                      | VRL29                    | $(74R/320R) * (GVDD-VGS) + VGS$  |
| 011110                      | VRL30                    | $(76R/320R) * (GVDD-VGS) + VGS$  |
| 011111                      | VRL31                    | $(78R/320R) * (GVDD-VGS) + VGS$  |
| 100000                      | VRL32                    | $(80R/320R) * (GVDD-VGS) + VGS$  |
| 100001                      | VRL33                    | $(82R/320R) * (GVDD-VGS) + VGS$  |
| 100010                      | VRL34                    | $(84R/320R) * (GVDD-VGS) + VGS$  |
| 100011                      | VRL35                    | $(86R/320R) * (GVDD-VGS) + VGS$  |
| 100100                      | VRL36                    | $(88R/320R) * (GVDD-VGS) + VGS$  |
| 100101                      | VRL37                    | $(90R/320R) * (GVDD-VGS) + VGS$  |
| 100110                      | VRL38                    | $(92R/320R) * (GVDD-VGS) + VGS$  |
| 100111                      | VRL39                    | $(94R/320R) * (GVDD-VGS) + VGS$  |
| 101000                      | VRL40                    | $(96R/320R) * (GVDD-VGS) + VGS$  |
| 101001                      | VRL41                    | $(98R/320R) * (GVDD-VGS) + VGS$  |
| 101010                      | VRL42                    | $(100R/320R) * (GVDD-VGS) + VGS$ |
| 101011                      | VRL43                    | $(102R/320R) * (GVDD-VGS) + VGS$ |
| 101100                      | VRL44                    | $(104R/320R) * (GVDD-VGS) + VGS$ |
| 101101                      | VRL45                    | $(106R/320R) * (GVDD-VGS) + VGS$ |
| 101110                      | VRL46                    | $(108R/320R) * (GVDD-VGS) + VGS$ |
| 101111                      | VRL47                    | $(110R/320R) * (GVDD-VGS) + VGS$ |
| 110000                      | VRL48                    | $(112R/320R) * (GVDD-VGS) + VGS$ |
| 110001                      | VRL49                    | $(114R/320R) * (GVDD-VGS) + VGS$ |
| 110010                      | VRL50                    | $(116R/320R) * (GVDD-VGS) + VGS$ |
| 110011                      | VRL51                    | $(118R/320R) * (GVDD-VGS) + VGS$ |

| Register Value OSP(N) [5:0] | Selected Voltage VBOTTOM | Formula of VBOTTOM               |
|-----------------------------|--------------------------|----------------------------------|
| 110100                      | VRL52                    | $(120R/320R) * (GVDD-VGS) + VGS$ |
| 110101                      | VRL53                    | $(122R/320R) * (GVDD-VGS) + VGS$ |
| 110110                      | VRL54                    | $(124R/320R) * (GVDD-VGS) + VGS$ |
| 110111                      | VRL55                    | $(126R/320R) * (GVDD-VGS) + VGS$ |
| 111000                      | VRL56                    | $(128R/320R) * (GVDD-VGS) + VGS$ |
| 111001                      | VRL57                    | $(130R/320R) * (GVDD-VGS) + VGS$ |
| 111010                      | VRL58                    | $(132R/320R) * (GVDD-VGS) + VGS$ |
| 111011                      | VRL59                    | $(134R/320R) * (GVDD-VGS) + VGS$ |
| 111100                      | VRL60                    | $(136R/320R) * (GVDD-VGS) + VGS$ |
| 111101                      | VRL61                    | $(138R/320R) * (GVDD-VGS) + VGS$ |
| 111110                      | VRL62                    | $(140R/320R) * (GVDD-VGS) + VGS$ |
| 111111                      | VRL63                    | $(142R/320R) * (GVDD-VGS) + VGS$ |

#### 4.2.5.2. Resistor ladder network 2 / selector

In the 64-to-1 selector, the voltage level must be selected by the given ladder resistance and the micro-adjustment register and output the nine types of the reference voltage, VIN1 to VIN9.

Following figure explains the relationship between the micro-adjustment register and the selected voltage

**Table 45. Relationship Between Micro-Adjustment Register and Selected Voltage**

| Register Value | Selected Voltage |           |           |           |           |           |           |           |           |
|----------------|------------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
| PKP(N) [5:0]   | VINP(N) 1        | VINP(N) 2 | VINP(N) 3 | VINP(N) 4 | VINP(N) 5 | VINP(N) 6 | VINP(N) 7 | VINP(N) 8 | VINP(N) 9 |
| 000000         | VRC0             | VRC10     | VRC16     | VRC26     | VRC48     | VRC143    | VRC150    | VRC154    | VRC158    |
| 000001         | VRC1             | VRC11     | VRC17     | VRC27     | VRC49     | VRC142    | VRC149    | VRC153    | VRC157    |
| 000010         | VRC2             | VRC12     | VRC18     | VRC28     | VRC50     | VRC141    | VRC148    | VRC152    | VRC156    |
| 000011         | VRC3             | VRC13     | VRC19     | VRC29     | VRC51     | VRC140    | VRC147    | VRC151    | VRC155    |
| 000100         | VRC4             | VRC14     | VRC20     | VRC30     | VRC52     | VRC139    | VRC146    | VRC150    | VRC154    |
| 000101         | VRC5             | VRC15     | VRC21     | VRC31     | VRC53     | VRC138    | VRC145    | VRC149    | VRC153    |
| 000110         | VRC6             | VRC16     | VRC22     | VRC32     | VRC54     | VRC137    | VRC144    | VRC148    | VRC152    |
| 000111         | VRC7             | VRC17     | VRC23     | VRC33     | VRC55     | VRC136    | VRC143    | VRC147    | VRC151    |
| 001000         | VRC8             | VRC18     | VRC24     | VRC34     | VRC56     | VRC135    | VRC142    | VRC146    | VRC150    |
| 001001         | VRC9             | VRC19     | VRC25     | VRC35     | VRC57     | VRC134    | VRC141    | VRC145    | VRC149    |
| 001010         | VRC10            | VRC20     | VRC26     | VRC36     | VRC58     | VRC133    | VRC140    | VRC144    | VRC148    |

| Register Value  | Selected Voltage |              |              |              |              |              |              |              |              |
|-----------------|------------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|
| PKP(N)<br>[5:0] | VINP(N)<br>1     | VINP(N)<br>2 | VINP(N)<br>3 | VINP(N)<br>4 | VINP(N)<br>5 | VINP(N)<br>6 | VINP(N)<br>7 | VINP(N)<br>8 | VINP(N)<br>9 |
| 001011          | VRC11            | VRC21        | VRC27        | VRC37        | VRC59        | VRC132       | VRC139       | VRC143       | VRC147       |
| 001100          | VRC12            | VRC22        | VRC28        | VRC38        | VRC60        | VRC131       | VRC138       | VRC142       | VRC146       |
| 001101          | VRC13            | VRC23        | VRC29        | VRC39        | VRC61        | VRC130       | VRC137       | VRC141       | VRC145       |
| 001110          | VRC14            | VRC24        | VRC30        | VRC40        | VRC62        | VRC129       | VRC136       | VRC140       | VRC144       |
| 001111          | VRC15            | VRC25        | VRC31        | VRC41        | VRC63        | VRC128       | VRC135       | VRC139       | VRC143       |
| 010000          | VRC16            | VRC26        | VRC32        | VRC42        | VRC64        | VRC127       | VRC134       | VRC138       | VRC142       |
| 010001          | VRC17            | VRC27        | VRC33        | VRC43        | VRC65        | VRC126       | VRC133       | VRC137       | VRC141       |
| 010010          | VRC18            | VRC28        | VRC34        | VRC44        | VRC66        | VRC125       | VRC132       | VRC136       | VRC140       |
| 010011          | VRC19            | VRC29        | VRC35        | VRC45        | VRC67        | VRC124       | VRC131       | VRC135       | VRC139       |
| 010100          | VRC20            | VRC30        | VRC36        | VRC46        | VRC68        | VRC123       | VRC130       | VRC134       | VRC138       |
| 010101          | VRC21            | VRC31        | VRC37        | VRC47        | VRC69        | VRC122       | VRC129       | VRC133       | VRC137       |
| 010110          | VRC22            | VRC32        | VRC38        | VRC48        | VRC70        | VRC121       | VRC128       | VRC132       | VRC136       |
| 010111          | VRC23            | VRC33        | VRC39        | VRC49        | VRC71        | VRC120       | VRC127       | VRC131       | VRC135       |
| 011000          | VRC24            | VRC34        | VRC40        | VRC50        | VRC72        | VRC119       | VRC126       | VRC130       | VRC134       |
| 011001          | VRC25            | VRC35        | VRC41        | VRC51        | VRC73        | VRC118       | VRC125       | VRC129       | VRC133       |
| 011010          | VRC26            | VRC36        | VRC42        | VRC52        | VRC74        | VRC117       | VRC124       | VRC128       | VRC132       |
| 011011          | VRC27            | VRC37        | VRC43        | VRC53        | VRC75        | VRC116       | VRC123       | VRC127       | VRC131       |
| 011100          | VRC28            | VRC38        | VRC44        | VRC54        | VRC76        | VRC115       | VRC122       | VRC126       | VRC130       |
| 011101          | VRC29            | VRC39        | VRC45        | VRC55        | VRC77        | VRC114       | VRC121       | VRC125       | VRC129       |
| 011110          | VRC30            | VRC40        | VRC46        | VRC56        | VRC78        | VRC113       | VRC120       | VRC124       | VRC128       |
| 011111          | VRC31            | VRC41        | VRC47        | VRC57        | VRC79        | VRC112       | VRC119       | VRC123       | VRC127       |
| 100000          | VRC32            | VRC42        | VRC48        | VRC58        | VRC80        | VRC111       | VRC118       | VRC122       | VRC126       |
| 100001          | VRC33            | VRC43        | VRC49        | VRC59        | VRC81        | VRC110       | VRC117       | VRC121       | VRC125       |
| 100010          | VRC34            | VRC44        | VRC50        | VRC60        | VRC82        | VRC109       | VRC116       | VRC120       | VRC124       |
| 100011          | VRC35            | VRC45        | VRC51        | VRC61        | VRC83        | VRC108       | VRC115       | VRC119       | VRC123       |
| 100100          | VRC36            | VRC46        | VRC52        | VRC62        | VRC84        | VRC107       | VRC114       | VRC118       | VRC122       |
| 100101          | VRC37            | VRC47        | VRC53        | VRC63        | VRC85        | VRC106       | VRC113       | VRC117       | VRC121       |
| 100110          | VRC38            | VRC48        | VRC54        | VRC64        | VRC86        | VRC105       | VRC112       | VRC116       | VRC120       |
| 100111          | VRC39            | VRC49        | VRC55        | VRC65        | VRC87        | VRC104       | VRC111       | VRC115       | VRC119       |

| Register Value  | Selected Voltage |              |              |              |              |              |              |              |              |
|-----------------|------------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|
| PKP(N)<br>[5:0] | VINP(N)<br>1     | VINP(N)<br>2 | VINP(N)<br>3 | VINP(N)<br>4 | VINP(N)<br>5 | VINP(N)<br>6 | VINP(N)<br>7 | VINP(N)<br>8 | VINP(N)<br>9 |
| 101000          | VRC40            | VRC50        | VRC56        | VRC66        | VRC88        | VRC103       | VRC110       | VRC114       | VRC118       |
| 101001          | VRC41            | VRC51        | VRC57        | VRC67        | VRC89        | VRC102       | VRC109       | VRC113       | VRC117       |
| 101010          | VRC42            | VRC52        | VRC58        | VRC68        | VRC90        | VRC101       | VRC108       | VRC112       | VRC116       |
| 101011          | VRC43            | VRC53        | VRC59        | VRC69        | VRC91        | VRC100       | VRC107       | VRC111       | VRC115       |
| 101100          | VRC44            | VRC54        | VRC60        | VRC70        | VRC92        | VRC99        | VRC106       | VRC110       | VRC114       |
| 101101          | VRC45            | VRC55        | VRC61        | VRC71        | VRC93        | VRC98        | VRC105       | VRC109       | VRC113       |
| 101110          | VRC46            | VRC56        | VRC62        | VRC72        | VRC94        | VRC97        | VRC104       | VRC108       | VRC112       |
| 101111          | VRC47            | VRC57        | VRC63        | VRC73        | VRC95        | VRC96        | VRC103       | VRC107       | VRC111       |
| 110000          | VRC48            | VRC58        | VRC64        | VRC74        | VRC96        | VRC95        | VRC102       | VRC106       | VRC110       |
| 110001          | VRC49            | VRC59        | VRC65        | VRC75        | VRC97        | VRC94        | VRC101       | VRC105       | VRC109       |
| 110010          | VRC50            | VRC60        | VRC66        | VRC76        | VRC98        | VRC93        | VRC100       | VRC104       | VRC108       |
| 110011          | VRC51            | VRC61        | VRC67        | VRC77        | VRC99        | VRC92        | VRC99        | VRC103       | VRC107       |
| 110100          | VRC52            | VRC62        | VRC68        | VRC78        | VRC100       | VRC91        | VRC98        | VRC102       | VRC106       |
| 110101          | VRC53            | VRC63        | VRC69        | VRC79        | VRC101       | VRC90        | VRC97        | VRC101       | VRC105       |
| 110110          | VRC54            | VRC64        | VRC70        | VRC80        | VRC102       | VRC89        | VRC96        | VRC100       | VRC104       |
| 110111          | VRC55            | VRC65        | VRC71        | VRC81        | VRC103       | VRC88        | VRC95        | VRC99        | VRC103       |
| 111000          | VRC56            | VRC66        | VRC72        | VRC82        | VRC104       | VRC87        | VRC94        | VRC98        | VRC102       |
| 111001          | VRC57            | VRC67        | VRC73        | VRC83        | VRC105       | VRC86        | VRC93        | VRC97        | VRC101       |
| 111010          | VRC58            | VRC68        | VRC74        | VRC84        | VRC106       | VRC85        | VRC92        | VRC96        | VRC100       |

Table 46. Relationship Between Micro-Adjustment Register and Selected Voltage(Continued)

| Register Value  | Selected Voltage |              |              |              |              |              |              |              |              |
|-----------------|------------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|
| PKP(N)<br>[5:0] | VINP(N)<br>1     | VINP(N)<br>2 | VINP(N)<br>3 | VINP(N)<br>4 | VINP(N)<br>5 | VINP(N)<br>6 | VINP(N)<br>7 | VINP(N)<br>8 | VINP(N)<br>9 |
| 111011          | VRC59            | VRC69        | VRC75        | VRC85        | VRC107       | VRC84        | VRC91        | VRC95        | VRC99        |
| 111100          | VRC60            | VRC70        | VRC76        | VRC86        | VRC108       | VRC83        | VRC90        | VRC94        | VRC98        |
| 111101          | VRC61            | VRC71        | VRC77        | VRC87        | VRC109       | VRC82        | VRC89        | VRC93        | VRC97        |
| 111110          | VRC62            | VRC72        | VRC78        | VRC88        | VRC110       | VRC81        | VRC88        | VRC92        | VRC96        |
| 111111          | VRC63            | VRC73        | VRC79        | VRC89        | VRC111       | VRC80        | VRC87        | VRC91        | VRC95        |



The grayscale levels are determined by the following formulas listed in the following equations.

Negative gamma voltages are calculated with the same equation of positive gamma voltages, but the gray scale is symmetric, which means negative  $V_{<0>}$  is equal to positive  $V_{<63>}$ .  $R_t$  and  $R_a$  in the below equations are determined by GL[1:0] Registers as follows.

GLP/N[1:0]=00,  $R_t = 154R$ ,  $R_a = R$

GLP/N [1:0]=01,  $R_t = 204R$ ,  $R_a = R + 50R$

GLP/N [1:0]=10,  $R_t = 204R$ ,  $R_a = R$

GLP/N [1:0]=11,  $R_t = 254R$ ,  $R_a = R + 50R$

## 4.2.6. GRAYSCALE LEVELS

Table 47. Formulas for Calculating Gamma Adjusting Voltage (Positive Polarity) 1

| Pads  | Formula                                      | Micro-Adjusting Register Value | Reference Voltage |
|-------|----------------------------------------------|--------------------------------|-------------------|
| VRC0  | $(153.5R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP0[5:0] = "000000"           | VNP1              |
| VRC1  | $(153R_a/R_t) * (VINP0 - VINP10) + VINP10$   | PKP0[5:0] = "000001"           |                   |
| VRC2  | $(152.5R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP0[5:0] = "000010"           |                   |
| VRC3  | $(152R_a/R_t) * (VINP0 - VINP10) + VINP10$   | PKP0[5:0] = "000011"           |                   |
| VRC4  | $(151.5R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP0[5:0] = "000100"           |                   |
| VRC5  | $(151R_a/R_t) * (VINP0 - VINP10) + VINP10$   | PKP0[5:0] = "000101"           |                   |
| VRC6  | $(150R_a/R_t) * (VINP0 - VINP10) + VINP10$   | PKP0[5:0] = "000110"           |                   |
| VRC7  | $(149R_a/R_t) * (VINP0 - VINP10) + VINP10$   | PKP0[5:0] = "000111"           |                   |
| VRC8  | $(148R_a/R_t) * (VINP0 - VINP10) + VINP10$   | PKP0[5:0] = "001000"           |                   |
| VRC9  | $(147R_a/R_t) * (VINP0 - VINP10) + VINP10$   | PKP0[5:0] = "001001"           |                   |
| VRC10 | $(146R_a/R_t) * (VINP0 - VINP10) + VINP10$   | PKP0[5:0] = "001010"           |                   |
| VRC11 | $(145R_a/R_t) * (VINP0 - VINP10) + VINP10$   | PKP0[5:0] = "001011"           |                   |
| VRC12 | $(144R_a/R_t) * (VINP0 - VINP10) + VINP10$   | PKP0[5:0] = "001100"           |                   |
| VRC13 | $(143R_a/R_t) * (VINP0 - VINP10) + VINP10$   | PKP0[5:0] = "001101"           |                   |
| VRC14 | $(142R_a/R_t) * (VINP0 - VINP10) + VINP10$   | PKP0[5:0] = "001110"           |                   |
| VRC15 | $(141R_a/R_t) * (VINP0 - VINP10) + VINP10$   | PKP0[5:0] = "001111"           |                   |
| VRC16 | $(140R_a/R_t) * (VINP0 - VINP10) + VINP10$   | PKP0[5:0] = "010000"           |                   |
| VRC17 | $(139R_a/R_t) * (VINP0 - VINP10) + VINP10$   | PKP0[5:0] = "010001"           |                   |
| VRC18 | $(138R_a/R_t) * (VINP0 - VINP10) + VINP10$   | PKP0[5:0] = "010010"           |                   |
| VRC19 | $(137R_a/R_t) * (VINP0 - VINP10) + VINP10$   | PKP0[5:0] = "010011"           |                   |
| VRC20 | $(136R_a/R_t) * (VINP0 - VINP10) + VINP10$   | PKP0[5:0] = "010100"           |                   |
| VRC21 | $(135R_a/R_t) * (VINP0 - VINP10) + VINP10$   | PKP0[5:0] = "010101"           |                   |
| VRC22 | $(134R_a/R_t) * (VINP0 - VINP10) + VINP10$   | PKP0[5:0] = "010110"           |                   |
| VRC23 | $(133R_a/R_t) * (VINP0 - VINP10) + VINP10$   | PKP0[5:0] = "010111"           |                   |
| VRC24 | $(132R_a/R_t) * (VINP0 - VINP10) + VINP10$   | PKP0[5:0] = "011000"           |                   |
| VRC25 | $(131R_a/R_t) * (VINP0 - VINP10) + VINP10$   | PKP0[5:0] = "011001"           |                   |
| VRC26 | $(130R_a/R_t) * (VINP0 - VINP10) + VINP10$   | PKP0[5:0] = "011010"           |                   |
| VRC27 | $(129R_a/R_t) * (VINP0 - VINP10) + VINP10$   | PKP0[5:0] = "011011"           |                   |
| VRC28 | $(128R_a/R_t) * (VINP0 - VINP10) + VINP10$   | PKP0[5:0] = "011100"           |                   |
| VRC29 | $(127R_a/R_t) * (VINP0 - VINP10) + VINP10$   | PKP0[5:0] = "011101"           |                   |

| Pads  | Formula                                    | Micro-Adjusting Register Value | Reference Voltage |
|-------|--------------------------------------------|--------------------------------|-------------------|
| VRC30 | $(126R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP0[5:0] = "011110"           |                   |
| VRC31 | $(125R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP0[5:0] = "011111"           |                   |
| VRC32 | $(124R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP0[5:0] = "100000"           |                   |
| VRC33 | $(123R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP0[5:0] = "100001"           |                   |
| VRC34 | $(122R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP0[5:0] = "100010"           |                   |
| VRC35 | $(121R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP0[5:0] = "100011"           |                   |

Table 48. Formulas for Calculating Gamma Adjusting Voltage (Positive Polarity) 1 (Continued)

| Pads  | Formula                                    | Micro-Adjusting Register Value | Reference Voltage |
|-------|--------------------------------------------|--------------------------------|-------------------|
| VRC36 | $(120R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP0[5:0] = "100100"           | VINP1             |
| VRC37 | $(119R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP0[5:0] = "100101"           |                   |
| VRC38 | $(118R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP0[5:0] = "100110"           |                   |
| VRC39 | $(117R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP0[5:0] = "100111"           |                   |
| VRC40 | $(116R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP0[5:0] = "101000"           |                   |
| VRC41 | $(115R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP0[5:0] = "101001"           |                   |
| VRC42 | $(114R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP0[5:0] = "101010"           |                   |
| VRC43 | $(113R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP0[5:0] = "101011"           |                   |
| VRC44 | $(112R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP0[5:0] = "101100"           |                   |
| VRC45 | $(111R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP0[5:0] = "101101"           |                   |
| VRC46 | $(110R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP0[5:0] = "101110"           |                   |
| VRC47 | $(109R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP0[5:0] = "101111"           |                   |
| VRC48 | $(108R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP0[5:0] = "110000"           |                   |
| VRC49 | $(107R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP0[5:0] = "110001"           |                   |
| VRC50 | $(106R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP0[5:0] = "110010"           |                   |
| VRC51 | $(105R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP0[5:0] = "110011"           |                   |
| VRC52 | $(104R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP0[5:0] = "110100"           |                   |
| VRC53 | $(103R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP0[5:0] = "110101"           |                   |
| VRC54 | $(102R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP0[5:0] = "110110"           |                   |
| VRC55 | $(101R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP0[5:0] = "110111"           |                   |
| VRC56 | $(100R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP0[5:0] = "111000"           |                   |
| VRC57 | $(99R_a/R_t) * (VINP0 - VINP10) + VINP10$  | PKP0[5:0] = "111001"           |                   |

| Pads  | Formula                                  | Micro-Adjusting Register Value | Reference Voltage |
|-------|------------------------------------------|--------------------------------|-------------------|
| VRC58 | $(98Ra/Rt) * (VINP0 - VINP10) + VINP10$  | PKP0[5:0] = "111010"           |                   |
| VRC59 | $(97Ra/Rt) * (VINP0 - VINP10) + VINP10$  | PKP0[5:0] = "111011"           |                   |
| VRC60 | $(96Ra/Rt) * (VINP0 - VINP10) + VINP10$  | PKP0[5:0] = "111100"           |                   |
| VRC61 | $(95Ra/Rt) * (VINP0 - VINP10) + VINP10$  | PKP0[5:0] = "111101"           |                   |
| VRC62 | $(94Ra/Rt) * (VINP0 - VINP10) + VINP10$  | PKP0[5:0] = "111110"           |                   |
| VRC63 | $(93Ra/Rt) * (VINP0 - VINP10) + VINP10$  | PKP0[5:0] = "111111"           |                   |
| VRC10 | $(146Ra/Rt) * (VINP0 - VINP10) + VINP10$ | PKP1[5:0] = "000000"           | VINP2             |
| VRC11 | $(145Ra/Rt) * (VINP0 - VINP10) + VINP10$ | PKP1[5:0] = "000001"           |                   |
| VRC12 | $(144Ra/Rt) * (VINP0 - VINP10) + VINP10$ | PKP1[5:0] = "000010"           |                   |
| VRC13 | $(143Ra/Rt) * (VINP0 - VINP10) + VINP10$ | PKP1[5:0] = "000011"           |                   |
| VRC14 | $(142Ra/Rt) * (VINP0 - VINP10) + VINP10$ | PKP1[5:0] = "000100"           |                   |
| VRC15 | $(141Ra/Rt) * (VINP0 - VINP10) + VINP10$ | PKP1[5:0] = "000101"           |                   |
| VRC16 | $(140Ra/Rt) * (VINP0 - VINP10) + VINP10$ | PKP1[5:0] = "000110"           |                   |
| VRC17 | $(139Ra/Rt) * (VINP0 - VINP10) + VINP10$ | PKP1[5:0] = "000111"           |                   |

Table 49. Formulas for Calculating Gamma Adjusting Voltage (Positive Polarity) 1 (Continued)

| Pads  | Formula                                  | Micro-Adjusting Register Value | Reference Voltage |
|-------|------------------------------------------|--------------------------------|-------------------|
| VRC18 | $(138Ra/Rt) * (VINP0 - VINP10) + VINP10$ | PKP1[5:0] = "001000"           | VINP2             |
| VRC19 | $(137Ra/Rt) * (VINP0 - VINP10) + VINP10$ | PKP1[5:0] = "001001"           |                   |
| VRC20 | $(136Ra/Rt) * (VINP0 - VINP10) + VINP10$ | PKP1[5:0] = "001010"           |                   |
| VRC21 | $(135Ra/Rt) * (VINP0 - VINP10) + VINP10$ | PKP1[5:0] = "001011"           |                   |
| VRC22 | $(134Ra/Rt) * (VINP0 - VINP10) + VINP10$ | PKP1[5:0] = "001100"           |                   |
| VRC23 | $(133Ra/Rt) * (VINP0 - VINP10) + VINP10$ | PKP1[5:0] = "001101"           |                   |
| VRC24 | $(132Ra/Rt) * (VINP0 - VINP10) + VINP10$ | PKP1[5:0] = "001110"           |                   |
| VRC25 | $(131Ra/Rt) * (VINP0 - VINP10) + VINP10$ | PKP1[5:0] = "001111"           |                   |
| VRC26 | $(130Ra/Rt) * (VINP0 - VINP10) + VINP10$ | PKP1[5:0] = "010000"           |                   |
| VRC27 | $(129Ra/Rt) * (VINP0 - VINP10) + VINP10$ | PKP1[5:0] = "010001"           |                   |
| VRC28 | $(128Ra/Rt) * (VINP0 - VINP10) + VINP10$ | PKP1[5:0] = "010010"           |                   |
| VRC29 | $(127Ra/Rt) * (VINP0 - VINP10) + VINP10$ | PKP1[5:0] = "010011"           |                   |
| VRC30 | $(126Ra/Rt) * (VINP0 - VINP10) + VINP10$ | PKP1[5:0] = "010100"           |                   |
| VRC31 | $(125Ra/Rt) * (VINP0 - VINP10) + VINP10$ | PKP1[5:0] = "010101"           |                   |

| Pads  | Formula                                    | Micro-Adjusting Register Value | Reference Voltage |
|-------|--------------------------------------------|--------------------------------|-------------------|
| VRC32 | $(124R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP1[5:0] = "010110"           |                   |
| VRC33 | $(123R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP1[5:0] = "010111"           |                   |
| VRC34 | $(122R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP1[5:0] = "011000"           |                   |
| VRC35 | $(121R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP1[5:0] = "011001"           |                   |
| VRC36 | $(120R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP1[5:0] = "011010"           |                   |
| VRC37 | $(119R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP1[5:0] = "011011"           |                   |
| VRC38 | $(118R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP1[5:0] = "011100"           |                   |
| VRC39 | $(117R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP1[5:0] = "011101"           |                   |
| VRC40 | $(116R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP1[5:0] = "011110"           |                   |
| VRC41 | $(115R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP1[5:0] = "011111"           |                   |
| VRC42 | $(114R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP1[5:0] = "100000"           |                   |
| VRC43 | $(113R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP1[5:0] = "100001"           |                   |
| VRC44 | $(112R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP1[5:0] = "100010"           |                   |
| VRC45 | $(111R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP1[5:0] = "100011"           |                   |
| VRC46 | $(110R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP1[5:0] = "100100"           |                   |
| VRC47 | $(109R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP1[5:0] = "100101"           |                   |
| VRC48 | $(108R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP1[5:0] = "100110"           |                   |
| VRC49 | $(107R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP1[5:0] = "100111"           |                   |
| VRC50 | $(106R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP1[5:0] = "101000"           |                   |
| VRC51 | $(105R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP1[5:0] = "101001"           |                   |
| VRC52 | $(104R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP1[5:0] = "101010"           |                   |
| VRC53 | $(103R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP1[5:0] = "101011"           |                   |

Table 50. Formulas for Calculating Gamma Adjusting Voltage (Positive Polarity) 1 (Continued)

| Pads  | Formula                                    | Micro-Adjusting Register Value | Reference Voltage |
|-------|--------------------------------------------|--------------------------------|-------------------|
| VRC54 | $(102R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP1[5:0] = "101100"           | VINP2             |
| VRC55 | $(101R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP1[5:0] = "101101"           |                   |
| VRC56 | $(100R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP1[5:0] = "101110"           |                   |
| VRC57 | $(99R_a/R_t) * (VINP0 - VINP10) + VINP10$  | PKP1[5:0] = "101111"           |                   |
| VRC58 | $(98R_a/R_t) * (VINP0 - VINP10) + VINP10$  | PKP1[5:0] = "110000"           |                   |
| VRC59 | $(97R_a/R_t) * (VINP0 - VINP10) + VINP10$  | PKP1[5:0] = "110001"           |                   |

| Pads  | Formula                                    | Micro-Adjusting Register Value | Reference Voltage |
|-------|--------------------------------------------|--------------------------------|-------------------|
| VRC60 | $(96R_a/R_t) * (VINP0 - VINP10) + VINP10$  | PKP1[5:0] = "110010"           |                   |
| VRC61 | $(95R_a/R_t) * (VINP0 - VINP10) + VINP10$  | PKP1[5:0] = "110011"           |                   |
| VRC62 | $(94R_a/R_t) * (VINP0 - VINP10) + VINP10$  | PKP1[5:0] = "110100"           |                   |
| VRC63 | $(93R_a/R_t) * (VINP0 - VINP10) + VINP10$  | PKP1[5:0] = "110101"           |                   |
| VRC64 | $(92R_a/R_t) * (VINP0 - VINP10) + VINP10$  | PKP1[5:0] = "110110"           |                   |
| VRC65 | $(91R_a/R_t) * (VINP0 - VINP10) + VINP10$  | PKP1[5:0] = "110111"           |                   |
| VRC66 | $(90R_a/R_t) * (VINP0 - VINP10) + VINP10$  | PKP1[5:0] = "111000"           |                   |
| VRC67 | $(89R_a/R_t) * (VINP0 - VINP10) + VINP10$  | PKP1[5:0] = "111001"           |                   |
| VRC68 | $(88R_a/R_t) * (VINP0 - VINP10) + VINP10$  | PKP1[5:0] = "111010"           |                   |
| VRC69 | $(87R_a/R_t) * (VINP0 - VINP10) + VINP10$  | PKP1[5:0] = "111011"           |                   |
| VRC70 | $(86R_a/R_t) * (VINP0 - VINP10) + VINP10$  | PKP1[5:0] = "111100"           |                   |
| VRC71 | $(85R_a/R_t) * (VINP0 - VINP10) + VINP10$  | PKP1[5:0] = "111101"           |                   |
| VRC72 | $(84R_a/R_t) * (VINP0 - VINP10) + VINP10$  | PKP1[5:0] = "111110"           |                   |
| VRC73 | $(83R_a/R_t) * (VINP0 - VINP10) + VINP10$  | PKP1[5:0] = "111111"           | VINP3             |
| VRC16 | $(140R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP2[5:0] = "000000"           |                   |
| VRC17 | $(139R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP2[5:0] = "000001"           |                   |
| VRC18 | $(138R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP2[5:0] = "000010"           |                   |
| VRC19 | $(137R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP2[5:0] = "000011"           |                   |
| VRC20 | $(136R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP2[5:0] = "000100"           |                   |
| VRC21 | $(135R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP2[5:0] = "000101"           |                   |
| VRC22 | $(134R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP2[5:0] = "000110"           |                   |
| VRC23 | $(133R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP2[5:0] = "000111"           |                   |
| VRC24 | $(132R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP2[5:0] = "001000"           |                   |
| VRC25 | $(131R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP2[5:0] = "001001"           |                   |
| VRC26 | $(130R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP2[5:0] = "001010"           |                   |
| VRC27 | $(129R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP2[5:0] = "001011"           |                   |
| VRC28 | $(128R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP2[5:0] = "001100"           |                   |
| VRC29 | $(127R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP2[5:0] = "001101"           |                   |
| VRC30 | $(126R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP2[5:0] = "001110"           |                   |
| VRC31 | $(125R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP2[5:0] = "001111"           |                   |

Table 51. Formulas for Calculating Gamma Adjusting Voltage (Positive Polarity) 1 (Continued)

| Pads  | Formula                                    | Micro-Adjusting Register Value | Reference Voltage |
|-------|--------------------------------------------|--------------------------------|-------------------|
| VRC32 | $(124R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP2[5:0] = "010000"           | VINP3             |
| VRC33 | $(123R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP2[5:0] = "010001"           |                   |
| VRC34 | $(122R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP2[5:0] = "010010"           |                   |
| VRC35 | $(121R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP2[5:0] = "010011"           |                   |
| VRC36 | $(120R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP2[5:0] = "010100"           |                   |
| VRC37 | $(119R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP2[5:0] = "010101"           |                   |
| VRC38 | $(118R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP2[5:0] = "010110"           |                   |
| VRC39 | $(117R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP2[5:0] = "010111"           |                   |
| VRC40 | $(116R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP2[5:0] = "011000"           |                   |
| VRC41 | $(115R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP2[5:0] = "011001"           |                   |
| VRC42 | $(114R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP2[5:0] = "011010"           |                   |
| VRC43 | $(113R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP2[5:0] = "011011"           |                   |
| VRC44 | $(112R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP2[5:0] = "011100"           |                   |
| VRC45 | $(111R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP2[5:0] = "011101"           |                   |
| VRC46 | $(110R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP2[5:0] = "011110"           |                   |
| VRC47 | $(109R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP2[5:0] = "011111"           |                   |
| VRC48 | $(108R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP2[5:0] = "100000"           |                   |
| VRC49 | $(107R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP2[5:0] = "100001"           |                   |
| VRC50 | $(106R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP2[5:0] = "100010"           |                   |
| VRC51 | $(105R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP2[5:0] = "100011"           |                   |
| VRC52 | $(104R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP2[5:0] = "100100"           |                   |
| VRC53 | $(103R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP2[5:0] = "100101"           |                   |
| VRC54 | $(102R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP2[5:0] = "100110"           |                   |
| VRC55 | $(101R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP2[5:0] = "100111"           |                   |
| VRC56 | $(100R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP2[5:0] = "101000"           |                   |
| VRC57 | $(99R_a/R_t) * (VINP0 - VINP10) + VINP10$  | PKP2[5:0] = "101001"           |                   |
| VRC58 | $(98R_a/R_t) * (VINP0 - VINP10) + VINP10$  | PKP2[5:0] = "101010"           |                   |
| VRC59 | $(97R_a/R_t) * (VINP0 - VINP10) + VINP10$  | PKP2[5:0] = "101011"           |                   |
| VRC60 | $(96R_a/R_t) * (VINP0 - VINP10) + VINP10$  | PKP2[5:0] = "101100"           |                   |
| VRC61 | $(95R_a/R_t) * (VINP0 - VINP10) + VINP10$  | PKP2[5:0] = "101101"           |                   |

| Pads  | Formula                                   | Micro-Adjusting Register Value | Reference Voltage |
|-------|-------------------------------------------|--------------------------------|-------------------|
| VRC62 | $(94R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP2[5:0] = "101110"           |                   |
| VRC63 | $(93R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP2[5:0] = "101111"           |                   |
| VRC64 | $(92R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP2[5:0] = "110000"           |                   |
| VRC65 | $(91R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP2[5:0] = "110001"           |                   |
| VRC66 | $(90R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP2[5:0] = "110010"           |                   |
| VRC67 | $(89R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP2[5:0] = "110011"           |                   |

Table 52. Formulas for Calculating Gamma Adjusting Voltage (Positive Polarity) 1 (Continued)

| Pads  | Formula                                    | Micro-Adjusting Register Value | Reference Voltage |
|-------|--------------------------------------------|--------------------------------|-------------------|
| VRC68 | $(88R_a/R_t) * (VINP0 - VINP10) + VINP10$  | PKP2[5:0] = "110100"           | VINP3             |
| VRC69 | $(87R_a/R_t) * (VINP0 - VINP10) + VINP10$  | PKP2[5:0] = "110101"           |                   |
| VRC70 | $(86R_a/R_t) * (VINP0 - VINP10) + VINP10$  | PKP2[5:0] = "110110"           |                   |
| VRC71 | $(85R_a/R_t) * (VINP0 - VINP10) + VINP10$  | PKP2[5:0] = "110111"           |                   |
| VRC72 | $(84R_a/R_t) * (VINP0 - VINP10) + VINP10$  | PKP2[5:0] = "111000"           |                   |
| VRC73 | $(83R_a/R_t) * (VINP0 - VINP10) + VINP10$  | PKP2[5:0] = "111001"           |                   |
| VRC74 | $(82R_a/R_t) * (VINP0 - VINP10) + VINP10$  | PKP2[5:0] = "111010"           |                   |
| VRC75 | $(81R_a/R_t) * (VINP0 - VINP10) + VINP10$  | PKP2[5:0] = "111011"           |                   |
| VRC76 | $(80R_a/R_t) * (VINP0 - VINP10) + VINP10$  | PKP2[5:0] = "111100"           |                   |
| VRC77 | $(79R_a/R_t) * (VINP0 - VINP10) + VINP10$  | PKP2[5:0] = "111101"           |                   |
| VRC78 | $(78R_a/R_t) * (VINP0 - VINP10) + VINP10$  | PKP2[5:0] = "111110"           |                   |
| VRC79 | $(77R_a/R_t) * (VINP0 - VINP10) + VINP10$  | PKP2[5:0] = "111111"           |                   |
| VRC26 | $(130R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP3[5:0] = "000000"           | VINP4             |
| VRC27 | $(129R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP3[5:0] = "000001"           |                   |
| VRC28 | $(128R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP3[5:0] = "000010"           |                   |
| VRC29 | $(127R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP3[5:0] = "000011"           |                   |
| VRC30 | $(126R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP3[5:0] = "000100"           |                   |
| VRC31 | $(125R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP3[5:0] = "000101"           |                   |
| VRC32 | $(124R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP3[5:0] = "000110"           |                   |
| VRC33 | $(123R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP3[5:0] = "000111"           |                   |
| VRC34 | $(122R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP3[5:0] = "001000"           |                   |
| VRC35 | $(121R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP3[5:0] = "001001"           |                   |



| Pads  | Formula                                    | Micro-Adjusting Register Value | Reference Voltage |
|-------|--------------------------------------------|--------------------------------|-------------------|
| VRC36 | $(120R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP3[5:0] = "001010"           |                   |
| VRC37 | $(119R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP3[5:0] = "001011"           |                   |
| VRC38 | $(118R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP3[5:0] = "001100"           |                   |
| VRC39 | $(117R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP3[5:0] = "001101"           |                   |
| VRC40 | $(116R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP3[5:0] = "001110"           |                   |
| VRC41 | $(115R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP3[5:0] = "001111"           |                   |
| VRC42 | $(114R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP3[5:0] = "010000"           |                   |
| VRC43 | $(113R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP3[5:0] = "010001"           |                   |
| VRC44 | $(112R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP3[5:0] = "010010"           |                   |
| VRC45 | $(111R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP3[5:0] = "010011"           |                   |
| VRC46 | $(110R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP3[5:0] = "010100"           |                   |
| VRC47 | $(109R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP3[5:0] = "010101"           |                   |
| VRC48 | $(108R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP3[5:0] = "010110"           |                   |
| VRC49 | $(107R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP3[5:0] = "010111"           |                   |

Table 53. Formulas for Calculating Gamma Adjusting Voltage (Positive Polarity) 1 (Continued)

| Pads  | Formula                                    | Micro-Adjusting Register Value | Reference Voltage |
|-------|--------------------------------------------|--------------------------------|-------------------|
| VRC50 | $(106R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP3[5:0] = "011000"           | VINP4             |
| VRC51 | $(105R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP3[5:0] = "011001"           |                   |
| VRC52 | $(104R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP3[5:0] = "011010"           |                   |
| VRC53 | $(103R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP3[5:0] = "011011"           |                   |
| VRC54 | $(102R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP3[5:0] = "011100"           |                   |
| VRC55 | $(101R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP3[5:0] = "011101"           |                   |
| VRC56 | $(100R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP3[5:0] = "011110"           |                   |
| VRC57 | $(99R_a/R_t) * (VINP0 - VINP10) + VINP10$  | PKP3[5:0] = "011111"           |                   |
| VRC58 | $(98R_a/R_t) * (VINP0 - VINP10) + VINP10$  | PKP3[5:0] = "100000"           |                   |
| VRC59 | $(97R_a/R_t) * (VINP0 - VINP10) + VINP10$  | PKP3[5:0] = "100001"           |                   |
| VRC60 | $(96R_a/R_t) * (VINP0 - VINP10) + VINP10$  | PKP3[5:0] = "100010"           |                   |
| VRC61 | $(95R_a/R_t) * (VINP0 - VINP10) + VINP10$  | PKP3[5:0] = "100011"           |                   |
| VRC62 | $(94R_a/R_t) * (VINP0 - VINP10) + VINP10$  | PKP3[5:0] = "100100"           |                   |
| VRC63 | $(93R_a/R_t) * (VINP0 - VINP10) + VINP10$  | PKP3[5:0] = "100101"           |                   |

| Pads  | Formula                                   | Micro-Adjusting Register Value | Reference Voltage |
|-------|-------------------------------------------|--------------------------------|-------------------|
| VRC64 | $(92R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP3[5:0] = "100110"           |                   |
| VRC65 | $(91R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP3[5:0] = "100111"           |                   |
| VRC66 | $(90R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP3[5:0] = "101000"           |                   |
| VRC67 | $(89R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP3[5:0] = "101001"           |                   |
| VRC68 | $(88R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP3[5:0] = "101010"           |                   |
| VRC69 | $(87R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP3[5:0] = "101011"           |                   |
| VRC70 | $(86R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP3[5:0] = "101100"           |                   |
| VRC71 | $(85R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP3[5:0] = "101101"           |                   |
| VRC72 | $(84R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP3[5:0] = "101110"           |                   |
| VRC73 | $(83R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP3[5:0] = "101111"           |                   |
| VRC74 | $(82R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP3[5:0] = "110000"           |                   |
| VRC75 | $(81R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP3[5:0] = "110001"           |                   |
| VRC76 | $(80R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP3[5:0] = "110010"           |                   |
| VRC77 | $(79R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP3[5:0] = "110011"           |                   |
| VRC78 | $(78R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP3[5:0] = "110100"           |                   |
| VRC79 | $(77R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP3[5:0] = "110101"           |                   |
| VRC80 | $(76R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP3[5:0] = "110110"           |                   |
| VRC81 | $(75R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP3[5:0] = "110111"           |                   |
| VRC82 | $(74R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP3[5:0] = "111000"           |                   |
| VRC83 | $(73R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP3[5:0] = "111001"           |                   |
| VRC84 | $(72R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP3[5:0] = "111010"           |                   |
| VRC85 | $(71R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP3[5:0] = "111011"           |                   |

Table 54. Formulas for Calculating Gamma Adjusting Voltage (Positive Polarity) 1 (Continued)

| Pads  | Formula                                    | Micro-Adjusting Register Value | Reference voltage |
|-------|--------------------------------------------|--------------------------------|-------------------|
| VRC86 | $(70R_a/R_t) * (VINP0 - VINP10) + VINP10$  | PKP3[5:0] = "111100"           | VINP4             |
| VRC87 | $(69R_a/R_t) * (VINP0 - VINP10) + VINP10$  | PKP3[5:0] = "111101"           |                   |
| VRC88 | $(68R_a/R_t) * (VINP0 - VINP10) + VINP10$  | PKP3[5:0] = "111110"           |                   |
| VRC89 | $(67R_a/R_t) * (VINP0 - VINP10) + VINP10$  | PKP3[5:0] = "111111"           |                   |
| VRC48 | $(108R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP4[5:0] = "000000"           | VINP5             |
| VRC49 | $(107R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP4[5:0] = "000001"           |                   |

| Pads  | Formula                                    | Micro-Adjusting Register Value | Reference voltage |
|-------|--------------------------------------------|--------------------------------|-------------------|
| VRC50 | $(106R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP4[5:0] = "000010"           |                   |
| VRC51 | $(105R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP4[5:0] = "000011"           |                   |
| VRC52 | $(104R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP4[5:0] = "000100"           |                   |
| VRC53 | $(103R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP4[5:0] = "000101"           |                   |
| VRC54 | $(102R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP4[5:0] = "000110"           |                   |
| VRC55 | $(101R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP4[5:0] = "000111"           |                   |
| VRC56 | $(100R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP4[5:0] = "001000"           |                   |
| VRC57 | $(99R_a/R_t) * (VINP0 - VINP10) + VINP10$  | PKP4[5:0] = "001001"           |                   |
| VRC58 | $(98R_a/R_t) * (VINP0 - VINP10) + VINP10$  | PKP4[5:0] = "001010"           |                   |
| VRC59 | $(97R_a/R_t) * (VINP0 - VINP10) + VINP10$  | PKP4[5:0] = "001011"           |                   |
| VRC60 | $(96R_a/R_t) * (VINP0 - VINP10) + VINP10$  | PKP4[5:0] = "001100"           |                   |
| VRC61 | $(95R_a/R_t) * (VINP0 - VINP10) + VINP10$  | PKP4[5:0] = "001101"           |                   |
| VRC62 | $(94R_a/R_t) * (VINP0 - VINP10) + VINP10$  | PKP4[5:0] = "001110"           |                   |
| VRC63 | $(93R_a/R_t) * (VINP0 - VINP10) + VINP10$  | PKP4[5:0] = "001111"           |                   |
| VRC64 | $(92R_a/R_t) * (VINP0 - VINP10) + VINP10$  | PKP4[5:0] = "010000"           |                   |
| VRC65 | $(91R_a/R_t) * (VINP0 - VINP10) + VINP10$  | PKP4[5:0] = "010001"           |                   |
| VRC66 | $(90R_a/R_t) * (VINP0 - VINP10) + VINP10$  | PKP4[5:0] = "010010"           |                   |
| VRC67 | $(89R_a/R_t) * (VINP0 - VINP10) + VINP10$  | PKP4[5:0] = "010011"           |                   |
| VRC68 | $(88R_a/R_t) * (VINP0 - VINP10) + VINP10$  | PKP4[5:0] = "010100"           |                   |
| VRC69 | $(87R_a/R_t) * (VINP0 - VINP10) + VINP10$  | PKP4[5:0] = "010101"           |                   |
| VRC70 | $(86R_a/R_t) * (VINP0 - VINP10) + VINP10$  | PKP4[5:0] = "010110"           |                   |
| VRC71 | $(85R_a/R_t) * (VINP0 - VINP10) + VINP10$  | PKP4[5:0] = "010111"           |                   |
| VRC72 | $(84R_a/R_t) * (VINP0 - VINP10) + VINP10$  | PKP4[5:0] = "011000"           |                   |
| VRC73 | $(83R_a/R_t) * (VINP0 - VINP10) + VINP10$  | PKP4[5:0] = "011001"           |                   |
| VRC74 | $(82R_a/R_t) * (VINP0 - VINP10) + VINP10$  | PKP4[5:0] = "011010"           |                   |
| VRC75 | $(81R_a/R_t) * (VINP0 - VINP10) + VINP10$  | PKP4[5:0] = "011011"           |                   |
| VRC76 | $(80R_a/R_t) * (VINP0 - VINP10) + VINP10$  | PKP4[5:0] = "011100"           |                   |
| VRC77 | $(79R_a/R_t) * (VINP0 - VINP10) + VINP10$  | PKP4[5:0] = "011101"           |                   |
| VRC78 | $(78R_a/R_t) * (VINP0 - VINP10) + VINP10$  | PKP4[5:0] = "011110"           |                   |
| VRC79 | $(77R_a/R_t) * (VINP0 - VINP10) + VINP10$  | PKP4[5:0] = "011111"           |                   |

Table 55. Formulas for Calculating Gamma Adjusting Voltage (Positive Polarity) 1 (Continued)

| Pads   | Formula                                   | Micro-Adjusting Register Value | Reference Voltage |
|--------|-------------------------------------------|--------------------------------|-------------------|
| VRC80  | $(76R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP4[5:0] = "100000"           | VINP5             |
| VRC81  | $(75R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP4[5:0] = "100001"           |                   |
| VRC82  | $(74R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP4[5:0] = "100010"           |                   |
| VRC83  | $(73R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP4[5:0] = "100011"           |                   |
| VRC84  | $(72R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP4[5:0] = "100100"           |                   |
| VRC85  | $(71R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP4[5:0] = "100101"           |                   |
| VRC86  | $(70R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP4[5:0] = "100110"           |                   |
| VRC87  | $(69R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP4[5:0] = "100111"           |                   |
| VRC88  | $(68R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP4[5:0] = "101000"           |                   |
| VRC89  | $(67R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP4[5:0] = "101001"           |                   |
| VRC90  | $(66R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP4[5:0] = "101010"           |                   |
| VRC91  | $(65R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP4[5:0] = "101011"           |                   |
| VRC92  | $(64R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP4[5:0] = "101100"           |                   |
| VRC93  | $(63R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP4[5:0] = "101101"           |                   |
| VRC94  | $(62R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP4[5:0] = "101110"           |                   |
| VRC95  | $(61R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP4[5:0] = "101111"           |                   |
| VRC96  | $(60R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP4[5:0] = "110000"           |                   |
| VRC97  | $(59R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP4[5:0] = "110001"           |                   |
| VRC98  | $(58R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP4[5:0] = "110010"           |                   |
| VRC99  | $(57R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP4[5:0] = "110011"           |                   |
| VRC100 | $(56R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP4[5:0] = "110100"           |                   |
| VRC101 | $(55R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP4[5:0] = "110101"           |                   |
| VRC102 | $(54R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP4[5:0] = "110110"           |                   |
| VRC103 | $(53R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP4[5:0] = "110111"           |                   |
| VRC104 | $(52R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP4[5:0] = "111000"           |                   |
| VRC105 | $(51R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP4[5:0] = "111001"           |                   |
| VRC106 | $(50R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP4[5:0] = "111010"           |                   |
| VRC107 | $(49R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP4[5:0] = "111011"           |                   |
| VRC108 | $(48R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP4[5:0] = "111100"           |                   |
| VRC109 | $(47R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP4[5:0] = "111101"           |                   |

| Pads   | Formula                                   | Micro-Adjusting Register Value | Reference Voltage |
|--------|-------------------------------------------|--------------------------------|-------------------|
| VRC110 | $(46R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP4[5:0] = "111110"           |                   |
| VRC111 | $(45R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP4[5:0] = "111111"           |                   |
| VRC143 | $(13R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP5[5:0] = "000000"           | VINP6             |
| VRC142 | $(14R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP5[5:0] = "000001"           |                   |
| VRC141 | $(15R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP5[5:0] = "000010"           |                   |
| VRC140 | $(16R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP5[5:0] = "000011"           |                   |

Table 56. Formulas for Calculating Gamma Adjusting Voltage (Positive Polarity) 1 (Continued)

| Pads   | Formula                                   | Micro-Adjusting Register Value | Reference Voltage |
|--------|-------------------------------------------|--------------------------------|-------------------|
| VRC139 | $(17R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP5[5:0] = "000100"           | VINP6             |
| VRC138 | $(18R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP5[5:0] = "000101"           |                   |
| VRC137 | $(19R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP5[5:0] = "000110"           |                   |
| VRC136 | $(20R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP5[5:0] = "000111"           |                   |
| VRC135 | $(21R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP5[5:0] = "001000"           |                   |
| VRC134 | $(22R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP5[5:0] = "001001"           |                   |
| VRC133 | $(23R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP5[5:0] = "001010"           |                   |
| VRC132 | $(24R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP5[5:0] = "001011"           |                   |
| VRC131 | $(25R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP5[5:0] = "001100"           |                   |
| VRC130 | $(26R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP5[5:0] = "001101"           |                   |
| VRC129 | $(27R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP5[5:0] = "001110"           |                   |
| VRC128 | $(28R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP5[5:0] = "001111"           |                   |
| VRC127 | $(29R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP5[5:0] = "010000"           |                   |
| VRC126 | $(30R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP5[5:0] = "010001"           |                   |
| VRC125 | $(31R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP5[5:0] = "010010"           |                   |
| VRC124 | $(32R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP5[5:0] = "010011"           |                   |
| VRC123 | $(33R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP5[5:0] = "010100"           |                   |
| VRC122 | $(34R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP5[5:0] = "010101"           |                   |
| VRC121 | $(35R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP5[5:0] = "010110"           |                   |
| VRC120 | $(36R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP5[5:0] = "010111"           |                   |
| VRC119 | $(37R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP5[5:0] = "011000"           |                   |
| VRC118 | $(38R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP5[5:0] = "011001"           |                   |

| Pads   | Formula                                   | Micro-Adjusting Register Value | Reference Voltage |
|--------|-------------------------------------------|--------------------------------|-------------------|
| VRC117 | $(39R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP5[5:0] = "011010"           |                   |
| VRC116 | $(40R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP5[5:0] = "011011"           |                   |
| VRC115 | $(41R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP5[5:0] = "011100"           |                   |
| VRC114 | $(42R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP5[5:0] = "011101"           |                   |
| VRC113 | $(43R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP5[5:0] = "011110"           |                   |
| VRC112 | $(44R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP5[5:0] = "011111"           |                   |
| VRC111 | $(45R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP5[5:0] = "100000"           |                   |
| VRC110 | $(46R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP5[5:0] = "100001"           |                   |
| VRC109 | $(47R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP5[5:0] = "100010"           |                   |
| VRC108 | $(48R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP5[5:0] = "100011"           |                   |
| VRC107 | $(49R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP5[5:0] = "100100"           |                   |
| VRC106 | $(50R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP5[5:0] = "100101"           |                   |
| VRC105 | $(51R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP5[5:0] = "100110"           |                   |
| VRC104 | $(52R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP5[5:0] = "100111"           |                   |

Table 57. Formulas for Calculating Gamma Adjusting Voltage (Positive Polarity) 1 (Continued)

| Pads   | Formula                                   | Micro-Adjusting Register Value | Reference Voltage |
|--------|-------------------------------------------|--------------------------------|-------------------|
| VRC103 | $(53R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP5[5:0] = "101000"           | VINP6             |
| VRC102 | $(54R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP5[5:0] = "101001"           |                   |
| VRC101 | $(55R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP5[5:0] = "101010"           |                   |
| VRC100 | $(56R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP5[5:0] = "101011"           |                   |
| VRC99  | $(57R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP5[5:0] = "101100"           |                   |
| VRC98  | $(58R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP5[5:0] = "101101"           |                   |
| VRC97  | $(59R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP5[5:0] = "101110"           |                   |
| VRC96  | $(60R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP5[5:0] = "101111"           |                   |
| VRC95  | $(61R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP5[5:0] = "110000"           |                   |
| VRC94  | $(62R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP5[5:0] = "110001"           |                   |
| VRC93  | $(63R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP5[5:0] = "110010"           |                   |
| VRC92  | $(64R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP5[5:0] = "110011"           |                   |
| VRC91  | $(65R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP5[5:0] = "110100"           |                   |
| VRC90  | $(66R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP5[5:0] = "110101"           |                   |

| Pads   | Formula                                   | Micro-Adjusting Register Value | Reference Voltage |
|--------|-------------------------------------------|--------------------------------|-------------------|
| VRC89  | $(67R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP5[5:0] = "110110"           |                   |
| VRC88  | $(68R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP5[5:0] = "110111"           |                   |
| VRC87  | $(69R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP5[5:0] = "111000"           |                   |
| VRC86  | $(70R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP5[5:0] = "111001"           |                   |
| VRC85  | $(71R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP5[5:0] = "111010"           |                   |
| VRC84  | $(72R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP5[5:0] = "111011"           |                   |
| VRC83  | $(73R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP5[5:0] = "111100"           |                   |
| VRC82  | $(74R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP5[5:0] = "111101"           |                   |
| VRC81  | $(75R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP5[5:0] = "111110"           |                   |
| VRC80  | $(76R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP5[5:0] = "111111"           |                   |
| VRC150 | $(6R_a/R_t) * (VINP0 - VINP10) + VINP10$  | PKP6[5:0] = "000000"           | VINP7             |
| VRC149 | $(7R_a/R_t) * (VINP0 - VINP10) + VINP10$  | PKP6[5:0] = "000001"           |                   |
| VRC148 | $(8R_a/R_t) * (VINP0 - VINP10) + VINP10$  | PKP6[5:0] = "000010"           |                   |
| VRC147 | $(9R_a/R_t) * (VINP0 - VINP10) + VINP10$  | PKP6[5:0] = "000011"           |                   |
| VRC146 | $(10R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP6[5:0] = "000100"           |                   |
| VRC145 | $(11R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP6[5:0] = "000101"           |                   |
| VRC144 | $(12R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP6[5:0] = "000110"           |                   |
| VRC143 | $(13R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP6[5:0] = "000111"           |                   |
| VRC142 | $(14R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP6[5:0] = "001000"           |                   |
| VRC141 | $(15R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP6[5:0] = "001001"           |                   |
| VRC140 | $(16R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP6[5:0] = "001010"           |                   |
| VRC139 | $(17R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP6[5:0] = "001011"           |                   |

Table 58. Formulas for Calculating Gamma Adjusting Voltage (Positive Polarity) 1 (Continued)

| Pads   | Formula                                   | Micro-Adjusting Register Value | Reference Voltage |
|--------|-------------------------------------------|--------------------------------|-------------------|
| VRC138 | $(18R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP6[5:0] = "001100"           | VINP7             |
| VRC137 | $(19R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP6[5:0] = "001101"           |                   |
| VRC136 | $(20R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP6[5:0] = "001110"           |                   |
| VRC135 | $(21R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP6[5:0] = "001111"           |                   |
| VRC134 | $(22R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP6[5:0] = "010000"           |                   |
| VRC133 | $(23R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP6[5:0] = "010001"           |                   |

| Pads   | Formula                                   | Micro-Adjusting Register Value | Reference Voltage |
|--------|-------------------------------------------|--------------------------------|-------------------|
| VRC132 | $(24R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP6[5:0] = "010010"           |                   |
| VRC131 | $(25R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP6[5:0] = "010011"           |                   |
| VRC130 | $(26R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP6[5:0] = "010100"           |                   |
| VRC129 | $(27R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP6[5:0] = "010101"           |                   |
| VRC128 | $(28R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP6[5:0] = "010110"           |                   |
| VRC127 | $(29R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP6[5:0] = "010111"           |                   |
| VRC126 | $(30R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP6[5:0] = "011000"           |                   |
| VRC125 | $(31R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP6[5:0] = "011001"           |                   |
| VRC124 | $(32R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP6[5:0] = "011010"           |                   |
| VRC123 | $(33R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP6[5:0] = "011011"           |                   |
| VRC122 | $(34R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP6[5:0] = "011100"           |                   |
| VRC121 | $(35R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP6[5:0] = "011101"           |                   |
| VRC120 | $(36R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP6[5:0] = "011110"           |                   |
| VRC119 | $(37R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP6[5:0] = "011111"           |                   |
| VRC118 | $(38R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP6[5:0] = "100000"           |                   |
| VRC117 | $(39R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP6[5:0] = "100001"           |                   |
| VRC116 | $(40R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP6[5:0] = "100010"           |                   |
| VRC115 | $(41R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP6[5:0] = "100011"           |                   |
| VRC114 | $(42R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP6[5:0] = "100100"           |                   |
| VRC113 | $(43R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP6[5:0] = "100101"           |                   |
| VRC112 | $(44R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP6[5:0] = "100110"           |                   |
| VRC111 | $(45R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP6[5:0] = "100111"           |                   |
| VRC110 | $(46R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP6[5:0] = "101000"           |                   |
| VRC109 | $(47R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP6[5:0] = "101001"           |                   |
| VRC108 | $(48R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP6[5:0] = "101010"           |                   |
| VRC107 | $(49R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP6[5:0] = "101011"           |                   |
| VRC106 | $(50R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP6[5:0] = "101100"           |                   |
| VRC105 | $(51R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP6[5:0] = "101101"           |                   |
| VRC104 | $(52R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP6[5:0] = "101110"           |                   |
| VRC103 | $(53R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP6[5:0] = "101111"           |                   |



Table 59. Formulas for Calculating Gamma Adjusting Voltage (Positive Polarity) 1 (Continued)

| Pads   | Formula                                    | Micro-Adjusting Register Value | Reference Voltage |
|--------|--------------------------------------------|--------------------------------|-------------------|
| VRC102 | $(54R_a/R_t) * (VINP0 - VINP10) + VINP10$  | PKP6[5:0] = "110000"           | VINP7             |
| VRC101 | $(55R_a/R_t) * (VINP0 - VINP10) + VINP10$  | PKP6[5:0] = "110001"           |                   |
| VRC100 | $(56R_a/R_t) * (VINP0 - VINP10) + VINP10$  | PKP6[5:0] = "110010"           |                   |
| VRC99  | $(57R_a/R_t) * (VINP0 - VINP10) + VINP10$  | PKP6[5:0] = "110011"           |                   |
| VRC98  | $(58R_a/R_t) * (VINP0 - VINP10) + VINP10$  | PKP6[5:0] = "110100"           |                   |
| VRC97  | $(59R_a/R_t) * (VINP0 - VINP10) + VINP10$  | PKP6[5:0] = "110101"           |                   |
| VRC96  | $(60R_a/R_t) * (VINP0 - VINP10) + VINP10$  | PKP6[5:0] = "110110"           |                   |
| VRC95  | $(61R_a/R_t) * (VINP0 - VINP10) + VINP10$  | PKP6[5:0] = "110111"           |                   |
| VRC94  | $(62R_a/R_t) * (VINP0 - VINP10) + VINP10$  | PKP6[5:0] = "111000"           |                   |
| VRC93  | $(63R_a/R_t) * (VINP0 - VINP10) + VINP10$  | PKP6[5:0] = "111001"           |                   |
| VRC92  | $(64R_a/R_t) * (VINP0 - VINP10) + VINP10$  | PKP6[5:0] = "111010"           |                   |
| VRC91  | $(65R_a/R_t) * (VINP0 - VINP10) + VINP10$  | PKP6[5:0] = "111011"           |                   |
| VRC90  | $(66R_a/R_t) * (VINP0 - VINP10) + VINP10$  | PKP6[5:0] = "111100"           |                   |
| VRC89  | $(67R_a/R_t) * (VINP0 - VINP10) + VINP10$  | PKP6[5:0] = "111101"           |                   |
| VRC88  | $(68R_a/R_t) * (VINP0 - VINP10) + VINP10$  | PKP6[5:0] = "111110"           |                   |
| VRC87  | $(69R_a/R_t) * (VINP0 - VINP10) + VINP10$  | PKP6[5:0] = "111111"           |                   |
| VRC154 | $(2.5R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP7[5:0] = "000000"           | VINP8             |
| VRC153 | $(3R_a/R_t) * (VINP0 - VINP10) + VINP10$   | PKP7[5:0] = "000001"           |                   |
| VRC152 | $(4R_a/R_t) * (VINP0 - VINP10) + VINP10$   | PKP7[5:0] = "000010"           |                   |
| VRC151 | $(5R_a/R_t) * (VINP0 - VINP10) + VINP10$   | PKP7[5:0] = "000011"           |                   |
| VRC150 | $(6R_a/R_t) * (VINP0 - VINP10) + VINP10$   | PKP7[5:0] = "000100"           |                   |
| VRC149 | $(7R_a/R_t) * (VINP0 - VINP10) + VINP10$   | PKP7[5:0] = "000101"           |                   |
| VRC148 | $(8R_a/R_t) * (VINP0 - VINP10) + VINP10$   | PKP7[5:0] = "000110"           |                   |
| VRC147 | $(9R_a/R_t) * (VINP0 - VINP10) + VINP10$   | PKP7[5:0] = "000111"           |                   |
| VRC146 | $(10R_a/R_t) * (VINP0 - VINP10) + VINP10$  | PKP7[5:0] = "001000"           |                   |
| VRC145 | $(11R_a/R_t) * (VINP0 - VINP10) + VINP10$  | PKP7[5:0] = "001001"           |                   |
| VRC144 | $(12R_a/R_t) * (VINP0 - VINP10) + VINP10$  | PKP7[5:0] = "001010"           |                   |
| VRC143 | $(13R_a/R_t) * (VINP0 - VINP10) + VINP10$  | PKP7[5:0] = "001011"           |                   |
| VRC142 | $(14R_a/R_t) * (VINP0 - VINP10) + VINP10$  | PKP7[5:0] = "001100"           |                   |
| VRC141 | $(15R_a/R_t) * (VINP0 - VINP10) + VINP10$  | PKP7[5:0] = "001101"           |                   |

| Pads   | Formula                                   | Micro-Adjusting Register Value | Reference Voltage |
|--------|-------------------------------------------|--------------------------------|-------------------|
| VRC140 | $(16R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP7[5:0] = "001110"           |                   |
| VRC139 | $(17R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP7[5:0] = "001111"           |                   |
| VRC138 | $(18R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP7[5:0] = "010000"           |                   |
| VRC137 | $(19R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP7[5:0] = "010001"           |                   |
| VRC136 | $(20R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP7[5:0] = "010010"           |                   |
| VRC135 | $(21R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP7[5:0] = "010011"           |                   |

Table 60. Formulas for Calculating Gamma Adjusting Voltage (Positive Polarity) 1 (Continued)

| Pads   | Formula                                   | Micro-Adjusting Register Value | Reference Voltage |
|--------|-------------------------------------------|--------------------------------|-------------------|
| VRC134 | $(22R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP7[5:0] = "010100"           | VINP8             |
| VRC133 | $(23R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP7[5:0] = "010101"           |                   |
| VRC132 | $(24R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP7[5:0] = "010110"           |                   |
| VRC131 | $(25R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP7[5:0] = "010111"           |                   |
| VRC130 | $(26R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP7[5:0] = "011000"           |                   |
| VRC129 | $(27R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP7[5:0] = "011001"           |                   |
| VRC128 | $(28R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP7[5:0] = "011010"           |                   |
| VRC127 | $(29R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP7[5:0] = "011011"           |                   |
| VRC126 | $(30R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP7[5:0] = "011100"           |                   |
| VRC125 | $(31R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP7[5:0] = "011101"           |                   |
| VRC124 | $(32R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP7[5:0] = "011110"           |                   |
| VRC123 | $(33R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP7[5:0] = "011111"           |                   |
| VRC122 | $(34R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP7[5:0] = "100000"           |                   |
| VRC121 | $(35R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP7[5:0] = "100001"           |                   |
| VRC120 | $(36R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP7[5:0] = "100010"           |                   |
| VRC119 | $(37R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP7[5:0] = "100011"           |                   |
| VRC118 | $(38R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP7[5:0] = "100100"           |                   |
| VRC117 | $(39R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP7[5:0] = "100101"           |                   |
| VRC116 | $(40R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP7[5:0] = "100110"           |                   |
| VRC115 | $(41R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP7[5:0] = "100111"           |                   |
| VRC114 | $(42R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP7[5:0] = "101000"           |                   |
| VRC113 | $(43R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP7[5:0] = "101001"           |                   |

| Pads   | Formula                                   | Micro-Adjusting Register Value | Reference Voltage |
|--------|-------------------------------------------|--------------------------------|-------------------|
| VRC112 | $(44R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP7[5:0] = "101010"           |                   |
| VRC111 | $(45R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP7[5:0] = "101011"           |                   |
| VRC110 | $(46R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP7[5:0] = "101100"           |                   |
| VRC109 | $(47R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP7[5:0] = "101101"           |                   |
| VRC108 | $(48R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP7[5:0] = "101110"           |                   |
| VRC107 | $(49R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP7[5:0] = "101111"           |                   |
| VRC106 | $(50R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP7[5:0] = "110000"           |                   |
| VRC105 | $(51R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP7[5:0] = "110001"           |                   |
| VRC104 | $(52R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP7[5:0] = "110010"           |                   |
| VRC103 | $(53R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP7[5:0] = "110011"           |                   |
| VRC102 | $(54R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP7[5:0] = "110100"           |                   |
| VRC101 | $(55R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP7[5:0] = "110101"           |                   |
| VRC100 | $(56R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP7[5:0] = "110110"           |                   |
| VRC99  | $(57R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP7[5:0] = "110111"           |                   |

Table 61. Formulas for Calculating Gamma Adjusting Voltage (Positive Polarity) 1 (Continued)

| Pads   | Formula                                    | Micro-Adjusting Register Value | Reference Voltage |
|--------|--------------------------------------------|--------------------------------|-------------------|
| VRC98  | $(58R_a/R_t) * (VINP0 - VINP10) + VINP10$  | PKP7[5:0] = "111000"           | VINP8             |
| VRC97  | $(59R_a/R_t) * (VINP0 - VINP10) + VINP10$  | PKP7[5:0] = "111001"           |                   |
| VRC96  | $(60R_a/R_t) * (VINP0 - VINP10) + VINP10$  | PKP7[5:0] = "111010"           |                   |
| VRC95  | $(61R_a/R_t) * (VINP0 - VINP10) + VINP10$  | PKP7[5:0] = "111011"           |                   |
| VRC94  | $(62R_a/R_t) * (VINP0 - VINP10) + VINP10$  | PKP7[5:0] = "111100"           |                   |
| VRC93  | $(63R_a/R_t) * (VINP0 - VINP10) + VINP10$  | PKP7[5:0] = "111101"           |                   |
| VRC92  | $(64R_a/R_t) * (VINP0 - VINP10) + VINP10$  | PKP7[5:0] = "111110"           |                   |
| VRC91  | $(65R_a/R_t) * (VINP0 - VINP10) + VINP10$  | PKP7[5:0] = "111111"           |                   |
| VRC158 | $(0.5R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP8[5:0] = "000000"           | VINP9             |
| VRC157 | $(1R_a/R_t) * (VINP0 - VINP10) + VINP10$   | PKP8[5:0] = "000001"           |                   |
| VRC156 | $(1.5R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP8[5:0] = "000010"           |                   |
| VRC155 | $(2R_a/R_t) * (VINP0 - VINP10) + VINP10$   | PKP8[5:0] = "000011"           |                   |
| VRC154 | $(2.5R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP8[5:0] = "000100"           |                   |
| VRC153 | $(3R_a/R_t) * (VINP0 - VINP10) + VINP10$   | PKP8[5:0] = "000101"           |                   |

| Pads   | Formula                                   | Micro-Adjusting Register Value | Reference Voltage |
|--------|-------------------------------------------|--------------------------------|-------------------|
| VRC152 | $(4R_a/R_t) * (VINP0 - VINP10) + VINP10$  | PKP8[5:0] = "000110"           |                   |
| VRC151 | $(5R_a/R_t) * (VINP0 - VINP10) + VINP10$  | PKP8[5:0] = "000111"           |                   |
| VRC150 | $(6R_a/R_t) * (VINP0 - VINP10) + VINP10$  | PKP8[5:0] = "001000"           |                   |
| VRC149 | $(7R_a/R_t) * (VINP0 - VINP10) + VINP10$  | PKP8[5:0] = "001001"           |                   |
| VRC148 | $(8R_a/R_t) * (VINP0 - VINP10) + VINP10$  | PKP8[5:0] = "001010"           |                   |
| VRC147 | $(9R_a/R_t) * (VINP0 - VINP10) + VINP10$  | PKP8[5:0] = "001011"           |                   |
| VRC146 | $(10R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP8[5:0] = "001100"           |                   |
| VRC145 | $(11R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP8[5:0] = "001101"           |                   |
| VRC144 | $(12R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP8[5:0] = "001110"           |                   |
| VRC143 | $(13R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP8[5:0] = "001111"           |                   |
| VRC142 | $(14R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP8[5:0] = "010000"           |                   |
| VRC141 | $(15R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP8[5:0] = "010001"           |                   |
| VRC140 | $(16R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP8[5:0] = "010010"           |                   |
| VRC139 | $(17R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP8[5:0] = "010011"           |                   |
| VRC138 | $(18R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP8[5:0] = "010100"           |                   |
| VRC137 | $(19R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP8[5:0] = "010101"           |                   |
| VRC136 | $(20R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP8[5:0] = "010110"           |                   |
| VRC135 | $(21R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP8[5:0] = "010111"           |                   |
| VRC134 | $(22R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP8[5:0] = "011000"           |                   |
| VRC133 | $(23R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP8[5:0] = "011001"           |                   |
| VRC132 | $(24R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP8[5:0] = "011010"           |                   |
| VRC131 | $(25R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP8[5:0] = "011011"           |                   |

Table 62. Formulas for Calculating Gamma Adjusting Voltage (Positive Polarity) 1 (Continued)

| Pads   | Formula                                   | Micro-Adjusting Register Value | Reference Voltage |
|--------|-------------------------------------------|--------------------------------|-------------------|
| VRC130 | $(26R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP8[5:0] = "011100"           | VINP9             |
| VRC129 | $(27R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP8[5:0] = "011101"           |                   |
| VRC128 | $(28R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP8[5:0] = "011110"           |                   |
| VRC127 | $(29R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP8[5:0] = "011111"           |                   |
| VRC126 | $(30R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP8[5:0] = "100000"           |                   |
| VRC125 | $(31R_a/R_t) * (VINP0 - VINP10) + VINP10$ | PKP8[5:0] = "100001"           |                   |

| Pads   | Formula                                            | Micro-Adjusting Register Value | Reference Voltage |
|--------|----------------------------------------------------|--------------------------------|-------------------|
| VRC124 | $(32R_a/R_t) * (V_{INP0} - V_{INP10}) + V_{INP10}$ | PKP8[5:0] = "100010"           |                   |
| VRC123 | $(33R_a/R_t) * (V_{INP0} - V_{INP10}) + V_{INP10}$ | PKP8[5:0] = "100011"           |                   |
| VRC122 | $(34R_a/R_t) * (V_{INP0} - V_{INP10}) + V_{INP10}$ | PKP8[5:0] = "100100"           |                   |
| VRC121 | $(35R_a/R_t) * (V_{INP0} - V_{INP10}) + V_{INP10}$ | PKP8[5:0] = "100101"           |                   |
| VRC120 | $(36R_a/R_t) * (V_{INP0} - V_{INP10}) + V_{INP10}$ | PKP8[5:0] = "100110"           |                   |
| VRC119 | $(37R_a/R_t) * (V_{INP0} - V_{INP10}) + V_{INP10}$ | PKP8[5:0] = "100111"           |                   |
| VRC118 | $(38R_a/R_t) * (V_{INP0} - V_{INP10}) + V_{INP10}$ | PKP8[5:0] = "101000"           |                   |
| VRC117 | $(39R_a/R_t) * (V_{INP0} - V_{INP10}) + V_{INP10}$ | PKP8[5:0] = "101001"           |                   |
| VRC116 | $(40R_a/R_t) * (V_{INP0} - V_{INP10}) + V_{INP10}$ | PKP8[5:0] = "101010"           |                   |
| VRC115 | $(41R_a/R_t) * (V_{INP0} - V_{INP10}) + V_{INP10}$ | PKP8[5:0] = "101011"           |                   |
| VRC114 | $(42R_a/R_t) * (V_{INP0} - V_{INP10}) + V_{INP10}$ | PKP8[5:0] = "101100"           |                   |
| VRC113 | $(43R_a/R_t) * (V_{INP0} - V_{INP10}) + V_{INP10}$ | PKP8[5:0] = "101101"           |                   |
| VRC112 | $(44R_a/R_t) * (V_{INP0} - V_{INP10}) + V_{INP10}$ | PKP8[5:0] = "101110"           |                   |
| VRC111 | $(45R_a/R_t) * (V_{INP0} - V_{INP10}) + V_{INP10}$ | PKP8[5:0] = "101111"           |                   |
| VRC110 | $(46R_a/R_t) * (V_{INP0} - V_{INP10}) + V_{INP10}$ | PKP8[5:0] = "110000"           |                   |
| VRC109 | $(47R_a/R_t) * (V_{INP0} - V_{INP10}) + V_{INP10}$ | PKP8[5:0] = "110001"           |                   |
| VRC108 | $(48R_a/R_t) * (V_{INP0} - V_{INP10}) + V_{INP10}$ | PKP8[5:0] = "110010"           |                   |
| VRC107 | $(49R_a/R_t) * (V_{INP0} - V_{INP10}) + V_{INP10}$ | PKP8[5:0] = "110011"           |                   |
| VRC106 | $(50R_a/R_t) * (V_{INP0} - V_{INP10}) + V_{INP10}$ | PKP8[5:0] = "110100"           |                   |
| VRC105 | $(51R_a/R_t) * (V_{INP0} - V_{INP10}) + V_{INP10}$ | PKP8[5:0] = "110101"           |                   |
| VRC104 | $(52R_a/R_t) * (V_{INP0} - V_{INP10}) + V_{INP10}$ | PKP8[5:0] = "110110"           |                   |
| VRC103 | $(53R_a/R_t) * (V_{INP0} - V_{INP10}) + V_{INP10}$ | PKP8[5:0] = "110111"           |                   |
| VRC102 | $(54R_a/R_t) * (V_{INP0} - V_{INP10}) + V_{INP10}$ | PKP8[5:0] = "111000"           |                   |
| VRC101 | $(55R_a/R_t) * (V_{INP0} - V_{INP10}) + V_{INP10}$ | PKP8[5:0] = "111001"           |                   |
| VRC100 | $(56R_a/R_t) * (V_{INP0} - V_{INP10}) + V_{INP10}$ | PKP8[5:0] = "111010"           |                   |
| VRC99  | $(57R_a/R_t) * (V_{INP0} - V_{INP10}) + V_{INP10}$ | PKP8[5:0] = "111011"           |                   |
| VRC98  | $(58R_a/R_t) * (V_{INP0} - V_{INP10}) + V_{INP10}$ | PKP8[5:0] = "111100"           |                   |
| VRC97  | $(59R_a/R_t) * (V_{INP0} - V_{INP10}) + V_{INP10}$ | PKP8[5:0] = "111101"           |                   |
| VRC96  | $(60R_a/R_t) * (V_{INP0} - V_{INP10}) + V_{INP10}$ | PKP8[5:0] = "111110"           |                   |
| VRC95  | $(61R_a/R_t) * (V_{INP0} - V_{INP10}) + V_{INP10}$ | PKP8[5:0] = "111111"           |                   |

Table 63. Formulas for Calculating Gamma Adjusting Voltage (Positive Polarity) 2

| Grayscale Voltage | Formula                       | Grayscale voltage | Formula                       |
|-------------------|-------------------------------|-------------------|-------------------------------|
| V0                | VINP0                         | V32               | $VC-(VC-V43) * (0.5/11.5)$    |
| V1                | VINP1                         | V33               | $VC-(VC-V43) * (1.25/11.5)$   |
| V2                | $V1-(V1-V4) * (6/12)$         | V34               | $VC-(VC-V43) * (2.25/11.5)$   |
| V3                | $V1-(V1-V4) * (10/12)$        | V35               | $VC-(VC-V43) * (3/11.5)$      |
| V4                | VINP2                         | V36               | $VC-(VC-V43) * (4/11.5)$      |
| V5                | $V4-(V4-V8) * (2.5/7.5)$      | V37               | $VC-(VC-V43) * (5/11.5)$      |
| V6                | $V4-(V4-V8) * (4.5/7.5)$      | V38               | $VC-(VC-V43) * (6/11.5)$      |
| V7                | $V4-(V4-V8) * (6/7.5)$        | V39               | $VC-(VC-V43) * (7/11.5)$      |
| V8                | VINP3                         | V40               | $VC-(VC-V43) * (8/11.5)$      |
| V9                | $V8-(V8-V20) * (1.5/13.25)$   | V41               | $VC-(VC-V43) * (9/11.5)$      |
| V10               | $V8-(V8-V20) * (3.5/13.25)$   | V42               | $VC-(VC-V43) * (10.5/11.5)$   |
| V11               | $V8-(V8-V20) * (4.5/13.25)$   | V43               | VINP6                         |
| V12               | $V8-(V8-V20) * (5.5/13.25)$   | V44               | $V43-(V43-V55) * (1/17.5)$    |
| V13               | $V8-(V8-V20) * (6.75/13.25)$  | V45               | $V43-(V43-V55) * (2.5/17.5)$  |
| V14               | $V8-(V8-V20) * (7.75/13.25)$  | V46               | $V43-(V43-V55) * (3.75/17.5)$ |
| V15               | $V8-(V8-V20) * (8.75/13.25)$  | V47               | $V43-(V43-V55) * (4.75/17.5)$ |
| V16               | $V8-(V8-V20) * (9.75/13.25)$  | V48               | $V43-(V43-V55) * (6.5/17.5)$  |
| V17               | $V8-(V8-V20) * (10.75/13.25)$ | V49               | $V43-(V43-V55) * (7.5/17.5)$  |
| V18               | $V8-(V8-V20) * (11.75/13.25)$ | V50               | $V43-(V43-V55) * (9/17.5)$    |
| V19               | $V8-(V8-V20) * (12.75/13.25)$ | V51               | $V43-(V43-V55) * (10.5/17.5)$ |
| V20               | VINP4                         | V52               | $V43-(V43-V55) * (12/17.5)$   |
| V21               | $V20-(V20-VC) * (1.5/12.25)$  | V53               | $V43-(V43-V55) * (13.5/17.5)$ |
| V22               | $V20-(V20-VC) * (2.5/12.25)$  | V54               | $V43-(V43-V55) * (15.5/17.5)$ |
| V23               | $V20-(V20-VC) * (3.75/12.25)$ | V55               | VINP7                         |
| V24               | $V20-(V20-VC) * (4.75/12.25)$ | V56               | $V55-(V55-V59) * (2/9.5)$     |
| V25               | $V20-(V20-VC) * (5.75/12.25)$ | V57               | $V55-(V55-V59) * (4/9.5)$     |
| V26               | $V20-(V20-VC) * (6.75/12.25)$ | V58               | $V55-(V55-V59) * (6.5/9.5)$   |
| V27               | $V20-(V20-VC) * (7.75/12.25)$ | V59               | VINP8                         |
| V28               | $V20-(V20-VC) * (8.75/12.25)$ | V60               | $V59-(V59-V62) * (3.5/11.5)$  |
| V29               | $V20-(V20-VC) * (9.75/12.25)$ | V61               | $V59-(V59-V62) * (6.5/11.5)$  |

| Grayscale Voltage | Formula                            | Grayscale voltage | Formula |
|-------------------|------------------------------------|-------------------|---------|
| V30               | $V20 - (V20 - VC) * (10.75/12.25)$ | V62               | VINP9   |
| V31               | $V20 - (V20 - VC) * (11.75/12.25)$ | V63               | VINP10  |
| VC                | VINP5                              |                   |         |

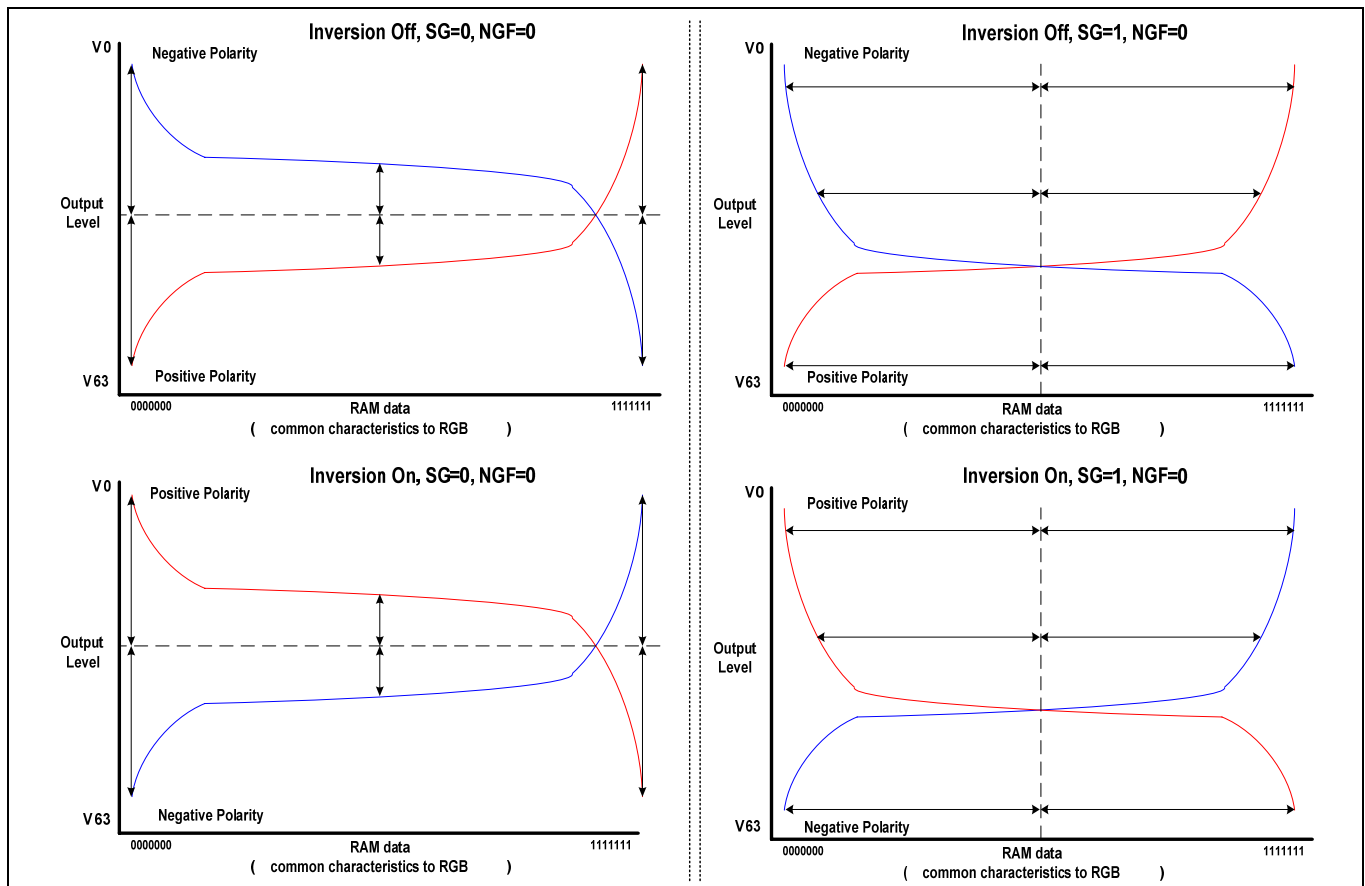


Figure69. Relationship Between RAM Data and Output Voltage

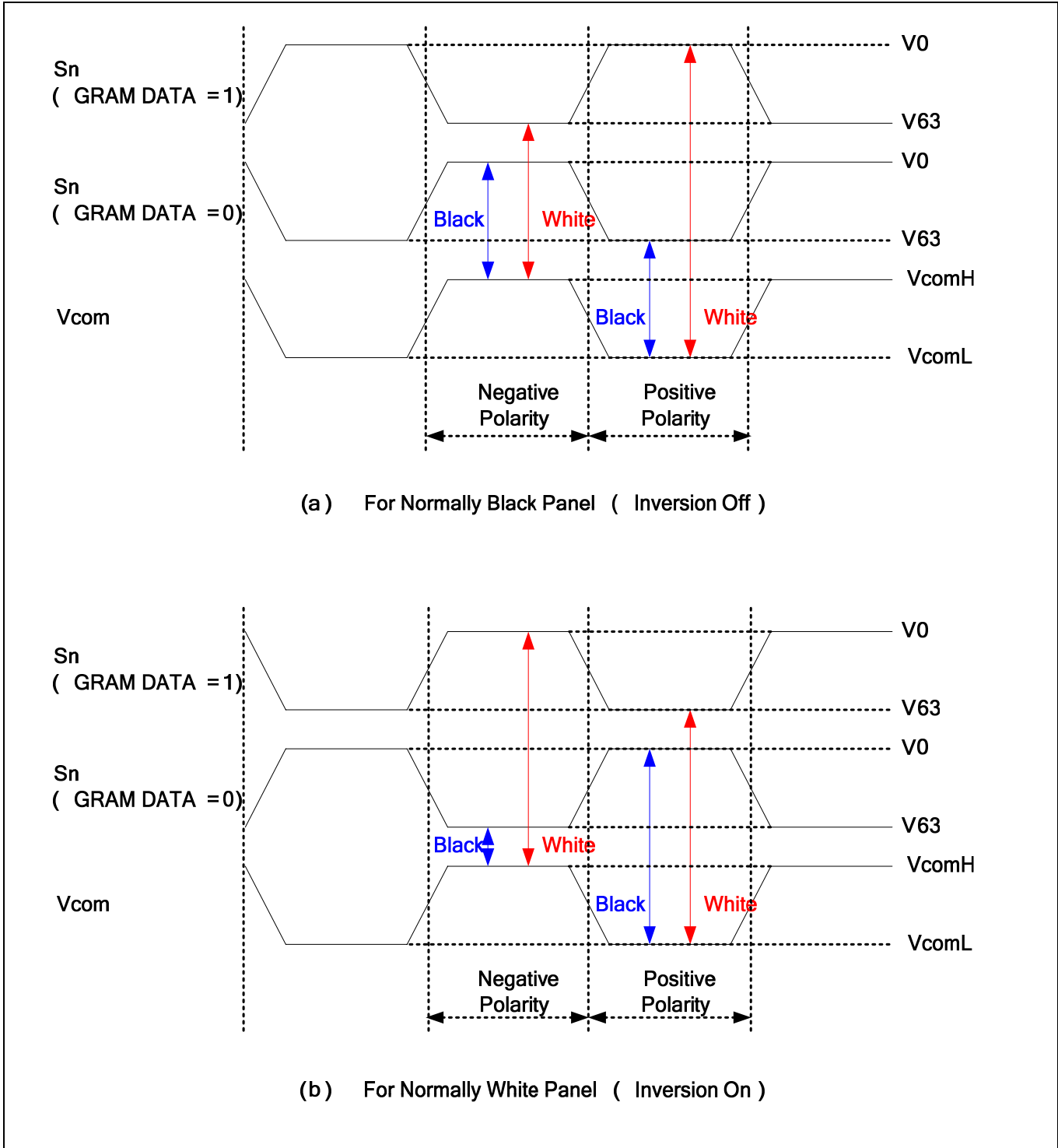


Figure70.

Relationship Between Source Output and VCOM



4.3. DISPLAY DATA RAM

4.3.1. CONFIGURATION

S6D04H0 has an integrated 240x320x18-bit graphic type of static RAM. This memory allows storing on-chip a 240xRGBx320 image with 18-bit resolution. 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.Memory to Display Address Mapping

4.3.1.1. When using 240RGB x 320 resolution

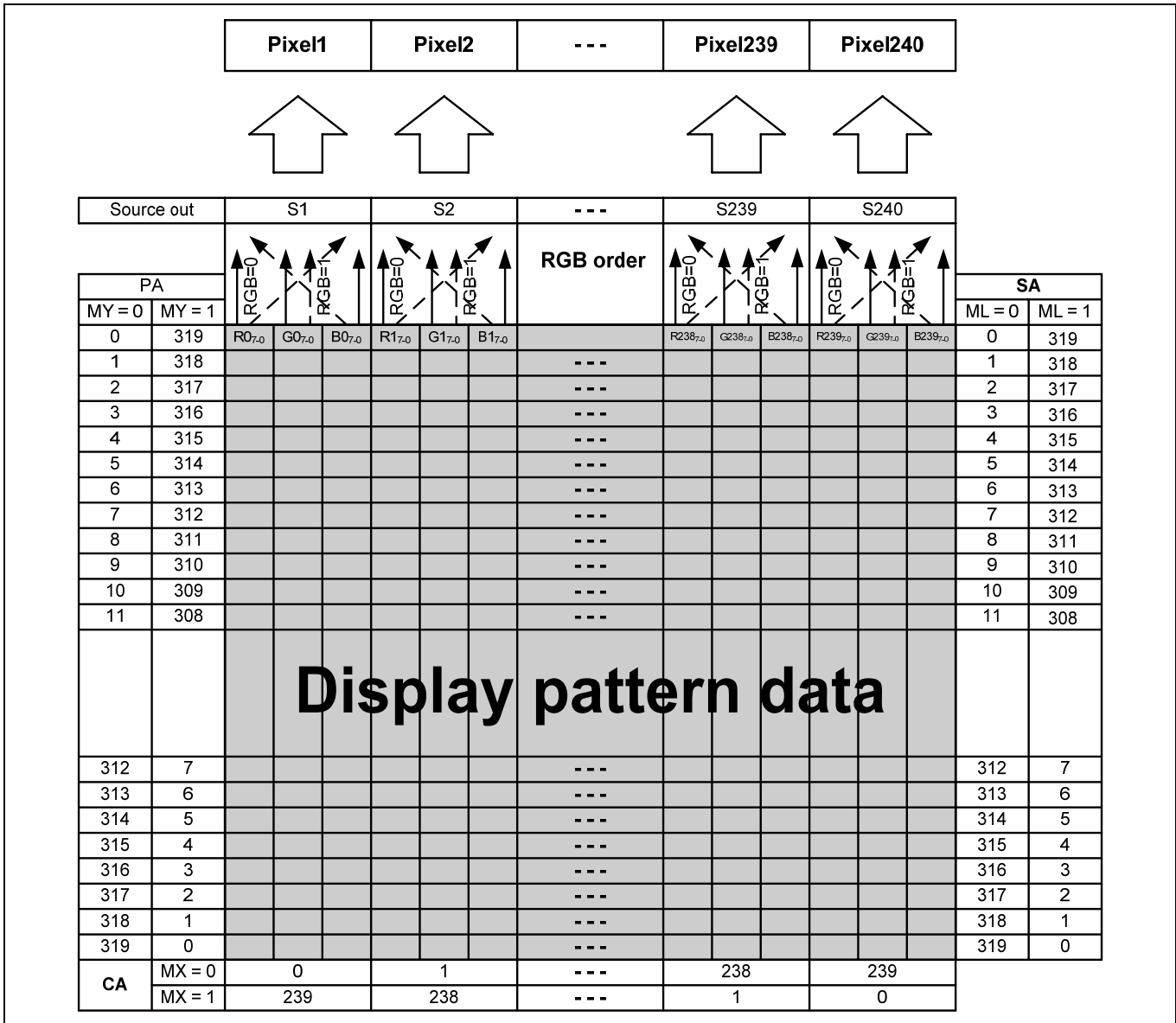


Figure71. When Using 240RGB x 320 Resolution

**Note.**

PA = Page Address,

CA = Column Address,

SA = Scan Address,

MX = Mirror X-axis (Column address direction parameter), B6 parameter of MADCTL command

MY = Mirror Y-axis (Page address direction parameter), B7 parameter of MADCTL command

ML = Scan direction parameter, B4 parameter of MADCTL command

RGB= Red, Green and Blue pixel position change, B3 parameter of MADCTL command

4.3.2. NORMAL DISPLAY ON OR PARTIAL MODE ON, VERTICAL SCROLL OFF

4.3.2.1. When using 240RGB x 320 resolution

In this mode, contents of the frame memory within an area where column pointer is 00h to EFh and page pointer is 000h to 13Fh is displayed. To display a dot on leftmost top corner, store the dot data at (column pointer, page pointer) = (0, 0).

1). Example for Normal Display On (B6 = B7 = B4 = '0' on MADCTL)

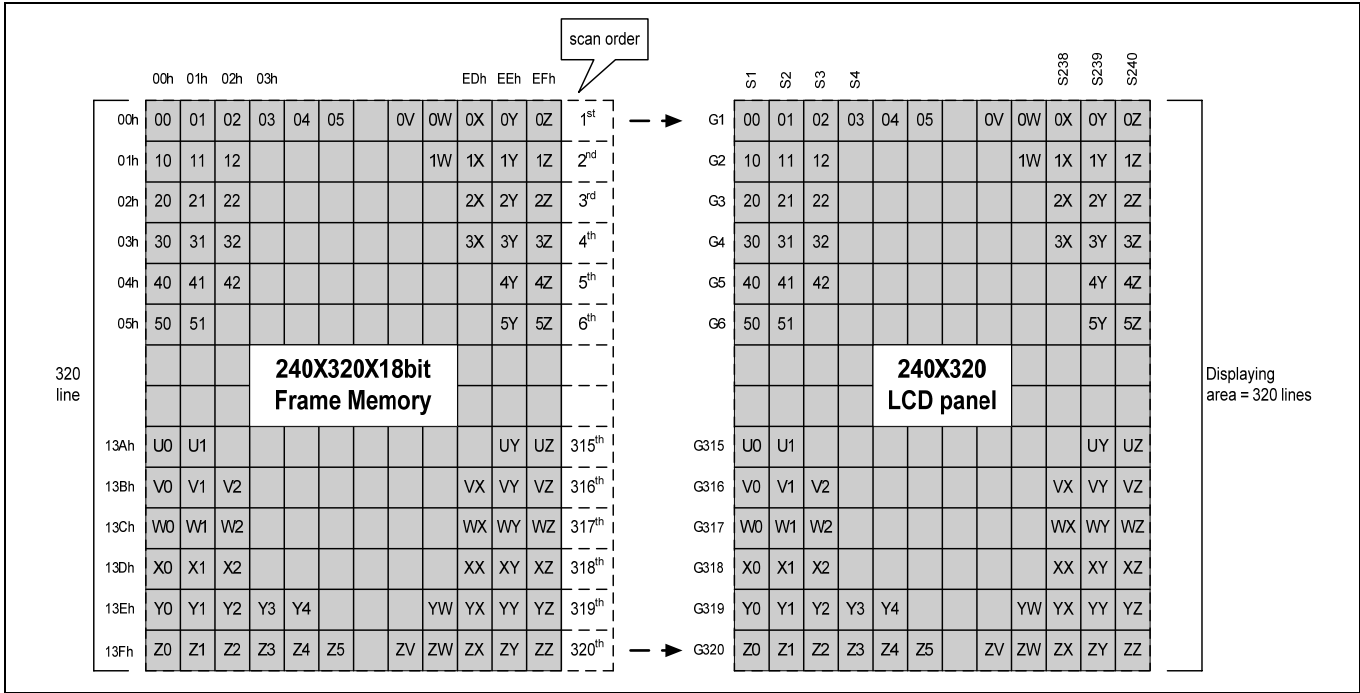


Figure72. Normal Display On (B6 = B7 = B4 = '0' On MADCTL)

2). Partial display on: SR [15:0] = 04h, ER [15:0] = 13Ch, madctl (B6 = B7 = B4 = '0')

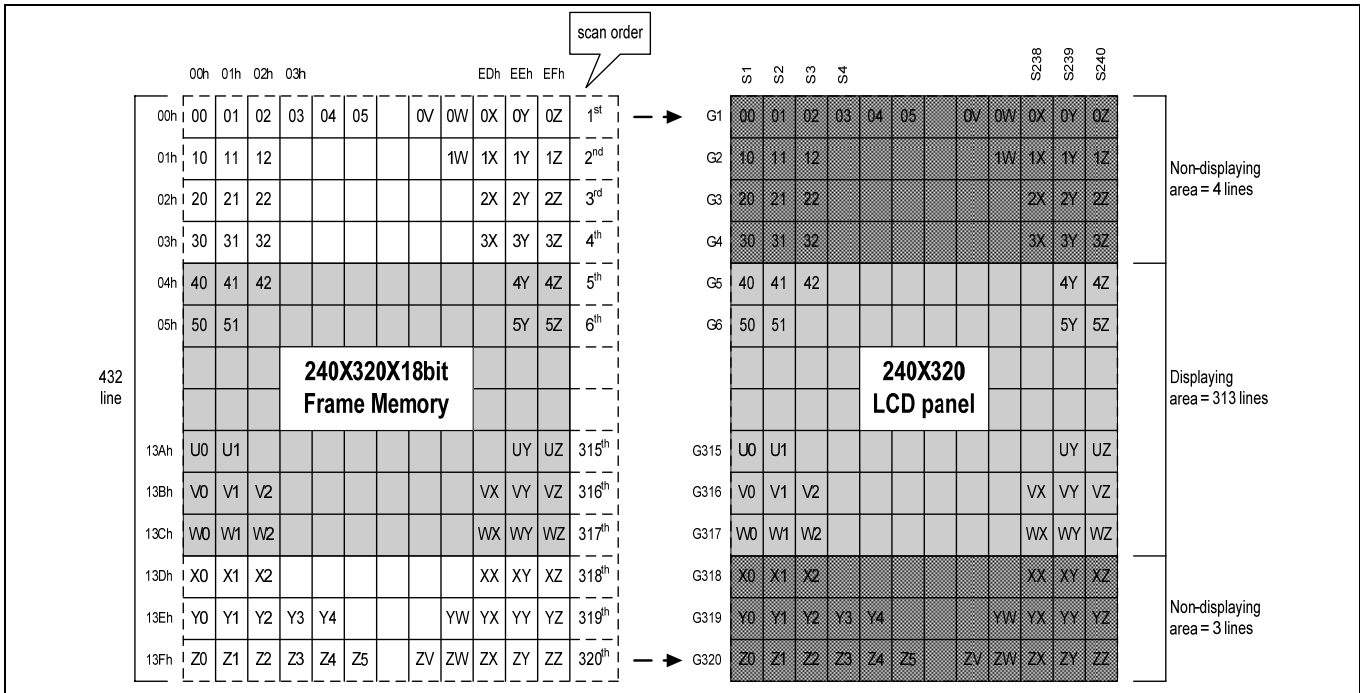
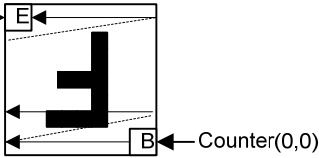
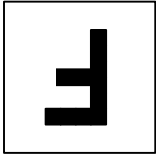
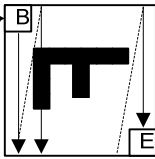
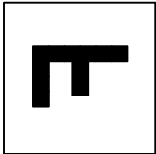
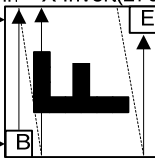
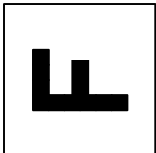
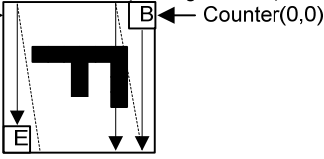
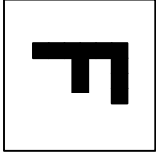
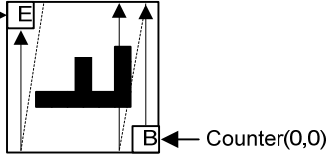
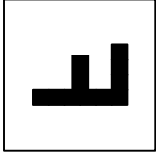


Figure73. Partial Display On: SR [15:0] = 04h, ER [15:0] = 13Ch, MADCTL (B6 = B7 = B4 = '0')

Table 64. MPU to Memory Write/Read Direction By Madctl

Note. There is not possible to avoid the tearing effect in normal display if B5=1.

| B5 B6 B7<br>(Bits) | Image in the Memory<br>("→" Means "MPU to Memory Read/Write Direction") | IMAGE in the Display |
|--------------------|-------------------------------------------------------------------------|----------------------|
| 0 0 0              | <p>Normal<br/>Memory(0,0) →</p>                                         |                      |
| 0 0 1              | <p>Y-Invert<br/>Memory(0,0) →</p> <p>Counter(0,0) →</p>                 |                      |
| 0 1 0              | <p>X-Invert<br/>Memory(0,0) →</p> <p>Counter(0,0) →</p>                 |                      |

| B5 B6 B7<br>(Bits) | Image in the Memory<br>("→" Means "MPU to Memory Read/Write Direction")                                                                                                         | IMAGE in the Display                                                                  |
|--------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|
| 0 1 1              | <p>X Invert + Y Invert<br/>Memory(0,0) →</p>                                                   |    |
| 1 0 0              | <p>Exchange Row-Column<br/>Memory(0,0) →<br/>Counter(0,0)</p>                                  |    |
| 1 0 1              | <p>Exchange Row-Column + X Invert(270 deg rotation)<br/>Memory(0,0) →<br/>Counter(0,0) →</p>  |   |
| 1 1 0              | <p>Exchange Row-Column + Y Invert(90 deg rotation)<br/>Memory(0,0) →<br/>Counter(0,0) ←</p>  |  |
| 1 1 1              | <p>Exchange Row-Column + X Invert + Y Invert<br/>Memory(0,0) →</p>                           |  |

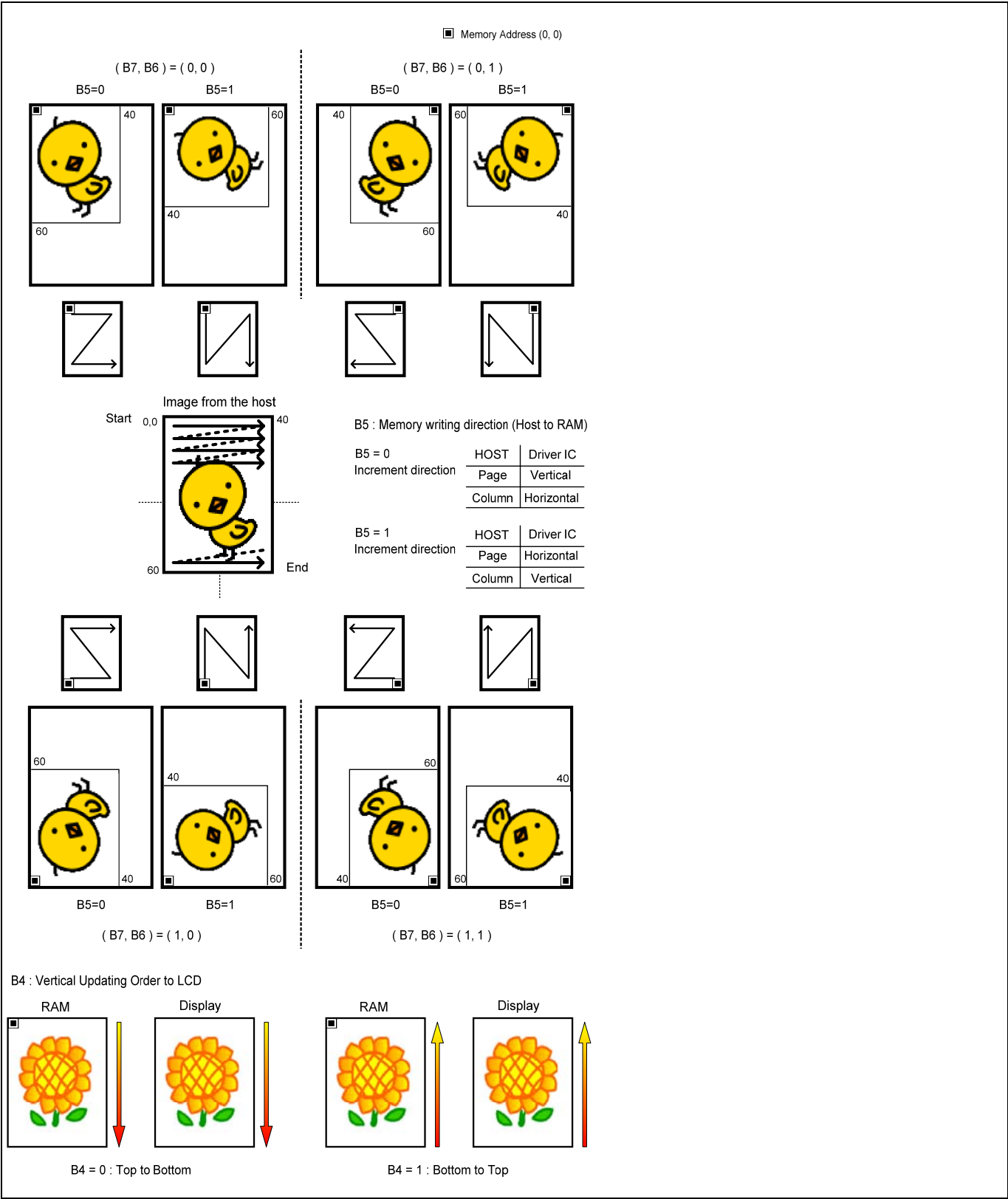


Figure74.      Example for Rotation With B7, B6, B5 and B4

4.3.3. COMMAND DEFINITION WHICH INDEPENDENT OF THE IC MOUNT POSITION

Depending on how the MADCTL command is set, the top-bottom / left-right definitions are changed in the driver IC to adapt the mounted form.

4.3.3.1. Model of LCD module for the S6D04H0

The LCD module for the S6D04H0 is shown below. The top-bottom / left-right positions, RGB filter and white or black ground defined in this development specification are in accordance with the diagram shown below.

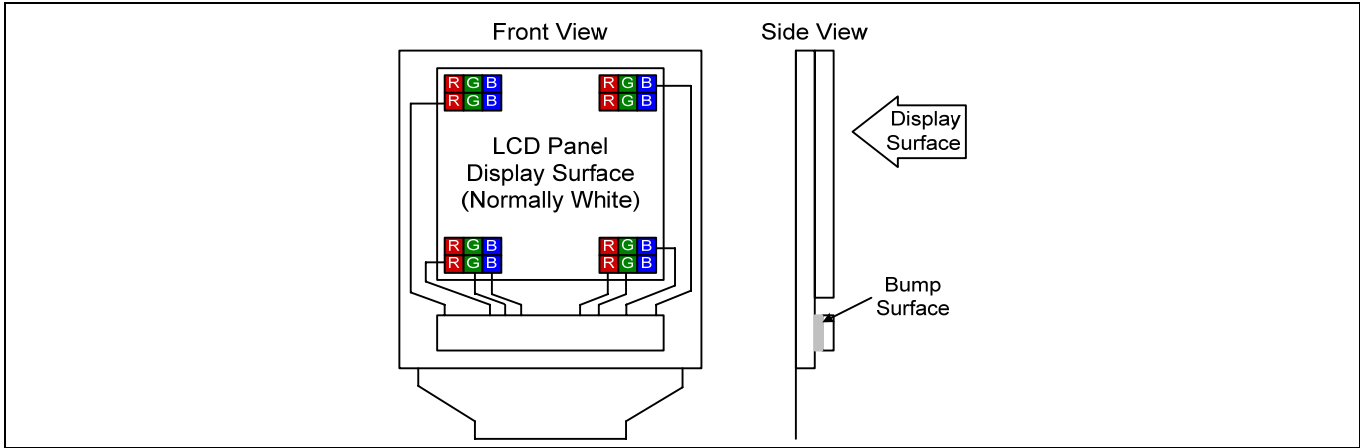


Figure75. Model of LCD Module for the S6D04H0

4.3.3.2. Position definition by IC mount

The set value of MADCTL actually used internally in the IC changes depending on how MADCTL is set. The arithmetic operation in the table below is performed on each bit.

Table 65. Position Definition by IC Mount

| MADCTL(36h) | IFCTL(F7h) | IC Internal Setting Value |
|-------------|------------|---------------------------|
| 0           | 0          | 0                         |
| 0           | 1          | 1                         |
| 1           | 0          | 1                         |
| 1           | 1          | 0                         |

The set value of MADCTL in the case in which is set to “00h” make a result in the memory access control direction as onto below.

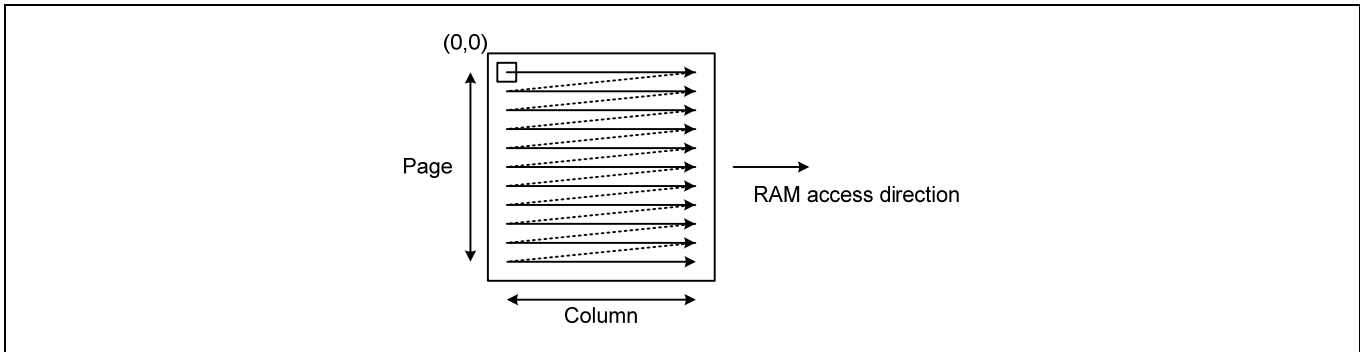


Figure76. Memory Access Control Direction

Refer to the top-bottom / left-right relationship. (The non-bump plane is the surface.)  
If the driver IC is left-mounted or right-mounted due to the device structure, the display data RAM to LCD display data readout and gate scan direction should be set left-right rather than top-bottom.

| Case of Bottom-Mounted IC                                                                                                                                                                                                                                                                                                                                                                                             |                  | Case of Top-Mounted IC |  |                            |          |                      |                  |        |             |      |             |                           |               |                          |               |                                                                                                                                                                                                                                                                                                                                                                                                                       |  |                       |  |                            |          |                      |                  |        |             |      |             |                           |               |                          |               |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------|------------------------|--|----------------------------|----------|----------------------|------------------|--------|-------------|------|-------------|---------------------------|---------------|--------------------------|---------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|-----------------------|--|----------------------------|----------|----------------------|------------------|--------|-------------|------|-------------|---------------------------|---------------|--------------------------|---------------|
|                                                                                                                                                                                                                                                                                                                                                                                                                       |                  |                        |  |                            |          |                      |                  |        |             |      |             |                           |               |                          |               |                                                                                                                                                                                                                                                                                                                                                                                                                       |  |                       |  |                            |          |                      |                  |        |             |      |             |                           |               |                          |               |
| <table><tr><th colspan="2">(Example) MADCTL(00h)</th></tr><tr><td>RAM address (0,0) Position</td><td>Left-top</td></tr><tr><td>RAM Access Direction</td><td>Column Direction</td></tr><tr><td>Column</td><td>X direction</td></tr><tr><td>Page</td><td>Y direction</td></tr><tr><td>RAM→LCD readout direction</td><td>Top to Bottom</td></tr><tr><td>Gate line scan Direction</td><td>Top to Bottom</td></tr></table> |                  | (Example) MADCTL(00h)  |  | RAM address (0,0) Position | Left-top | RAM Access Direction | Column Direction | Column | X direction | Page | Y direction | RAM→LCD readout direction | Top to Bottom | Gate line scan Direction | Top to Bottom | <table><tr><th colspan="2">(Example) MADCTL(D0h)</th></tr><tr><td>RAM address (0,0) Position</td><td>Left-top</td></tr><tr><td>RAM Access Direction</td><td>Column Direction</td></tr><tr><td>Column</td><td>X direction</td></tr><tr><td>Page</td><td>Y direction</td></tr><tr><td>RAM→LCD readout direction</td><td>Top to Bottom</td></tr><tr><td>Gate line scan Direction</td><td>Top to Bottom</td></tr></table> |  | (Example) MADCTL(D0h) |  | RAM address (0,0) Position | Left-top | RAM Access Direction | Column Direction | Column | X direction | Page | Y direction | RAM→LCD readout direction | Top to Bottom | Gate line scan Direction | Top to Bottom |
| (Example) MADCTL(00h)                                                                                                                                                                                                                                                                                                                                                                                                 |                  |                        |  |                            |          |                      |                  |        |             |      |             |                           |               |                          |               |                                                                                                                                                                                                                                                                                                                                                                                                                       |  |                       |  |                            |          |                      |                  |        |             |      |             |                           |               |                          |               |
| RAM address (0,0) Position                                                                                                                                                                                                                                                                                                                                                                                            | Left-top         |                        |  |                            |          |                      |                  |        |             |      |             |                           |               |                          |               |                                                                                                                                                                                                                                                                                                                                                                                                                       |  |                       |  |                            |          |                      |                  |        |             |      |             |                           |               |                          |               |
| RAM Access Direction                                                                                                                                                                                                                                                                                                                                                                                                  | Column Direction |                        |  |                            |          |                      |                  |        |             |      |             |                           |               |                          |               |                                                                                                                                                                                                                                                                                                                                                                                                                       |  |                       |  |                            |          |                      |                  |        |             |      |             |                           |               |                          |               |
| Column                                                                                                                                                                                                                                                                                                                                                                                                                | X direction      |                        |  |                            |          |                      |                  |        |             |      |             |                           |               |                          |               |                                                                                                                                                                                                                                                                                                                                                                                                                       |  |                       |  |                            |          |                      |                  |        |             |      |             |                           |               |                          |               |
| Page                                                                                                                                                                                                                                                                                                                                                                                                                  | Y direction      |                        |  |                            |          |                      |                  |        |             |      |             |                           |               |                          |               |                                                                                                                                                                                                                                                                                                                                                                                                                       |  |                       |  |                            |          |                      |                  |        |             |      |             |                           |               |                          |               |
| RAM→LCD readout direction                                                                                                                                                                                                                                                                                                                                                                                             | Top to Bottom    |                        |  |                            |          |                      |                  |        |             |      |             |                           |               |                          |               |                                                                                                                                                                                                                                                                                                                                                                                                                       |  |                       |  |                            |          |                      |                  |        |             |      |             |                           |               |                          |               |
| Gate line scan Direction                                                                                                                                                                                                                                                                                                                                                                                              | Top to Bottom    |                        |  |                            |          |                      |                  |        |             |      |             |                           |               |                          |               |                                                                                                                                                                                                                                                                                                                                                                                                                       |  |                       |  |                            |          |                      |                  |        |             |      |             |                           |               |                          |               |
| (Example) MADCTL(D0h)                                                                                                                                                                                                                                                                                                                                                                                                 |                  |                        |  |                            |          |                      |                  |        |             |      |             |                           |               |                          |               |                                                                                                                                                                                                                                                                                                                                                                                                                       |  |                       |  |                            |          |                      |                  |        |             |      |             |                           |               |                          |               |
| RAM address (0,0) Position                                                                                                                                                                                                                                                                                                                                                                                            | Left-top         |                        |  |                            |          |                      |                  |        |             |      |             |                           |               |                          |               |                                                                                                                                                                                                                                                                                                                                                                                                                       |  |                       |  |                            |          |                      |                  |        |             |      |             |                           |               |                          |               |
| RAM Access Direction                                                                                                                                                                                                                                                                                                                                                                                                  | Column Direction |                        |  |                            |          |                      |                  |        |             |      |             |                           |               |                          |               |                                                                                                                                                                                                                                                                                                                                                                                                                       |  |                       |  |                            |          |                      |                  |        |             |      |             |                           |               |                          |               |
| Column                                                                                                                                                                                                                                                                                                                                                                                                                | X direction      |                        |  |                            |          |                      |                  |        |             |      |             |                           |               |                          |               |                                                                                                                                                                                                                                                                                                                                                                                                                       |  |                       |  |                            |          |                      |                  |        |             |      |             |                           |               |                          |               |
| Page                                                                                                                                                                                                                                                                                                                                                                                                                  | Y direction      |                        |  |                            |          |                      |                  |        |             |      |             |                           |               |                          |               |                                                                                                                                                                                                                                                                                                                                                                                                                       |  |                       |  |                            |          |                      |                  |        |             |      |             |                           |               |                          |               |
| RAM→LCD readout direction                                                                                                                                                                                                                                                                                                                                                                                             | Top to Bottom    |                        |  |                            |          |                      |                  |        |             |      |             |                           |               |                          |               |                                                                                                                                                                                                                                                                                                                                                                                                                       |  |                       |  |                            |          |                      |                  |        |             |      |             |                           |               |                          |               |
| Gate line scan Direction                                                                                                                                                                                                                                                                                                                                                                                              | Top to Bottom    |                        |  |                            |          |                      |                  |        |             |      |             |                           |               |                          |               |                                                                                                                                                                                                                                                                                                                                                                                                                       |  |                       |  |                            |          |                      |                  |        |             |      |             |                           |               |                          |               |



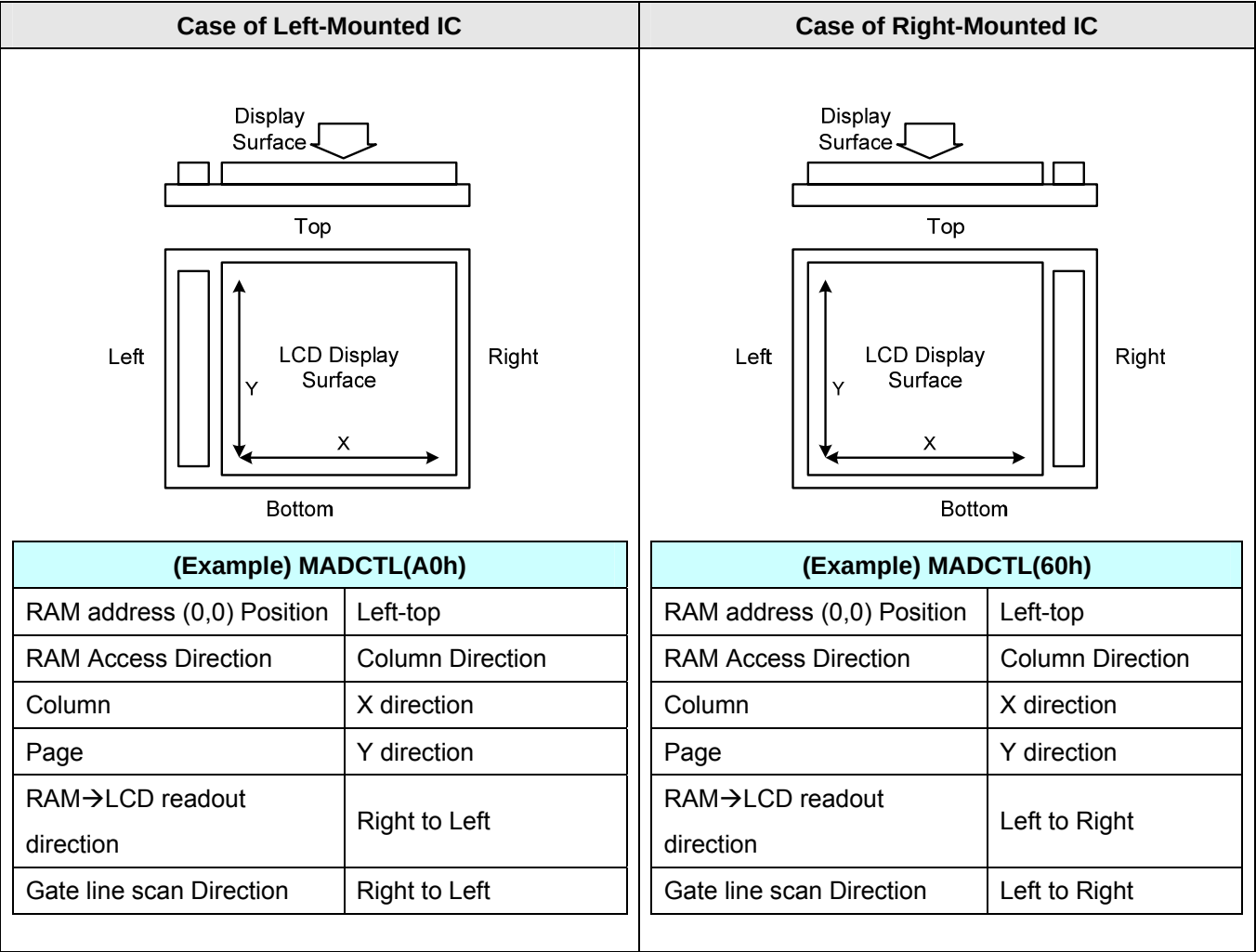


Figure77. Relationship of Each Direction

4.3.4. 0-ADDRESS POSITION AND RAM ACCESS SCAN DIRECTION

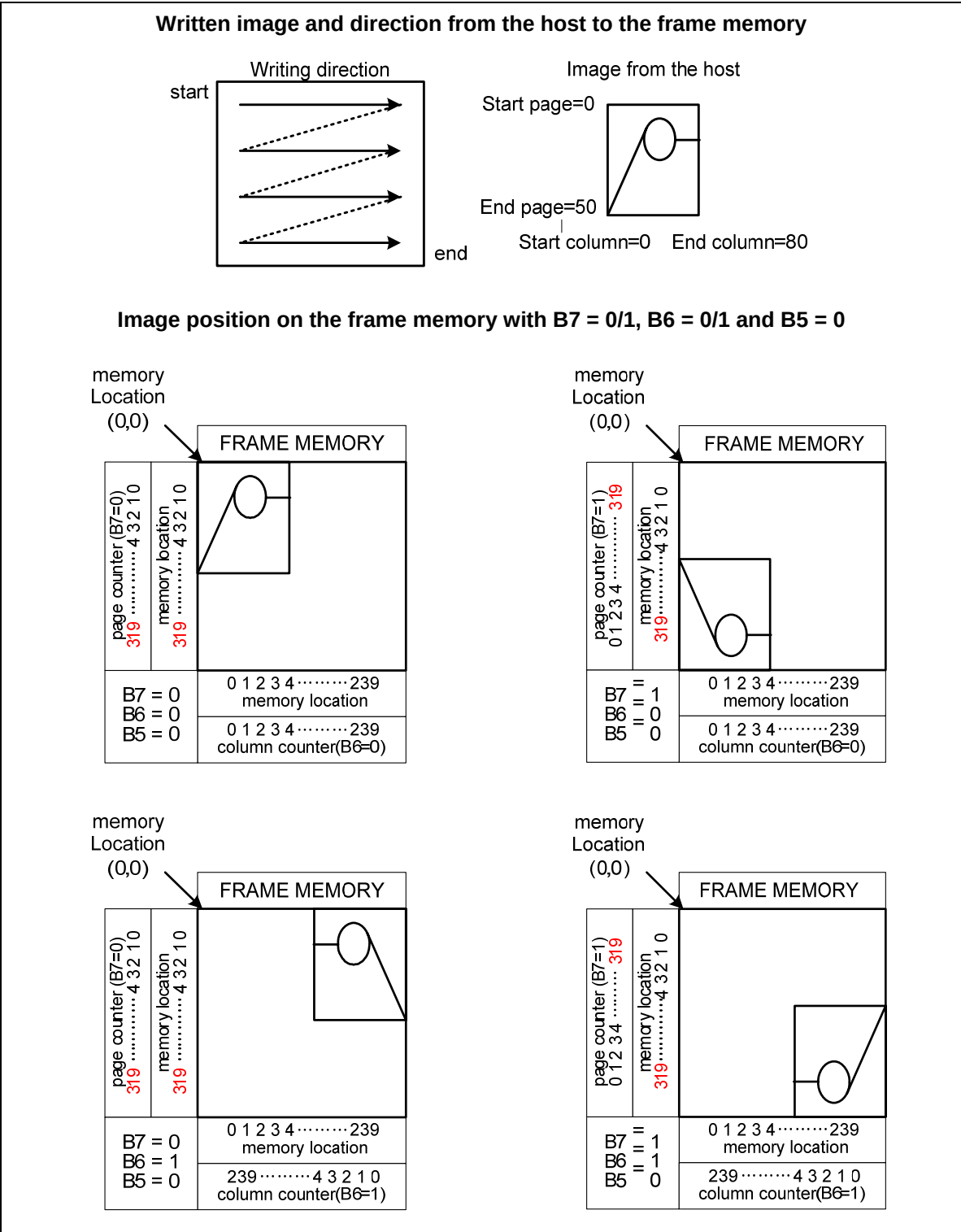


Figure78.    Refer to MADCTL (MADCTL=00h)

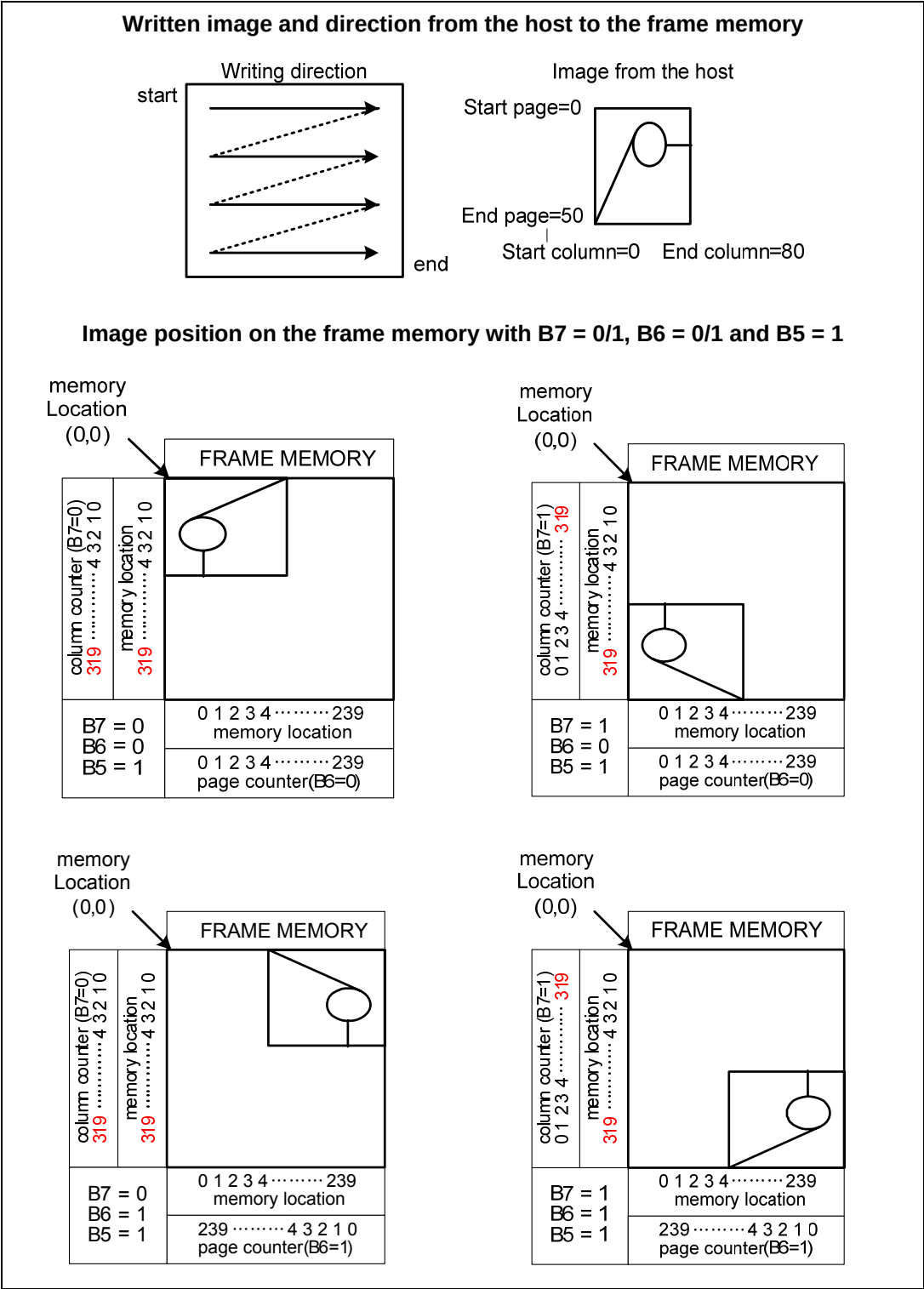


Figure79.      Refer to MADCTL (MADCTL=00h)

## 4.4. MTP CONTROL

### 4.4.1. MTP CONTROL IN INTERNAL MODE

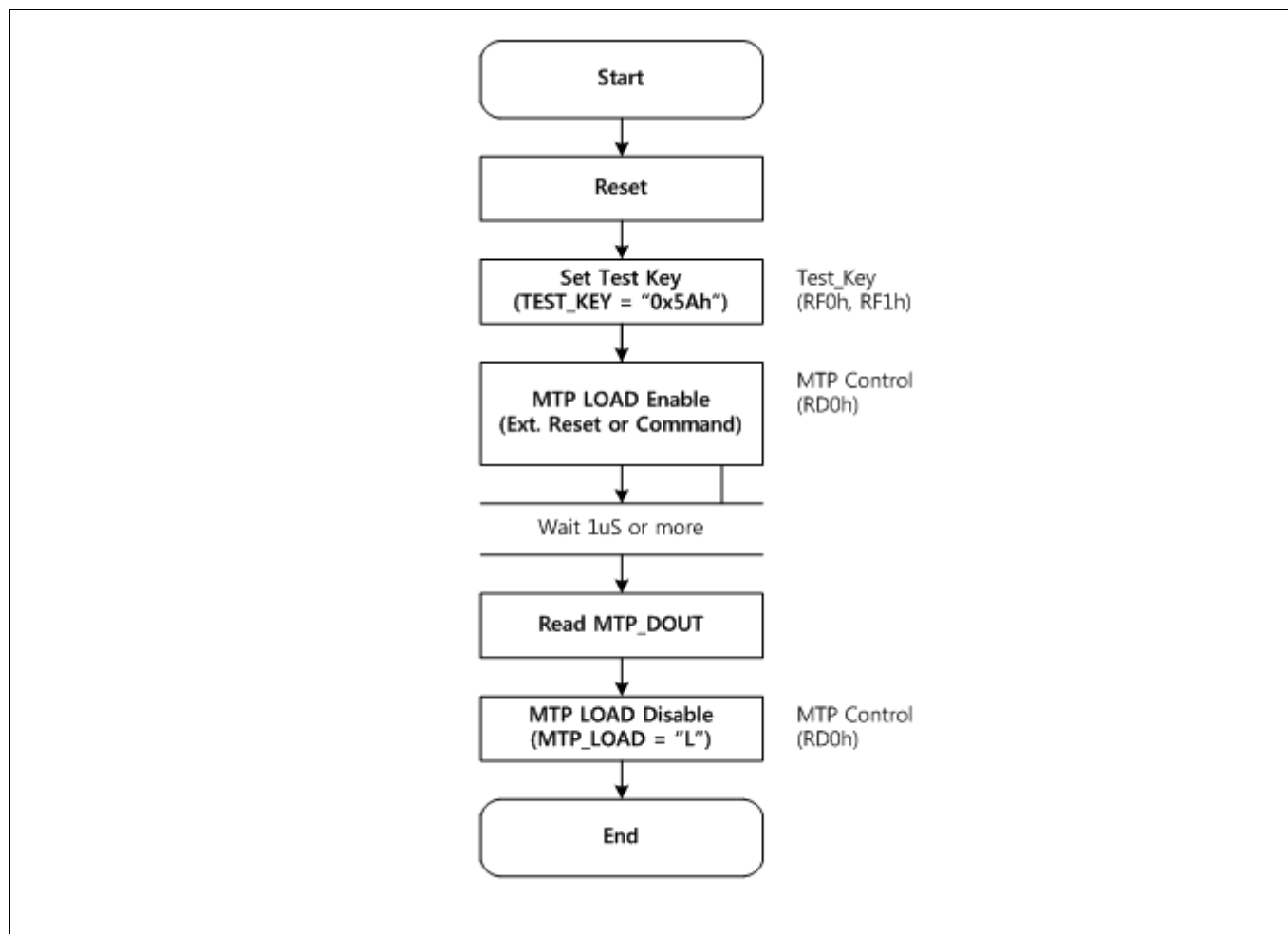


Figure80. Flow of MTP Load / Read

## 4.4.1.1. Using VCI1 for MTP at Internal Power Mode

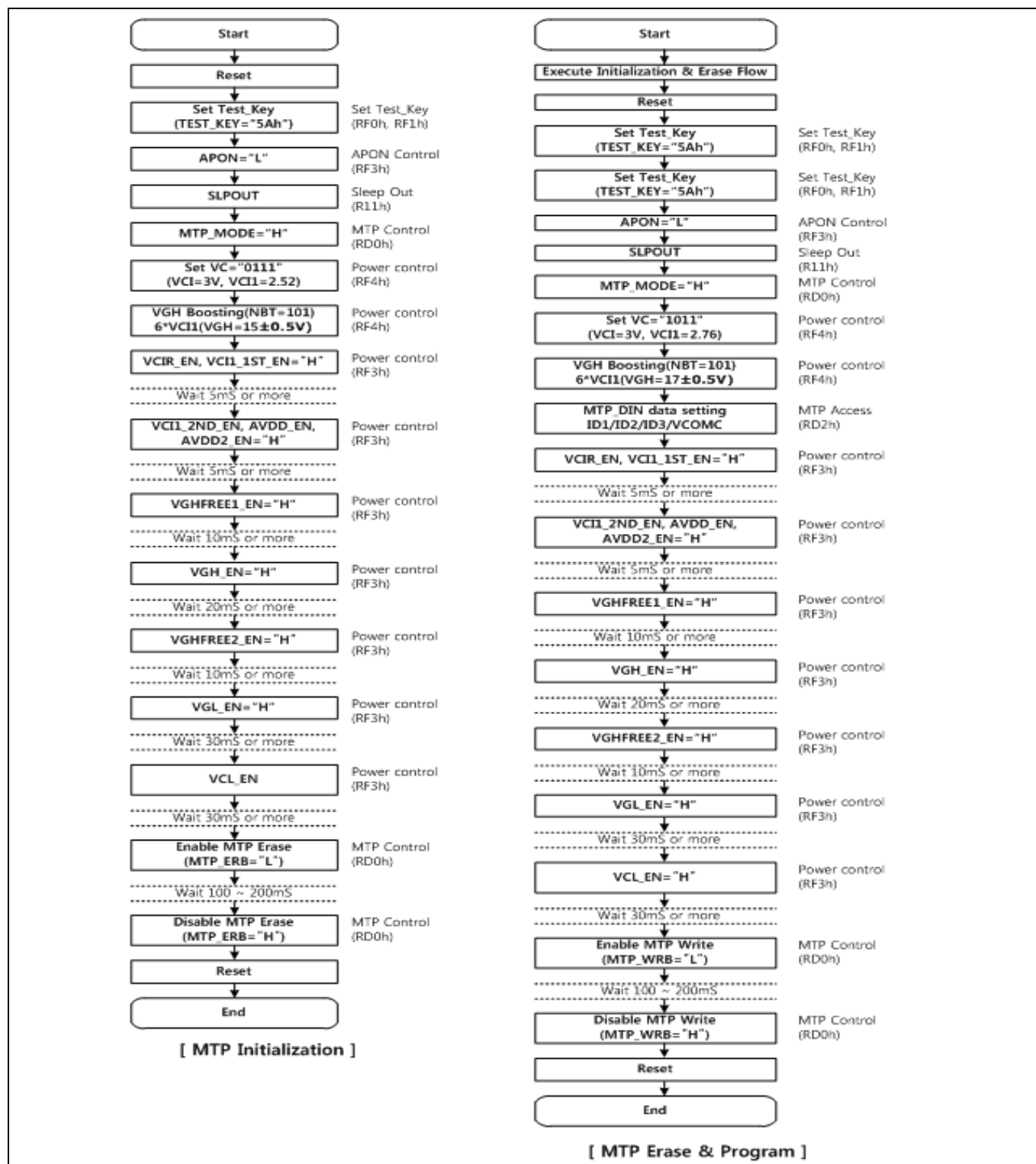


Figure81. MTP Initialization, Erase and Program Internal Power Mode(VCI1)

## 4.4.1.2. Using VCI for MTP at Internal Power Mode

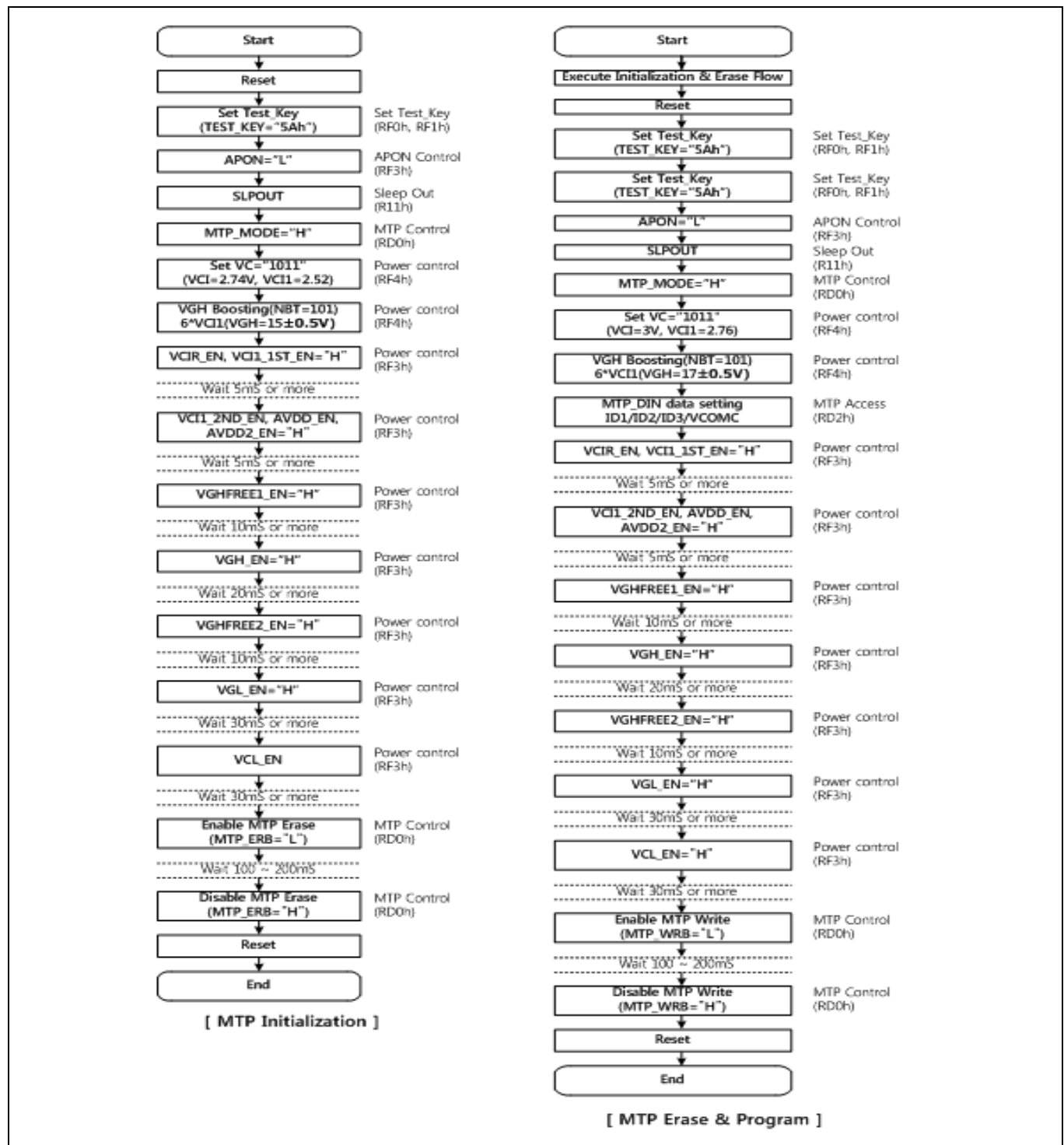


Figure82. MTP Initialization, Erase and Program Internal Power Mode(VCI)

## 4.4.1.3. Using External Power for MTP

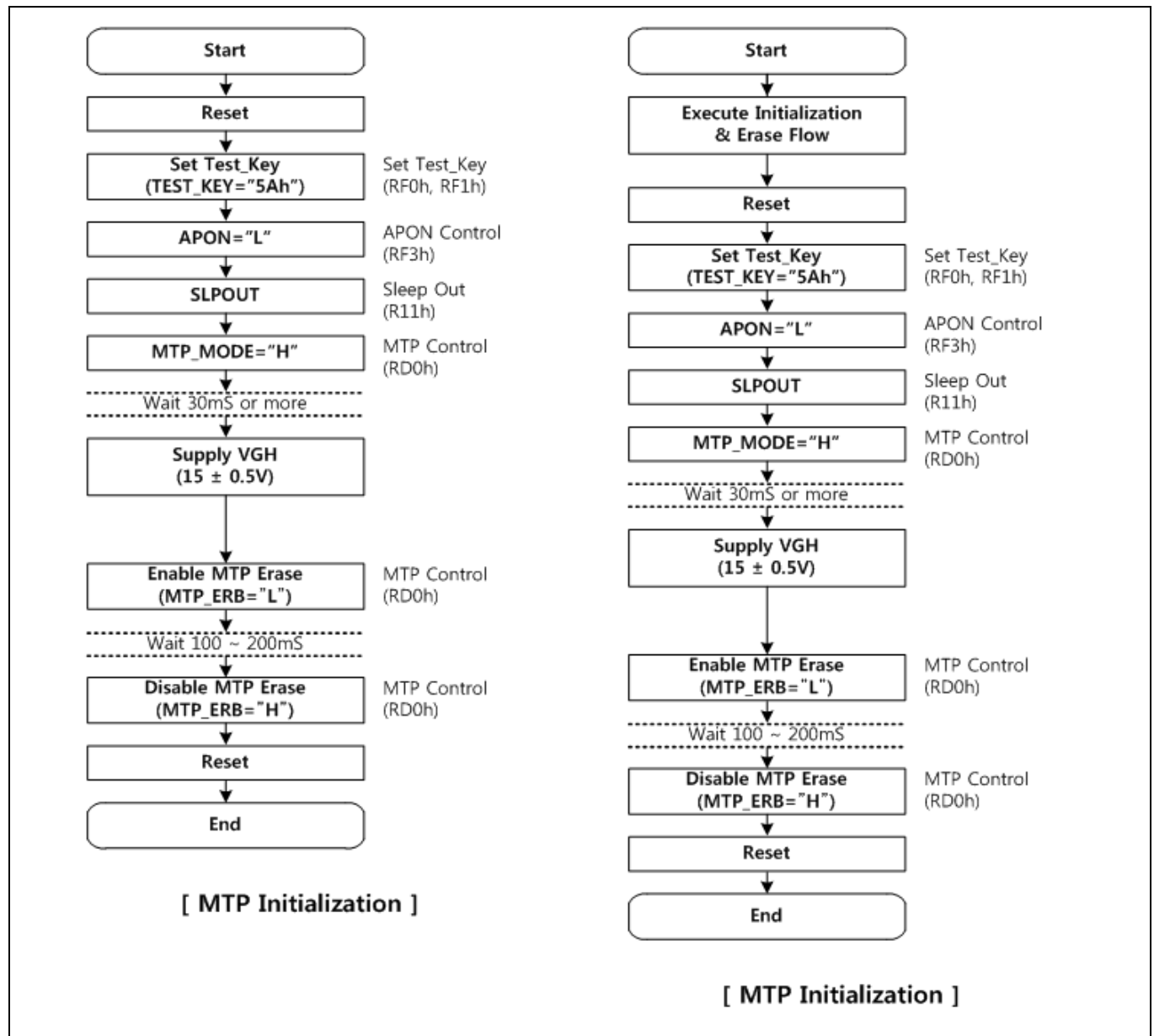


Figure83. MTP Initialization, Erase and Program External Power Mode

4.4.2. TIMING OF MTP CONTROL

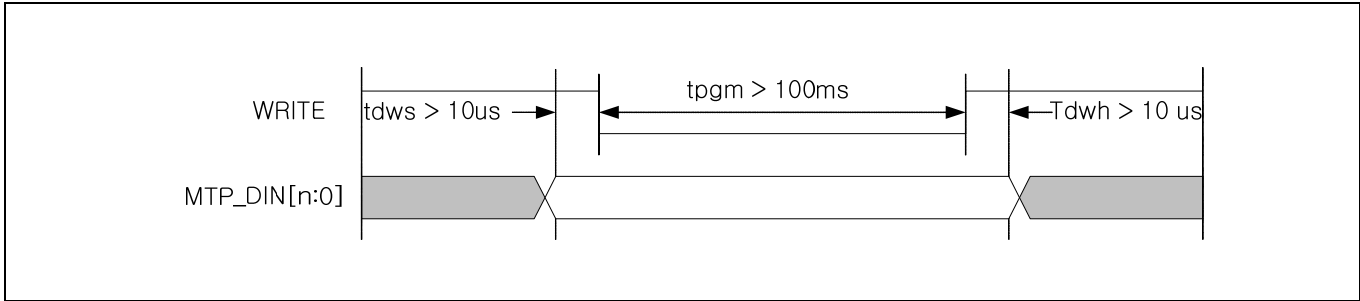


Figure84. Timing of MTP Program

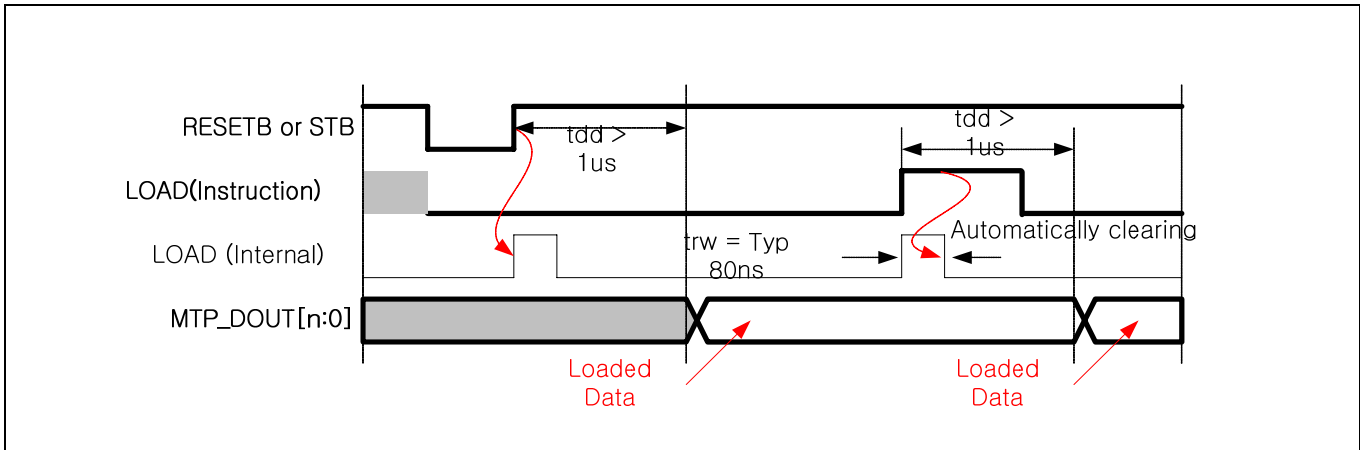


Figure85. Timing of MTP Load



#### 4.5. TEARING EFFECT OUTPUT LINE

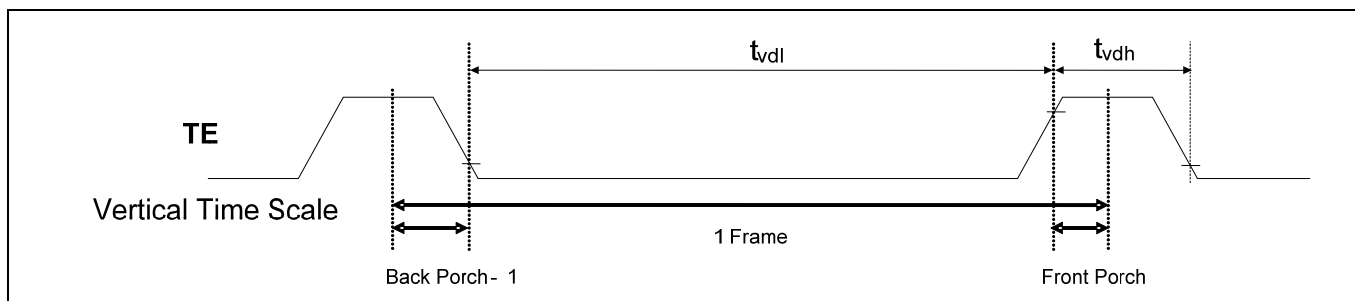
Tearing Effect is the effect that the overwritten two frames are shown as they are torn when Display Data RAM (DDRAM) is updated during Display Driver IC (DDI) scans the panel. This effect caused by the asynchronous timing between scanning of the DDI timing controller and frame transfer of the host processor.

To help the host processor avoid this effect, DDI generates Tearing Effect output line (TE) signal which has the timing of the period in which the DDI does not do panel-scan and the timing of vertical or horizontal synchronization. Host processor can avoid Tearing Effect by transfer only during TE signal is high.

The period in which the DDI does not panel-scan is the vertical blanking time. By TEON Command (35h) with parameter 0, the host can make the TE pin high in the vertical blanking time. With parameter 1, the TE signal includes the vertical blanking time and horizontal sync. By TEOFF Command (34h), the host can turn off the TE signal and this is the default state.

#### 4.5.1. TEARING EFFECT LINE MODES

Mode 1, TEON (35h) Command, Parameter 0: The Tearing Effect Output signal consists of V-Blanking Information only

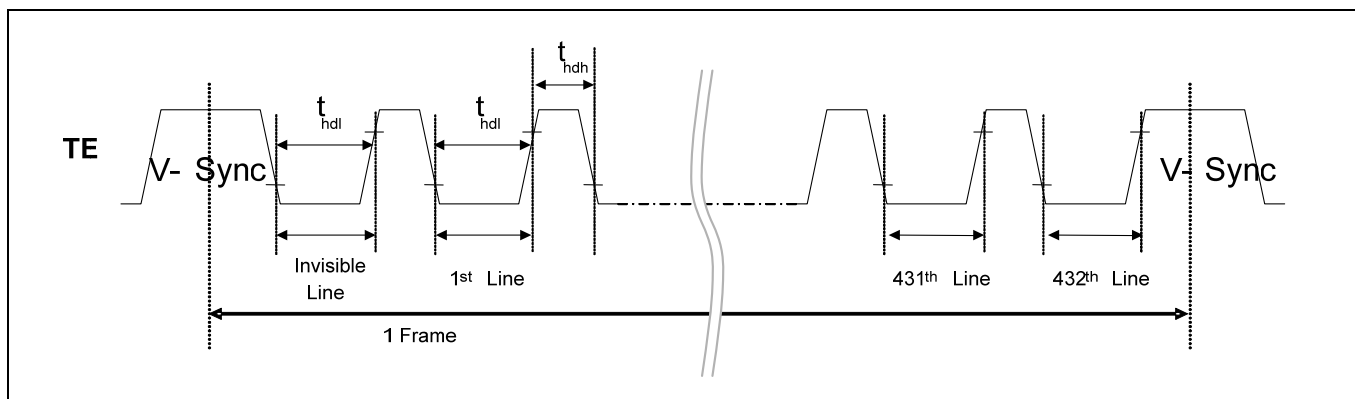


**Figure86. Tearing Effect Line Mode 1**

$t_{vdh}$  = The LCD display is not updated from the Frame Memory

$t_{vdl}$  = The LCD display is updated from the Frame Memory(except Invisible Line – see below).

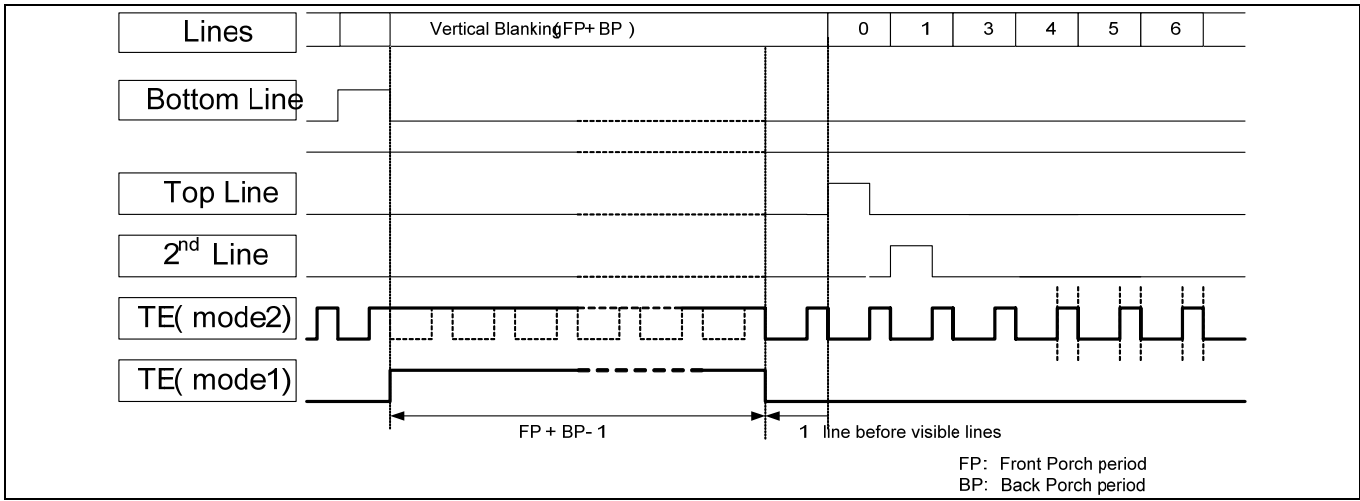
Mode 2, TEON (35h) Command, Parameter 1: the Tearing Effect Output signal consists of V-Blanking and H-Sync



**Figure87. Tearing Effect Line Mode 2**

$t_{hdh}$  = The LCD display is not updated from the Frame Memory

$t_{hdl}$  = The LCD display is updated from the Frame Memory(except Invisible Line – see below).



**Note.**

During Sleep In Mode, the Tearing Effect Pin Output is Low.

4.5.2. TEARING EFFECT LINE TIMINGS

The Tearing Effect signal is described below

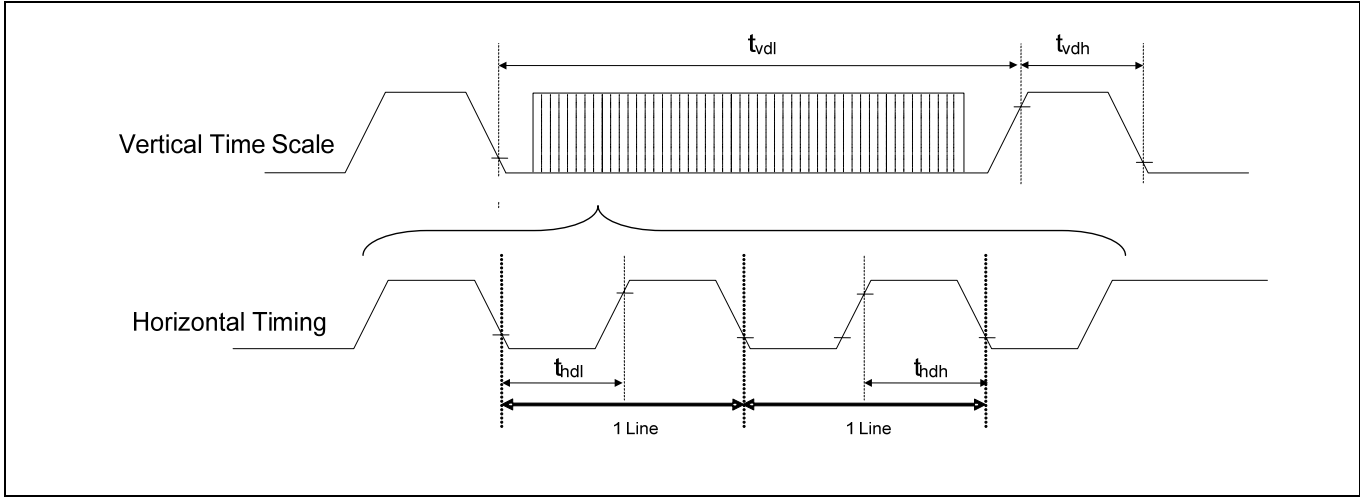


Figure88. Tearing Effect Line Timing

Table 66. AC Characteristics of Tearing Effect Signal

| Symbol           | Parameter                       | Min  | Max | Unit | Description |
|------------------|---------------------------------|------|-----|------|-------------|
| t <sub>vdl</sub> | Vertical Timing Low Duration    | -    | -   | ms   |             |
| t <sub>vdh</sub> | Vertical Timing High Duration   | 1000 | -   | μs   |             |
| t <sub>hdl</sub> | Horizontal Timing Low Duration  | -    | -   | μs   |             |
| t <sub>hdh</sub> | Horizontal Timing High Duration | -    | 500 | μs   |             |

Note.

1. Idle Mode Off/On (Frame Rate = 60 Hz)
2. The signal's rise and fall times ( $t_r$ ,  $t_f$ ) are stipulated to be equal to or less than 15ns.

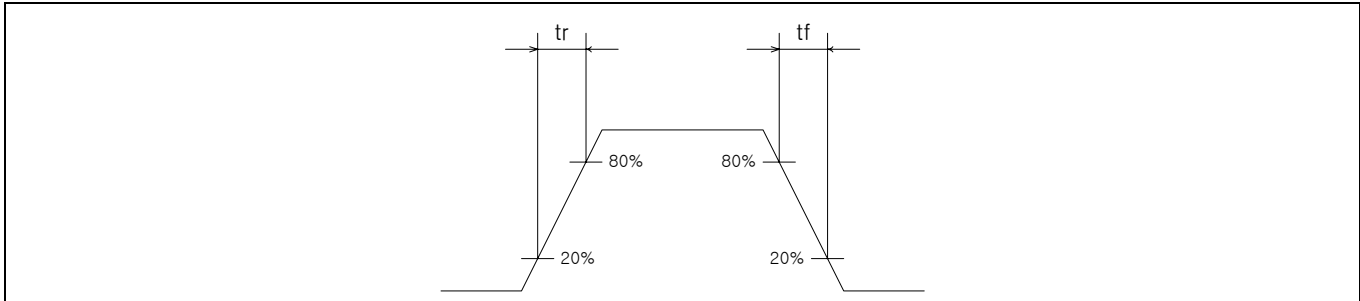


Figure89. Rising and Falling Times

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

## 4.6. SLEEP OUT COMMAND AND SELF-DIAGNOSTIC FUNCTIONS

### 4.6.1. REGISTER LOADING DETECTION

Sleep out command (See “Sleep out (11h) command”) is a trigger for an internal function of the display module which indicates, if the display module loading function of factory default values from EEPROM (or similar device) to registers of the display controller is working properly.

There are compared factory values of the EEPROM and register values of the display controller by the display controller (1<sup>st</sup> step: Compares register and EEPROM) values, 2<sup>nd</sup> step: Loads EEPROM value to register. If those both values (EEPROM and register values) are same, there is inverted (= increased by 1) a bit, which is defined in command 5.1.10 “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 (= not increased by 1).

The flow chart for this internal function is following:

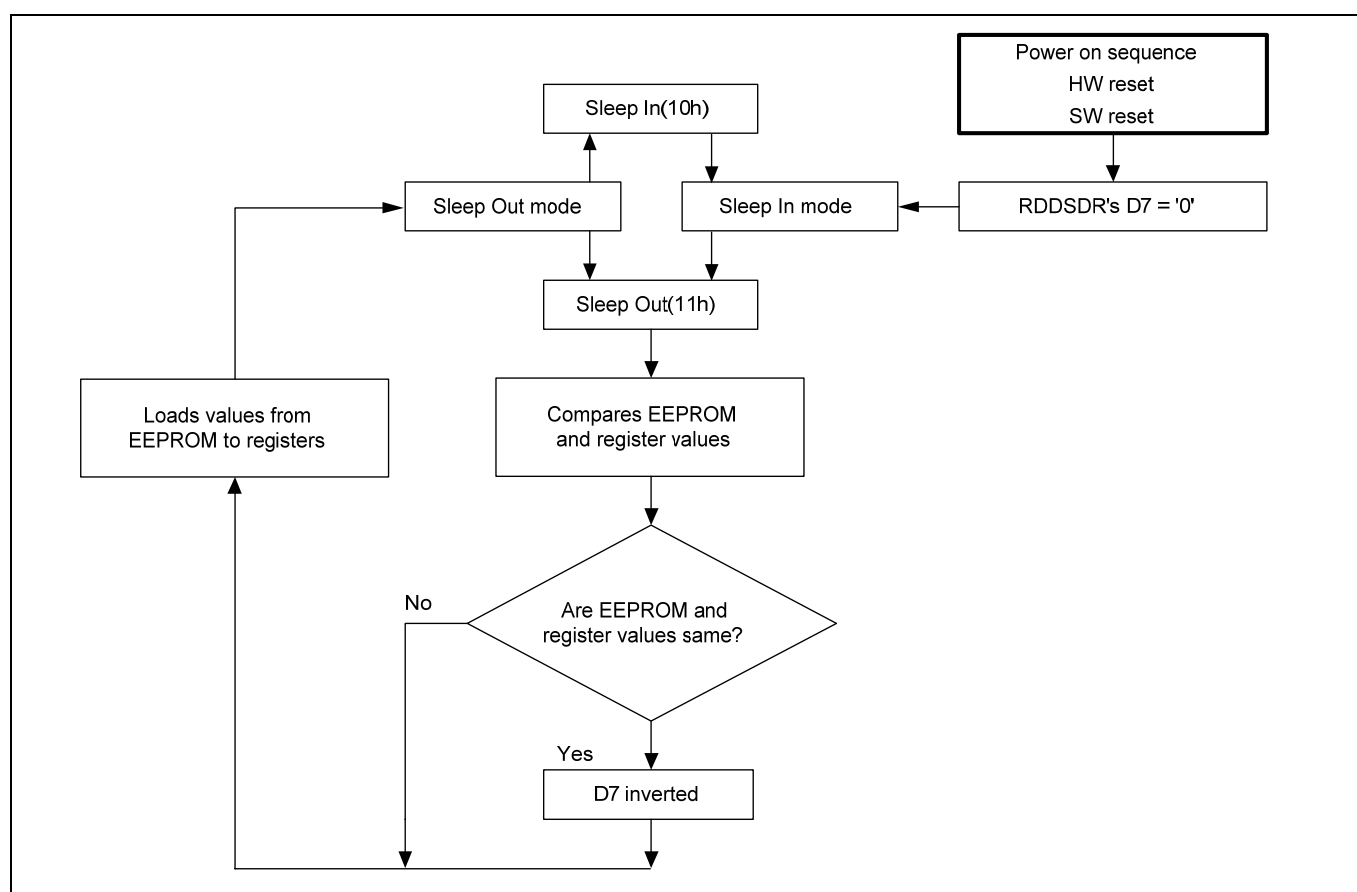


Figure90. Flowchart of Register Loading Detection

**Note.**

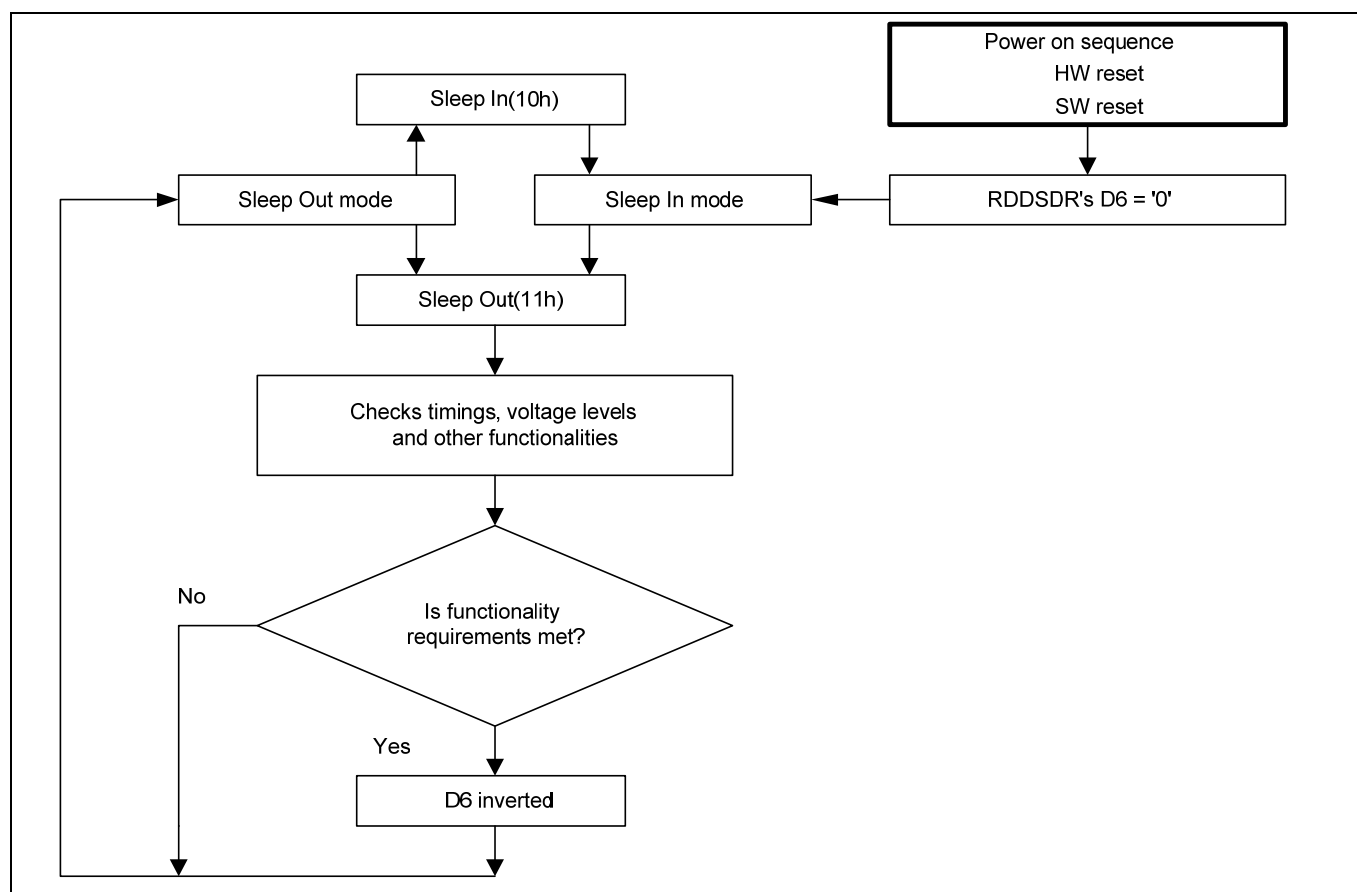
There is not compared and loaded register values, which can be changed by the display module.

#### 4.6.2. FUNCTIONALITY DETECTION

Sleep out command (See section 5.1.12 “Sleep Out (11h) command”) 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 is still meeting functionality requirements (e.g. step up circuit voltage levels, timings, etc.) If functionality requirement is met, there is inverted (=increased by 1) a bit, which defined in command 5.1.10 “Read Display Self-Diagnostic Result (0Fh)” (= RDDSDR) (The used bit of this command is D6). If functionality requirement is not same, this bit (D6) is not inverted (= not increased by 1).

The flow chart for this internal function is following:



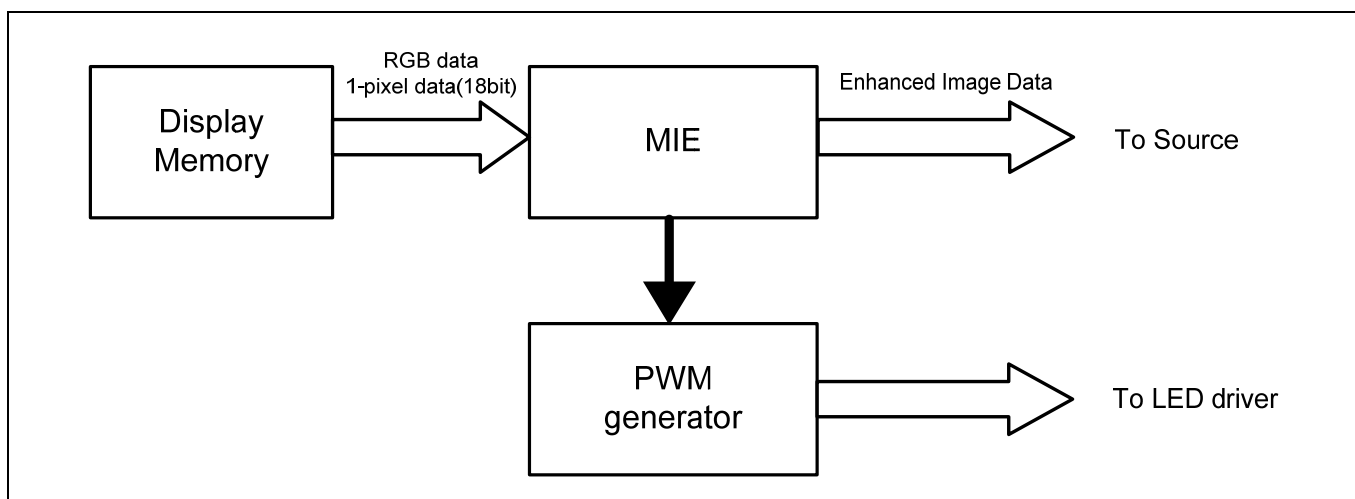
**Figure91. Flowchart of Functionality Detection**

**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 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.

## 4.7. MIE FUNCTION

S6D04H0 has a special image enhancement function. MIE (Mobile Image Enhancement) reduces power consumption of backlight unit by adaptive enhancement of luminance and contrast. According the brightness enhancement rate of input image, the power reduction of BLU is controlled automatically.'



**Figure92. Flowchart of MIE Function**

When MIE is enabled, MIE dynamically changes the brightness of backlight unit by on-chip PWM Generator. Host can control the rate of BLU power reduction by setting RRC value (Refer to E9h Command.)

When MIE is enabled, the enhanced data is applied after written Display Memory data and in case MIE mode, data transfer shift register method to Source block. Host processor should select movie or still-Image mode (Refer to E9h Command).

\*MIE applied, ML = 1'b0. Recommended MIE applied, when ML = 1'b0.

## 4.8. DEEP STANDBY MODE

### 4.8.1. DEEP STANDBY SEQUENCE

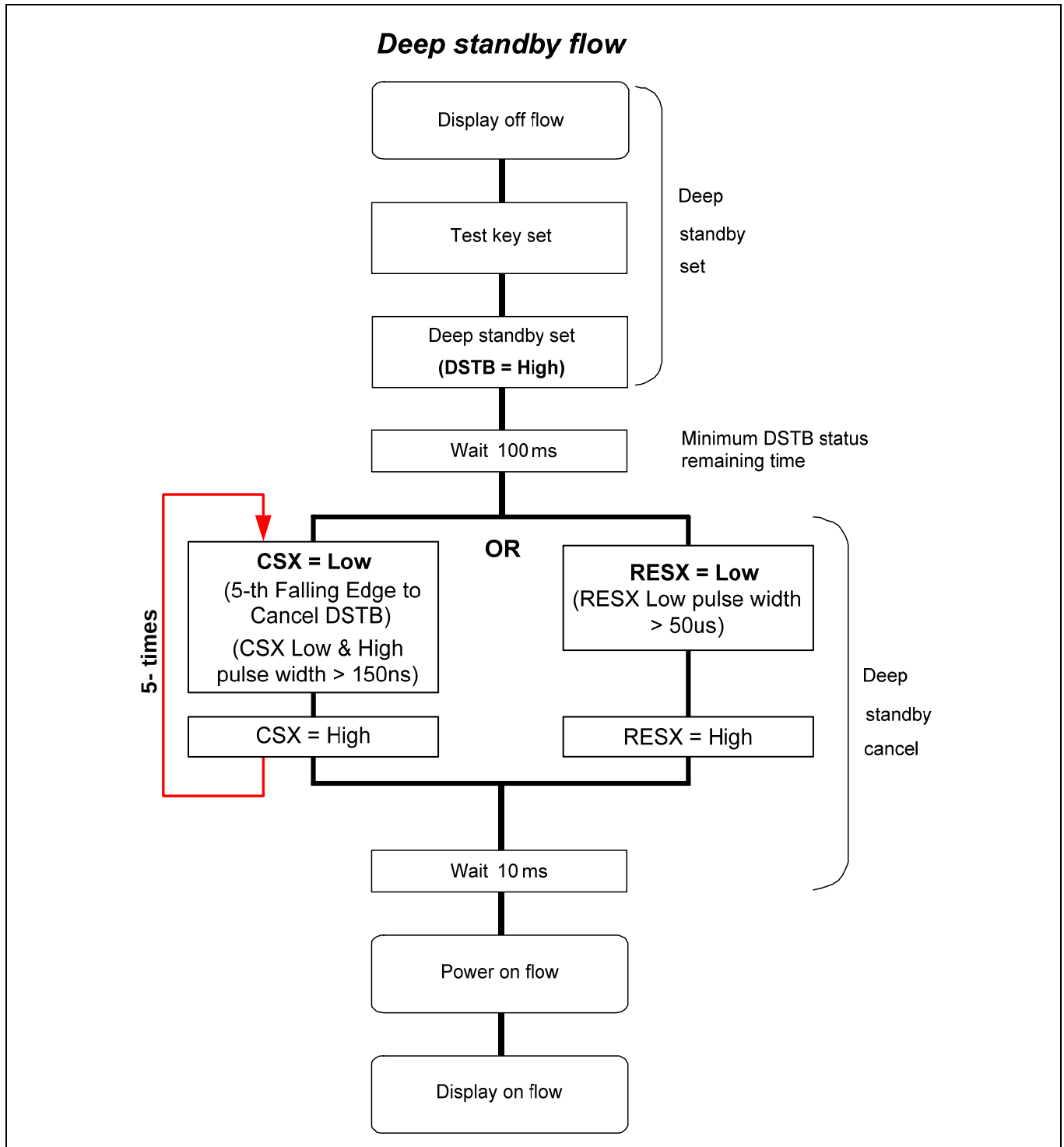


Figure93. Flowchart of Deep Standby Mode



4.8.2. DEEP STANDBY EXIT FLOW

4.8.2.1. Using CSX to wake-up

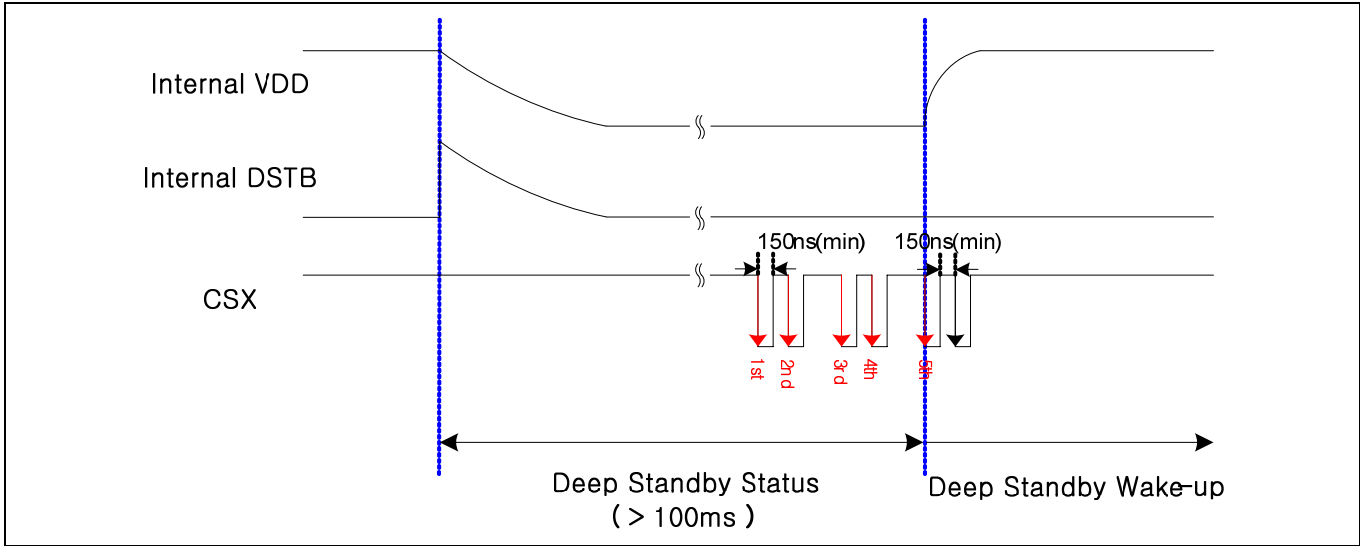


Figure94. Using CSX to Wake-Up

4.8.2.2. Using RESX to wake-up

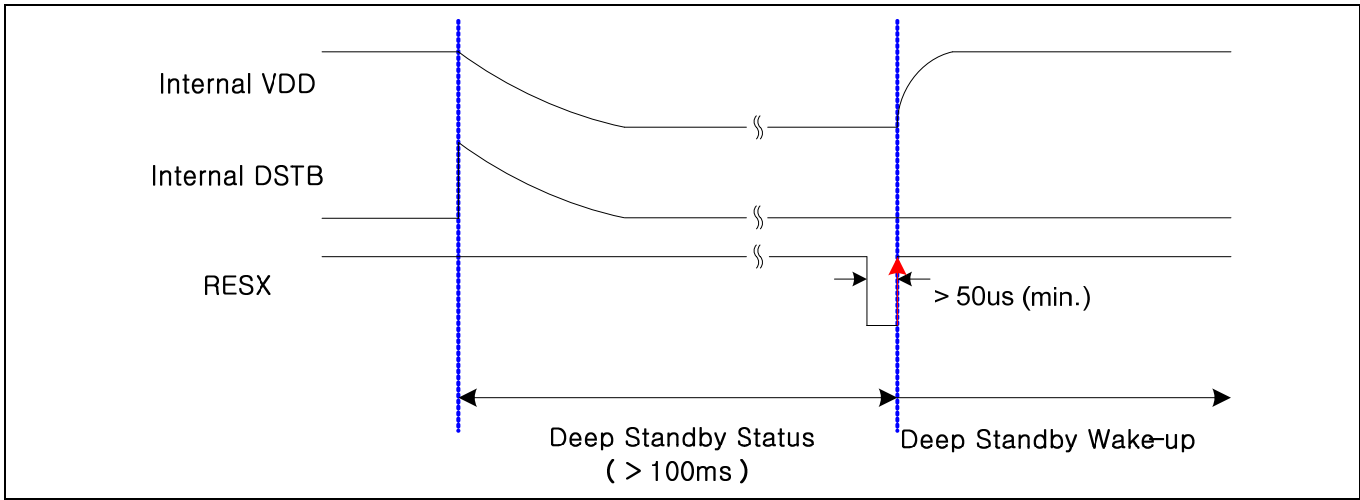


Figure95. Using RESX to Wake-Up

4.8.3. DEEP STANDBY ENTER FLOW

4.8.3.1. During display state

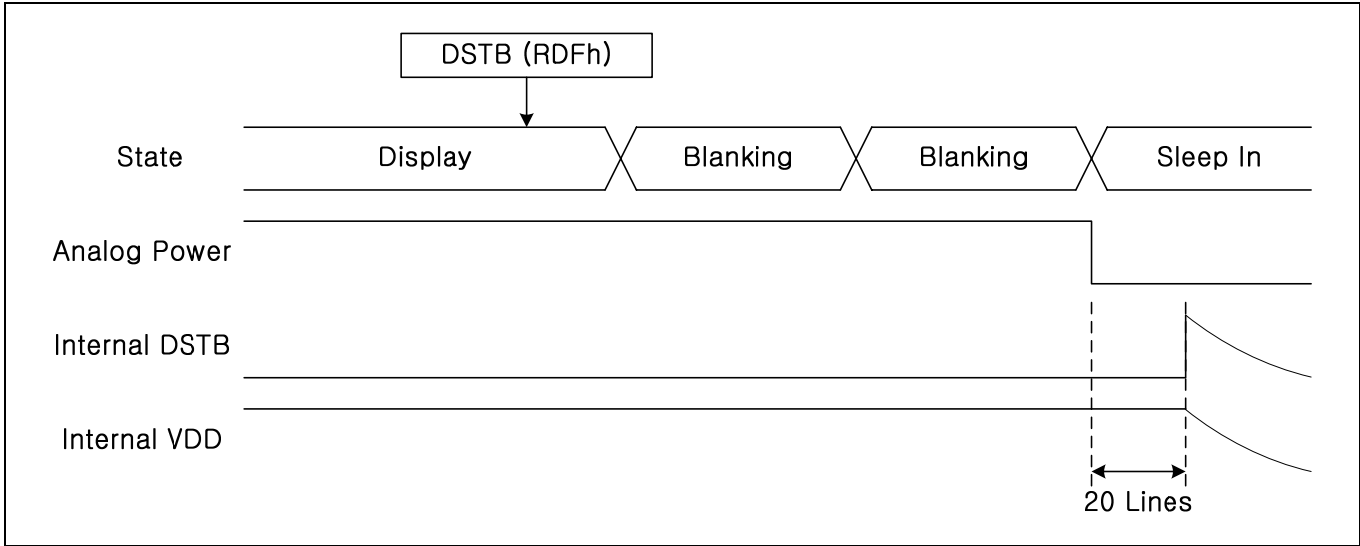


Figure96. DSTB Enter During Display State

4.8.3.2. During sleep in state

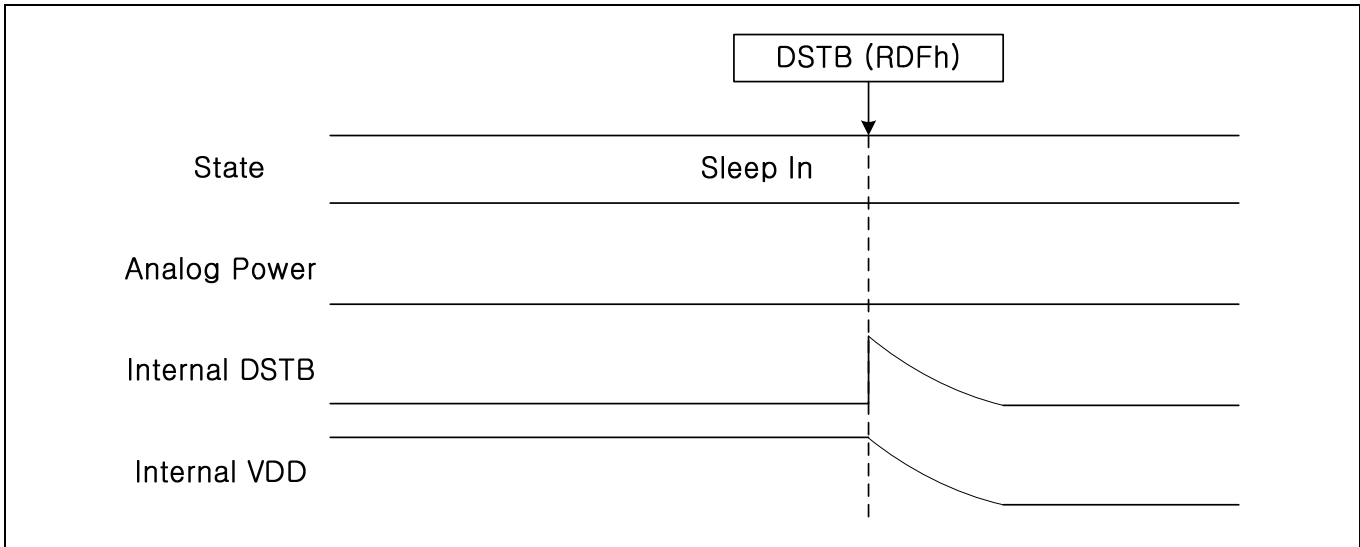


Figure97. DSTB Enter During Sleep in State

4.9. DISPLAY ON/OFF SEQUENCE

4.9.1. DISPLAY ON SEQUENCE

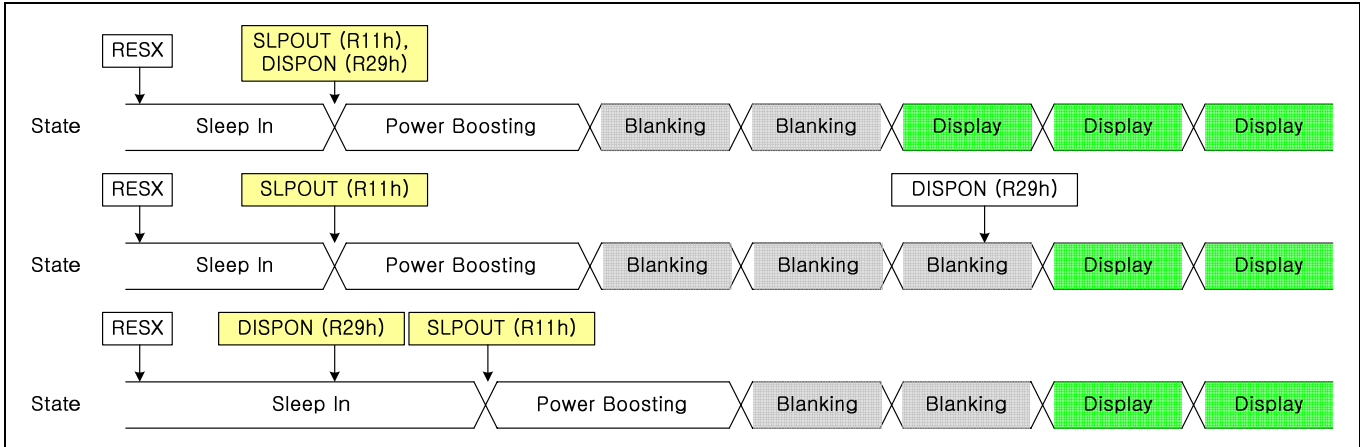


Figure98. Display On Sequence (APON=1)

4.9.2. DISPLAY OFF SEQUENCE

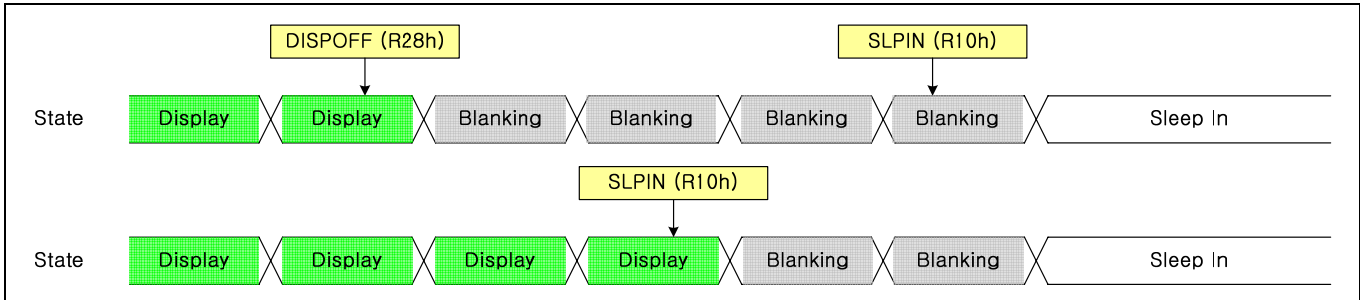


Figure99. Display Off Sequence (APON=1)

## CHAPTER 5

# COMMAND

- 5.1 Description of Level 1 Command
- 5.2 Description of Level 2 Command

# 5. COMMAND

## 5.1. DESCRIPTION OF LEVEL 1 COMMAND

Table 67. List of Level 1 Command

| Operational Code (HEX) | Function                                | Read/Write/ Command | Number of Parameter | Parameters                                                                           |
|------------------------|-----------------------------------------|---------------------|---------------------|--------------------------------------------------------------------------------------|
| 00                     | No Operation                            | C                   | 0                   | -                                                                                    |
| 01                     | Software Reset                          | C                   | 0                   | -                                                                                    |
| 04                     | Read Display Identification Information | R                   | 4                   |                                                                                      |
| 09                     | Read Display Status                     | R                   | 5                   |                                                                                      |
| 0A                     | Read Display Power Mode                 | R                   | 2                   |                                                                                      |
| 0B                     | Read Display MADCTL                     | R                   | 2                   |                                                                                      |
| 0C                     | Read Display Pixel Format               | R                   | 2                   |                                                                                      |
| 0D                     | Read Display Image Mode                 | R                   | 2                   |                                                                                      |
| 0E                     | Read Display Signal Mode                | R                   | 2                   |                                                                                      |
| 0F                     | Read Display Self Diagnostic Result     | R                   | 2                   |                                                                                      |
| 10                     | Sleep In                                | C                   | 0                   | -                                                                                    |
| 11                     | Sleep Out                               | C                   | 0                   | -                                                                                    |
| 12                     | Partial Mode On                         | C                   | 0                   | -                                                                                    |
| 13                     | Normal Display Mode On                  | C                   | 0                   | -                                                                                    |
| 20                     | Display Inversion Off                   | C                   | 0                   | -                                                                                    |
| 21                     | Display Inversion On                    | C                   | 0                   | -                                                                                    |
| 26                     | Gamma Set                               | W                   | 1                   | format: 1 byte for curve selection                                                   |
| 28                     | Display Off                             | C                   | 0                   | -                                                                                    |
| 29                     | Display On                              | C                   | 0                   | -                                                                                    |
| 2A                     | Column Address Set                      | W                   | 4                   | format:<br>2 byte for leftmost Column counter<br>2 byte for rightmost Column counter |

| Operational Code (HEX) | Function                         | Read/Write/Command | Number of Parameter | Parameters                                                                                                                         |
|------------------------|----------------------------------|--------------------|---------------------|------------------------------------------------------------------------------------------------------------------------------------|
| 2B                     | Page Address Set                 | W                  | 4                   | format:<br>2 byte for top line pointer<br>2 byte for bottom line pointer                                                           |
| 2C                     | Memory Write                     | W                  | Any Length          | Successive video data stream Format in all color modes                                                                             |
| 2E                     | Memory Read                      | R                  | Any length          | Successive video data stream Format in all color modes.                                                                            |
| 30                     | Partial Area                     | W                  | 4                   | format:<br>2 byte for top line pointer<br>2 byte for bottom line pointer                                                           |
| 33                     | Vertical Scrolling Definition    | W                  | 6                   | format:<br>2 byte for fixed area top line pointer<br>2 byte for scrolling area height<br>2 byte for fixed area bottom line pointer |
| 34                     | Tearing Effect Line Off          | C                  | 0                   | -                                                                                                                                  |
| 35                     | Tearing Effect Line On           | W                  | 1                   | 1 byte for Tearing Effect Line Mode selection                                                                                      |
| 36                     | Memory Data Access Control       | W                  | 1                   | 1 byte for memory scan direction                                                                                                   |
| 37                     | Vertical Scrolling Start Address | W                  | 2                   | 2 byte for line pointer                                                                                                            |
| 38                     | Idle Mode Off                    | C                  | 0                   | -                                                                                                                                  |
| 39                     | Idle Mode On                     | C                  | 0                   | -                                                                                                                                  |
| 3A                     | Interface Pixel format           | W                  | 1                   | Refer to Section 5.1.33                                                                                                            |
| 3C                     | Memory Write Continue            | W                  | Any length          |                                                                                                                                    |
| 3E                     | Memory Read Continue             | R                  | Any length          |                                                                                                                                    |
| 44                     | Set Tear Scanline                | W                  | 2                   | format:<br>2 byte for TE signal turns on when the display module reaches line N.                                                   |
| 45                     | Get Scanline                     | R                  | 2                   |                                                                                                                                    |
| 51                     | Write Manual Brightness          | W                  | 1                   | MAN_BRIGHT[7:0]                                                                                                                    |
| 52                     | Read Display Brightness          | R                  | 2                   | DISP_BRIGHT[7:0]                                                                                                                   |
| 53                     | Write BL Control                 | W                  | 1                   | BCTRL, DD, BL                                                                                                                      |

| Operational Code (HEX) | Function                 | Read/Write/Command | Number of Parameter | Parameters      |
|------------------------|--------------------------|--------------------|---------------------|-----------------|
| 54                     | Read BL Control          | R                  | 2                   | BCTRL, DD, BL   |
| 55                     | Write MIE Mode           | W                  | 1                   | MIE_MODE[1:0]   |
| 56                     | Read MIE Mode            | R                  | 2                   | MIE_MODE[1:0]   |
| 5E                     | Write Minimum Brightness | W                  | 1                   | MIN_BRIGHT[7:0] |
| 5F                     | Read Minimum Brightness  | R                  | 2                   | MIN_BRIGHT[7:0] |
| A1                     | Read DDB Start           | R                  | Any length          |                 |
| A8                     | Read DDB Continue        | R                  | Any length          |                 |
| DA                     | Read ID1                 | R                  | 2                   |                 |
| DB                     | Read ID2                 | R                  | 2                   |                 |
| DC                     | Read ID3                 | R                  | 2                   |                 |

**Note.**

1. Undefined commands are treated as NOP (00h) command.
2. B0h to D9h and DEh to FFh are for factory (= display supplier) use. These commands are treated as NOP (00h) commands after shipping to factory. Default value is NOP (00h).
3. Commands 10h, 12h, 13h, 20h, 21h, 26h, 28h, 29h, 30h, 36h (Bit B4 only), 38h and 39h are updated during V-sync when Module is in Sleep Out mode to avoid abnormal visual effects. During Sleep In mode, these commands are updated immediately. Read status (09h), Read Display Power Mode (0Ah), Read Display MADCTL (0Bh), Read Display Pixel Format (0Ch), Read Display Image Mode (0Dh), Read Display Signal Mode (0Eh) and Read Display Self Diagnostic Result (0Fh) of these commands is updated immediately both in Sleep In mode and Sleep Out mode.

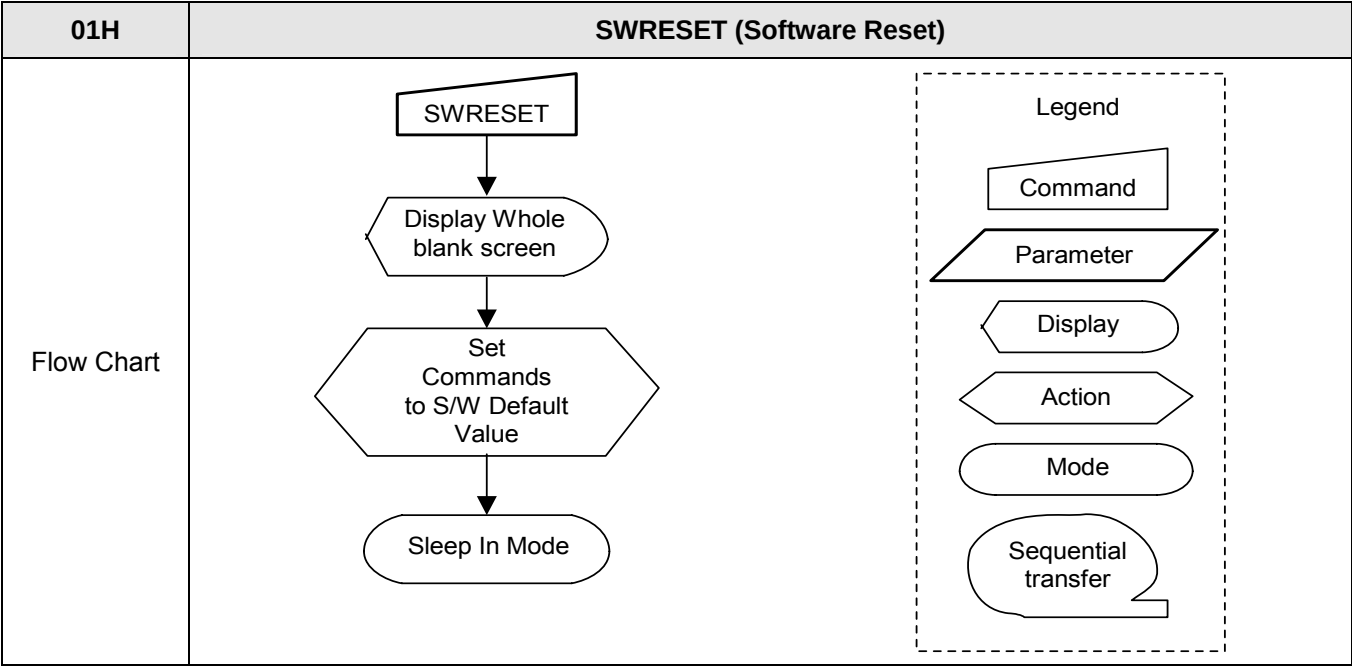
## 5.1.1. NO OPERATION (00H)

| 00H                   | NOP (No Operation)                                                                                                                                                                                                             |     |     |    |    |    |               |    |    |    |    |     |
|-----------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|-----|----|----|----|---------------|----|----|----|----|-----|
|                       | DCX                                                                                                                                                                                                                            | RDX | WRX | 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.<br>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           |    |    |    |    |     |
|                       | Sleep In or Step up circuit Off                                                                                                                                                                                                |     |     |    |    |    | Yes           |    |    |    |    |     |
| Default               | Status                                                                                                                                                                                                                         |     |     |    |    |    | Default Value |    |    |    |    |     |
|                       | Power On Sequence                                                                                                                                                                                                              |     |     |    |    |    | N/A           |    |    |    |    |     |
|                       | S/W Reset                                                                                                                                                                                                                      |     |     |    |    |    | N/A           |    |    |    |    |     |
|                       | H/W Reset                                                                                                                                                                                                                      |     |     |    |    |    | N/A           |    |    |    |    |     |
| Flow Chart            |                                                                                                                                                                                                                                |     |     |    |    |    |               |    |    |    |    |     |



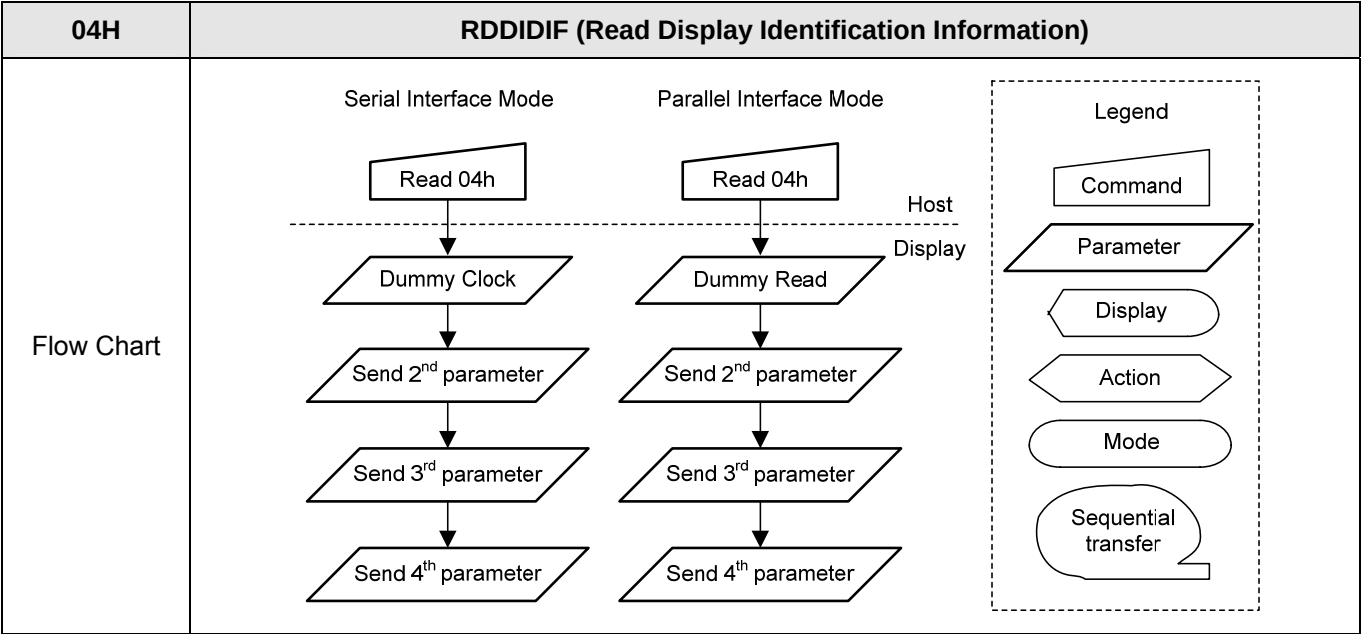
## 5.1.2. SOFTWARE RESET (01H)

| 01H                   | SWRESET (Software Reset)                                                                                                                                                                                                                                                                                                                                                                                               |     |     |    |    |    |               |    |    |    |    |     |
|-----------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|-----|----|----|----|---------------|----|----|----|----|-----|
|                       | DCX                                                                                                                                                                                                                                                                                                                                                                                                                    | RDX | WRX | D7 | D6 | D5 | D4            | D3 | D2 | D1 | D0 | HEX |
| Command               | 0                                                                                                                                                                                                                                                                                                                                                                                                                      | 1   | ↑   | 0  | 0  | 0  | 0             | 0  | 0  | 0  | 1  | 01  |
| Parameter             | NO PARAMETER                                                                                                                                                                                                                                                                                                                                                                                                           |     |     |    |    |    |               |    |    |    |    |     |
| Description           | <p>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.)</p> <p>Note: The Frame Memory contents are unaffected by this command.</p>                                                                                                                                       |     |     |    |    |    |               |    |    |    |    |     |
| Restriction           | <p>It will be necessary to wait 5 msec before sending new command following software reset. The display module loads all display suppliers' factory default values to the registers during this 5 msec.</p> <p>If Software Reset is applied during Sleep out mode, it will be necessary to wait 120 msec before sending Sleep out command.</p> <p>Software Reset command cannot be sent during Sleep out sequence.</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           |    |    |    |    |     |
|                       | Sleep In or Step up circuit Off                                                                                                                                                                                                                                                                                                                                                                                        |     |     |    |    |    | Yes           |    |    |    |    |     |
| Default               | Status                                                                                                                                                                                                                                                                                                                                                                                                                 |     |     |    |    |    | Default Value |    |    |    |    |     |
|                       | Power On Sequence                                                                                                                                                                                                                                                                                                                                                                                                      |     |     |    |    |    | N/A           |    |    |    |    |     |
|                       | S/W Reset                                                                                                                                                                                                                                                                                                                                                                                                              |     |     |    |    |    | N/A           |    |    |    |    |     |
|                       | H/W Reset                                                                                                                                                                                                                                                                                                                                                                                                              |     |     |    |    |    | N/A           |    |    |    |    |     |



## 5.1.3. READ DISPLAY IDENTIFICATION INFORMATION (04H)

| 04H                   | RDDIDIF (Read Display Identification Information)                                                                                                                                                                                                                                                                                                                                                                                                                             |     |     |               |      |      |              |      |      |      |      |     |
|-----------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|-----|---------------|------|------|--------------|------|------|------|------|-----|
|                       | DCX                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | RDX | WRX | D7            | D6   | D5   | D4           | D3   | D2   | D1   | D0   | HEX |
| Command               | 0                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | 1   | ↑   | 0             | 0    | 0    | 0            | 0    | 1    | 0    | 0    | 04  |
| 1 <sup>st</sup> para  | 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | ↑   | 1   | xx            | xx   | xx   | xx           | xx   | xx   | xx   | xx   | xx  |
| 2 <sup>nd</sup> para  | 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | ↑   | 1   | ID17          | ID16 | ID15 | ID14         | ID13 | ID12 | ID11 | ID10 | -   |
| 3 <sup>rd</sup> para  | 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | ↑   | 1   | ID27          | ID26 | ID25 | ID24         | ID23 | ID22 | ID21 | ID20 | -   |
| 4 <sup>th</sup> para  | 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | ↑   | 1   | ID37          | ID36 | ID35 | ID34         | ID33 | ID32 | ID31 | ID30 | -   |
| Description           | <p>This read byte returns 24-bits display identification information.</p> <p>The 1st Parameter is dummy data.</p> <p>The 2nd Parameter (ID17 to ID10): LCD module's manufacture ID.</p> <p>The 3rd Parameter (ID27 to ID20): LCD module / driver version ID.</p> <p>The 4th Parameter (ID37 to ID30): LCD module / driver.</p> <p>Note: Commands RDID1 / RDID2 / RDID3 (DAh, DBh and DCh) read data correspond to the parameter 2, 3, 4 of the command 04h, respectively.</p> |     |     |               |      |      |              |      |      |      |      |     |
| 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 Step up circuit Off                                                                                                                                                                                                                                                                                                                                                                                                                                               |     |     |               |      |      | Yes          |      |      |      |      |     |
| Default               | ID1, ID2 and ID3 default value                                                                                                                                                                                                                                                                                                                                                                                                                                                |     |     |               |      |      |              |      |      |      |      |     |
|                       | Status                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |     |     | Default Value |      |      |              |      |      |      |      |     |
|                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |     |     | ID1           |      |      | ID2          |      |      | ID3  |      |     |
|                       | Power On Sequence                                                                                                                                                                                                                                                                                                                                                                                                                                                             |     |     | 00h           |      |      | 00h          |      |      | 00h  |      |     |
|                       | S/W Reset                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |     |     | 00h           |      |      | 00h          |      |      | 00h  |      |     |
|                       | H/W Reset                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |     |     | 00h           |      |      | 00h          |      |      | 00h  |      |     |



## 5.1.4. READ DISPLAY STATUS (09H)

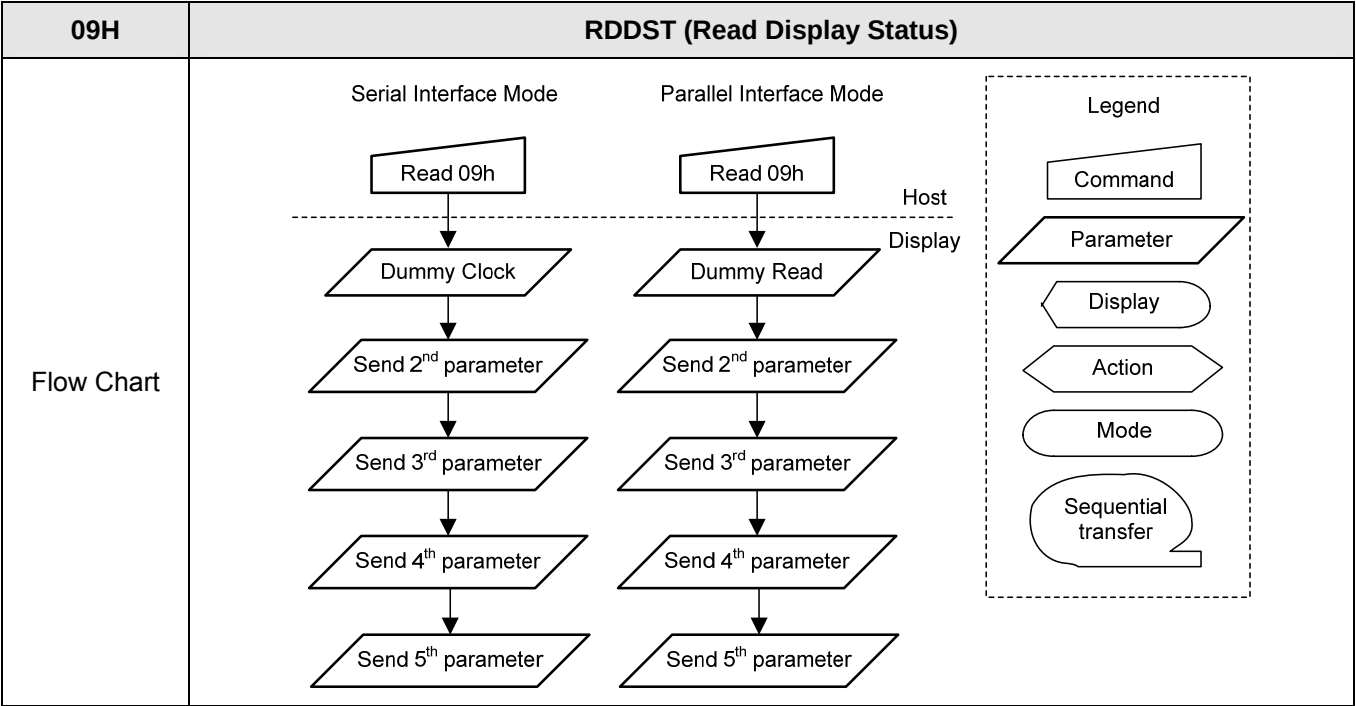
| 09H                  | RDDST (Read Display Status)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                         |            |     |     |     |     |     |     |     |     |     |     |             |         |     |                                |  |     |                    |  |     |                      |  |     |                   |  |     |                |  |     |               |  |     |          |            |     |          |            |     |          |            |     |                                         |  |     |  |     |  |     |                  |  |     |                     |  |     |              |  |     |                            |  |     |                             |  |     |          |            |     |                  |  |     |          |            |     |          |            |
|----------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------|------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-------------|---------|-----|--------------------------------|--|-----|--------------------|--|-----|----------------------|--|-----|-------------------|--|-----|----------------|--|-----|---------------|--|-----|----------|------------|-----|----------|------------|-----|----------|------------|-----|-----------------------------------------|--|-----|--|-----|--|-----|------------------|--|-----|---------------------|--|-----|--------------|--|-----|----------------------------|--|-----|-----------------------------|--|-----|----------|------------|-----|------------------|--|-----|----------|------------|-----|----------|------------|
|                      | DCX                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | RDX                                     | WRX        | D7  | D6  | D5  | D4  | D3  | D2  | D1  | D0  | HEX |     |             |         |     |                                |  |     |                    |  |     |                      |  |     |                   |  |     |                |  |     |               |  |     |          |            |     |          |            |     |          |            |     |                                         |  |     |  |     |  |     |                  |  |     |                     |  |     |              |  |     |                            |  |     |                             |  |     |          |            |     |                  |  |     |          |            |     |          |            |
| Command              | 0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | 1                                       | ↑          | 0   | 0   | 0   | 0   | 1   | 0   | 0   | 1   | 09  |     |             |         |     |                                |  |     |                    |  |     |                      |  |     |                   |  |     |                |  |     |               |  |     |          |            |     |          |            |     |          |            |     |                                         |  |     |  |     |  |     |                  |  |     |                     |  |     |              |  |     |                            |  |     |                             |  |     |          |            |     |                  |  |     |          |            |     |          |            |
| 1 <sup>st</sup> para | 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | ↑                                       | 1          | xx  | xx  | xx  | xx  | xx  | xx  | xx  | xx  | xx  |     |             |         |     |                                |  |     |                    |  |     |                      |  |     |                   |  |     |                |  |     |               |  |     |          |            |     |          |            |     |          |            |     |                                         |  |     |  |     |  |     |                  |  |     |                     |  |     |              |  |     |                            |  |     |                             |  |     |          |            |     |                  |  |     |          |            |     |          |            |
| 2 <sup>nd</sup> para | 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | ↑                                       | 1          | D31 | D30 | D29 | D28 | D27 | D26 | 0   | 0   | xx  |     |             |         |     |                                |  |     |                    |  |     |                      |  |     |                   |  |     |                |  |     |               |  |     |          |            |     |          |            |     |          |            |     |                                         |  |     |  |     |  |     |                  |  |     |                     |  |     |              |  |     |                            |  |     |                             |  |     |          |            |     |                  |  |     |          |            |     |          |            |
| 3 <sup>rd</sup> para | 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | ↑                                       | 1          | 0   | D22 | D21 | D20 | D19 | D18 | D17 | D16 | xx  |     |             |         |     |                                |  |     |                    |  |     |                      |  |     |                   |  |     |                |  |     |               |  |     |          |            |     |          |            |     |          |            |     |                                         |  |     |  |     |  |     |                  |  |     |                     |  |     |              |  |     |                            |  |     |                             |  |     |          |            |     |                  |  |     |          |            |     |          |            |
| 4 <sup>th</sup> para | 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | ↑                                       | 1          | D15 | 0   | D13 | 0   | 0   | D10 | D9  | D8  | xx  |     |             |         |     |                                |  |     |                    |  |     |                      |  |     |                   |  |     |                |  |     |               |  |     |          |            |     |          |            |     |          |            |     |                                         |  |     |  |     |  |     |                  |  |     |                     |  |     |              |  |     |                            |  |     |                             |  |     |          |            |     |                  |  |     |          |            |     |          |            |
| 5 <sup>th</sup> para | 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | ↑                                       | 1          | D7  | D6  | D5  | 0   | 0   | 0   | 0   | 0   | xx  |     |             |         |     |                                |  |     |                    |  |     |                      |  |     |                   |  |     |                |  |     |               |  |     |          |            |     |          |            |     |          |            |     |                                         |  |     |  |     |  |     |                  |  |     |                     |  |     |              |  |     |                            |  |     |                             |  |     |          |            |     |                  |  |     |          |            |     |          |            |
| Description          | This command indicates the current status of the display as described in the table below:<br>The 1st Parameter is dummy data.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                         |            |     |     |     |     |     |     |     |     |     |     |             |         |     |                                |  |     |                    |  |     |                      |  |     |                   |  |     |                |  |     |               |  |     |          |            |     |          |            |     |          |            |     |                                         |  |     |  |     |  |     |                  |  |     |                     |  |     |              |  |     |                            |  |     |                             |  |     |          |            |     |                  |  |     |          |            |     |          |            |
|                      | <table><tr><th>Bit</th><th>Description</th><th>Comment</th></tr><tr><td>D31</td><td>Step up circuit Voltage Status</td><td></td></tr><tr><td>D30</td><td>Page Address Order</td><td></td></tr><tr><td>D29</td><td>Column Address Order</td><td></td></tr><tr><td>D28</td><td>Page/Column Order</td><td></td></tr><tr><td>D27</td><td>Vertical Order</td><td></td></tr><tr><td>D26</td><td>RGB/BGR Order</td><td></td></tr><tr><td>D25</td><td>Not used</td><td>Set to '0'</td></tr><tr><td>D24</td><td>Not used</td><td>Set to '0'</td></tr><tr><td>D23</td><td>Not used</td><td>Set to '0'</td></tr><tr><td>D22</td><td rowspan="3">Interface Color Pixel Format Definition</td><td></td></tr><tr><td>D21</td><td></td></tr><tr><td>D20</td><td></td></tr><tr><td>D19</td><td>Idle Mode On/Off</td><td></td></tr><tr><td>D18</td><td>Partial Mode On/Off</td><td></td></tr><tr><td>D17</td><td>Sleep In/Out</td><td></td></tr><tr><td>D16</td><td>Display Normal Mode On/Off</td><td></td></tr><tr><td>D15</td><td>Vertical Scroll Mode On/Off</td><td></td></tr><tr><td>D14</td><td>Not used</td><td>Set to '0'</td></tr><tr><td>D13</td><td>Inversion Status</td><td></td></tr><tr><td>D12</td><td>Not used</td><td>Set to '0'</td></tr><tr><td>D11</td><td>Not used</td><td>Set to '0'</td></tr></table> |                                         |            |     |     |     |     |     |     |     |     |     | Bit | Description | Comment | D31 | Step up circuit Voltage Status |  | D30 | Page Address Order |  | D29 | Column Address Order |  | D28 | Page/Column Order |  | D27 | Vertical Order |  | D26 | RGB/BGR Order |  | D25 | Not used | Set to '0' | D24 | Not used | Set to '0' | D23 | Not used | Set to '0' | D22 | Interface Color Pixel Format Definition |  | D21 |  | D20 |  | D19 | Idle Mode On/Off |  | D18 | Partial Mode On/Off |  | D17 | Sleep In/Out |  | D16 | Display Normal Mode On/Off |  | D15 | Vertical Scroll Mode On/Off |  | D14 | Not used | Set to '0' | D13 | Inversion Status |  | D12 | Not used | Set to '0' | D11 | Not used | Set to '0' |
|                      | Bit                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Description                             | Comment    |     |     |     |     |     |     |     |     |     |     |             |         |     |                                |  |     |                    |  |     |                      |  |     |                   |  |     |                |  |     |               |  |     |          |            |     |          |            |     |          |            |     |                                         |  |     |  |     |  |     |                  |  |     |                     |  |     |              |  |     |                            |  |     |                             |  |     |          |            |     |                  |  |     |          |            |     |          |            |
|                      | D31                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Step up circuit Voltage Status          |            |     |     |     |     |     |     |     |     |     |     |             |         |     |                                |  |     |                    |  |     |                      |  |     |                   |  |     |                |  |     |               |  |     |          |            |     |          |            |     |          |            |     |                                         |  |     |  |     |  |     |                  |  |     |                     |  |     |              |  |     |                            |  |     |                             |  |     |          |            |     |                  |  |     |          |            |     |          |            |
|                      | D30                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Page Address Order                      |            |     |     |     |     |     |     |     |     |     |     |             |         |     |                                |  |     |                    |  |     |                      |  |     |                   |  |     |                |  |     |               |  |     |          |            |     |          |            |     |          |            |     |                                         |  |     |  |     |  |     |                  |  |     |                     |  |     |              |  |     |                            |  |     |                             |  |     |          |            |     |                  |  |     |          |            |     |          |            |
|                      | D29                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Column Address Order                    |            |     |     |     |     |     |     |     |     |     |     |             |         |     |                                |  |     |                    |  |     |                      |  |     |                   |  |     |                |  |     |               |  |     |          |            |     |          |            |     |          |            |     |                                         |  |     |  |     |  |     |                  |  |     |                     |  |     |              |  |     |                            |  |     |                             |  |     |          |            |     |                  |  |     |          |            |     |          |            |
|                      | D28                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Page/Column Order                       |            |     |     |     |     |     |     |     |     |     |     |             |         |     |                                |  |     |                    |  |     |                      |  |     |                   |  |     |                |  |     |               |  |     |          |            |     |          |            |     |          |            |     |                                         |  |     |  |     |  |     |                  |  |     |                     |  |     |              |  |     |                            |  |     |                             |  |     |          |            |     |                  |  |     |          |            |     |          |            |
|                      | D27                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Vertical Order                          |            |     |     |     |     |     |     |     |     |     |     |             |         |     |                                |  |     |                    |  |     |                      |  |     |                   |  |     |                |  |     |               |  |     |          |            |     |          |            |     |          |            |     |                                         |  |     |  |     |  |     |                  |  |     |                     |  |     |              |  |     |                            |  |     |                             |  |     |          |            |     |                  |  |     |          |            |     |          |            |
|                      | D26                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | RGB/BGR Order                           |            |     |     |     |     |     |     |     |     |     |     |             |         |     |                                |  |     |                    |  |     |                      |  |     |                   |  |     |                |  |     |               |  |     |          |            |     |          |            |     |          |            |     |                                         |  |     |  |     |  |     |                  |  |     |                     |  |     |              |  |     |                            |  |     |                             |  |     |          |            |     |                  |  |     |          |            |     |          |            |
|                      | D25                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Not used                                | Set to '0' |     |     |     |     |     |     |     |     |     |     |             |         |     |                                |  |     |                    |  |     |                      |  |     |                   |  |     |                |  |     |               |  |     |          |            |     |          |            |     |          |            |     |                                         |  |     |  |     |  |     |                  |  |     |                     |  |     |              |  |     |                            |  |     |                             |  |     |          |            |     |                  |  |     |          |            |     |          |            |
|                      | D24                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Not used                                | Set to '0' |     |     |     |     |     |     |     |     |     |     |             |         |     |                                |  |     |                    |  |     |                      |  |     |                   |  |     |                |  |     |               |  |     |          |            |     |          |            |     |          |            |     |                                         |  |     |  |     |  |     |                  |  |     |                     |  |     |              |  |     |                            |  |     |                             |  |     |          |            |     |                  |  |     |          |            |     |          |            |
|                      | D23                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Not used                                | Set to '0' |     |     |     |     |     |     |     |     |     |     |             |         |     |                                |  |     |                    |  |     |                      |  |     |                   |  |     |                |  |     |               |  |     |          |            |     |          |            |     |          |            |     |                                         |  |     |  |     |  |     |                  |  |     |                     |  |     |              |  |     |                            |  |     |                             |  |     |          |            |     |                  |  |     |          |            |     |          |            |
|                      | D22                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Interface Color Pixel Format Definition |            |     |     |     |     |     |     |     |     |     |     |             |         |     |                                |  |     |                    |  |     |                      |  |     |                   |  |     |                |  |     |               |  |     |          |            |     |          |            |     |          |            |     |                                         |  |     |  |     |  |     |                  |  |     |                     |  |     |              |  |     |                            |  |     |                             |  |     |          |            |     |                  |  |     |          |            |     |          |            |
|                      | D21                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                         |            |     |     |     |     |     |     |     |     |     |     |             |         |     |                                |  |     |                    |  |     |                      |  |     |                   |  |     |                |  |     |               |  |     |          |            |     |          |            |     |          |            |     |                                         |  |     |  |     |  |     |                  |  |     |                     |  |     |              |  |     |                            |  |     |                             |  |     |          |            |     |                  |  |     |          |            |     |          |            |
|                      | D20                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                         |            |     |     |     |     |     |     |     |     |     |     |             |         |     |                                |  |     |                    |  |     |                      |  |     |                   |  |     |                |  |     |               |  |     |          |            |     |          |            |     |          |            |     |                                         |  |     |  |     |  |     |                  |  |     |                     |  |     |              |  |     |                            |  |     |                             |  |     |          |            |     |                  |  |     |          |            |     |          |            |
|                      | D19                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Idle Mode On/Off                        |            |     |     |     |     |     |     |     |     |     |     |             |         |     |                                |  |     |                    |  |     |                      |  |     |                   |  |     |                |  |     |               |  |     |          |            |     |          |            |     |          |            |     |                                         |  |     |  |     |  |     |                  |  |     |                     |  |     |              |  |     |                            |  |     |                             |  |     |          |            |     |                  |  |     |          |            |     |          |            |
|                      | D18                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Partial Mode On/Off                     |            |     |     |     |     |     |     |     |     |     |     |             |         |     |                                |  |     |                    |  |     |                      |  |     |                   |  |     |                |  |     |               |  |     |          |            |     |          |            |     |          |            |     |                                         |  |     |  |     |  |     |                  |  |     |                     |  |     |              |  |     |                            |  |     |                             |  |     |          |            |     |                  |  |     |          |            |     |          |            |
|                      | D17                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Sleep In/Out                            |            |     |     |     |     |     |     |     |     |     |     |             |         |     |                                |  |     |                    |  |     |                      |  |     |                   |  |     |                |  |     |               |  |     |          |            |     |          |            |     |          |            |     |                                         |  |     |  |     |  |     |                  |  |     |                     |  |     |              |  |     |                            |  |     |                             |  |     |          |            |     |                  |  |     |          |            |     |          |            |
|                      | D16                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Display Normal Mode On/Off              |            |     |     |     |     |     |     |     |     |     |     |             |         |     |                                |  |     |                    |  |     |                      |  |     |                   |  |     |                |  |     |               |  |     |          |            |     |          |            |     |          |            |     |                                         |  |     |  |     |  |     |                  |  |     |                     |  |     |              |  |     |                            |  |     |                             |  |     |          |            |     |                  |  |     |          |            |     |          |            |
|                      | D15                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Vertical Scroll Mode On/Off             |            |     |     |     |     |     |     |     |     |     |     |             |         |     |                                |  |     |                    |  |     |                      |  |     |                   |  |     |                |  |     |               |  |     |          |            |     |          |            |     |          |            |     |                                         |  |     |  |     |  |     |                  |  |     |                     |  |     |              |  |     |                            |  |     |                             |  |     |          |            |     |                  |  |     |          |            |     |          |            |
|                      | D14                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Not used                                | Set to '0' |     |     |     |     |     |     |     |     |     |     |             |         |     |                                |  |     |                    |  |     |                      |  |     |                   |  |     |                |  |     |               |  |     |          |            |     |          |            |     |          |            |     |                                         |  |     |  |     |  |     |                  |  |     |                     |  |     |              |  |     |                            |  |     |                             |  |     |          |            |     |                  |  |     |          |            |     |          |            |
|                      | D13                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Inversion Status                        |            |     |     |     |     |     |     |     |     |     |     |             |         |     |                                |  |     |                    |  |     |                      |  |     |                   |  |     |                |  |     |               |  |     |          |            |     |          |            |     |          |            |     |                                         |  |     |  |     |  |     |                  |  |     |                     |  |     |              |  |     |                            |  |     |                             |  |     |          |            |     |                  |  |     |          |            |     |          |            |
|                      | D12                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Not used                                | Set to '0' |     |     |     |     |     |     |     |     |     |     |             |         |     |                                |  |     |                    |  |     |                      |  |     |                   |  |     |                |  |     |               |  |     |          |            |     |          |            |     |          |            |     |                                         |  |     |  |     |  |     |                  |  |     |                     |  |     |              |  |     |                            |  |     |                             |  |     |          |            |     |                  |  |     |          |            |     |          |            |
|                      | D11                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Not used                                | Set to '0' |     |     |     |     |     |     |     |     |     |     |             |         |     |                                |  |     |                    |  |     |                      |  |     |                   |  |     |                |  |     |               |  |     |          |            |     |          |            |     |          |            |     |                                         |  |     |  |     |  |     |                  |  |     |                     |  |     |              |  |     |                            |  |     |                             |  |     |          |            |     |                  |  |     |          |            |     |          |            |

| 09H | RDDST (Read Display Status)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                 |            |
|-----|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------|------------|
|     | D10                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | Display On/Off                  |            |
|     | D9                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | Tearing Effect Line On/Off      |            |
|     | D8                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | Gamma Curve Selection           |            |
|     | D7                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                 |            |
|     | D6                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                 |            |
|     | D5                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | Tearing Effect Output Line Mode |            |
|     | D4                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | Not used                        | Set to '0' |
|     | D3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | Not used                        | Set to '0' |
|     | D2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | Not used                        | Set to '0' |
|     | D1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | Not used                        | Set to '0' |
|     | D0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | Not used                        | Set to '0' |
|     | <p>Bit Values are explained overleaf.</p> <p>D31: Step up circuit Voltage status.</p> <p>    "0": Step up circuit Off or has a fault.</p> <p>    "1": Step up circuit On and working OK.</p> <p>D30: Page Address Order.</p> <p>    "0": Top to Bottom (When MADCTL B7 = '0').</p> <p>    "1": Bottom to Top (When MADCTL B7 = '1').</p> <p>D29: Column Address Order.</p> <p>    "0": Left to Right (When MADCTL B6 = '0').</p> <p>    "1": Right to Left (When MADCTL B6 = '1').</p> <p>D28: Page/Column Order.</p> <p>    "0": Normal Mode (When MADCTL B5 = '0').</p> <p>    "1": Reverse Mode (When MADCTL B5 = '1').</p> <p>D27: Line Address Order</p> <p>    "0": LCD Refresh Top to Bottom (When MADCTL B4 = '0').</p> <p>    "1": LCD Refresh Bottom to Top (When MADCTL B4 = '1').</p> <p>D26: RGB/BGR Order</p> <p>    "0": RGB (When MADCTL B3 = '0').</p> <p>    "1": BGR (When MADCTL B3 = '1').</p> <p>D25: Set to "0"</p> <p>D24: Set to "0"</p> <p>D23: Set to "0"</p> |                                 |            |

| 09H                  | RDDST (Read Display Status)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                      |    |                           |    |                           |               |   |   |   |     |               |   |   |   |     |               |   |   |   |     |
|----------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------|----|---------------------------|----|---------------------------|---------------|---|---|---|-----|---------------|---|---|---|-----|---------------|---|---|---|-----|
|                      | <p>D22, D21, D20: Interface Color Pixel Format Definition.</p> <p>D19: Idle Mode On/Off</p> <p>“0”: Idle Mode Off.</p> <p>“1” : Idle Mode On.</p> <p>D18: Partial Mode On/Off</p> <p>“0”: Partial Mode Off.</p> <p>“1” : Partial Mode On.</p> <p>D17: Sleep In/Out</p> <p>“0”: Sleep In Mode.</p> <p>“1”: S0leep Out Mode.</p> <p>D16: Display Normal Mode</p> <p>“0”: Display Normal Mode Off.</p> <p>“1”: Display Normal Mode On.</p> <p>D15: Vertical Scroll Mode</p> <p>“0”: Vertical Scroll Mode Off.</p> <p>“1”: Vertical Scroll Mode On.</p> <p>D14: Set to “0”</p> <p>D13: Inversion Status</p> <p>“0”: Inversion is Off.</p> <p>“1”: Inversion is On.</p> <p>D12: Set to “0”</p> <p>D11: Set to “0”</p> <p>D10: Display On/Off</p> <p>“0”: Display is Off.</p> <p>“1”: Display is On.</p> <p>D9: Tearing Effect Line On/Off</p> <p>“0”: Tearing Effect Line Off.</p> <p>“1”: Tearing Effect Line On.</p> <p>D8, D7, D6: Gamma Curve Selection</p> <table><tr><th>Gamma Curve Selected</th><th>D8</th><th>D7</th><th>D6</th><th>Gamma Set (26h) Parameter</th></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></table> | Gamma Curve Selected | D8 | D7                        | D6 | 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 Selected | D8                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | D7                   | D6 | 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                       |    |                           |               |   |   |   |     |               |   |   |   |     |               |   |   |   |     |

| 09H                                                                                                                                                               | RDDST (Read Display Status)               |   |                                         |   |             |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------|---|-----------------------------------------|---|-------------|
|                                                                                                                                                                   | Gamma Curve 4                             | 0 | 1                                       | 1 | GC3         |
|                                                                                                                                                                   | Not Defined                               | 1 | -                                       | - | Not Defined |
| D5: Tearing Effect Line Output Mode<br>"0": TE Mode1.<br>"1": TE Mode2.<br>D4: Set to "0"<br>D3: Set to "0"<br>D2: Set to "0"<br>D1: Set to "0"<br>D0: Set to "0" |                                           |   |                                         |   |             |
| 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 Step up circuit Off           |   | Yes                                     |   |             |
| Default                                                                                                                                                           | Status                                    |   | Default Value                           |   |             |
|                                                                                                                                                                   | Power On Sequence                         |   | 0000 0000_0110 0001_0000 0000_0000 0000 |   |             |
|                                                                                                                                                                   | S/W Reset                                 |   | 0xxx xx00_0xxx 0001_0000 0000_0000 0000 |   |             |
|                                                                                                                                                                   | H/W Reset                                 |   | 0000 0000_0110 0001_0000 0000_0000 0000 |   |             |





## 5.1.5. READ DISPLAY POWER MODE (0AH)

| 0AH                                 | RDDPM (Read Display Power Mode)                                                           |     |                                |    |    |    |    |    |    |            |    |     |
|-------------------------------------|-------------------------------------------------------------------------------------------|-----|--------------------------------|----|----|----|----|----|----|------------|----|-----|
|                                     | DCX                                                                                       | RDX | WRX                            | 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> para                | 1                                                                                         | ↑   | 1                              | xx | xx | xx | xx | xx | xx | xx         | xx | xx  |
| 2 <sup>nd</sup> para                | 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                                                                                        |     | Step up circuit Voltage Status |    |    |    |    |    |    |            |    |     |
|                                     | 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                                                                                        |     | -                              |    |    |    |    |    |    | Set to '0' |    |     |
|                                     | D0                                                                                        |     | -                              |    |    |    |    |    |    | Set to '0' |    |     |
|                                     | Bit D7 : Step up circuit Voltage Status                                                   |     |                                |    |    |    |    |    |    |            |    |     |
|                                     | "0": Step up circuit Off or has a fault.                                                  |     |                                |    |    |    |    |    |    |            |    |     |
|                                     | "1": Step up circuit On and working OK (Meets optical requirements).                      |     |                                |    |    |    |    |    |    |            |    |     |
|                                     | Bit D6 : Idle Mode On/Off                                                                 |     |                                |    |    |    |    |    |    |            |    |     |
|                                     | "0": Idle Mode Off.                                                                       |     |                                |    |    |    |    |    |    |            |    |     |
| "1" : Idle Mode On.                 |                                                                                           |     |                                |    |    |    |    |    |    |            |    |     |
| Bit D5 : Partial Mode On/Off        |                                                                                           |     |                                |    |    |    |    |    |    |            |    |     |
| "0": Partial Mode Off.              |                                                                                           |     |                                |    |    |    |    |    |    |            |    |     |
| "1": Partial Mode On.               |                                                                                           |     |                                |    |    |    |    |    |    |            |    |     |
| Bit D4 : Sleep In/Out               |                                                                                           |     |                                |    |    |    |    |    |    |            |    |     |
| "0": Sleep In Mode.                 |                                                                                           |     |                                |    |    |    |    |    |    |            |    |     |
| "1": Sleep Out Mode.                |                                                                                           |     |                                |    |    |    |    |    |    |            |    |     |
| Bit D3 : Display Normal Mode On/Off |                                                                                           |     |                                |    |    |    |    |    |    |            |    |     |
| "0": Display Normal Mode Off.       |                                                                                           |     |                                |    |    |    |    |    |    |            |    |     |
| "1": Display Normal Mode On.        |                                                                                           |     |                                |    |    |    |    |    |    |            |    |     |
| Bit D2 : Display On/Off             |                                                                                           |     |                                |    |    |    |    |    |    |            |    |     |
| "0": Display Off.                   |                                                                                           |     |                                |    |    |    |    |    |    |            |    |     |

| 0AH                   | RDDPM (Read Display Power Mode)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |               |
|-----------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|
|                       | “1”: Display On.<br>Bit D1, D0 : Set to ‘0’                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |               |
| Restrictions          | There is no dummy read parameter(1 <sup>st</sup> para) at serial I/F, refer to 3.1.4.2, 3.1.5.2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |               |
| 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 Step up circuit Off                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | Yes           |
| Default               | Status                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Default Value |
|                       | Power On Sequence                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | 08HEX         |
|                       | S/W Reset                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | 08HEX         |
|                       | H/W Reset                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | 08HEX         |
| Flow Chart            | <div> <div>Serial Interface Mode</div> <div>Parallel Interface Mode</div> </div> <pre> graph TD     subgraph Serial_Interface_Mode [Serial Interface Mode]         Host1[Host] -- "Read RDDPM" --&gt; Display1[Display]         Display1 -- "Send 2nd parameter" --&gt; Host1     end     subgraph Parallel_Interface_Mode [Parallel Interface Mode]         Host2[Host] -- "Read RDDPM" --&gt; Display2[Display]         Display2 -- "Dummy Read" --&gt; Display2         Display2 -- "Send 2nd parameter" --&gt; Host2     end   </pre> <div> <b>Legend</b><br/>       Command<br/>       Parameter<br/>       Display<br/>       Action<br/>       Mode<br/>       Sequential transfer     </div> |               |

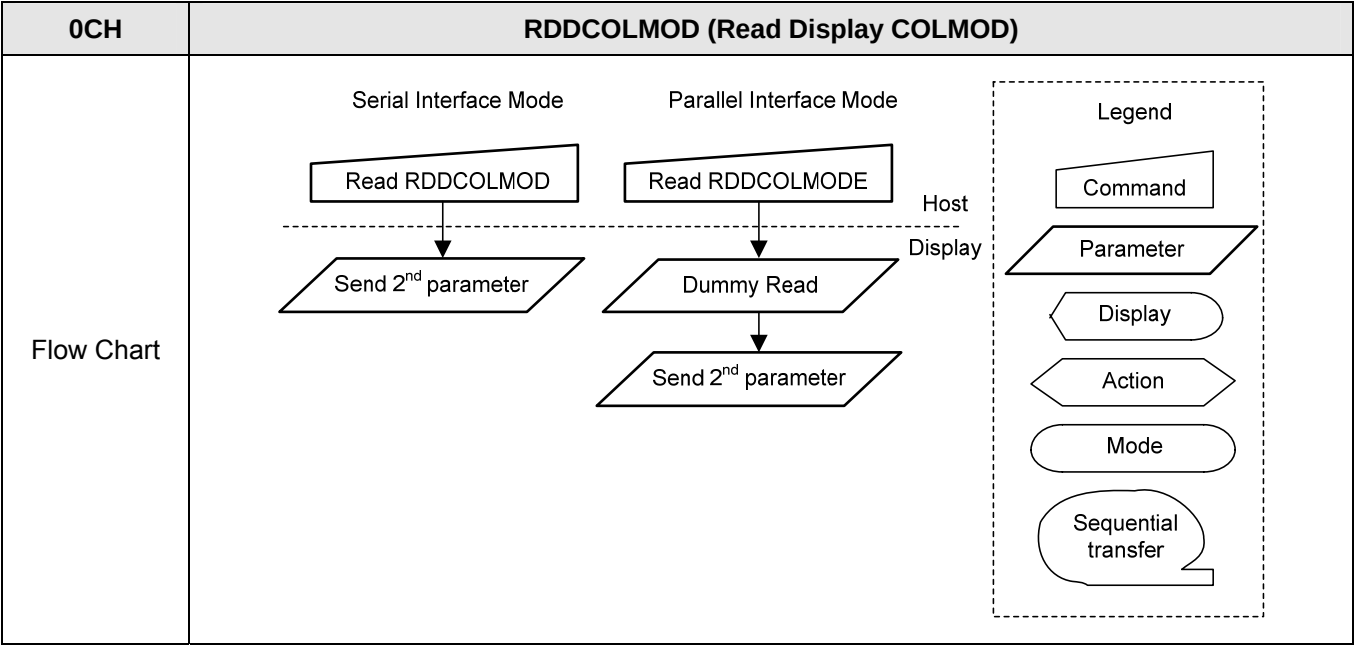
## 5.1.6. READ DISPLAY MADCTL (0BH)

| 0BH                         | RDDMADCTL (Read Display MADCTL)                                                                                                             |     |                      |    |    |    |    |    |    |            |    |     |
|-----------------------------|---------------------------------------------------------------------------------------------------------------------------------------------|-----|----------------------|----|----|----|----|----|----|------------|----|-----|
|                             | DCX                                                                                                                                         | RDX | WRX                  | D7 | D6 | D5 | D4 | D3 | D2 | D1         | D0 | HEX |
| Command                     | 0                                                                                                                                           | 1   | ↑                    | 0  | 0  | 0  | 0  | 1  | 0  | 1          | 1  | 0B  |
| 1 <sup>st</sup> para        | 1                                                                                                                                           | ↑   | 1                    | xx | xx | xx | xx | xx | xx | xx         | xx | xx  |
| 2 <sup>nd</sup> para        | 1                                                                                                                                           | ↑   | 1                    | D7 | D6 | D5 | D4 | D3 | 0  | 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                                                                                                                                          |     | -                    |    |    |    |    |    |    | Set to '0' |    |     |
|                             | D1                                                                                                                                          |     | -                    |    |    |    |    |    |    | Set to '0' |    |     |
|                             | D0                                                                                                                                          |     | -                    |    |    |    |    |    |    | 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 Mode (When MADCTL B5='0').<br>"1": Reverse Mode (When MADCTL B5='1')                              |     |                      |    |    |    |    |    |    |            |    |     |
|                             | 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').                                                  |     |                      |    |    |    |    |    |    |            |    |     |
| Bit D2, D1, D0 : Set to '0' |                                                                                                                                             |     |                      |    |    |    |    |    |    |            |    |     |
| Restrictions                | There is no dummy read parameter(1 <sup>st</sup> para) at serial I/F, refer to 3.1.4.2, 3.1.5.2                                             |     |                      |    |    |    |    |    |    |            |    |     |

| 0BH                   | RDDMADCTL (Read Display MADCTL)                                                                                                                                                                                                                          |               |
|-----------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|
| 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 Step up circuit Off                                                                                                                                                                                                                          | Yes           |
| Default               | Status                                                                                                                                                                                                                                                   | Default Value |
|                       | Power On Sequence                                                                                                                                                                                                                                        | 00HEX         |
|                       | S/W Reset                                                                                                                                                                                                                                                | No Change     |
|                       | H/W Reset                                                                                                                                                                                                                                                | 00HEX         |
| Flow Chart            | <div> <div>Serial Interface Mode</div> <div>Parallel Interface 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> |               |

## 5.1.7. READ DISPLAY PIXEL FORMAT (0CH)

| 0CH                   | RDDCOLMOD (Read Display COLMOD)                                                                 |     |                                |    |    |                          |    |    |    |                                          |    |     |
|-----------------------|-------------------------------------------------------------------------------------------------|-----|--------------------------------|----|----|--------------------------|----|----|----|------------------------------------------|----|-----|
|                       | DCX                                                                                             | RDX | WRX                            | 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> para  | 1                                                                                               | ↑   | 1                              | xx | xx | xx                       | xx | xx | xx | xx                                       | xx | xx  |
| 2 <sup>nd</sup> para  | 1                                                                                               | ↑   | 1                              | 0  | D6 | D5                       | D4 | 0  | D2 | D1                                       | D0 | xx  |
| Description           | This command indicates the current status of the display as described in the table below:       |     |                                |    |    |                          |    |    |    |                                          |    |     |
|                       | Bit                                                                                             |     | Description                    |    |    |                          |    |    |    | Value                                    |    |     |
|                       | D7                                                                                              |     | -                              |    |    |                          |    |    |    | “0” (Not used)                           |    |     |
|                       | D6                                                                                              |     | RGB Interface Color Format     |    |    |                          |    |    |    | “101”=16 bit/pixel<br>“110”=18 bit/pixel |    |     |
|                       | D5                                                                                              |     |                                |    |    |                          |    |    |    |                                          |    |     |
|                       | D4                                                                                              |     |                                |    |    |                          |    |    |    |                                          |    |     |
|                       | D3                                                                                              |     | -                              |    |    |                          |    |    |    | “0” (Not used)                           |    |     |
|                       | D2                                                                                              |     | Control Interface Color Format |    |    |                          |    |    |    | “101”=16 bit/pixel<br>“110”=18 bit/pixel |    |     |
|                       | D1                                                                                              |     |                                |    |    |                          |    |    |    |                                          |    |     |
|                       | D0                                                                                              |     |                                |    |    |                          |    |    |    |                                          |    |     |
| Restrictions          | There is no dummy read parameter(1 <sup>st</sup> para) at serial I/F, refer to 3.1.4.2, 3.1.5.2 |     |                                |    |    |                          |    |    |    |                                          |    |     |
| 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 Step up circuit Off                                                                 |     |                                |    |    | Yes                      |    |    |    |                                          |    |     |
| Default               | Status                                                                                          |     |                                |    |    | Default Value            |    |    |    |                                          |    |     |
|                       | Power On Sequence                                                                               |     |                                |    |    | 0000_0110 (18 bit/pixel) |    |    |    |                                          |    |     |
|                       | S/W Reset                                                                                       |     |                                |    |    | No change                |    |    |    |                                          |    |     |
|                       | H/W Reset                                                                                       |     |                                |    |    | 0000_0110 (18 bit/pixel) |    |    |    |                                          |    |     |



## 5.1.8. READ DISPLAY IMAGE MODE (0DH)

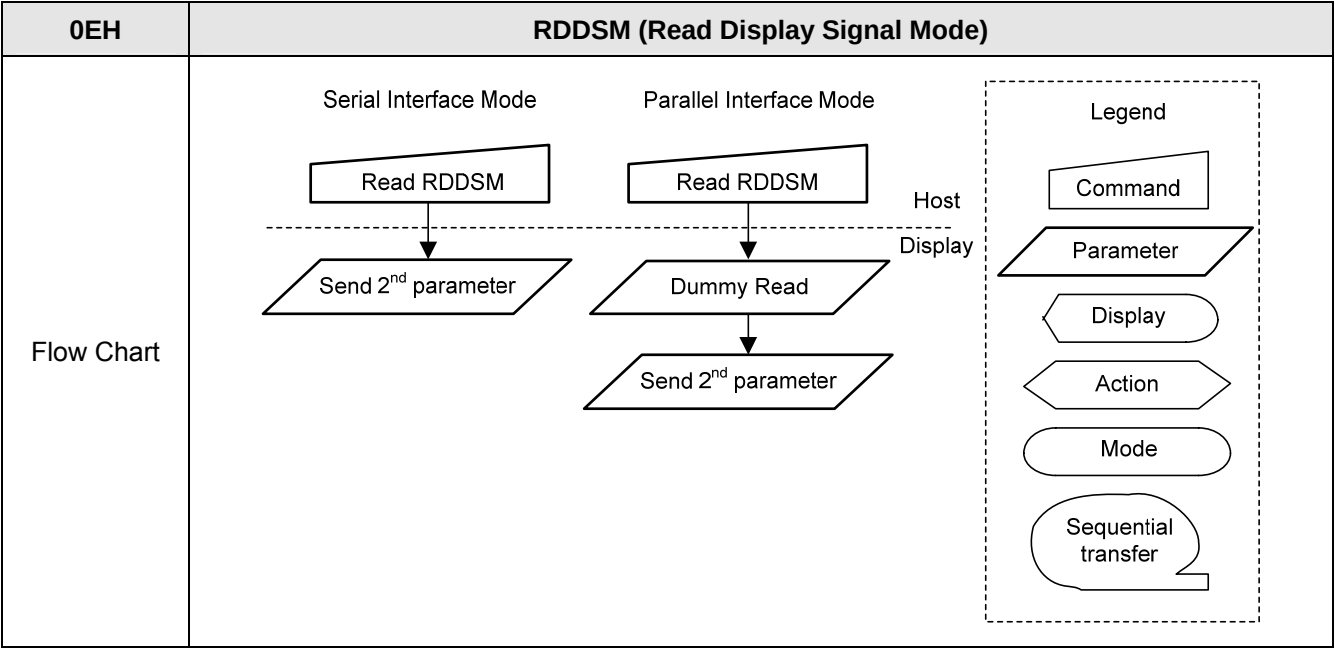
| 0DH                                       | RDDIM (Read Display Image Mode)                                                                                                                                                                                                                                                                                                                                                               |        |     |    |    |     |                           |              |    |    |    |     |
|-------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------|-----|----|----|-----|---------------------------|--------------|----|----|----|-----|
|                                           | DCX                                                                                                                                                                                                                                                                                                                                                                                           | RDX    | WRX | D7 | D6 | D5  | D4                        | D3           | D2 | D1 | D0 | HEX |
| Command                                   | 0                                                                                                                                                                                                                                                                                                                                                                                             | 1      | ↑   | 0  | 0  | 0   | 0                         | 1            | 1  | 0  | 1  | 0D  |
| 1 <sup>st</sup> para                      | 1                                                                                                                                                                                                                                                                                                                                                                                             | ↑      | 1   | xx | xx | xx  | xx                        | xx           | xx | xx | xx | xx  |
| 2 <sup>nd</sup> para                      | 1                                                                                                                                                                                                                                                                                                                                                                                             | ↑      | 1   | D7 | 0  | 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 Scroll Mode On/Off<br>“0”: Vertical Scroll Mode Off.<br>“1”: Vertical Scroll Mode On.<br>Bit D6 : Set to ‘0’<br>Bit D5 : Inversion On/Off<br>“0”: Inversion Off.<br>“1”: Inversion On.<br>Bit D4 : Set to ‘0’<br>Bit D3 : Set to ‘0’<br>Bit D2, D1, D0 : Gamma Curve Selection |        |     |    |    |     |                           |              |    |    |    |     |
|                                           | 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                                                                                                                                                                                                                                                                                                                                                                                  |        |     |    |    |     |                           |              |    |    |    |     |
|                                           | There is no dummy read parameter(1 <sup>st</sup> para) at serial I/F, refer to 3.1.4.2, 3.1.5.2                                                                                                                                                                                                                                                                                               |        |     |    |    |     |                           |              |    |    |    |     |
|                                           | 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 Step up circuit Off           |                                                                                                                                                                                                                                                                                                                                                                                               |        |     |    |    | Yes |                           |              |    |    |    |     |



| 0DH        | RDDIM (Read Display Image Mode)                                                                                                                                                                                                                                                                                                                                                                                                                   |               |
|------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|
| Default    | Status                                                                                                                                                                                                                                                                                                                                                                                                                                            | Default Value |
|            | Power On Sequence                                                                                                                                                                                                                                                                                                                                                                                                                                 | 00HEX         |
|            | S/W Reset                                                                                                                                                                                                                                                                                                                                                                                                                                         | 00HEX         |
|            | H/W Reset                                                                                                                                                                                                                                                                                                                                                                                                                                         | 00HEX         |
| Flow Chart | <div><div><div>Serial Interface Mode</div><div>Read RDDIM</div><div>Send 2<sup>nd</sup> parameter</div></div><div><div>Parallel Interface Mode</div><div>Read RDDIM</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> |               |
|            |                                                                                                                                                                                                                                                                                                                                                                                                                                                   |               |

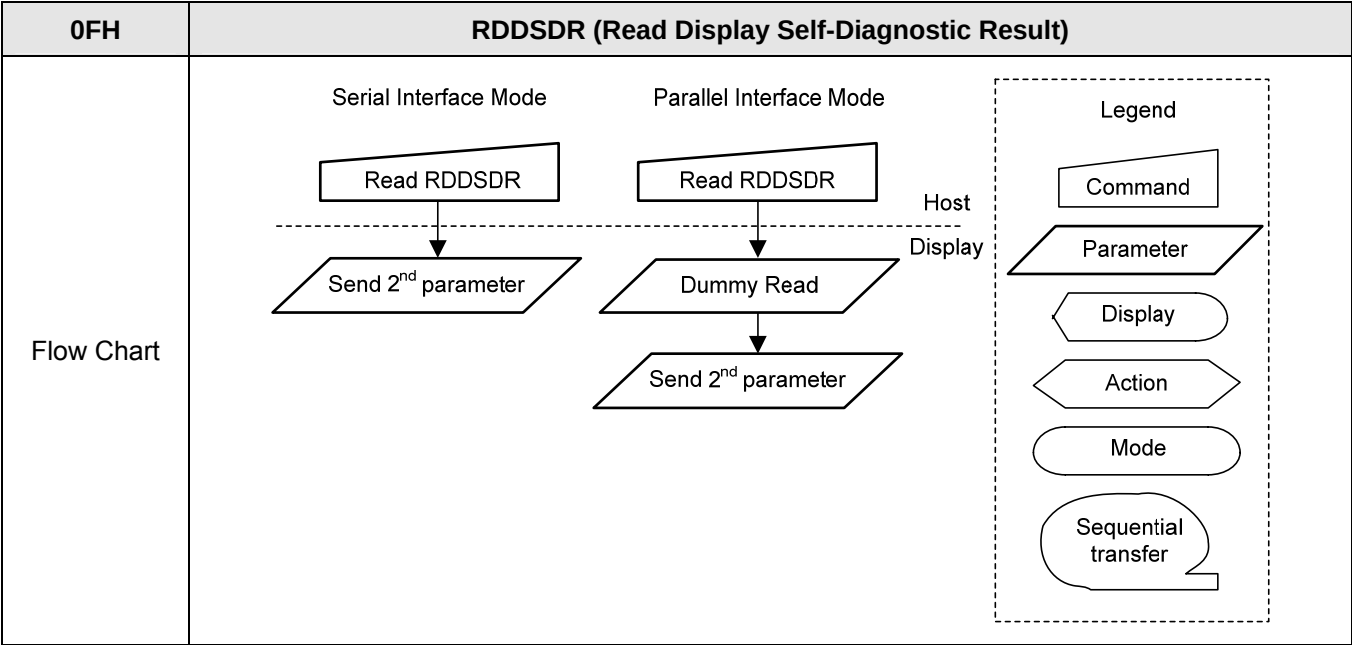
## 5.1.9. READ DISPLAY SIGNAL MODE (0EH)

| 0EH                   | RDDSM (Read Display Signal Mode)                                                                                                                                                                                                                                                                                                             |     |     |    |    |    |                   |    |    |    |    |     |
|-----------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|-----|----|----|----|-------------------|----|----|----|----|-----|
|                       | DCX                                                                                                                                                                                                                                                                                                                                          | RDX | WRX | 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> para  | 1                                                                                                                                                                                                                                                                                                                                            | ↑   | 1   | xx | xx | xx | xx                | xx | xx | xx | xx | xx  |
| 2 <sup>nd</sup> para  | 1                                                                                                                                                                                                                                                                                                                                            | ↑   | 1   | D7 | D6 | 0  | 0                 | 0  | 0  | 0  | 0  | xx  |
| Description           | <p>This command indicates the current status of the display as described in the table below:</p> <p>Bit D7 : Tearing Effect Line On/Off.</p> <p>“0”: Tearing Effect Line Off.</p> <p>“1”: Tearing Effect On.</p> <p>Bit D6 : Tearing Effect Line Output Mode.</p> <p>“0” : Mode 1.</p> <p>“1” : Mode 2.</p> <p>Bit D5 to D0 : Set to ‘0’</p> |     |     |    |    |    |                   |    |    |    |    |     |
| Restrictions          | There is no dummy read parameter(1 <sup>st</sup> para) at serial I/F, refer to 3.1.4.2, 3.1.5.2                                                                                                                                                                                                                                              |     |     |    |    |    |                   |    |    |    |    |     |
| 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 Step up circuit Off                                                                                                                                                                                                                                                                                                              |     |     |    |    |    | Yes               |    |    |    |    |     |
| Default               | Status                                                                                                                                                                                                                                                                                                                                       |     |     |    |    |    | Default Value     |    |    |    |    |     |
|                       | Power On Sequence                                                                                                                                                                                                                                                                                                                            |     |     |    |    |    | 00 <sub>HEX</sub> |    |    |    |    |     |
|                       | S/W Reset                                                                                                                                                                                                                                                                                                                                    |     |     |    |    |    | 00 <sub>HEX</sub> |    |    |    |    |     |
|                       | H/W Reset                                                                                                                                                                                                                                                                                                                                    |     |     |    |    |    | 00 <sub>HEX</sub> |    |    |    |    |     |



## 5.1.10. READ DISPLAY SELF-DIAGNOSTIC RESULT (0FH)

| 0FH                   | RDDSDR (Read Display Self-Diagnostic Result)                                                                                                                                                                                             |     |     |    |    |    |                   |    |    |    |    |     |
|-----------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|-----|----|----|----|-------------------|----|----|----|----|-----|
|                       | DCX                                                                                                                                                                                                                                      | RDX | WRX | 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> para  | 1                                                                                                                                                                                                                                        | ↑   | 1   | xx | xx | xx | xx                | xx | xx | xx | xx | xx  |
| 2 <sup>nd</sup> para  | 1                                                                                                                                                                                                                                        | ↑   | 1   | D7 | D6 | 0  | 0                 | 0  | 0  | 0  | 0  | xx  |
| Description           | This command indicates the status of the display self-diagnostic result after Sleep Out command as described in the table below:<br>Bit D7 : Register Loading Detection<br>Bit D6 : Functionality Detection<br>Bit D5 to D0 : Set to "0" |     |     |    |    |    |                   |    |    |    |    |     |
| Restrictions          | There is no dummy read parameter(1 <sup>st</sup> para) at serial I/F, refer to 3.1.4.2, 3.1.5.2                                                                                                                                          |     |     |    |    |    |                   |    |    |    |    |     |
| 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 Step up circuit Off                                                                                                                                                                                                          |     |     |    |    |    | Yes               |    |    |    |    |     |
| Default               | Status                                                                                                                                                                                                                                   |     |     |    |    |    | Default Value     |    |    |    |    |     |
|                       | Power On Sequence                                                                                                                                                                                                                        |     |     |    |    |    | 00 <sub>HEX</sub> |    |    |    |    |     |
|                       | S/W Reset                                                                                                                                                                                                                                |     |     |    |    |    | 00 <sub>HEX</sub> |    |    |    |    |     |
|                       | H/W Reset                                                                                                                                                                                                                                |     |     |    |    |    | 00 <sub>HEX</sub> |    |    |    |    |     |



## 5.1.11. SLEEP IN (10H)

| 10H                                       | SLPIN (Sleep In)                                                                                                                                                                                                                                                                                                                                                                                                                         |     |     |    |    |    |    |    |    |    |    |     |        |              |                                          |     |                                         |     |                                           |     |                                          |     |                                 |     |
|-------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|-----|----|----|----|----|----|----|----|----|-----|--------|--------------|------------------------------------------|-----|-----------------------------------------|-----|-------------------------------------------|-----|------------------------------------------|-----|---------------------------------|-----|
|                                           | DCX                                                                                                                                                                                                                                                                                                                                                                                                                                      | RDX | WRX | 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>MPU 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).</p> <p>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.</p> <p>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><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 Step up circuit 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 Step up circuit 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 Step up circuit Off           | Yes                                                                                                                                                                                                                                                                                                                                                                                                                                      |     |     |    |    |    |    |    |    |    |    |     |        |              |                                          |     |                                         |     |                                           |     |                                          |     |                                 |     |

| 10H        | SLPIN (Sleep In)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |               |
|------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|
| Default    | Status                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | Default Value |
|            | Power On Sequence                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | Sleep In Mode |
|            | S/W Reset                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | Sleep In Mode |
|            | H/W Reset                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | Sleep In Mode |
| Flow Chart | <pre> graph TD     SLPIN[/SLPIN/] --&gt; DisplayBlank{{Display whole blank screen<br/>(Automatic No effect to DISP<br/>ON/OFF Commands)}}     DisplayBlank --&gt; DrainCharge{{Drain Charge From LCD Panel}}     DrainCharge --&gt; StopDCDC{{Stop DC:DC Converter}}     StopDCDC --&gt; StopOscillator{{Stop Internal Oscillator}}     StopOscillator --&gt; SleepInMode([Sleep In mode]) </pre> <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> <p>It takes 120msec to get into Sleep In mode after SLPIN command issued.</p> |               |
|            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |               |

## 5.1.12. SLEEP OUT (11H)

| 11H         | SLPOUT (Sleep Out)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |     |     |    |    |    |    |    |    |    |    |     |
|-------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|-----|----|----|----|----|----|----|----|----|-----|
|             | DCX                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | RDX | WRX | 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.</p> <p>In this mode the DC/DC converter is enabled, Internal oscillator is started, and panel scanning is started.</p> <p>(If DISPON 29h is set)</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |     |     |    |    |    |    |    |    |    |    |     |
| 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)</p> <p>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.</p> <p>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 when the display module is already Sleep Out mode.</p> <p>The display module is doing self-diagnostic function during this 5msec. See also section "Sleep Out Command and Self-Diagnostic Functions of the Display Module".</p> <p>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> |     |     |    |    |    |    |    |    |    |    |     |



| 11H                   | SLPOUT (Sleep Out)                        |               |
|-----------------------|-------------------------------------------|---------------|
| 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 Step up circuit Off           | Yes           |
| Default               | Status                                    | Default Value |
|                       | Power On Sequence                         | Sleep In Mode |
|                       | S/W Reset                                 | Sleep In Mode |
|                       | H/W Reset                                 | Sleep In Mode |

| 11H        | SLPOUT (Sleep Out)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Flow Chart | <div><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></div> <p>It takes 120msec to become Sleep Out mode after SLPOUT command issued.</p> |

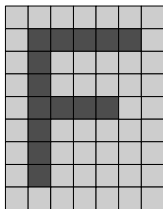
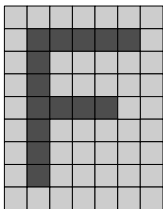
## 5.1.13. PARTIAL MODE ON (12H)

| 12H                   | PTLON (Partial Mode On)                                                                                                                                                                     |     |     |    |    |    |                |    |    |    |    |     |
|-----------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|-----|----|----|----|----------------|----|----|----|----|-----|
|                       | DCX                                                                                                                                                                                         | RDX | WRX | 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 Partial Area command (30h). To leave Partial mode, the Normal Display Mode command (13h) should be written. |     |     |    |    |    |                |    |    |    |    |     |
| Restriction           | 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 Step up circuit Off                                                                                                                                                             |     |     |    |    |    | Yes            |    |    |    |    |     |
| Default               | Status                                                                                                                                                                                      |     |     |    |    |    | Default Value  |    |    |    |    |     |
|                       | Power On Sequence                                                                                                                                                                           |     |     |    |    |    | Normal Mode On |    |    |    |    |     |
|                       | S/W Reset                                                                                                                                                                                   |     |     |    |    |    | Normal Mode On |    |    |    |    |     |
|                       | H/W Reset                                                                                                                                                                                   |     |     |    |    |    | Normal Mode On |    |    |    |    |     |
| Flow Chart            | See Partial Area (30h)                                                                                                                                                                      |     |     |    |    |    |                |    |    |    |    |     |

## 5.1.14. NORMAL DISPLAY MODE ON (13H)

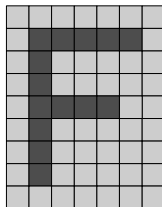
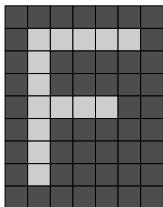
| 13 H                  | NORON (Normal Display Mode On)                                                                     |     |     |    |    |    |                |    |    |    |    |     |
|-----------------------|----------------------------------------------------------------------------------------------------|-----|-----|----|----|----|----------------|----|----|----|----|-----|
|                       | DCX                                                                                                | RDX | WRX | 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.<br>Normal Display Mode On means Partial 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 Step up circuit Off                                                                    |     |     |    |    |    | Yes            |    |    |    |    |     |
| Default               | Status                                                                                             |     |     |    |    |    | Default Value  |    |    |    |    |     |
|                       | Power On Sequence                                                                                  |     |     |    |    |    | Normal Mode On |    |    |    |    |     |
|                       | S/W Reset                                                                                          |     |     |    |    |    | Normal Mode On |    |    |    |    |     |
|                       | H/W Reset                                                                                          |     |     |    |    |    | Normal Mode On |    |    |    |    |     |
| Flow Chart            | See Partial Area Descriptions for details when use this command                                    |     |     |    |    |    |                |    |    |    |    |     |

## 5.1.15. DISPLAY INVERSION OFF (20H)

| 20H                   | INVOFF (Display Inversion Off)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |     |     |    |    |    |                       |    |    |    |    |     |
|-----------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|-----|----|----|----|-----------------------|----|----|----|----|-----|
|                       | DCX                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | RDX | WRX | 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           | <p>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</p> <p>(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 inversion off mode.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |     |     |    |    |    |                       |    |    |    |    |     |
| Register Availability | <b>Status</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |     |     |    |    |    | <b>Availability</b>   |    |    |    |    |     |
|                       | 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 Step up circuit Off                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |     |     |    |    |    | Yes                   |    |    |    |    |     |
| Default               | <b>Status</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |     |     |    |    |    | <b>Default Value</b>  |    |    |    |    |     |
|                       | Power On Sequence                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |     |     |    |    |    | Display Inversion Off |    |    |    |    |     |
|                       | S/W Reset                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |     |     |    |    |    | Display Inversion Off |    |    |    |    |     |
|                       | H/W Reset                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |     |     |    |    |    | Display Inversion Off |    |    |    |    |     |

| 20H        | INVOFF (Display Inversion Off)                                                                                                                                                                                                                                     |
|------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Flow Chart | <div><div><div>Display Inversion On Mode</div><div>IDMOFF</div><div>Display Inversion 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> |

## 5.1.16. DISPLAY INVERSION ON (21H)

| 21H                   | INVON (Display Inversion On)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |     |     |    |    |    |                       |    |    |    |    |     |
|-----------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|-----|----|----|----|-----------------------|----|----|----|----|-----|
|                       | DCX                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | RDX | WRX | 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.</p> <p>This command makes no change of contents of frame memory. Every bit is inverted from the frame memory to the display.</p> <p>This command does not change any other status.</p> <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 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 Step up circuit Off                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |     |     |    |    |    | Yes                   |    |    |    |    |     |
| Default               | Status                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |     |     |    |    |    | Default Value         |    |    |    |    |     |
|                       | Power On Sequence                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |     |     |    |    |    | Display Inversion Off |    |    |    |    |     |
|                       | S/W Reset                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |     |     |    |    |    | Display Inversion Off |    |    |    |    |     |
|                       | H/W Reset                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |     |     |    |    |    | Display Inversion Off |    |    |    |    |     |

| 21H        | INVON (Display Inversion On)                                                                                                                                                                                                                                                                         |
|------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Flow Chart | <div><div><div>Display Inversion Off Mode</div><div>↓</div><div>IDMON</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> |

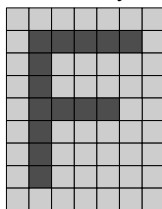
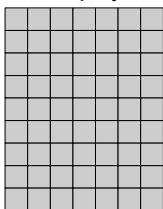


**5.1.17. GAMMA SET (26H)**

| 26H                   | GAMSET (Gamma Set)                                                                                                                                                                                                                                                |                                                                                                                                             |     |           |     |     |                |     |     |     |     |      |
|-----------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------|-----|-----------|-----|-----|----------------|-----|-----|-----|-----|------|
|                       | DCX                                                                                                                                                                                                                                                               | RDX                                                                                                                                         | WRX | 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 | Note |
| Description           | This command is used to select the desired Gamma curve for the current display.<br>A maximum of 4 curves can be selected. 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><br>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            |     |     |     |     |      |
|                       | Sleep In or Step up circuit Off                                                                                                                                                                                                                                   |                                                                                                                                             |     |           |     |     | Yes            |     |     |     |     |      |
| Default               | Status                                                                                                                                                                                                                                                            |                                                                                                                                             |     |           |     |     | Default Value  |     |     |     |     |      |
|                       | Power On Sequence                                                                                                                                                                                                                                                 |                                                                                                                                             |     |           |     |     | 01h            |     |     |     |     |      |
|                       | S/W Reset                                                                                                                                                                                                                                                         |                                                                                                                                             |     |           |     |     | 01h            |     |     |     |     |      |
|                       | H/W Reset                                                                                                                                                                                                                                                         |                                                                                                                                             |     |           |     |     | 01h            |     |     |     |     |      |

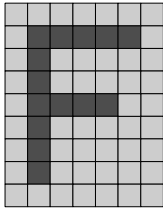
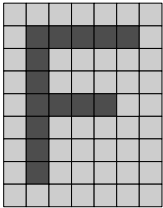
| 26H        | GAMSET (Gamma Set)                                                                                                                                                                                                                                                                        |
|------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Flow Chart | <div><div><div><div>GAMSET</div><div></div><div>GC[7..0]</div><div></div><div>New Gamma Curve Loaded</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></div> |

## 5.1.18. DISPLAY OFF (28H)

| 28H                   | DISPOFF (Display Off)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |     |     |    |    |    |               |    |    |    |    |     |
|-----------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|-----|----|----|----|---------------|----|----|----|----|-----|
|                       | DCX                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | RDX | WRX | 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.</p> <p>In this mode, the output from Frame Memory is disabled and blank page is inserted.</p> <p>This command is 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> <div style="text-align: center;"><p>(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></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 Step up circuit Off                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |     |     |    |    |    | Yes           |    |    |    |    |     |
| Default               | Status                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |     |     |    |    |    | Default Value |    |    |    |    |     |
|                       | Power On Sequence                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |     |     |    |    |    | Display Off   |    |    |    |    |     |
|                       | S/W Reset                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |     |     |    |    |    | Display Off   |    |    |    |    |     |
|                       | H/W Reset                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |     |     |    |    |    | Display Off   |    |    |    |    |     |

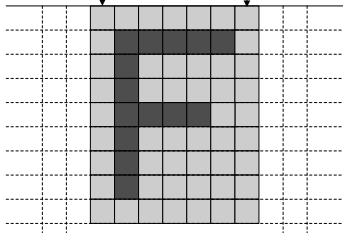
| 28H        | DISPOFF (Display Off)                                                                                                                                                                                                                                                              |
|------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Flow Chart | <div><div><div>Display On Mode</div><div>↓</div><div>DISPOFF</div><div>↓</div><div>Display 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> |

## 5.1.19. DISPLAY ON (29H)

| 29H                   | DISPON (Display On)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |     |     |    |    |    |               |    |    |    |    |     |
|-----------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|-----|----|----|----|---------------|----|----|----|----|-----|
|                       | DCX                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | RDX | WRX | 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 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 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 Step up circuit Off                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |     |     |    |    |    | Yes           |    |    |    |    |     |
| Default               | Status                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |     |     |    |    |    | Default Value |    |    |    |    |     |
|                       | Power On Sequence                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |     |     |    |    |    | Display Off   |    |    |    |    |     |
|                       | S/W Reset                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |     |     |    |    |    | Display Off   |    |    |    |    |     |
|                       | H/W Reset                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |     |     |    |    |    | Display Off   |    |    |    |    |     |

| 29H        | DISPON (Display On)                                                                                                                                                                                                                                                               |
|------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Flow Chart | <div><div><div>Display Off Mode</div><div>↓</div><div>DISPON</div><div>↓</div><div>Display 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> |

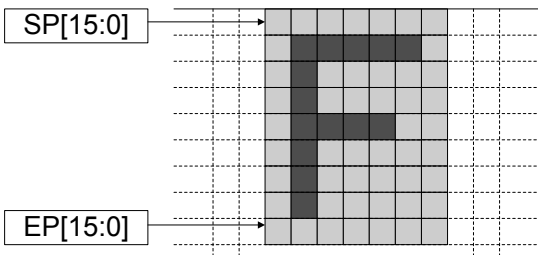
## 5.1.20. COLUMN ADDRESS SET (2AH)

| 2AH                   | CASET (Column Address Set)                                                                                                                                                                                                                                                                                                                                                                                                                                  |     |     |        |        |        |              |        |        |       |       |      |
|-----------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|-----|--------|--------|--------|--------------|--------|--------|-------|-------|------|
|                       | DCX                                                                                                                                                                                                                                                                                                                                                                                                                                                         | RDX | WRX | 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> para  | 1                                                                                                                                                                                                                                                                                                                                                                                                                                                           | 1   | ↑   | SC[15] | SC[14] | SC[13] | SC[12]       | SC[11] | SC[10] | SC[9] | SC[8] | Note |
| 2 <sup>nd</sup> para  | 1                                                                                                                                                                                                                                                                                                                                                                                                                                                           | 1   | ↑   | SC[7]  | SC[6]  | SC[5]  | SC[4]        | SC[3]  | SC[2]  | SC[1] | SC[0] |      |
| 3 <sup>rd</sup> para  | 1                                                                                                                                                                                                                                                                                                                                                                                                                                                           | 1   | ↑   | EC[15] | EC[14] | EC[13] | EC[12]       | EC[11] | EC[10] | EC[9] | EC[8] | Note |
| 4 <sup>th</sup> para  | 1                                                                                                                                                                                                                                                                                                                                                                                                                                                           | 1   | ↑   | EC[7]  | EC[6]  | EC[5]  | EC[4]        | EC[3]  | EC[2]  | EC[1] | EC[0] |      |
| Description           | <p>This command is used to define area of frame memory where MPU can access.</p> <p>This command makes No Change on the other driver status.</p> <p>The values of SC[15:0] and EC[15:0] are referred when RAMWR command comes.</p> <p>Each value represents one column line in the Frame Memory.</p> <p>(Example)</p> <div><div>SC[15:0]</div><div>EC[15:0]</div></div> |     |     |        |        |        |              |        |        |       |       |      |
| Restriction           | <p>SC[15:0] always must be equal to or less than EC[15:0]. When SC[15:0] or EC[15:0] is greater than maximum address as below, data of out of range will be ignored.</p> <p><b>Note.</b></p> <p>(Parameter range: 0 ≤ SC[15:0], EC[15:0] ≤ 239 (00EFh) (B5=0))</p> <p>(Parameter range: 0 ≤ SC[15:0], EC[15:0] ≤ 319 (013Fh) (B5=1))</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          |        |        |       |       |      |
|                       | Sleep In or Step up circuit Off                                                                                                                                                                                                                                                                                                                                                                                                                             |     |     |        |        |        | Yes          |        |        |       |       |      |

| 2AH        | CASET (Column Address Set)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                |                                                                                |
|------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------|--------------------------------------------------------------------------------|
| Default    | Status                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Default Value                                                                  |                                                                                |
|            | Power On Sequence                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | SC[15:0]=0000h                                                                 | EC[15:0]=00EFh                                                                 |
|            | S/W Reset                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | When MADCTL's B5=0:<br>SC[15:0]=0000h<br>When MADCTL's B5=1:<br>SC[15:0]=0000h | When MADCTL's B5=0:<br>EC[15:0]=00EFh<br>When MADCTL's B5=1:<br>EC[15:0]=013Fh |
|            | H/W Reset                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | SC[15:0]=0000h                                                                 | EC[15:0]=00EFh                                                                 |
| Flow Chart | <pre> graph TD     CASET[CASET] --&gt; Param1[1st parameter SC[15:0]<br/>2nd parameter EC[15:0]]     Param1 --&gt; PASET[PASET]     PASET --&gt; Param2[1st parameter SP[15:0]<br/>2nd parameter EP[15:0]]     Param2 --&gt; RAMWR[RAMWR]     RAMWR --&gt; VideoData[Video Data<br/>D1[7:0], D2[7:0]<br/>...Dn[7:0]]     VideoData --&gt; AnyCommand[Any Command]     </pre> <p style="text-align: right;">If needed</p> <div style="border: 1px dashed black; padding: 10px; margin-top: 20px;"> <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> |                                                                                |                                                                                |



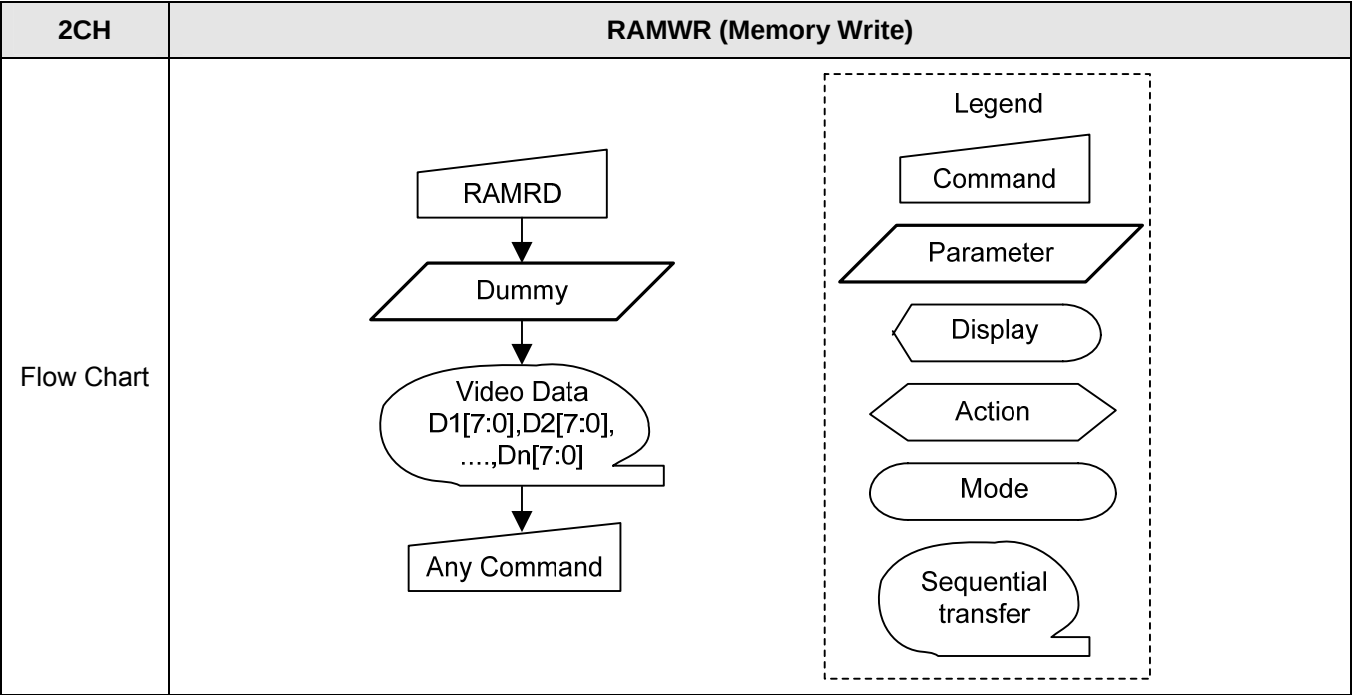
## 5.1.21. PAGE ADDRESS SET (2BH)

| 2BH                   | PASET (Page Address Set)                                                                                                                                                                                                                                                                                                                                                                                 |     |     |        |        |        |              |        |        |       |       |      |
|-----------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|-----|--------|--------|--------|--------------|--------|--------|-------|-------|------|
|                       | DCX                                                                                                                                                                                                                                                                                                                                                                                                      | RDX | WRX | 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> para  | 1                                                                                                                                                                                                                                                                                                                                                                                                        | 1   | ↑   | SP[15] | SP[14] | SP[13] | SP[12]       | SP[11] | SP[10] | SP[9] | SP[8] | Note |
| 2 <sup>nd</sup> para  | 1                                                                                                                                                                                                                                                                                                                                                                                                        | 1   | ↑   | SP[7]  | SP[6]  | SP[5]  | SP[4]        | SP[3]  | SP[2]  | SP[1] | SP[0] |      |
| 3 <sup>rd</sup> para  | 1                                                                                                                                                                                                                                                                                                                                                                                                        | 1   | ↑   | EP[15] | EP[14] | EP[13] | EP[12]       | EP[11] | EP[10] | EP[9] | EP[8] | Note |
| 4 <sup>th</sup> para  | 1                                                                                                                                                                                                                                                                                                                                                                                                        | 1   | ↑   | EP[7]  | EP[6]  | EP[5]  | EP[4]        | EP[3]  | EP[2]  | EP[1] | EP[0] |      |
| Description           | <p>This command is used to define area of frame memory where MPU can access.</p> <p>This command makes No Change on the other driver status.</p> <p>The values of SP[15:0] and EP[15:0] are referred when RAMWR command comes.</p> <p>Each value represents one Page line in the Frame Memory.</p> <p>(Example)</p>  |     |     |        |        |        |              |        |        |       |       |      |
| Restriction           | <p>SP[15:0] always must be equal to or less than EP[15:0]. When SP[15:0] or EP[15:0] is greater than maximum address as below, data of out of range will be ignored.</p> <p><b>Note.</b></p> <p>(Parameter range: 0 ≤ SP[15:0], EP[15:0] ≤ 319 (013Fh) (B5=0)</p> <p>(Parameter range: 0 ≤ SP[15:0], EP[15:0] ≤ 239 (00EFh) (B5=1)</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          |        |        |       |       |      |
|                       | Sleep In or Step up circuit Off                                                                                                                                                                                                                                                                                                                                                                          |     |     |        |        |        | Yes          |        |        |       |       |      |

| 2BH        | PASET (Page Address Set)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                       |                                       |
|------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------|---------------------------------------|
| Default    | Status                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Default Value                         |                                       |
|            | Power On Sequence                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | SC[15:0]=0000h                        | EC[15:0]=01AFh                        |
|            | S/W Reset                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | When MADCTL's B5=0:<br>SC[15:0]=0000h | When MADCTL's B5=0:<br>EC[15:0]=013Fh |
|            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | When MADCTL's B5=1:<br>SC[15:0]=0000h | When MADCTL's B5=1:<br>EC[15:0]=00EFh |
|            | H/W Reset                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | SC[15:0]=0000h                        | EC[15:0]=013Fh                        |
| Flow Chart | <pre> graph TD     CASET[CASET] --&gt; P1[/1st parameter SC[15:0]<br/>2nd parameter EC[15:0]/]     P1 --&gt; PASET[PASET]     PASET --&gt; P2[/1st parameter SP[15:0]<br/>2nd parameter EP[15:0]/]     P2 --&gt; RAMWR[RAMWR]     RAMWR --&gt; VD[/Video Data<br/>D1[7:0], D2[7:0]<br/>... Dn[7:0]/]     VD --&gt; AC[Any Command]     subgraph If_needed [If needed]         PASET         P2         RAMWR         VD     end </pre> <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> |                                       |                                       |

## 5.1.22. MEMORY WRITE (2CH)

| 2CH                   | RAMWR (Memory Write)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |     |     |       |       |       |                                    |       |       |       |       |        |
|-----------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|-----|-------|-------|-------|------------------------------------|-------|-------|-------|-------|--------|
|                       | DCX                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | RDX | WRX | 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> para  | 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | 1   | ↑   | D[17] | D[16] | D[15] | D[14]                              | D[13] | D[12] | D[11] | D[10] | 00..FF |
| :                     | 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | 1   | ↑   | Dx[7] | Dx[6] | Dx[5] | Dx[4]                              | Dx[3] | Dx[2] | Dx[1] | Dx[0] | 00..FF |
| N <sup>th</sup> para  | 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | 1   | ↑   | Dn[7] | Dn[6] | Dn[5] | Dn[4]                              | Dn[3] | Dn[2] | Dn[1] | Dn[0] | 00..FF |
| Description           | <p>This command is used to transfer data from MPU to frame memory.</p> <p>This command makes No Change to the other driver status.</p> <p>When this command is accepted, the column register and the page register are reset to the Start Column/Start Page position.</p> <p>The Start Column/Start Page positions are different in accordance with MADCTL setting. Then D[7:0] is stored in frame memory and the column register and the page register incremented.</p> <p>Sending any other command can stop frame Write.</p> |     |     |       |       |       |                                    |       |       |       |       |        |
| Restriction           | In all color 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                                |       |       |       |       |        |
|                       | Sleep In or Step up circuit Off                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |     |     |       |       |       | Yes                                |       |       |       |       |        |
| Default               | Status                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |     |     |       |       |       | Default Value                      |       |       |       |       |        |
|                       | Power On Sequence                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |     |     |       |       |       | Contents of memory is set randomly |       |       |       |       |        |
|                       | S/W Reset                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |     |     |       |       |       | Contents of memory is not cleared  |       |       |       |       |        |
|                       | H/W Reset                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |     |     |       |       |       | Contents of memory is not cleared  |       |       |       |       |        |



## 5.1.23. MEMORY READ (2EH)

| 2EH                      | RAMRD (Memory Read)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |     |     |       |       |       |                                    |       |       |       |       |        |
|--------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|-----|-------|-------|-------|------------------------------------|-------|-------|-------|-------|--------|
|                          | DCX                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | RDX | WRX | 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> para     | 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | ↑   | 1   | X     | X     | X     | X                                  | X     | X     | X     | X     | 00..FF |
| :                        | 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | ↑   | 1   | Dx[7] | Dx[6] | Dx[5] | Dx[4]                              | Dx[3] | Dx[2] | Dx[1] | Dx[0] | 00..FF |
| (N+1) <sup>th</sup> para | 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | ↑   | 1   | Dn[7] | Dn[6] | Dn[5] | Dn[4]                              | Dn[3] | Dn[2] | Dn[1] | Dn[0] | 00..FF |
| Description              | <p>This command is used to transfer data from frame memory to MPU.</p> <p>This command makes No Change to the other driver status.</p> <p>When this command is accepted, the column register and the page register are reset to the Start Column / Start Page position.</p> <p>The Start Column / Start positions are different in accordance with MADCTL setting.</p> <p>Then D[7:0] is read back from the frame memory and the column register and the page register incremented. Frame memory read can be stopped by sending any other command.</p> |     |     |       |       |       |                                    |       |       |       |       |        |
| Restriction              | <p>In all color modes, the frame memory read is always 18bit, so there is no restriction on length of parameters.</p> <p><b>Note.</b></p> <p>Frame memory read is only possible via the Parallel Interface.</p>                                                                                                                                                                                                                                                                                                                                        |     |     |       |       |       |                                    |       |       |       |       |        |
| Register Availability    | <b>Status</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |     |     |       |       |       | <b>Availability</b>                |       |       |       |       |        |
|                          | 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 Step up circuit Off                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |     |     |       |       |       | Yes                                |       |       |       |       |        |
| Default                  | <b>Status</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |     |     |       |       |       | <b>Default Value</b>               |       |       |       |       |        |
|                          | Power On Sequence                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |     |     |       |       |       | Contents of memory is set randomly |       |       |       |       |        |
|                          | S/W Reset                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |     |     |       |       |       | Contents of memory is not cleared  |       |       |       |       |        |
|                          | H/W Reset                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |     |     |       |       |       | Contents of memory is not cleared  |       |       |       |       |        |

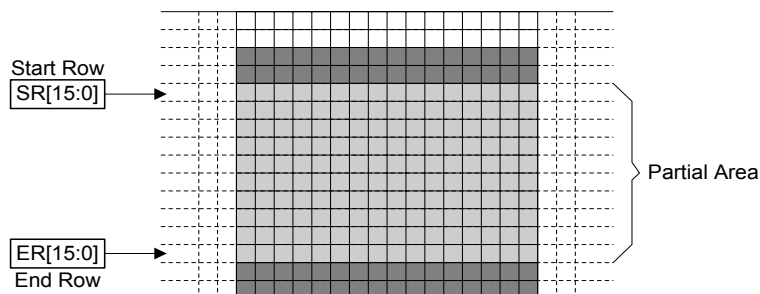
| 2EH        | RAMRD (Memory Read)                                                                                                                                                                                                                                                                                              |
|------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Flow Chart | <div><div><div>RAMRD</div><div>↓</div><div>Video Data<br/>D1[7:0],D2[7:0],<br/>.....,Dn[7:0]:0]</div><div>↓</div><div>Any Command</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> |

## 5.1.24. PARTIAL AREA (30H)

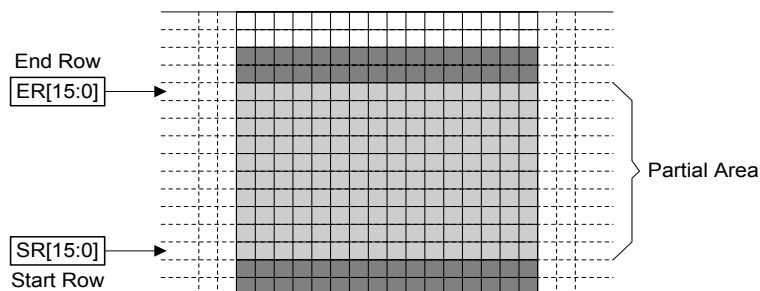
| 30H                  | PLTAR (Partial Area) |     |     |        |        |        |        |        |        |       |       |        |
|----------------------|----------------------|-----|-----|--------|--------|--------|--------|--------|--------|-------|-------|--------|
|                      | DCX                  | RDX | WRX | 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> para | 1                    | 1   | ↑   | SR[15] | SR[14] | SR[13] | SR[12] | SR[11] | SR[10] | SR[9] | SR[8] | 0000.. |
| 2 <sup>nd</sup> para | 1                    | 1   | ↑   | SR[7]  | SR[6]  | SR[5]  | SR[4]  | SR[3]  | SR[2]  | SR[1] | SR[0] | 013F   |
| 3 <sup>rd</sup> para | 1                    | 1   | ↑   | ER[15] | ER[14] | ER[13] | ER[12] | ER[11] | ER[10] | ER[9] | ER[8] | 0000.. |
| 4 <sup>th</sup> para | 1                    | 1   | ↑   | ER[7]  | ER[6]  | ER[5]  | ER[4]  | ER[3]  | ER[2]  | ER[1] | ER[0] | 013F   |

This command defines the partial mode's display area. There are 2 parameters associated with this command, the first defines the Start Row(SR) and the second defines the End Row(ER), as illustrated in the figures below. SR and ER refer to the Frame Memory Line Pointer.

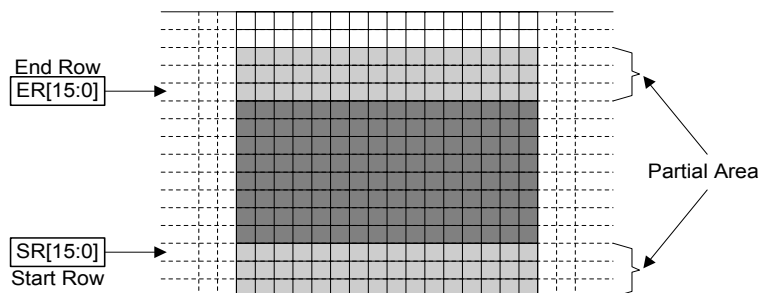
If End Row>Start Row When MADCTL B4=0:



If End Row>Start Row When MADCTL B4=1:



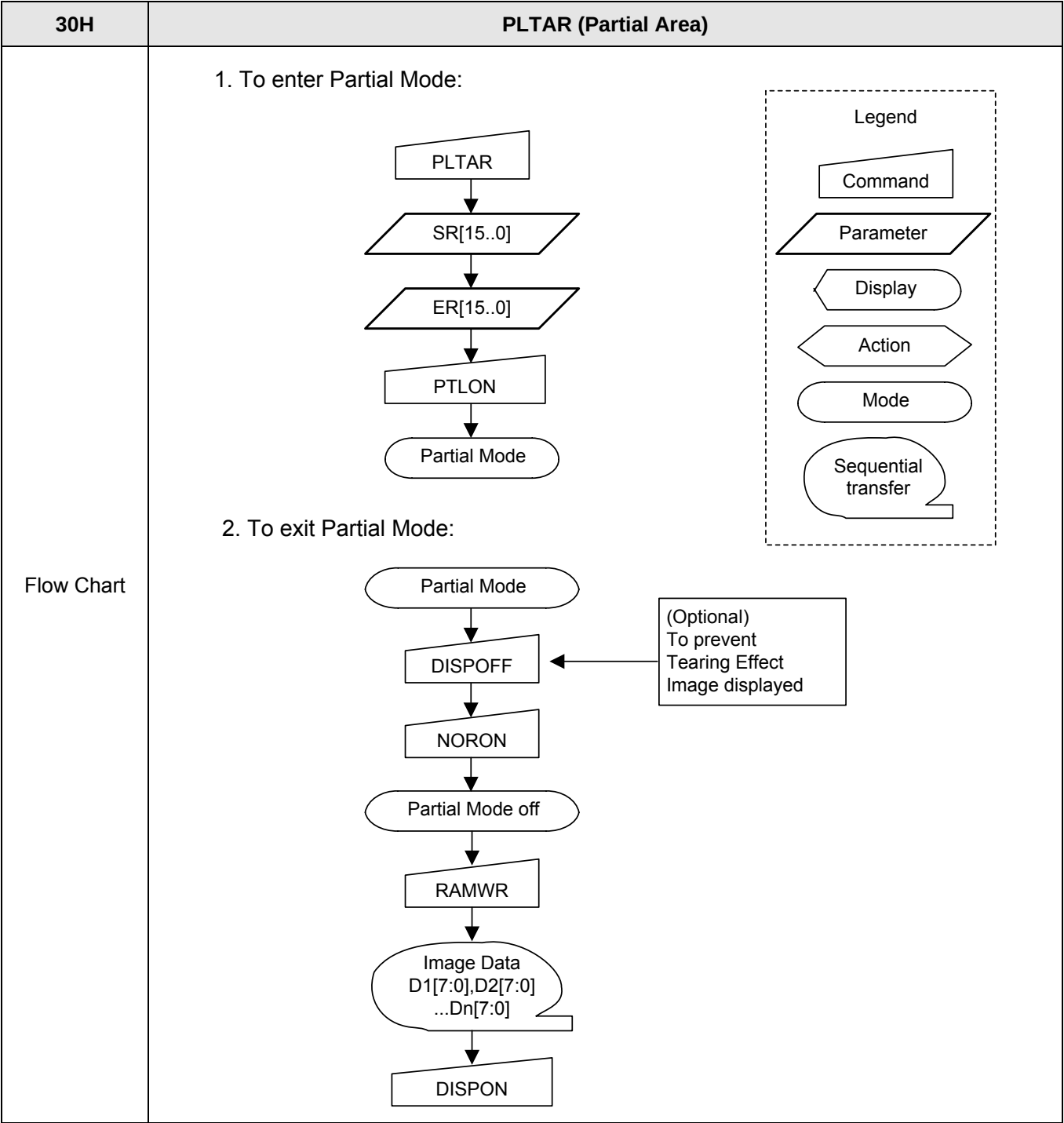
If End Row<Start Row When MADCTL B4=0:



If End Row=Start Row then the Partial Area will be one row deep.

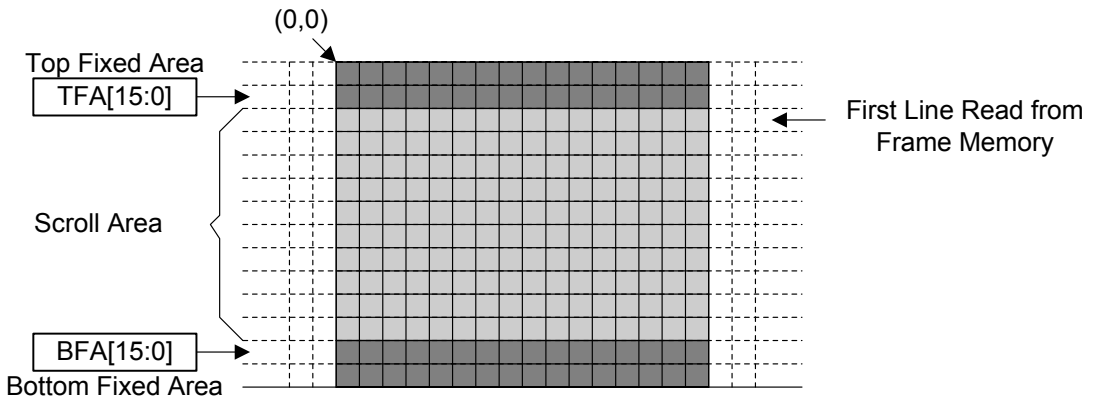
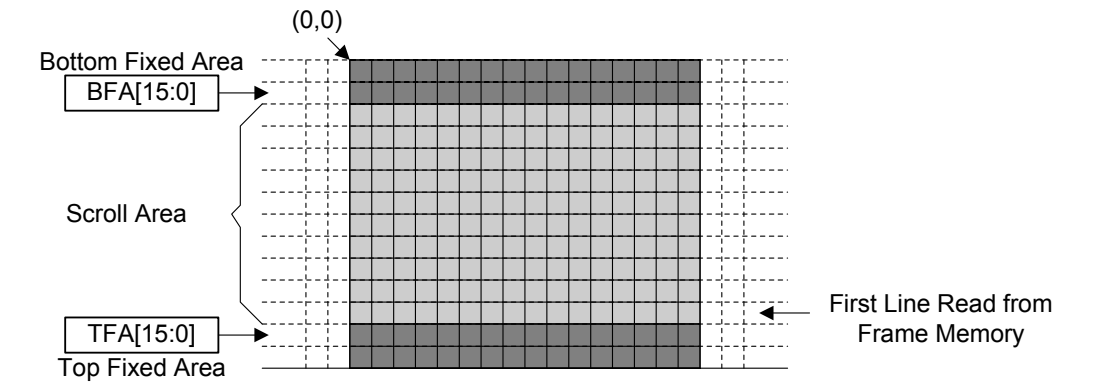
| 30H                   | PLTAR (Partial Area)                                                  |                               |
|-----------------------|-----------------------------------------------------------------------|-------------------------------|
| Restriction           | Each detail initial values by the display resolution will be updated. |                               |
| 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 Step up circuit Off                                       | Yes                           |
| Default               | Status                                                                | Default Value                 |
|                       | Power On Sequence                                                     | SR[15:0]=0000h ER[15:0]=013Fh |
|                       | H/W Reset                                                             | SR[15:0]=0000h ER[15:0]=013Fh |
|                       | H/W Reset                                                             | SR[15:0]=0000h ER[15:0]=013Fh |



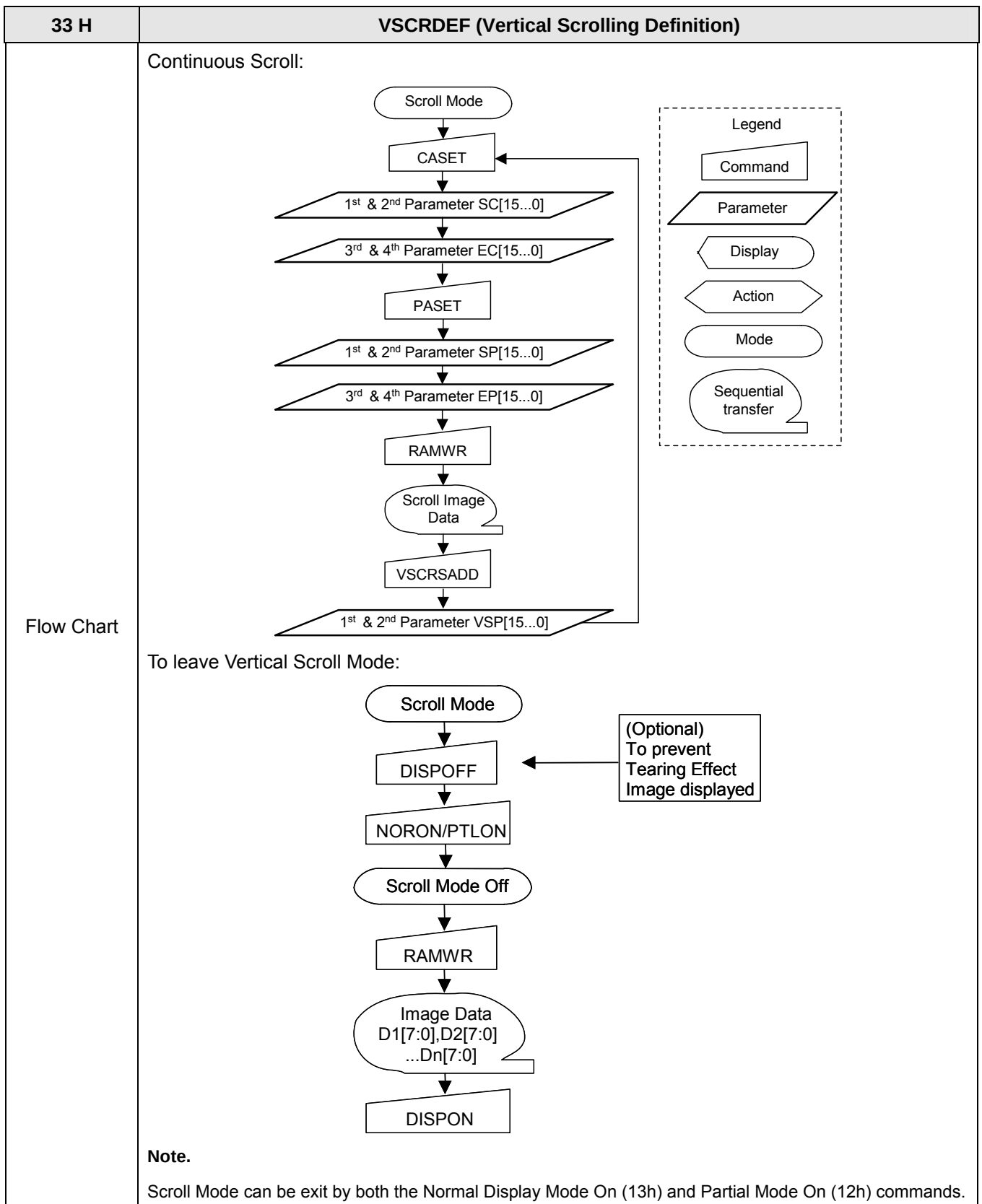


## 5.1.25. VERTICAL SCROLLING DEFINITION (33H)

| 33 H                      | VSCRDEF (Vertical Scrolling Definition)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |     |     |             |             |             |             |             |             |            |            |                      |
|---------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|-----|-------------|-------------|-------------|-------------|-------------|-------------|------------|------------|----------------------|
|                           | DCX                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | RDX | WRX | 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   | ↑   | TFA<br>[15] | TFA<br>[14] | TFA<br>[13] | TFA<br>[12] | TFA<br>[11] | TFA<br>[10] | TFA<br>[9] | TFA<br>[8] | 0000<br>....<br>013F |
| 2 <sup>nd</sup> parameter | 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | 1   | ↑   | TFA<br>[7]  | TFA<br>[6]  | TFA<br>[5]  | TFA<br>[4]  | TFA<br>[3]  | TFA<br>[2]  | TFA<br>[1] | TFA<br>[0] |                      |
| 3 <sup>rd</sup> parameter | 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | 1   | ↑   | VSA<br>[15] | VSA<br>[14] | VSA<br>[13] | VSA<br>[12] | VSA<br>[11] | VSA<br>[10] | VSA<br>[9] | VSA<br>[8] | 0000<br>....<br>013F |
| 4 <sup>th</sup> parameter | 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | 1   | ↑   | VSA<br>[7]  | VSA<br>[6]  | VSA<br>[5]  | VSA<br>[4]  | VSA<br>[3]  | VSA<br>[2]  | VSA<br>[1] | VSA<br>[0] |                      |
| 5 <sup>th</sup> parameter | 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | 1   | ↑   | BFA<br>[15] | BFA<br>[14] | BFA<br>[13] | BFA<br>[12] | BFA<br>[11] | BFA<br>[10] | BFA<br>[9] | BFA<br>[8] | 0000<br>....<br>013F |
| 6 <sup>th</sup> parameter | 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | 1   | ↑   | BFA<br>[7]  | BFA<br>[6]  | BFA<br>[5]  | BFA<br>[4]  | BFA<br>[3]  | BFA<br>[2]  | BFA<br>[1] | BFA<br>[0] |                      |
| Description               | <p>This command defines the Vertical Scrolling Area of the display. (refer to Restriction)</p> <p>When MADCTL B4 = 0</p> <p>The 1st &amp; 2nd parameter TFA[15..0] describes the Top Fixed Area (in No. of lines from Top of the Frame Memory and Display).</p> <p>The 3rd &amp; 4th 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.</p> <p>The 5th &amp; 6th parameter BFA[15..0] describes the Bottom Fixed Area(in No. of lines from Bottom of the Frame Memory and Display).</p> <p>TFA, VSA and BFA refer to the Frame Memory Line Pointer.</p> |     |     |             |             |             |             |             |             |            |            |                      |

| 33 H                                     | VSCRDEF (Vertical Scrolling Definition)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |        |              |                                          |     |                                         |     |  |
|------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------|--------------|------------------------------------------|-----|-----------------------------------------|-----|--|
|                                          | <div></div> <p>When MADCTL B4 = 1</p> <p>The 1st &amp; 2nd parameter TFA[15..0] describes the Top Fixed Area (in No. of lines from Bottom of the Frame Memory and Display).</p> <p>The 3rd &amp; 4th 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.</p> <p>The 5th &amp; 6th parameter BFA[15..0] describes the Bottom Fixed Area(in No. of lines from Top of the Frame Memory and Display).</p> <p>TFA, VSA and BFA refer to the Frame Memory Line Pointer.</p> <div></div> |        |              |                                          |     |                                         |     |  |
| Restriction                              | <p><b>Note.</b></p> <p>The condition is (TFA+VSA+BFA)≥320, otherwise Scrolling mode is undefined.</p> <p>In Vertical Scroll Mode, MADCTL B5 should be set to “0” – this only affects the Frame Memory Write.</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></tbody></table>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | Status | Availability | Normal Mode On, Idle Mode Off, Sleep Out | Yes | Normal 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                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |        |              |                                          |     |                                         |     |  |

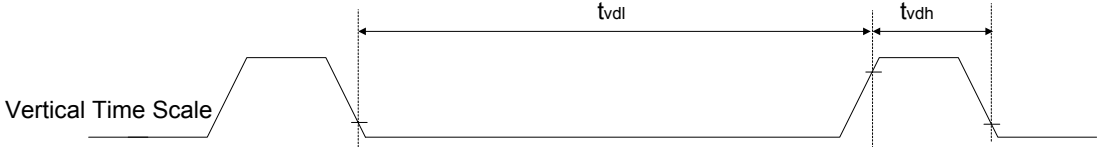
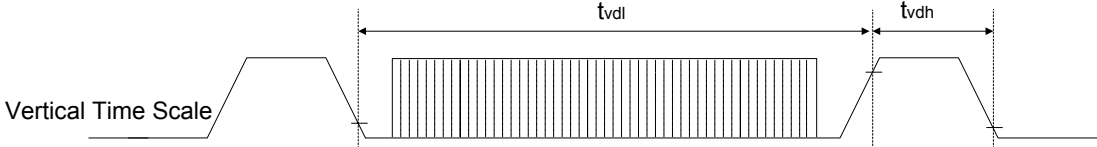
| 33 H       | VSCRDEF (Vertical Scrolling Definition)                                                                                                                            |     |
|------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|
|            | Partial Mode On, Idle Mode Off, Sleep Out                                                                                                                          | Yes |
|            | Partial Mode On, Idle Mode On, Sleep Out                                                                                                                           | Yes |
|            | Sleep In or Booster Off                                                                                                                                            | Yes |
| Flow Chart | <p>To enter Vertical Scroll Mode:</p> <p><b>Note.</b><br/>The Frame Memory Window size must be defined correctly otherwise undesirable image will be displayed</p> |     |



## 5.1.26. TEARING EFFECT LINE OFF (34H)

| 34 H                  | TEOFF (Tearing Effect Line OFF)                                                                                                                                                                                                                                                      |     |     |    |    |    |               |    |    |    |    |     |
|-----------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|-----|----|----|----|---------------|----|----|----|----|-----|
|                       | DCX                                                                                                                                                                                                                                                                                  | RDX | WRX | 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 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 Step up circuit Off                                                                                                                                                                                                                                                      |     |     |    |    |    | Yes           |    |    |    |    |     |
| Default               | Status                                                                                                                                                                                                                                                                               |     |     |    |    |    | Default Value |    |    |    |    |     |
|                       | Power On Sequence                                                                                                                                                                                                                                                                    |     |     |    |    |    | Off           |    |    |    |    |     |
|                       | S/W Reset                                                                                                                                                                                                                                                                            |     |     |    |    |    | Off           |    |    |    |    |     |
|                       | H/W Reset                                                                                                                                                                                                                                                                            |     |     |    |    |    | Off           |    |    |    |    |     |
| Flow Chart            | <div><div><div>TE Line Output ON</div><div>↓</div><div>TEOFF</div><div>↓</div><div>TE Line Output OFF</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> |     |     |    |    |    |               |    |    |    |    |     |

## 5.1.27. TEARING EFFECT LINE ON (35H)

| 35 H                  | TEON (Tearing Effect Line ON)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |     |     |    |    |    |              |    |    |    |    |     |
|-----------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|-----|----|----|----|--------------|----|----|----|----|-----|
|                       | DCX                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | RDX | WRX | 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.</p> <p>This output is not affected by changing Memory Address Control command bit “B4”.</p> <p>The Tearing Effect Line On has one parameter that 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>  <p>When M=1:</p> <p>The Tearing Effect Output Line consists of both V-Blanking and H-Blanking information:</p>  <p>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 | 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 Step up circuit Off                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |     |     |    |    |    | Yes          |    |    |    |    |     |

| 35 H       | TEON (Tearing Effect Line ON)                                                                                                                                                                                                                                                                               |               |
|------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|
| Default    | Status                                                                                                                                                                                                                                                                                                      | Default Value |
|            | Power On Sequence                                                                                                                                                                                                                                                                                           | Off           |
|            | S/W Reset                                                                                                                                                                                                                                                                                                   | Off           |
|            | H/W Reset                                                                                                                                                                                                                                                                                                   | Off           |
| Flow Chart | <div><div><div>TE Line Output OFF</div><div>↓</div><div>TEON</div><div>↓</div><div>M</div><div>↓</div><div>TE Line Output ON</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> |               |
|            |                                                                                                                                                                                                                                                                                                             |               |



## 5.1.28. MEMORY DATA ACCESS CONTROL (36H)

| 36 H                                                                       | MADCTL (Memory Data Access Control)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                       |                                                                                       |    |    |    |    |    |    |    |    |     |     |      |             |    |                    |                                                          |    |                      |    |                       |    |                    |                               |    |               |                                                                                       |
|----------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|---------------------------------------------------------------------------------------|----|----|----|----|----|----|----|----|-----|-----|------|-------------|----|--------------------|----------------------------------------------------------|----|----------------------|----|-----------------------|----|--------------------|-------------------------------|----|---------------|---------------------------------------------------------------------------------------|
|                                                                            | DCX                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | RDX                   | WRX                                                                                   | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 | HEX |     |      |             |    |                    |                                                          |    |                      |    |                       |    |                    |                               |    |               |                                                                                       |
| Command                                                                    | 0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | 1                     | ↑                                                                                     | 0  | 0  | 1  | 1  | 0  | 1  | 1  | 0  | 36  |     |      |             |    |                    |                                                          |    |                      |    |                       |    |                    |                               |    |               |                                                                                       |
| parameter                                                                  | 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | 1                     | ↑                                                                                     | B7 | B6 | B5 | B4 | B3 | X  | 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.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                       |                                                                                       |    |    |    |    |    |    |    |    |     |     |      |             |    |                    |                                                          |    |                      |    |                       |    |                    |                               |    |               |                                                                                       |
|                                                                            | <table><tr><th>Bit</th><th>Name</th><th>Description</th></tr><tr><td>B7</td><td>Page Address Order</td><td rowspan="3">These 3 bits control MPU to memory write/read Direction.</td></tr><tr><td>B6</td><td>Column Address Order</td></tr><tr><td>B5</td><td>Page/Column Selection</td></tr><tr><td>B4</td><td>Line Address Order</td><td>LCD refresh direction control</td></tr><tr><td>B3</td><td>RGB-BGR Order</td><td>Color selector switch control<br/>(0=RGB color filter panel, 1=BGR color filter panel)</td></tr></table>                                                                                                                                                                                             |                       |                                                                                       |    |    |    |    |    |    |    |    |     | Bit | Name | Description | B7 | Page Address Order | These 3 bits control MPU to memory write/read Direction. | B6 | Column Address Order | B5 | Page/Column Selection | B4 | Line Address Order | LCD refresh direction control | B3 | RGB-BGR Order | Color selector switch control<br>(0=RGB color filter panel, 1=BGR color filter panel) |
|                                                                            | Bit                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | Name                  | Description                                                                           |    |    |    |    |    |    |    |    |     |     |      |             |    |                    |                                                          |    |                      |    |                       |    |                    |                               |    |               |                                                                                       |
|                                                                            | B7                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Page Address Order    | These 3 bits control MPU to memory write/read Direction.                              |    |    |    |    |    |    |    |    |     |     |      |             |    |                    |                                                          |    |                      |    |                       |    |                    |                               |    |               |                                                                                       |
|                                                                            | B6                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Column Address Order  |                                                                                       |    |    |    |    |    |    |    |    |     |     |      |             |    |                    |                                                          |    |                      |    |                       |    |                    |                               |    |               |                                                                                       |
|                                                                            | B5                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Page/Column Selection |                                                                                       |    |    |    |    |    |    |    |    |     |     |      |             |    |                    |                                                          |    |                      |    |                       |    |                    |                               |    |               |                                                                                       |
|                                                                            | B4                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Line Address Order    | LCD refresh direction control                                                         |    |    |    |    |    |    |    |    |     |     |      |             |    |                    |                                                          |    |                      |    |                       |    |                    |                               |    |               |                                                                                       |
|                                                                            | B3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | RGB-BGR Order         | Color selector switch control<br>(0=RGB color filter panel, 1=BGR color filter panel) |    |    |    |    |    |    |    |    |     |     |      |             |    |                    |                                                          |    |                      |    |                       |    |                    |                               |    |               |                                                                                       |
|                                                                            | <div><div><p>B4 - Vertical Updating order</p><div><div><p>B4="0"</p><div><p>Top-Left(0,0)</p><p>Memory</p></div><div><p>(example)</p><div><p>Top-Left(0,0)</p><p>Display</p></div><div><p>Sent First(1)</p><p>Sent 2nd</p><p>Sent 3rd</p><p>Sent Last(320)</p></div></div></div><div><p>B4="1"</p><div><p>Top-Left(0,0)</p><p>Memory</p></div><div><p>(example)</p><div><p>Top-Left(0,0)</p><p>Display</p></div><div><p>Sent Last(320)</p><p>Sent 3rd</p><p>Sent 2nd</p><p>Sent First(1)</p></div></div></div></div></div></div>                                                                                                                                                                                               |                       |                                                                                       |    |    |    |    |    |    |    |    |     |     |      |             |    |                    |                                                          |    |                      |    |                       |    |                    |                               |    |               |                                                                                       |
|                                                                            | <div><div><p>B3 - RGB/BGR Order</p><div><div><p>B3 = "0"</p><div><div><p>Driver IC</p><div><p>Source1</p><p>Source2</p><p>Source240</p></div><div><p>Source1</p><p>Source2</p><p>Source240</p></div></div><div><p>LCD panel</p><div><div><p>Source1</p><p>Source2</p><p>Source240</p></div><div><p>Source1</p><p>Source2</p><p>Source240</p></div></div></div></div><div><p>B3 = "1"</p><div><div><p>Driver IC</p><div><p>Source1</p><p>Source2</p><p>Source240</p></div><div><p>Source1</p><p>Source2</p><p>Source240</p></div></div><div><p>LCD panel</p><div><div><p>Source1</p><p>Source2</p><p>Source240</p></div><div><p>Source1</p><p>Source2</p><p>Source240</p></div></div></div></div></div></div></div></div></div> |                       |                                                                                       |    |    |    |    |    |    |    |    |     |     |      |             |    |                    |                                                          |    |                      |    |                       |    |                    |                               |    |               |                                                                                       |
| <p><b>Note.</b></p> <p>Top-Left (0,0) means a physical memory location</p> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                       |                                                                                       |    |    |    |    |    |    |    |    |     |     |      |             |    |                    |                                                          |    |                      |    |                       |    |                    |                               |    |               |                                                                                       |
|                                                                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                       |                                                                                       |    |    |    |    |    |    |    |    |     |     |      |             |    |                    |                                                          |    |                      |    |                       |    |                    |                               |    |               |                                                                                       |
|                                                                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                       |                                                                                       |    |    |    |    |    |    |    |    |     |     |      |             |    |                    |                                                          |    |                      |    |                       |    |                    |                               |    |               |                                                                                       |
|                                                                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                       |                                                                                       |    |    |    |    |    |    |    |    |     |     |      |             |    |                    |                                                          |    |                      |    |                       |    |                    |                               |    |               |                                                                                       |

| 36 H                  | MADCTL (Memory Data Access Control)                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                |
|-----------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------|
| Restriction           | D2, D1 and D0 are set to "000" internally.                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                |
| 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 Step up circuit 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                                      |
|                       | H/W Reset                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | B7=0, B6=0, B5=0, B4=0, B3=0, B2=0, B1=0, B0=0 |
| Flow Chart            | <div style="display: flex; align-items: center; justify-content: center;"> <div style="text-align: center; margin-right: 20px;"> <pre> graph TD     A[MADCTL] --&gt; B[/1<sup>st</sup> parameter B[7:0]/]           </pre> </div> <div style="border: 1px dashed black; padding: 10px;"> <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> </div> |                                                |

## 5.1.29. VERTICAL SCROLLING START ADDRESS (37H)

| 37H                       | VSCRSADD (Vertical Scrolling Start Address) |     |     |           |           |           |           |           |           |          |          |              |
|---------------------------|---------------------------------------------|-----|-----|-----------|-----------|-----------|-----------|-----------|-----------|----------|----------|--------------|
|                           | DCX                                         | RDX | WRX | 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 | 0000         |
| 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 | ....<br>013F |

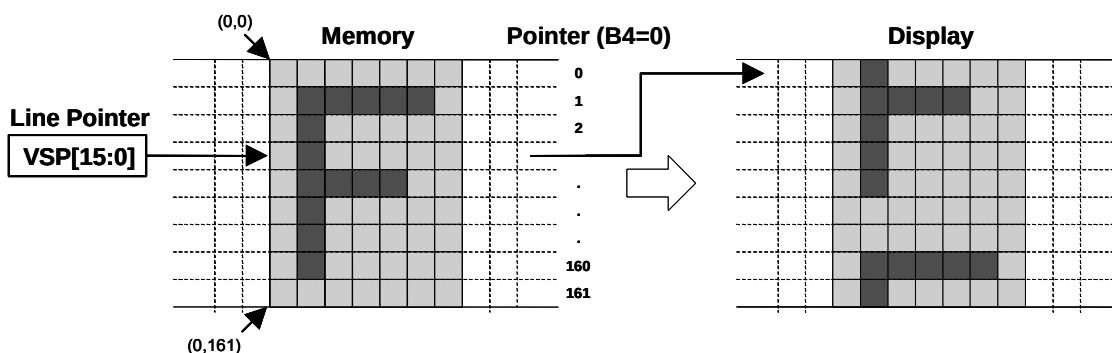
Description

This command is used together with Vertical Scrolling Definition (33h). These two commands describe the scrolling area and the scrolling mode. (refer to Restriction)

The Vertical Scrolling Start Address command has one parameter which describes which line in the Frame Memory will be written as the first line after the last line of the Top Fixed Area on the display as illustrated below.

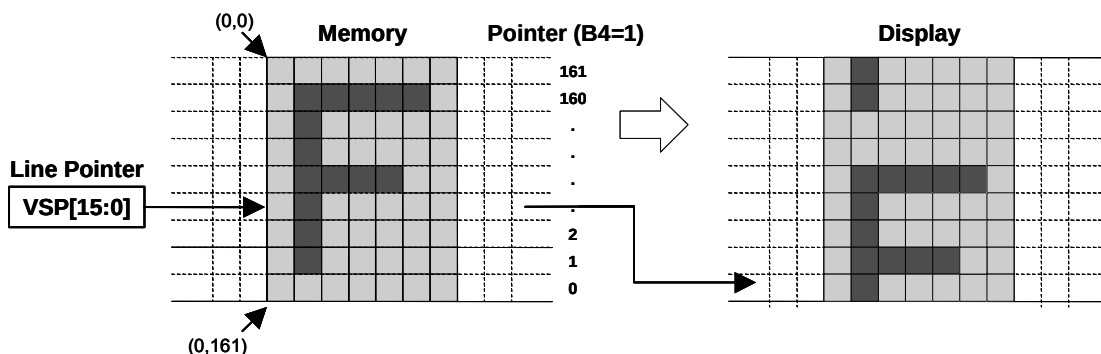
When MADCTL B4 = 0

When Top Fixed Area = Bottom Fixed Area = 00, Vertical Scrolling Area = 320 and VSP = '3'.



When MADCTL B4 = 1

When Top Fixed Area = Bottom Fixed Area = 00, Vertical Scrolling Area = 320 and VSP = '3'.



| 37H                   | VSCRSADD (Vertical Scrolling Start Address)                                                                                                                                                                                                                                                                                                          |               |
|-----------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|
|                       | <b>Note.</b><br>1. When new Pointer position and Picture Data are sent, the result on the display will happen at the next Panel Scan to avoid tearing effect.<br>2. VSP refers to the Vertical Scrolling Start Address.                                                                                                                              |               |
| Restriction           | <b>Note.</b><br>Each detail initial values by the display resolution will be updated.<br><br>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. |               |
| 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            |
|                       | Sleep In or Booster Off                                                                                                                                                                                                                                                                                                                              | Yes           |
| Default               |                                                                                                                                                                                                                                                                                                                                                      |               |
|                       | Status                                                                                                                                                                                                                                                                                                                                               | Default Value |
|                       | Power On Sequence                                                                                                                                                                                                                                                                                                                                    | 0000          |
|                       | S/W Reset                                                                                                                                                                                                                                                                                                                                            | 0000          |
|                       | H/W Reset                                                                                                                                                                                                                                                                                                                                            | 0000          |
| Flow Chart            | See Vertical Scrolling Definition (33h) description.                                                                                                                                                                                                                                                                                                 |               |

## 5.1.30. IDLE MODE OFF (38H)

| 38H                   | IDMOFF (Idle Mode Off)                                                                                                                                                                                                                                                                                |     |     |    |    |    |               |    |    |    |    |     |
|-----------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|-----|----|----|----|---------------|----|----|----|----|-----|
|                       | DCX                                                                                                                                                                                                                                                                                                   | RDX | WRX | 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 262k-color.                                                                                                                                                                                          |     |     |    |    |    |               |    |    |    |    |     |
| 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           |    |    |    |    |     |
|                       | Sleep In or Step up circuit Off                                                                                                                                                                                                                                                                       |     |     |    |    |    | Yes           |    |    |    |    |     |
| Default               | Status                                                                                                                                                                                                                                                                                                |     |     |    |    |    | Default Value |    |    |    |    |     |
|                       | Power On Sequence                                                                                                                                                                                                                                                                                     |     |     |    |    |    | Idle off mode |    |    |    |    |     |
|                       | S/W Reset                                                                                                                                                                                                                                                                                             |     |     |    |    |    | Idle off mode |    |    |    |    |     |
|                       | H/W Reset                                                                                                                                                                                                                                                                                             |     |     |    |    |    | Idle off mode |    |    |    |    |     |
| Flow Chart            | <div><div><div>Display Inversion On Mode</div><div>↓</div><div>IDMOFF</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> |     |     |    |    |    |               |    |    |    |    |     |

## 5.1.31. IDLE MODE ON (39H)

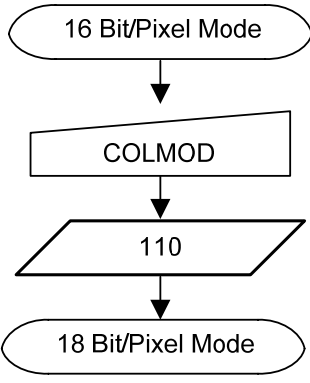
| 39H                   | IDMON (Idle Mode On)                                                                                                                                                                                                                                                                                     |     |     |                   |    |    |                   |    |    |                   |    |     |
|-----------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|-----|-------------------|----|----|-------------------|----|----|-------------------|----|-----|
|                       | DCX                                                                                                                                                                                                                                                                                                      | RDX | WRX | 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.<br>In the idle on mode, color expression is reduced. The primary and the secondary using MSB of each R, G and B in the Frame Memory, 8 color depth data is displayed.<br>Memory contents vs Display Color <span style="float:right">X=don't care</span> |     |     |                   |    |    |                   |    |    |                   |    |     |
|                       | Color                                                                                                                                                                                                                                                                                                    |     |     | R5,R4,R3,R2,R1,R0 |    |    | G5,G4,G3,G2,G1,G0 |    |    | B5,B4,B3,B2,B1,B0 |    |     |
|                       | Red                                                                                                                                                                                                                                                                                                      |     |     | 1 x x x x x x     |    |    | 0 x x x x x x     |    |    | 0 x x x x x x     |    |     |
|                       | Green                                                                                                                                                                                                                                                                                                    |     |     | 0 x x x x x x     |    |    | 1 x x x x x x     |    |    | 0 x x x x x x     |    |     |
|                       | Blue                                                                                                                                                                                                                                                                                                     |     |     | 0 x x x x x x     |    |    | 0 x x x x x x     |    |    | 1 x x x x x x     |    |     |
|                       | White                                                                                                                                                                                                                                                                                                    |     |     | 1 x x x x x x     |    |    | 1 x x x x x x     |    |    | 1 x x x x x x     |    |     |
|                       | Black                                                                                                                                                                                                                                                                                                    |     |     | 0 x x x x x x     |    |    | 0 x x x x x x     |    |    | 0 x x x x x x     |    |     |
|                       | Cyan                                                                                                                                                                                                                                                                                                     |     |     | 0 x x x x x x     |    |    | 1 x x x x x x     |    |    | 1 x x x x x x     |    |     |
|                       | Magenta                                                                                                                                                                                                                                                                                                  |     |     | 1 x x x x x x     |    |    | 0 x x x x x x     |    |    | 1 x x x x x x     |    |     |
|                       | Yellow                                                                                                                                                                                                                                                                                                   |     |     | 1 x x x x x x     |    |    | 1 x x x x x x     |    |    | 0 x x x x x x     |    |     |
| 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 Step up circuit Off                                                                                                                                                                                                                                                                          |     |     |                   |    |    | Yes               |    |    |                   |    |     |
| Default               | Status                                                                                                                                                                                                                                                                                                   |     |     |                   |    |    | Default Value     |    |    |                   |    |     |
|                       | Power On Sequence                                                                                                                                                                                                                                                                                        |     |     |                   |    |    | Idle Off Mode     |    |    |                   |    |     |
|                       | S/W Reset                                                                                                                                                                                                                                                                                                |     |     |                   |    |    | Idle Off Mode     |    |    |                   |    |     |
|                       | H/W Reset                                                                                                                                                                                                                                                                                                |     |     |                   |    |    | Idle Off Mode     |    |    |                   |    |     |

| 39H        | IDMON (Idle Mode On)                                                                                                                                                                                                                                                                                         |
|------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Flow Chart | <div><div><div>Display Inversion<br/>Off Mode</div><div>↓</div><div>IDMON</div><div>↓</div><div>Display Inversion<br/>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> |

## 5.1.32. INTERFACE PIXEL FORMAT (3AH)

| 3AH                   | COLMOD (Interface Pixel Format)                                                                                                                            |     |                                |    |    |    |                |                                          |    |    |    |     |
|-----------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|--------------------------------|----|----|----|----------------|------------------------------------------|----|----|----|-----|
|                       | DCX                                                                                                                                                        | RDX | WRX                            | D7 | D6 | D5 | D4             | D3                                       | D2 | D1 | D0 | HEX |
| Command               | 0                                                                                                                                                          | 1   | ↑                              | 0  | 0  | 1  | 1              | 1                                        | 0  | 1  | 0  | 3A  |
| 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, which is to be transferred via the MPU interface. The formats are shown in the table below: |     |                                |    |    |    |                |                                          |    |    |    |     |
|                       | Bit                                                                                                                                                        |     | Description                    |    |    |    |                | Value                                    |    |    |    |     |
|                       | D7                                                                                                                                                         |     | -                              |    |    |    |                | “0” (Not used)                           |    |    |    |     |
|                       | D6                                                                                                                                                         |     | RGB Interface Color Format     |    |    |    |                | “101”=16 bit/pixel<br>“110”=18 bit/pixel |    |    |    |     |
|                       | D5                                                                                                                                                         |     |                                |    |    |    |                |                                          |    |    |    |     |
|                       | D4                                                                                                                                                         |     |                                |    |    |    |                |                                          |    |    |    |     |
|                       | D3                                                                                                                                                         |     | -                              |    |    |    |                | “0” (Not used)                           |    |    |    |     |
|                       | D2                                                                                                                                                         |     | Control Interface Color Format |    |    |    |                | “101”=16 bit/pixel<br>“110”=18 bit/pixel |    |    |    |     |
|                       | D1                                                                                                                                                         |     |                                |    |    |    |                |                                          |    |    |    |     |
|                       | D0                                                                                                                                                         |     |                                |    |    |    |                |                                          |    |    |    |     |
| 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            |                                          |    |    |    |     |
|                       | Sleep In or Step up circuit Off                                                                                                                            |     |                                |    |    |    | Yes            |                                          |    |    |    |     |
| Default               | Status                                                                                                                                                     |     |                                |    |    |    | Default Value  |                                          |    |    |    |     |
|                       | Power On Sequence                                                                                                                                          |     |                                |    |    |    | 18 bit / pixel |                                          |    |    |    |     |
|                       | S/W Reset                                                                                                                                                  |     |                                |    |    |    | No Change      |                                          |    |    |    |     |
|                       | H/W Reset                                                                                                                                                  |     |                                |    |    |    | 18 bit / pixel |                                          |    |    |    |     |



| 3AH        | COLMOD (Interface Pixel Format)                                                                                                                                                                                                                                               |
|------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Flow Chart | <div>Example:</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> |

## 5.1.33. MEMORY WRITE CONTINUE (3CH)

| 3CH                          | RAMWRC (Memory Write Continue)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |     |     |       |       |       |       |       |       |       |       |            |
|------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|-----|-------|-------|-------|-------|-------|-------|-------|-------|------------|
|                              | DCX                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | RDX | WRX | 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><br>Parameter | 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | 1   | ↑   | D[17] | D[16] | D[15] | D[14] | D[13] | D[12] | D[11] | D[10] | 00..<br>FF |
| :                            | 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | 1   | ↑   | Dx[7] | Dx[6] | Dx[5] | Dx[4] | Dx[3] | Dx[2] | Dx[1] | Dx[0] | 00..<br>FF |
| N <sup>th</sup><br>Parameter | 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | 1   | ↑   | Dn[7] | Dn[6] | Dn[5] | Dn[4] | Dn[3] | Dn[2] | Dn[1] | Dn[0] | 00..<br>FF |
| Description                  | <p>This command is 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.</p> <p>If set_address_mode B5=0:<br/>Data is written continuing from the pixel location after the write range of the previous write_memory_continue or write_memory_start. 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 the Start Column (SC) and the page register is incremented. Pixels are written to the frame memory until the page register equals the End Page (EP) value and the column register equals the EC value, or the host processor sends another command. If the number of pixels exceeds <math>(EC - SC + 1) * (EP - SP + 1)</math> the extra pixels are ignored.</p> <p>If set_address_mode B5=1:<br/>Data is written continuing from the pixel location after the write range of the previous write_memory_continue or write_memory_start. 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 the Start Page (SP) and the column register is incremented. Pixels are written to the frame memory until the column register equals the End Column (EC) value and the page register equals the EP value, or the host processor sends another command. If the number of pixels exceeds <math>(EC - SC + 1) * (EP - SP + 1)</math> the extra pixels are ignored.</p> |     |     |       |       |       |       |       |       |       |       |            |

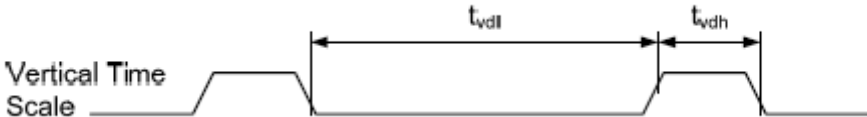
| Restriction           | A write_memory_start should follow a set_column_address, set_page_address or set_address_mode to define the write address. Otherwise, data written with write_memory_continue is written to undefined addresses.                                                              |                                    |
|-----------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------|
| 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 Step up circuit Off                                                                                                                                                                                                                                               | Yes                                |
| Default               | Status                                                                                                                                                                                                                                                                        | Default Value                      |
|                       | Power On Sequence                                                                                                                                                                                                                                                             | Contents of memory is set randomly |
|                       | S/W Reset                                                                                                                                                                                                                                                                     | Contents of memory is not cleared  |
|                       | H/W Reset                                                                                                                                                                                                                                                                     | Contents of memory is not cleared  |
| Flow Chart            | <div><div><div>RAMWR</div><div>Image Data<br/>D1[15:0],D2[15:0],<br/>.....,Dn[15:0]</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> |                                    |

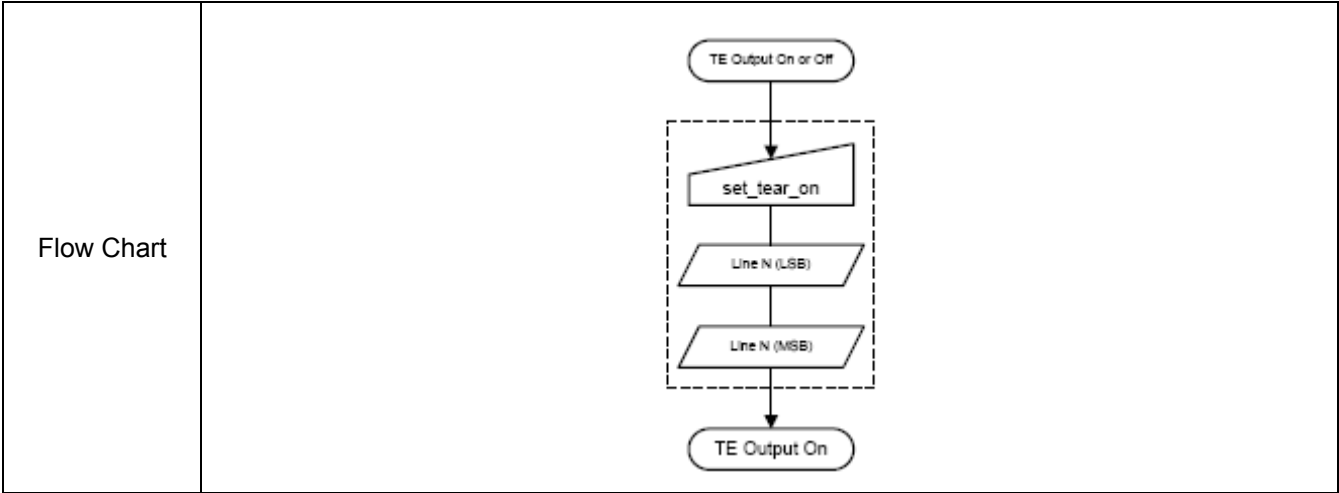
## 5.1.34. MEMORY READ CONTINUE (3EH)

| 3EH                          | RAMRDC (Memory Read Continue)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |     |     |       |       |       |       |       |       |       |       |            |
|------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|-----|-------|-------|-------|-------|-------|-------|-------|-------|------------|
|                              | DCX                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | RDX | WRX | 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><br>Parameter | 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | ↑   | 1   | D[17] | D[16] | D[15] | D[14] | D[13] | D[12] | D[11] | D[10] | 00..<br>FF |
| :                            | 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | ↑   | 1   | Dx[7] | Dx[6] | Dx[5] | Dx[4] | Dx[3] | Dx[2] | Dx[1] | Dx[0] | 00..<br>FF |
| N <sup>th</sup><br>Parameter | 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | ↑   | 1   | Dn[7] | Dn[6] | Dn[5] | Dn[4] | Dn[3] | Dn[2] | Dn[1] | Dn[0] | 00..<br>FF |
| Description                  | <p>This command is 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:<br/>Pixels are read continuing from the pixel location after the read range of the previous read_memory_continue or read_memory_start. 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 and the column register equals the EC value, or the host processor sends another command.</p> <p>If set_address_mode B5=1:<br/>Pixels are read continuing from the pixel location after the read range of the previous read_memory_continue or read_memory_start. 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 and the page register equals the EP 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 18-bit so there is no restriction on the length of data.</p> <p>A read_memory_start should follow a set_column_address, set_page_address or set_address_mode to define the read address. Otherwise, data read with</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |     |     |       |       |       |       |       |       |       |       |            |

|                       |                                                                                                                                                                                                                                                                                                                |                                    |
|-----------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------|
|                       | read_memory_continue is undefined.                                                                                                                                                                                                                                                                             |                                    |
| Register Availability | <b>Status</b>                                                                                                                                                                                                                                                                                                  | <b>Availability</b>                |
|                       | 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 Step up circuit Off                                                                                                                                                                                                                                                                                | Yes                                |
| Default               | <b>Status</b>                                                                                                                                                                                                                                                                                                  | <b>Default Value</b>               |
|                       | Power On Sequence                                                                                                                                                                                                                                                                                              | Contents of memory is set randomly |
|                       | S/W Reset                                                                                                                                                                                                                                                                                                      | Contents of memory is not cleared  |
|                       | H/W Reset                                                                                                                                                                                                                                                                                                      | Contents of memory is not cleared  |
| Flow Chart            | <div><div><div>RAMRD</div><div>↓</div><div>Video Data<br/>D1[7:0],D2[7:0],<br/>...,Dn[7:0]:0]</div><div>↓</div><div>Any Command</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> |                                    |

## 5.1.35. SET TEAR SCANLINE (44H)

| 44H                       | TESCAN (Set Tear Scanline)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |     |     |       |       |       |               |       |       |      |      |     |
|---------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|-----|-------|-------|-------|---------------|-------|-------|------|------|-----|
|                           | DCX                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | RDX | WRX | 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   | ↑   | N[15] | N[14] | N[13] | N[12]         | N[11] | N[10] | N[9] | N[8] | xx  |
| 2 <sup>nd</sup> Parameter | 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | 1   | ↑   | N[7]  | N[6]  | N[5]  | N[4]          | N[3]  | N[2]  | N[1] | N[0] | xx  |
| Description               | <p>This command turns on the display module's Tearing Effect output signal on the TE signal line when the display module reaches line N. The TE signal is not affected by changing set_address_mode bit B4.</p> <p>The Tearing Effect Line On has one parameter that describes the Tearing Effect Output Line mode.</p> <p>The Tearing Effect Output line consists of V-Blanking information only.</p>  <p>Note that set_tear_scanline with N=0 is equivalent to set_tear_on with M=0.</p> <p>The Tearing Effect Output line shall be active low when the display module is in Sleep mode.</p> |     |     |       |       |       |               |       |       |      |      |     |
| Restriction               | This command takes affect on the frame following the current frame. Therefore, if the Tear Effect (TE) output is already ON, the TE output shall continue to operate as programmed by the previous set_tear_on, or set_tear_scanline, command until the end of the frame.                                                                                                                                                                                                                                                                                                                                                                                                         |     |     |       |       |       |               |       |       |      |      |     |
| 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 Step up circuit Off                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |     |     |       |       |       | Yes           |       |       |      |      |     |
| Default                   | Status                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |     |     |       |       |       | Default Value |       |       |      |      |     |
|                           | Power On Sequence                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |     |     |       |       |       | 16'h0000      |       |       |      |      |     |
|                           | S/W Reset                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |     |     |       |       |       | 16'h0000      |       |       |      |      |     |
|                           | H/W Reset                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |     |     |       |       |       | 16'h0000      |       |       |      |      |     |



## 5.1.36. GET SCANLINE (45H)

| 45H                       | RDTESCAN (Get Scanline)                                                                                                                                                                                                                                                                                                                                |     |     |       |       |       |       |               |       |      |      |     |
|---------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|-----|-------|-------|-------|-------|---------------|-------|------|------|-----|
|                           | DCX                                                                                                                                                                                                                                                                                                                                                    | RDX | WRX | 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   | N[15] | N[14] | N[13] | N[12] | N[11]         | N[10] | N[9] | N[8] | xx  |
| 2 <sup>nd</sup> Parameter | 1                                                                                                                                                                                                                                                                                                                                                      | ↑   | 1   | N[7]  | N[6]  | N[5]  | N[4]  | N[3]          | N[2]  | N[1] | N[0] | xx  |
| Description               | <p>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 Vsync and is denoted as Line 0.</p> <p>When in Sleep Mode, the value returned by get_scanline is undefined.</p> |     |     |       |       |       |       |               |       |      |      |     |
| 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 Step up circuit Off                                                                                                                                                                                                                                                                                                                        |     |     |       |       |       |       | Yes           |       |      |      |     |
| Default                   | Status                                                                                                                                                                                                                                                                                                                                                 |     |     |       |       |       |       | Default Value |       |      |      |     |
|                           | Power On Sequence                                                                                                                                                                                                                                                                                                                                      |     |     |       |       |       |       | 16'h0000      |       |      |      |     |
|                           | S/W Reset                                                                                                                                                                                                                                                                                                                                              |     |     |       |       |       |       | 16'h0000      |       |      |      |     |
|                           | H/W Reset                                                                                                                                                                                                                                                                                                                                              |     |     |       |       |       |       | 16'h0000      |       |      |      |     |
| Flow Chart                | <div><div><div>get_scanline</div><div>scanline MSB</div><div>scanline LSB</div></div><div>Host Processor</div><div>Display Module</div></div>                                                                                                                                                                                                          |     |     |       |       |       |       |               |       |      |      |     |

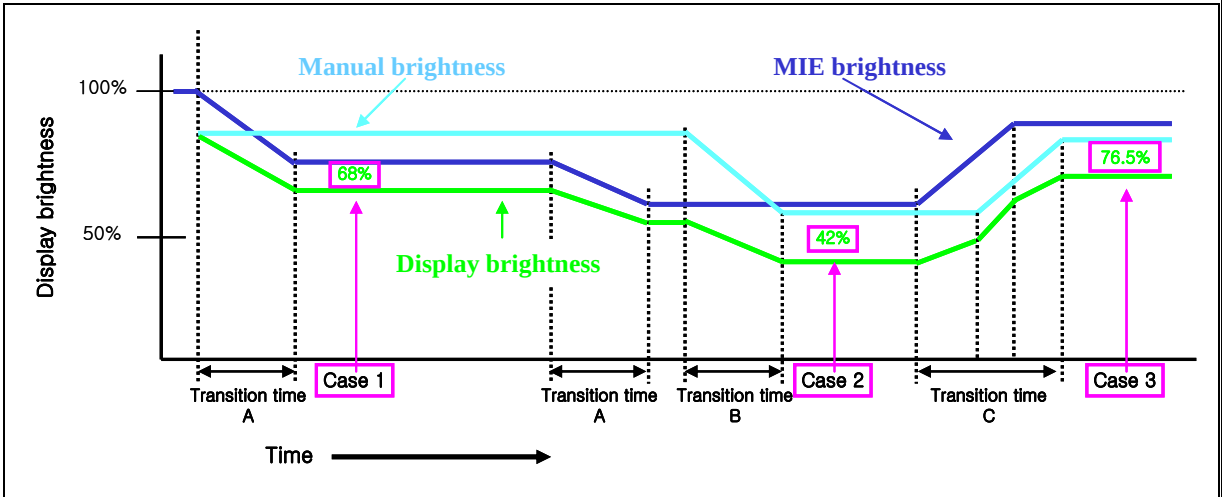


## 5.1.37. WRITE MANUAL BRIGHTNESS (51H)

| 51H                                                                                                                                                                                                                                       | WRDISBV (Write Manual Brightness)                                                                                                                                                                                                                                                                                                                                                                                                                     |                  |     |               |               |               |               |               |               |               |               |     |              |                  |           |   |           |   |           |   |           |   |     |     |           |     |           |     |           |     |           |     |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------|-----|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|-----|--------------|------------------|-----------|---|-----------|---|-----------|---|-----------|---|-----|-----|-----------|-----|-----------|-----|-----------|-----|-----------|-----|
|                                                                                                                                                                                                                                           | DCX                                                                                                                                                                                                                                                                                                                                                                                                                                                   | RDX              | WRX | D7            | D6            | D5            | D4            | D3            | D2            | D1            | D0            | HEX |              |                  |           |   |           |   |           |   |           |   |     |     |           |     |           |     |           |     |           |     |
| Command                                                                                                                                                                                                                                   | 0                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 1                | ↑   | 0             | 1             | 0             | 1             | 0             | 0             | 0             | 1             | 51  |              |                  |           |   |           |   |           |   |           |   |     |     |           |     |           |     |           |     |           |     |
| Parameter                                                                                                                                                                                                                                 | 1                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 1                | ↑   | MAN_<br>BR[7] | MAN_<br>BR[6] | MAN_<br>BR[5] | MAN_<br>BR[4] | MAN_<br>BR[3] | MAN_<br>BR[2] | MAN_<br>BR[1] | MAN_<br>BR[0] | xx  |              |                  |           |   |           |   |           |   |           |   |     |     |           |     |           |     |           |     |           |     |
| Description                                                                                                                                                                                                                               | This command is used to set the manual brightness value. If the manual brightness is used (BC_MODE = “01” or “11”), the value of register “MAN_BR [7:0] is selected or merged with the MIE brightness to generate PWM.                                                                                                                                                                                                                                |                  |     |               |               |               |               |               |               |               |               |     |              |                  |           |   |           |   |           |   |           |   |     |     |           |     |           |     |           |     |           |     |
|                                                                                                                                                                                                                                           | <table><thead><tr><th>MAN_BR [7:0]</th><th>Brightness Level</th></tr></thead><tbody><tr><td>0000_0000</td><td>0</td></tr><tr><td>0000_0001</td><td>1</td></tr><tr><td>0000_0010</td><td>2</td></tr><tr><td>0000_0011</td><td>3</td></tr><tr><td>...</td><td>...</td></tr><tr><td>1111_1100</td><td>252</td></tr><tr><td>1111_1101</td><td>253</td></tr><tr><td>1111_1110</td><td>254</td></tr><tr><td>1111_1111</td><td>255</td></tr></tbody></table> |                  |     |               |               |               |               |               |               |               |               |     | MAN_BR [7:0] | Brightness Level | 0000_0000 | 0 | 0000_0001 | 1 | 0000_0010 | 2 | 0000_0011 | 3 | ... | ... | 1111_1100 | 252 | 1111_1101 | 253 | 1111_1110 | 254 | 1111_1111 | 255 |
|                                                                                                                                                                                                                                           | MAN_BR [7:0]                                                                                                                                                                                                                                                                                                                                                                                                                                          | Brightness Level |     |               |               |               |               |               |               |               |               |     |              |                  |           |   |           |   |           |   |           |   |     |     |           |     |           |     |           |     |           |     |
|                                                                                                                                                                                                                                           | 0000_0000                                                                                                                                                                                                                                                                                                                                                                                                                                             | 0                |     |               |               |               |               |               |               |               |               |     |              |                  |           |   |           |   |           |   |           |   |     |     |           |     |           |     |           |     |           |     |
|                                                                                                                                                                                                                                           | 0000_0001                                                                                                                                                                                                                                                                                                                                                                                                                                             | 1                |     |               |               |               |               |               |               |               |               |     |              |                  |           |   |           |   |           |   |           |   |     |     |           |     |           |     |           |     |           |     |
| 0000_0010                                                                                                                                                                                                                                 | 2                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                  |     |               |               |               |               |               |               |               |               |     |              |                  |           |   |           |   |           |   |           |   |     |     |           |     |           |     |           |     |           |     |
| 0000_0011                                                                                                                                                                                                                                 | 3                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                  |     |               |               |               |               |               |               |               |               |     |              |                  |           |   |           |   |           |   |           |   |     |     |           |     |           |     |           |     |           |     |
| ...                                                                                                                                                                                                                                       | ...                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                  |     |               |               |               |               |               |               |               |               |     |              |                  |           |   |           |   |           |   |           |   |     |     |           |     |           |     |           |     |           |     |
| 1111_1100                                                                                                                                                                                                                                 | 252                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                  |     |               |               |               |               |               |               |               |               |     |              |                  |           |   |           |   |           |   |           |   |     |     |           |     |           |     |           |     |           |     |
| 1111_1101                                                                                                                                                                                                                                 | 253                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                  |     |               |               |               |               |               |               |               |               |     |              |                  |           |   |           |   |           |   |           |   |     |     |           |     |           |     |           |     |           |     |
| 1111_1110                                                                                                                                                                                                                                 | 254                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                  |     |               |               |               |               |               |               |               |               |     |              |                  |           |   |           |   |           |   |           |   |     |     |           |     |           |     |           |     |           |     |
| 1111_1111                                                                                                                                                                                                                                 | 255                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                  |     |               |               |               |               |               |               |               |               |     |              |                  |           |   |           |   |           |   |           |   |     |     |           |     |           |     |           |     |           |     |
| Manual Brightness                                                                                                                                                                                                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                  |     |               |               |               |               |               |               |               |               |     |              |                  |           |   |           |   |           |   |           |   |     |     |           |     |           |     |           |     |           |     |
| <div><div><div>MIE</div><div>Manual Input</div></div><div><div>MIE Brightness[7:0]</div><div>Manual Brightness[7:0]</div></div><div><div>⊗</div><div>PWM Gen</div></div><div><div>Display Brightness[7:0]</div><div>PWM</div></div></div> |                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                  |     |               |               |               |               |               |               |               |               |     |              |                  |           |   |           |   |           |   |           |   |     |     |           |     |           |     |           |     |           |     |
| The display brightness level is calculated with the following formula.                                                                                                                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                  |     |               |               |               |               |               |               |               |               |     |              |                  |           |   |           |   |           |   |           |   |     |     |           |     |           |     |           |     |           |     |
| <div><div><div><i>Display_Brightness = MIE_Brightness X Manual_Brightness / 255</i></div></div></div>                                                                                                                                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                  |     |               |               |               |               |               |               |               |               |     |              |                  |           |   |           |   |           |   |           |   |     |     |           |     |           |     |           |     |           |     |

The MIE brightness has transition time A and the manual brightness has transition time B.  
The maximum transition time is transition time C ( $C \leq A + B$ ).

Example of manual brightness



| Operation Mode | Manual Brightness | MIE Brightness | Display Brightness |
|----------------|-------------------|----------------|--------------------|
| Case 1         | 85 %              | 80 %           | 68 %               |
| Case 2         | 60 %              | 70 %           | 42 %               |
| Case 3         | 85 %              | 90 %           | 76.5 %             |

Restriction

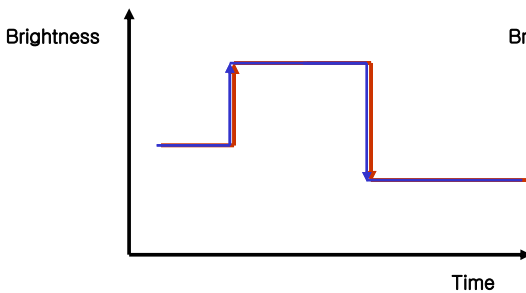
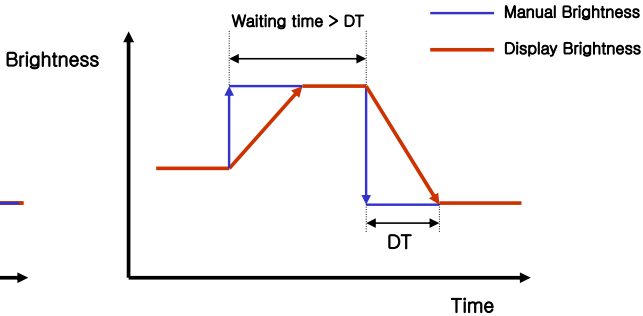
| Register Availability | Status                                    | Availability  |
|-----------------------|-------------------------------------------|---------------|
|                       | Normal Mode On, Idle Mode Off, Sleep Out  | Yes           |
|                       | Normal Mode On, Idle 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 Step up circuit Off           | Yes           |
| Default               | Status                                    | Default Value |
|                       | Power On Sequence                         | 8'h00         |
|                       | S/W Reset                                 | 8'h00         |
|                       | H/W Reset                                 | 8'h00         |

## 5.1.38. READ DISPLAY BRIGHTNESS (52H)

| 52H                       | RDISBV (Read Display Brightness)                                                                                                                                                                                                                                                                                                             |     |     |               |               |               |                  |               |               |               |               |     |
|---------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|-----|---------------|---------------|---------------|------------------|---------------|---------------|---------------|---------------|-----|
|                           | DCX                                                                                                                                                                                                                                                                                                                                          | RDX | WRX | 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   | x             | x             | x             | x                | x             | x             | x             | x             | xx  |
| 2 <sup>nd</sup> Parameter | 1                                                                                                                                                                                                                                                                                                                                            | ↑   | 1   | BR_<br>OUT[7] | BR_<br>OUT[6] | BR_<br>OUT[5] | BR_<br>OUT[4]    | BR_<br>OUT[3] | BR_<br>OUT[2] | BR_<br>OUT[1] | BR_<br>OUT[0] | xx  |
| Description               | This command is used to read the display brightness value. It is a real brightness value of PWM output which is calculated with MIE brightness and manual brightness. The value of this register is updated after display V-sync and host can read exact value after display V-sync.<br>RDISBV is valid in case that BCTRL(WRCTRLD 53h) = 1. |     |     |               |               |               |                  |               |               |               |               |     |
|                           | BR_OUT [7:0]                                                                                                                                                                                                                                                                                                                                 |     |     |               |               |               | Brightness Level |               |               |               |               |     |
|                           | 0000_0000                                                                                                                                                                                                                                                                                                                                    |     |     |               |               |               | 0                |               |               |               |               |     |
|                           | 0000_0001                                                                                                                                                                                                                                                                                                                                    |     |     |               |               |               | 1                |               |               |               |               |     |
|                           | 0000_0010                                                                                                                                                                                                                                                                                                                                    |     |     |               |               |               | 2                |               |               |               |               |     |
|                           | 0000_0011                                                                                                                                                                                                                                                                                                                                    |     |     |               |               |               | 3                |               |               |               |               |     |
|                           | ...                                                                                                                                                                                                                                                                                                                                          |     |     |               |               |               | ...              |               |               |               |               |     |
|                           | 1111_1100                                                                                                                                                                                                                                                                                                                                    |     |     |               |               |               | 252              |               |               |               |               |     |
|                           | 1111_1101                                                                                                                                                                                                                                                                                                                                    |     |     |               |               |               | 253              |               |               |               |               |     |
|                           | 1111_1110                                                                                                                                                                                                                                                                                                                                    |     |     |               |               |               | 254              |               |               |               |               |     |
|                           | 1111_1111                                                                                                                                                                                                                                                                                                                                    |     |     |               |               |               | 255              |               |               |               |               |     |
| Restriction               | There is no dummy read parameter(1 <sup>st</sup> para) at serial I/F, refer to 3.1.4.2, 3.1.5.2                                                                                                                                                                                                                                              |     |     |               |               |               |                  |               |               |               |               |     |
| 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 Step up circuit Off                                                                                                                                                                                                                                                                                                              |     |     |               |               |               | Yes              |               |               |               |               |     |

|            |                                                                                                                                                                                                                                                                                                                                                                                                                                                       |  |               |
|------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|---------------|
| Default    | Status                                                                                                                                                                                                                                                                                                                                                                                                                                                |  | Default Value |
|            | Power On Sequence                                                                                                                                                                                                                                                                                                                                                                                                                                     |  | 8'h00         |
|            | S/W Reset                                                                                                                                                                                                                                                                                                                                                                                                                                             |  | 8'h00         |
|            | H/W Reset                                                                                                                                                                                                                                                                                                                                                                                                                                             |  | 8'h00         |
| Flow Chart | <div><div><div>Serial Interface Mode</div><div>Read RDDISBV</div><div>Send 2<sup>nd</sup> parameter</div></div><div><div>Parallel Interface Mode</div><div>Read RDDISBV</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> |  |               |

## 5.1.39. WRITE BL CONTROL (53H)

| 53H                                                                                                                                                                                                                                                                       | WRCTRLD (Write BL Control)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |            |     |    |    |       |    |    |    |    |    |     |        |                         |   |     |   |    |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|-----|----|----|-------|----|----|----|----|----|-----|--------|-------------------------|---|-----|---|----|
|                                                                                                                                                                                                                                                                           | DCX                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | RDX        | WRX | D7 | D6 | D5    | D4 | D3 | D2 | D1 | D0 | HEX |        |                         |   |     |   |    |
| Command                                                                                                                                                                                                                                                                   | 0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | 1          | ↑   | 0  | 1  | 0     | 1  | 0  | 0  | 1  | 1  | 53  |        |                         |   |     |   |    |
| Parameter                                                                                                                                                                                                                                                                 | 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | 1          | ↑   | 0  | 0  | BCTRL | 0  | DD | BL | 0  | 0  | xx  |        |                         |   |     |   |    |
| Description                                                                                                                                                                                                                                                               | <div>- BCTRL</div> <p>This register is used to enable the backlight control block. If BCTRL is turned off, the BL control block is not working and PWM output is fixed to low.</p> <table><tr><th>BRCTRL</th><th>BL Control</th></tr><tr><td>0</td><td>Off</td></tr><tr><td>1</td><td>On</td></tr></table>                                                                                                                                                                                                                                                                                                                              |            |     |    |    |       |    |    |    |    |    |     | BRCTRL | BL Control              | 0 | Off | 1 | On |
|                                                                                                                                                                                                                                                                           | BRCTRL                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | BL Control |     |    |    |       |    |    |    |    |    |     |        |                         |   |     |   |    |
|                                                                                                                                                                                                                                                                           | 0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | Off        |     |    |    |       |    |    |    |    |    |     |        |                         |   |     |   |    |
|                                                                                                                                                                                                                                                                           | 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | On         |     |    |    |       |    |    |    |    |    |     |        |                         |   |     |   |    |
|                                                                                                                                                                                                                                                                           | <div>- DD</div> <p>This register is used to enable the manual brightness dimming function. The manual brightness should be changed smoothly for preventing a visible artifact, e.g. flicker. So the dimming function is needed when the transition of input manual brightness is fast to make a visible artifact. When the manual dimming is enabled, the new manual brightness value has to be changed after former dimming transition is finished. The transition time is controlled by DT[2:0].</p> <table><tr><th>DD</th><th>Manual Dimming Function</th></tr><tr><td>0</td><td>Off</td></tr><tr><td>1</td><td>On</td></tr></table> |            |     |    |    |       |    |    |    |    |    |     | DD     | Manual Dimming Function | 0 | Off | 1 | On |
| DD                                                                                                                                                                                                                                                                        | Manual Dimming Function                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |            |     |    |    |       |    |    |    |    |    |     |        |                         |   |     |   |    |
| 0                                                                                                                                                                                                                                                                         | Off                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |            |     |    |    |       |    |    |    |    |    |     |        |                         |   |     |   |    |
| 1                                                                                                                                                                                                                                                                         | On                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |            |     |    |    |       |    |    |    |    |    |     |        |                         |   |     |   |    |
| <div>Manual dimming function</div> <div><div><p>DD = "0"</p></div><div><p>DD = "1"</p></div></div> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |            |     |    |    |       |    |    |    |    |    |     |        |                         |   |     |   |    |

|                                 | <div>- BL</div> <div>This register is used to enable the PWM output. Even if the value of BL is “0”, the backlight control block is working when BCTRL is “1”. And the host can read the display brightness value(DISP_BRIGHT[7:0]) and control the BLU directly.</div> <table><tr><th>BL</th><th>PWM state</th></tr><tr><td>0</td><td>Low</td></tr><tr><td>1</td><td>Active</td></tr></table>                    | BL            | PWM state     | 0                                        | Low   | 1                                       | Active |                                           |       |                                          |     |                                 |     |
|---------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|---------------|------------------------------------------|-------|-----------------------------------------|--------|-------------------------------------------|-------|------------------------------------------|-----|---------------------------------|-----|
| BL                              | PWM state                                                                                                                                                                                                                                                                                                                                                                                                         |               |               |                                          |       |                                         |        |                                           |       |                                          |     |                                 |     |
| 0                               | Low                                                                                                                                                                                                                                                                                                                                                                                                               |               |               |                                          |       |                                         |        |                                           |       |                                          |     |                                 |     |
| 1                               | Active                                                                                                                                                                                                                                                                                                                                                                                                            |               |               |                                          |       |                                         |        |                                           |       |                                          |     |                                 |     |
| Restriction                     |                                                                                                                                                                                                                                                                                                                                                                                                                   |               |               |                                          |       |                                         |        |                                           |       |                                          |     |                                 |     |
| 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 Step up circuit 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 Step up circuit 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 Step up circuit Off | Yes                                                                                                                                                                                                                                                                                                                                                                                                               |               |               |                                          |       |                                         |        |                                           |       |                                          |     |                                 |     |
| Default                         | <table><tr><th>Status</th><th>Default Value</th></tr><tr><td>Power On Sequence</td><td>8'h00</td></tr><tr><td>S/W Reset</td><td>8'h00</td></tr><tr><td>H/W Reset</td><td>8'h00</td></tr></table>                                                                                                                                                                                                                  | Status        | Default Value | Power On Sequence                        | 8'h00 | S/W Reset                               | 8'h00  | H/W Reset                                 | 8'h00 |                                          |     |                                 |     |
|                                 | Status                                                                                                                                                                                                                                                                                                                                                                                                            | Default Value |               |                                          |       |                                         |        |                                           |       |                                          |     |                                 |     |
|                                 | Power On Sequence                                                                                                                                                                                                                                                                                                                                                                                                 | 8'h00         |               |                                          |       |                                         |        |                                           |       |                                          |     |                                 |     |
|                                 | S/W Reset                                                                                                                                                                                                                                                                                                                                                                                                         | 8'h00         |               |                                          |       |                                         |        |                                           |       |                                          |     |                                 |     |
| H/W Reset                       | 8'h00                                                                                                                                                                                                                                                                                                                                                                                                             |               |               |                                          |       |                                         |        |                                           |       |                                          |     |                                 |     |
| Flow Chart                      | <div><div><div>WRCTRLD</div><div></div><div>1<sup>st</sup> parameter</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>                                                                                                                                                               |               |               |                                          |       |                                         |        |                                           |       |                                          |     |                                 |     |

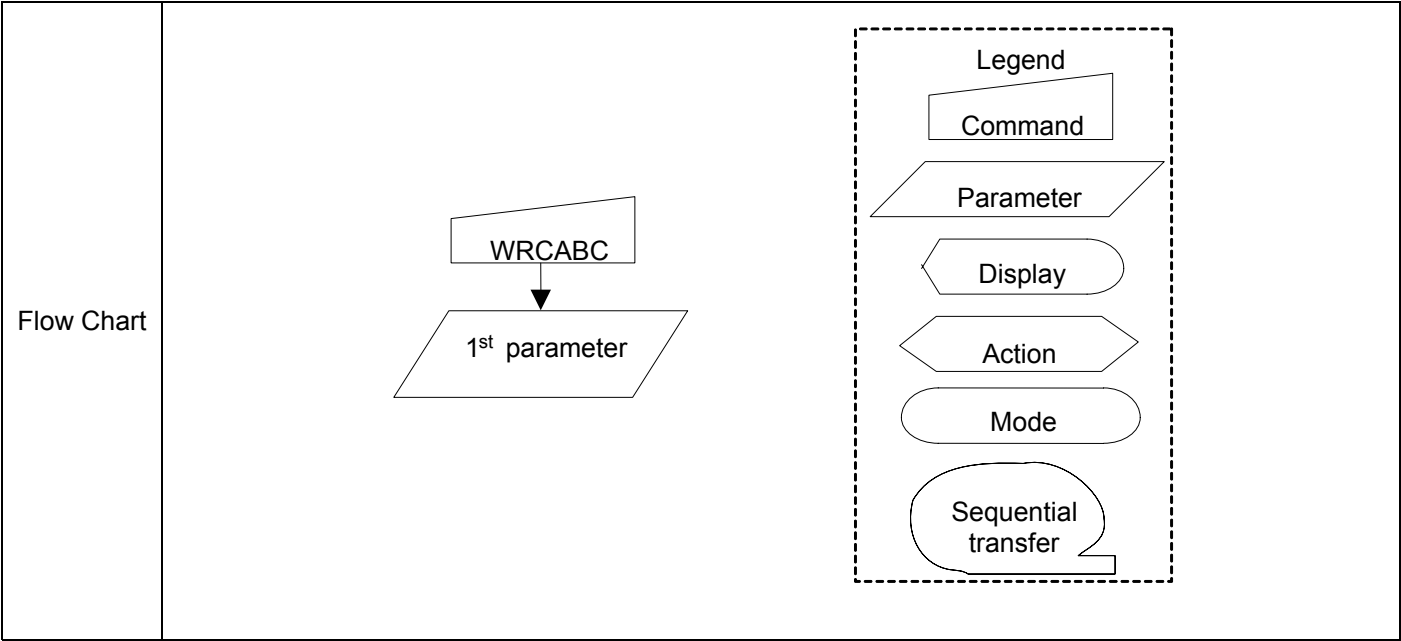
## 5.1.40. READ BL CONTROL (54H)

| 54H                       | RDCTRLD (Read BL Control)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |     |     |    |    |       |               |    |    |    |    |     |
|---------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|-----|----|----|-------|---------------|----|----|----|----|-----|
|                           | DCX                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | RDX | WRX | 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   | x  | x  | x     | x             | x  | x  | x  | x  | xx  |
| 2 <sup>nd</sup> Parameter | 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | ↑   | 1   | 0  | 0  | BCTRL | 0             | DD | BL | 0  | 0  | xx  |
| Description               | This command is used to read BL control register. For details, refer to Write BL Control (53h).                                                                                                                                                                                                                                                                                                                                                                                                                                            |     |     |    |    |       |               |    |    |    |    |     |
| Restriction               | There is no dummy read parameter(1 <sup>st</sup> para) at serial I/F, refer to 3.1.4.2, 3.1.5.2                                                                                                                                                                                                                                                                                                                                                                                                                                            |     |     |    |    |       |               |    |    |    |    |     |
| 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 Step up circuit Off                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |     |     |    |    |       | Yes           |    |    |    |    |     |
| Default                   | Status                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |     |     |    |    |       | Default Value |    |    |    |    |     |
|                           | Power On Sequence                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |     |     |    |    |       | 8'h00         |    |    |    |    |     |
|                           | S/W Reset                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |     |     |    |    |       | 8'h00         |    |    |    |    |     |
|                           | H/W Reset                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |     |     |    |    |       | 8'h00         |    |    |    |    |     |
| Flow Chart                | <div><div><div>Serial Interface Mode</div><div><div>Read RDCTRLD</div><div>↓</div><div>Send 2<sup>nd</sup> parameter</div></div></div><div><div>Parallel Interface Mode</div><div><div>Read RDCTRLD</div><div>↓</div><div>Dummy Read</div><div>↓</div><div>Send 2<sup>nd</sup> parameter</div></div></div><div><div>Host</div><div>-----</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> |     |     |    |    |       |               |    |    |    |    |     |

## 5.1.41. WRITE MIE MODE (55H)

| 55H                   | WRCABC (Write MIE Mode)                                                                                                                                                                                                                        |     |     |    |    |    |                     |    |    |                 |                 |     |
|-----------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|-----|----|----|----|---------------------|----|----|-----------------|-----------------|-----|
|                       | DCX                                                                                                                                                                                                                                            | RDX | WRX | D7 | D6 | D5 | D4                  | D3 | D2 | D1              | D0              | HEX |
| Command               | 0                                                                                                                                                                                                                                              | 1   | ↑   | 0  | 1  | 0  | 1                   | 0  | 1  | 0               | 1               | 55  |
| Parameter             | 1                                                                                                                                                                                                                                              | 1   | ↑   | 0  | 0  | 0  | 0                   | 0  | 0  | MIE_<br>MODE[1] | MIE_<br>MODE[0] | xx  |
| Description           | This command is used to select the operation mode of MIE. In UI or Still-image mode, the host should send same image at least two times to apply MIE algorithm exactly. If the MIE is off mode, the BLU brightness value of MIE is set to 255. |     |     |    |    |    |                     |    |    |                 |                 |     |
|                       | MIE_MODE[1:0]                                                                                                                                                                                                                                  |     |     |    |    |    | Operation Mode      |    |    |                 |                 |     |
|                       | 00                                                                                                                                                                                                                                             |     |     |    |    |    | Off                 |    |    |                 |                 |     |
|                       | 01                                                                                                                                                                                                                                             |     |     |    |    |    | UI (User Interface) |    |    |                 |                 |     |
|                       | 10                                                                                                                                                                                                                                             |     |     |    |    |    | Still Image         |    |    |                 |                 |     |
|                       | 11                                                                                                                                                                                                                                             |     |     |    |    |    | Moving Image        |    |    |                 |                 |     |
| 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 Step up circuit Off                                                                                                                                                                                                                |     |     |    |    |    | Yes                 |    |    |                 |                 |     |
| Default               | Status                                                                                                                                                                                                                                         |     |     |    |    |    | Default Value       |    |    |                 |                 |     |
|                       | Power On Sequence                                                                                                                                                                                                                              |     |     |    |    |    | 8'h00               |    |    |                 |                 |     |
|                       | S/W Reset                                                                                                                                                                                                                                      |     |     |    |    |    | 8'h00               |    |    |                 |                 |     |
|                       | H/W Reset                                                                                                                                                                                                                                      |     |     |    |    |    | 8'h00               |    |    |                 |                 |     |





## 5.1.42. READ MIE MODE (56H)

| 56H                       | RDCABC (Read MIE Mode)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |     |     |    |    |    |    |               |    |                 |                 |     |
|---------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|-----|----|----|----|----|---------------|----|-----------------|-----------------|-----|
|                           | DCX                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | RDX | WRX | 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   | x  | x  | x  | x  | x             | x  | x               | x               | xx  |
| 2 <sup>nd</sup> Parameter | 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | ↑   | 1   | 0  | 0  | 0  | 0  | 0             | 0  | MIE_<br>MODE[1] | MIE_<br>MODE[0] | xx  |
| Description               | This command is used to read MIE mode register. For details, refer to Write MIE Mode (55h).                                                                                                                                                                                                                                                                                                                                                                                                                                              |     |     |    |    |    |    |               |    |                 |                 |     |
| Restriction               | There is no dummy read parameter(1 <sup>st</sup> para) at serial I/F, refer to 3.1.4.2, 3.1.5.2                                                                                                                                                                                                                                                                                                                                                                                                                                          |     |     |    |    |    |    |               |    |                 |                 |     |
| 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 Step up circuit Off                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |     |     |    |    |    |    | Yes           |    |                 |                 |     |
| Default                   | Status                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |     |     |    |    |    |    | Default Value |    |                 |                 |     |
|                           | Power On Sequence                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |     |     |    |    |    |    | 8'h00         |    |                 |                 |     |
|                           | S/W Reset                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |     |     |    |    |    |    | 8'h00         |    |                 |                 |     |
|                           | H/W Reset                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |     |     |    |    |    |    | 8'h00         |    |                 |                 |     |
| Flow Chart                | <div><div><div>Serial Interface Mode</div><div><div>Read RDCABC</div><div>↓</div><div>Send 2<sup>nd</sup> parameter</div></div></div><div><div>Parallel Interface Mode</div><div><div>Read RDCABC</div><div>↓</div><div>Dummy Read</div><div>↓</div><div>Send 2<sup>nd</sup> parameter</div></div></div><div><div>Host</div><div>-----</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> |     |     |    |    |    |    |               |    |                 |                 |     |

## 5.1.43. WRITE MINIMUM BRIGHTNESS (5EH)

| 5EH       | WRCABCMB (Write Minimum Brightness) |     |     |                       |                       |                       |                       |                       |                       |                       |                       |     |
|-----------|-------------------------------------|-----|-----|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----|
|           | DCX                                 | RDX | WRX | D7                    | D6                    | D5                    | D4                    | D3                    | D2                    | D1                    | D0                    | HEX |
| Command   | 0                                   | 1   | ↑   | 0                     | 1                     | 0                     | 1                     | 1                     | 1                     | 1                     | 0                     | 5E  |
| Parameter | 1                                   | 1   | ↑   | MIN_<br>BRIGHT<br>[7] | MIN_<br>BRIGHT<br>[6] | MIN_<br>BRIGHT<br>[5] | MIN_<br>BRIGHT<br>[4] | MIN_<br>BRIGHT<br>[3] | MIN_<br>BRIGHT<br>[2] | MIN_<br>BRIGHT<br>[1] | MIN_<br>BRIGHT<br>[0] | xx  |

## Description

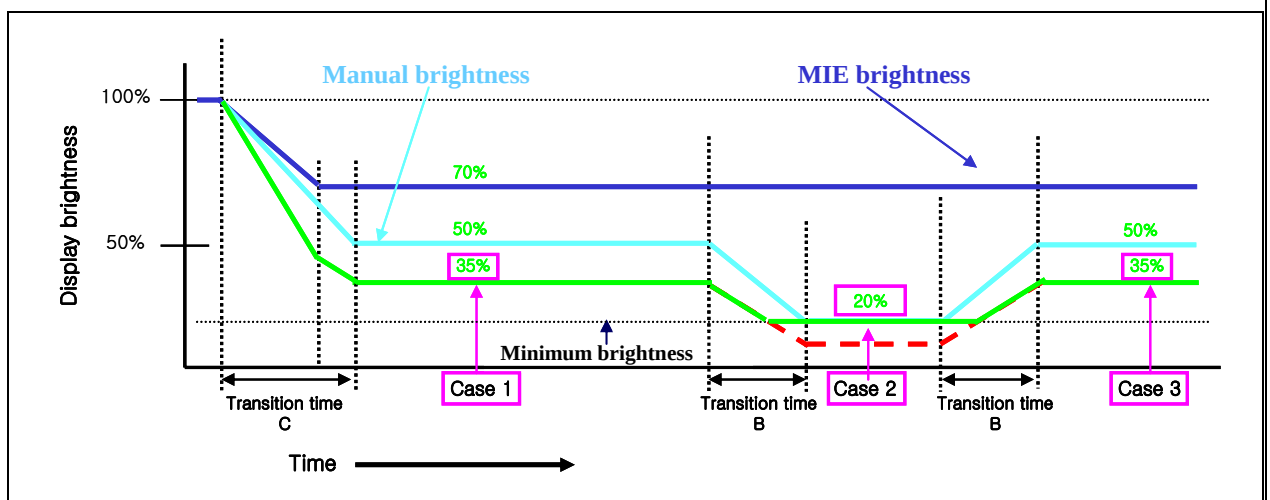
This command is used to set the minimum brightness value.

The MIE function is automatically reduced the backlight brightness based on the content of image. In the case of the combination with the manual brightness setting, the display brightness can be too dark. It must affect to image quality degradation. So the minimum brightness setting is used to avoid too much brightness reduction.

When the MIE is activated, the display brightness can not be reduced less than the value of minimum brightness setting. The image processing function is worked as normal, even if the display brightness can not be decreased by the minimum brightness setting.

This function of the manual brightness setting does not affect to the other functions. The smooth transition and dimming function can be worked as normal. The manual brightness shouldn't be set less than the minimum brightness. When the BL control block is turned off (BCTRL=0), the MIE minimum brightness setting is ignored.

Example of minimum brightness



|                                                                                                                            | <table><tr><th>Operation Mode</th><th>Manual Brightness</th><th>MIE Brightness</th><th>Calculated Display Brightness</th><th>Display Brightness</th></tr><tr><td>Case 1</td><td>50 %</td><td>70 %</td><td>35%</td><td>35 %</td></tr><tr><td>Case 2</td><td>20 %</td><td>70 %</td><td>14%</td><td>20 %</td></tr><tr><td>Case 3</td><td>50 %</td><td>70 %</td><td>35%</td><td>35 %</td></tr></table>                         | Operation Mode    | Manual Brightness    | MIE Brightness                | Calculated Display Brightness | Display Brightness | Case 1 | 50 %      | 70 % | 35%       | 35 % | Case 2 | 20 % | 70 %      | 14% | 20 %      | Case 3 | 50 %      | 70 % | 35%       | 35 % |
|----------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|----------------------|-------------------------------|-------------------------------|--------------------|--------|-----------|------|-----------|------|--------|------|-----------|-----|-----------|--------|-----------|------|-----------|------|
|                                                                                                                            | Operation Mode                                                                                                                                                                                                                                                                                                                                                                                                             | Manual Brightness | MIE Brightness       | Calculated Display Brightness | Display Brightness            |                    |        |           |      |           |      |        |      |           |     |           |        |           |      |           |      |
|                                                                                                                            | Case 1                                                                                                                                                                                                                                                                                                                                                                                                                     | 50 %              | 70 %                 | 35%                           | 35 %                          |                    |        |           |      |           |      |        |      |           |     |           |        |           |      |           |      |
|                                                                                                                            | Case 2                                                                                                                                                                                                                                                                                                                                                                                                                     | 20 %              | 70 %                 | 14%                           | 20 %                          |                    |        |           |      |           |      |        |      |           |     |           |        |           |      |           |      |
|                                                                                                                            | Case 3                                                                                                                                                                                                                                                                                                                                                                                                                     | 50 %              | 70 %                 | 35%                           | 35 %                          |                    |        |           |      |           |      |        |      |           |     |           |        |           |      |           |      |
|                                                                                                                            | <table><tr><th>MIN_BRIGHT[7:0]</th><th>Brightness Level</th></tr><tr><td>0000_0000</td><td>0</td></tr><tr><td>0000_0001</td><td>1</td></tr><tr><td>0000_0010</td><td>2</td></tr><tr><td>0000_0011</td><td>3</td></tr><tr><td>...</td><td>...</td></tr><tr><td>1111_1100</td><td>252</td></tr><tr><td>1111_1101</td><td>253</td></tr><tr><td>1111_1110</td><td>254</td></tr><tr><td>1111_1111</td><td>255</td></tr></table> | MIN_BRIGHT[7:0]   | Brightness Level     | 0000_0000                     | 0                             | 0000_0001          | 1      | 0000_0010 | 2    | 0000_0011 | 3    | ...    | ...  | 1111_1100 | 252 | 1111_1101 | 253    | 1111_1110 | 254  | 1111_1111 | 255  |
|                                                                                                                            | MIN_BRIGHT[7:0]                                                                                                                                                                                                                                                                                                                                                                                                            | Brightness Level  |                      |                               |                               |                    |        |           |      |           |      |        |      |           |     |           |        |           |      |           |      |
|                                                                                                                            | 0000_0000                                                                                                                                                                                                                                                                                                                                                                                                                  | 0                 |                      |                               |                               |                    |        |           |      |           |      |        |      |           |     |           |        |           |      |           |      |
|                                                                                                                            | 0000_0001                                                                                                                                                                                                                                                                                                                                                                                                                  | 1                 |                      |                               |                               |                    |        |           |      |           |      |        |      |           |     |           |        |           |      |           |      |
|                                                                                                                            | 0000_0010                                                                                                                                                                                                                                                                                                                                                                                                                  | 2                 |                      |                               |                               |                    |        |           |      |           |      |        |      |           |     |           |        |           |      |           |      |
|                                                                                                                            | 0000_0011                                                                                                                                                                                                                                                                                                                                                                                                                  | 3                 |                      |                               |                               |                    |        |           |      |           |      |        |      |           |     |           |        |           |      |           |      |
|                                                                                                                            | ...                                                                                                                                                                                                                                                                                                                                                                                                                        | ...               |                      |                               |                               |                    |        |           |      |           |      |        |      |           |     |           |        |           |      |           |      |
| 1111_1100                                                                                                                  | 252                                                                                                                                                                                                                                                                                                                                                                                                                        |                   |                      |                               |                               |                    |        |           |      |           |      |        |      |           |     |           |        |           |      |           |      |
| 1111_1101                                                                                                                  | 253                                                                                                                                                                                                                                                                                                                                                                                                                        |                   |                      |                               |                               |                    |        |           |      |           |      |        |      |           |     |           |        |           |      |           |      |
| 1111_1110                                                                                                                  | 254                                                                                                                                                                                                                                                                                                                                                                                                                        |                   |                      |                               |                               |                    |        |           |      |           |      |        |      |           |     |           |        |           |      |           |      |
| 1111_1111                                                                                                                  | 255                                                                                                                                                                                                                                                                                                                                                                                                                        |                   |                      |                               |                               |                    |        |           |      |           |      |        |      |           |     |           |        |           |      |           |      |
| <table><tr><th>Status</th><th>Default Value</th></tr><tr><td>Initial</td><td>MIN_BRIGHT[7:0] = 0000_0000</td></tr></table> | Status                                                                                                                                                                                                                                                                                                                                                                                                                     | Default Value     | Initial              | MIN_BRIGHT[7:0] = 0000_0000   |                               |                    |        |           |      |           |      |        |      |           |     |           |        |           |      |           |      |
| Status                                                                                                                     | Default Value                                                                                                                                                                                                                                                                                                                                                                                                              |                   |                      |                               |                               |                    |        |           |      |           |      |        |      |           |     |           |        |           |      |           |      |
| Initial                                                                                                                    | MIN_BRIGHT[7:0] = 0000_0000                                                                                                                                                                                                                                                                                                                                                                                                |                   |                      |                               |                               |                    |        |           |      |           |      |        |      |           |     |           |        |           |      |           |      |
| Restriction                                                                                                                | Set the minimum brightness value to 00h before brightness control block turns on(BCTRL = 0 → 1)                                                                                                                                                                                                                                                                                                                            |                   |                      |                               |                               |                    |        |           |      |           |      |        |      |           |     |           |        |           |      |           |      |
| Register Availability                                                                                                      | <b>Status</b>                                                                                                                                                                                                                                                                                                                                                                                                              |                   | <b>Availability</b>  |                               |                               |                    |        |           |      |           |      |        |      |           |     |           |        |           |      |           |      |
|                                                                                                                            | 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 Step up circuit Off                                                                                                                                                                                                                                                                                                                                                                                            |                   | Yes                  |                               |                               |                    |        |           |      |           |      |        |      |           |     |           |        |           |      |           |      |
| Default                                                                                                                    | <b>Status</b>                                                                                                                                                                                                                                                                                                                                                                                                              |                   | <b>Default Value</b> |                               |                               |                    |        |           |      |           |      |        |      |           |     |           |        |           |      |           |      |
|                                                                                                                            | Power On Sequence                                                                                                                                                                                                                                                                                                                                                                                                          |                   | 8'h00                |                               |                               |                    |        |           |      |           |      |        |      |           |     |           |        |           |      |           |      |
|                                                                                                                            | S/W Reset                                                                                                                                                                                                                                                                                                                                                                                                                  |                   | 8'h00                |                               |                               |                    |        |           |      |           |      |        |      |           |     |           |        |           |      |           |      |
|                                                                                                                            | H/W Reset                                                                                                                                                                                                                                                                                                                                                                                                                  |                   | 8'h00                |                               |                               |                    |        |           |      |           |      |        |      |           |     |           |        |           |      |           |      |

## 5.1.44. READ MINIMUM BRIGHTNESS (5FH)

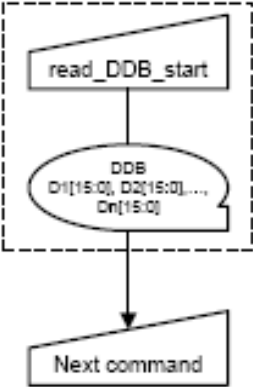
| 5FH                          | RDCABCMB (Read Minimum Brightness)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |         |         |                       |                       |                       |                       |                       |                       |                       |                       |         |
|------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------|---------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|---------|
|                              | DC<br>X                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | RD<br>X | WR<br>X | D7                    | D6                    | D5                    | D4                    | D3                    | D2                    | D1                    | D0                    | HE<br>X |
| Command                      | 0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 1       | ↑       | 0                     | 1                     | 0                     | 1                     | 1                     | 1                     | 1                     | 1                     | 5F      |
| 1 <sup>st</sup><br>Parameter | 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | ↑       | 1       | x                     | x                     | x                     | x                     | x                     | x                     | x                     | x                     | xx      |
| 2 <sup>nd</sup><br>Parameter | 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | ↑       | 1       | MIN_<br>BRIGHT<br>[7] | MIN_<br>BRIGHT<br>[6] | MIN_<br>BRIGHT<br>[5] | MIN_<br>BRIGHT<br>[4] | MIN_<br>BRIGHT<br>[3] | MIN_<br>BRIGHT<br>[2] | MIN_<br>BRIGHT<br>[1] | MIN_<br>BRIGHT<br>[0] | xx      |
| Description                  | This command is used to read Minimum Brightness register. For details, refer to Write Minimum Brightness (5Eh).<br>RDCABCMB is valid in case that BCTRL(WRCTRLD 53h) = 1.                                                                                                                                                                                                                                                                                                                                                                |         |         |                       |                       |                       |                       |                       |                       |                       |                       |         |
| Restriction                  | There is no dummy read parameter(1 <sup>st</sup> para) at serial I/F, refer to 3.1.4.2, 3.1.5.2                                                                                                                                                                                                                                                                                                                                                                                                                                          |         |         |                       |                       |                       |                       |                       |                       |                       |                       |         |
| Register<br>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 Step up circuit Off                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |         |         |                       |                       |                       | Yes                   |                       |                       |                       |                       |         |
| Default                      | Status                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |         |         |                       |                       |                       | Default Value         |                       |                       |                       |                       |         |
|                              | Power On Sequence                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |         |         |                       |                       |                       | 8'h00                 |                       |                       |                       |                       |         |
|                              | S/W Reset                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |         |         |                       |                       |                       | 8'h00                 |                       |                       |                       |                       |         |
|                              | H/W Reset                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |         |         |                       |                       |                       | 8'h00                 |                       |                       |                       |                       |         |
| Flow Chart                   | <div><div><div>Serial Interface Mode</div><div><div>Read RDCABC</div><div>↓</div><div>Send 2<sup>nd</sup> parameter</div></div></div><div><div>Parallel Interface Mode</div><div><div>Read RDCABC</div><div>↓</div><div>Dummy Read</div><div>↓</div><div>Send 2<sup>nd</sup> parameter</div></div></div><div><div>Host</div><div>-----</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> |         |         |                       |                       |                       |                       |                       |                       |                       |                       |         |

## 5.1.45. READ DDB START (A1H)

| A1H                          | RDDDBS (Read DDB Start)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |     |     |       |       |       |       |       |       |       |       |            |
|------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|-----|-------|-------|-------|-------|-------|-------|-------|-------|------------|
|                              | DCX                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | RDX | WRX | 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><br>Parameter | 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | ↑   | 1   | D[17] | D[16] | D[15] | D[14] | D[13] | D[12] | D[11] | D[10] | 00..<br>FF |
| :                            | 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | ↑   | 1   | Dx[7] | Dx[6] | Dx[5] | Dx[4] | Dx[3] | Dx[2] | Dx[1] | Dx[0] | 00..<br>FF |
| N <sup>th</sup><br>Parameter | 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | ↑   | 1   | Dn[7] | Dn[6] | Dn[5] | Dn[4] | Dn[3] | Dn[2] | Dn[1] | Dn[0] | 00..<br>FF |
| 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>Parameter 1 : MS (most significant) byte of Supplier ID. Supplier ID is a unique value assigned to each peripheral supplier by the MIPI organization.</p> <p>Parameter 2 : LS (least significant) byte of Supplier ID.</p> <p>Parameter 3 : MS (most 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 4 : LS (least significant) byte of Supplier Elective Data.</p> <p>Parameter 5 : single-byte Escape of Exit Code (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 Alliance standard)</li> <li>- Any other value : there is DDB data in the Descriptor Block. The format and interpretation of this data is documented in MIPI Alliance Standard for Device Descriptor Block (DDB).</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</p> |     |     |       |       |       |       |       |       |       |       |            |

|                       | <p>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> |               |
|-----------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|
| 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 Step up circuit Off                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | Yes           |
| Default               | Status                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Default Value |
|                       | Power On Sequence                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | 00h           |
|                       | S/W Reset                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | 00h           |
|                       | H/W Reset                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | 00h           |

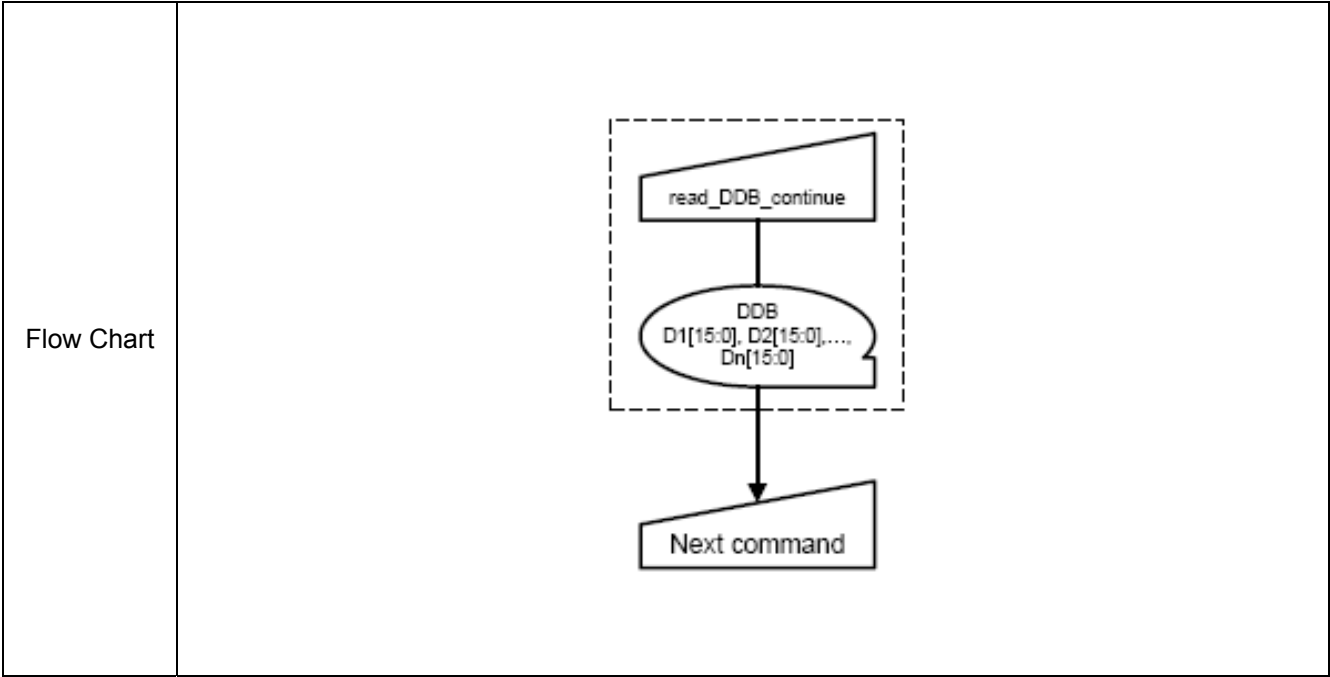
Flow Chart





## 5.1.46. READ DDB CONTINUE (A8H)

| A8H                          | RDDDBC (Read DDB Continue)                                                                                                                                                                    |     |     |       |       |       |               |       |       |       |       |            |
|------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|-----|-------|-------|-------|---------------|-------|-------|-------|-------|------------|
|                              | DCX                                                                                                                                                                                           | RDX | WRX | 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><br>Parameter | 1                                                                                                                                                                                             | ↑   | 1   | D[17] | D[16] | D[15] | D[14]         | D[13] | D[12] | D[11] | D[10] | 00..<br>FF |
| :                            | 1                                                                                                                                                                                             | ↑   | 1   | Dx[7] | Dx[6] | Dx[5] | Dx[4]         | Dx[3] | Dx[2] | Dx[1] | Dx[0] | 00..<br>FF |
| N <sup>th</sup><br>Parameter | 1                                                                                                                                                                                             | ↑   | 1   | Dn[7] | Dn[6] | Dn[5] | Dn[4]         | Dn[3] | Dn[2] | Dn[1] | Dn[0] | 00..<br>FF |
| Description                  | See section 5.1.48 (A1h)                                                                                                                                                                      |     |     |       |       |       |               |       |       |       |       |            |
| Restriction                  | 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. |     |     |       |       |       |               |       |       |       |       |            |
| Register<br>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 Step up circuit Off                                                                                                                                                               |     |     |       |       |       | Yes           |       |       |       |       |            |
| Default                      | Status                                                                                                                                                                                        |     |     |       |       |       | Default Value |       |       |       |       |            |
|                              | Power On Sequence                                                                                                                                                                             |     |     |       |       |       | 00h           |       |       |       |       |            |
|                              | S/W Reset                                                                                                                                                                                     |     |     |       |       |       | 00h           |       |       |       |       |            |
|                              | H/W Reset                                                                                                                                                                                     |     |     |       |       |       | 00h           |       |       |       |       |            |



## 5.1.47. READ ID1 (DAH)

| DAH                   | RDID1 (Read ID1)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |     |     |      |      |      |               |      |      |      |      |     |
|-----------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|-----|------|------|------|---------------|------|------|------|------|-----|
|                       | DCX                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | RDX | WRX | 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> para  | 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | ↑   | 1   | xx   | xx   | xx   | xx            | xx   | xx   | xx   | xx   | -   |
| 2 <sup>nd</sup> para  | 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | ↑   | 1   | ID17 | ID16 | ID15 | ID14          | ID13 | ID12 | ID11 | ID10 | -   |
| Description           | The 1 <sup>st</sup> Parameter is dummy data.<br>This read byte identifies the LCD module's manufacturer.                                                                                                                                                                                                                                                                                                                                                                                                                       |     |     |      |      |      |               |      |      |      |      |     |
| Restriction           | There is no dummy read parameter(1 <sup>st</sup> para) at serial I/F, refer to 3.1.4.2, 3.1.5.2                                                                                                                                                                                                                                                                                                                                                                                                                                |     |     |      |      |      |               |      |      |      |      |     |
| 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 Step up circuit Off                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |     |     |      |      |      | Yes           |      |      |      |      |     |
| Default               | Status                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |     |     |      |      |      | Default Value |      |      |      |      |     |
|                       | Power On Sequence                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |     |     |      |      |      | 00h           |      |      |      |      |     |
|                       | S/W Reset                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |     |     |      |      |      | 00h           |      |      |      |      |     |
|                       | H/W Reset                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |     |     |      |      |      | 00h           |      |      |      |      |     |
| Flow Chart            | <div><div><div>Serial Interface Mode</div><div><div>Read ID1</div><div>↓</div><div>Send 2<sup>nd</sup> parameter</div></div></div><div><div>Parallel Interface Mode</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>↓</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> |     |     |      |      |      |               |      |      |      |      |     |

## 5.1.48. READ ID2 (DBH)

| DBH                   | RDID2 (Read ID2)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |     |     |      |      |      |               |      |      |      |      |     |
|-----------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|-----|------|------|------|---------------|------|------|------|------|-----|
|                       | DCX                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | RDX | WRX | 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> para  | 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | ↑   | 1   | xx   | xx   | xx   | xx            | xx   | xx   | xx   | xx   | -   |
| 2 <sup>nd</sup> para  | 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | ↑   | 1   | ID27 | ID26 | ID25 | ID24          | ID23 | ID22 | ID21 | ID20 | -   |
| Description           | The 1 <sup>st</sup> Parameter is dummy data.<br>This read byte identifies the LCD module / driver version ID.                                                                                                                                                                                                                                                                                                                                                                                                                  |     |     |      |      |      |               |      |      |      |      |     |
| Restriction           | There is no dummy read parameter(1 <sup>st</sup> para) at serial I/F, refer to 3.1.4.2, 3.1.5.2                                                                                                                                                                                                                                                                                                                                                                                                                                |     |     |      |      |      |               |      |      |      |      |     |
| 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 Step up circuit Off                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |     |     |      |      |      | Yes           |      |      |      |      |     |
| Default               | Status                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |     |     |      |      |      | Default Value |      |      |      |      |     |
|                       | Power On Sequence                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |     |     |      |      |      | 00h           |      |      |      |      |     |
|                       | S/W Reset                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |     |     |      |      |      | 00h           |      |      |      |      |     |
|                       | H/W Reset                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |     |     |      |      |      | 00h           |      |      |      |      |     |
| Flow Chart            | <div><div><div>Serial Interface Mode</div><div><div>Read ID2</div><div>↓</div><div>Send 2<sup>nd</sup> parameter</div></div></div><div><div>Parallel Interface Mode</div><div><div>Read ID2</div><div>↓</div><div>Dummy Read</div><div>↓</div><div>Send 2<sup>nd</sup> parameter</div></div></div><div><div>Host</div><div>↓</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> |     |     |      |      |      |               |      |      |      |      |     |

## 5.1.49. READ ID3 (DCH)

| DCH                   | RDID3 (Read ID3)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |     |     |      |      |      |               |      |      |      |      |     |
|-----------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|-----|------|------|------|---------------|------|------|------|------|-----|
|                       | DCX                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | RDX | WRX | 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> para  | 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | ↑   | 1   | xx   | xx   | xx   | xx            | xx   | xx   | xx   | xx   | xx  |
| 2 <sup>nd</sup> para  | 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | ↑   | 1   | ID37 | ID36 | ID35 | ID34          | ID33 | ID32 | ID31 | ID30 | xx  |
| Description           | The 1 <sup>st</sup> Parameter is dummy data.<br>This read byte identifies the LCD module/driver.                                                                                                                                                                                                                                                                                                                                                                                                                               |     |     |      |      |      |               |      |      |      |      |     |
| Restriction           | There is no dummy read parameter(1 <sup>st</sup> para) at serial I/F, refer to 3.1.4.2, 3.1.5.2                                                                                                                                                                                                                                                                                                                                                                                                                                |     |     |      |      |      |               |      |      |      |      |     |
| 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 Step up circuit Off                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |     |     |      |      |      | Yes           |      |      |      |      |     |
| Default               | Status                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |     |     |      |      |      | Default Value |      |      |      |      |     |
|                       | Power On Sequence                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |     |     |      |      |      | 00h           |      |      |      |      |     |
|                       | S/W Reset                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |     |     |      |      |      | 00h           |      |      |      |      |     |
|                       | H/W Reset                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |     |     |      |      |      | 00h           |      |      |      |      |     |
| Flow Chart            | <div><div><div>Serial Interface Mode</div><div><div>Read ID3</div><div>↓</div><div>Send 2<sup>nd</sup> parameter</div></div></div><div><div>Parallel Interface Mode</div><div><div>Read ID3</div><div>↓</div><div>Dummy Read</div><div>↓</div><div>Send 2<sup>nd</sup> parameter</div></div></div><div><div>Host</div><div>↓</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> |     |     |      |      |      |               |      |      |      |      |     |

## 5.2. DESCRIPTION OF LEVEL 2 COMMAND

Table 68. List of level 2 command

| Operational Code (HEX) | Function  | Read/Write/ Command | Number of Parameter | Parameters             |
|------------------------|-----------|---------------------|---------------------|------------------------|
| C0h                    | MIECTL    | W                   | 3                   | MIE control            |
| C1h                    | BCMODE    | W                   | 1                   | MIE control            |
| C2h                    | WRMIECTL  | W                   | 9                   | MIE control            |
| C3h                    | WRBLCTL   | W                   | 2                   | MIE control            |
| D0h                    | MTPCTL    | W                   | 1                   | MTP control            |
| D2h                    | MTPACCS   | W                   | 2                   | MTP control            |
| D3h                    | MTPRD     | R                   | 8                   | MTP control            |
| DFh                    | DSTB      | W                   | 1                   | Deep Standby           |
| F0h                    | PASSWD1   | W                   | 2                   | Test Key               |
| F1h                    | PASSWD2   | W                   | 2                   | Test Key               |
| F2h                    | DISCTL    | W                   | 17                  | Display control        |
| F3h                    | MANPWRSEQ | W                   | 5                   | Power sequence control |
| F4h                    | PWRCTL    | W                   | 20                  | Power control          |
| F5h                    | VCMCTL    | W                   | 12                  | VCOM control           |
| F6h                    | SRCCTL    | W                   | 9                   | Source control         |
| F7h                    | IFCTL     | W                   | 4                   | Interface control      |
| F8h                    | PANELCTL  | W                   | 3                   | Gate control           |
| F9h                    | GAMMASEL  | W                   | 1                   | Gamma selection        |
| FAh                    | PGAMMACTL | W                   | 12                  | Positive gamma control |
| FBh                    | NGAMMACTL | W                   | 12                  | Negative gamma control |

Note: The number of parameter is the number of real parameter except dummy parameter.

## 5.2.1. MIECTL1 (C0H)

| C0h                       | MIECTL1 (MIE Control1) |     |     |         |         |                 |         |         |         |         |         |       |
|---------------------------|------------------------|-----|-----|---------|---------|-----------------|---------|---------|---------|---------|---------|-------|
|                           | DCX                    | RDX | WRX | D7      | D6      | D5              | D4      | D3      | D2      | D1      | D0      | HEX   |
| Command                   | 0                      | 1   | ↑   | 1       | 1       | 0               | 0       | 0       | 0       | 0       | 0       | C0    |
| 1 <sup>st</sup> Parameter | 1                      | 1   | ↑   | RRC[7]  | RRC[6]  | RRC[5]          | RRC[4]  | RRC[3]  | RRC[2]  | RRC[1]  | RRC[0]  | 8'h80 |
| 2 <sup>nd</sup> Parameter | 1                      | 1   | ↑   | IERC[7] | IERC[6] | IERC[5]         | IERC[4] | IERC[3] | IERC[2] | IERC[1] | IERC[0] | 8'h80 |
| 3 <sup>rd</sup> Parameter | 1                      | 1   | ↑   | -       | -       | ONOFF<br>DIMMEN | SERC[4] | SERC[3] | SERC[2] | SERC[1] | SERC[0] | 8'h10 |

5.2.1.1. RRC [7:0]: Reduction Rate Control of backlight power. Default value is RRC[7:0]=10000000.

$$\text{Power\_Reduction\_Rate} = \text{Contents\_Based\_Reduction\_Rate} \times \frac{\text{RRC}}{128}$$

Figure100. Expression of power reduction rate

Contents\_Based\_Reduction\_Rate is the power reduction rate. Reduction range is from '0' (no reduction) to two times of contents adaptive backlight power.

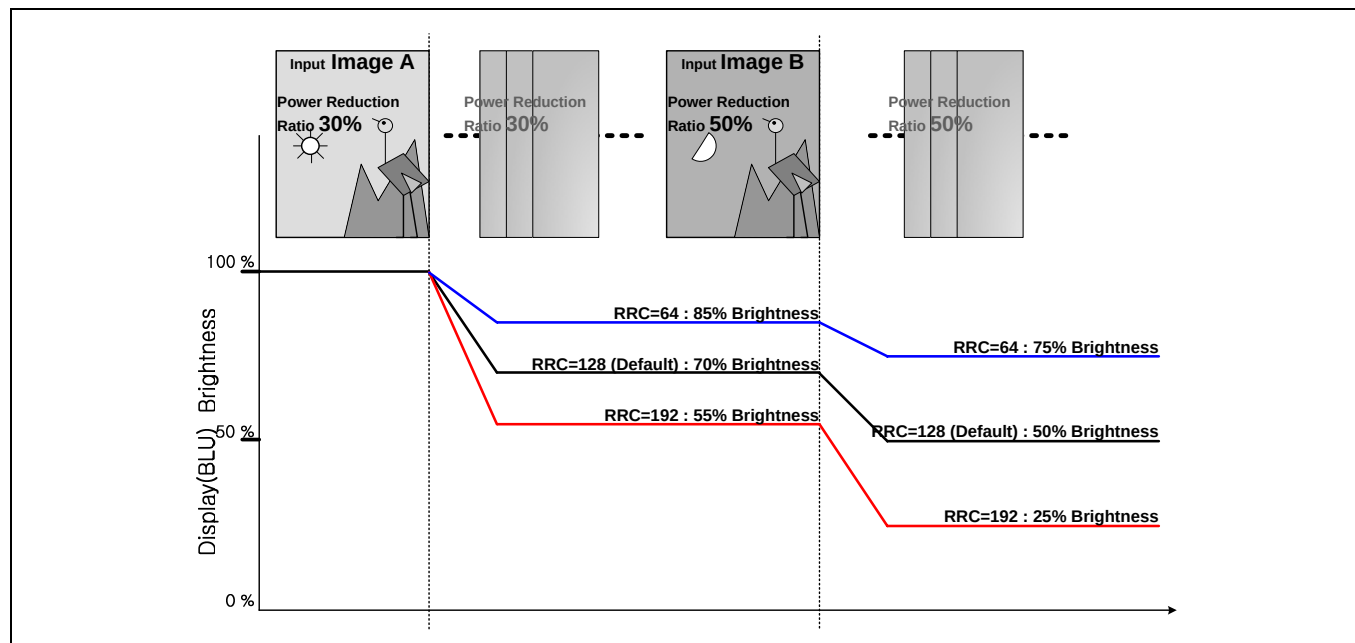


Figure101. According to RRC value, brightness variation

5.2.1.2. IERC [7:0]: Image Enhancement Rate Control. If IERC is '0', there is no enhancement of input image. If its value is '255', enhancement rate is two times of Image\_Enhancement\_Rate. Default value is RRC[7:0]=10000000.

$$\text{Adjusted\_Image\_Enhancement\_Rate} = \text{Image\_Enhancement\_Rate} \times \frac{\text{IERC}}{128}$$

Figure102. Expression of adjusted image enhancement rate

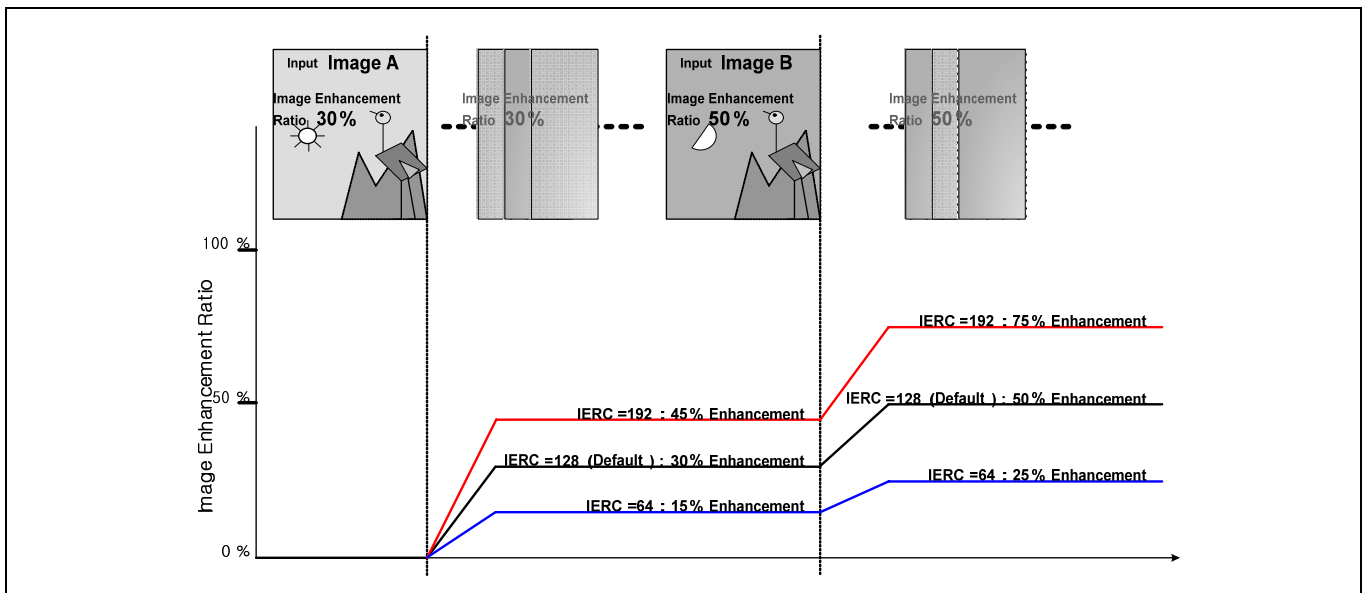


Figure103. According to IERC value, image enhancement ratio variation



5.2.1.3. ONOFF\_DIMM\_EN

This register is used to enable the on/off dimming function of MIE.

The MIE has a dimming function for preventing abnormal visible artifacts when the MIE is turning on or off. If the ONOFF\_DIMM\_EN is “1”, the MIE is smoothly turning on or off. When the ONOFF\_DIMM\_EN is “0”, the MIE is turning on or off immediately. The transition time is controlled by CST[1:0].

If this dimming function is enabled in UI or STILL mode, the host must write frames more than the transition time of CST[1:0] to finish the dimming transition. If the MIE mode is changed during on/off dimming transition, it will be updated after finishing the dimming transition.

Table 69. ONOFF\_DIMM\_EN

| ONOFF_DIMM_EN | On / Off Dimming Function |
|---------------|---------------------------|
| 0             | Disable                   |
| 1             | Enable                    |

| Status  | Default Value     |
|---------|-------------------|
| Initial | ONOFF_DIMM_EN = 0 |

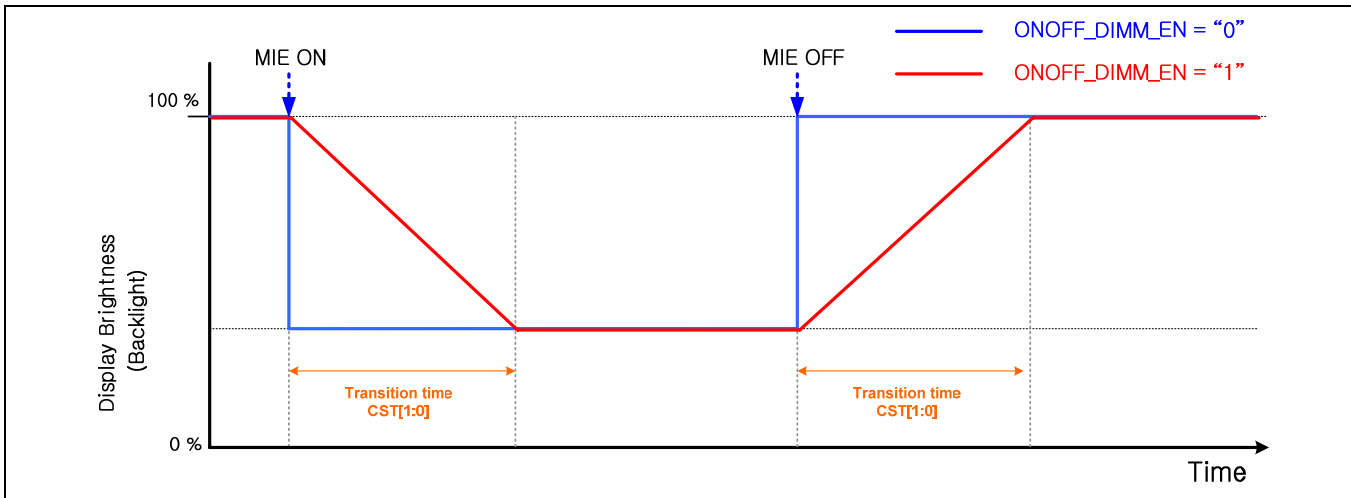


Figure104. Example of MIE On / Off dimming transition control

5.2.1.4. SERC[4:0]

This register is used to adjust the Image Saturation Enhancement Rate.

$$Adjusted\_Saturation\_Enhancement\_Rate = Saturation\_Enhancement\_Rate \times \frac{SERC}{16}$$

Figure105. Saturation enhancement rate

If the value of SERC is '0', there is no saturation enhancement in output image. If the value of SERC is increased, the saturation enhancement rate will be increased and more vivid image is obtained. The other way, if the value of SERC is decreased, the saturation enhancement rate will be decreased.

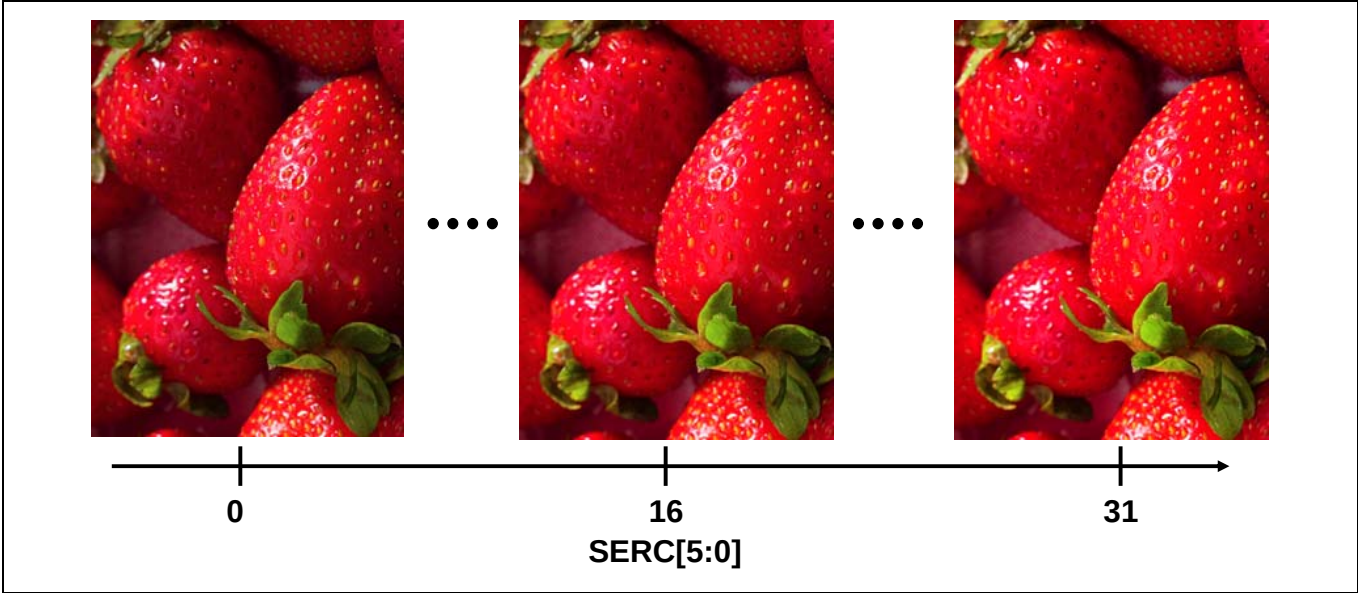


Figure106. Example of SERC

Table 70. SERC[4:0]

| SERC[4:0] | Adjust Saturation Enhancement Rate  |
|-----------|-------------------------------------|
| 00000     | Saturation Enhancement Rate x 0/16  |
| 00001     | Saturation Enhancement Rate x 1/16  |
| 00010     | Saturation Enhancement Rate x 2/16  |
| ...       | ...                                 |
| 10000     | Saturation Enhancement Rate x 16/16 |
| ...       | ...                                 |

| SERC[4:0] | Adjust Saturation Enhancement Rate  |
|-----------|-------------------------------------|
| 11101     | Saturation Enhancement Rate x 29/16 |
| 11110     | Saturation Enhancement Rate x 30/16 |
| 11111     | Saturation Enhancement Rate x 31/16 |

| Status  | Default Value     |
|---------|-------------------|
| Initial | SERC[4:0] = 10000 |

## 5.2.2. BCMODE (C1H)

| C1h       | BCMODE |     |     |    |    |    |    |    |    |            |            |       |
|-----------|--------|-----|-----|----|----|----|----|----|----|------------|------------|-------|
|           | DCX    | RDX | WRX | D7 | D6 | D5 | D4 | D3 | D2 | D1         | D0         | HEX   |
| Command   | 0      | 1   | ↑   | 1  | 1  | 0  | 0  | 0  | 0  | 0          | 1          | C1    |
| Parameter | 1      | 1   | ↑   | -  | -  | -  | -  | -  | -  | BC_MODE[1] | BC_MODE[0] | 8'h01 |

## 5.2.2.1. BC\_MODE[1:0]

Table 71. BC\_MODE[1:0]

| BC_MODE[1:0] | BLU Control Mode |
|--------------|------------------|
| 0            | Off              |
| 1            | Manual Only      |
| 2            | MIE Brightness   |
| 3            | Both             |

## 5.2.3. WRMIECTL2 (C2H)

| C2h                       | Write MIE Control 2 |     |     |    |    |    |    |            |            |            |            |        |
|---------------------------|---------------------|-----|-----|----|----|----|----|------------|------------|------------|------------|--------|
|                           | DCX                 | RDX | WRX | D7 | D6 | D5 | D4 | D3         | D2         | D1         | D0         | HEX    |
| Command                   | 0                   | 1   | ↑   | 1  | 1  | 0  | 0  | 0          | 0          | 1          | 0          | C2     |
| 1 <sup>st</sup> Parameter | 1                   | 1   | ↑   | -  | -  | -  | -  | CAT<br>[1] | CAT<br>[0] | CST<br>[1] | CST<br>[0] | 8'h00- |

## 5.2.3.1. CAT[1:0]

This register is used to select the abrupt transition time. The MIE has two transition times based on image contents for preventing abnormal visible artifacts (e.g. flicker). The MIE controls transition time between CAT and CST automatically in moving mode (MIE\_MODE = "11").

- Abrupt transition time : If input image is changed abruptly, short transition time is needed.
- Smooth transition time : If input image is changed smoothly, long transition time is needed.

Table 72. CAT[1:0]

| CAT[1:0] | Abrupt Transition Time |
|----------|------------------------|
| 00       | 1 frame                |
| 01       | 2 frames               |
| 10       | 4 frames               |
| 11       | 8 frames               |

| Status  | Default Value |
|---------|---------------|
| Initial | CAT[1:0] = 00 |

5.2.3.2. CST[1 :0]

This register is used to select the smooth transition time

Table 73. CST[1:0]

| CST[1:0] | Smooth Transition Time |
|----------|------------------------|
| 00       | 32 frames              |
| 01       | 64 frames              |
| 10       | 96 frames              |
| 11       | 128 frames             |

| Status  | Default Value |
|---------|---------------|
| Initial | CST[1:0] = 00 |

An example of MIE transition time is illustrated as below. If the input image is changed abruptly, the MIE has an abrupt transition time “case (1)” and if the input image is changed smoothly, the MIE has a smooth transition time “case (2)”. The display brightness changes to target brightness abruptly “case (4)” when the abrupt change of image is happened during the smooth transition “case (3)”.

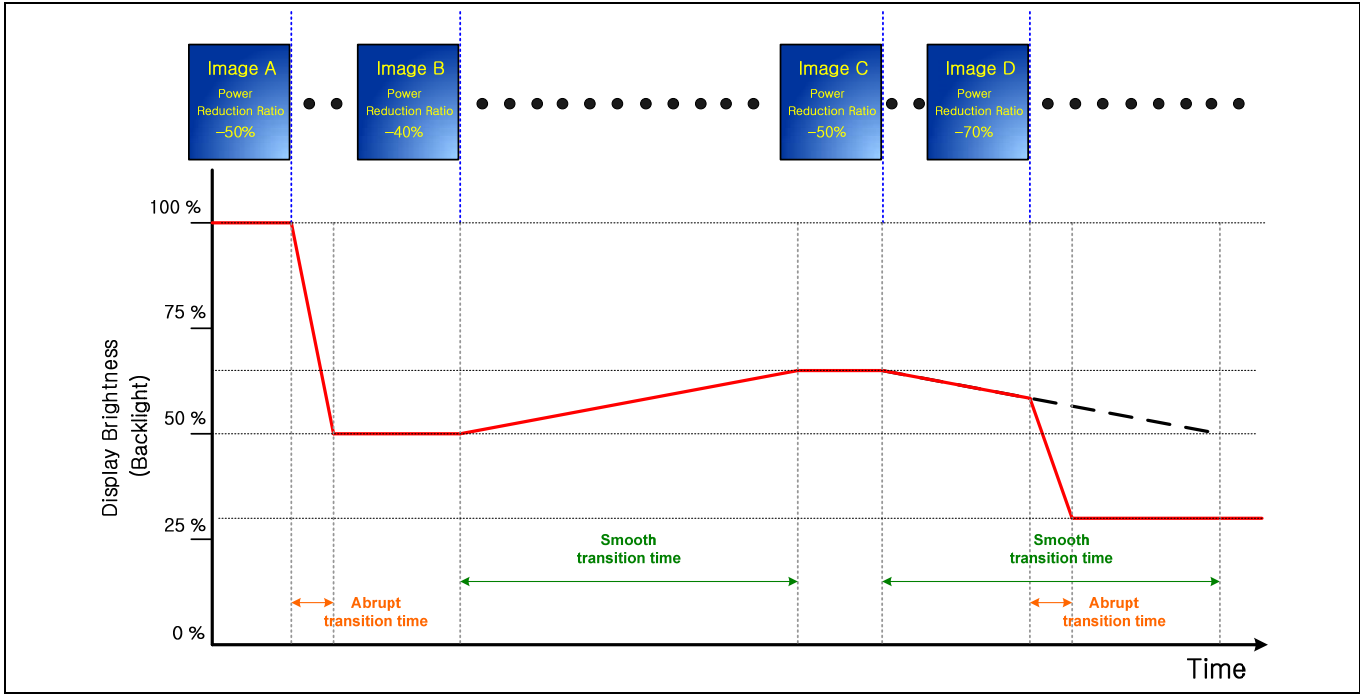


Figure107. Example of MIE transition control

## 5.2.4. WRBLCTL (C3H)

| C3h                       | WRBLCTL |     |     |                       |                 |                  |                  |                  |                  |                         |                         |     |
|---------------------------|---------|-----|-----|-----------------------|-----------------|------------------|------------------|------------------|------------------|-------------------------|-------------------------|-----|
|                           | DCX     | RDX | WRX | 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   | ↑   | -                     | BCFRQ<br>SEL[6] | BCFRQ<br>SEL [5] | BCFRQ<br>SEL [4] | BCFRQ<br>SEL [3] | BCFRQ<br>SEL [2] | BCFRQ<br>SEL [1]        | BCFRQ<br>SEL [0]        | -   |
| 2 <sup>nd</sup> Parameter | 1       | 1   | ↑   | BL_<br>MODE_<br>INSLP | -               | DT<br>[2]        | DT<br>[1]        | DT<br>[0]        | BL_<br>DRV_EN    | BL_<br>DIMM_<br>STEP[1] | BL_<br>DIMM_<br>STEP[0] | -   |

## 5.2.4.1. BCFRQSEL[6:0]

This register is used to select the frequency of PWM. To select the PWM frequency, two registers are needed. Those register are BCFRQSEL[6:0] and BL\_DIMM\_STEP[1:0].

For details, refer to the table of PWM frequency.

| Status  | Default Value            |
|---------|--------------------------|
| Initial | BCFRQSEL[6:0] = 100_0000 |

## 5.2.4.2. BL\_DIMM\_STEP[1:0]

This register is used to select the dimming step of PWM level. It is used to select the frequency of PWM with BCFRQSEL[6:0].

Table 74. BL\_DIMM\_STEP[1:0]

| BL_DIMM_STEP[1:0] | Dimming Steps of PWM |
|-------------------|----------------------|
| 00                | 256                  |
| 01                | 128                  |
| 10                | 64                   |
| 11                | Disable              |

| Status  | Default Value          |
|---------|------------------------|
| Initial | BL_DIMM_STEP[1:0] = 00 |

The PWM frequency is calculated with the following formula.

$$\text{Num. of PWM} / 1 \text{ frame} = (\text{PWM\_FRQ\_SEL} + 1) \times 2^{\text{BL\_DIMM\_STEP}}$$

Figure108. Calculation formula of PWM frequency

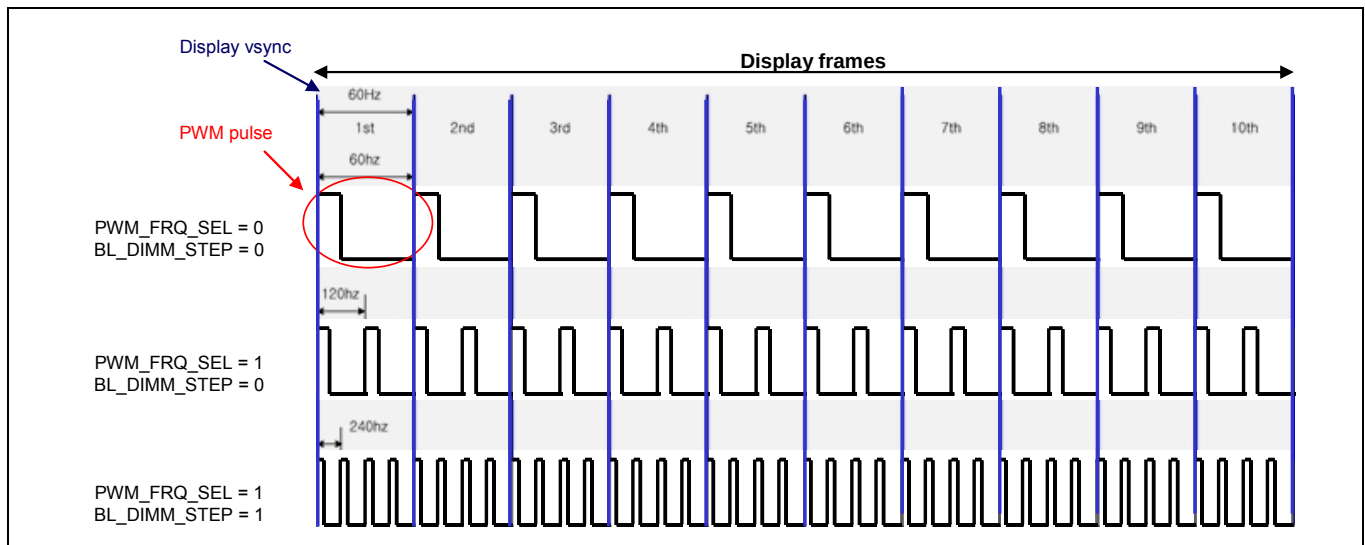


Figure109. Example of PWM frequency selection



Table 75. PWM Frequency

|                      |         | PWM Frequency [Hz] |            |            |    |
|----------------------|---------|--------------------|------------|------------|----|
| BL_DIMM<br>STEP[1:0] |         | 00                 | 01         | 10         | 11 |
| Dimming<br>Step No.  |         | 256                | 128        | 64         | 32 |
| PWM_FRQ_SEL[6:0]     | 0000000 | F.F. x 1           | F.F. x 2   | F.F. x 4   |    |
|                      | 0000001 | F.F. x 2           | F.F. x 4   | F.F. x 8   |    |
|                      | 0000010 | F.F. x 3           | F.F. x 6   | F.F. x 12  |    |
|                      | 0000011 | F.F. x 4           | F.F. x 8   | F.F. x 16  |    |
|                      | 0000100 | F.F. x 5           | F.F. x 10  | F.F. x 20  |    |
|                      | 0000101 | F.F. x 6           | F.F. x 12  | F.F. x 24  |    |
|                      | 0000110 | F.F. x 7           | F.F. x 14  | F.F. x 28  |    |
|                      | 0000111 | F.F. x 8           | F.F. x 16  | F.F. x 32  |    |
|                      | 0001000 | F.F. x 9           | F.F. x 18  | F.F. x 36  |    |
|                      | 0001001 | F.F. x 10          | F.F. x 20  | F.F. x 40  |    |
|                      | 0001010 | F.F. x 11          | F.F. x 22  | F.F. x 44  |    |
|                      | 0001011 | F.F. x 12          | F.F. x 24  | F.F. x 48  |    |
|                      | 0001100 | F.F. x 13          | F.F. x 26  | F.F. x 52  |    |
|                      | 0001101 | F.F. x 14          | F.F. x 28  | F.F. x 56  |    |
|                      | 0001110 | F.F. x 15          | F.F. x 30  | F.F. x 60  |    |
|                      | 0001111 | F.F. x 16          | F.F. x 32  | F.F. x 64  |    |
|                      | 0010000 | F.F. x 17          | F.F. x 34  | F.F. x 68  |    |
|                      | 0010001 | F.F. x 18          | F.F. x 36  | F.F. x 72  |    |
|                      | 0010010 | F.F. x 19          | F.F. x 38  | F.F. x 76  |    |
|                      | 0010011 | F.F. x 20          | F.F. x 40  | F.F. x 80  |    |
|                      | 0010100 | F.F. x 21          | F.F. x 42  | F.F. x 84  |    |
|                      | 0010101 | F.F. x 22          | F.F. x 44  | F.F. x 88  |    |
|                      | 0010110 | F.F. x 23          | F.F. x 46  | F.F. x 92  |    |
|                      | 0010111 | F.F. x 24          | F.F. x 48  | F.F. x 96  |    |
|                      | 0011000 | F.F. x 25          | F.F. x 50  | F.F. x 100 |    |
|                      | 0011001 | F.F. x 26          | F.F. x 52  | F.F. x 104 |    |
|                      | 0011010 | F.F. x 27          | F.F. x 54  | F.F. x 108 |    |
|                      | 0011011 | F.F. x 28          | F.F. x 56  | F.F. x 112 |    |
|                      | 0011100 | F.F. x 29          | F.F. x 58  | F.F. x 116 |    |
|                      | 0011101 | F.F. x 30          | F.F. x 60  | F.F. x 120 |    |
|                      | 0011110 | F.F. x 31          | F.F. x 62  | F.F. x 124 |    |
|                      | 0011111 | F.F. x 32          | F.F. x 64  | F.F. x 128 |    |
|                      | 0100000 | F.F. x 33          | F.F. x 66  | F.F. x 132 |    |
|                      | 0100001 | F.F. x 34          | F.F. x 68  | F.F. x 136 |    |
|                      | 0100010 | F.F. x 35          | F.F. x 70  | F.F. x 140 |    |
|                      | 0100011 | F.F. x 36          | F.F. x 72  | F.F. x 144 |    |
|                      | 0100100 | F.F. x 37          | F.F. x 74  | F.F. x 148 |    |
|                      | 0100101 | F.F. x 38          | F.F. x 76  | F.F. x 152 |    |
|                      | 0100110 | F.F. x 39          | F.F. x 78  | F.F. x 156 |    |
|                      | 0100111 | F.F. x 40          | F.F. x 80  | F.F. x 160 |    |
|                      | 0101000 | F.F. x 41          | F.F. x 82  | F.F. x 164 |    |
|                      | 0101001 | F.F. x 42          | F.F. x 84  | F.F. x 168 |    |
|                      | 0101010 | F.F. x 43          | F.F. x 86  | F.F. x 172 |    |
|                      | 0101011 | F.F. x 44          | F.F. x 88  | F.F. x 176 |    |
|                      | 0101100 | F.F. x 45          | F.F. x 90  | F.F. x 180 |    |
|                      | 0101101 | F.F. x 46          | F.F. x 92  | F.F. x 184 |    |
|                      | 0101110 | F.F. x 47          | F.F. x 94  | F.F. x 188 |    |
|                      | 0101111 | F.F. x 48          | F.F. x 96  | F.F. x 192 |    |
|                      | 0110000 | F.F. x 49          | F.F. x 98  | F.F. x 196 |    |
|                      | 0110001 | F.F. x 50          | F.F. x 100 | F.F. x 200 |    |
|                      | 0110010 | F.F. x 51          | F.F. x 102 | F.F. x 204 |    |
|                      | 0110011 | F.F. x 52          | F.F. x 104 | F.F. x 208 |    |
|                      | 0110100 | F.F. x 53          | F.F. x 106 | F.F. x 212 |    |
|                      | 0110101 | F.F. x 54          | F.F. x 108 | F.F. x 216 |    |
|                      | 0110110 | F.F. x 55          | F.F. x 110 | F.F. x 220 |    |
|                      | 0110111 | F.F. x 56          | F.F. x 112 | F.F. x 224 |    |
|                      | 0111000 | F.F. x 57          | F.F. x 114 | F.F. x 228 |    |
|                      | 0111001 | F.F. x 58          | F.F. x 116 | F.F. x 232 |    |
|                      | 0111010 | F.F. x 59          | F.F. x 118 | F.F. x 236 |    |
|                      | 0111011 | F.F. x 60          | F.F. x 120 | F.F. x 240 |    |
|                      | 0111100 | F.F. x 61          | F.F. x 122 | F.F. x 244 |    |
|                      | 0111101 | F.F. x 62          | F.F. x 124 | F.F. x 248 |    |
|                      | 0111110 | F.F. x 63          | F.F. x 126 | F.F. x 252 |    |
|                      | 0111111 | F.F. x 64          | F.F. x 128 | F.F. x 256 |    |

|                      |            | PWM Frequency [Hz] |            |            |    |
|----------------------|------------|--------------------|------------|------------|----|
| BL_DIMM<br>STEP[1:0] |            | 00                 | 01         | 10         | 11 |
| Dimming<br>Step No.  |            | 256                | 128        | 64         | 32 |
| PWM_FREQ_SEL[6:0]    | 1000000    | F.F. x 65          | F.F. x 130 | F.F. x 260 |    |
|                      | 1000001    | F.F. x 66          | F.F. x 132 | F.F. x 264 |    |
|                      | 1000010    | F.F. x 67          | F.F. x 134 | F.F. x 268 |    |
|                      | 1000011    | F.F. x 68          | F.F. x 136 | F.F. x 272 |    |
|                      | 1000100    | F.F. x 69          | F.F. x 138 | F.F. x 276 |    |
|                      | 1000101    | F.F. x 70          | F.F. x 140 | F.F. x 280 |    |
|                      | 1000110    | F.F. x 71          | F.F. x 142 | F.F. x 284 |    |
|                      | 1000111    | F.F. x 72          | F.F. x 144 | F.F. x 288 |    |
|                      | 1001000    | F.F. x 73          | F.F. x 146 | F.F. x 292 |    |
|                      | 1001001    | F.F. x 74          | F.F. x 148 | F.F. x 296 |    |
|                      | 1001010    | F.F. x 75          | F.F. x 150 | F.F. x 300 |    |
|                      | 1001011    | F.F. x 76          | F.F. x 152 | F.F. x 304 |    |
|                      | 1001100    | F.F. x 77          | F.F. x 154 | F.F. x 308 |    |
|                      | 1001101    | F.F. x 78          | F.F. x 156 | F.F. x 312 |    |
|                      | 1001110    | F.F. x 79          | F.F. x 158 | F.F. x 316 |    |
|                      | 1001111    | F.F. x 80          | F.F. x 160 | F.F. x 320 |    |
|                      | 1010000    | F.F. x 81          | F.F. x 162 | F.F. x 324 |    |
|                      | 1010001    | F.F. x 82          | F.F. x 164 | F.F. x 328 |    |
|                      | 1010010    | F.F. x 83          | F.F. x 166 | F.F. x 332 |    |
|                      | 1010011    | F.F. x 84          | F.F. x 168 | F.F. x 336 |    |
|                      | 1010100    | F.F. x 85          | F.F. x 170 | F.F. x 340 |    |
|                      | 1010101    | F.F. x 86          | F.F. x 172 | F.F. x 344 |    |
|                      | 1010110    | F.F. x 87          | F.F. x 174 | F.F. x 348 |    |
|                      | 1010111    | F.F. x 88          | F.F. x 176 | F.F. x 352 |    |
|                      | 1011000    | F.F. x 89          | F.F. x 178 | F.F. x 356 |    |
|                      | 1011001    | F.F. x 90          | F.F. x 180 | F.F. x 360 |    |
|                      | 1011010    | F.F. x 91          | F.F. x 182 | F.F. x 364 |    |
|                      | 1011011    | F.F. x 92          | F.F. x 184 | F.F. x 368 |    |
|                      | 1011100    | F.F. x 93          | F.F. x 186 | F.F. x 372 |    |
|                      | 1011101    | F.F. x 94          | F.F. x 188 | F.F. x 376 |    |
|                      | 1011110    | F.F. x 95          | F.F. x 190 | F.F. x 380 |    |
|                      | 1011111    | F.F. x 96          | F.F. x 192 | F.F. x 384 |    |
|                      | 1100000    | F.F. x 97          | F.F. x 194 | F.F. x 388 |    |
|                      | 1100001    | F.F. x 98          | F.F. x 196 | F.F. x 392 |    |
|                      | 1100010    | F.F. x 99          | F.F. x 198 | F.F. x 396 |    |
|                      | 1100011    | F.F. x 100         | F.F. x 200 | F.F. x 400 |    |
|                      | 1100100    | F.F. x 101         | F.F. x 202 | F.F. x 404 |    |
|                      | 1100101    | F.F. x 102         | F.F. x 204 | F.F. x 408 |    |
|                      | 1100110    | F.F. x 103         | F.F. x 206 | F.F. x 412 |    |
|                      | 1100111    | F.F. x 104         | F.F. x 208 | F.F. x 416 |    |
|                      | 1101000    | F.F. x 105         | F.F. x 210 | F.F. x 420 |    |
|                      | 1101001    | F.F. x 106         | F.F. x 212 | F.F. x 424 |    |
|                      | 1101010    | F.F. x 107         | F.F. x 214 | F.F. x 428 |    |
|                      | 1101011    | F.F. x 108         | F.F. x 216 | F.F. x 432 |    |
|                      | 1101100    | F.F. x 109         | F.F. x 218 | F.F. x 436 |    |
|                      | 1101101    | F.F. x 110         | F.F. x 220 | F.F. x 440 |    |
|                      | 1101110    | F.F. x 111         | F.F. x 222 | F.F. x 444 |    |
|                      | 1101111    | F.F. x 112         | F.F. x 224 | F.F. x 448 |    |
|                      | 1110000    | F.F. x 113         | F.F. x 226 | F.F. x 452 |    |
|                      | 1110001    | F.F. x 114         | F.F. x 228 | F.F. x 456 |    |
|                      | 1110010    | F.F. x 115         | F.F. x 230 | F.F. x 460 |    |
|                      | 1110011    | F.F. x 116         | F.F. x 232 | F.F. x 464 |    |
| 1110100              | F.F. x 117 | F.F. x 234         | F.F. x 468 |            |    |
| 1110101              | F.F. x 118 | F.F. x 236         | F.F. x 472 |            |    |
| 1110110              | F.F. x 119 | F.F. x 238         | F.F. x 476 |            |    |
| 1110111              | F.F. x 120 | F.F. x 240         | F.F. x 480 |            |    |
| 1111000              | F.F. x 121 | F.F. x 242         | F.F. x 484 |            |    |
| 1111001              | F.F. x 122 | F.F. x 244         | F.F. x 488 |            |    |
| 1111010              | F.F. x 123 | F.F. x 246         | F.F. x 492 |            |    |
| 1111011              | F.F. x 124 | F.F. x 248         | F.F. x 496 |            |    |
| 1111100              | F.F. x 125 | F.F. x 250         | F.F. x 500 |            |    |
| 1111101              | F.F. x 126 | F.F. x 252         | F.F. x 504 |            |    |
| 1111110              | F.F. x 127 | F.F. x 254         | F.F. x 508 |            |    |
| 1111111              | F.F. x 128 | F.F. x 256         | F.F. x 512 |            |    |

Note: F.F. means Frame Frequency.

When the display frame frequency is 60Hz, PWM frequency is represented at the table below.

**Table 76. Example of PWM Frequency Selection**

|                   |         | PWM Frequency [Hz] |      |       |    |  |  |  | PWM Frequency [Hz] |         |      |       |       |    |  |
|-------------------|---------|--------------------|------|-------|----|--|--|--|--------------------|---------|------|-------|-------|----|--|
| BL_DIMM STEP[1:0] |         | 00                 | 01   | 10    | 11 |  |  |  | BL_DIMM STEP[1:0]  |         | 00   | 01    | 10    | 11 |  |
| Dimming Step No.  |         | 256                | 128  | 64    | 32 |  |  |  | Dimming Step No.   |         | 256  | 128   | 64    | 32 |  |
| PWM_FRQ_SEL[6:0]  | 0000000 | 60                 | 120  | 240   |    |  |  |  | PWM_FRQ_SEL[6:0]   | 1000000 | 3900 | 7800  | 15600 |    |  |
|                   | 0000001 | 120                | 240  | 480   |    |  |  |  |                    | 1000001 | 3960 | 7920  | 15840 |    |  |
|                   | 0000010 | 180                | 360  | 720   |    |  |  |  |                    | 1000010 | 4020 | 8040  | 16080 |    |  |
|                   | 0000011 | 240                | 480  | 960   |    |  |  |  |                    | 1000011 | 4080 | 8160  | 16320 |    |  |
|                   | 0000100 | 300                | 600  | 1200  |    |  |  |  |                    | 1000100 | 4140 | 8280  | 16560 |    |  |
|                   | 0000101 | 360                | 720  | 1440  |    |  |  |  |                    | 1000101 | 4200 | 8400  | 16800 |    |  |
|                   | 0000110 | 420                | 840  | 1680  |    |  |  |  |                    | 1000110 | 4260 | 8520  | 17040 |    |  |
|                   | 0000111 | 480                | 960  | 1920  |    |  |  |  |                    | 1000111 | 4320 | 8640  | 17280 |    |  |
|                   | 0001000 | 540                | 1080 | 2160  |    |  |  |  |                    | 1001000 | 4380 | 8760  | 17520 |    |  |
|                   | 0001001 | 600                | 1200 | 2400  |    |  |  |  |                    | 1001001 | 4440 | 8880  | 17760 |    |  |
|                   | 0001010 | 660                | 1320 | 2640  |    |  |  |  |                    | 1001010 | 4500 | 9000  | 18000 |    |  |
|                   | 0001011 | 720                | 1440 | 2880  |    |  |  |  |                    | 1001011 | 4560 | 9120  | 18240 |    |  |
|                   | 0001100 | 780                | 1560 | 3120  |    |  |  |  |                    | 1001100 | 4620 | 9240  | 18480 |    |  |
|                   | 0001101 | 840                | 1680 | 3360  |    |  |  |  |                    | 1001101 | 4680 | 9360  | 18720 |    |  |
|                   | 0001110 | 900                | 1800 | 3600  |    |  |  |  |                    | 1001110 | 4740 | 9480  | 18960 |    |  |
|                   | 0001111 | 960                | 1920 | 3840  |    |  |  |  |                    | 1001111 | 4800 | 9600  | 19200 |    |  |
|                   | 0010000 | 1020               | 2040 | 4080  |    |  |  |  |                    | 1010000 | 4860 | 9720  | 19440 |    |  |
|                   | 0010001 | 1080               | 2160 | 4320  |    |  |  |  |                    | 1010001 | 4920 | 9840  | 19680 |    |  |
|                   | 0010010 | 1140               | 2280 | 4560  |    |  |  |  |                    | 1010010 | 4980 | 9960  | 19920 |    |  |
|                   | 0010011 | 1200               | 2400 | 4800  |    |  |  |  |                    | 1010011 | 5040 | 10080 | 20160 |    |  |
|                   | 0010100 | 1260               | 2520 | 5040  |    |  |  |  |                    | 1010100 | 5100 | 10200 | 20400 |    |  |
|                   | 0010101 | 1320               | 2640 | 5280  |    |  |  |  |                    | 1010101 | 5160 | 10320 | 20640 |    |  |
|                   | 0010110 | 1380               | 2760 | 5520  |    |  |  |  |                    | 1010110 | 5220 | 10440 | 20880 |    |  |
|                   | 0010111 | 1440               | 2880 | 5760  |    |  |  |  |                    | 1010111 | 5280 | 10560 | 21120 |    |  |
|                   | 0011000 | 1500               | 3000 | 6000  |    |  |  |  |                    | 1011000 | 5340 | 10680 | 21360 |    |  |
|                   | 0011001 | 1560               | 3120 | 6240  |    |  |  |  |                    | 1011001 | 5400 | 10800 | 21600 |    |  |
|                   | 0011010 | 1620               | 3240 | 6480  |    |  |  |  |                    | 1011010 | 5460 | 10920 | 21840 |    |  |
|                   | 0011011 | 1680               | 3360 | 6720  |    |  |  |  |                    | 1011011 | 5520 | 11040 | 22080 |    |  |
|                   | 0011100 | 1740               | 3480 | 6960  |    |  |  |  |                    | 1011100 | 5580 | 11160 | 22320 |    |  |
|                   | 0011101 | 1800               | 3600 | 7200  |    |  |  |  |                    | 1011101 | 5640 | 11280 | 22560 |    |  |
|                   | 0011110 | 1860               | 3720 | 7440  |    |  |  |  |                    | 1011110 | 5700 | 11400 | 22800 |    |  |
|                   | 0011111 | 1920               | 3840 | 7680  |    |  |  |  |                    | 1011111 | 5760 | 11520 | 23040 |    |  |
|                   | 0100000 | 1980               | 3960 | 7920  |    |  |  |  |                    | 1100000 | 5820 | 11640 | 23280 |    |  |
|                   | 0100001 | 2040               | 4080 | 8160  |    |  |  |  |                    | 1100001 | 5880 | 11760 | 23520 |    |  |
|                   | 0100010 | 2100               | 4200 | 8400  |    |  |  |  |                    | 1100010 | 5940 | 11880 | 23760 |    |  |
|                   | 0100011 | 2160               | 4320 | 8640  |    |  |  |  |                    | 1100011 | 6000 | 12000 | 24000 |    |  |
|                   | 0100100 | 2220               | 4440 | 8880  |    |  |  |  |                    | 1100100 | 6060 | 12120 | 24240 |    |  |
|                   | 0100101 | 2280               | 4560 | 9120  |    |  |  |  |                    | 1100101 | 6120 | 12240 | 24480 |    |  |
|                   | 0100110 | 2340               | 4680 | 9360  |    |  |  |  |                    | 1100110 | 6180 | 12360 | 24720 |    |  |
|                   | 0100111 | 2400               | 4800 | 9600  |    |  |  |  |                    | 1100111 | 6240 | 12480 | 24960 |    |  |
|                   | 0101000 | 2460               | 4920 | 9840  |    |  |  |  |                    | 1101000 | 6300 | 12600 | 25200 |    |  |
|                   | 0101001 | 2520               | 5040 | 10080 |    |  |  |  |                    | 1101001 | 6360 | 12720 | 25440 |    |  |
|                   | 0101010 | 2580               | 5160 | 10320 |    |  |  |  |                    | 1101010 | 6420 | 12840 | 25680 |    |  |
|                   | 0101011 | 2640               | 5280 | 10560 |    |  |  |  |                    | 1101011 | 6480 | 12960 | 25920 |    |  |
|                   | 0101100 | 2700               | 5400 | 10800 |    |  |  |  |                    | 1101100 | 6540 | 13080 | 26160 |    |  |
|                   | 0101101 | 2760               | 5520 | 11040 |    |  |  |  |                    | 1101101 | 6600 | 13200 | 26400 |    |  |
|                   | 0101110 | 2820               | 5640 | 11280 |    |  |  |  |                    | 1101110 | 6660 | 13320 | 26640 |    |  |
|                   | 0101111 | 2880               | 5760 | 11520 |    |  |  |  |                    | 1101111 | 6720 | 13440 | 26880 |    |  |
|                   | 0110000 | 2940               | 5880 | 11760 |    |  |  |  |                    | 1110000 | 6780 | 13560 | 27120 |    |  |
|                   | 0110001 | 3000               | 6000 | 12000 |    |  |  |  |                    | 1110001 | 6840 | 13680 | 27360 |    |  |
|                   | 0110010 | 3060               | 6120 | 12240 |    |  |  |  |                    | 1110010 | 6900 | 13800 | 27600 |    |  |
|                   | 0110011 | 3120               | 6240 | 12480 |    |  |  |  |                    | 1110011 | 6960 | 13920 | 27840 |    |  |
|                   | 0110100 | 3180               | 6360 | 12720 |    |  |  |  |                    | 1110100 | 7020 | 14040 | 28080 |    |  |
|                   | 0110101 | 3240               | 6480 | 12960 |    |  |  |  |                    | 1110101 | 7080 | 14160 | 28320 |    |  |
|                   | 0110110 | 3300               | 6600 | 13200 |    |  |  |  |                    | 1110110 | 7140 | 14280 | 28560 |    |  |
|                   | 0110111 | 3360               | 6720 | 13440 |    |  |  |  |                    | 1110111 | 7200 | 14400 | 28800 |    |  |
|                   | 0111000 | 3420               | 6840 | 13680 |    |  |  |  |                    | 1111000 | 7260 | 14520 | 29040 |    |  |
|                   | 0111001 | 3480               | 6960 | 13920 |    |  |  |  |                    | 1111001 | 7320 | 14640 | 29280 |    |  |
|                   | 0111010 | 3540               | 7080 | 14160 |    |  |  |  |                    | 1111010 | 7380 | 14760 | 29520 |    |  |
|                   | 0111011 | 3600               | 7200 | 14400 |    |  |  |  |                    | 1111011 | 7440 | 14880 | 29760 |    |  |
|                   | 0111100 | 3660               | 7320 | 14640 |    |  |  |  |                    | 1111100 | 7500 | 15000 | 30000 |    |  |
|                   | 0111101 | 3720               | 7440 | 14880 |    |  |  |  |                    | 1111101 | 7560 | 15120 | 30240 |    |  |
|                   | 0111110 | 3780               | 7560 | 15120 |    |  |  |  |                    | 1111110 | 7620 | 15240 | 30480 |    |  |
|                   | 0111111 | 3840               | 7680 | 15360 |    |  |  |  |                    | 1111111 | 7680 | 15360 | 30720 |    |  |

## 5.2.4.3. BL\_MODE\_IN\_SLP

This register is used to select the state of PWM when driver IC is sleep in mode.

Table 77. BL\_MODE\_IN\_SLP

| BL_MODE_IN_SLP | State of PWM |
|----------------|--------------|
| 0              | Low          |
| 1              | High         |

| Status  | Default Value      |
|---------|--------------------|
| Initial | BL_MODE_IN_SLP = 0 |

Table 78. State of PWM

| Pin | State      |          |                         |             |            |             |
|-----|------------|----------|-------------------------|-------------|------------|-------------|
|     | Hard Reset | SW Reset | SLPIN                   |             | SPLOUT     |             |
|     |            |          | Display On              | Display Off | Display On | Display Off |
| PWM | Low        | Low      | Fixed as BL_MODE_IN_SLP |             | Active     | Low         |

## 5.2.4.4. BL\_DRV\_EN

This register is used to enable the LED driver IC when the IC needs the chip enable signal.

Table 79. BL\_DRV\_EN

| BL_DRV_EN | State of BL_DRV_EN Pin |
|-----------|------------------------|
| 0         | Low                    |
| 1         | High                   |

| Status  | Default Value |
|---------|---------------|
| Initial | BL_DRV_EN = 1 |

5.2.4.5. DT[2:0]

This register is used to select the transition time of the manual dimming function.

Table 80. DT[2:0]

| DT[2:0] | Transition Time | Dimming Step |
|---------|-----------------|--------------|
| 000     | 16 frames       | 16           |
| 001     | 24 frames       | 24           |
| 010     | 32 frames       | 32           |
| 011     | 40 frames       | 40           |
| 100     | 48 frames       | 48           |
| 101     | 56 frames       | 56           |
| 110     | 64 frames       | 64           |
| 111     | 72 frames       | 72           |

$$\% \text{ Transition\_Time} = (DT[2:0] + 2) \times 8 \times \frac{1}{\text{Display\_Frequency}}$$

Figure110. Transition time of manual dimming function

| Status  | Default Value |
|---------|---------------|
| Initial | DT[2:0] = 010 |

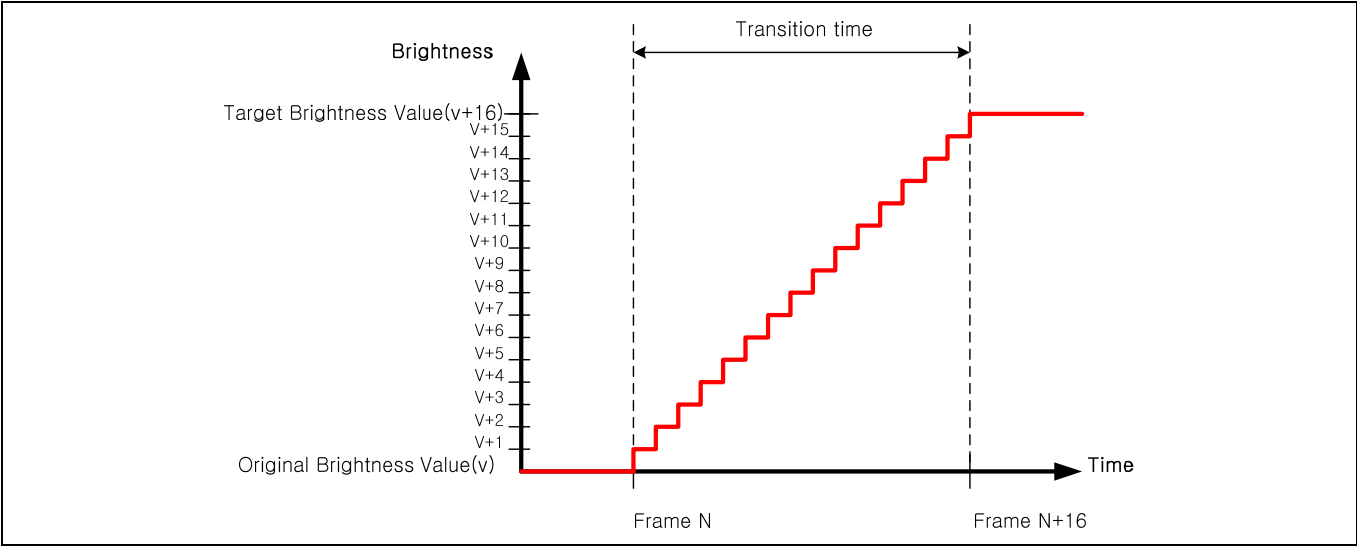


Figure111. Example of dimming function (DT[2:0] = 000)

## 5.2.5. MTPCTL (D0H)

| D0h       | MTPCTL (MTP control) |     |     |    |          |    |             |         |         |         |          |     |
|-----------|----------------------|-----|-----|----|----------|----|-------------|---------|---------|---------|----------|-----|
|           | DCX                  | RDX | WRX | D7 | D6       | D5 | D4          | D3      | D2      | D1      | D0       | HEX |
| Command   | 0                    | 1   | ↑   | 1  | 1        | 0  | 1           | 0       | 0       | 0       | 0        | D0  |
| Parameter | 1                    | 1   | ↑   | -  | MTP_MODE | -  | RDMTPOFFSET | MTP_SEL | MTP_WRB | MTP_ERB | MTP_LOAD | -   |

This command is used to control MTP.

MTP initial operation is advanced after set both MTP Test Key Command is enable.

## 5.2.5.1. MTP\_MODE

: Set the 2nd booster operating condition.

MTP\_MODE = 0: The 2<sup>nd</sup> booster operates as a user-specified condition. VGH/VGL voltages are generated as a designated level by BT2-0 setting.

MTP\_MODE = 1: Available BT2-0 settings are limited only '101'.

Table 81. MTP\_MODE

| MTP_MODE | MTP operation mode                                                    |
|----------|-----------------------------------------------------------------------|
| 0        | All BT2-0 settings are available (Normal operating condition)         |
| 1        | Setting of BT2-0 is limited. (An MTP-programming / erasing condition) |

Note. Do not execute MTP programming / erasing operation when MTP\_MODE = 0.

## 5.2.5.2. RDMTPOFFSET

: This command selects whether reading data of 4<sup>th</sup> Parameter(D3h) is VCMOC\_PO, VCMOC[4:0] or VCMH\_SET[6:0].

Setting RDMTPOFFSET = "0": VCMOC\_PO, VCMOC[4:0]

Setting RDMTPOFFSET = "1": VCMH\_SET[6:0] = VCMH[6:0] ± VCMOC[4:0]

## 5.2.5.3. MTP\_ERB

: This command is a setting for using MTP Data Initialization or Erase.

Setting MTP\_ERB = "0": MTP Data Initialization or Erase Enable.

Setting MTP\_ERB = "1": MTP Data Initialization or Erase Disable.

## 5.2.5.4. MTP\_LOAD

: This command is a setting for using MTP data load from MTP to post-register.

Setting MTP\_LOAD = "0": MTP data load disable.

Setting MTP\_LOAD = "1": MTP data load enable.

## 5.2.5.5. MTP\_SEL

: This command is to select ID1[7:0], ID2[7:0], ID3[7:0], VCMOC\_PO, VCMOC[4:0] for using MTP value or register value.

MTP\_SEL = "1": select ID1[7:0], ID2[7:0], ID3[7:0], VCMOC\_PO, VCMOC[4:0] from pre-register value.

MTP\_SEL = "0": select ID1[7:0], ID2[7:0], ID3[7:0], VCMOC\_PO, VCMOC[4:0] from post-register (loaded data from MTP) value.

## 5.2.5.6. MTP\_WRB

: This command is used to MTP programming

MTP\_WRB = "0": MTP writing enable.

MTP\_WRB = "1": MTP writing disable.

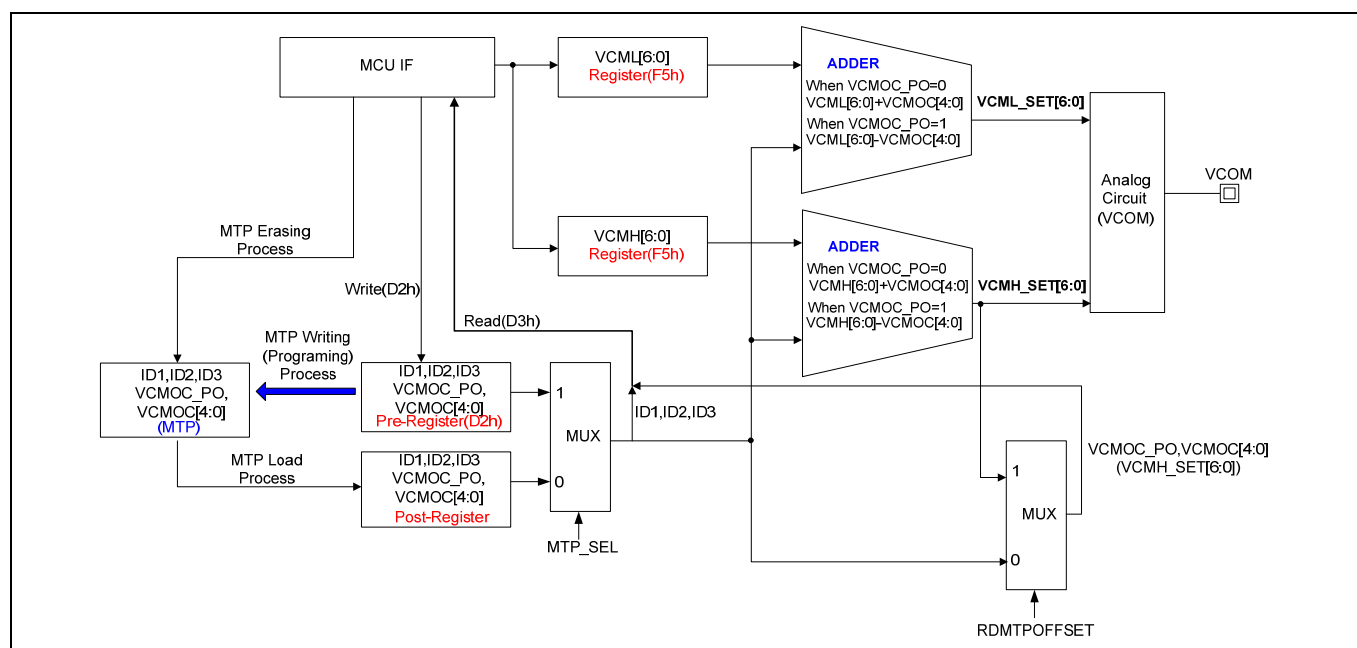


Figure112. MTP block diagram

| Status  | Default Value                                                            |
|---------|--------------------------------------------------------------------------|
| Initial | MTP_MODE = 0, RDMTPOFFSET=0, MTP_SEL=0, MTP_WRB=1, MTP_ERB=1, MTP_LOAD=0 |

## 5.2.6. MTPACCS (D2H)

| D2h                       | MTPACCS |     |     |         |         |         |         |         |         |         |         |     |
|---------------------------|---------|-----|-----|---------|---------|---------|---------|---------|---------|---------|---------|-----|
|                           | DCX     | RDX | WRX | D7      | D6      | D5      | D4      | D3      | D2      | D1      | D0      | HEX |
| Command                   | 0       | 1   | ↑   | 1       | 1       | 0       | 1       | 0       | 0       | 1       | 0       | D2  |
| 1 <sup>st</sup> Parameter | 1       | 1   | ↑   | ADDR[7] | ADDR[6] | ADDR[5] | ADDR[4] | ADDR[3] | ADDR[2] | ADDR[1] | ADDR[0] | -   |
| 2 <sup>nd</sup> Parameter | 1       | 1   | ↑   | DATA[7] | DATA[6] | DATA[5] | DATA[4] | DATA[3] | DATA[2] | DATA[1] | DATA[0] | -   |

This command writes pre-registers.

## 5.2.6.1. ADDR[7:0]

This is the address (Parameter) of pre-register. Refer to MTPRD(D3h) command.

Ex) When ADDR[7:0] = 1, This command accesses ID1[7:0] of pre-register.

## 5.2.6.2. DATA[7:0]

This is the writing data of pre-register.

| Status  | Default Value                |
|---------|------------------------------|
| Initial | ADDR[7:0]=00h, DATA[7:0]=00h |

## 5.2.7. MTPRD (D3H)

| D3h                       | MTPRD |     |     |             |             |             |             |             |             |             |             |     |
|---------------------------|-------|-----|-----|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-----|
|                           | DCX   | RDX | WRX | D7          | D6          | D5          | D4          | D3          | D2          | D1          | D0          | HEX |
| Command                   | 0     | 1   | ↑   | 1           | 1           | 0           | 1           | 0           | 0           | 1           | 1           | D3  |
| 1 <sup>st</sup> Parameter | 1     | ↑   | 1   | ID1[7]      | ID1[6]      | ID1[5]      | ID1[4]      | ID1[3]      | ID1[2]      | ID1[1]      | ID1[0]      | -   |
| 2 <sup>nd</sup> Parameter | 1     | ↑   | 1   | ID2[7]      | ID2[6]      | ID2[5]      | ID2[4]      | ID2[3]      | ID2[2]      | ID2[1]      | ID2[0]      | -   |
| 3 <sup>rd</sup> Parameter | 1     | ↑   | 1   | ID3[7]      | ID3[6]      | ID3[5]      | ID3[4]      | ID3[3]      | ID3[2]      | ID3[1]      | ID3[0]      | -   |
| 4 <sup>th</sup> Parameter | 1     | ↑   | 1   | -           | -           | VCMOC_PO    | VCMOC[4]    | VCMOC[3]    | VCMOC[2]    | VCMOC[1]    | VCMOC[0]    | -   |
| 5 <sup>th</sup> Parameter | 1     | ↑   | 1   | -           | -           | -           | -           | -           | -           | -           | -           | -   |
| 6 <sup>th</sup> Parameter | 1     | ↑   | 1   | -           | -           | -           | -           | -           | -           | -           | -           | -   |
| 7 <sup>th</sup> Parameter | 1     | ↑   | 1   | MIPIIDMS[7] | MIPIIDMS[6] | MIPIIDMS[5] | MIPIIDMS[4] | MIPIIDMS[3] | MIPIIDMS[2] | MIPIIDMS[1] | MIPIIDMS[0] | -   |
| 8 <sup>th</sup> Parameter | 1     | ↑   | 1   | MIPIIDLS[7] | MIPIIDLS[6] | MIPIIDLS[5] | MIPIIDLS[4] | MIPIIDLS[3] | MIPIIDLS[2] | MIPIIDLS[1] | MIPIIDLS[0] | -   |

## 5.2.7.1. ID1[7:0]

This read byte identifies the LCD module's manufacturer.

## 5.2.7.2. ID2[7:0]

This read byte identifies the LCD module / driver version ID.

## 5.2.7.3. ID3[7:0]

This read byte identifies the LCD module/driver.

## 5.2.7.4. VCMOC\_PO/VCMOC[4:0]

This read byte identifies the VCOM Offset.

$$\text{VCMH\_SET}[6:0] = \text{VCMH}[6:0] \pm \text{VCMOC}[4:0]$$

$$\text{VCML\_SET}[6:0] = \text{VCML}[6:0] \pm \text{VCMOC}[4:0]$$



Table 82. VCMOC\_PO/ VCMOC[4:0]

| VCMOC_PO/<br>VCMOC[4:0] | VCM_OFFSET | VCMOC_PO/<br>VCMOC[4:0] | VCM_OFFSET |
|-------------------------|------------|-------------------------|------------|
| 000000                  | 0          | 100000                  | 0          |
| 000001                  | +1         | 100001                  | -1         |
| 000010                  | +2         | 100010                  | -2         |
| 000011                  | +3         | 100011                  | -3         |
| 000100                  | +4         | 100100                  | -4         |
| 000101                  | +5         | 100101                  | -5         |
| 000110                  | +6         | 100110                  | -6         |
| 000111                  | +7         | 100111                  | -7         |
| 001000                  | +8         | 101000                  | -8         |
| 001001                  | +9         | 101001                  | -9         |
| 001010                  | +10        | 101010                  | -10        |
| 001011                  | +11        | 101011                  | -11        |
| 001100                  | +12        | 101100                  | -12        |
| 001101                  | +13        | 101101                  | -13        |
| 001110                  | +14        | 101110                  | -14        |
| 001111                  | +15        | 101111                  | -15        |
| 010000                  | +16        | 110000                  | -16        |
| 010001                  | +17        | 110001                  | -17        |
| 010010                  | +18        | 110010                  | -18        |
| 010011                  | +19        | 110011                  | -19        |
| 010100                  | +20        | 110100                  | -20        |
| 010101                  | +21        | 110101                  | -21        |
| 010110                  | +22        | 110110                  | -22        |
| 010111                  | +23        | 110111                  | -23        |
| 011000                  | +24        | 111000                  | -24        |
| 011001                  | +25        | 111001                  | -25        |
| 011010                  | +26        | 111010                  | -26        |
| 011011                  | +27        | 111011                  | -27        |
| 011100                  | +28        | 111100                  | -28        |
| 011101                  | +29        | 111101                  | -29        |
| 011110                  | +30        | 111110                  | -30        |
| 011111                  | +31        | 111111                  | -31        |

For example, if VCMH[6:0] = "1001101"(4.0V) and VCML[6:0] = "1100110"(-0.5V) and VCMOC\_PO/VCMOC[4:0] = 100011 are selected, then VCM\_OFFSET is "-3," and therefore VCMH\_SET[6:0] is "1001010," which results in VCOM high level voltage = 3.94V from VCMH[6:0] table, VCML\_SET[6:0] is "1100011," which results in VCOM low level voltage = 0.56V from VCML[6:0] table.

Note that VCMH\_SET[6:0]/VCML\_SET[6:0] cannot be set to the value above "1111111" or below "0000000," that is,  $128 \geq \text{VCMH}[6:0](\text{VCML}[6:0]) + \text{VCMOC\_PO/VCMOC}[4:0] \geq 0$ .

Note: VCMH\_SET[6:0] is VCMH[6:0] ± Post-register(VCOMOC) when MTP\_SEL=0 and is VCMH[6:0] ± Pre-register(VCOMOC) when MTP\_SEL=1. Refer to figure 112. MTP block diagram.

## 5.2.7.5. MIPIIDMS[7:0]

This read byte identifies the MS byte of Supplier ID.

## 5.2.7.6. MIPIIDLS[7:0]

This read byte identifies the LS byte of Supplier ID.

\* MIPIIDMS and MIPIIDLS are NOT stored in MTP(post-register) but stored in pre-register.

## 5.2.8. DSTB (DFH)

| DFh       | DSTB |     |     |    |    |    |    |    |    |    |      |     |
|-----------|------|-----|-----|----|----|----|----|----|----|----|------|-----|
|           | DCX  | RDX | WRX | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0   | HEX |
| Command   | 0    | 1   | ↑   | 1  | 1  | 0  | 1  | 1  | 1  | 1  | 1    | DF  |
| Parameter | 1    | 1   | ↑   | -  | -  | -  | -  | -  | -  | -  | DSTB | -   |

This command enters deep standby mode. Refer to 4.8 Deep Standby Mode.

Table 83. DSTB

| DSTB | State            |
|------|------------------|
| 0    | Deep Standby Off |
| 1    | Deep Standby In  |

| Status  | Default Value |
|---------|---------------|
| Initial | DSTB = 0      |

## 5.2.9. PASSWD1 (F0H)

| F0h                       | Password command for level 2 |     |     |             |             |             |             |             |             |             |             |     |
|---------------------------|------------------------------|-----|-----|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-----|
|                           | DCX                          | RDX | WRX | D7          | D6          | D5          | D4          | D3          | D2          | D1          | D0          | HEX |
| Command                   | 0                            | 1   | ↑   | 1           | 1           | 1           | 1           | 0           | 0           | 0           | 0           | F0  |
| 1 <sup>st</sup> Parameter | 1                            | 1   | ↑   | TEST_KEY[7] | TEST_KEY[6] | TEST_KEY[5] | TEST_KEY[4] | TEST_KEY[3] | TEST_KEY[2] | TEST_KEY[1] | TEST_KEY[0] | -   |
| 2 <sup>nd</sup> Parameter | 1                            | 1   | ↑   | TEST_KEY[7] | TEST_KEY[6] | TEST_KEY[5] | TEST_KEY[4] | TEST_KEY[3] | TEST_KEY[2] | TEST_KEY[1] | TEST_KEY[0] | -   |

When the Parameter (TEST\_KEY[7:0]) of this command is inputted by 5Ah, this command enable level 2 command input. When the Parameter (TEST\_KEY[7:0]) of this command is inputted by except 5Ah, this command disable level 2 command input.

| Status  | Default Value                  |
|---------|--------------------------------|
| Initial | TEST_KEY[7:0]=8'b01011010(5Ah) |

## 5.2.10. PASSWD2 (F1H)

| F1h                       | Password command for level 2 |     |     |             |             |             |             |             |             |             |             |     |
|---------------------------|------------------------------|-----|-----|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-----|
|                           | DCX                          | RDX | WRX | D7          | D6          | D5          | D4          | D3          | D2          | D1          | D0          | HEX |
| Command                   | 0                            | 1   | ↑   | 1           | 1           | 1           | 1           | 0           | 0           | 0           | 1           | F1  |
| 1 <sup>st</sup> Parameter | 1                            | 1   | ↑   | TEST_KEY[7] | TEST_KEY[6] | TEST_KEY[5] | TEST_KEY[4] | TEST_KEY[3] | TEST_KEY[2] | TEST_KEY[1] | TEST_KEY[0] | -   |
| 2 <sup>nd</sup> Parameter | 1                            | 1   | ↑   | TEST_KEY[7] | TEST_KEY[6] | TEST_KEY[5] | TEST_KEY[4] | TEST_KEY[3] | TEST_KEY[2] | TEST_KEY[1] | TEST_KEY[0] | -   |

When the Parameter (TEST\_KEY[7:0]) of this command is inputted by 5Ah, this command enable level 2 command input. When the Parameter (TEST\_KEY[7:0]) of this command is inputted by except 5Ah, this command disable level 2 command input.

| Status  | Default Value                  |
|---------|--------------------------------|
| Initial | TEST_KEY[7:0]=8'b01011010(5Ah) |

## 5.2.11. DISCTL (F2H)

| F2h                           | DISCTL (Display Control) |     |     |              |                |                |                |                |                |              |              |     |
|-------------------------------|--------------------------|-----|-----|--------------|----------------|----------------|----------------|----------------|----------------|--------------|--------------|-----|
|                               | DCX                      | RDX | WRX | D7           | D6             | D5             | D4             | D3             | D2             | D1           | D0           | HEX |
| Command                       | 0                        | 1   | ↑   | 1            | 1              | 1              | 1              | 0              | 0              | 1            | 0            | F2  |
| 1 <sup>st</sup> Parameter     | 1                        | 1   | ↑   | -            | -              | NL<br>[5]      | NL<br>[4]      | NL<br>[3]      | NL<br>[2]      | NL<br>[1]    | NL<br>[0]    | -   |
| 2 <sup>nd</sup> Parameter     | 1                        | 1   | ↑   | NHW<br>[7]   | NHW<br>[6]     | NHW<br>[5]     | NHW<br>[4]     | NHW<br>[3]     | NHW<br>[2]     | NHW<br>[1]   | NHW<br>[0]   | -   |
| 3 <sup>rd</sup> Parameter     | 1                        | 1   | ↑   | -            | BLKINV         | PINDINV        | PNDINV         | PIINV          | IINV           | PINV         | NINV         | -   |
| 4 <sup>th</sup> Parameter     | 1                        | 1   | ↑   | NVBP<br>[7]  | NVBP<br>[6]    | NVBP<br>[5]    | NVBP<br>[4]    | NVBP<br>[3]    | NVBP<br>[2]    | NVBP<br>[1]  | NVBP<br>[0]  | -   |
| 5 <sup>th</sup> Parameter     | 1                        | 1   | ↑   | NVFP<br>[7]  | NVFP<br>[6]    | NVFP<br>[5]    | NVFP<br>[4]    | NVFP<br>[3]    | NVFP<br>[2]    | NVFP<br>[1]  | NVFP<br>[0]  | -   |
| 6 <sup>th</sup> Parameter     | 1                        | 1   | ↑   | -            | -              | -              | -              | -              | -              | -            | -            | -   |
| 7 <sup>th</sup> Parameter     | 1                        | 1   | ↑   | -            | -              | -              | -              | -              | -              | -            | -            | -   |
| 8 <sup>th</sup> Parameter     | 1                        | 1   | ↑   | -            | DIV_SRC<br>[4] | DIV_SRC<br>[3] | DIV_SRC<br>[2] | DIV_SRC<br>[1] | DIV_SRC<br>[0] | TE_ST<br>[9] | TE_ST<br>[8] | -   |
| 9 <sup>th</sup> Parameter     | 1                        | 1   | ↑   | TE_ST<br>[7] | TE_ST<br>[6]   | TE_ST<br>[5]   | TE_ST<br>[4]   | TE_ST<br>[3]   | TE_ST<br>[2]   | TE_ST<br>[1] | TE_ST<br>[0] | -   |
| 10 <sup>th</sup><br>Parameter | 1                        | 1   | ↑   | -            | -              | -              | -              | -              | TE_SEL         | TE_ED<br>[9] | TE_ED<br>[8] | -   |
| 11 <sup>th</sup><br>Parameter | 1                        | 1   | ↑   | TE_ED<br>[7] | TE_ED<br>[6]   | TE_ED<br>[5]   | TE_ED<br>[4]   | TE_ED<br>[3]   | TE_ED<br>[2]   | TE_ED<br>[1] | TE_ED<br>[0] | -   |
| 12 <sup>th</sup><br>Parameter | 1                        | 1   | ↑   | -            | -              | -              | -              | -              | -              | -            | REV          | -   |
| 13 <sup>th</sup><br>Parameter | 1                        | 1   | ↑   | -            | -              | -              | -              | -              | -              | -            | -            | -   |
| 14 <sup>th</sup><br>Parameter | 1                        | 1   | ↑   | -            | -              | -              | -              | -              | -              | -            | -            | -   |
| 15 <sup>th</sup><br>Parameter | 1                        | 1   | ↑   | PIHW<br>[7]  | PIHW<br>[6]    | PIHW<br>[5]    | PIHW<br>[4]    | PIHW<br>[3]    | PIHW<br>[2]    | PIHW<br>[1]  | PIHW<br>[0]  | -   |
| 16 <sup>th</sup><br>Parameter | 1                        | 1   | ↑   | PIVBP<br>[7] | PIVBP<br>[6]   | PIVBP<br>[5]   | PIVBP<br>[4]   | PIVBP<br>[3]   | PIVBP<br>[2]   | PIVBP<br>[1] | PIVBP<br>[0] | -   |
| 17 <sup>th</sup><br>Parameter | 1                        | 1   | ↑   | PIVFP<br>[7] | PIVFP<br>[6]   | PIVFP<br>[5]   | PIVFP<br>[4]   | PIVFP<br>[3]   | PIVFP<br>[2]   | PIVFP<br>[1] | PIVFP<br>[0] | -   |

## 5.2.11.1. NL[5:0]

: Set the display duty. The total number of scan line can be set in the range between 8-line and 320-line. A step size is 8-line.

Table 84. NL[5:0]

| NL[5:0]       | Total number of scan line |
|---------------|---------------------------|
| 000000        | Setting disabled          |
| 000001        | 8                         |
| 000010        | 16                        |
| ....          | ....                      |
| 101000        | 320                       |
| 110110~111111 | Setting disabled          |

| Status  | Default Value          |
|---------|------------------------|
| Initial | NL[5:0] = 101000 (320) |

Note: ML (MADCTL D4) setting low when Display size < 320.

## 5.2.11.2. NHW[7:0]/PIHW[7:0]

: Set the horizontal clock (CL1) period in the Normal mode, Partial mode, Idle mode / Partial-Idle mode, respectively. In the case of MPU interface mode.

Table 85. NHW[7:0]/PIHW[7:0]

| *HW[7:0]          | Number of Display Clock |
|-------------------|-------------------------|
| 00000000~00011010 | Setting disabled        |
| 01001000          | 72                      |
| 01001001          | 73                      |
| .....             | .....                   |
| 11111110          | 254                     |
| 11111111          | 255                     |

Note: OSCK is the internal oscillator clock.

| Status  | Default Value                                           |
|---------|---------------------------------------------------------|
| Initial | NHW[7:0] = 10010100 (148)<br>PIHW[7:0] = 10010100 (148) |

## 5.2.11.3. NINV / PINV / IINV / PIINV / PNDINV / PINDINV / BLKINV

: Select the panel driving method in the Normal mode / Partial mode (display area) / Idle mode / Partial-Idle mode (display area) / Partial mode (non-display area) / Partial-Idle mode (non-display area) / Blanking display, respectively. Either frame inversion method or line inversion method can be selected.

Table 86. NINV/PINV/IINV/PIINV/PNDINV/PINDINV/BLKINV

| *INV | Panel driving method |
|------|----------------------|
| 0    | Frame inversion      |
| 1    | Line inversion       |

| Status  | Default Value                                              |
|---------|------------------------------------------------------------|
| Initial | NINV, PINV = 1<br>IINV, PIINV, PNDINV, PINDINV, BLKINV = 0 |

\*non-display area is (porch + non display area) when partial mode.

## 5.2.11.4. NVBP[7:0]/ PIVBP[7:0]

: Set the vertical back-porch period in the Normal mode, Partial mode, Idle mode / Partial-Idle mode, respectively. In the case of MPU interface mode.

Table 87. NVBP[7:0]/ PIVBP[7:0]

| *VBP[7:0] | Number of Horizontal Line |
|-----------|---------------------------|
| 00000000  | Setting disable           |
| 00000001  | Setting disable           |
| 00000010  | 2                         |
| .....     | .....                     |
| 11111101  | 253                       |
| 11111110  | 254                       |
| 11111111  | 255                       |

| Status  | Default Value           |
|---------|-------------------------|
| Initial | *BP[7:0] = 00001000 (8) |

## 5.2.11.5. NVFP[7:0]/PIVFP[7:0]

: Set the vertical front-porch period in the Normal mode, Partial mode, Idle mode / Partial-Idle mode, respectively.  
In the case of MPU interface mode.

Table 88. NVFP[7:0]/PIVFP[7:0]

| *VFP[7:0] | Number of Horizontal Line |
|-----------|---------------------------|
| 00000000  | Setting disable           |
| 00000001  | Setting disable           |
| 00000010  | 2                         |
| .....     | .....                     |
| 11111101  | 253                       |
| 11111110  | 254                       |
| 11111111  | 255                       |

| Status  | Default Value           |
|---------|-------------------------|
| Initial | *FP[7:0] = 00001000 (8) |



## 5.2.11.6. REV

: Select whether the liquid crystal type is normally white type or normally black type.

Table 89. REV

| REV | Liquid crystal type |
|-----|---------------------|
| 0   | Normally black      |
| 1   | Normally white      |

| Status  | Default Value |
|---------|---------------|
| Initial | REV = 0       |

## 5.2.11.7. DIV\_SRC[4:0]

: This controls the period of internal track signal.

Table 90. DIV\_SRC[4:0]

| DIV_SRC | Track Period(number of oscillator clock) |
|---------|------------------------------------------|
| 00000   | Setting disable                          |
| .....   | .....                                    |
| 00100   | Setting disable                          |
| 00101   | 5                                        |
| 00110   | 6                                        |
| .....   | .....                                    |
| 01101   | 13                                       |
| 01110   | 14                                       |
| 01111   | 15                                       |
| 10000   | 16                                       |
| 10001   | 17                                       |
| 10010   | 18                                       |
| 10010   | Setting disable                          |
| .....   | ....                                     |
| 11111   | Setting disable                          |

| Status  | Default Value         |
|---------|-----------------------|
| Initial | DIV_SRC [4:0] = 00101 |

5.2.11.8. TE\_ST[9:0]

: Select the time when TE signal rises to high level(VDD3).

This command is available when TE\_SEL = 1 .

| Status  | Default Value                  |
|---------|--------------------------------|
| Initial | TE_ST[9:0] = 01_0100_1000(328) |

5.2.11.9. TE\_SEL

: Select whether the liquid crystal type is normally white type or normally black type.

Table 91. TE\_SEL

| TE_SEL | TE Output Select |
|--------|------------------|
| 0      | Level1 TE Ouptut |
| 1      | Level2 TE Output |

| Status  | Default Value |
|---------|---------------|
| Initial | TE_SEL = 0    |

5.2.11.10. TE\_ED[9:0]

: Select the time when TE signal falls to low level(VSS3).

This command is available when TE\_SEL = 1 .

| Status  | Default Value                |
|---------|------------------------------|
| Initial | TE_ED[9:0] = 00_0000_0111(7) |

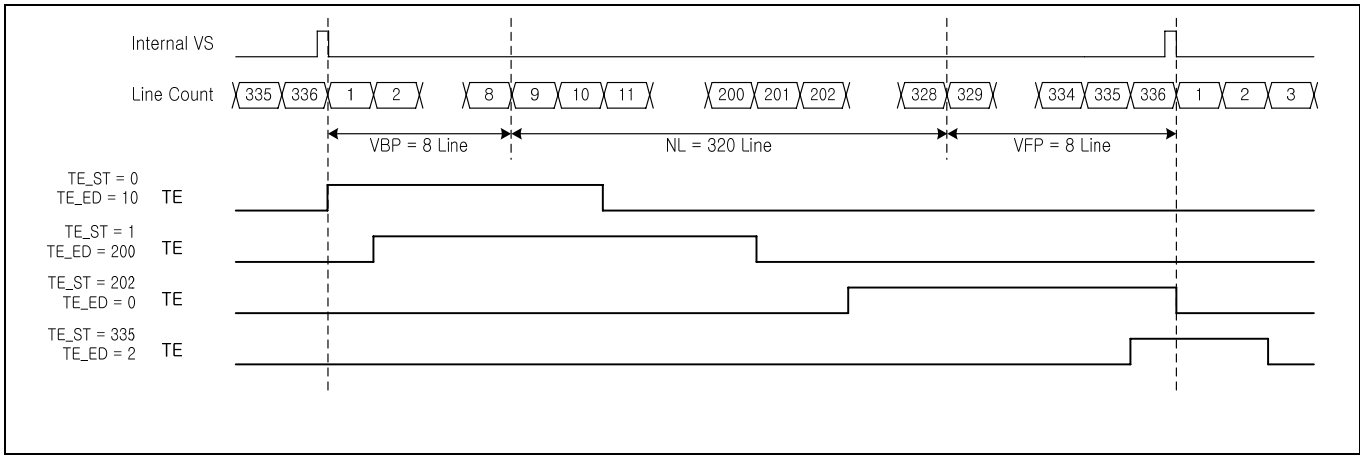


Figure113. TE Timing diagram

## 5.2.12. MANPWRSEQ (F3H)

| F3h                       | MANPWRSEQ (Power Control) |     |     |        |        |        |                 |             |                 |                 |              |     |
|---------------------------|---------------------------|-----|-----|--------|--------|--------|-----------------|-------------|-----------------|-----------------|--------------|-----|
|                           | DCX                       | RDX | WRX | D7     | D6     | D5     | D4              | D3          | D2              | D1              | D0           | HEX |
| Command                   | 0                         | 1   | ↑   | 1      | 1      | 1      | 1               | 0           | 0               | 1               | 1            | F3  |
| 1 <sup>st</sup> Parameter | 1                         | 1   | ↑   | -      | -      | -      | -               | -           | -               | -               | APON         | -   |
| 2 <sup>nd</sup> Parameter | 1                         | 1   | ↑   | VCL_EN | VGL_EN | VGH_EN | VGHFRE<br>E1_EN | AVDD_E<br>N | VC11_2N<br>D_EN | VC11_1ST<br>_EN | VCIR_EN      | -   |
| 3 <sup>rd</sup> Parameter | 1                         | 1   | ↑   | -      | -      | -      | GATE_O<br>N     | VCOM_E<br>N | GVDD_E<br>N     | VGHFRE<br>E2_EN | AVDD2_E<br>N | -   |
| 4 <sup>th</sup> Parameter | 1                         | 1   | ↑   | -      | -      | -      | -               | -           | -               | -               | -            | -   |
| 5 <sup>th</sup> Parameter | 1                         | 1   | ↑   | -      | -      | -      | -               | -           | -               | D1              | D0           | -   |

## 5.2.12.1. APON

: This is an automatic-boosting-operation-starting bit for the booster circuits. In case of APON=0, the automatic boosting sequence starter is halted and the booster circuits are operated independently by AVDD\_EN, VGH\_EN, VGL\_EN and VCL\_EN bits. In case of APON=1, booster circuits are operated automatically and sequentially.

| Status  | Default Value |
|---------|---------------|
| Initial | APON = 1      |

## 5.2.12.2. VCIR\_EN

: Internal VCIR generation amplifier operation control bit. When VCIR\_EN=0, VCIR voltage is not generated.

| Status  | Default Value |
|---------|---------------|
| Initial | VCIR_EN = 0   |

## 5.2.12.3. VCI1\_1ST\_EN/VCI1\_2ND\_EN

: Internal VCI1 generation amplifier operation control bit. When VCI1\_1ST\_EN=0, VCI1 voltage is not generated.

| Status  | Default Value                    |
|---------|----------------------------------|
| Initial | VCI1_1ST_EN = 0, VCI1_2ND_EN = 0 |

## 5.2.12.4. AVDD\_EN

: This is an operation-starting bit for the booster circuit1. In case of AVDD\_EN = 0, the circuit is stopped and vice versa. For further information about timing for adjusting to the AVDD\_EN = 1

| Status  | Default Value |
|---------|---------------|
| Initial | AVDD_EN = 0   |

## 5.2.12.5. VGHFREE1\_EN/VGHFREE2\_EN

: These are about the booster circuit 2(VGH). These prevent latch-up event.

| Status  | Default Value                    |
|---------|----------------------------------|
| Initial | VGHFREE1_EN = 0, VGHFREE2_EN = 0 |

## 5.2.12.6. VGH\_EN

: This is an operation-starting bit for the booster circuit 2(VGH). In case of VGH\_EN, the circuit is stopped and vice versa. For further information about timing for adjusting to the VGH\_EN= 1.

| Status  | Default Value |
|---------|---------------|
| Initial | VGH_EN = 0    |

## 5.2.12.7. VGL\_EN

: This is an operation-starting bit for the booster circuit 2(VGL). In case of VGL\_EN = 0, the circuit is stopped and vice versa. For further information about timing for adjusting to the VGL\_EN = 1.

| Status  | Default Value |
|---------|---------------|
| Initial | VGL_EN = 0    |

## 5.2.12.8. VCL\_EN

: This is an operation-starting bit for the booster circuit 3(VCL). In case of VCL\_EN = 0, the circuit is stopped and vice versa. For further information about timing for adjusting to the VCL\_EN= 1.

| Status  | Default Value |
|---------|---------------|
| Initial | VCL_EN = 0    |

## 5.2.12.9. VCOM\_EN/GVDD\_EN

: This is an operation-starting bit for GVDD/VCOM amplifiers. In case of VCOM/\_ENVCOM\_EN = 0, the amplifier circuits are stopped. On the other hand, the operation of the amplifiers is getting started when VCOM\_EN/GVDD\_EN = 1. For further information about timing for adjusting to VCOM\_EN/GVDD\_EN = 1.

| Status  | Default Value            |
|---------|--------------------------|
| Initial | VCOM_EN = 0, GVDD_EN = 0 |

## 5.2.12.10. GATE\_ON

: This is a gate on/off control signal. All gate outputs are set to be gate off level when GATE\_ON = 0. When GATE\_ON = 1, gate driver is working: G1 to G320 output is either VGH or VGL level.

| Status  | Default Value |
|---------|---------------|
| Initial | GATE_ON = 0   |

## 5.2.12.11. D[1:0]

: This controls the status of source, VCOM, gate.

Table 92. D[1:0]

| D[1:0] | GATE_ON    | Source    | VCOM    | Gate    |
|--------|------------|-----------|---------|---------|
| 00     | Don't care | AVSS      | AVSS    | VGL     |
| 01     | 0          | AVSS      | AVSS    | VGL     |
| 01     | 1          | AVSS      | AVSS    | Operate |
| 10     | 0          | Binary    | Operate | VGL     |
| 10     | 1          | Binary    | Operate | Operate |
| 11     | 0          | Amplifier | Operate | VGL     |
| 11     | 1          | Amplifier | Operate | Operate |

| Status  | Default Value |
|---------|---------------|
| Initial | D[1:0] = 00   |

## 5.2.13. PWRCTL (F4H)

| F4h                        | PWRCTL (Power Control) |     |     |    |             |             |             |          |             |                  |                 |     |
|----------------------------|------------------------|-----|-----|----|-------------|-------------|-------------|----------|-------------|------------------|-----------------|-----|
|                            | DCX                    | RDX | WRX | 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   | ↑   | -  | -           | -           | -           | VC[3]    | VC[2]       | VC[1]            | VC[0]           | -   |
| 2 <sup>nd</sup> Parameter  | 1                      | 1   | ↑   | -  | -           | -           | -           | -        | -           | -                | -               | -   |
| 3 <sup>rd</sup> Parameter  | 1                      | 1   | ↑   | -  | -           | -           | -           | -        | -           | -                | -               | -   |
| 4 <sup>th</sup> Parameter  | 1                      | 1   | ↑   | -  | -           | -           | -           | -        | -           | -                | -               | -   |
| 5 <sup>th</sup> Parameter  | 1                      | 1   | ↑   | -  | SEQ2<br>[2] | SEQ2<br>[1] | SEQ2<br>[0] | -        | SEQ1<br>[2] | SEQ1<br>[1]      | SEQ1<br>[0]     | -   |
| 6 <sup>th</sup> Parameter  | 1                      | 1   | ↑   | -  | SEQ4<br>[2] | SEQ4<br>[1] | SEQ4<br>[0] | -        | SEQ3<br>[2] | SEQ3<br>[1]      | SEQ3<br>[0]     | -   |
| 7 <sup>th</sup> Parameter  | 1                      | 1   | ↑   | -  | -           | -           | -           | -        | SEQ5<br>[2] | SEQ5<br>[1]      | SEQ5<br>[0]     | -   |
| 8 <sup>th</sup> Parameter  | 1                      | 1   | ↑   | -  | -           | BLK_SEL     | BLK_OFF     | -        | -           | BLK_FRA<br>ME[1] | BLK_FRA<br>M[0] | -   |
| 9 <sup>th</sup> Parameter  | 1                      | 1   | ↑   | -  | -           | NDC3[1]     | NDC3[0]     | NDC2[1]  | NDC2[0]     | NDC1[1]          | NDC1[0]         | -   |
| 10 <sup>th</sup> Parameter | 1                      | 1   | ↑   | -  | NGVD[6]     | NGVD[5]     | NGVD[4]     | NGVD[3]  | NGVD[2]     | NGVD[1]          | NGVD[0]         | -   |
| 11 <sup>th</sup> Parameter | 1                      | 1   | ↑   | -  | -           | -           | -           | -        | NBT[2]      | NBT[1]           | NBT[0]          | -   |
| 12 <sup>th</sup> Parameter | 1                      | 1   | ↑   | -  | -           | PIDC3[1]    | PIDC3[0]    | PIDC2[1] | PIDC2[0]    | PIDC1[1]         | PIDC1[0]        | -   |
| 13 <sup>th</sup> Parameter | 1                      | 1   | ↑   | -  | -           | -           | -           | -        | -           | -                | -               | -   |
| 14 <sup>th</sup> Parameter | 1                      | 1   | ↑   | -  | -           | -           | -           | -        | PIBT[2]     | PIBT[1]          | PIBT[0]         | -   |
| 15 <sup>th</sup> Parameter | 1                      | 1   | ↑   | -  | -           | -           | -           | -        | -           | -                | -               | -   |
| 16 <sup>th</sup> Parameter | 1                      | 1   | ↑   | -  | -           | -           | -           | -        | -           | -                | -               | -   |
| 17 <sup>th</sup> Parameter | 1                      | 1   | ↑   | -  | -           | -           | -           | -        | -           | -                | -               | -   |
| 18 <sup>th</sup> Parameter | 1                      | 1   | ↑   | -  | -           | -           | -           | -        | -           | -                | -               | -   |
| 19 <sup>th</sup> Parameter | 1                      | 1   | ↑   | -  | -           | -           | -           | -        | -           | -                | -               | -   |
| 20 <sup>th</sup> Parameter | 1                      | 1   | ↑   | -  | -           | -           | -           | -        | -           | -                | -               | -   |

## 5.2.13.1. VC[3:0]

: This register is used to set the VCI1 voltage. These bits set the VCI1 voltage up to 3V as the nominal output (upper limit value may depend on VCI voltage)

Table 93. VC[3:0]

| VC3 | VC2 | VC1 | VC0 | VCI1   |
|-----|-----|-----|-----|--------|
| 0   | 0   | 0   | 0   | 2.100V |
| 0   | 0   | 0   | 1   | 2.160V |
| 0   | 0   | 1   | 0   | 2.220V |
| 0   | 0   | 1   | 1   | 2.280V |
| 0   | 1   | 0   | 0   | 2.340V |
| 0   | 1   | 0   | 1   | 2.400V |
| 0   | 1   | 1   | 0   | 2.460V |
| 0   | 1   | 1   | 1   | 2.520V |
| 1   | 0   | 0   | 0   | 2.580V |
| 1   | 0   | 0   | 1   | 2.640V |
| 1   | 0   | 1   | 0   | 2.700V |
| 1   | 0   | 1   | 1   | 2.760V |
| 1   | 1   | 0   | 0   | 2.820V |
| 1   | 1   | 0   | 1   | 2.880V |
| 1   | 1   | 1   | 0   | 2.940V |
| 1   | 1   | 1   | 1   | 3.000V |

Note: Do not set any higher VCI1 level than VCI -0.15V.

| Status  | Default Value  |
|---------|----------------|
| Initial | VC[3:0] = 1011 |



## 5.2.13.2. SEQ1[2:0]

: : This register is used to set the period between from start of AVDD boosting to start of VGH charging when sleep-out command is applied on sleep-in mode. (APON = 1)

Table 94. SEQ1[2:0]

| SEQ1[2:0] | VGHFREE1_EN on timing                                                     |
|-----------|---------------------------------------------------------------------------|
|           | Period time from AVDD boosting start to VGH charging start (unit : frame) |
| 000       | Set disable                                                               |
| 001       | 1/4                                                                       |
| 010       | 2/4                                                                       |
| 011       | 3/4                                                                       |
| 100       | 1                                                                         |
| 101       | 5/4                                                                       |
| 110       | 6/4                                                                       |
| 111       | 7/4                                                                       |

| Status  | Default Value   |
|---------|-----------------|
| Initial | SEQ1[2:0] = 001 |

## 5.2.13.3. SEQ2[2:0]

: This register is used to set the period between from start of VGH charging to start of VGH boosting when sleep-out command is applied on sleep-in mode. (APON = 1)

Table 95. SEQ2[2:0]

| SEQ2[2:0] | VGH_EN on timing                                                         |
|-----------|--------------------------------------------------------------------------|
|           | Period time from VGH charging start to VGH boosting start (unit : frame) |
| 000       | Set disable                                                              |
| 001       | Set disable                                                              |
| 010       | 2/4                                                                      |
| 011       | 3/4                                                                      |
| 100       | 1                                                                        |
| 101       | 5/4                                                                      |
| 110       | 6/4                                                                      |
| 111       | 7/4                                                                      |

| Status  | Default Value   |
|---------|-----------------|
| Initial | SEQ2[2:0] = 010 |

## 5.2.13.4. SEQ3[2:0]

: This register is used to set the period between from start of VGH boosting to start of VGL boosting when sleep-out command is applied on sleep-in mode. (APON = 1)

Table 96. SEQ3[2:0]

| SEQ3[2:0] | VGL_EN on timing                                                         |
|-----------|--------------------------------------------------------------------------|
|           | Period time from VGH boosting start to VGL boosting start (unit : frame) |
| 000       | Set disable                                                              |
| 001       | Set disable                                                              |
| 010       | Set disable                                                              |
| 011       | Set disable                                                              |
| 100       | Set disable                                                              |
| 101       | Set disable                                                              |
| 110       | Set disable                                                              |
| 111       | 7/4                                                                      |

| Status  | Default Value   |
|---------|-----------------|
| Initial | SEQ3[2:0] = 111 |

## 5.2.13.5. SEQ4[2:0]

: This register is used to set the period between from start of VGL boosting to VCL boosting when sleep-out command is applied on sleep-in mode. (APON = 1)

Table 97. SEQ4[2:0]

| SEQ4[2:0] | VCL_EN on timing                                                         |
|-----------|--------------------------------------------------------------------------|
|           | Period time from VGL boosting start to VCL boosting start (unit : frame) |
| 000       | Set disable                                                              |
| 001       | Set disable                                                              |
| 010       | Set disable                                                              |
| 011       | Set disable                                                              |
| 100       | 1                                                                        |
| 101       | 5/4                                                                      |
| 110       | 6/4                                                                      |
| 111       | 7/4                                                                      |

| Status  | Default Value   |
|---------|-----------------|
| Initial | SEQ4[2:0] = 100 |

## 5.2.13.6. SEQ5[2:0]

: This register is used to set the period between from VCL boosting to GVDD/VCOM amplifier turn-on when sleep-out command is applied on sleep-in mode(APON = 1)

Table 98. SEQ5[2:0]

| SEQ5[2:0] | VGL_EN on timing                                                            |
|-----------|-----------------------------------------------------------------------------|
|           | Period time from VCL boosting start to AMP_EN boosting start (unit : frame) |
| 000       | Set disable                                                                 |
| 001       | 1/4                                                                         |
| 010       | 2/4                                                                         |
| 011       | 3/4                                                                         |
| 100       | 1                                                                           |
| 101       | 5/4                                                                         |
| 110       | 6/4                                                                         |
| 111       | 7/4                                                                         |

| Status  | Default Value   |
|---------|-----------------|
| Initial | SEQ5[2:0] = 001 |

## 5.2.13.7. BLK\_SEL

: BLK\_SEL selects the source driving method(Amplifier or Binary mode) in blanking display period.

BLK\_SEL = 0 : Source operates in amplifier mode in normal display mode, Source operates in binary mode in idle display mode.

BLK\_SEL = 1 : Source only operates in binary mode.

| Status  | Default Value |
|---------|---------------|
| Initial | BLK_SEL=0     |

## 5.2.13.8. BLK\_OFF

: BLK\_OFF selects whether blanking display uses or not on display off sequence.

BLK\_OFF = 0 : Blanking display uses on display off sequence.

BLK\_OFF = 1 : Blanking display don't use on display off sequence.

| Status  | Default Value |
|---------|---------------|
| Initial | BLK_OFF=0     |

5.2.13.9. BLK\_FRAME[1:0]

: BLK\_FRAME[1:0] select the period of blanking display(0~ 3frames) on display on/off sequence.

| Status  | Default Value                 |
|---------|-------------------------------|
| Initial | BLK_FRAME[1:0] = 10 (2frames) |

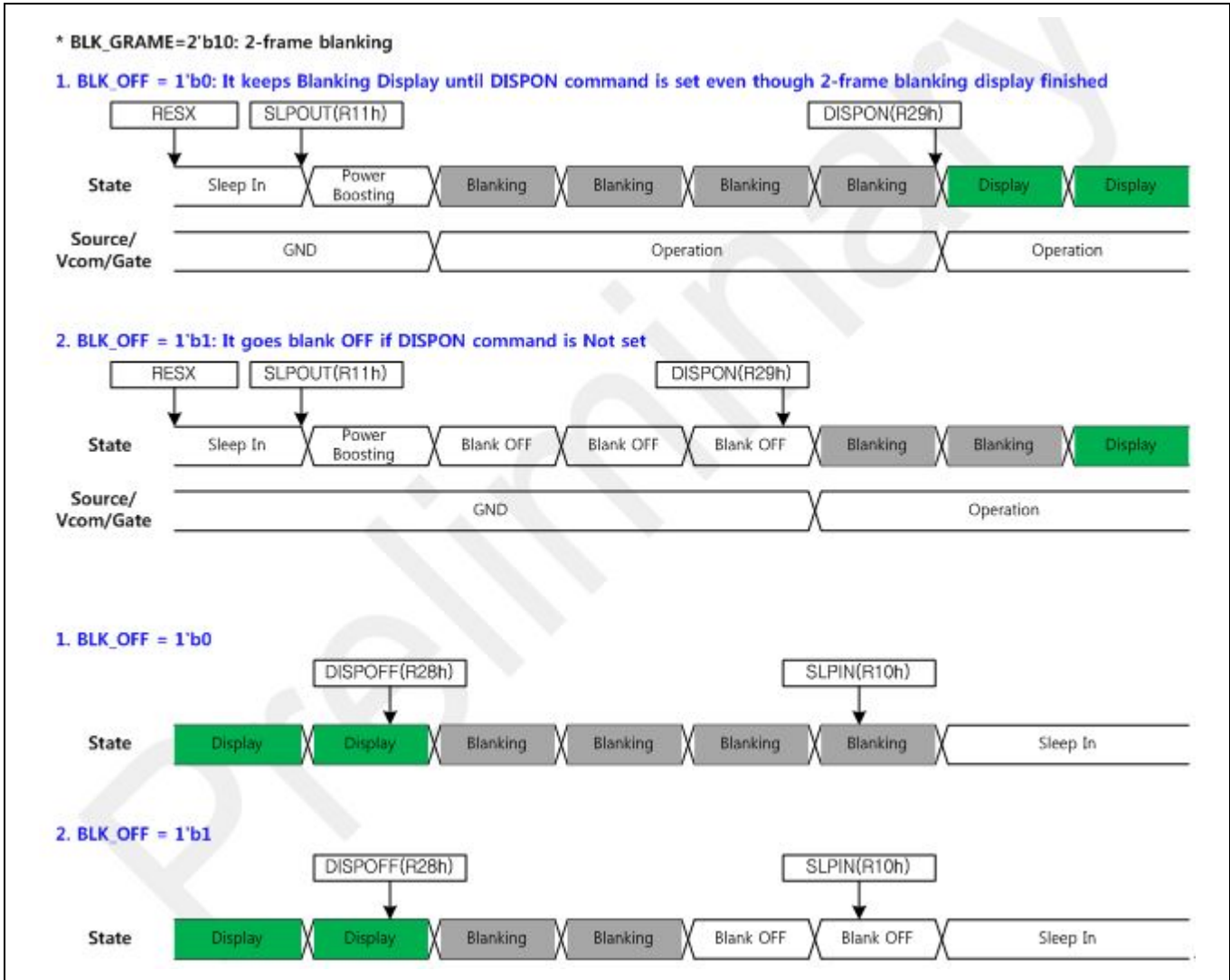


Figure114. BLK\_OFF Timing diagram

## 5.2.13.10. NDC3[1:0] / PIDC3[1:0]

: The operating frequency in the booster circuit 3 is selected. PIDC3 is applied in Idle Partial mode.

Table 99. NDC3[1:0] / PIDC3[1:0]

| NDC31/<br>PIDC31 | NDC30/<br>PIDC30 | Internal Operation<br>(synchronized with internal clock) |
|------------------|------------------|----------------------------------------------------------|
|                  |                  | f(CL1) : f(DCCLK3)                                       |
| 0                | 0                | 1:4                                                      |
| 0                | 1                | 1:2                                                      |
| 1                | 0                | 1:1                                                      |
| 1                | 1                | Setting disabled                                         |

Note. DCCLK3 is pumping clock for booster circuit3

| Status  | Default Value              |
|---------|----------------------------|
| Initial | NDC3[1:0], PIDC3[1:0] = 10 |

## 5.2.13.11. NDC2[1:0] / PIDC2[1:0]

: The operating frequency in the booster circuit 2 is selected. PIDC2 is applied in Idle Partial mode.

Table 100. NDC2[1:0] / PIDC2[1:0]

| NDC21/<br>PIDC21 | DC20/<br>PIDC20 | Internal Operation<br>(synchronized with internal clock) |
|------------------|-----------------|----------------------------------------------------------|
|                  |                 | f(CL1) : f(DCCLK2)                                       |
| 0                | 0               | 1:2                                                      |
| 0                | 1               | 1:1                                                      |
| 1                | 0               | 1:0.5                                                    |
| 1                | 1               | 1:0.25                                                   |

Note. DCCLK2 is pumping clock for booster circuit2

| Status  | Default Value              |
|---------|----------------------------|
| Initial | NDC2[1:0], PIDC2[1:0] = 10 |

## 5.2.13.12. NDC1[1:0] / PIDC1[1:0]

: The operating frequency in the booster circuit1 is selected. When the boosting operating frequency is high, the driving ability of the booster circuit and the display quality become high, but the current consumption is increased. Adjust the frequency considering the display quality and the current consumption. PIDC1 is applied in Idle Partial mode.

Table 101. NDC1[1:0] / PIDC1[1:0]

| NDC11/<br>PIDC11 | NDC10/<br>PIDC10 | Internal Operation<br>(synchronized with internal clock) |
|------------------|------------------|----------------------------------------------------------|
|                  |                  | f(CL1) : f(DCCLK1)                                       |
| 0                | 0                | 1:4                                                      |
| 0                | 1                | 1:2                                                      |
| 1                | 0                | 1:1                                                      |
| 1                | 1                | Setting disabled                                         |

Note. DCCLK1 is pumping clock for booster circuit1. f(1H) is horizontal frequency (1 raster-row)

| Status  | Default Value              |
|---------|----------------------------|
| Initial | NDC1[1:0], PIDC1[1:0] = 10 |

**5.2.13.13. PIBT[2:0] / NBT[2:0]**

: The output factor of booster is switched. Adjust scale factor of the booster circuit by the voltage used. When the boosting operating frequency is high, the driving ability of the booster circuit and the display quality become high, but the current consumption is increased. Adjust the frequency considering the display quality and the current consumption.

PIBT is applied in Idle Partial mode.

**Table 102. PIBT[2:0] / NBT[2:0]**

| PIBT1/<br>NBT2 | PIBT1/<br>NBT1 | IPBP0/<br>NBT0 | VGH      | VGL       | Notes* |         |
|----------------|----------------|----------------|----------|-----------|--------|---------|
| 0              | 0              | 0              | 4 X VCI1 | -3 X VCI1 | 11.00V | -8.25V  |
| 0              | 0              | 1              | 4 X VCI1 | -4 X VCI1 | 11.00V | -11.00V |
| 0              | 1              | 0              | 5 X VCI1 | -3 X VCI1 | 13.75V | -8.25V  |
| 0              | 1              | 1              | 5 X VCI1 | -4 X VCI1 | 13.75V | -11.00V |
| 1              | 0              | 0              | 5 X VCI1 | -5 X VCI1 | 13.75V | -13.75V |
| 1              | 0              | 1              | 6 X VCI1 | -3 X VCI1 | 16.50V | -8.25V  |
| 1              | 1              | 0              | 6 X VCI1 | -4 X VCI1 | 16.50V | -11.00V |
| 1              | 1              | 1              | 6 X VCI1 | -5 X VCI1 | 16.50V | -13.75V |

Note: The values in table above are example of nominal upper-limit by register setting when VCI1=3.0V.

Do not set any higher VGH level than 16.5V.

| Status  | Default Value             |
|---------|---------------------------|
| Initial | PIBT[2:0], NBT[2:0] = 101 |

## 5.2.13.14. NGVD[5:0]

: This register is used to set the amplifying factor of the GVDD voltage on Normal Mode (the voltage for the Gamma voltage). It allows ranging from 2.46V to 5.00V.

Table 103. NGVD[6:0]

| NGVD6-0 | GVDD Voltage | NGVD6-0 | GVDD Voltage | NGVD6-0 | GVDD Voltage | NGVD6-0 | GVDD Voltage |
|---------|--------------|---------|--------------|---------|--------------|---------|--------------|
| 0000000 | 2.46V        | 0100000 | 3.10V        | 1000000 | 3.74V        | 1100000 | 4.38V        |
| 0000001 | 2.48V        | 0100001 | 3.12V        | 1000001 | 3.76V        | 1100001 | 4.40V        |
| 0000010 | 2.50V        | 0100010 | 3.14V        | 1000010 | 3.78V        | 1100010 | 4.42V        |
| 0000011 | 2.52V        | 0100011 | 3.16V        | 1000011 | 3.80V        | 1100011 | 4.44V        |
| 0000100 | 2.54V        | 0100100 | 3.18V        | 1000100 | 3.82V        | 1100100 | 4.46V        |
| 0000101 | 2.56V        | 0100101 | 3.20V        | 1000101 | 3.84V        | 1100101 | 4.48V        |
| 0000110 | 2.58V        | 0100110 | 3.22V        | 1000110 | 3.86V        | 1100110 | 4.50V        |
| 0000111 | 2.60V        | 0100111 | 3.24V        | 1000111 | 3.88V        | 1100111 | 4.52V        |
| 0001000 | 2.62V        | 0101000 | 3.26V        | 1001000 | 3.90V        | 1101000 | 4.54V        |
| 0001001 | 2.64V        | 0101001 | 3.28V        | 1001001 | 3.92V        | 1101001 | 4.56V        |
| 0001010 | 2.66V        | 0101010 | 3.30V        | 1001010 | 3.94V        | 1101010 | 4.58V        |
| 0001011 | 2.68V        | 0101011 | 3.32V        | 1001011 | 3.96V        | 1101011 | 4.60V        |
| 0001100 | 2.70V        | 0101100 | 3.34V        | 1001100 | 3.98V        | 1101100 | 4.62V        |
| 0001101 | 2.72V        | 0101101 | 3.36V        | 1001101 | 4.00V        | 1101101 | 4.64V        |
| 0001110 | 2.74V        | 0101110 | 3.38V        | 1001110 | 4.02V        | 1101110 | 4.66V        |
| 0001111 | 2.76V        | 0101111 | 3.40V        | 1001111 | 4.04V        | 1101111 | 4.68V        |
| 0010000 | 2.78V        | 0110000 | 3.42V        | 1010000 | 4.06V        | 1110000 | 4.70V        |
| 0010001 | 2.78V        | 0110001 | 3.44V        | 1010001 | 4.08V        | 1110001 | 4.72V        |
| 0010010 | 2.80V        | 0110010 | 3.46V        | 1010010 | 4.10V        | 1110010 | 4.74V        |
| 0010011 | 2.82V        | 0110011 | 3.48V        | 1010011 | 4.12V        | 1110011 | 4.76V        |
| 0010100 | 2.84V        | 0110100 | 3.50V        | 1010100 | 4.14V        | 1110100 | 4.78V        |
| 0010101 | 2.86V        | 0110101 | 3.52V        | 1010101 | 4.16V        | 1110101 | 4.80V        |
| 0010110 | 2.88V        | 0110110 | 3.54V        | 1010110 | 4.18V        | 1110110 | 4.82V        |
| 0010111 | 2.90V        | 0110111 | 3.56V        | 1010111 | 4.20V        | 1110111 | 4.84V        |
| 0011000 | 2.92V        | 0111000 | 3.58V        | 1011000 | 4.22V        | 1111000 | 4.86V        |
| 0011001 | 2.94V        | 0111001 | 3.60V        | 1011001 | 4.24V        | 1111001 | 4.88V        |
| 0011010 | 2.96V        | 0111010 | 3.62V        | 1011010 | 4.26V        | 1111010 | 4.90V        |
| 0011011 | 2.98V        | 0111011 | 3.64V        | 1011011 | 4.28V        | 1111011 | 4.92V        |
| 0011100 | 3.02V        | 0111100 | 3.66V        | 1011100 | 4.20V        | 1111100 | 4.94V        |
| 0011101 | 3.04V        | 0111101 | 3.68V        | 1011101 | 4.32V        | 1111101 | 4.96V        |
| 0011110 | 3.06V        | 0111110 | 3.70V        | 1011110 | 4.34V        | 1111110 | 4.98V        |
| 0011111 | 3.08V        | 0111111 | 3.72V        | 1011111 | 4.36V        | 1111111 | 5.00V        |

Note. Don't set any higher GVDD level than AVDD-0.3V

| Status  | Default Value             |
|---------|---------------------------|
| Initial | NGVD[5:0] = 1100110(4.5V) |



## 5.2.14. VCMCTL (F5H)

| F5h                        | VCMCTL (VCOM Control) |     |     |    |         |         |          |             |             |          |          |     |
|----------------------------|-----------------------|-----|-----|----|---------|---------|----------|-------------|-------------|----------|----------|-----|
|                            | DCX                   | RDX | WRX | D7 | D6      | D5      | D4       | D3          | D2          | D1       | D0       | HEX |
| Command                    | 0                     | 1   | ↑   | 1  | 1       | 1       | 1        | 0           | 1           | 0        | 1        | F5  |
| 1 <sup>st</sup> Parameter  | 1                     | 1   | ↑   | -  | -       | -       | -        | -           | -           | -        | VCOMG    | -   |
| 2 <sup>nd</sup> Parameter  | 1                     | 1   | ↑   | -  | VCMH[6] | VCMH[5] | VCMH[4]  | VCMH[3]     | VCMH[2]     | VCMH[1]  | VCMH[0]  | -   |
| 3 <sup>rd</sup> Parameter  | 1                     | 1   | ↑   | -  | VCML[6] | VCML[5] | VCML[4]  | VCML[3]     | VCML[2]     | VCML[1]  | VCML[0]  | -   |
| 4 <sup>th</sup> Parameter  | 1                     | 1   | ↑   | -  | -       | -       | -        | -           | -           | -        | -        | -   |
| 5 <sup>th</sup> Parameter  | 1                     | 1   | ↑   | -  | -       | -       | -        | -           | -           | -        | -        | -   |
| 6 <sup>th</sup> Parameter  | 1                     | 1   | ↑   | -  | -       | -       | VCIR1[4] | VCIR1[3]    | VCIR1[2]    | VCIR1[1] | VCIR1[0] | -   |
| 7 <sup>th</sup> Parameter  | 1                     | 1   | ↑   | -  | -       | -       | -        | -           | -           | -        | -        | -   |
| 8 <sup>th</sup> Parameter  | 1                     | 1   | ↑   | -  | -       | -       | -        | -           | -           | -        | -        | -   |
| 9 <sup>th</sup> Parameter  | 1                     | 1   | ↑   | -  | -       | -       | -        | NVC_BLK[1]  | NVC_BLK[0]  | -        | NVC_ND   | -   |
| 10 <sup>th</sup> Parameter | 1                     | 1   | ↑   | -  | -       | -       | -        | PIVC_BLK[1] | PIVC_BLK[0] | -        | PIVC_ND  | -   |
| 11 <sup>th</sup> Parameter | 1                     | 1   | ↑   | -  | -       | -       | -        | -           | -           | -        | -        | -   |
| 12 <sup>th</sup> Parameter | 1                     | 1   | ↑   | -  | -       | -       | -        | -           | -           | -        | -        | -   |

## 5.2.14.1. VCOMG

When VCOMG = 1, low level of VCOM signal is to be fixed at VSSA. Therefore, the amplitude of VCOM signal is determined as  $|VCOMH - VSSA|$  regardless of VCML setting.

| Status  | Default Value |
|---------|---------------|
| Initial | VCOMG = 0     |

## 5.2.14.2. VCMH[6:0]

Set the VCOMH voltage (a high level voltage at the Vcom alternating drive), It allows ranging from 2.46V to 5.00V.

Table 104. VCOMH setting

| VCMH6-0 | VCOMH Voltage | VCMH6-0 | VCOMH Voltage | VCMH6-0 | VCOMH Voltage | VCMH6-0 | VCOMH Voltage |
|---------|---------------|---------|---------------|---------|---------------|---------|---------------|
| 0000000 | 2.46V         | 0100000 | 3.10V         | 1000000 | 3.74V         | 1100000 | 4.38V         |
| 0000001 | 2.48V         | 0100001 | 3.12V         | 1000001 | 3.76V         | 1100001 | 4.40V         |
| 0000010 | 2.50V         | 0100010 | 3.14V         | 1000010 | 3.78V         | 1100010 | 4.42V         |
| 0000011 | 2.52V         | 0100011 | 3.16V         | 1000011 | 3.80V         | 1100011 | 4.44V         |
| 0000100 | 2.54V         | 0100100 | 3.18V         | 1000100 | 3.82V         | 1100100 | 4.46V         |
| 0000101 | 2.56V         | 0100101 | 3.20V         | 1000101 | 3.84V         | 1100101 | 4.48V         |
| 0000110 | 2.58V         | 0100110 | 3.22V         | 1000110 | 3.86V         | 1100110 | 4.50V         |
| 0000111 | 2.60V         | 0100111 | 3.24V         | 1000111 | 3.88V         | 1100111 | 4.52V         |
| 0001000 | 2.62V         | 0101000 | 3.26V         | 1001000 | 3.90V         | 1101000 | 4.54V         |
| 0001001 | 2.64V         | 0101001 | 3.28V         | 1001001 | 3.92V         | 1101001 | 4.56V         |
| 0001010 | 2.66V         | 0101010 | 3.30V         | 1001010 | 3.94V         | 1101010 | 4.58V         |
| 0001011 | 2.68V         | 0101011 | 3.32V         | 1001011 | 3.96V         | 1101011 | 4.60V         |
| 0001100 | 2.70V         | 0101100 | 3.34V         | 1001100 | 3.98V         | 1101100 | 4.62V         |
| 0001101 | 2.72V         | 0101101 | 3.36V         | 1001101 | 4.00V         | 1101101 | 4.64V         |
| 0001110 | 2.74V         | 0101110 | 3.38V         | 1001110 | 4.02V         | 1101110 | 4.66V         |
| 0001111 | 2.76V         | 0101111 | 3.40V         | 1001111 | 4.04V         | 1101111 | 4.68V         |
| 0010000 | 2.78V         | 0110000 | 3.42V         | 1010000 | 4.06V         | 1110000 | 4.70V         |
| 0010001 | 2.78V         | 0110001 | 3.44V         | 1010001 | 4.08V         | 1110001 | 4.72V         |
| 0010010 | 2.80V         | 0110010 | 3.46V         | 1010010 | 4.10V         | 1110010 | 4.74V         |
| 0010011 | 2.82V         | 0110011 | 3.48V         | 1010011 | 4.12V         | 1110011 | 4.76V         |
| 0010100 | 2.84V         | 0110100 | 3.50V         | 1010100 | 4.14V         | 1110100 | 4.78V         |
| 0010101 | 2.86V         | 0110101 | 3.52V         | 1010101 | 4.16V         | 1110101 | 4.80V         |
| 0010110 | 2.88V         | 0110110 | 3.54V         | 1010110 | 4.18V         | 1110110 | 4.82V         |
| 0010111 | 2.90V         | 0110111 | 3.56V         | 1010111 | 4.20V         | 1110111 | 4.84V         |
| 0011000 | 2.92V         | 0111000 | 3.58V         | 1011000 | 4.22V         | 1111000 | 4.86V         |
| 0011001 | 2.94V         | 0111001 | 3.60V         | 1011001 | 4.24V         | 1111001 | 4.88V         |
| 0011010 | 2.96V         | 0111010 | 3.62V         | 1011010 | 4.26V         | 1111010 | 4.90V         |
| 0011011 | 2.98V         | 0111011 | 3.64V         | 1011011 | 4.28V         | 1111011 | 4.92V         |
| 0011100 | 3.02V         | 0111100 | 3.66V         | 1011100 | 4.20V         | 1111100 | 4.94V         |
| 0011101 | 3.04V         | 0111101 | 3.68V         | 1011101 | 4.32V         | 1111101 | 4.96V         |
| 0011110 | 3.06V         | 0111110 | 3.70V         | 1011110 | 4.34V         | 1111110 | 4.98V         |
| 0011111 | 3.08V         | 0111111 | 3.72V         | 1011111 | 4.36V         | 1111111 | 5.00V         |

Note. Don't set any higher VCOM high level than AVDD-0.3V. VCOMH voltage should be higher than VCI.

| Status  | Default Value              |
|---------|----------------------------|
| Initial | VCMH[6:0] = 1001101 (4.0V) |

## 5.2.14.3. VCML[6:0]

Set the VCOML voltage (a low level voltage at the Vcom alternating drive), It allows ranging from -2.54V to 0V.

Table 105.VCOML setting

| VCML6-0 | VCOML Voltage | VCML6-0 | VCOML Voltage | VCML6-0 | VCOML Voltage | VCML6-0 | VCOML Voltage |
|---------|---------------|---------|---------------|---------|---------------|---------|---------------|
| 0000000 | -2.54V        | 0100000 | -1.90V        | 1000000 | -1.26V        | 1100000 | -0.62V        |
| 0000001 | -2.52V        | 0100001 | -1.88V        | 1000001 | -1.24V        | 1100001 | -0.60V        |
| 0000010 | -2.50V        | 0100010 | -1.86V        | 1000010 | -1.22V        | 1100010 | -0.58V        |
| 0000011 | -2.48V        | 0100011 | -1.84V        | 1000011 | -1.10V        | 1100011 | -0.56V        |
| 0000100 | -2.46V        | 0100100 | -1.82V        | 1000100 | -1.18V        | 1100100 | -0.54V        |
| 0000101 | -2.44V        | 0100101 | -1.80V        | 1000101 | -1.16V        | 1100101 | -0.52V        |
| 0000110 | -2.42V        | 0100110 | -1.78V        | 1000110 | -1.14V        | 1100110 | -0.50V        |
| 0000111 | -2.40V        | 0100111 | -1.76V        | 1000111 | -1.12V        | 1100111 | -0.48V        |
| 0001000 | -2.38V        | 0101000 | -1.74V        | 1001000 | -1.10V        | 1101000 | -0.46V        |
| 0001001 | -2.36V        | 0101001 | -1.72V        | 1001001 | -1.08V        | 1101001 | -0.44V        |
| 0001010 | -2.34V        | 0101010 | -1.70V        | 1001010 | -1.06V        | 1101010 | -0.42V        |
| 0001011 | -2.32V        | 0101011 | -1.68V        | 1001011 | -1.04V        | 1101011 | -0.40V        |
| 0001100 | -2.30V        | 0101100 | -1.66V        | 1001100 | -1.02V        | 1101100 | -0.38V        |
| 0001101 | -2.28V        | 0101101 | -1.64V        | 1001101 | -1.00V        | 1101101 | -0.36V        |
| 0001110 | -2.26V        | 0101110 | -1.62V        | 1001110 | -0.98V        | 1101110 | -0.34V        |
| 0001111 | -2.24V        | 0101111 | -1.60V        | 1001111 | -0.96V        | 1101111 | -0.32V        |
| 0010000 | -2.22V        | 0110000 | -1.58V        | 1010000 | -0.94V        | 1110000 | -0.30V        |
| 0010001 | -2.20V        | 0110001 | -1.56V        | 1010001 | -0.92V        | 1110001 | -0.28V        |
| 0010010 | -2.18V        | 0110010 | -1.54V        | 1010010 | -0.90V        | 1110010 | -0.26V        |
| 0010011 | -2.16V        | 0110011 | -1.52V        | 1010011 | -0.88V        | 1110011 | -0.24V        |
| 0010100 | -2.14V        | 0110100 | -1.50V        | 1010100 | -0.86V        | 1110100 | -0.22V        |
| 0010101 | -2.12V        | 0110101 | -1.48V        | 1010101 | -0.84V        | 1110101 | -0.20V        |
| 0010110 | -2.10V        | 0110110 | -1.46V        | 1010110 | -0.82V        | 1110110 | -0.18V        |
| 0010111 | -2.08V        | 0110111 | -1.44V        | 1010111 | -0.80V        | 1110111 | -0.16V        |
| 0011000 | -2.06V        | 0111000 | -1.42V        | 1011000 | -0.78V        | 1111000 | -0.14V        |
| 0011001 | -2.04V        | 0111001 | -1.40V        | 1011001 | -0.76V        | 1111001 | -0.12V        |
| 0011010 | -2.02V        | 0111010 | -1.38V        | 1011010 | -0.74V        | 1111010 | -0.10V        |
| 0011011 | -2.00V        | 0111011 | -1.36V        | 1011011 | -0.72V        | 1111011 | -0.08V        |
| 0011100 | -1.98V        | 0111100 | -1.34V        | 1011100 | -0.70V        | 1111100 | -0.06V        |
| 0011101 | -1.96V        | 0111101 | -1.32V        | 1011101 | -0.68V        | 1111101 | -0.04V        |
| 0011110 | -1.94V        | 0111110 | -1.30V        | 1011110 | -0.66V        | 1111110 | -0.02V        |
| 0011111 | -1.92V        | 0111111 | -1.28V        | 1011111 | -0.64V        | 1111111 | -0.00V        |

Note. Available setting range of VCOM low level is from VCL+0.5V to 0V.

| Status  | Default Value               |
|---------|-----------------------------|
| Initial | VCML[6:0] = 1100110 (-0.5V) |

## 5.2.14.4. VCIR1[4:0]

VCI recycling clock cycle of VCOM driver is sustained for the number of clock cycles that is set in VCIR1[4:0].

Note. When VCI Recycling is used, VCOMH level must be larger than VCI level.

Table 106.VCIR1 setting

| VCIR14-0 | Recycling Period<br>(number of display clock) | VCIR14-0 | Recycling Period<br>(number of display clock) |
|----------|-----------------------------------------------|----------|-----------------------------------------------|
| 00000    | 0                                             | 10000    | 64                                            |
| 00001    | 4                                             | 10001    | 68                                            |
| 00010    | 8                                             | 10010    | 72                                            |
| 00011    | 12                                            | 10011    | 76                                            |
| 00100    | 16                                            | 10100    | 80                                            |
| 00101    | 20                                            | 10101    | 84                                            |
| 00110    | 24                                            | 10110    | 88                                            |
| 00111    | 28                                            | 10111    | 92                                            |
| 01000    | 32                                            | 11000    | 96                                            |
| 01001    | 36                                            | 11001    | 100                                           |
| 01010    | 40                                            | 11010    | 104                                           |
| 01011    | 44                                            | 11011    | 108                                           |
| 01100    | 48                                            | 11100    | 112                                           |
| 01101    | 52                                            | 11101    | 116                                           |
| 01110    | 56                                            | 11110    | 120                                           |
| 01111    | 60                                            | 11111    | 124                                           |

| Status  | Default Value           |
|---------|-------------------------|
| Initial | VCIR1[4:0] = 10010 (72) |

## 5.2.14.5. NVC\_BLK/PIVC\_BLK

: This register controls VCOM state in porch period.

Table 107.NVC\_BLK/PIVC\_BLK

| VC_BLK | Operation                                     |
|--------|-----------------------------------------------|
| 00     | VCOM is GND in porch period.                  |
| 01     | VCOM is GND in porch period.                  |
| 10     | VCOM holds end line polarity in porch period. |
| 11     | VCOM is continuously toggled in porch period. |

| Status  | Default Value                       |
|---------|-------------------------------------|
| Initial | PIVC_BLK[1:0]=00, NVC_BLK[1:0] = 11 |

## 5.2.14.6. NVC\_ND/PIVC\_ND

: This register controls VCOM state in nod-display period.

Table 108.NVC\_ND/PIVC\_ND

| VC_ND | Operation                                  |
|-------|--------------------------------------------|
| 0     | VCOM is the opposite polarity with Source. |
| 1     | VCOM is the same polarity with Source.     |

| Status  | Default Value          |
|---------|------------------------|
| Initial | PIVC_ND =1, NVC_ND = 1 |

## 5.2.15. SRCCTL (F6H)

| F6h                       | SRCCTL (Source Control) |     |     |           |    |    |    |             |             |             |             |     |
|---------------------------|-------------------------|-----|-----|-----------|----|----|----|-------------|-------------|-------------|-------------|-----|
|                           | DCX                     | RDX | WRX | D7        | D6 | D5 | D4 | D3          | D2          | D1          | D0          | HEX |
| Command                   | 0                       | 1   | ↑   | 1         | 1  | 1  | 1  | 0           | 1           | 1           | 0           | F6  |
| 1 <sup>st</sup> Parameter | 1                       | 1   | ↑   | SVCIR_SEL | -  | -  | -  | -           | SVCIR[2]    | SVCIR[1]    | SVCIR[0]    | -   |
| 2 <sup>nd</sup> Parameter | 1                       | 1   | ↑   | -         | -  | -  | -  | -           | -           | -           | SG          | -   |
| 3 <sup>rd</sup> Parameter | 1                       | 1   | ↑   | -         | -  | -  | -  | -           | SAP[2]      | SAP[1]      | SAP[0]      | -   |
| 4 <sup>th</sup> Parameter | 1                       | 1   | ↑   | -         | -  | -  | -  | -           | -           | -           | -           | -   |
| 5 <sup>th</sup> Parameter | 1                       | 1   | ↑   | -         | -  | -  | -  | NSDT[3]     | NSDT[2]     | NSDT[1]     | NSDT[0]     | -   |
| 6 <sup>th</sup> Parameter | 1                       | 1   | ↑   | -         | -  | -  | -  | NSR_BLK[1]  | NSR_BLK[0]  | -           | NSR_ND      | -   |
| 7 <sup>th</sup> Parameter | 1                       | 1   | ↑   | -         | -  | -  | -  | PISDT[3]    | PISDT[2]    | PISDT[1]    | PISDT[0]    | -   |
| 8 <sup>th</sup> Parameter | 1                       | 1   | ↑   | -         | -  | -  | -  | PISR_BLK[1] | PISR_BLK[0] | -           | PISR_ND     | -   |
| 9 <sup>th</sup> Parameter | 1                       | 1   | ↑   | -         | -  | -  | -  | -           | HBLK_SRC[2] | HBLK_SRC[1] | HBLK_SRC[0] | -   |

## 5.2.15.1. SVCIR\_SEL

: This controls the period of source Output Enable.

| SVCIR_SEL | Source Output Enable                                                                 |
|-----------|--------------------------------------------------------------------------------------|
| 0         | When SVCIR=000,, Source Output Enable Fix High.                                      |
| 1         | When SVCIR=000, Source Output Enable<br>Output Enable On (After HBLK_SRC+15*DIV_SRC) |

| Status  | Default Value |
|---------|---------------|
| Initial | SVCIR_SEL=0   |

## 5.2.15.2. SVCIR[2 :0]

: This controls the period of source VCI recycling

**Table 109.SVCIR[2:0]**

| SVCIR | Source VCI Recycling Period            |
|-------|----------------------------------------|
| 000   | Select SVCIR_SEL                       |
| 001   | VCI Recycling On (HBLK_SRC+15*DIV_SRC) |
| 010   | VCI Recycling On (HBLK_SRC+16*DIV_SRC) |
| 011   | VCI Recycling On (HBLK_SRC+17*DIV_SRC) |
| 100   | VCI Recycling On (HBLK_SRC+18*DIV_SRC) |
| 101   | VCI Recycling On (HBLK_SRC+19*DIV_SRC) |
| 110   | VCI Recycling On (HBLK_SRC+20*DIV_SRC) |
| 111   | VCI Recycling On (HBLK_SRC+21*DIV_SRC) |

| Status  | Default Value    |
|---------|------------------|
| Initial | SVCIR[2:0] = 001 |

## 5.2.15.3. HBLK\_SRC [2:0]

: This controls the high pulse width of internal track0 signal.

**Table 110.HB LK\_SRC[2:0]**

| HBLK_SRC[2:0] | Track0 Width Period(number of display clock) |
|---------------|----------------------------------------------|
| 000 ~ 010     | Set disable                                  |
| 011           | 3 * DIV_SRC                                  |
| 100           | 4 * DIV_SRC                                  |
| 101           | 5 * DIV_SRC                                  |
| 110           | 6 * DIV_SRC                                  |
| 111           | 7 * DIV_SRC                                  |

| Status  | Default Value        |
|---------|----------------------|
| Initial | HBLK_SRC [2:0] = 011 |

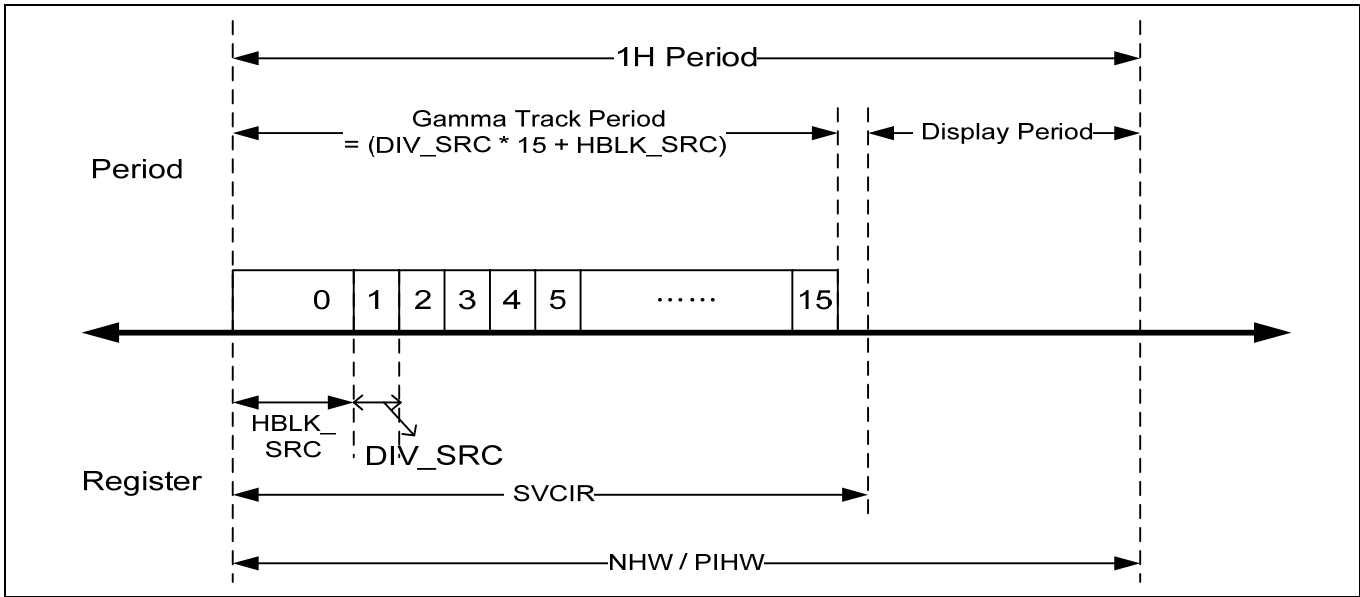


Figure115. 1H Period Timing control



## 5.2.15.4. NSR\_BLK/PISR\_BLK

: This register controls source state in porch period.

Table 111.NSR\_BLK/PISR\_BLK

| SR_BLK | Operation                                         |
|--------|---------------------------------------------------|
| 00     | Source is hi-z in porch period.                   |
| 01     | Source is GND in porch period.                    |
| 10     | Source is binary driving mode in porch period.    |
| 11     | Source is amplifier driving mode in porch period. |

| Status  | Default Value                       |
|---------|-------------------------------------|
| Initial | PISR_BLK[1:0]=10, NSR_BLK[1:0] = 11 |

## 5.2.15.5. NSR\_ND/PISR\_ND

: This register controls source state in nod-display period.

Table 112.NSR\_ND/PISR\_ND

| SR_ND | Operation                                               |
|-------|---------------------------------------------------------|
| 0     | Source is binary driving mode in non-display period.    |
| 1     | Source is amplifier driving mode in non-display period. |

| Status  | Default Value          |
|---------|------------------------|
| Initial | PISR_ND =0, NSR_ND = 0 |

## 5.2.15.6. SG

: This controls the gamma symmetric axis.

SG = 0 : The adjustment register is to adjust X-axis symmetric of the grayscale voltage.

SG = 1 : The adjustment register is to adjust Y-axis symmetric of the grayscale voltage.

| Status  | Default Value |
|---------|---------------|
| Initial | SG = 1        |

## 5.2.15.7. SAP[2:0]

: Adjust the slew-rate of the operational amplifier for the source driver. If higher SAP2-0 is set, LCD panel having higher resolution or higher frame frequency can be driven because the slew-rate of the operational amplifier is increased. But these bits must be set as adequate value because the amount of fixed current of the operational amplifier is also adjusted. During non-display, when SAP2-0 = "000," operational amplifiers are turned off, so current consumption can be reduced.

**Table 113.SAP[2:0]**

| SAP2 | SAP1 | SAP0 | Source Amp. Current Level | Slew rate of Operational amplifier |
|------|------|------|---------------------------|------------------------------------|
| 0    | 0    | 0    | Amp. Stop                 |                                    |
| 0    | 0    | 1    | Setting Disable           |                                    |
| 0    | 1    | 0    | Setting Disable           |                                    |
| 0    | 1    | 1    | Slow                      |                                    |
| 1    | 0    | 0    | Medium Slow 1             |                                    |
| 1    | 0    | 1    | Medium Slow 2             |                                    |
| 1    | 1    | 0    | Medium Slow 3             |                                    |
| 1    | 1    | 1    | Medium Slow 4             |                                    |

| Status  | Default Value |
|---------|---------------|
| Initial | SAP[2:0]= 011 |

## 5.2.15.8. PISDT[3:0] / NSDT[3:0]

: This register is used to set delay amount from gate falling(end) to source output. PISDT is applied in Idle Partial mode.

Table 114. PISDT[3:0] / NSDT[3:0]

| NSDT3/<br>PISDT3 | NSDT2/<br>PISDT2 | NSDT1/<br>PISDT1 | NSDT0/<br>PISDT0 | Delay amount of the source output                              |                                                 |                 |
|------------------|------------------|------------------|------------------|----------------------------------------------------------------|-------------------------------------------------|-----------------|
|                  |                  |                  |                  | Internal Operation<br>(synchronized<br>with<br>internal clock) | RGB I/F Operation<br>(synchronized with DOTCLK) |                 |
|                  |                  |                  |                  |                                                                | 18-bit RGB                                      | 6-bit RGB       |
| 0                | 0                | 0                | 0                | Setting Disable                                                | Setting Disable                                 | Setting Disable |
| 0                | 0                | 0                | 1                | 1 INCLK                                                        | 2 DOTCLK                                        | 2 * 3 DOTCLK    |
| 0                | 0                | 1                | 0                | 2 INCLK                                                        | 4 DOTCLK                                        | 4 * 3 DOTCLK    |
| 0                | 0                | 1                | 1                | 3 INCLK                                                        | 6 DOTCLK                                        | 6 * 3 DOTCLK    |
| 0                | 1                | 0                | 0                | 4 INCLK                                                        | 8 DOTCLK                                        | 8 * 3 DOTCLK    |
| 0                | 1                | 0                | 1                | 5 INCLK                                                        | 10 DOTCLK                                       | 10 * 3 DOTCLK   |
| 0                | 1                | 1                | 0                | 6 INCLK                                                        | 12 DOTCLK                                       | 12 * 3 DOTCLK   |
| 0                | 1                | 1                | 1                | 7 INCLK                                                        | 14 DOTCLK                                       | 14 * 3 DOTCLK   |
| 1                | 0                | 0                | 0                | 8 INCLK                                                        | 16 DOTCLK                                       | 16 * 3 DOTCLK   |
| 1                | 0                | 0                | 1                | 9 INCLK                                                        | 18 DOTCLK                                       | 18 * 3 DOTCLK   |
| 1                | 0                | 1                | 0                | 10 INCLK                                                       | 20 DOTCLK                                       | 20 * 3 DOTCLK   |
| 1                | 0                | 1                | 1                | 11 INCLK                                                       | 22 DOTCLK                                       | 22 * 3 DOTCLK   |
| 1                | 1                | 0                | 0                | 12 INCLK                                                       | 24 DOTCLK                                       | 24 * 3 DOTCLK   |
| 1                | 1                | 0                | 1                | 13 INCLK                                                       | 26 DOTCLK                                       | 26 * 3 DOTCLK   |
| 1                | 1                | 1                | 0                | 14 INCLK                                                       | 28 DOTCLK                                       | 28 * 3 DOTCLK   |
| 1                | 1                | 1                | 1                | 15 INCLK                                                       | 30 DOTCLK                                       | 30 * 3 DOTCLK   |

| Status  | Default Value                |
|---------|------------------------------|
| Initial | PISDT[3:0], NSDT[3:0] = 0010 |

\*note : INCLK is about 3Mhz.

When 18-bit RGB I/F, DOTCLK is about 5~6Mhz.

When 6-bit RGB I/F, DOTCLK is about 15~18Mhz .

## 5.2.16. IFCTL (F7H)

| F7h                       | IFCTL (Interface Control) |     |     |              |        |        |         |         |    |       |       |     |
|---------------------------|---------------------------|-----|-----|--------------|--------|--------|---------|---------|----|-------|-------|-----|
|                           | DCX                       | RDX | WRX | D7           | D6     | D5     | D4      | D3      | D2 | D1    | D0    | HEX |
| Command                   | 0                         | 1   | ↑   | 1            | 1      | 1      | 1       | 0       | 1  | 1     | 1     | F7  |
| 1 <sup>st</sup> Parameter | 1                         | 1   | ↑   | MY_EOR       | MX_EOR | MV_EOR | -       | BGR_EOR | -  | GS    | SS    | -   |
| 2 <sup>nd</sup> Parameter | 1                         | 1   | ↑   | -            | IPM[1] | IPM[0] | MDT[1]  | MDT[0]  | -  | DM[1] | DM[0] | -   |
| 3 <sup>rd</sup> Parameter | 1                         | 1   | ↑   | VPL          | HPL    | DPL    | EPL     | ENDIAN  | -  | -     | RIM   | -   |
| 4 <sup>th</sup> Parameter | 1                         | 1   | ↑   | RAM_AC<br>CS | -      | -      | SPR_SEL | -       | -  | -     | -     | -   |

## 5.2.16.1. MY\_EOR / MX\_EOR / MV\_EOR / BGR\_EOR

: Each of these register will be used inside the IC. The set value of MADCTL is used in the IC is derived as exclusive OR between 1<sup>st</sup> Parameter of IFCTL and MADCTL Parameter.

| Status  | Default Value                       |
|---------|-------------------------------------|
| Initial | MY_EOR, MX_EOR, MV_EOR, BGR_EOR = 0 |

## 5.2.16.2. GS

: Set the order of Gate Clock generation. When GS = 0, the order of GATE\_ON is from G1 to G320, and then GS = 1, from G320 to G1.

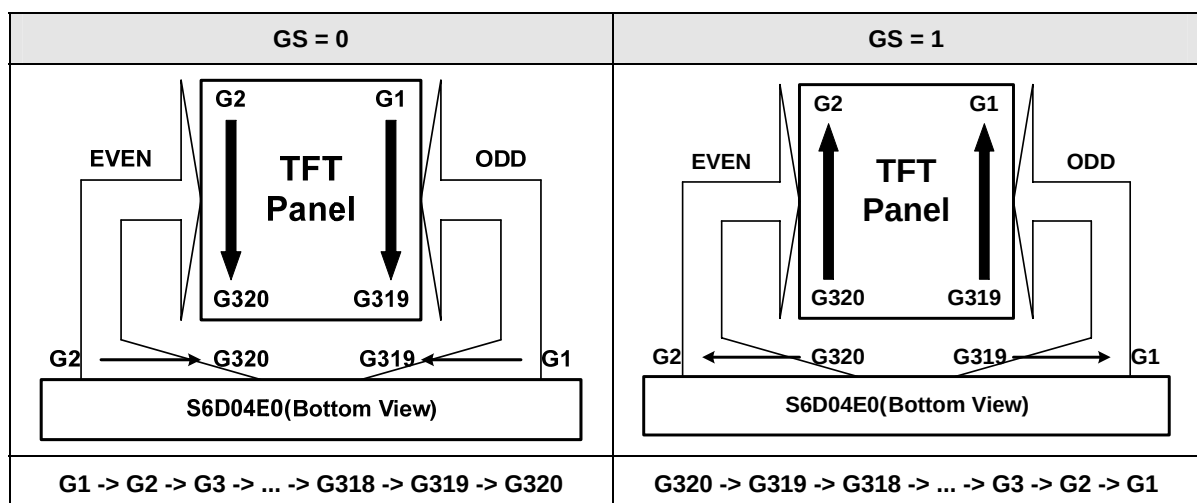


Figure116. Gate Clock order selection

| Status  | Default Value |
|---------|---------------|
| Initial | GS = 0        |

## 5.2.16.3. SS

: Set the order of Shift Register. When SS = 0, the order of Shift Register is from S1 to S720, and then SS = 1, from S720 to S1.

This command is available when MIE\_ON or RAM\_ACCS=0 in RGB mode .

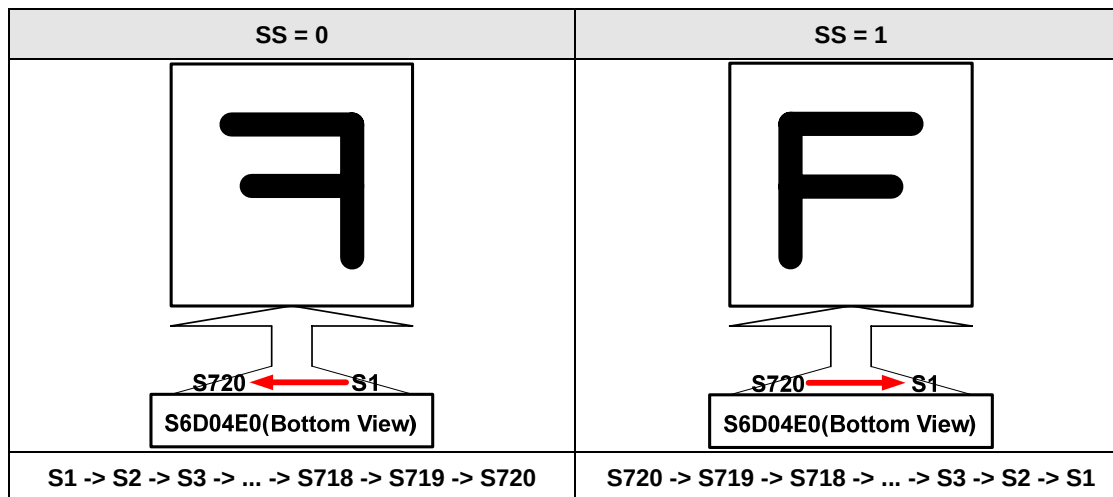


Figure117. Shift Register order selection

| Status  | Default Value |
|---------|---------------|
| Initial | SS = 0        |

## 5.2.16.4. IPM[2:0]

Controls what value the lowest 1 bits (565→666) are set to in the 65k color mode.

Table 115. IPM[1:0]

| IPM1 | IPM0 | Value of the Lowest 1 Bits in the 65k Color MODE |
|------|------|--------------------------------------------------|
| 0    | 0    | Normal 65k color mode operation                  |
| 0    | 1    | Copy the highest 1-bit                           |
| 1    | 0    | 0                                                |
| 1    | 1    | 1                                                |

| Status  | Default Value |
|---------|---------------|
| Initial | IPM[1:0] = 00 |

## 5.2.16.5. MDT[1:0]

: refer to the 3.3 Display Data Format section.

| Status  | Default Value |
|---------|---------------|
| Initial | MDT[1:0] = 00 |

## 5.2.16.6. DM[1:0]

: Specify the display operation mode. The interface can be set based on the bits of DM. This setting enables switching interface between internal operation and the external display interface.

Table 116.DM[1:0]

| DM1 | DM0 | Display Operation Mode |
|-----|-----|------------------------|
| 0   | 0   | CPU interface mode     |
| 0   | 1   | RGB interface mode     |
| 1   | 0   | VSYNC interface mode   |
| 1   | 1   | Setting disabled       |

| Status  | Default Value |
|---------|---------------|
| Initial | DM = 00       |

## 5.2.16.7. ENDIAN

: Select Little Endian Interface bit. At Little Endian mode, the host sends LSB data first.

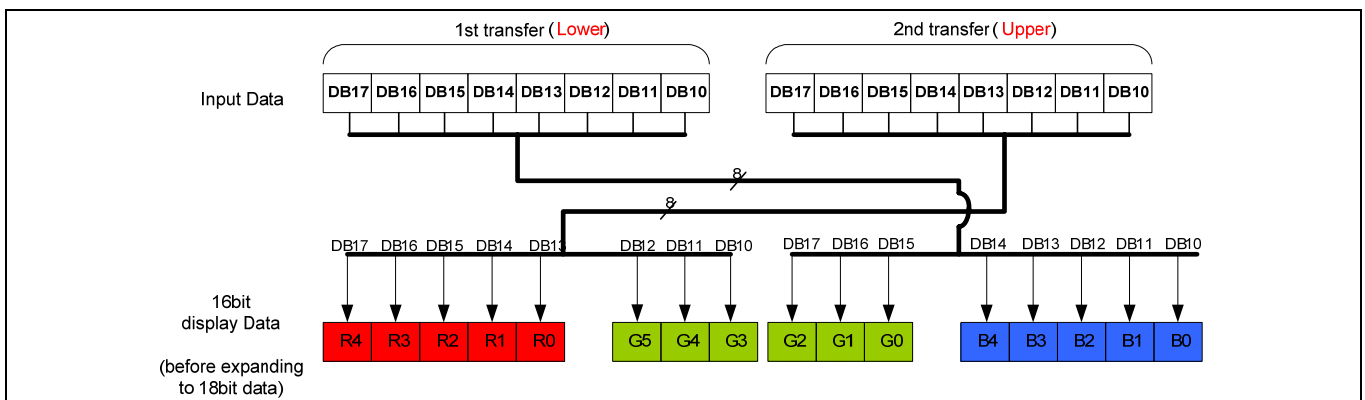


Figure118. Little endian (65K 8bit I/F type II)

Table 117.ENDIAN

| ENDIAN | Data transfer mode        |
|--------|---------------------------|
| 0      | Normal (MSB first)        |
| 1      | Little Endian (LSB first) |

Note. Little Endian is valid on only 65K 8bit, 9bit I/F mode.

| Status  | Default Value |
|---------|---------------|
| Initial | ENDIAN = 0    |

## 5.2.16.8. VPL

: Reverse the polarity of the VSYNC signal.

**Table 118.VPL**

| VPL | Operation            |
|-----|----------------------|
| 0   | VSYNC is low active  |
| 1   | VSYNC is high active |

| Status  | Default Value |
|---------|---------------|
| Initial | VPL = 0       |

## 5.2.16.9. HPL

: Reverse the polarity of the HSYNC signal.

**Table 119.HPL**

| HPL | Operation            |
|-----|----------------------|
| 0   | HSYNC is low active  |
| 1   | HSYNC is high active |

| Status  | Default Value |
|---------|---------------|
| Initial | HPL = 0       |

## 5.2.16.10. DPL

: Reverse the polarity of the DOTCLK signal.

**Table 120.DPL**

| DPL | Operation                                        |
|-----|--------------------------------------------------|
| 0   | Display data is fetched at DOTCLK's rising edge  |
| 1   | Display data is fetched at DOTCLK's falling edge |

| Status  | Default Value |
|---------|---------------|
| Initial | DPL = 0       |

## 5.2.16.11. EPL

: Set the polarity of ENABLE pad while using RGB interface.

**Table 121. Relationship between EPL, ENABLE and RAM Access**

| EPL | ENABLE | RAM write | RAM address |
|-----|--------|-----------|-------------|
| 0   | 0      | Valid     | Updated     |
| 0   | 1      | Invalid   | Held        |
| 1   | 0      | Invalid   | Held        |
| 1   | 1      | Valid     | Update      |

| Status  | Default Value |
|---------|---------------|
| Initial | EPL = 1       |

## 5.2.16.12. RIM

: Specify the RGB interface mode when the RGB interface is used. Specifically, this setting specifies the mode when the bit of DM is set to RGB interface. These bits should be set before display operation through the RGB interface and should not be set during operation.

**Table 122. RIM**

| RIM | RGB Interface Mode                          |
|-----|---------------------------------------------|
| 0   | 18-bit RGB interface (one transfer/pixel)   |
| 1   | 6-bit RGB interface (three transfer /pixel) |

| Status  | Default Value |
|---------|---------------|
| Initial | RIM = 0       |

You should notice that some display functions, which will be described later, cannot be used according to the display mode shown below.

**Table 123. Display functions and display modes**

| Function        | RGB interface  | Internal Clock Operation Mode |
|-----------------|----------------|-------------------------------|
| Partial Display | Cannot be used | Can be used                   |
| Scroll Function | Cannot be used | Can be used                   |
| Rotation        | Cannot be used | Can be used                   |
| Mirroring       | Cannot be used | Can be used                   |
| Window Function | Cannot be used | Can be used                   |

Depending on the external display interface setting, various interfaces can be specified to match the display state. While displaying motion pictures (RGB interface), the data for display can be written in high-speed write mode, which achieves both low power consumption and high-speed access.



## 5.2.16.13. RAM\_ACCS

: Select display data path whether Memory or Shift register when RGB Interface .

Table 124.RAM\_ACCS

| RAM_ACCS | Display Data Path |
|----------|-------------------|
| 0        | Shift Register    |
| 1        | Memory            |

| Status  | Default Value |
|---------|---------------|
| Initial | RAM_ACCS = 0  |

## 5.2.16.14. SPR\_SEL

: Select the usage of Short Pulse Rejection (SPR) circuit to Logic input signals.

Table 125.SPR\_SEL

| SPR_SEL | Description              |
|---------|--------------------------|
| 0       | Apply SPR circuit        |
| 1       | Do not apply SPR circuit |

| Status  | Default Value |
|---------|---------------|
| Initial | SPR_SEL = 0   |

## 5.2.17. PANELCTL (F8H)

| F8h                       | PANELCTL (Panel Control) |     |     |         |         |         |         |        |        |        |        |     |
|---------------------------|--------------------------|-----|-----|---------|---------|---------|---------|--------|--------|--------|--------|-----|
|                           | DCX                      | RDX | WRX | D7      | D6      | D5      | D4      | D3     | D2     | D1     | D0     | HEX |
| Command                   | 0                        | 1   | ↑   | 1       | 1       | 1       | 1       | 1      | 0      | 0      | 0      | F8  |
| 1 <sup>st</sup> Parameter | 1                        | 1   | ↑   | PINO[3] | PINO[2] | PINO[1] | PINO[0] | NNO[3] | NNO[2] | NNO[1] | NNO[0] | -   |
| 2 <sup>nd</sup> Parameter | 1                        | 1   | ↑   | -       | -       | SCN[5]  | SCN[4]  | SCN[3] | SCN[2] | SCN[1] | SCN[0] | -   |
| 3 <sup>rd</sup> Parameter | 1                        | 1   | ↑   | -       | -       | -       | -       | -      | -      | -      | -      | -   |

## 5.2.17.1. PINO[3:0] / NNO[3:0]

: Set amount of non-overlap for the gate output. PINO is applied in Idle Partial mode.

Table 126. PINO[3:0] / NNO[3:0]

| PINO3<br>/ NNO3 | PINO2<br>/ NNO2 | PINO1<br>/ NNO1 | PINO0<br>/ NNO0 | Amount of non-overlap                                       |                                                 |                 |
|-----------------|-----------------|-----------------|-----------------|-------------------------------------------------------------|-------------------------------------------------|-----------------|
|                 |                 |                 |                 | Internal Operation<br>(synchronized with<br>internal clock) | RGB I/F Operation<br>(synchronized with DOTCLK) |                 |
|                 |                 |                 |                 |                                                             | 18-bit RGB                                      | 6-bit RGB       |
| 0               | 0               | 0               | 0               | Setting disable                                             | Setting disable                                 | Setting disable |
| 0               | 0               | 0               | 1               | 3 INCLK                                                     | 6 DOTCLK                                        | 6 *3 DOTCLK     |
| 0               | 0               | 1               | 0               | 6 INCLK                                                     | 12 DOTCLK                                       | 12 *3 DOTCLK    |
| 0               | 0               | 1               | 1               | 9 INCLK                                                     | 18 DOTCLK                                       | 18 *3 DOTCLK    |
| 0               | 1               | 0               | 0               | 12 INCLK                                                    | 24 DOTCLK                                       | 24 *3 DOTCLK    |
| 0               | 1               | 0               | 1               | 15 INCLK                                                    | 30 DOTCLK                                       | 30 *3 DOTCLK    |
| 0               | 1               | 1               | 0               | 18 INCLK                                                    | 36 DOTCLK                                       | 36 *3 DOTCLK    |
| 0               | 1               | 1               | 1               | 21 INCLK                                                    | 42 DOTCLK                                       | 42 *3 DOTCLK    |
| 1               | 0               | 0               | 0               | 24 INCLK                                                    | 48 DOTCLK                                       | 48 *3 DOTCLK    |
| 1               | 0               | 0               | 1               | 27 INCLK                                                    | 54 DOTCLK                                       | 54 *3 DOTCLK    |
| 1               | 0               | 1               | 0               | 30 INCLK                                                    | 60 DOTCLK                                       | 60 *3 DOTCLK    |
| 1               | 0               | 1               | 1               | 33 INCLK                                                    | 66 DOTCLK                                       | 66 *3 DOTCLK    |
| 1               | 1               | 0               | 0               | 36 INCLK                                                    | 72 DOTCLK                                       | 72 *3 DOTCLK    |
| 1               | 1               | 0               | 1               | 39 INCLK                                                    | 78 DOTCLK                                       | 78 *3 DOTCLK    |
| 1               | 1               | 1               | 0               | 42 INCLK                                                    | 84 DOTCLK                                       | 84 *3 DOTCLK    |
| 1               | 1               | 1               | 1               | 45 INCLK                                                    | 90 DOTCLK                                       | 90 *3 DOTCLK    |

Note: The amount of non-overlap time is defined from starting time of 1H.

| Status  | Default Value              |
|---------|----------------------------|
| Initial | IPON[3:0], NNO[3:0] = 0011 |

5.2.17.2. SCN[5:0]

: Set the gate output start position.

Table 127. SCN[5:0]

| SCN[5:0]      | Gate Start position |                  |
|---------------|---------------------|------------------|
|               | GS = 0              | GS = 1           |
| 000000        | G1                  | G320             |
| 000001        | G9                  | G312             |
| 000010        | G17                 | G304             |
| ....          | ....                | ....             |
| 100110        | G305                | G16              |
| 100111        | G313                | G8               |
| 101000~111111 | Setting disabled    | Setting disabled |

| Status  | Default Value     |
|---------|-------------------|
| Initial | SCN[5:0] = 000000 |

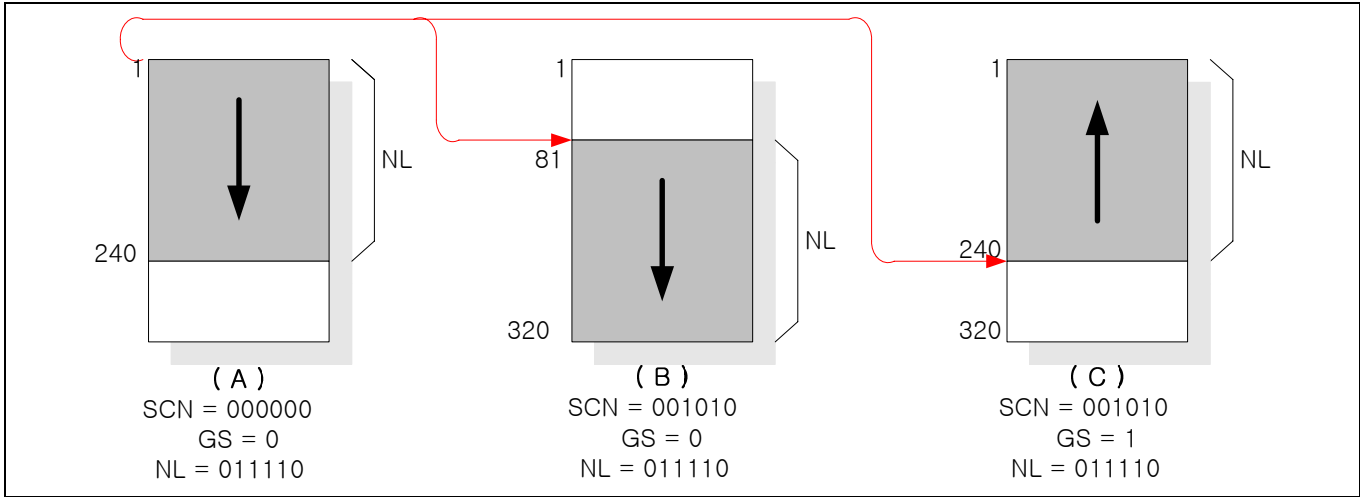


Figure119. SCN

**5.2.18. GAMMASEL (F9H)**

| F9h       | GAMMASEL(Gamma Selection) |     |     |    |    |    |     |    |    |    |    |     |
|-----------|---------------------------|-----|-----|----|----|----|-----|----|----|----|----|-----|
|           | DCX                       | RDX | WRX | D7 | D6 | D5 | D4  | D3 | D2 | D1 | D0 | HEX |
| Command   | 0                         | 1   | ↑   | 1  | 1  | 1  | 1   | 1  | 0  | 0  | 1  | F9  |
| Parameter | 1                         | 1   | ↑   | -  | -  | -  | NGF | -  | R  | G  | B  | -   |

**5.2.18.1. NGF**

: Set the negative polarity gamma register to positive polarity gamma register or user setting value. Refer to the section 4.2

NGF = 0 : negative polarity gamma is applied by the negative polarity gamma register.

NGF = 1 : negative polarity gamma is applied by the same data as positive polarity gamma register.

**5.2.18.2. R,G,B**

: These register selects the RGB separate gamma register. Refer to the section 4.2

**Table 128.R,G,B**

| R      | G | B | Selected gamma preset register           |
|--------|---|---|------------------------------------------|
| 1      | 0 | 0 | Red gamma preset register is selected.   |
| 0      | 1 | 0 | Green gamma preset register is selected. |
| 0      | 0 | 1 | Blue gamma preset register is selected.  |
| others |   |   | Setting disable                          |

| Status  | Default Value                |
|---------|------------------------------|
| Initial | NGF = 0, R = 1, G = 0, B = 0 |

## 5.2.19. PGAMMACTL (FAH)

| FAh                        | PGAMMACTL (Positive Gamma Control Register) |     |     |    |    |         |         |         |         |         |         |     |
|----------------------------|---------------------------------------------|-----|-----|----|----|---------|---------|---------|---------|---------|---------|-----|
|                            | DCX                                         | RDX | WRX | D7 | D6 | D5      | D4      | D3      | D2      | D1      | D0      | HEX |
| Command                    | 0                                           | 1   | ↑   | 1  | 1  | 1       | 1       | 1       | 0       | 1       | 0       | FA  |
| 1 <sup>st</sup> Parameter  | 1                                           | 1   | ↑   | -  | -  | RFP[5]  | RFP[4]  | RFP[3]  | RFP[2]  | RFP[1]  | RFP[0]  | --  |
| 2 <sup>nd</sup> Parameter  | 1                                           | 1   | ↑   | -  | -  | OSP[5]  | OSP[4]  | OSP[3]  | OSP[2]  | OSP[1]  | OSP[0]  | --  |
| 3 <sup>rd</sup> Parameter  | 1                                           | 1   | ↑   | -  | -  | PKP0[5] | PKP0[4] | PKP0[3] | PKP0[2] | PKP0[1] | PKP0[0] | --  |
| 4 <sup>th</sup> Parameter  | 1                                           | 1   | ↑   | -  | -  | PKP1[5] | PKP1[4] | PKP1[3] | PKP1[2] | PKP1[1] | PKP1[0] | --  |
| 5 <sup>th</sup> Parameter  | 1                                           | 1   | ↑   | -  | -  | PKP2[5] | PKP2[4] | PKP2[3] | PKP2[2] | PKP2[1] | PKP2[0] | --  |
| 6 <sup>th</sup> Parameter  | 1                                           | 1   | ↑   | -  | -  | PKP3[5] | PKP3[4] | PKP3[3] | PKP3[2] | PKP3[1] | PKP3[0] | --  |
| 7 <sup>th</sup> Parameter  | 1                                           | 1   | ↑   | -  | -  | PKP4[5] | PKP4[4] | PKP4[3] | PKP4[2] | PKP4[1] | PKP4[0] | --  |
| 8 <sup>th</sup> Parameter  | 1                                           | 1   | ↑   | -  | -  | PKP5[5] | PKP5[4] | PKP5[3] | PKP5[2] | PKP5[1] | PKP5[0] | --  |
| 9 <sup>th</sup> Parameter  | 1                                           | 1   | ↑   | -  | -  | PKP6[5] | PKP6[4] | PKP6[3] | PKP6[2] | PKP6[1] | PKP6[0] | --  |
| 10 <sup>th</sup> Parameter | 1                                           | 1   | ↑   | -  | -  | PKP7[5] | PKP7[4] | PKP7[3] | PKP7[2] | PKP7[1] | PKP7[0] | --  |
| 11 <sup>th</sup> Parameter | 1                                           | 1   | ↑   | -  | -  | PKP8[5] | PKP8[4] | PKP8[3] | PKP8[2] | PKP8[1] | PKP8[0] | --  |
| 12 <sup>th</sup> Parameter | 1                                           | 1   | ↑   | -  | -  | -       | -       | -       | -       | -       | -       | --  |
| 13 <sup>th</sup> Parameter | 1                                           | 1   | ↑   | -  | -  | -       | -       | -       | -       | -       | -       | --  |
| 14 <sup>th</sup> Parameter | 1                                           | 1   | ↑   | -  | -  | -       | -       | -       | -       | -       | -       | --  |
| 15 <sup>th</sup> Parameter | 1                                           | 1   | ↑   | -  | -  | -       | -       | -       | -       | -       | -       | --  |
| 16 <sup>th</sup> Parameter | 1                                           | 1   | ↑   | -  | -  | -       | -       | -       | -       | GLP[1]  | GLP[0]  | --  |

This command is used to set the gamma preset register for positive.

GLP[1:0] : The positive voltage of grayscale number from V1 or V62 is mainly adjusted.

RFP[5:0] : The positive voltage of grayscale number from V0 is mainly adjusted.

OSP[5:0] : The positive voltage of grayscale number from V63 is mainly adjusted.

PKP0[5:0] ~ PKP10[5:0] : The positive voltage of grayscale number from V1 to V62 is finely adjusted.

**Table 129. Gamma preset for positive**

| Status  | Default Value                                                                                                   |
|---------|-----------------------------------------------------------------------------------------------------------------|
| Initial | RFP[5:0], OSP[5:0], PKP0[5:0]~PKP8[5:0], GLP[1:0]<br>00h, 0Ch, 01h, 0Dh, 13h, 1Ch, 15h, 3Ah, 26h, 1Bh, 0Eh, 00h |

## 5.2.20. NGAMMACTL (FBH)

| FBh                        | NGAMMACTL (Negative Gamma Control Register) |     |     |    |    |         |         |         |         |         |         |     |
|----------------------------|---------------------------------------------|-----|-----|----|----|---------|---------|---------|---------|---------|---------|-----|
|                            | DCX                                         | RDX | WRX | D7 | D6 | D5      | D4      | D3      | D2      | D1      | D0      | HEX |
| Command                    | 0                                           | 1   | ↑   | 1  | 1  | 1       | 1       | 1       | 0       | 1       | 0       | FB  |
| 1 <sup>st</sup> Parameter  | 1                                           | 1   | ↑   | -  | -  | RFN[5]  | RFN[4]  | RFN[3]  | RFN[2]  | RFN[1]  | RFN[0]  | --  |
| 2 <sup>nd</sup> Parameter  | 1                                           | 1   | ↑   | -  | -  | OSN[5]  | OSN[4]  | OSN[3]  | OSN[2]  | OSN[1]  | OSN[0]  | --  |
| 3 <sup>rd</sup> Parameter  | 1                                           | 1   | ↑   | -  | -  | PKN0[5] | PKN0[4] | PKN0[3] | PKN0[2] | PKN0[1] | PKN0[0] | --  |
| 4 <sup>th</sup> Parameter  | 1                                           | 1   | ↑   | -  | -  | PKN1[5] | PKN1[4] | PKN1[3] | PKN1[2] | PKN1[1] | PKN1[0] | --  |
| 5 <sup>th</sup> Parameter  | 1                                           | 1   | ↑   | -  | -  | PKN2[5] | PKN2[4] | PKN2[3] | PKN2[2] | PKN2[1] | PKN2[0] | --  |
| 6 <sup>th</sup> Parameter  | 1                                           | 1   | ↑   | -  | -  | PKN3[5] | PKN3[4] | PKN3[3] | PKN3[2] | PKN3[1] | PKN3[0] | --  |
| 7 <sup>th</sup> Parameter  | 1                                           | 1   | ↑   | -  | -  | PKN4[5] | PKN4[4] | PKN4[3] | PKN4[2] | PKN4[1] | PKN4[0] | --  |
| 8 <sup>th</sup> Parameter  | 1                                           | 1   | ↑   | -  | -  | PKN5[5] | PKN5[4] | PKN5[3] | PKN5[2] | PKN5[1] | PKN5[0] | --  |
| 9 <sup>th</sup> Parameter  | 1                                           | 1   | ↑   | -  | -  | PKN6[5] | PKN6[4] | PKN6[3] | PKN6[2] | PKN6[1] | PKN6[0] | --  |
| 10 <sup>th</sup> Parameter | 1                                           | 1   | ↑   | -  | -  | PKN7[5] | PKN7[4] | PKN7[3] | PKN7[2] | PKN7[1] | PKN7[0] | --  |
| 11 <sup>th</sup> Parameter | 1                                           | 1   | ↑   | -  | -  | PKN8[5] | PKN8[4] | PKN8[3] | PKN8[2] | PKN8[1] | PKN8[0] | --  |
| 12 <sup>th</sup> Parameter | 1                                           | 1   | ↑   | -  | -  | -       | -       | -       | -       | -       | -       | --  |
| 13 <sup>th</sup> Parameter | 1                                           | 1   | ↑   | -  | -  | -       | -       | -       | -       | -       | -       | --  |
| 14 <sup>th</sup> Parameter | 1                                           | 1   | ↑   | -  | -  | -       | -       | -       | -       | -       | -       | --  |
| 15 <sup>th</sup> Parameter | 1                                           | 1   | ↑   | -  | -  | -       | -       | -       | -       | -       | -       | --  |
| 16 <sup>th</sup> Parameter | 1                                           | 1   | ↑   | -  | -  | -       | -       | -       | -       | GLN[1]  | GLN[0]  | --  |

This command is used to set the gamma preset register for negative.

GLN[1:0] : The negative voltage of grayscale number from V1 or V62 is mainly adjusted.

RFN[5:0] : The negative voltage of grayscale number from V0 is mainly adjusted.

OSN[5:0] : The negative voltage of grayscale number from V63 is mainly adjusted.

PKN0[5:0] ~ PKN10[5:0] : The negative voltage of grayscale number from V1 to V62 is finely adjusted.

**Table 130. Gamma preset for negative**

| Status  | Default Value                                                                                                   |
|---------|-----------------------------------------------------------------------------------------------------------------|
| Initial | RFN[5:0], OSN[5:0], PKN0[5:0]~PKN8[5:0], GLN[1:0]<br>00h, 0Ch, 01h, 0Dh, 13h, 1Ch, 15h, 3Ah, 26h, 1Bh, 0Eh, 00h |

## CHAPTER 6

# APPENDIX

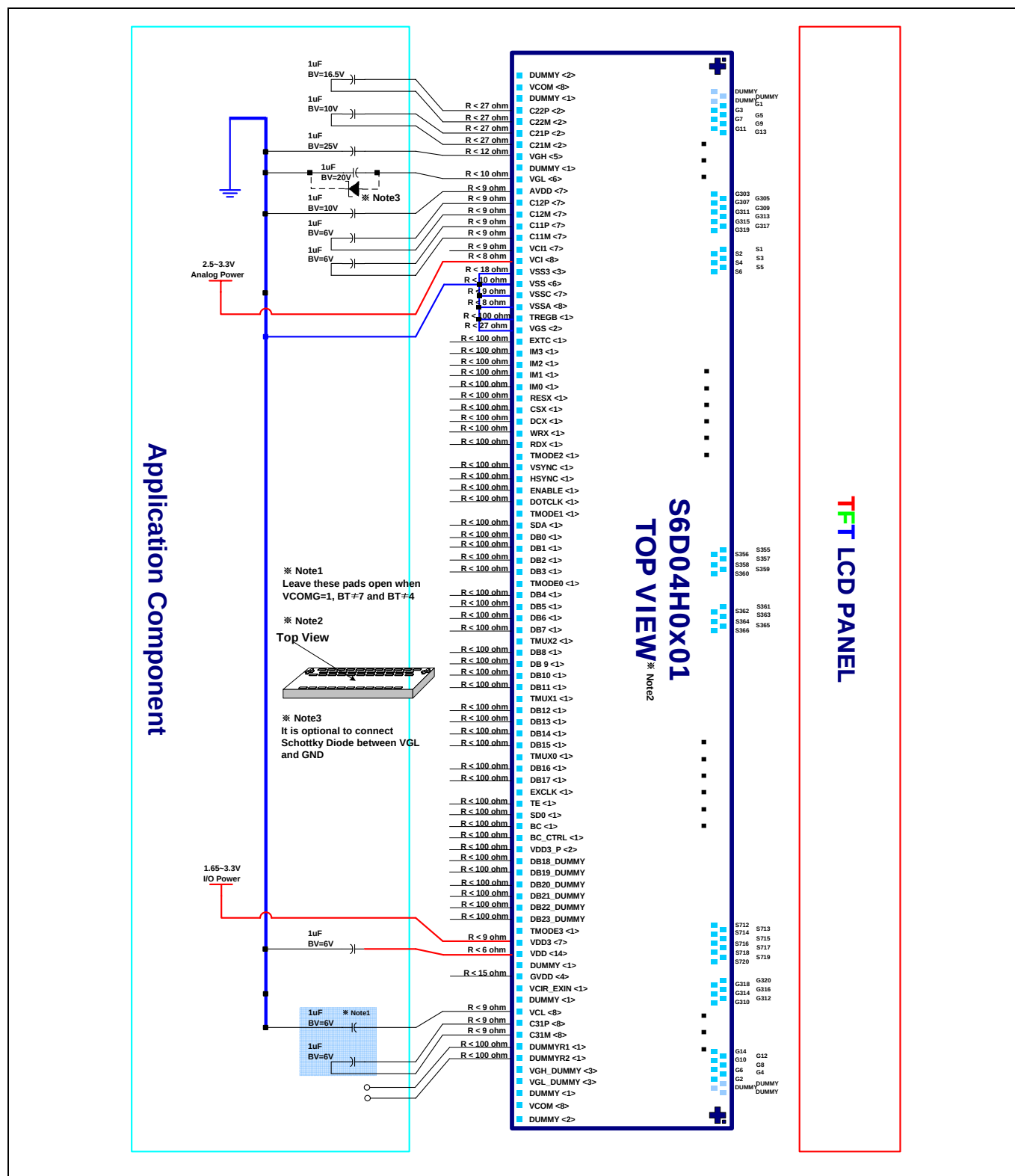
- 6.1 Application Circuit
- 6.2 External Components
- 6.3 PAD Center Coordinates
- 6.4 Display Module Default Position

# 6. ■ APPENDIX

## 6.1. APPLICATION CIRCUIT

A typical application circuit is shown in following figure. All black-colored capacitors are 1uF capacitors.





**Figure120. Application circuit.**

## 6.2. EXTERNAL COMPONENTS

Table 131. External Components

| Name    | Device    | Value | Connection      | Note                                                                                      |       |
|---------|-----------|-------|-----------------|-------------------------------------------------------------------------------------------|-------|
| C1      | Capacitor | 1uF   | AVDD – GND      | Maximum<br>Ratings<br>Voltage                                                             | 10V   |
| C2      | Capacitor | 1uF   | VGH – GND       |                                                                                           | 25V   |
| C3      | Capacitor | 1uF   | VGL – GND       |                                                                                           | 20V   |
| C4      | Capacitor | 1uF   | C11P – C11M     |                                                                                           | 6V    |
| C5      | Capacitor | 1uF   | C12P – C12M     |                                                                                           | 6V    |
| C6      | Capacitor | 1uF   | C21P – C21M     |                                                                                           | 10V   |
| C7      | Capacitor | 1uF   | C22P – C22M     |                                                                                           | 16.5V |
| C8      | Capacitor | 1uF   | C31P – C31M     |                                                                                           | 6V    |
| C9      | Capacitor | 1uF   | VCL-GND         |                                                                                           | 6V    |
| C10     | Capacitor | 1uF   | RVDD – GND      |                                                                                           | 6V    |
| D1*note | Diode     | -     | (+)VGL – GND(-) | VF < 0.4V<br>(@ IF = 20mA, Ta = 25℃)<br>VR ≥ max.25V (Option)<br>*Recommended diode RB521 |       |

Note1: It is optional to connect S/D between VGL and GND

Note2: Maximum Ratings Voltage should not be exceed 25volt.

## 6.3. PAD CENTER COORDINATES

### 6.3.1. INPUT PAD

Table 132. Pad Center Coordinates [Unit:  $\mu\text{m}$ ]

| No.    | Pad Name | X       | Y    | No.    | Pad Name | X       | Y    | No.     | Pad Name | X       | Y    |
|--------|----------|---------|------|--------|----------|---------|------|---------|----------|---------|------|
| I - 1  | DUMMY    | -7292.5 | -285 | I - 51 | C12M     | -4292.5 | -285 | I - 101 | VSSA     | -1292.5 | -285 |
| I - 2  | DUMMY    | -7232.5 | -285 | I - 52 | C12M     | -4232.5 | -285 | I - 102 | VSSA     | -1232.5 | -285 |
| I - 3  | VCOM     | -7172.5 | -285 | I - 53 | C11P     | -4172.5 | -285 | I - 103 | VSSA     | -1172.5 | -285 |
| I - 4  | VCOM     | -7112.5 | -285 | I - 54 | C11P     | -4112.5 | -285 | I - 104 | VSSA     | -1112.5 | -285 |
| I - 5  | VCOM     | -7052.5 | -285 | I - 55 | C11P     | -4052.5 | -285 | I - 105 | VSSA     | -1052.5 | -285 |
| I - 6  | VCOM     | -6992.5 | -285 | I - 56 | C11P     | -3992.5 | -285 | I - 106 | TREGB    | -992.5  | -285 |
| I - 7  | VCOM     | -6932.5 | -285 | I - 57 | C11P     | -3932.5 | -285 | I - 107 | VGS      | -932.5  | -285 |
| I - 8  | VCOM     | -6872.5 | -285 | I - 58 | C11P     | -3872.5 | -285 | I - 108 | VGS      | -872.5  | -285 |
| I - 9  | VCOM     | -6812.5 | -285 | I - 59 | C11P     | -3812.5 | -285 | I - 109 | EXTC     | -812.5  | -285 |
| I - 10 | VCOM     | -6752.5 | -285 | I - 60 | C11M     | -3752.5 | -285 | I - 110 | IM<3>    | -752.5  | -285 |
| I - 11 | DUMMY    | -6692.5 | -285 | I - 61 | C11M     | -3692.5 | -285 | I - 111 | IM<2>    | -692.5  | -285 |
| I - 12 | C22P     | -6632.5 | -285 | I - 62 | C11M     | -3632.5 | -285 | I - 112 | IM<1>    | -632.5  | -285 |
| I - 13 | C22P     | -6572.5 | -285 | I - 63 | C11M     | -3572.5 | -285 | I - 113 | IM<0>    | -572.5  | -285 |
| I - 14 | C22M     | -6512.5 | -285 | I - 64 | C11M     | -3512.5 | -285 | I - 114 | RESX     | -512.5  | -285 |
| I - 15 | C22M     | -6452.5 | -285 | I - 65 | C11M     | -3452.5 | -285 | I - 115 | CSX      | -452.5  | -285 |
| I - 16 | C21P     | -6392.5 | -285 | I - 66 | C11M     | -3392.5 | -285 | I - 116 | DCX      | -392.5  | -285 |
| I - 17 | C21P     | -6332.5 | -285 | I - 67 | VCI1     | -3332.5 | -285 | I - 117 | WRX      | -332.5  | -285 |
| I - 18 | C21M     | -6272.5 | -285 | I - 68 | VCI1     | -3272.5 | -285 | I - 118 | RDX      | -272.5  | -285 |
| I - 19 | C21M     | -6212.5 | -285 | I - 69 | VCI1     | -3212.5 | -285 | I - 119 | TMODE<2> | -212.5  | -285 |
| I - 20 | VGH      | -6152.5 | -285 | I - 70 | VCI1     | -3152.5 | -285 | I - 120 | VSYNC    | -152.5  | -285 |
| I - 21 | VGH      | -6092.5 | -285 | I - 71 | VCI1     | -3092.5 | -285 | I - 121 | HSYNC    | -92.5   | -285 |
| I - 22 | VGH      | -6032.5 | -285 | I - 72 | VCI1     | -3032.5 | -285 | I - 122 | ENABLE   | -32.5   | -285 |
| I - 23 | VGH      | -5972.5 | -285 | I - 73 | VCI1     | -2972.5 | -285 | I - 123 | DOTCLK   | 27.5    | -285 |
| I - 24 | VGH      | -5912.5 | -285 | I - 74 | VCI      | -2912.5 | -285 | I - 124 | TMODE<1> | 87.5    | -285 |
| I - 25 | DUMMY    | -5852.5 | -285 | I - 75 | VCI      | -2852.5 | -285 | I - 125 | SDA      | 160     | -285 |
| I - 26 | VGL      | -5792.5 | -285 | I - 76 | VCI      | -2792.5 | -285 | I - 126 | DB<0>    | 245     | -285 |
| I - 27 | VGL      | -5732.5 | -285 | I - 77 | VCI      | -2732.5 | -285 | I - 127 | DB<1>    | 330     | -285 |
| I - 28 | VGL      | -5672.5 | -285 | I - 78 | VCI      | -2672.5 | -285 | I - 128 | DB<2>    | 415     | -285 |
| I - 29 | VGL      | -5612.5 | -285 | I - 79 | VCI      | -2612.5 | -285 | I - 129 | DB<3>    | 500     | -285 |
| I - 30 | VGL      | -5552.5 | -285 | I - 80 | VCI      | -2552.5 | -285 | I - 130 | TMODE<0> | 572.5   | -285 |
| I - 31 | VGL      | -5492.5 | -285 | I - 81 | VCI      | -2492.5 | -285 | I - 131 | DB<4>    | 645     | -285 |
| I - 32 | AVDD     | -5432.5 | -285 | I - 82 | VSS3     | -2432.5 | -285 | I - 132 | DB<5>    | 730     | -285 |
| I - 33 | AVDD     | -5372.5 | -285 | I - 83 | VSS3     | -2372.5 | -285 | I - 133 | DB<6>    | 815     | -285 |
| I - 34 | AVDD     | -5312.5 | -285 | I - 84 | VSS3     | -2312.5 | -285 | I - 134 | DB<7>    | 900     | -285 |
| I - 35 | AVDD     | -5252.5 | -285 | I - 85 | VSS      | -2252.5 | -285 | I - 135 | TMUX<2>  | 972.5   | -285 |
| I - 36 | AVDD     | -5192.5 | -285 | I - 86 | VSS      | -2192.5 | -285 | I - 136 | DB<8>    | 1045    | -285 |
| I - 37 | AVDD     | -5132.5 | -285 | I - 87 | VSS      | -2132.5 | -285 | I - 137 | DB<9>    | 1130    | -285 |
| I - 38 | AVDD     | -5072.5 | -285 | I - 88 | VSS      | -2072.5 | -285 | I - 138 | DB<10>   | 1215    | -285 |
| I - 39 | C12P     | -5012.5 | -285 | I - 89 | VSS      | -2012.5 | -285 | I - 139 | DB<11>   | 1300    | -285 |
| I - 40 | C12P     | -4952.5 | -285 | I - 90 | VSS      | -1952.5 | -285 | I - 140 | TMUX<1>  | 1372.5  | -285 |
| I - 41 | C12P     | -4892.5 | -285 | I - 91 | VSSC     | -1892.5 | -285 | I - 141 | DB<12>   | 1445    | -285 |
| I - 42 | C12P     | -4832.5 | -285 | I - 92 | VSSC     | -1832.5 | -285 | I - 142 | DB<13>   | 1530    | -285 |

| No.    | Pad Name | X       | Y    | No.     | Pad Name | X       | Y    | No.     | Pad Name | X      | Y    |
|--------|----------|---------|------|---------|----------|---------|------|---------|----------|--------|------|
| I - 43 | C12P     | -4772.5 | -285 | I - 93  | VSSC     | -1772.5 | -285 | I - 143 | DB<14>   | 1615   | -285 |
| I - 44 | C12P     | -4712.5 | -285 | I - 94  | VSSC     | -1712.5 | -285 | I - 144 | DB<15>   | 1700   | -285 |
| I - 45 | C12P     | -4652.5 | -285 | I - 95  | VSSC     | -1652.5 | -285 | I - 145 | TMUX<0>  | 1772.5 | -285 |
| I - 46 | C12M     | -4592.5 | -285 | I - 96  | VSSC     | -1592.5 | -285 | I - 146 | DB<16>   | 1845   | -285 |
| I - 47 | C12M     | -4532.5 | -285 | I - 97  | VSSC     | -1532.5 | -285 | I - 147 | DB<17>   | 1930   | -285 |
| I - 48 | C12M     | -4472.5 | -285 | I - 98  | VSSA     | -1472.5 | -285 | I - 148 | EXCLK    | 2002.5 | -285 |
| I - 49 | C12M     | -4412.5 | -285 | I - 99  | VSSA     | -1412.5 | -285 | I - 149 | TE       | 2075   | -285 |
| I - 50 | C12M     | -4352.5 | -285 | I - 100 | VSSA     | -1352.5 | -285 | I - 150 | SD0      | 2160   | -285 |

Table 133. Pad Center Coordinates [Unit:  $\mu\text{m}$ ]

| No.     | Pad Name   | X      | Y    | no.     | Pad Name  | X      | Y    |
|---------|------------|--------|------|---------|-----------|--------|------|
| I - 151 | BC         | 2245   | -285 | I - 201 | C31P      | 5432.5 | -285 |
| I - 152 | BC_CTRL    | 2330   | -285 | I - 202 | C31P      | 5492.5 | -285 |
| I - 153 | VDD3_P     | 2402.5 | -285 | I - 203 | C31P      | 5552.5 | -285 |
| I - 154 | VDD3_P     | 2462.5 | -285 | I - 204 | C31P      | 5612.5 | -285 |
| I - 155 | DB18_DUMMY | 2535   | -285 | I - 205 | C31P      | 5672.5 | -285 |
| I - 156 | DB19_DUMMY | 2620   | -285 | I - 206 | C31M      | 5732.5 | -285 |
| I - 157 | DB20_DUMMY | 2705   | -285 | I - 207 | C31M      | 5792.5 | -285 |
| I - 158 | DB21_DUMMY | 2790   | -285 | I - 208 | C31M      | 5852.5 | -285 |
| I - 159 | DB22_DUMMY | 2875   | -285 | I - 209 | C31M      | 5912.5 | -285 |
| I - 160 | DB23_DUMMY | 2960   | -285 | I - 210 | C31M      | 5972.5 | -285 |
| I - 161 | TMODE<3>   | 3032.5 | -285 | I - 211 | C31M      | 6032.5 | -285 |
| I - 162 | VDD3       | 3092.5 | -285 | I - 212 | C31M      | 6092.5 | -285 |
| I - 163 | VDD3       | 3152.5 | -285 | I - 213 | C31M      | 6152.5 | -285 |
| I - 164 | VDD3       | 3212.5 | -285 | I - 214 | DUMMYR1   | 6212.5 | -285 |
| I - 165 | VDD3       | 3272.5 | -285 | I - 215 | DUMMYR2   | 6272.5 | -285 |
| I - 166 | VDD3       | 3332.5 | -285 | I - 216 | VGH_DUMMY | 6332.5 | -285 |
| I - 167 | VDD3       | 3392.5 | -285 | I - 217 | VGH_DUMMY | 6392.5 | -285 |
| I - 168 | VDD3       | 3452.5 | -285 | I - 218 | VGH_DUMMY | 6452.5 | -285 |
| I - 169 | VDD        | 3512.5 | -285 | I - 219 | VGL_DUMMY | 6512.5 | -285 |
| I - 170 | VDD        | 3572.5 | -285 | I - 220 | VGL_DUMMY | 6572.5 | -285 |
| I - 171 | VDD        | 3632.5 | -285 | I - 221 | VGL_DUMMY | 6632.5 | -285 |
| I - 172 | VDD        | 3692.5 | -285 | I - 222 | DUMMY     | 6692.5 | -285 |
| I - 173 | VDD        | 3752.5 | -285 | I - 223 | VCOM      | 6752.5 | -285 |
| I - 174 | VDD        | 3812.5 | -285 | I - 224 | VCOM      | 6812.5 | -285 |
| I - 175 | VDD        | 3872.5 | -285 | I - 225 | VCOM      | 6872.5 | -285 |
| I - 176 | VDD        | 3932.5 | -285 | I - 226 | VCOM      | 6932.5 | -285 |
| I - 177 | VDD        | 3992.5 | -285 | I - 227 | VCOM      | 6992.5 | -285 |
| I - 178 | VDD        | 4052.5 | -285 | I - 228 | VCOM      | 7052.5 | -285 |
| I - 179 | VDD        | 4112.5 | -285 | I - 229 | VCOM      | 7112.5 | -285 |
| I - 180 | VDD        | 4172.5 | -285 | I - 230 | VCOM      | 7172.5 | -285 |
| I - 181 | VDD        | 4232.5 | -285 | I - 231 | DUMMY     | 7232.5 | -285 |
| I - 182 | VDD        | 4292.5 | -285 | I - 232 | DUMMY     | 7292.5 | -285 |
| I - 183 | DUMMY      | 4352.5 | -285 |         |           |        |      |
| I - 184 | GVDD       | 4412.5 | -285 |         |           |        |      |
| I - 185 | GVDD       | 4472.5 | -285 |         |           |        |      |
| I - 186 | GVDD       | 4532.5 | -285 |         |           |        |      |

| No.     | Pad Name  | X      | Y    |  | no. | Pad Name | X | Y |
|---------|-----------|--------|------|--|-----|----------|---|---|
| I - 187 | GVDD      | 4592.5 | -285 |  |     |          |   |   |
| I - 188 | VCIR_EXIN | 4652.5 | -285 |  |     |          |   |   |
| I - 189 | DUMMY     | 4712.5 | -285 |  |     |          |   |   |
| I - 190 | VCL       | 4772.5 | -285 |  |     |          |   |   |
| I - 191 | VCL       | 4832.5 | -285 |  |     |          |   |   |
| I - 192 | VCL       | 4892.5 | -285 |  |     |          |   |   |
| I - 193 | VCL       | 4952.5 | -285 |  |     |          |   |   |
| I - 194 | VCL       | 5012.5 | -285 |  |     |          |   |   |
| I - 195 | VCL       | 5072.5 | -285 |  |     |          |   |   |
| I - 196 | VCL       | 5132.5 | -285 |  |     |          |   |   |
| I - 197 | VCL       | 5192.5 | -285 |  |     |          |   |   |
| I - 198 | C31P      | 5252.5 | -285 |  |     |          |   |   |
| I - 199 | C31P      | 5312.5 | -285 |  |     |          |   |   |
| I - 200 | C31P      | 5372.5 | -285 |  |     |          |   |   |

## 6.3.2. OUTPUT PAD

Table 134. Pad Center Coordinates [Unit:  $\mu\text{m}$ ]

| No.    | Pad Name | X    | Y   | No.    | Pad Name | X    | Y   | No.     | Pad Name | X    | Y   |
|--------|----------|------|-----|--------|----------|------|-----|---------|----------|------|-----|
| O - 1  | DUMMY    | 7399 | 261 | O - 51 | G96      | 6699 | 261 | O - 101 | G196     | 5999 | 261 |
| O - 2  | DUMMY    | 7385 | 126 | O - 52 | G98      | 6685 | 126 | O - 102 | G198     | 5985 | 126 |
| O - 3  | DUMMY    | 7371 | 261 | O - 53 | G100     | 6671 | 261 | O - 103 | G200     | 5971 | 261 |
| O - 4  | G2       | 7357 | 126 | O - 54 | G102     | 6657 | 126 | O - 104 | G202     | 5957 | 126 |
| O - 5  | G4       | 7343 | 261 | O - 55 | G104     | 6643 | 261 | O - 105 | G204     | 5943 | 261 |
| O - 6  | G6       | 7329 | 126 | O - 56 | G106     | 6629 | 126 | O - 106 | G206     | 5929 | 126 |
| O - 7  | G8       | 7315 | 261 | O - 57 | G108     | 6615 | 261 | O - 107 | G208     | 5915 | 261 |
| O - 8  | G10      | 7301 | 126 | O - 58 | G110     | 6601 | 126 | O - 108 | G210     | 5901 | 126 |
| O - 9  | G12      | 7287 | 261 | O - 59 | G112     | 6587 | 261 | O - 109 | G212     | 5887 | 261 |
| O - 10 | G14      | 7273 | 126 | O - 60 | G114     | 6573 | 126 | O - 110 | G214     | 5873 | 126 |
| O - 11 | G16      | 7259 | 261 | O - 61 | G116     | 6559 | 261 | O - 111 | G216     | 5859 | 261 |
| O - 12 | G18      | 7245 | 126 | O - 62 | G118     | 6545 | 126 | O - 112 | G218     | 5845 | 126 |
| O - 13 | G20      | 7231 | 261 | O - 63 | G120     | 6531 | 261 | O - 113 | G220     | 5831 | 261 |
| O - 14 | G22      | 7217 | 126 | O - 64 | G122     | 6517 | 126 | O - 114 | G222     | 5817 | 126 |
| O - 15 | G24      | 7203 | 261 | O - 65 | G124     | 6503 | 261 | O - 115 | G224     | 5803 | 261 |
| O - 16 | G26      | 7189 | 126 | O - 66 | G126     | 6489 | 126 | O - 116 | G226     | 5789 | 126 |
| O - 17 | G28      | 7175 | 261 | O - 67 | G128     | 6475 | 261 | O - 117 | G228     | 5775 | 261 |
| O - 18 | G30      | 7161 | 126 | O - 68 | G130     | 6461 | 126 | O - 118 | G230     | 5761 | 126 |
| O - 19 | G32      | 7147 | 261 | O - 69 | G132     | 6447 | 261 | O - 119 | G232     | 5747 | 261 |
| O - 20 | G34      | 7133 | 126 | O - 70 | G134     | 6433 | 126 | O - 120 | G234     | 5733 | 126 |
| O - 21 | G36      | 7119 | 261 | O - 71 | G136     | 6419 | 261 | O - 121 | G236     | 5719 | 261 |
| O - 22 | G38      | 7105 | 126 | O - 72 | G138     | 6405 | 126 | O - 122 | G238     | 5705 | 126 |
| O - 23 | G40      | 7091 | 261 | O - 73 | G140     | 6391 | 261 | O - 123 | G240     | 5691 | 261 |
| O - 24 | G42      | 7077 | 126 | O - 74 | G142     | 6377 | 126 | O - 124 | G242     | 5677 | 126 |
| O - 25 | G44      | 7063 | 261 | O - 75 | G144     | 6363 | 261 | O - 125 | G244     | 5663 | 261 |
| O - 26 | G46      | 7049 | 126 | O - 76 | G146     | 6349 | 126 | O - 126 | G246     | 5649 | 126 |
| O - 27 | G48      | 7035 | 261 | O - 77 | G148     | 6335 | 261 | O - 127 | G248     | 5635 | 261 |
| O - 28 | G50      | 7021 | 126 | O - 78 | G150     | 6321 | 126 | O - 128 | G250     | 5621 | 126 |
| O - 29 | G52      | 7007 | 261 | O - 79 | G152     | 6307 | 261 | O - 129 | G252     | 5607 | 261 |
| O - 30 | G54      | 6993 | 126 | O - 80 | G154     | 6293 | 126 | O - 130 | G254     | 5593 | 126 |
| O - 31 | G56      | 6979 | 261 | O - 81 | G156     | 6279 | 261 | O - 131 | G256     | 5579 | 261 |
| O - 32 | G58      | 6965 | 126 | O - 82 | G158     | 6265 | 126 | O - 132 | G258     | 5565 | 126 |
| O - 33 | G60      | 6951 | 261 | O - 83 | G160     | 6251 | 261 | O - 133 | G260     | 5551 | 261 |
| O - 34 | G62      | 6937 | 126 | O - 84 | G162     | 6237 | 126 | O - 134 | G262     | 5537 | 126 |
| O - 35 | G64      | 6923 | 261 | O - 85 | G164     | 6223 | 261 | O - 135 | G264     | 5523 | 261 |
| O - 36 | G66      | 6909 | 126 | O - 86 | G166     | 6209 | 126 | O - 136 | G266     | 5509 | 126 |
| O - 37 | G68      | 6895 | 261 | O - 87 | G168     | 6195 | 261 | O - 137 | G268     | 5495 | 261 |
| O - 38 | G70      | 6881 | 126 | O - 88 | G170     | 6181 | 126 | O - 138 | G270     | 5481 | 126 |
| O - 39 | G72      | 6867 | 261 | O - 89 | G172     | 6167 | 261 | O - 139 | G272     | 5467 | 261 |
| O - 40 | G74      | 6853 | 126 | O - 90 | G174     | 6153 | 126 | O - 140 | G274     | 5453 | 126 |
| O - 41 | G76      | 6839 | 261 | O - 91 | G176     | 6139 | 261 | O - 141 | G276     | 5439 | 261 |
| O - 42 | G78      | 6825 | 126 | O - 92 | G178     | 6125 | 126 | O - 142 | G278     | 5425 | 126 |
| O - 43 | G80      | 6811 | 261 | O - 93 | G180     | 6111 | 261 | O - 143 | G280     | 5411 | 261 |
| O - 44 | G82      | 6797 | 126 | O - 94 | G182     | 6097 | 126 | O - 144 | G282     | 5397 | 126 |
| O - 45 | G84      | 6783 | 261 | O - 95 | G184     | 6083 | 261 | O - 145 | G284     | 5383 | 261 |
| O - 46 | G86      | 6769 | 126 | O - 96 | G186     | 6069 | 126 | O - 146 | G286     | 5369 | 126 |

| No.    | Pad Name | X    | Y   | No.     | Pad Name | X    | Y   | No.     | Pad Name | X    | Y   |
|--------|----------|------|-----|---------|----------|------|-----|---------|----------|------|-----|
| O - 47 | G88      | 6755 | 261 | O - 97  | G188     | 6055 | 261 | O - 147 | G288     | 5355 | 261 |
| O - 48 | G90      | 6741 | 126 | O - 98  | G190     | 6041 | 126 | O - 148 | G290     | 5341 | 126 |
| O - 49 | G92      | 6727 | 261 | O - 99  | G192     | 6027 | 261 | O - 149 | G292     | 5327 | 261 |
| O - 50 | G94      | 6713 | 126 | O - 100 | G194     | 6013 | 126 | O - 150 | G294     | 5313 | 126 |

Table 135. Pad Center Coordinates [Unit:  $\mu\text{m}$ ]

| no.     | Pad Name | X    | Y   | No.     | Pad Name | X    | Y   | No.     | Pad Name | X    | Y   |
|---------|----------|------|-----|---------|----------|------|-----|---------|----------|------|-----|
| O - 151 | G296     | 5299 | 261 | O - 201 | S683     | 4557 | 261 | O - 251 | S633     | 3857 | 261 |
| O - 152 | G298     | 5285 | 126 | O - 202 | S682     | 4543 | 126 | O - 252 | S632     | 3843 | 126 |
| O - 153 | G300     | 5271 | 261 | O - 203 | S681     | 4529 | 261 | O - 253 | S631     | 3829 | 261 |
| O - 154 | G302     | 5257 | 126 | O - 204 | S680     | 4515 | 126 | O - 254 | S630     | 3815 | 126 |
| O - 155 | G304     | 5243 | 261 | O - 205 | S679     | 4501 | 261 | O - 255 | S629     | 3801 | 261 |
| O - 156 | G306     | 5229 | 126 | O - 206 | S678     | 4487 | 126 | O - 256 | S628     | 3787 | 126 |
| O - 157 | G308     | 5215 | 261 | O - 207 | S677     | 4473 | 261 | O - 257 | S627     | 3773 | 261 |
| O - 158 | G310     | 5201 | 126 | O - 208 | S676     | 4459 | 126 | O - 258 | S626     | 3759 | 126 |
| O - 159 | G312     | 5187 | 261 | O - 209 | S675     | 4445 | 261 | O - 259 | S625     | 3745 | 261 |
| O - 160 | G314     | 5173 | 126 | O - 210 | S674     | 4431 | 126 | O - 260 | S624     | 3731 | 126 |
| O - 161 | G316     | 5159 | 261 | O - 211 | S673     | 4417 | 261 | O - 261 | S623     | 3717 | 261 |
| O - 162 | G318     | 5145 | 126 | O - 212 | S672     | 4403 | 126 | O - 262 | S622     | 3703 | 126 |
| O - 163 | G320     | 5131 | 261 | O - 213 | S671     | 4389 | 261 | O - 263 | S621     | 3689 | 261 |
| O - 164 | S720     | 5075 | 126 | O - 214 | S670     | 4375 | 126 | O - 264 | S620     | 3675 | 126 |
| O - 165 | S719     | 5061 | 261 | O - 215 | S669     | 4361 | 261 | O - 265 | S619     | 3661 | 261 |
| O - 166 | S718     | 5047 | 126 | O - 216 | S668     | 4347 | 126 | O - 266 | S618     | 3647 | 126 |
| O - 167 | S717     | 5033 | 261 | O - 217 | S667     | 4333 | 261 | O - 267 | S617     | 3633 | 261 |
| O - 168 | S716     | 5019 | 126 | O - 218 | S666     | 4319 | 126 | O - 268 | S616     | 3619 | 126 |
| O - 169 | S715     | 5005 | 261 | O - 219 | S665     | 4305 | 261 | O - 269 | S615     | 3605 | 261 |
| O - 170 | S714     | 4991 | 126 | O - 220 | S664     | 4291 | 126 | O - 270 | S614     | 3591 | 126 |
| O - 171 | S713     | 4977 | 261 | O - 221 | S663     | 4277 | 261 | O - 271 | S613     | 3577 | 261 |
| O - 172 | S712     | 4963 | 126 | O - 222 | S662     | 4263 | 126 | O - 272 | S612     | 3563 | 126 |
| O - 173 | S711     | 4949 | 261 | O - 223 | S661     | 4249 | 261 | O - 273 | S611     | 3549 | 261 |
| O - 174 | S710     | 4935 | 126 | O - 224 | S660     | 4235 | 126 | O - 274 | S610     | 3535 | 126 |
| O - 175 | S709     | 4921 | 261 | O - 225 | S659     | 4221 | 261 | O - 275 | S609     | 3521 | 261 |
| O - 176 | S708     | 4907 | 126 | O - 226 | S658     | 4207 | 126 | O - 276 | S608     | 3507 | 126 |
| O - 177 | S707     | 4893 | 261 | O - 227 | S657     | 4193 | 261 | O - 277 | S607     | 3493 | 261 |
| O - 178 | S706     | 4879 | 126 | O - 228 | S656     | 4179 | 126 | O - 278 | S606     | 3479 | 126 |
| O - 179 | S705     | 4865 | 261 | O - 229 | S655     | 4165 | 261 | O - 279 | S605     | 3465 | 261 |
| O - 180 | S704     | 4851 | 126 | O - 230 | S654     | 4151 | 126 | O - 270 | S604     | 3451 | 126 |
| O - 181 | S703     | 4837 | 261 | O - 231 | S653     | 4137 | 261 | O - 281 | S603     | 3437 | 261 |
| O - 182 | S702     | 4823 | 126 | O - 232 | S652     | 4123 | 126 | O - 282 | S602     | 3423 | 126 |
| O - 183 | S701     | 4809 | 261 | O - 233 | S651     | 4109 | 261 | O - 283 | S601     | 3409 | 261 |
| O - 184 | S700     | 4795 | 126 | O - 234 | S650     | 4095 | 126 | O - 284 | S600     | 3395 | 126 |
| O - 185 | S699     | 4781 | 261 | O - 235 | S649     | 4081 | 261 | O - 285 | S599     | 3381 | 261 |
| O - 186 | S698     | 4767 | 126 | O - 236 | S648     | 4067 | 126 | O - 286 | S598     | 3367 | 126 |
| O - 187 | S697     | 4753 | 261 | O - 237 | S647     | 4053 | 261 | O - 287 | S597     | 3353 | 261 |
| O - 188 | S696     | 4739 | 126 | O - 238 | S646     | 4039 | 126 | O - 288 | S596     | 3339 | 126 |
| O - 189 | S695     | 4725 | 261 | O - 239 | S645     | 4025 | 261 | O - 289 | S595     | 3325 | 261 |
| O - 190 | S694     | 4711 | 126 | O - 240 | S644     | 4011 | 126 | O - 290 | S594     | 3311 | 126 |
| O - 191 | S693     | 4697 | 261 | O - 241 | S643     | 3997 | 261 | O - 291 | S593     | 3297 | 261 |

| no.     | Pad Name | X    | Y   | No.     | Pad Name | X    | Y   | No.     | Pad Name | X    | Y   |
|---------|----------|------|-----|---------|----------|------|-----|---------|----------|------|-----|
| O - 192 | S692     | 4683 | 126 | O - 242 | S642     | 3983 | 126 | O - 292 | S592     | 3283 | 126 |
| O - 193 | S691     | 4669 | 261 | O - 243 | S641     | 3969 | 261 | O - 293 | S591     | 3269 | 261 |
| O - 194 | S690     | 4655 | 126 | O - 244 | S640     | 3955 | 126 | O - 294 | S590     | 3255 | 126 |
| O - 195 | S689     | 4641 | 261 | O - 245 | S639     | 3941 | 261 | O - 295 | S589     | 3241 | 261 |
| O - 196 | S688     | 4627 | 126 | O - 246 | S638     | 3927 | 126 | O - 296 | S588     | 3227 | 126 |
| O - 197 | S687     | 4613 | 261 | O - 247 | S637     | 3913 | 261 | O - 297 | S587     | 3213 | 261 |
| O - 198 | S686     | 4599 | 126 | O - 248 | S636     | 3899 | 126 | O - 298 | S586     | 3199 | 126 |
| O - 199 | S685     | 4585 | 261 | O - 249 | S635     | 3885 | 261 | O - 299 | S585     | 3185 | 261 |
| O - 200 | S684     | 4571 | 126 | O - 250 | S634     | 3871 | 126 | O - 300 | S584     | 3171 | 126 |

Table 136. Pad Center Coordinates [Unit:  $\mu\text{m}$ ]

| No.     | Pad Name | X    | Y   | No.     | Pad Name | X    | Y   | No.     | Pad Name | X    | Y   |
|---------|----------|------|-----|---------|----------|------|-----|---------|----------|------|-----|
| O - 301 | S583     | 3157 | 261 | O - 351 | S533     | 2457 | 261 | O - 401 | S483     | 1757 | 261 |
| O - 302 | S582     | 3143 | 126 | O - 352 | S532     | 2443 | 126 | O - 402 | S482     | 1743 | 126 |
| O - 303 | S581     | 3129 | 261 | O - 353 | S531     | 2429 | 261 | O - 403 | S481     | 1729 | 261 |
| O - 304 | S580     | 3115 | 126 | O - 354 | S530     | 2415 | 126 | O - 404 | S480     | 1715 | 126 |
| O - 305 | S579     | 3101 | 261 | O - 355 | S529     | 2401 | 261 | O - 405 | S479     | 1701 | 261 |
| O - 306 | S578     | 3087 | 126 | O - 356 | S528     | 2387 | 126 | O - 406 | S478     | 1687 | 126 |
| O - 307 | S577     | 3073 | 261 | O - 357 | S527     | 2373 | 261 | O - 407 | S477     | 1673 | 261 |
| O - 308 | S576     | 3059 | 126 | O - 358 | S526     | 2359 | 126 | O - 408 | S476     | 1659 | 126 |
| O - 309 | S575     | 3045 | 261 | O - 359 | S525     | 2345 | 261 | O - 409 | S475     | 1645 | 261 |
| O - 310 | S574     | 3031 | 126 | O - 360 | S524     | 2331 | 126 | O - 410 | S474     | 1631 | 126 |
| O - 311 | S573     | 3017 | 261 | O - 361 | S523     | 2317 | 261 | O - 411 | S473     | 1617 | 261 |
| O - 312 | S572     | 3003 | 126 | O - 362 | S522     | 2303 | 126 | O - 412 | S472     | 1603 | 126 |
| O - 313 | S571     | 2989 | 261 | O - 363 | S521     | 2289 | 261 | O - 413 | S471     | 1589 | 261 |
| O - 314 | S570     | 2975 | 126 | O - 364 | S520     | 2275 | 126 | O - 414 | S470     | 1575 | 126 |
| O - 315 | S569     | 2961 | 261 | O - 365 | S519     | 2261 | 261 | O - 415 | S469     | 1561 | 261 |
| O - 316 | S568     | 2947 | 126 | O - 366 | S518     | 2247 | 126 | O - 416 | S468     | 1547 | 126 |
| O - 317 | S567     | 2933 | 261 | O - 367 | S517     | 2233 | 261 | O - 417 | S467     | 1533 | 261 |
| O - 318 | S566     | 2919 | 126 | O - 368 | S516     | 2219 | 126 | O - 418 | S466     | 1519 | 126 |
| O - 319 | S565     | 2905 | 261 | O - 369 | S515     | 2205 | 261 | O - 419 | S465     | 1505 | 261 |
| O - 320 | S564     | 2891 | 126 | O - 370 | S514     | 2191 | 126 | O - 420 | S464     | 1491 | 126 |
| O - 321 | S563     | 2877 | 261 | O - 371 | S513     | 2177 | 261 | O - 421 | S463     | 1477 | 261 |
| O - 322 | S562     | 2863 | 126 | O - 372 | S512     | 2163 | 126 | O - 422 | S462     | 1463 | 126 |
| O - 323 | S561     | 2849 | 261 | O - 373 | S511     | 2149 | 261 | O - 423 | S461     | 1449 | 261 |
| O - 324 | S560     | 2835 | 126 | O - 374 | S510     | 2135 | 126 | O - 424 | S460     | 1435 | 126 |
| O - 325 | S559     | 2821 | 261 | O - 375 | S509     | 2121 | 261 | O - 425 | S459     | 1421 | 261 |
| O - 326 | S558     | 2807 | 126 | O - 376 | S508     | 2107 | 126 | O - 426 | S458     | 1407 | 126 |
| O - 327 | S557     | 2793 | 261 | O - 377 | S507     | 2093 | 261 | O - 427 | S457     | 1393 | 261 |
| O - 328 | S556     | 2779 | 126 | O - 378 | S506     | 2079 | 126 | O - 428 | S456     | 1379 | 126 |
| O - 329 | S555     | 2765 | 261 | O - 379 | S505     | 2065 | 261 | O - 429 | S455     | 1365 | 261 |
| O - 330 | S554     | 2751 | 126 | O - 380 | S504     | 2051 | 126 | O - 430 | S454     | 1351 | 126 |
| O - 331 | S553     | 2737 | 261 | O - 381 | S503     | 2037 | 261 | O - 431 | S453     | 1337 | 261 |
| O - 332 | S552     | 2723 | 126 | O - 382 | S502     | 2023 | 126 | O - 432 | S452     | 1323 | 126 |
| O - 333 | S551     | 2709 | 261 | O - 383 | S501     | 2009 | 261 | O - 433 | S451     | 1309 | 261 |
| O - 334 | S550     | 2695 | 126 | O - 384 | S500     | 1995 | 126 | O - 434 | S450     | 1295 | 126 |
| O - 335 | S549     | 2681 | 261 | O - 385 | S499     | 1981 | 261 | O - 435 | S449     | 1281 | 261 |
| O - 336 | S548     | 2667 | 126 | O - 386 | S498     | 1967 | 126 | O - 436 | S448     | 1267 | 126 |



| No.     | Pad Name | X    | Y   | No.     | Pad Name | X    | Y   | No.     | Pad Name | X    | Y   |
|---------|----------|------|-----|---------|----------|------|-----|---------|----------|------|-----|
| O - 337 | S547     | 2653 | 261 | O - 387 | S497     | 1953 | 261 | O - 437 | S447     | 1253 | 261 |
| O - 338 | S546     | 2639 | 126 | O - 388 | S496     | 1939 | 126 | O - 438 | S446     | 1239 | 126 |
| O - 339 | S545     | 2625 | 261 | O - 389 | S495     | 1925 | 261 | O - 439 | S445     | 1225 | 261 |
| O - 340 | S544     | 2611 | 126 | O - 390 | S494     | 1911 | 126 | O - 440 | S444     | 1211 | 126 |
| O - 341 | S543     | 2597 | 261 | O - 391 | S493     | 1897 | 261 | O - 441 | S443     | 1197 | 261 |
| O - 342 | S542     | 2583 | 126 | O - 392 | S492     | 1883 | 126 | O - 442 | S442     | 1183 | 126 |
| O - 343 | S541     | 2569 | 261 | O - 393 | S491     | 1869 | 261 | O - 443 | S441     | 1169 | 261 |
| O - 344 | S540     | 2555 | 126 | O - 394 | S490     | 1855 | 126 | O - 444 | S440     | 1155 | 126 |
| O - 345 | S539     | 2541 | 261 | O - 395 | S489     | 1841 | 261 | O - 445 | S439     | 1141 | 261 |
| O - 346 | S538     | 2527 | 126 | O - 396 | S488     | 1827 | 126 | O - 446 | S438     | 1127 | 126 |
| O - 347 | S537     | 2513 | 261 | O - 397 | S487     | 1813 | 261 | O - 447 | S437     | 1113 | 261 |
| O - 348 | S536     | 2499 | 126 | O - 398 | S486     | 1799 | 126 | O - 448 | S436     | 1099 | 126 |
| O - 349 | S535     | 2485 | 261 | O - 399 | S485     | 1785 | 261 | O - 449 | S435     | 1085 | 261 |
| O - 350 | S534     | 2471 | 126 | O - 400 | S484     | 1771 | 126 | O - 450 | S434     | 1071 | 126 |

Table 137. Pad Center Coordinates [Unit:  $\mu\text{m}$ ]

| No.     | Pad Name | X    | Y   | No.     | Pad Name | X    | Y   | No.     | Pad Name | X    | Y   |
|---------|----------|------|-----|---------|----------|------|-----|---------|----------|------|-----|
| O - 451 | S433     | 1057 | 261 | O - 501 | S383     | 357  | 261 | O - 551 | S333     | -427 | 261 |
| O - 452 | S432     | 1043 | 126 | O - 502 | S382     | 343  | 126 | O - 552 | S332     | -441 | 126 |
| O - 453 | S431     | 1029 | 261 | O - 503 | S381     | 329  | 261 | O - 553 | S331     | -455 | 261 |
| O - 454 | S430     | 1015 | 126 | O - 504 | S380     | 315  | 126 | O - 554 | S330     | -469 | 126 |
| O - 455 | S429     | 1001 | 261 | O - 505 | S379     | 301  | 261 | O - 555 | S329     | -483 | 261 |
| O - 456 | S428     | 987  | 126 | O - 506 | S378     | 287  | 126 | O - 556 | S328     | -497 | 126 |
| O - 457 | S427     | 973  | 261 | O - 507 | S377     | 273  | 261 | O - 557 | S327     | -511 | 261 |
| O - 458 | S426     | 959  | 126 | O - 508 | S376     | 259  | 126 | O - 558 | S326     | -525 | 126 |
| O - 459 | S425     | 945  | 261 | O - 509 | S375     | 245  | 261 | O - 559 | S325     | -539 | 261 |
| O - 460 | S424     | 931  | 126 | O - 510 | S374     | 231  | 126 | O - 560 | S324     | -553 | 126 |
| O - 461 | S423     | 917  | 261 | O - 511 | S373     | 217  | 261 | O - 561 | S323     | -567 | 261 |
| O - 462 | S422     | 903  | 126 | O - 512 | S372     | 203  | 126 | O - 562 | S322     | -581 | 126 |
| O - 463 | S421     | 889  | 261 | O - 513 | S371     | 189  | 261 | O - 563 | S321     | -595 | 261 |
| O - 464 | S420     | 875  | 126 | O - 514 | S370     | 175  | 126 | O - 564 | S320     | -609 | 126 |
| O - 465 | S419     | 861  | 261 | O - 515 | S369     | 161  | 261 | O - 565 | S319     | -623 | 261 |
| O - 466 | S418     | 847  | 126 | O - 516 | S368     | 147  | 126 | O - 566 | S318     | -637 | 126 |
| O - 467 | S417     | 833  | 261 | O - 517 | S367     | 133  | 261 | O - 567 | S317     | -651 | 261 |
| O - 468 | S416     | 819  | 126 | O - 518 | S366     | 119  | 126 | O - 568 | S316     | -665 | 126 |
| O - 469 | S415     | 805  | 261 | O - 519 | S365     | 105  | 261 | O - 569 | S315     | -679 | 261 |
| O - 470 | S414     | 791  | 126 | O - 520 | S364     | 91   | 126 | O - 570 | S314     | -693 | 126 |
| O - 471 | S413     | 777  | 261 | O - 521 | S363     | 77   | 261 | O - 571 | S313     | -707 | 261 |
| O - 472 | S412     | 763  | 126 | O - 522 | S362     | 63   | 126 | O - 572 | S312     | -721 | 126 |
| O - 473 | S411     | 749  | 261 | O - 523 | S361     | 49   | 261 | O - 573 | S311     | -735 | 261 |
| O - 474 | S410     | 735  | 126 | O - 524 | S360     | -49  | 126 | O - 574 | S310     | -749 | 126 |
| O - 475 | S409     | 721  | 261 | O - 525 | S359     | -63  | 261 | O - 575 | S309     | -763 | 261 |
| O - 476 | S408     | 707  | 126 | O - 526 | S358     | -77  | 126 | O - 576 | S308     | -777 | 126 |
| O - 477 | S407     | 693  | 261 | O - 527 | S357     | -91  | 261 | O - 577 | S307     | -791 | 261 |
| O - 478 | S406     | 679  | 126 | O - 528 | S356     | -105 | 126 | O - 578 | S306     | -805 | 126 |
| O - 479 | S405     | 665  | 261 | O - 529 | S355     | -119 | 261 | O - 579 | S305     | -819 | 261 |
| O - 480 | S404     | 651  | 126 | O - 530 | S354     | -133 | 126 | O - 580 | S304     | -833 | 126 |
| O - 481 | S403     | 637  | 261 | O - 531 | S353     | -147 | 261 | O - 581 | S303     | -847 | 261 |

| No.     | Pad Name | X   | Y   | No.     | Pad Name | X    | Y   | No.     | Pad Name | X     | Y   |
|---------|----------|-----|-----|---------|----------|------|-----|---------|----------|-------|-----|
| O - 482 | S402     | 623 | 126 | O - 532 | S352     | -161 | 126 | O - 582 | S302     | -861  | 126 |
| O - 483 | S401     | 609 | 261 | O - 533 | S351     | -175 | 261 | O - 583 | S301     | -875  | 261 |
| O - 484 | S400     | 595 | 126 | O - 534 | S350     | -189 | 126 | O - 584 | S300     | -889  | 126 |
| O - 485 | S399     | 581 | 261 | O - 535 | S349     | -203 | 261 | O - 585 | S299     | -903  | 261 |
| O - 486 | S398     | 567 | 126 | O - 536 | S348     | -217 | 126 | O - 586 | S298     | -917  | 126 |
| O - 487 | S397     | 553 | 261 | O - 537 | S347     | -231 | 261 | O - 587 | S297     | -931  | 261 |
| O - 488 | S396     | 539 | 126 | O - 538 | S346     | -245 | 126 | O - 588 | S296     | -945  | 126 |
| O - 489 | S395     | 525 | 261 | O - 539 | S345     | -259 | 261 | O - 589 | S295     | -959  | 261 |
| O - 490 | S394     | 511 | 126 | O - 540 | S344     | -273 | 126 | O - 590 | S294     | -973  | 126 |
| O - 491 | S393     | 497 | 261 | O - 541 | S343     | -287 | 261 | O - 591 | S293     | -987  | 261 |
| O - 492 | S392     | 483 | 126 | O - 542 | S342     | -301 | 126 | O - 592 | S292     | -1001 | 126 |
| O - 493 | S391     | 469 | 261 | O - 543 | S341     | -315 | 261 | O - 593 | S291     | -1015 | 261 |
| O - 494 | S390     | 455 | 126 | O - 544 | S340     | -329 | 126 | O - 594 | S290     | -1029 | 126 |
| O - 495 | S389     | 441 | 261 | O - 545 | S339     | -343 | 261 | O - 595 | S289     | -1043 | 261 |
| O - 496 | S388     | 427 | 126 | O - 546 | S338     | -357 | 126 | O - 596 | S288     | -1057 | 126 |
| O - 497 | S387     | 413 | 261 | O - 547 | S337     | -371 | 261 | O - 597 | S287     | -1071 | 261 |
| O - 498 | S386     | 399 | 126 | O - 548 | S336     | -385 | 126 | O - 598 | S286     | -1085 | 126 |
| O - 499 | S385     | 385 | 261 | O - 549 | S335     | -399 | 261 | O - 599 | S285     | -1099 | 261 |
| O - 500 | S384     | 371 | 126 | O - 550 | S334     | -413 | 126 | O - 600 | S284     | -1113 | 126 |

Table 138. Pad Center Coordinates [Unit: μm]

| No.     | Pad Name | X     | Y   | No.     | Pad Name | X     | Y   | No.     | Pad Name | X     | Y   |
|---------|----------|-------|-----|---------|----------|-------|-----|---------|----------|-------|-----|
| O - 601 | S283     | -1127 | 261 | O - 651 | S233     | -1827 | 261 | O - 701 | S183     | -2527 | 261 |
| O - 602 | S282     | -1141 | 126 | O - 652 | S232     | -1841 | 126 | O - 702 | S182     | -2541 | 126 |
| O - 603 | S281     | -1155 | 261 | O - 653 | S231     | -1855 | 261 | O - 703 | S181     | -2555 | 261 |
| O - 604 | S280     | -1169 | 126 | O - 654 | S230     | -1869 | 126 | O - 704 | S180     | -2569 | 126 |
| O - 605 | S279     | -1183 | 261 | O - 655 | S229     | -1883 | 261 | O - 705 | S179     | -2583 | 261 |
| O - 606 | S278     | -1197 | 126 | O - 656 | S228     | -1897 | 126 | O - 706 | S178     | -2597 | 126 |
| O - 607 | S277     | -1211 | 261 | O - 657 | S227     | -1911 | 261 | O - 707 | S177     | -2611 | 261 |
| O - 608 | S276     | -1225 | 126 | O - 658 | S226     | -1925 | 126 | O - 708 | S176     | -2625 | 126 |
| O - 609 | S275     | -1239 | 261 | O - 659 | S225     | -1939 | 261 | O - 709 | S175     | -2639 | 261 |
| O - 610 | S274     | -1253 | 126 | O - 660 | S224     | -1953 | 126 | O - 710 | S174     | -2653 | 126 |
| O - 611 | S273     | -1267 | 261 | O - 661 | S223     | -1967 | 261 | O - 711 | S173     | -2667 | 261 |
| O - 612 | S272     | -1281 | 126 | O - 662 | S222     | -1981 | 126 | O - 712 | S172     | -2681 | 126 |
| O - 613 | S271     | -1295 | 261 | O - 663 | S221     | -1995 | 261 | O - 713 | S171     | -2695 | 261 |
| O - 614 | S270     | -1309 | 126 | O - 664 | S220     | -2009 | 126 | O - 714 | S170     | -2709 | 126 |
| O - 615 | S269     | -1323 | 261 | O - 665 | S219     | -2023 | 261 | O - 715 | S169     | -2723 | 261 |
| O - 616 | S268     | -1337 | 126 | O - 666 | S218     | -2037 | 126 | O - 716 | S168     | -2737 | 126 |
| O - 617 | S267     | -1351 | 261 | O - 667 | S217     | -2051 | 261 | O - 717 | S167     | -2751 | 261 |
| O - 618 | S266     | -1365 | 126 | O - 668 | S216     | -2065 | 126 | O - 718 | S166     | -2765 | 126 |
| O - 619 | S265     | -1379 | 261 | O - 669 | S215     | -2079 | 261 | O - 719 | S165     | -2779 | 261 |
| O - 620 | S264     | -1393 | 126 | O - 670 | S214     | -2093 | 126 | O - 720 | S164     | -2793 | 126 |
| O - 621 | S263     | -1407 | 261 | O - 671 | S213     | -2107 | 261 | O - 721 | S163     | -2807 | 261 |
| O - 622 | S262     | -1421 | 126 | O - 672 | S212     | -2121 | 126 | O - 722 | S162     | -2821 | 126 |
| O - 623 | S261     | -1435 | 261 | O - 673 | S211     | -2135 | 261 | O - 723 | S161     | -2835 | 261 |
| O - 624 | S260     | -1449 | 126 | O - 674 | S210     | -2149 | 126 | O - 724 | S160     | -2849 | 126 |
| O - 625 | S259     | -1463 | 261 | O - 675 | S209     | -2163 | 261 | O - 725 | S159     | -2863 | 261 |
| O - 626 | S258     | -1477 | 126 | O - 676 | S208     | -2177 | 126 | O - 726 | S158     | -2877 | 126 |

| No.     | Pad Name | X     | Y   | No.     | Pad Name | X     | Y   | No.     | Pad Name | X     | Y   |
|---------|----------|-------|-----|---------|----------|-------|-----|---------|----------|-------|-----|
| O - 627 | S257     | -1491 | 261 | O - 677 | S207     | -2191 | 261 | O - 727 | S157     | -2891 | 261 |
| O - 628 | S256     | -1505 | 126 | O - 678 | S206     | -2205 | 126 | O - 728 | S156     | -2905 | 126 |
| O - 629 | S255     | -1519 | 261 | O - 679 | S205     | -2219 | 261 | O - 729 | S155     | -2919 | 261 |
| O - 630 | S254     | -1533 | 126 | O - 680 | S204     | -2233 | 126 | O - 730 | S154     | -2933 | 126 |
| O - 631 | S253     | -1547 | 261 | O - 681 | S203     | -2247 | 261 | O - 731 | S153     | -2947 | 261 |
| O - 632 | S252     | -1561 | 126 | O - 682 | S202     | -2261 | 126 | O - 732 | S152     | -2961 | 126 |
| O - 633 | S251     | -1575 | 261 | O - 683 | S201     | -2275 | 261 | O - 733 | S151     | -2975 | 261 |
| O - 634 | S250     | -1589 | 126 | O - 684 | S200     | -2289 | 126 | O - 734 | S150     | -2989 | 126 |
| O - 635 | S249     | -1603 | 261 | O - 685 | S199     | -2303 | 261 | O - 735 | S149     | -3003 | 261 |
| O - 636 | S248     | -1617 | 126 | O - 686 | S198     | -2317 | 126 | O - 736 | S148     | -3017 | 126 |
| O - 637 | S247     | -1631 | 261 | O - 687 | S197     | -2331 | 261 | O - 737 | S147     | -3031 | 261 |
| O - 638 | S246     | -1645 | 126 | O - 688 | S196     | -2345 | 126 | O - 738 | S146     | -3045 | 126 |
| O - 639 | S245     | -1659 | 261 | O - 689 | S195     | -2359 | 261 | O - 739 | S145     | -3059 | 261 |
| O - 640 | S244     | -1673 | 126 | O - 690 | S194     | -2373 | 126 | O - 740 | S144     | -3073 | 126 |
| O - 641 | S243     | -1687 | 261 | O - 691 | S193     | -2387 | 261 | O - 741 | S143     | -3087 | 261 |
| O - 642 | S242     | -1701 | 126 | O - 692 | S192     | -2401 | 126 | O - 742 | S142     | -3101 | 126 |
| O - 643 | S241     | -1715 | 261 | O - 693 | S191     | -2415 | 261 | O - 743 | S141     | -3115 | 261 |
| O - 644 | S240     | -1729 | 126 | O - 694 | S190     | -2429 | 126 | O - 744 | S140     | -3129 | 126 |
| O - 645 | S239     | -1743 | 261 | O - 695 | S189     | -2443 | 261 | O - 745 | S139     | -3143 | 261 |
| O - 646 | S238     | -1757 | 126 | O - 696 | S188     | -2457 | 126 | O - 746 | S138     | -3157 | 126 |
| O - 647 | S237     | -1771 | 261 | O - 697 | S187     | -2471 | 261 | O - 747 | S137     | -3171 | 261 |
| O - 648 | S236     | -1785 | 126 | O - 698 | S186     | -2485 | 126 | O - 748 | S136     | -3185 | 126 |
| O - 649 | S235     | -1799 | 261 | O - 699 | S185     | -2499 | 261 | O - 749 | S135     | -3199 | 261 |
| O - 650 | S234     | -1813 | 126 | O - 700 | S184     | -2513 | 126 | O - 750 | S134     | -3213 | 126 |

Table 139. Pad Center Coordinates [Unit:  $\mu\text{m}$ ]

| No.     | Pad Name | X     | Y   | No.     | Pad Name | X     | Y   | No.     | Pad Name | X     | Y   |
|---------|----------|-------|-----|---------|----------|-------|-----|---------|----------|-------|-----|
| O - 751 | S133     | -3227 | 261 | O - 801 | S83      | -3927 | 261 | O - 851 | S33      | -4627 | 261 |
| O - 752 | S132     | -3241 | 126 | O - 802 | S82      | -3941 | 126 | O - 852 | S32      | -4641 | 126 |
| O - 753 | S131     | -3255 | 261 | O - 803 | S81      | -3955 | 261 | O - 853 | S31      | -4655 | 261 |
| O - 754 | S130     | -3269 | 126 | O - 804 | S80      | -3969 | 126 | O - 854 | S30      | -4669 | 126 |
| O - 755 | S129     | -3283 | 261 | O - 805 | S79      | -3983 | 261 | O - 855 | S29      | -4683 | 261 |
| O - 756 | S128     | -3297 | 126 | O - 806 | S78      | -3997 | 126 | O - 856 | S28      | -4697 | 126 |
| O - 757 | S127     | -3311 | 261 | O - 807 | S77      | -4011 | 261 | O - 857 | S27      | -4711 | 261 |
| O - 758 | S126     | -3325 | 126 | O - 808 | S76      | -4025 | 126 | O - 858 | S26      | -4725 | 126 |
| O - 759 | S125     | -3339 | 261 | O - 809 | S75      | -4039 | 261 | O - 859 | S25      | -4739 | 261 |
| O - 760 | S124     | -3353 | 126 | O - 810 | S74      | -4053 | 126 | O - 860 | S24      | -4753 | 126 |
| O - 761 | S123     | -3367 | 261 | O - 811 | S73      | -4067 | 261 | O - 861 | S23      | -4767 | 261 |
| O - 762 | S122     | -3381 | 126 | O - 812 | S72      | -4081 | 126 | O - 862 | S22      | -4781 | 126 |
| O - 763 | S121     | -3395 | 261 | O - 813 | S71      | -4095 | 261 | O - 863 | S21      | -4795 | 261 |
| O - 764 | S120     | -3409 | 126 | O - 814 | S70      | -4109 | 126 | O - 864 | S20      | -4809 | 126 |
| O - 765 | S119     | -3423 | 261 | O - 815 | S69      | -4123 | 261 | O - 865 | S19      | -4823 | 261 |
| O - 766 | S118     | -3437 | 126 | O - 816 | S68      | -4137 | 126 | O - 866 | S18      | -4837 | 126 |
| O - 767 | S117     | -3451 | 261 | O - 817 | S67      | -4151 | 261 | O - 867 | S17      | -4851 | 261 |
| O - 768 | S116     | -3465 | 126 | O - 818 | S66      | -4165 | 126 | O - 868 | S16      | -4865 | 126 |
| O - 769 | S115     | -3479 | 261 | O - 819 | S65      | -4179 | 261 | O - 869 | S15      | -4879 | 261 |
| O - 770 | S114     | -3493 | 126 | O - 820 | S64      | -4193 | 126 | O - 870 | S14      | -4893 | 126 |
| O - 771 | S113     | -3507 | 261 | O - 821 | S63      | -4207 | 261 | O - 871 | S13      | -4907 | 261 |

| No.     | Pad Name | X     | Y   | No.     | Pad Name | X     | Y   | No.     | Pad Name | X     | Y   |
|---------|----------|-------|-----|---------|----------|-------|-----|---------|----------|-------|-----|
| O - 772 | S112     | -3521 | 126 | O - 822 | S62      | -4221 | 126 | O - 872 | S12      | -4921 | 126 |
| O - 773 | S111     | -3535 | 261 | O - 823 | S61      | -4235 | 261 | O - 873 | S11      | -4935 | 261 |
| O - 774 | S110     | -3549 | 126 | O - 824 | S60      | -4249 | 126 | O - 874 | S10      | -4949 | 126 |
| O - 775 | S109     | -3563 | 261 | O - 825 | S59      | -4263 | 261 | O - 875 | S9       | -4963 | 261 |
| O - 776 | S108     | -3577 | 126 | O - 826 | S58      | -4277 | 126 | O - 876 | S8       | -4977 | 126 |
| O - 777 | S107     | -3591 | 261 | O - 827 | S57      | -4291 | 261 | O - 877 | S7       | -4991 | 261 |
| O - 778 | S106     | -3605 | 126 | O - 828 | S56      | -4305 | 126 | O - 878 | S6       | -5005 | 126 |
| O - 779 | S105     | -3619 | 261 | O - 829 | S55      | -4319 | 261 | O - 879 | S5       | -5019 | 261 |
| O - 780 | S104     | -3633 | 126 | O - 830 | S54      | -4333 | 126 | O - 880 | S4       | -5033 | 126 |
| O - 781 | S103     | -3647 | 261 | O - 831 | S53      | -4347 | 261 | O - 881 | S3       | -5047 | 261 |
| O - 782 | S102     | -3661 | 126 | O - 832 | S52      | -4361 | 126 | O - 882 | S2       | -5061 | 126 |
| O - 783 | S101     | -3675 | 261 | O - 833 | S51      | -4375 | 261 | O - 883 | S1       | -5075 | 261 |
| O - 784 | S100     | -3689 | 126 | O - 834 | S50      | -4389 | 126 | O - 884 | G319     | -5131 | 126 |
| O - 785 | S99      | -3703 | 261 | O - 835 | S49      | -4403 | 261 | O - 885 | G317     | -5145 | 261 |
| O - 786 | S98      | -3717 | 126 | O - 836 | S48      | -4417 | 126 | O - 886 | G315     | -5159 | 126 |
| O - 787 | S97      | -3731 | 261 | O - 837 | S47      | -4431 | 261 | O - 887 | G313     | -5173 | 261 |
| O - 788 | S96      | -3745 | 126 | O - 838 | S46      | -4445 | 126 | O - 888 | G311     | -5187 | 126 |
| O - 789 | S95      | -3759 | 261 | O - 839 | S45      | -4459 | 261 | O - 889 | G309     | -5201 | 261 |
| O - 790 | S94      | -3773 | 126 | O - 840 | S44      | -4473 | 126 | O - 890 | G307     | -5215 | 126 |
| O - 791 | S93      | -3787 | 261 | O - 841 | S43      | -4487 | 261 | O - 891 | G305     | -5229 | 261 |
| O - 792 | S92      | -3801 | 126 | O - 842 | S42      | -4501 | 126 | O - 892 | G303     | -5243 | 126 |
| O - 793 | S91      | -3815 | 261 | O - 843 | S41      | -4515 | 261 | O - 893 | G301     | -5257 | 261 |
| O - 794 | S90      | -3829 | 126 | O - 844 | S40      | -4529 | 126 | O - 894 | G299     | -5271 | 126 |
| O - 795 | S89      | -3843 | 261 | O - 845 | S39      | -4543 | 261 | O - 895 | G297     | -5285 | 261 |
| O - 796 | S88      | -3857 | 126 | O - 846 | S38      | -4557 | 126 | O - 896 | G295     | -5299 | 126 |
| O - 797 | S87      | -3871 | 261 | O - 847 | S37      | -4571 | 261 | O - 897 | G293     | -5313 | 261 |
| O - 798 | S86      | -3885 | 126 | O - 848 | S36      | -4585 | 126 | O - 898 | G291     | -5327 | 126 |
| O - 799 | S85      | -3899 | 261 | O - 849 | S35      | -4599 | 261 | O - 899 | G289     | -5341 | 261 |
| O - 800 | S84      | -3913 | 126 | O - 850 | S34      | -4613 | 126 | O - 900 | G287     | -5355 | 126 |

Table 140. Pad Center Coordinates [Unit:  $\mu\text{m}$ ]

| No.     | Pad Name | X     | Y   | No.     | Pad Name | X     | Y   | No.      | Pad Name | X     | Y   |
|---------|----------|-------|-----|---------|----------|-------|-----|----------|----------|-------|-----|
| O - 901 | G285     | -5369 | 261 | O - 951 | G185     | -6069 | 261 | O - 1001 | G85      | -6769 | 261 |
| O - 902 | G283     | -5383 | 126 | O - 952 | G183     | -6083 | 126 | O - 1002 | G83      | -6783 | 126 |
| O - 903 | G281     | -5397 | 261 | O - 953 | G181     | -6097 | 261 | O - 1003 | G81      | -6797 | 261 |
| O - 904 | G279     | -5411 | 126 | O - 954 | G179     | -6111 | 126 | O - 1004 | G79      | -6811 | 126 |
| O - 905 | G277     | -5425 | 261 | O - 955 | G177     | -6125 | 261 | O - 1005 | G77      | -6825 | 261 |
| O - 906 | G275     | -5439 | 126 | O - 956 | G175     | -6139 | 126 | O - 1006 | G75      | -6839 | 126 |
| O - 907 | G273     | -5453 | 261 | O - 957 | G173     | -6153 | 261 | O - 1007 | G73      | -6853 | 261 |
| O - 908 | G271     | -5467 | 126 | O - 958 | G171     | -6167 | 126 | O - 1008 | G71      | -6867 | 126 |
| O - 909 | G269     | -5481 | 261 | O - 959 | G169     | -6181 | 261 | O - 1009 | G69      | -6881 | 261 |
| O - 910 | G267     | -5495 | 126 | O - 960 | G167     | -6195 | 126 | O - 1010 | G67      | -6895 | 126 |
| O - 911 | G265     | -5509 | 261 | O - 961 | G165     | -6209 | 261 | O - 1011 | G65      | -6909 | 261 |
| O - 912 | G263     | -5523 | 126 | O - 962 | G163     | -6223 | 126 | O - 1012 | G63      | -6923 | 126 |
| O - 913 | G261     | -5537 | 261 | O - 963 | G161     | -6237 | 261 | O - 1013 | G61      | -6937 | 261 |
| O - 914 | G259     | -5551 | 126 | O - 964 | G159     | -6251 | 126 | O - 1014 | G59      | -6951 | 126 |
| O - 915 | G257     | -5565 | 261 | O - 965 | G157     | -6265 | 261 | O - 1015 | G57      | -6965 | 261 |
| O - 916 | G255     | -5579 | 126 | O - 966 | G155     | -6279 | 126 | O - 1016 | G55      | -6979 | 126 |

| No.     | Pad Name | X     | Y   | No.     | Pad Name | X     | Y   | No.      | Pad Name | X     | Y   |
|---------|----------|-------|-----|---------|----------|-------|-----|----------|----------|-------|-----|
| O - 917 | G253     | -5593 | 261 | O - 967 | G153     | -6293 | 261 | O - 1017 | G53      | -6993 | 261 |
| O - 918 | G251     | -5607 | 126 | O - 968 | G151     | -6307 | 126 | O - 1018 | G51      | -7007 | 126 |
| O - 919 | G249     | -5621 | 261 | O - 969 | G149     | -6321 | 261 | O - 1019 | G49      | -7021 | 261 |
| O - 920 | G247     | -5635 | 126 | O - 970 | G147     | -6335 | 126 | O - 1020 | G47      | -7035 | 126 |
| O - 921 | G245     | -5649 | 261 | O - 971 | G145     | -6349 | 261 | O - 1021 | G45      | -7049 | 261 |
| O - 922 | G243     | -5663 | 126 | O - 972 | G143     | -6363 | 126 | O - 1022 | G43      | -7063 | 126 |
| O - 923 | G241     | -5677 | 261 | O - 973 | G141     | -6377 | 261 | O - 1023 | G41      | -7077 | 261 |
| O - 924 | G239     | -5691 | 126 | O - 974 | G139     | -6391 | 126 | O - 1024 | G39      | -7091 | 126 |
| O - 925 | G237     | -5705 | 261 | O - 975 | G137     | -6405 | 261 | O - 1025 | G37      | -7105 | 261 |
| O - 926 | G235     | -5719 | 126 | O - 976 | G135     | -6419 | 126 | O - 1026 | G35      | -7119 | 126 |
| O - 927 | G233     | -5733 | 261 | O - 977 | G133     | -6433 | 261 | O - 1027 | G33      | -7133 | 261 |
| O - 928 | G231     | -5747 | 126 | O - 978 | G131     | -6447 | 126 | O - 1028 | G31      | -7147 | 126 |
| O - 929 | G229     | -5761 | 261 | O - 979 | G129     | -6461 | 261 | O - 1029 | G29      | -7161 | 261 |
| O - 930 | G227     | -5775 | 126 | O - 980 | G127     | -6475 | 126 | O - 1030 | G27      | -7175 | 126 |
| O - 931 | G225     | -5789 | 261 | O - 981 | G125     | -6489 | 261 | O - 1031 | G25      | -7189 | 261 |
| O - 932 | G223     | -5803 | 126 | O - 982 | G123     | -6503 | 126 | O - 1032 | G23      | -7203 | 126 |
| O - 933 | G221     | -5817 | 261 | O - 983 | G121     | -6517 | 261 | O - 1033 | G21      | -7217 | 261 |
| O - 934 | G219     | -5831 | 126 | O - 984 | G119     | -6531 | 126 | O - 1034 | G19      | -7231 | 126 |
| O - 935 | G217     | -5845 | 261 | O - 985 | G117     | -6545 | 261 | O - 1035 | G17      | -7245 | 261 |
| O - 936 | G215     | -5859 | 126 | O - 986 | G115     | -6559 | 126 | O - 1036 | G15      | -7259 | 126 |
| O - 937 | G213     | -5873 | 261 | O - 987 | G113     | -6573 | 261 | O - 1037 | G13      | -7273 | 261 |
| O - 938 | G211     | -5887 | 126 | O - 988 | G111     | -6587 | 126 | O - 1038 | G11      | -7287 | 126 |
| O - 939 | G209     | -5901 | 261 | O - 989 | G109     | -6601 | 261 | O - 1039 | G9       | -7301 | 261 |
| O - 940 | G207     | -5915 | 126 | O - 990 | G107     | -6615 | 126 | O - 1040 | G7       | -7315 | 126 |
| O - 941 | G205     | -5929 | 261 | O - 991 | G105     | -6629 | 261 | O - 1041 | G5       | -7329 | 261 |
| O - 942 | G203     | -5943 | 126 | O - 992 | G103     | -6643 | 126 | O - 1042 | G3       | -7343 | 126 |
| O - 943 | G201     | -5957 | 261 | O - 993 | G101     | -6657 | 261 | O - 1043 | G1       | -7357 | 261 |
| O - 944 | G199     | -5971 | 126 | O - 994 | G99      | -6671 | 126 | O - 1044 | DUMMY    | -7371 | 126 |
| O - 945 | G197     | -5985 | 261 | O - 995 | G97      | -6685 | 261 | O - 1045 | DUMMY    | -7385 | 261 |
| O - 946 | G195     | -5999 | 126 | O - 996 | G95      | -6699 | 126 | O - 1046 | DUMMY    | -7399 | 126 |
| O - 947 | G193     | -6013 | 261 | O - 997 | G93      | -6713 | 261 |          |          |       |     |
| O - 948 | G191     | -6027 | 126 | O - 998 | G91      | -6727 | 126 |          |          |       |     |
| O - 949 | G189     | -6041 | 261 | O - 999 | G89      | -6741 | 261 |          |          |       |     |
| O - 950 | G187     | -6055 | 126 | O -     | G87      | -6755 | 126 |          |          |       |     |

6.4. DISPLAY MODULE DEFAULT POSITION

The default position (display driver, glass, filter order, etc) of the display module is always as follow, when MADCTL's (36h) parameter is 00h. The color filter is always RGB (if color filters are used).

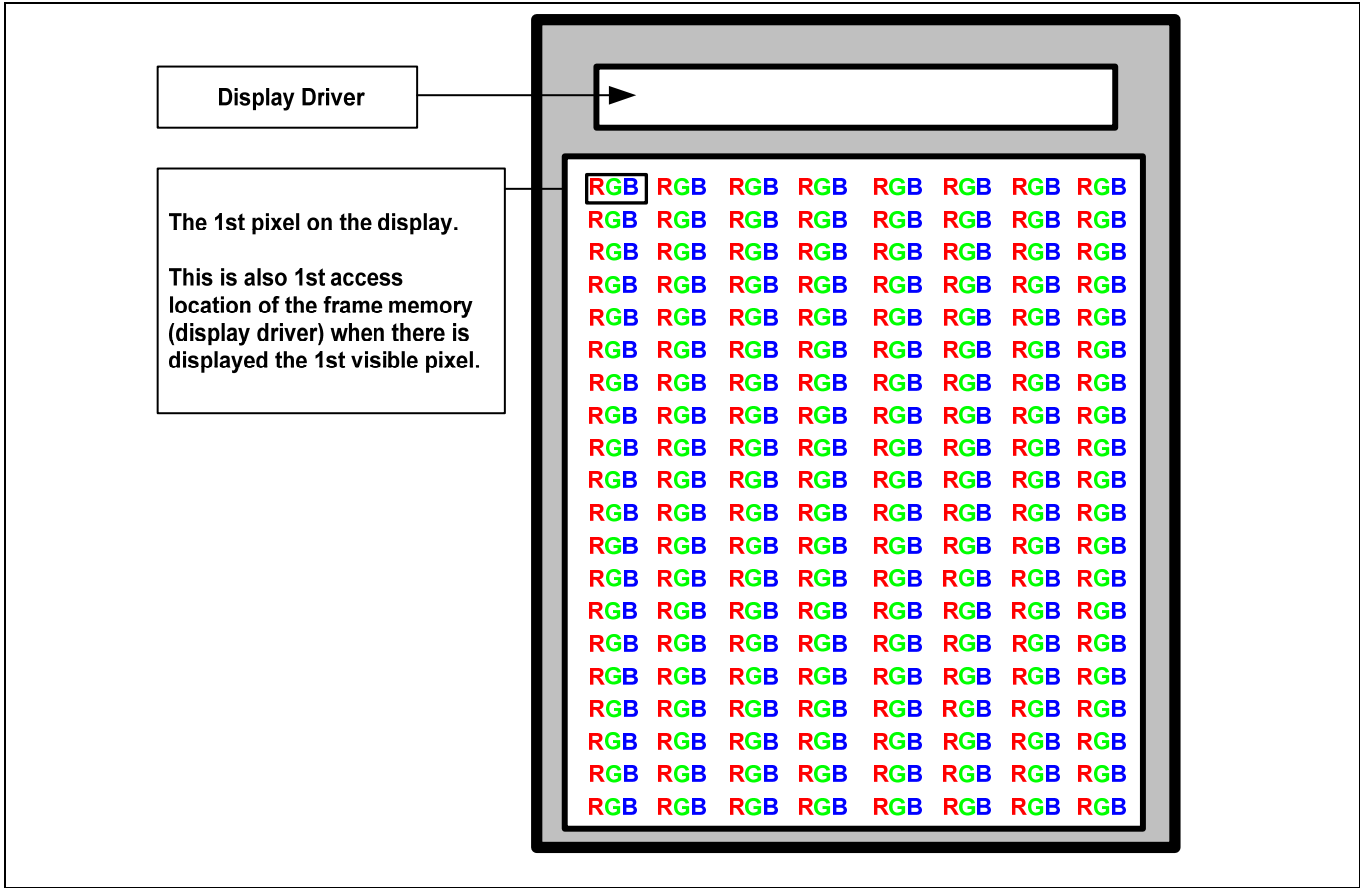


Figure121. Display Module Default Position

With collaboration of <https://www.displayfuture.com>