MULTI-INNO TECHNOLOGY CO., LTD.

www.multi-inno.com

LCD MODULE SPECIFICATION

Model : MI0145BT-1

This module uses ROHS material

For Customer's Acceptance:

Customer	
Approved	
Comment	

This specification may change without prior notice in order to improve performance or quality. Please contact Multi-Inno for updated specification and product status before design for this product or release of this order.	Revision	1.3
	Engineering	
	Date	2013-09-10
	Our Reference	

REVISION RECORD

REV NO.	REV DATE	CONTENTS	REMARKS
1.0	2012-02-10	First release	
1.1	2012-09-24	Update backlight forward voltage	
1.2	2013-01-06	Update power consumption	
1.3	2013-09-10	Change IC from HX8353D to ST7735S	

CONTENTS

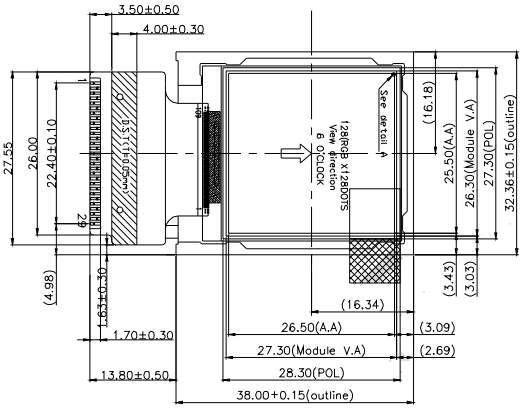
■ GENERAL INFORMATION

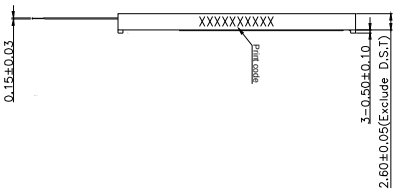
Item	Contents	Unit
LCD type	TFT/Transmissive/Normally white	/
Size	1.45	Inch
Viewing direction	6:00	O' Clock
Gray scale inversion direction	12:00	O' Clock
LCM (W × H × D)	32.36×38.00×2.60	mm^3
Active area (W×H)	25.50×26.50	mm^2
Pixel pitch (W×H)	0.1992×0.2070	mm^2
Number of dots	128 (RGB) × 128	/
Driver IC	ST7735S	/
Backlight type	1 LED	/
Interface type	CPU 8 bit,SPI3,SPI4	/
Color depth	65K/262K	/
Pixel configuration	R.G.B stripe	/
Surface treatment	Clear type	/
Input voltage	2.75	V
With/Without TSP	Without TSP	/
Weight	4.34	g

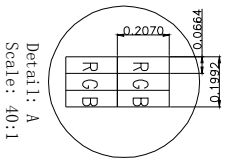
Note 1:Viewing direction for best image quality is different from TFT definition, there is a 180 degree shift.
Note 2 : RoHS compliant;
Note 3: LCM weight tolerance: ± 5% .

■ EXTERNAL DIMENSIONS .

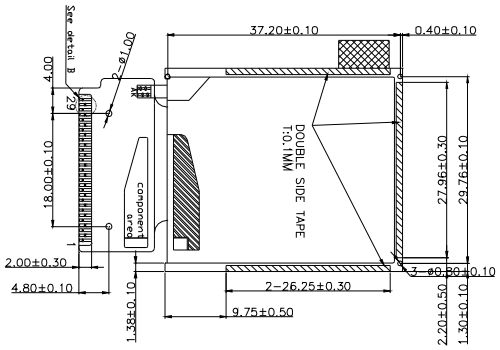
No:	PIN NAME
1	LCM-ID(VDD)
2	LED+
3	LED-
4	VG
5	XV0
6	V0
7	Vm
8	VDD
9	VSS
10	VDD
11	/EXT
12	/CS
13	IF3
14	IF1
15	RESET
16	RD
17	IOVCC
18	D7
19	D6
20	D5
21	D4
22	D3
23	D2
24	D1
25	D0
26	WR
27	RS
28	VPP
29	GND

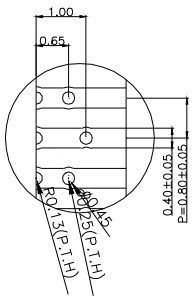






Detail: A
Scale: 40:1





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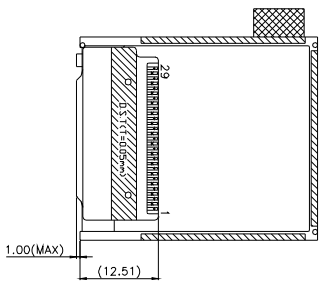


LED CIRCUIT DIAGRAM

NOTES:
1.Display Type: TFT
2.Backlight:1-chips LED
3.Gray Scale Inversion: 12 o'clock;
4.Driver IC:ST7735S
5.General Tolerance: ±0.2
6.Requirements on Environment Protection:RoHS Compliant.
7.Recommeded Case Open Area should be less than Module V/A.

CUSTOMER APVL	CUSTOMER		
DRAWN		DATE	
DFTG CHK			
ENGR CHK		SCALE	
APPROVAL		UNIT	mm
MULTI-INNO TECHNOLOGY CO.,LTD.		MODEL	
	TITLE	MI0145BT-1	
	DWG NO		PAGE 1/1

■ ABSOLUTE MAXIMUM RATINGS

Parameter of absolute maximum ratings	Symbol	Min	Max	Unit
Analog supply voltage	VDD	-0.3	4.8	V
Logic supply volage	IOVCC	-0.3	4.6	V
Input volage	VIN	-0.3	IOVCC+0.3	V
Backlight forward current	I_{LED}	-	15	mA
Operating temperature	Top	-30	85	°C
Storage temperature	TST	-40	125	°C
Humidity	RH	-	90%(Max60 °C)	RH

NOTE1 : VIN: D 7:0 ,/CS,D/C,W/R,RD/RESET,SCL,SDA

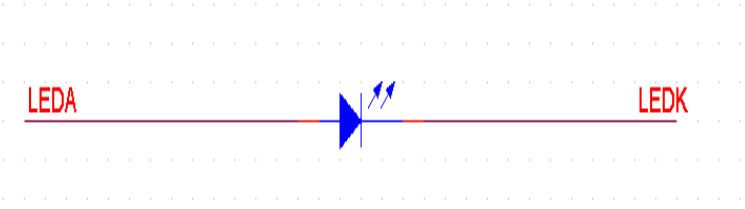
■ ELECTRICAL CHARACTERISTICS

DC CHARACTERISTICS

Parameter of DC characteristics	Symbol	Min	Typ	Max	Unit
Logic supply voltage	IOVCC	1.65	1.8	3.7	V
Analog supply voltage	VDD	2.5	2.75	4.8	V
Input voltage 'H' level	VIH	0.7IOVCC	-	IOVCC	V
Input voltage 'L' level	VIL	VSSD	-	0.3IOVCC	V
Output voltage 'H' level	VOH	0.8IOVCC	-	IOVCC	V
Output voltage 'L' level	VOL	VSSD	-	0.2IOVCC	V
(Panel+LSI) Power consumption	Black mode (60Hz)	-	3.808	-	mW
	8-color mode	-	1.596	-	mW
	Sleeping mode	-	0.004	-	mW

■ BACKLIGHT CHARACTERISTICS

Item of backlight characteristics	Symbol	Min.	Typ.	Max.	Unit	Condition
Forward voltage	Vf	3.1	3.2	3.3	V	If=15mA,One LED
Number of LED	-	-	1	-	Piece	
Backlight power consumption	W_{BL}	-	48	-	mW	One LED
Operating life time	-	-	20000	-	Hrs	



LED driver circuit

Note1: The minimal life of LED : 20,000 hours.

Optical performance should be evaluated at Ta=25℃ only.

If LED is driven by high current, high ambient temperature & humidity condition. The life time of LED will be reduced. Operating life means brightness goes down to 50% initial brightness. Typical operating life time is estimated data.

■ ELECTRO-OPTICAL CHARACTERISTICS

Item of electro-optical characteristics	Symbol	Condition	Min	Typ	Max	Unit	Remark	Note
Response time	Tr+ Tf	θ=0° ∅=0° Ta=25℃	-	40	60	ms	Fig.1	4
Contrast ratio	Cr		400	500	-	---	FIG 2.	1
Luminance uniformity	δ WHITE		-	80	-	%	FIG 2.	3
Surface Luminance	Lv		-	180	-	cd/m^2	FIG 2.	2
Viewing angle range	θ	∅ = 90°	60	70	-	deg	FIG3.	6
		∅ = 270°	50	60	-	deg	FIG3.	
		∅ = 0°	60	70	-	deg	FIG 3.	
		∅ = 180°	60	70	-	deg	FIG 3.	
CIE (x, y) chromaticity	Red x	θ=0° ∅=0° Ta=25℃	0.526	0.576	0.626	-	FIG 2.	5
	Red y		0.267	0.317	0.367	-		
	Green x		0.290	0.340	0.390	-		
	Green y		0.527	0.577	0.627			
	Blue x		0.101	0.151	0.201	-		
	Blue y		0.037	0.087	0.137	-		
	White x		0.228	0.278	0.328	-		
	White y		0.242	0.292	0.342			

Note1. Contrast Ratio(CR) is defined mathematically by the following formula. For more information see FIG 2.:

$$\text{ContrastRatio} = \frac{\text{AverageSurface Luminance with all white pixels } (\text{P 1, P2, P 3, P4, P5})}{\text{Average SurfaceLuminance with all black pixels } (\text{P1, P2, P 3, P4, P5})}$$

Note2. Surface luminance is the LCD surface from the surface with all pixels displaying white. For more information see FIG 2.

Lv = Average Surface Luminance with all white pixels (P1, P2, P 3,P4, P5)

Note3. The uniformity in surface luminance（δ WHITE）is determined by measuring luminance at each test position 1 through 5, and then dividing the maximum luminance of 5 points luminance by minimum luminance of 5 points luminance. For more information see FIG 2.

$$\delta \text{ WHITE} = \frac{\textbf{Minimum Surface Luminance with all white pixels } (\mathbf{P_1, P_2, P_3, P_4, P_5})}{\textbf{Maximum Surface Luminance with allwhite pixels } (\mathbf{P_1, P_2, P_3, P_4, P_5})}$$

Note4. Response time is the time required for the display to transition from White to black(Rise Time, Tr) and from black to white(Decay Time, Tf). For additional information see FIG 1..

Note5. CIE (x, y) chromaticity ,The x,y value is determined by screen active area position 5. For more information see FIG 2.

Note6. Viewing angle is the angle at which the contrast ratio is greater than 2. For TFT module the conrast ratio is greater than 10. The angles are determined for the horizontal or x axis and the vertical or y axis with respect to the z axis which is normal to the LCD surface. For more information see FIG 3.

Note7. For Viewing angle and response time testing, the testing data is base on Autronic-Melchers's ConoScope. Series Instruments. For contrast ratio, Surface Luminance, Luminance uniformity and CIE， the testing data is base on TOPCON's BM-5 photo detector.

Note8. For TFT transmissive module,Gray scale reverse occurs in the direction of panel viewing angle.

FIG.1. The definition of Response Time

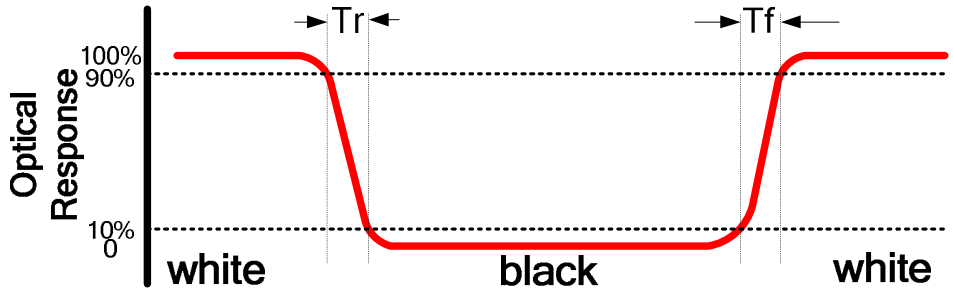


FIG.2. Measuring method for Contrast ratio,surface luminance, Luminance uniformity,CIE (x, y) chromaticity

A : 5 mm
B : 5 mm
H,V : Active Area
Light spot size ∅=5mm, 500mm distance from the LCD surface to detector lens
measurement instrument is TOPCON's luminance meter BM-5

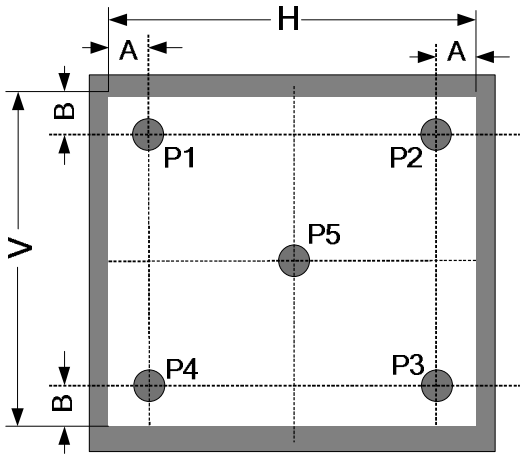
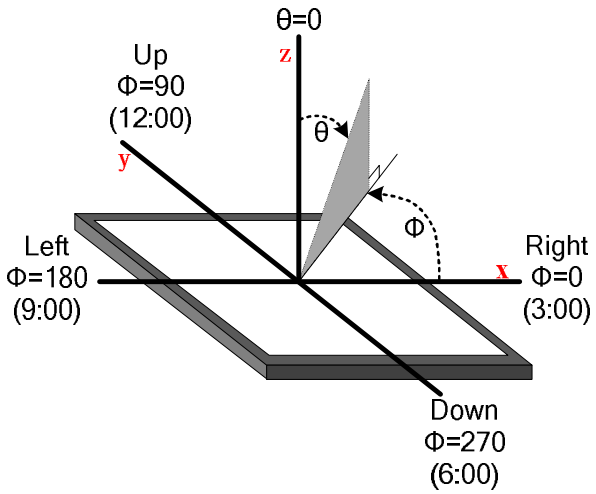


FIG.3. The definition of viewing angle

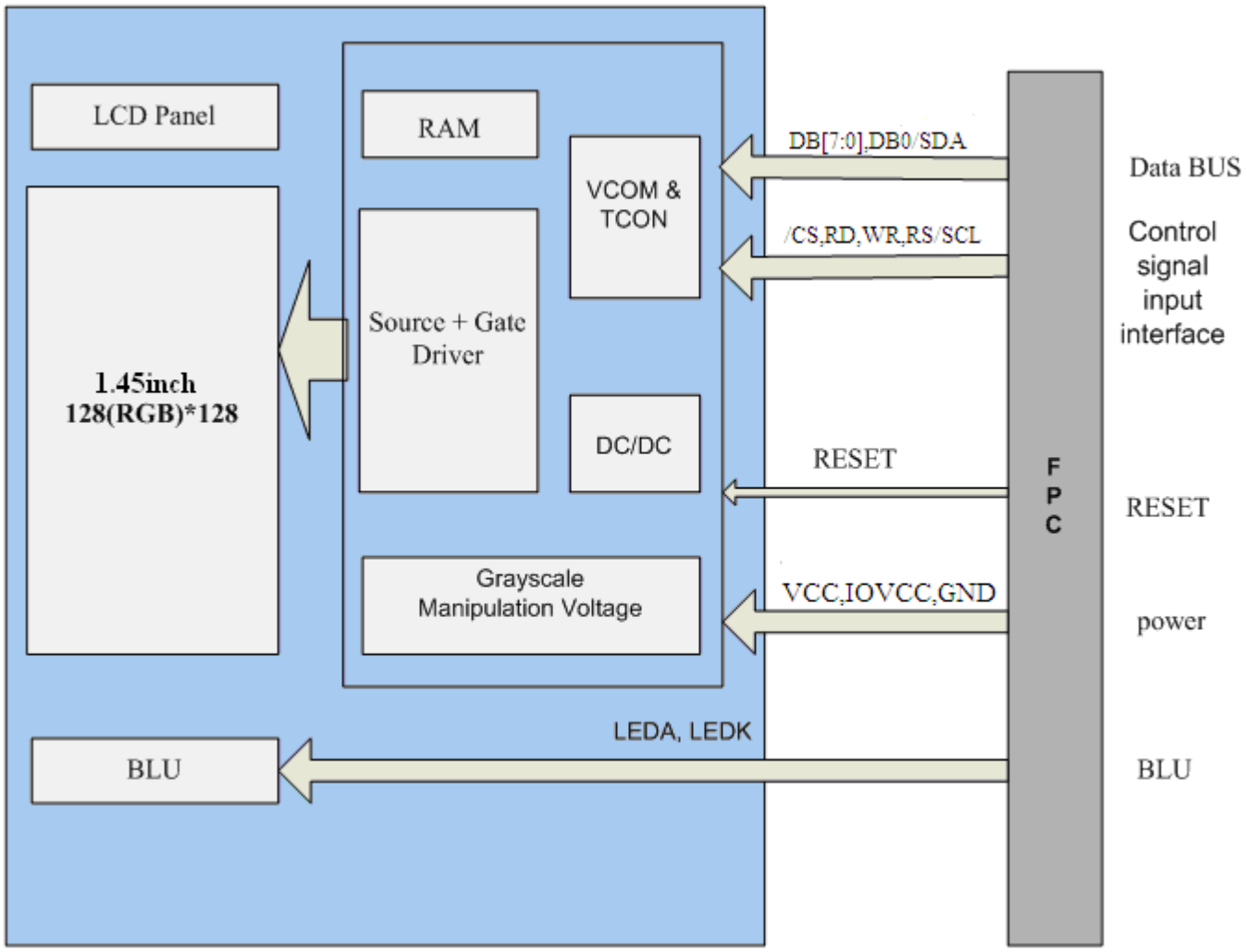


■ INTERFACE DESCRIPTION

Num	Symbol	I/O	Description	Remarks
1	LCM_ID(VDD)	O	Distinction of LCD maker	
2	LED+	P	Back light anode	
3	LED-	P	Back light cathode	
4	VG	-	NC	
5	XVD	-	NC	
6	VO	-	NC	
7	VM	-	NC	
8	VDD	P	Power supply for internal analog circuits	
9	VSS	P	Ground	
10	VDD	P	Power supply for internal analog circuits l	
11	/EXT	-	NC	
12	/CS	I	Chip select signal , low: chip can be accessed	
13	IF3	I	IF[3,1]=00:3w; IF[3,1]=01:4w IF[3,1]=10:8bit; IF[3,1]=11:8bit	
14	IF1	I		
15	RESET	I	Reset signal	
16	RD	I	Read signal	
17	IOVCC	P	Power supply for I/O system.	
18	D7	I	Data input, connect to GND when unused	
19	D6	I	Data input, connect to GND when unused	
20	D5	I	Data input, connect to GND when unused	
21	D4	I	Data input, connect to GND when unused	
22	D3	I	Data input, connect to GND when unused	
23	D2	I	Data input, connect to GND when unused	
24	D1	I	Data input, connect to GND when unused	
25	D0/SDA	I	Data input/Serial data pin	
26	WR	I	Write signal	
27	RS/SCL	I	Command/Data select signal, low: instruction； high: data When under serial interface, it servers as SCL.	
28	VPP	-	NC	
29	GND	P	Ground	

■ BLOCK DIAGRAM

LCD module diagram

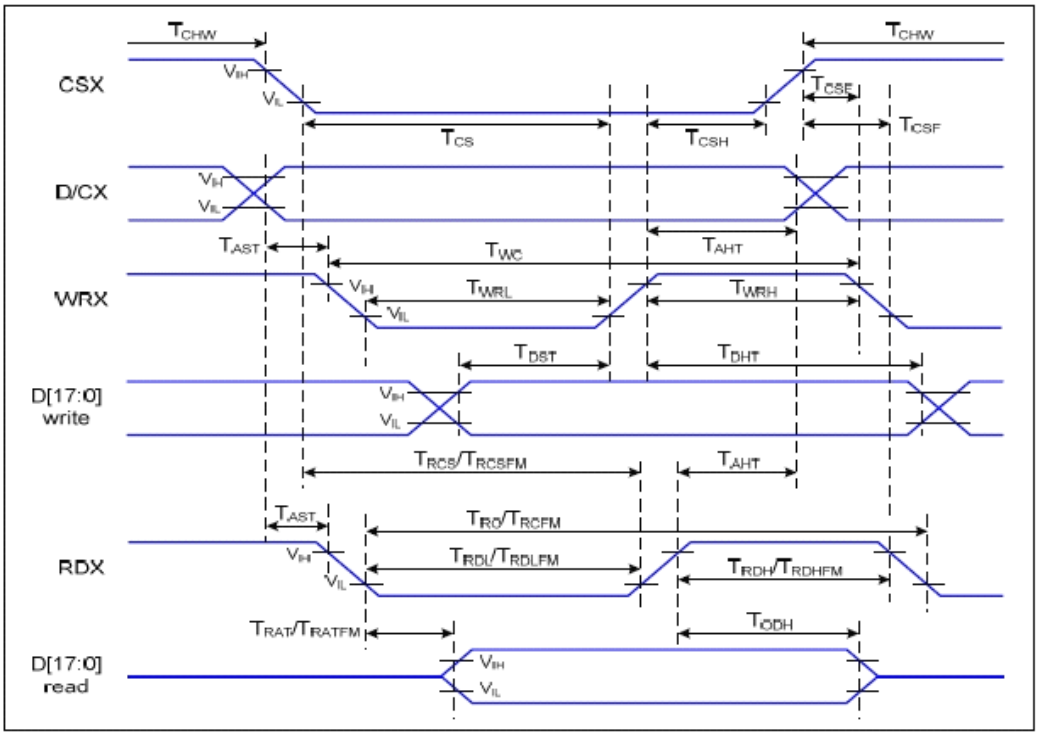


■ REFERENCE APPLICATION NOTES

1. Interface timing

1.1 CPU Interface

1.1.1 Interface Characteristics



CPU Interface Characteristics

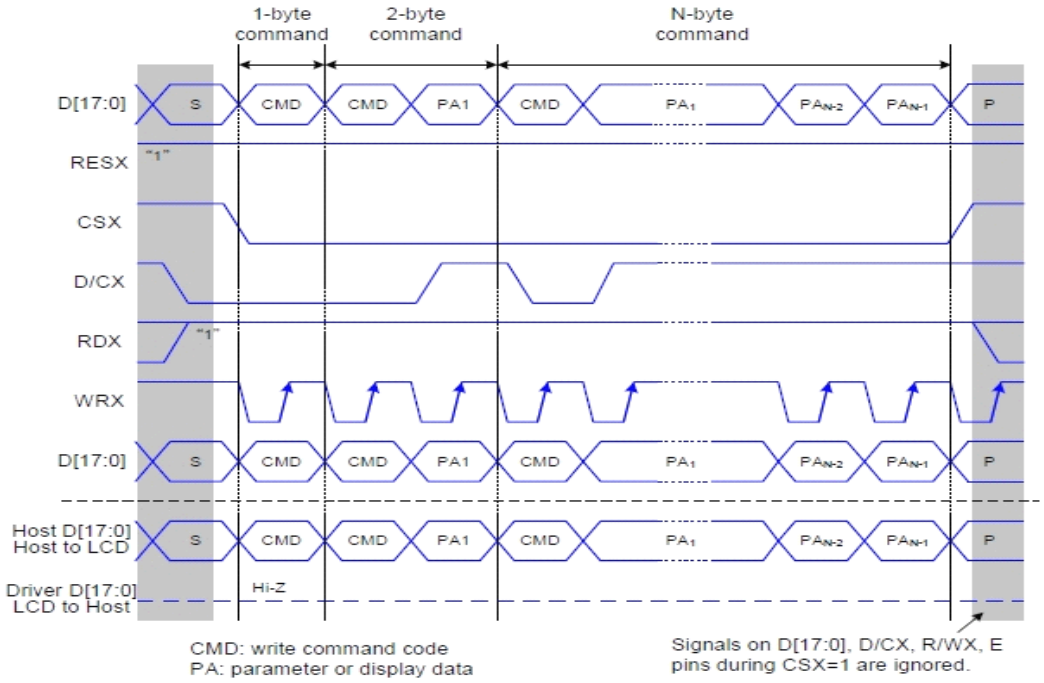
1.1.2 Interface Timing Parameters

Signal	Symbol	Parameter	Min.	Max.	Unit	Description
RS	tAST	Address setup time	0	-	ns	-
	tAHT	Address hold time (Write/Read)	10	-		
/CS	tCHW	Chip select "H" pulse width	0	-	ns	-
	tCS	Chip select setup time (Write)	15	-		
	tRCS	Chip select setup time (Read ID)	45	-		
	tRCSFM	Chip select setup time (Read FM)	355	-		
	tCSF	Chip select wait time (Write/Read)	10	-		
	tCSH	Chip select hold time	10	-		
WR	tWC	Write cycle	66	-	ns	-
	tWRH	Control pulse "H" duration	15	-		
	tWRL	Control pulse "L" duration	15	-		
RD(ID)	tRC	Read cycle (ID)	160	-	ns	When read ID data
	tRDH	Control pulse "H" duration (ID)	90	-		
	tRDL	Control pulse "L" duration (ID)	45	-		
RD(FM)	tRCFM	Read cycle (FM)	450	-	ns	When read from frame memory
	tRDHFM	Control pulse "H" duration (FM)	90	-		
	tRDLFM	Control pulse "L" duration (FM)	355	-		
D[7:0]	tDST	Data setup time	10	-	ns	For maximum CL=30pF For minimum CL=8pF
	tDHT	Data hold time	10	-		
	tRAT	Read access time (ID)	-	40		
	tRATFM	Read access time (FM)	-	340		
	tODH	Output disable time	20	80		

CPU Interface Timing Parameters

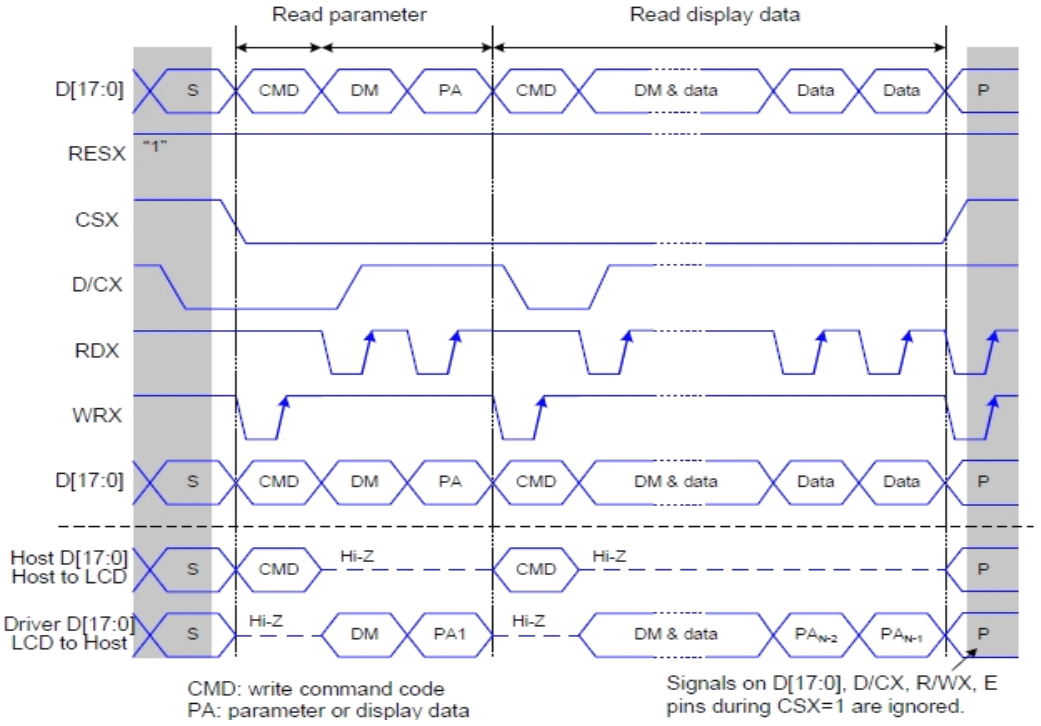
1.1.3 Register Write/Read Timing

1.1.3.1 System Bus Interface Register Write Timing



Register Write Timing in Parallel Bus System Interface (for I80 series MPU)

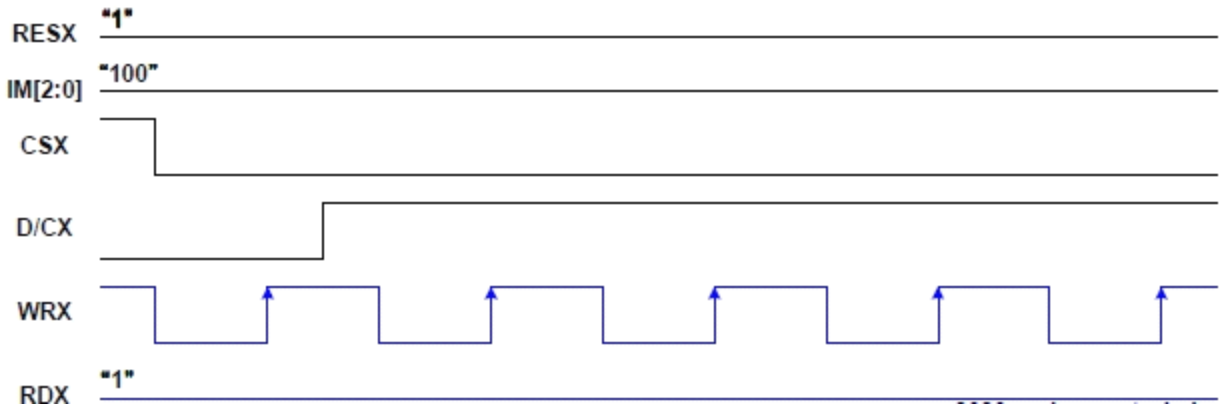
1.1.3.2 System Bus Interface Register Read Timing



Register Read Timing in Parallel Bus System Interface (for I80 series MPU)

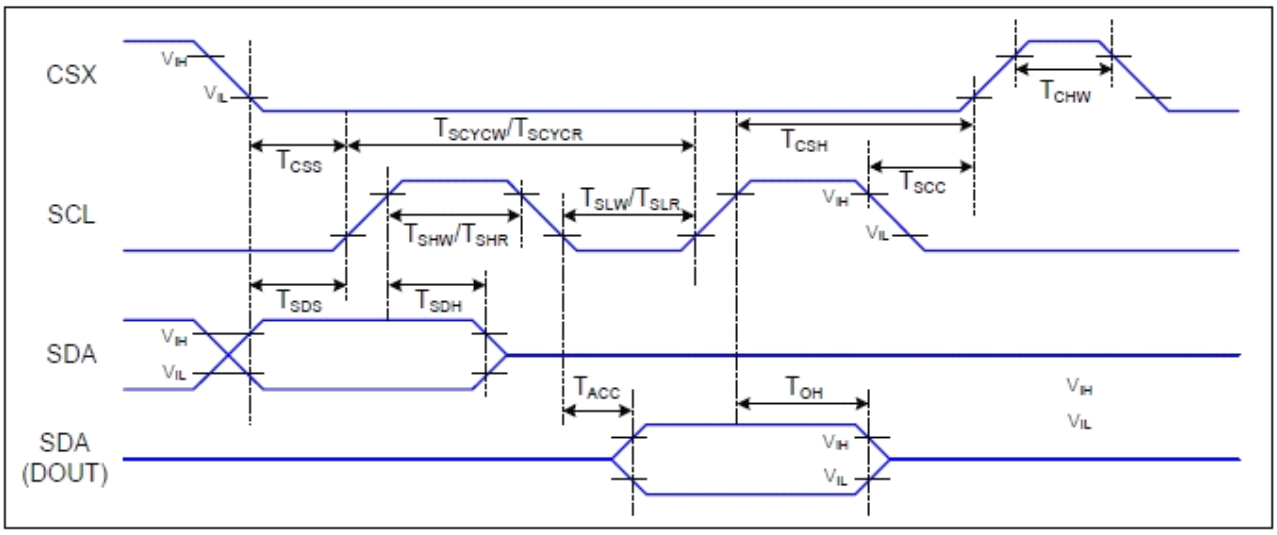
1.1.4 GRAM Write/Read timing

Register Command	D17	D16	D15	D14	D13	D12	D11	D10	D9	D8	D7	D6	D5	D4	D3	D2	D1	D0	Command
	x	x	x	x	x	x	x	x	x	x	0	0	1	0	1	1	0	0	2CH
3AH	D17	D16	D15	D14	D13	D12	D11	D10	D9	D8	D7	D6	D5	D4	D3	D2	D1	D0	Color
03h	x	x	x	x	x	x	x	x	x	x	R3	R2	R1	R0	G3	G2	G1	G0	4K-Color (2-pixel/ 3-bytes)
	x	x	x	x	x	x	x	x	x	x	B3	B2	B1	B0	R3	R2	R1	R0	
	x	x	x	x	x	x	x	x	x	x	G3	G2	G1	G0	B3	B2	B1	B0	
05h	x	x	x	x	x	x	x	x	x	x	R4	R3	R2	R1	R0	G5	G4	G3	65K-Color (1-pixel/ 2-bytes)
	x	x	x	x	x	x	x	x	x	x	G2	G1	G0	B4	B3	B2	B1	B0	
06h	x	x	x	x	x	x	x	x	x	x	R5	R4	R3	R2	R1	R0	x	x	262K-Color (1-pixel/ 3bytes)
	x	x	x	x	x	x	x	x	x	x	G5	G4	G3	G2	G1	G0	x	x	
	x	x	x	x	x	x	x	x	x	x	B5	B4	B3	B2	B1	B0	x	x	



1.2 SPI Interface

1.2.1 3-line Interface Characteristics



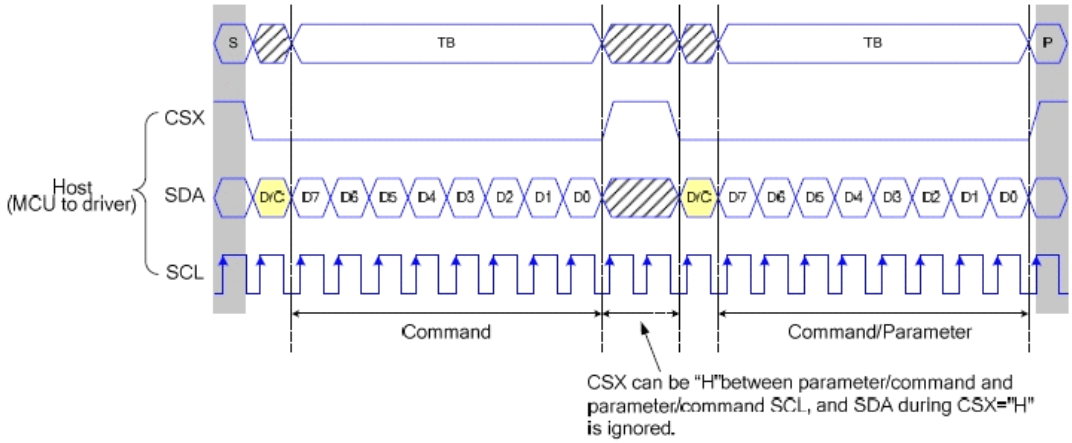
1.2.2 3-line Interface Timing Parameters

Signal	Symbol	Parameter	Min	Max	Unit	Description
CSX	TCSS	Chip Select Setup Time (Write)	15		ns	
	TCSH	Chip Select Hold Time (Write)	15		ns	
	TCSS	Chip Select Setup Time (Read)	60		ns	
	TSCC	Chip Select Hold Time (Read)	65		ns	
	TCHW	Chip Select "H" pulse width	40		ns	
SCL	TSCYCW	Serial Clock Cycle (Write)	66		ns	
	TSHW	SCL "H" Pulse Width (Write)	15		ns	
	TSLW	SCL "L" Pulse Width (Write)	15		ns	
	TSCYCR	Serial Clock Cycle (Read)	150		ns	
	TSHR	SCL "H" Pulse Width (Read)	60		ns	
	TSLR	SCL "L" Pulse Width (Read)	60		ns	
SDA (DIN) (DOUT)	TSDS	Data Setup Time	10		ns	For Maximum CL=30pF For Minimum CL=8pF
	TSDH	Data Hold Time	10		ns	
	TACC	Access Time	10	50	ns	
	TOH	Output Disable Time	15	50	ns	

SPI Interface Timing Parameters

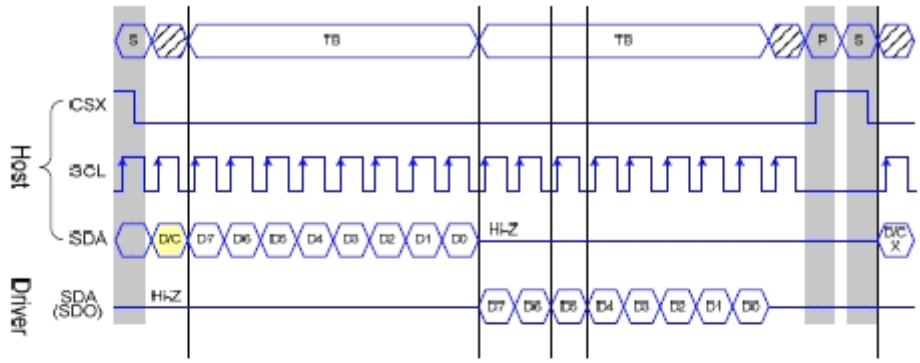
1.2.3 3-line Interface Register Write/Read Timing

1.2.3.1 System Bus Interface Register Write Timin

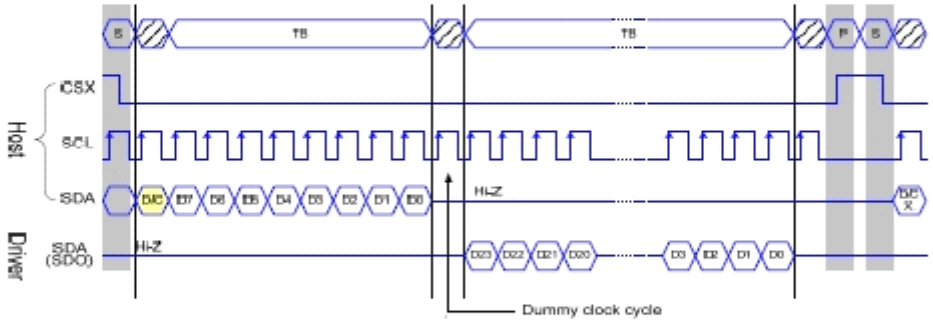


1.2.3.2 System Bus Interface Register Read Timing

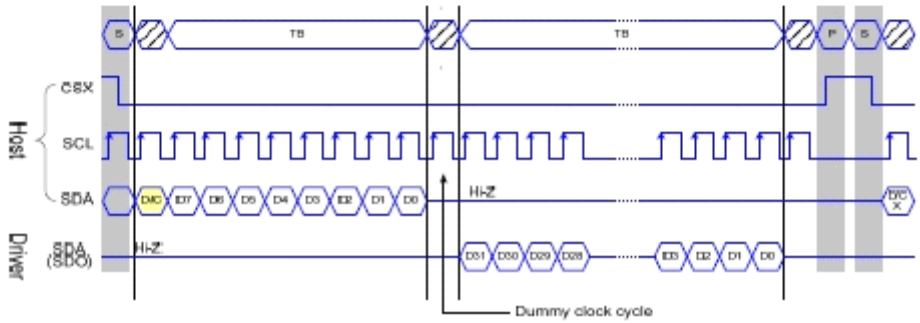
3-line Serial Protocol (for RDID1/RDID2/RDID3/0Ah/0Bh/0Ch/0Dh/0Eh/0Fh Command: 8-bit Read):



3-line Serial Protocol (for RDDID Command: 24-bit Read)

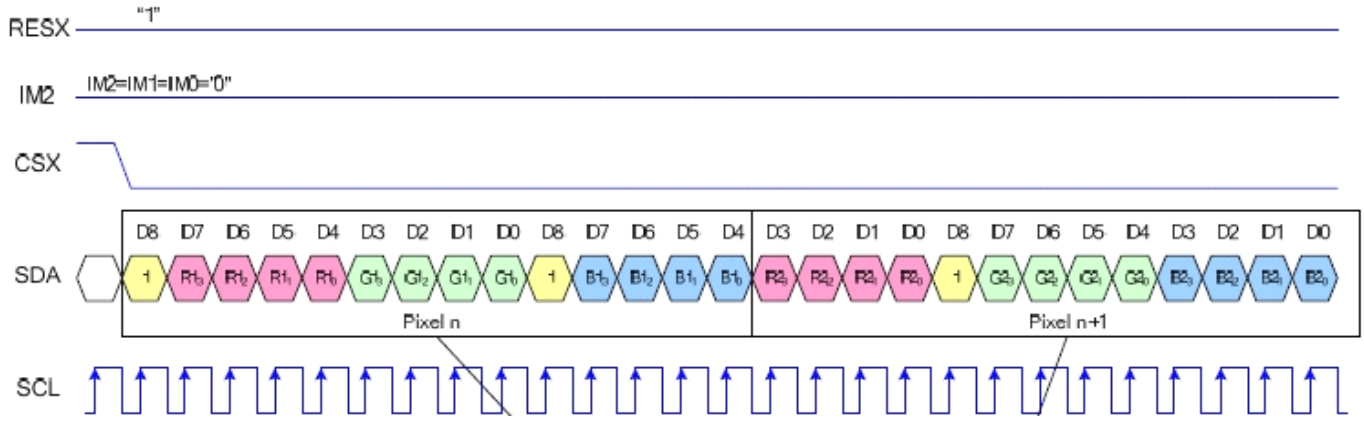


3-line Serial Protocol (for RDDST Command: 32-bit Read)

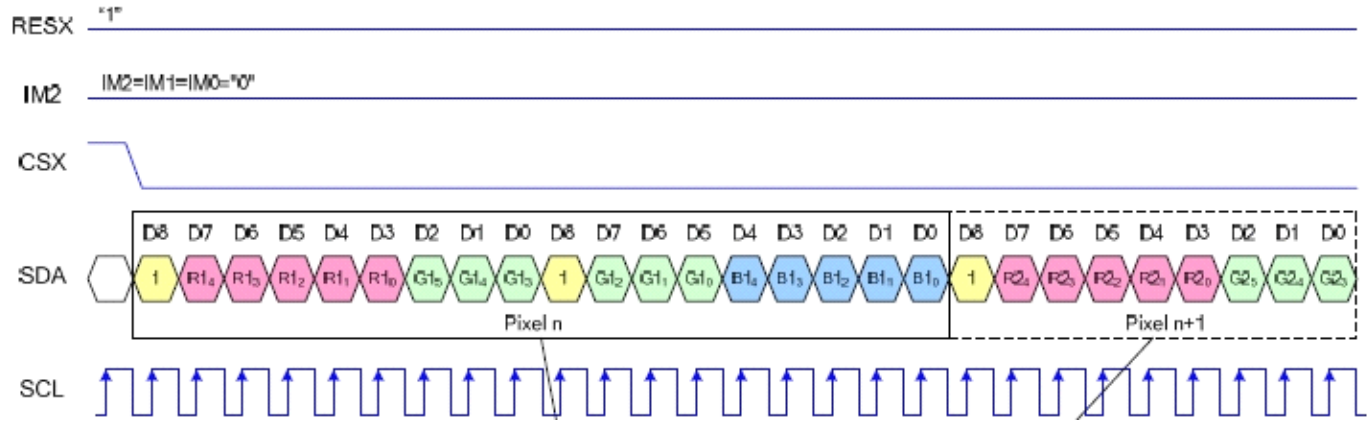


1.2.4 3-line Interface GRAM Write/Read timing

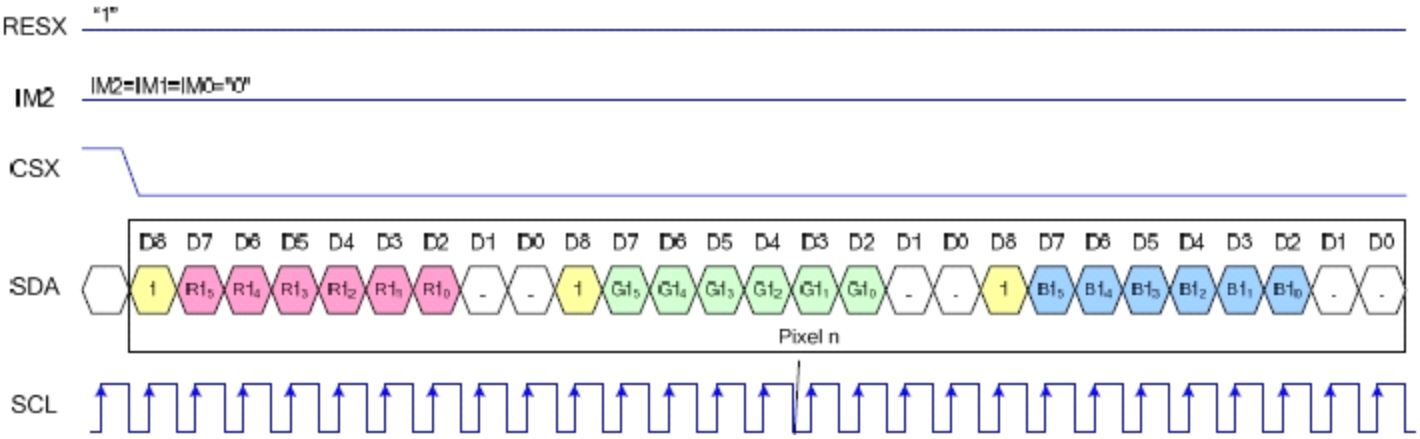
Write Data for 12-bit/Pixel (RGB 4-4-4-bit Input), 4K-Colors, 3AH="03h"



Write Data for 16-bit/Pixel (RGB 5-6-5-bit Input), 65K-Colors, 3AH="05h"



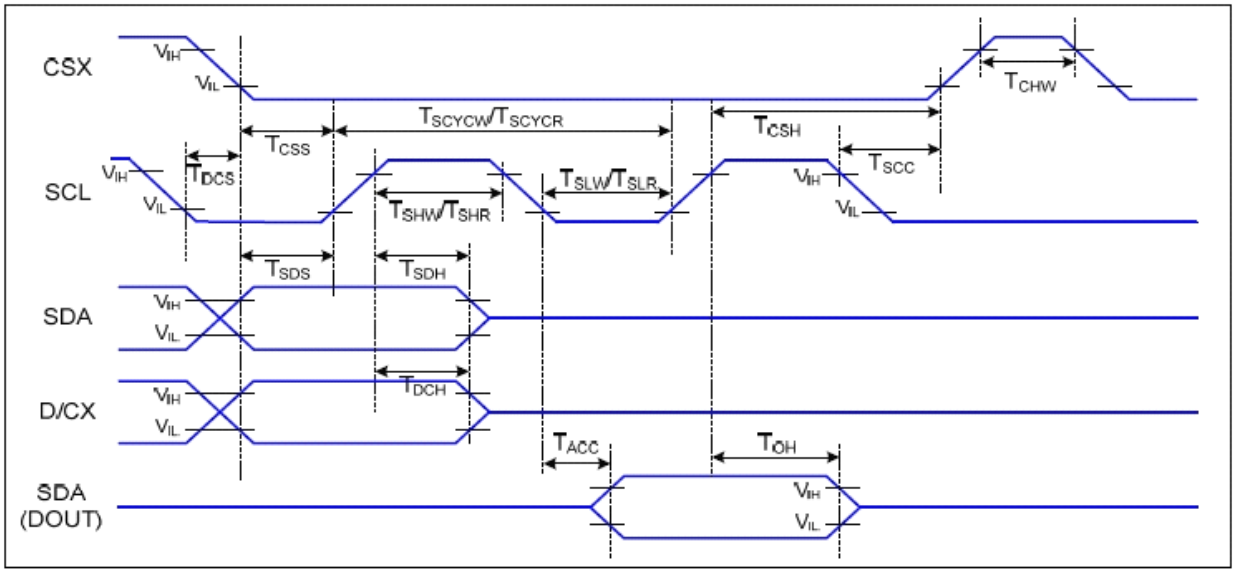
Write Data for 18-bit/Pixel (RGB 6-6-6-bit Input), 262K-Colors, 3AH="06h"



SPI Interface Characteristics

3-wire Serial Interface Protocol, Read Mode

1.2.5 4-line Interface Characteristics

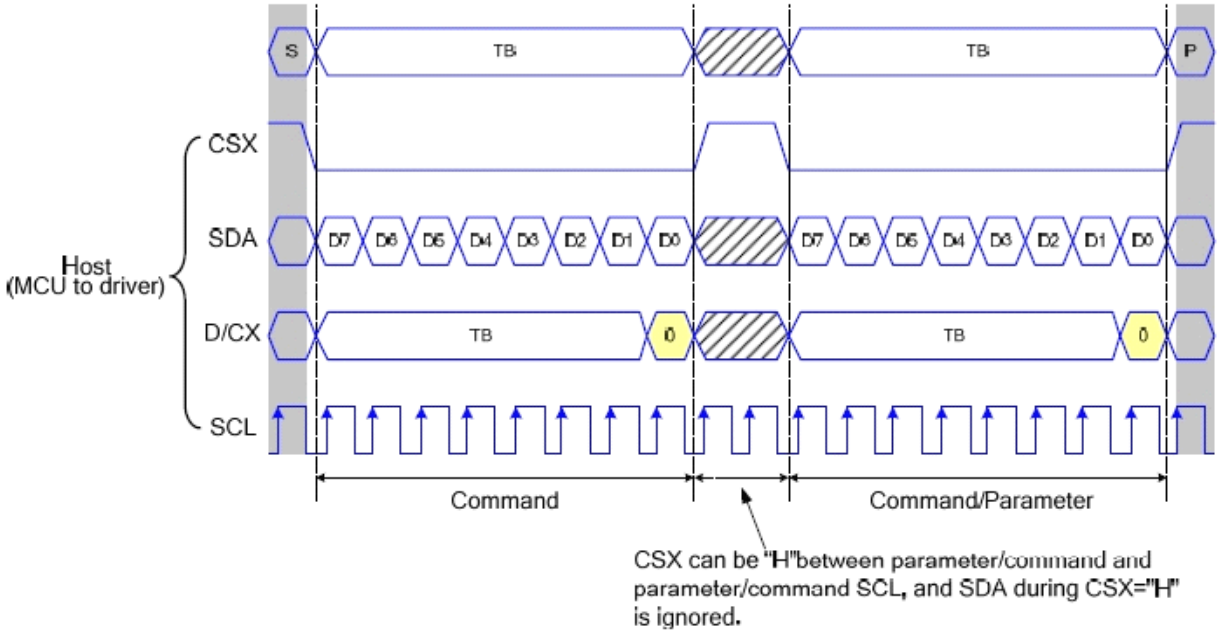


1.2.6 4-line Interface Timing Parameters

Signal	Symbol	Parameter	MIN	MAX	Unit	Description
CSX	TCSS	Chip Select Setup Time (Write)	45		ns	
	TCSH	Chip Select Hold Time (Write)	45		ns	
	TCSS	Chip Select Setup Time (Read)	60		ns	
	TSCC	Chip Select Hold Time (Read)	65		ns	
	TCHW	Chip Select "H" Pulse Width	40		ns	
SCL	TSCYCW	Serial Clock Cycle (Write)	66		ns	-Write Command & Data Ram
	TSHW	SCL "H" Pulse Width (Write)	15		ns	
	TSLW	SCL "L" Pulse Width (Write)	15		ns	
	TSCYCR	Serial Clock Cycle (Read)	150		ns	-Read Command & Data Ram
	TSHR	SCL "H" Pulse Width (Read)	60		ns	
	TSLR	SCL "L" Pulse Width (Read)	60		ns	
D/CX	TDCS	D/CX Setup Time	10		ns	
	TDCH	D/CX Hold Time	10		ns	
SDA (DIN) (DOUT)	TSDS	Data Setup Time	10		ns	For Maximum CL=30pF For Minimum CL=8pF
	TSDH	Data Hold Time	10		ns	
	TACC	Access Time	10	50	ns	
	TOH	Output Disable Time	15	50	ns	

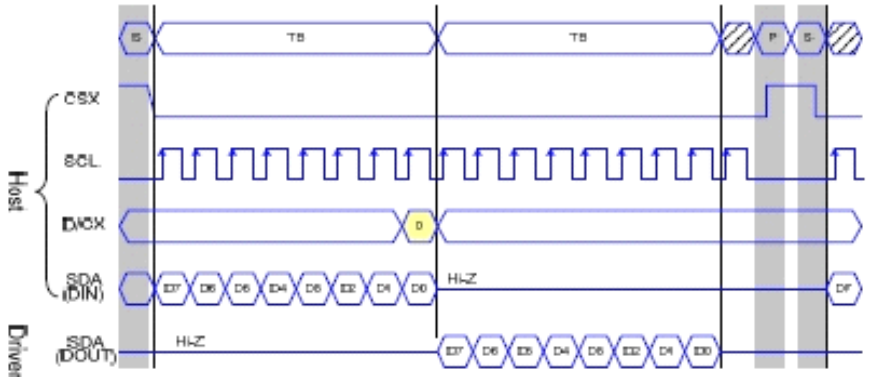
1.2.7 4-line Interface Register Write/Read Timing

1.2 7.1 System Bus Interface Register Write Timin

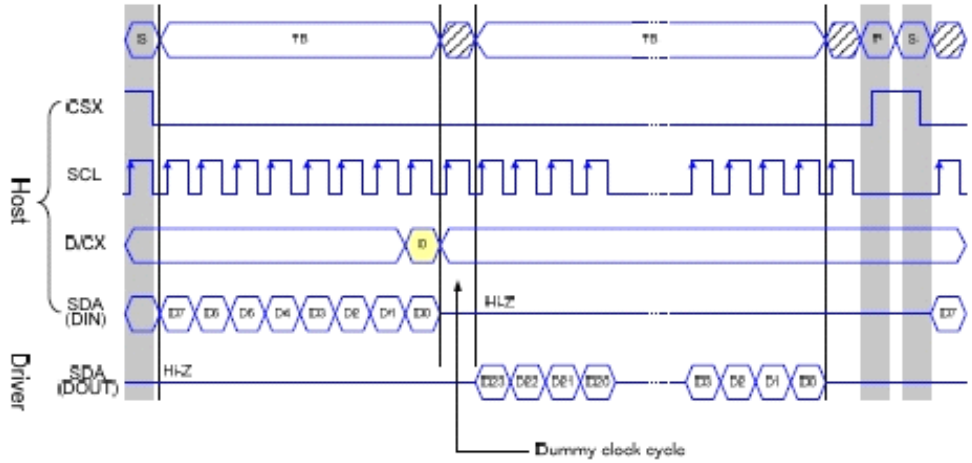


1.2 7.2 System Bus Interface Register Write Timing

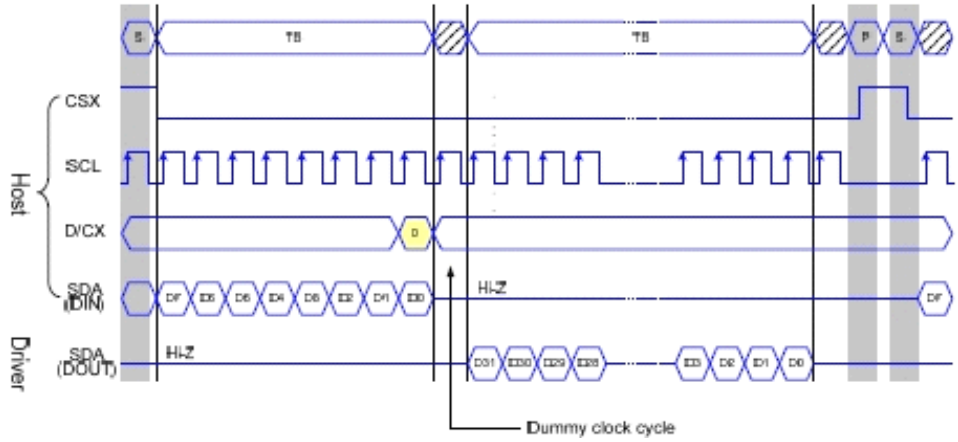
4-line Serial Protocol (for RDID1/RDID2/RDID3/0Ah/0Bh/0Ch/0Dh/0Eh/0Fh Command: 8-bit Read):



4-line Serial Protocol (for RDDID Command: 24-bit Read)

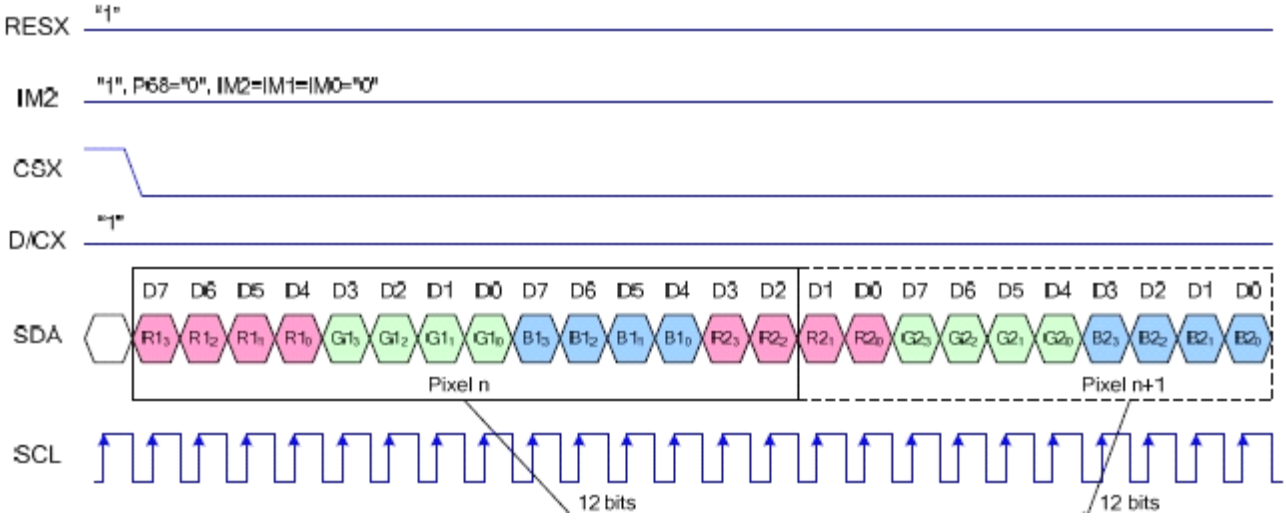


4-line Serial Protocol (for RDDST Command: 32-bit Read)

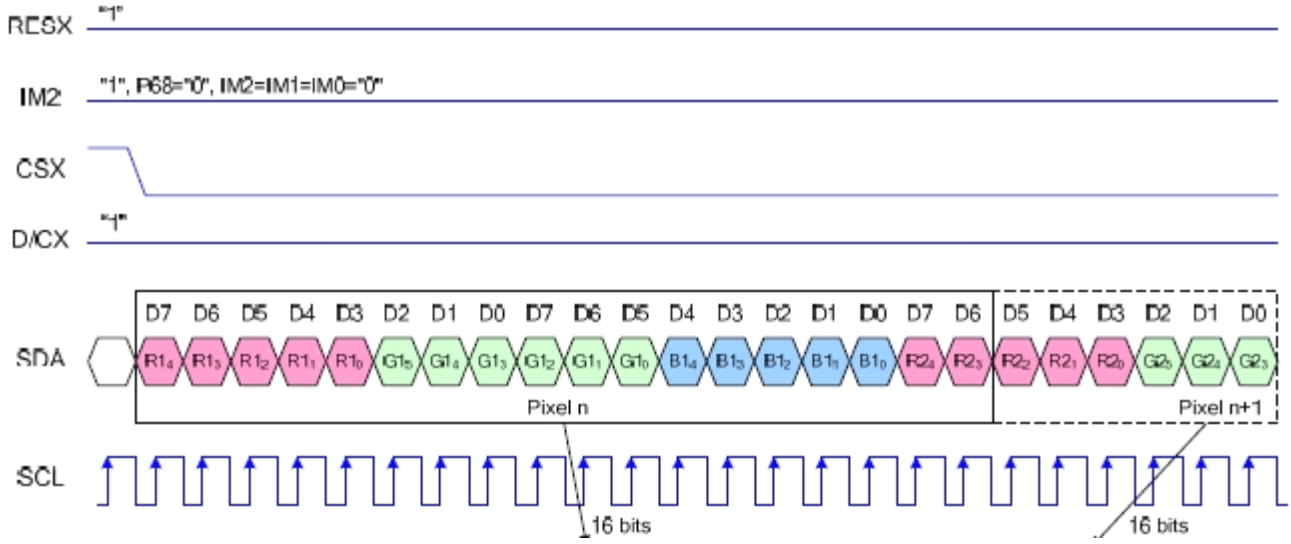


1.2.8 4-line Interface GRAM Write/Read timing

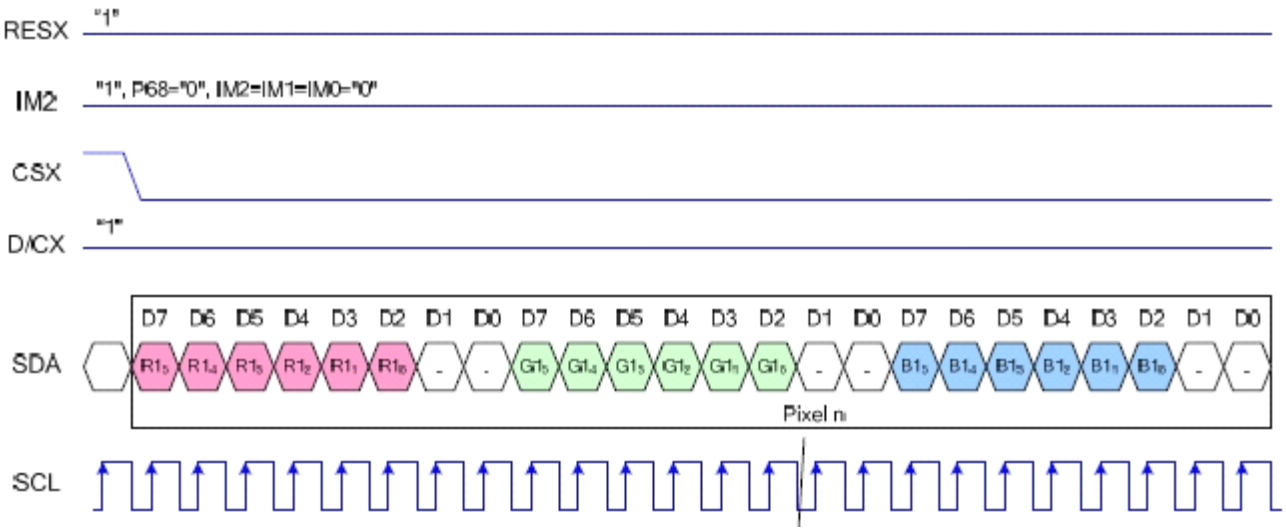
Write Data for 12-bit/Pixel (RGB 4-4-4-bit Input), 4K-Colors, 3AH="03h"



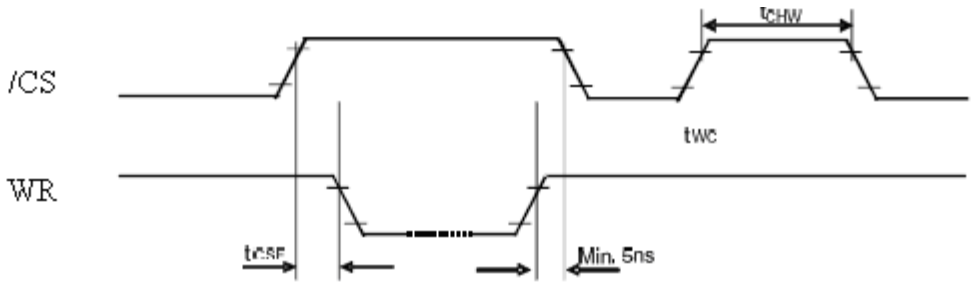
Write Data for 16-bit/Pixel (RGB 5-6-5-bit Input), 65K-Colors, 3AH="05h"



Write Data for 18-bit/Pixel (RGB 6-6-6-bit Input), 262K-Colors, 3AH="06h"

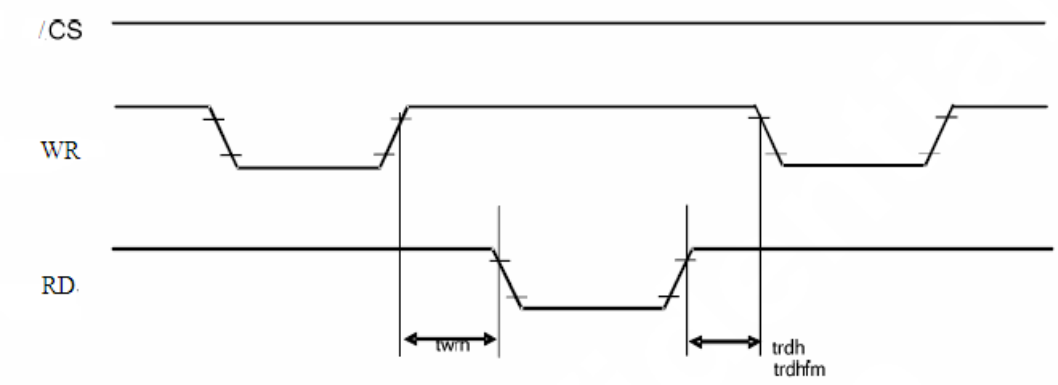


1.3 Chip selection&Write/Read Timing



Note: Logic high and low levels are specified as 30% and 70% of IOVCC for

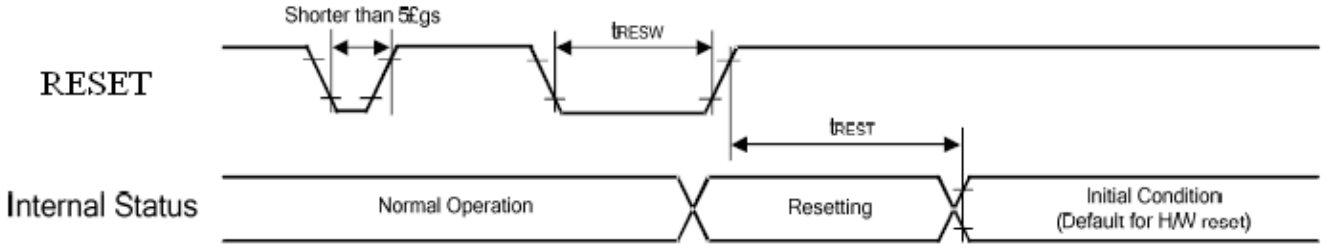
Chip selection Timing



Note: Logic high and low levels are specified as 30% and 70% of IOVCC

Write-to-read and read-to-write timing

1.4 Reset Timing

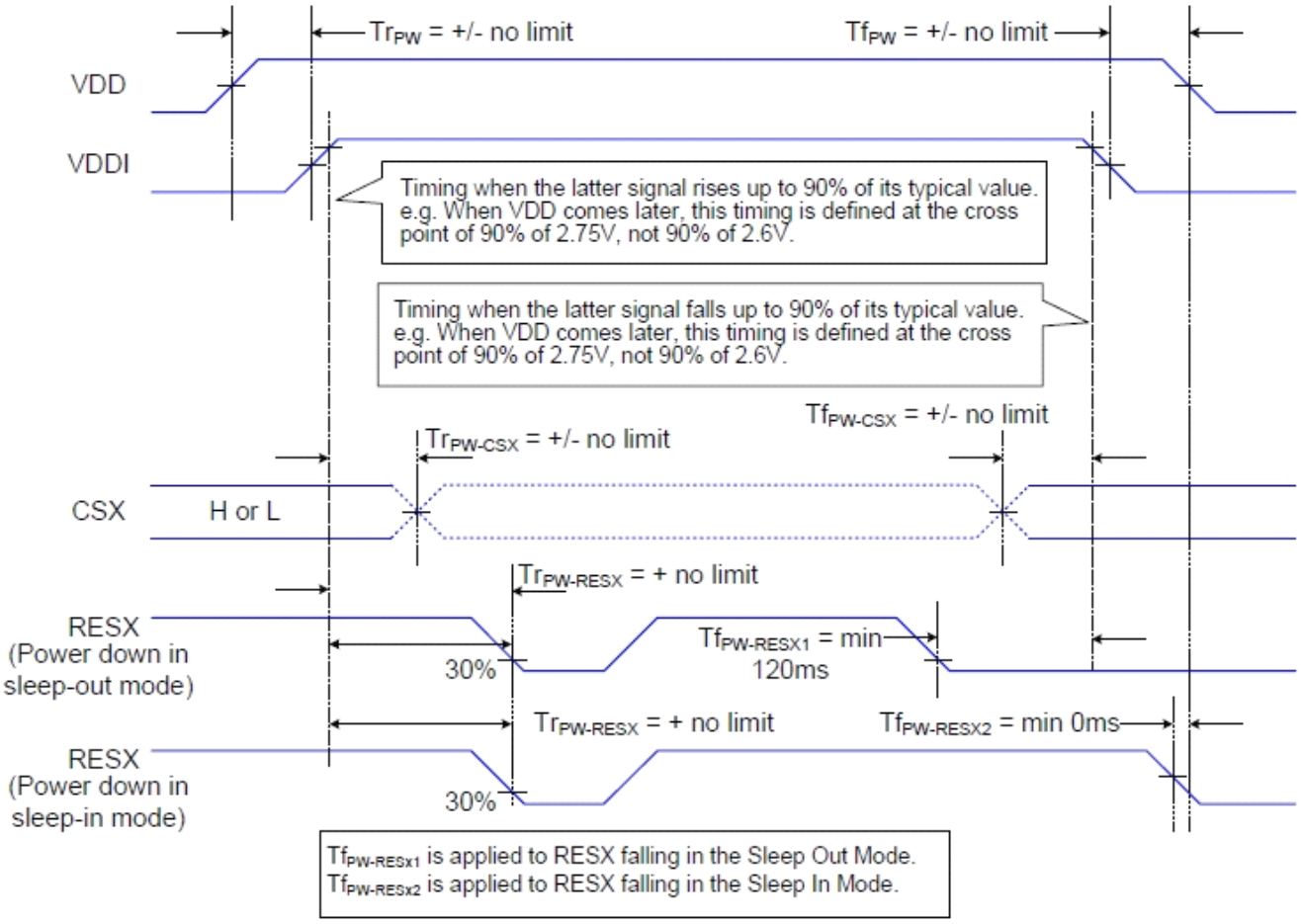


Reset Timing

Related Pins	Symbol	Parameter	MIN	MAX	Unit
RESX	tRESW	Reset Pulse Duration	10	-	us
	tREST	Reset Cancel	-	5	ms
				120	ms

Reset Timing Parameters

2. Power on/off sequence



■ RELIABILITY TEST CONDITIONS

No.	Test Item	Test Condition	Remark
1	High Temperature Storage	80±2℃/120 hours	IEC60068-2-1 GB2423.2
2	Low Temperature Storage	-30±2℃/120 hours	IEC60068-2-1 GB2423.1
3	High Temperature Operating	70±2℃/120 hours	IEC60068-2-1 GB2423.2
4	Low Temperature Operating	-20±2℃/120 hours	IEC60068-2-1 GB2423.1
5	Temperature Cycle storage	-30±2℃~25~70±2℃×20cycles (30min.) (5min.) (30min.)	Start with cold temperature, with high temperature, IEC60068-2-14 GB2423.22
6	Damp proof Test operating	60℃±5℃×90%RH/120 hours	IEC60068-2-78 GB/T2423.3
7	Vibration Test (non-operation)	Frequency range:10Hz~55Hz, Stroke:1.5mm Sweep:10Hz~55Hz~10Hz 2hours for each direction of X,Y,Z(6 hours for total)	IEC60068-2-6 GB/T2423.10
8	Package drop test	Height:80 cm,1 corner,3 edges,6 surfaces	IEC60068-2-32,GB2423.8
9	ESD test (operation)	C=150pF,R=330Ω,5points/panel Air: ±8KV,5times Contact: ±4KV,5times(Environment: 15℃~35℃,30%~60%,86Kpa~106Kpa)	IEC61000-4-2 GB/T17626.2
10	Shock(non-operation)	60G 6ms,±X,±Y,±Z 3times each direction	IEC60068-2-27 GB/T2423.5

Note 1:Ts is the temperature of panel's surface.
Note 2:Ta is the ambient temperature of sample.

■ INSPECTION CRITERION

OUTGOING QUALITY STANDARD	PAGE 1 OF 4
TITLE:FUNCTIONAL TEST & INSPECTION CRITERIA	MDS Product

This specification is made to be used as the standard acceptance/rejection criteria for Color mobile phone LCM.

1 Sample plan

Sampling plan according to GB/T2828.1-2003/ISO 2859-1：1999 and ANSI/ASQC Z1.4-1993, normal level 2 and based on:

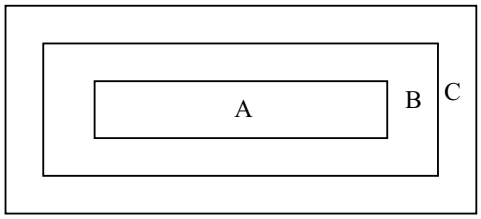
Major defect: AQL 0.65

Minor defect: AQL 1.5

2. Inspection condition

Viewing distance for cosmetic inspection is about 30cm with bare eyes, and under an environment of 20~40W light intensity, all directions for inspecting the sample should be within 45°against perpendicular line.

3. Definition of inspection zone in LCD.



Zone A: character/Digit area

Zone B: viewing area except Zone A (ZoneA+ZoneB=minimum Viewing area)

Zone C: Outside viewing area (invisible area after assembly in customer's product)

Fig.1 Inspection zones in an LCD.

Note: As a general rule, visual defects in Zone C are permissible, when it is no trouble for quality and assembly of customer's product.

OUTGOING QUALITY STANDARD	PAGE 2 OF 4
TITLE:FUNCTIONAL TEST & INSPECTION CRITERIA	MDS Product

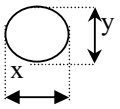
4. Inspection standards

4.1 Major Defect

Item No	Items to be inspected	Inspection Standard	Classification of defects
4.1.1	All functional defects	1) No display 2) Display abnormally 3) Missing vertical，horizontal segment 4) Short circuit 5) Back-light no lighting, flickering and abnormal lighting.	Major
4.1.2	Missing	Missing component	
4.1.3	Outline dimension	Overall outline dimension beyond the drawing is not allowed.	

4.2 Cosmetic Defect

<table>
<tr><th>Item No</th><th>Items to be inspected</th><th>Inspection Standard</th><th>Classification of defects</th></tr>
<tr><td rowspan="2">4.2.1</td><td>Clear Spots

Black and white Spot defect Pinhole, Foreign Particle, Dirt under polarizer</td><td>For dark/white spot, sizeΦis defined as Φ= $\frac{(x+y)}{2}$ 
1.
<table>
<tr><th rowspan="2">Zone
Size(mm)</th><th colspan="3">Acceptable Qty</th></tr>
<tr><th>A</th><th>B</th><th>C</th></tr>
<tr><td>Φ≤0.10</td><td colspan="2">Ignore</td><td rowspan="4">Ignore</td></tr>
<tr><td>0.10＜Φ≤0.15</td><td colspan="2">2</td></tr>
<tr><td>0.15＜Φ≤0.20</td><td colspan="2">1</td></tr>
<tr><td>Φ＞0.20</td><td colspan="2">0</td></tr>
</table></td><td>Minor</td></tr>
<tr><td>Dim Spots

Circle shaped and dim edged defects</td><td>2.
<table>
<tr><th rowspan="2">2. Zone
Size(mm)</th><th colspan="3">Acceptable Qty</th></tr>
<tr><th>A</th><th>B</th><th>C</th></tr>
<tr><td>Φ≤0.2</td><td colspan="2">Ignore</td><td rowspan="4">Ignore</td></tr>
<tr><td>0.20＜Φ≤0.40</td><td colspan="2">3</td></tr>
<tr><td>0.40＜Φ≤0.60</td><td colspan="2">2</td></tr>
<tr><td>0.60＜Φ≤0.80</td><td colspan="2">1</td></tr>
<tr><td>0.80＜Φ</td><td colspan="2">0</td><td></td></tr>
</table></td><td>Minor</td></tr>
</table>

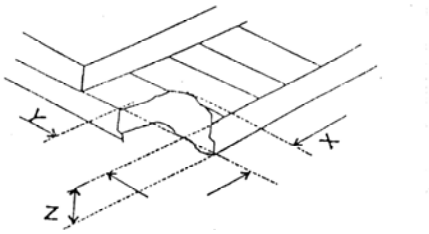
OUTGOING QUALITY STANDARD	PAGE 3 OF 4
TITLE: FUNCTIONAL TEST & INSPECTION CRITERIA	MDS Product

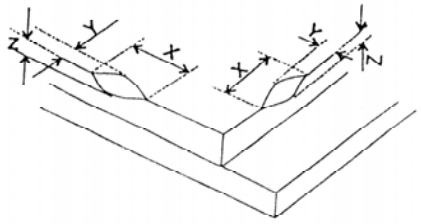
4.2. Cosmetic Defect

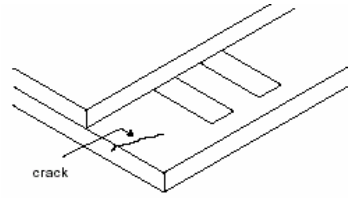
<table>
<tr><th>Item No</th><th>Items to be inspected</th><th>Inspection Standard</th><th>Classification of defects</th></tr>
<tr><td>4.2.2</td><td>Line defect
Black line,
White line,
Foreign material under polarizer,</td><td>
<table>
<tr><th colspan="2">Size(mm)</th><th colspan="3">Acceptable Qty</th></tr>
<tr><th rowspan="2">L(Length)</th><th rowspan="2">W(Width)</th><th colspan="3">Zone</th></tr>
<tr><th>A</th><th>B</th><th>C</th></tr>
<tr><td>Ignore</td><td>W≤0.02</td><td colspan="2">Ignore</td><td rowspan="4">Ignore</td></tr>
<tr><td>L≤3.0</td><td>0.02＜W≤0.03</td><td colspan="2">2</td></tr>
<tr><td>L≤2.0</td><td>0.03＜W≤0.05</td><td colspan="2">1</td></tr>
<tr><td></td><td>0.05＜W</td><td colspan="2">Define as spot defect</td></tr>
</table>
</td><td>Minor</td></tr>
<tr><td>4.2.3</td><td>Polarizer scratch</td><td>If the Polarizer scratch can be seen after mobile phone cover assembling or in the operating condition, judge by the line defect of 4.2.2.
If the Polarizer scratch can be seen only in non-operating condition or some special angle, judge by the following.
<table>
<tr><th colspan="2">Size(mm)</th><th colspan="3">Acceptable Qty</th></tr>
<tr><th rowspan="2">L(Length)</th><th rowspan="2">W(Width)</th><th colspan="3">Zone</th></tr>
<tr><th>A</th><th>B</th><th>C</th></tr>
<tr><td>Ignore</td><td>W≤0.03</td><td colspan="2">Ignore</td><td rowspan="4">Ignore</td></tr>
<tr><td>5.0＜L≤10.0</td><td>0.03＜W≤0.05</td><td colspan="2">2</td></tr>
<tr><td>L≤5.0</td><td>0.05＜W≤0.08</td><td colspan="2">1</td></tr>
<tr><td></td><td>0.08＜W</td><td colspan="2">0</td></tr>
</table>
</td><td>Minor</td></tr>
<tr><td>4.2.4</td><td>Polarize
Air bubble</td><td>Air bubbles between glass & polarizer
<table>
<tr><th rowspan="2">2. Zone
Size(mm)</th><th colspan="3">Acceptable Qty</th></tr>
<tr><th>A</th><th>B</th><th>C</th></tr>
<tr><td>Φ≤0.2</td><td colspan="2">Ignore</td><td rowspan="4">Ignore</td></tr>
<tr><td>0.20＜Φ≤0.30</td><td colspan="2">2</td></tr>
<tr><td>0.30＜Φ≤0.50</td><td colspan="2">1</td></tr>
<tr><td>0.50＜Φ</td><td colspan="2">0</td></tr>
</table>
</td><td>Minor</td></tr>
</table>

OUTGOING QUALITY STANDARD	PAGE 4 OF 4
TITLE:FUNCTIONAL TEST & INSPECTION CRITERIA	MDS Product

4.3. Cosmetic Defect

<table>
<tr><th>Item No</th><th>Items to be inspected</th><th>Inspection Standard</th><th>Classification of defects</th></tr>
<tr><td rowspan="3">4.3.5</td><td rowspan="3">Glass defect</td><td>(i) Chips on corner
 

<table><tr><th>X</th><th>Y</th><th>Z</th></tr><tr><td>≤2.0</td><td>≤S</td><td>Disregard</td></tr></table>Notes: S=contact pad length
Chips on the corner of terminal shall not be allowed to extend into the ITO pad or expose perimeter seal.</td><td>Minor</td></tr>
<tr><td>(ii)Usual surface cracks
 

<table><tr><th>X</th><th>Y</th><th>Z</th></tr><tr><td>≤3.0</td><td><Inner border line of the seal</td><td>Disregard</td></tr></table></td><td>Minor</td></tr>
<tr><td>(iii) Crack
Cracks tend to break are not allowed.
 
</td><td>Major</td></tr>
<tr><td>4.3.6</td><td>Parts alignment</td><td>1) Not allow IC and FPC/heat-seal lead width is more than 50% beyond lead pattern.
2) Not allow chip or solder component is off center more than 50% of the pad outline.</td><td>Minor</td></tr>
<tr><td>4.3.7</td><td>SMT</td><td>According to the <Acceptability of electronic assemblies> IPC-A-610C class 2 standard. Component missing or function defect are Major defect, the others are Minor defect.</td><td></td></tr>
</table>

■ PRECAUTIONS FOR USING LCD MODULES

1 Handing Precautions

1.1 The display panel is made of glass and polarizer. As glass is fragile. It tends to become or chipped during handling especially on the edges. Please avoid dropping or jarring. Do not subject it to a mechanical shock by dropping it or impact.

1.2 If the display panel is damaged and the liquid crystal substance leaks out, be sure not to get any in your mouth. If the substance contacts your skin or clothes, wash it off using soap and water.

1.3 Do not apply excessive force to the display surface or the adjoining areas since this may cause the color tone to vary. Do not touch the display with bare hands. This will stain the display area and degraded insulation between terminals (some cosmetics are determined to the polarizer).

1.4 The polarizer covering the display surface of the LCD module is soft and easily scratched. Handle this polarizer carefully. Do not touch, push or rub the exposed polarizers with anything harder than an HB pencil lead (glass, tweezers, etc.). Do not put or attach anything on the display area to avoid leaving marks on it. Condensation on the surface and contact with terminals due to cold will damage, stain or dirty the polarizer. After products are tested at low temperature they must be warmed up in a container before coming in to contact with room temperature air.

1.5 If the display surface becomes contaminated, breathe on the surface and gently wipe it with a soft dry cloth. If it is heavily contaminated, moisten cloth with one of the following solvents

- Isopropyl alcohol
- Ethyl alcohol

Do not scrub hard to avoid damaging the display surface.

1.6 Solvents other than those above-mentioned may damage the polarizer. Especially, do not use the following.

- Water
- Ketone
- Aromatic solvents

Wipe off saliva or water drops immediately, contact with water over a long period of time may cause deformation or color fading. Avoid contact with oil and fats.

1.7 Exercise care to minimize corrosion of the electrode. Corrosion of the electrodes is accelerated by water droplets, moisture condensation or a current flow in a high-humidity environment.

1.8 Install the LCD Module by using the mounting holes. When mounting the LCD module make sure it is free of twisting, warping and distortion. In particular, do not forcibly pull or bend the I/O cable or the backlight cable.

1.9 Do not attempt to disassemble or process the LCD module.

1.10 NC terminal should be open. Do not connect anything.

1.11 If the logic circuit power is off, do not apply the input signals.

1.12 Electro-Static Discharge Control, Since this module uses a CMOS LSI, the same careful attention should be paid to electrostatic discharge as for an ordinary CMOS IC. To prevent destruction of the elements by static electricity, be careful to maintain an optimum work environment.

- Before removing LCM from its packing case or incorporating it into a set, be sure the module and your body have the same electric potential. Be sure to ground the body when handling the LCD modules.
- Tools required for assembling, such as soldering irons, must be properly grounded. Make certain the AC power source for the soldering iron does not leak. When using an electric screwdriver to attach LCM, the screwdriver should be of ground potentiality to minimize as much as possible any transmission of electromagnetic waves produced sparks coming from the commutator of the motor.
- To reduce the amount of static electricity generated, do not conduct assembling

and other work under dry conditions. To reduce the generation of static electricity be careful that the air in the work is not too dry. A relative humidity of 50%-60% is recommended. As far as possible make the electric potential of your work clothes and that of the work bench the ground potential.

- The LCD module is coated with a film to protect the display surface. Exercise care when peeling off this protective film since static electricity may be generated.

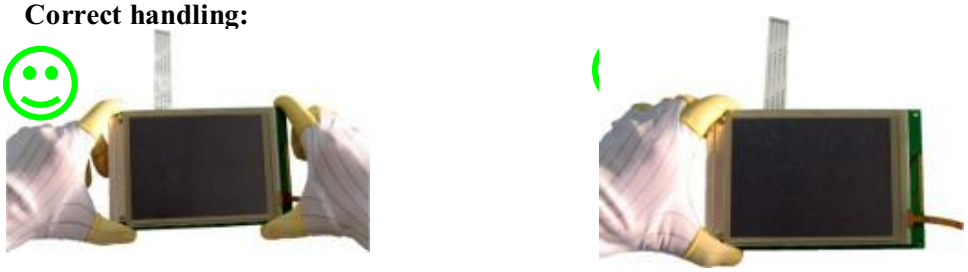
1.13 Since LCM has been assembled and adjusted with a high degree of precision, avoid applying excessive shocks to the module or making any alterations or modifications to it.

- Do not alter, modify or change the shape of the tab on the metal frame.
- Do not make extra holes on the printed circuit board, modify its shape or change the positions of components to be attached.
- Do not damage or modify the pattern writing on the printed circuit board.
- Absolutely do not modify the zebra rubber strip (conductive rubber) or heat seal connector.
- Except for soldering the interface, do not make any alterations or modifications with a soldering iron.
- Do not drop, bend or twist the LCM.

2 Handling precaution for LCM

2.1 LCM is easy to be damaged. Please note below and be careful for handling.

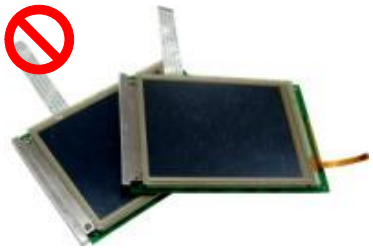
2.2 Correct handling:



As above picture, please handle with anti-static gloves around LCM edges.

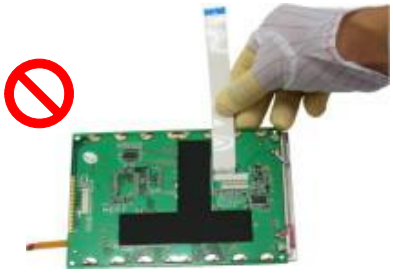
2.3 Incorrect handling:

Please don't touch IC directly.

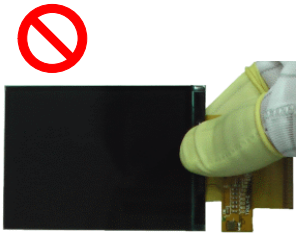


Please don't stack LCM.

Please don't hold the surface of panel.



Please don't stretch interface of output, such as FPC cable.



Please don't hold the surface of IC.

Please don't operate with sharp stick such as pens.

3 Storage Precautions

3.1 When storing the LCD modules, the following precaution are necessary.

3.1.1 Store them in a sealed polyethylene bag. If properly sealed, there is no need for the desiccant.

3.1.2 Store them in a dark place. Do not expose to sunlight or fluorescent light, keep the temperature between 0°C and 35°C, and keep the relative humidity between 40%RH and 60%RH.

3.1.3 The polarizer surface should not come in contact with any other objects (We advise you to store them in the anti-static electricity container in which they were shipped).

3.2 Others 其它

3.2.1 Liquid crystals solidify under low temperature (below the storage temperature range) leading to defective orientation or the generation of air bubbles (black or white). Air bubbles may also be generated if the module is subject to a low temperature.

3.2.2 If the LCD modules have been operating for a long time showing the same display patterns, the display patterns may remain on the screen as ghost images and a slight contrast irregularity may also appear. A normal operating status can be regained by suspending use for some time. It should be noted that this phenomenon does not adversely affect performance reliability.

3.2.3 To minimize the performance degradation of the LCD modules resulting from destruction caused by static electricity etc., exercise care to avoid holding the following sections when handling the modules.

3.2.3.1 - Exposed area of the printed circuit board.

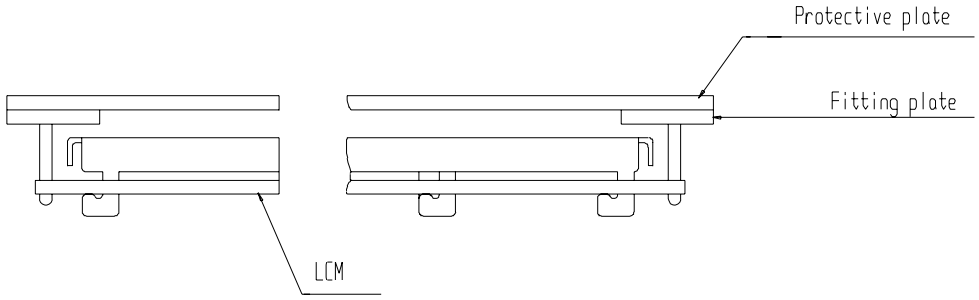
3.2.3.2 -Terminal electrode sections.

4 USING LCD MODULES

4.1 Installing LCD Modules

The hole in the printed circuit board is used to fix LCM as shown in the picture below. Attend to the following items when installing the LCM.

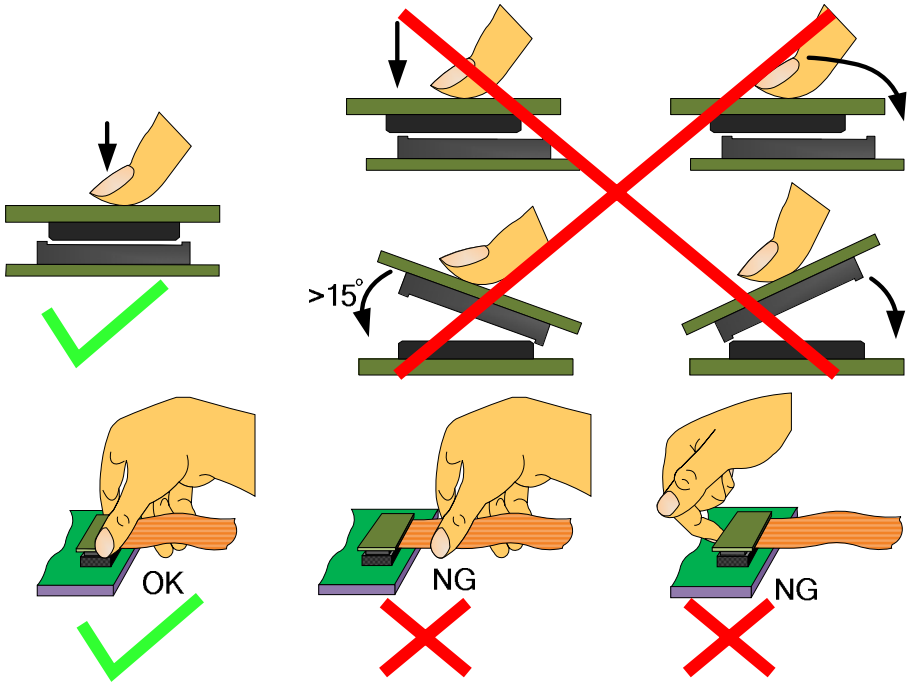
4.1.1 Cover the surface with a transparent protective plate to protect the polarizer and LC cell.



4.1.2 When assembling the LCM into other equipment, the spacer to the bit between the LCM and the fitting plate should have enough height to avoid causing stress to the module surface, refer to the individual specifications for measurements. The measurement tolerance should be ±0.1mm.

4.2 Precaution for assemble the module with BTB connector:

Please note the position of the male and female connector position, don't assemble or assemble like the method which the following picture shows



4.3 Precaution for soldering the LCM

	Manual soldering	Machine drag soldering	Machine press soldering
No RoHS Product	290°C ~350°C. Time : 3-5S.	330°C ~350°C. Speed : 15-17 mm/s.	300°C ~330°C. Time : 3-6S. Press: 0.8~1.2Mpa
RoHS Product	340°C ~370°C. Time : 3-5S.	350°C ~370°C. Speed : 15-17 mm/s.	330°C ~360°C. Time : 3-6S. Press: 0.8~1.2Mpa

4.3.1 If soldering flux is used, be sure to remove any remaining flux after finishing to soldering operation (This does not apply in the case of a non-halogen type of flux). It is recommended that you protect the LCD surface with a cover during soldering to prevent any damage due to flux spatters.

4.3.2 When soldering the electroluminescent panel and PC board, the panel and board should not be detached more than three times. This maximum number is determined by the temperature and time conditions mentioned above, though there may be some variance depending on the temperature of the soldering iron.

4.3.3 When remove the electroluminescent panel from the PC board, be sure the solder has completely melted, the soldered pad on the PC board could be damaged.

4.4 Precautions for Operation

4.4.1 Viewing angle varies with the change of liquid crystal driving voltage (VLCD). Adjust VLCD to show the best contrast.

4.4.2 It is an indispensable condition to drive LCD's within the specified voltage limit since the higher voltage then the limit cause the shorter LCD life. An electrochemical reaction due to direct current causes LCD's undesirable deterioration, so that the use of direct current drive should be avoided.

4.4.3 Response time will be extremely delayed at lower temperature than the operating temperature range and on the other hand at higher temperature LCD's show dark color in them. However those phenomena do not mean malfunction or out of order with LCD's, which will come back in the specified operating temperature.

4.4.4 If the display area is pushed hard during operation, the display will become abnormal. However, it will return to normal if it is turned off and then back on.

4.4.5 A slight dew depositing on terminals is a cause for electro-chemical reaction resulting in terminal open circuit. Usage under the maximum operating temperature, 50%RH or less is required.

4.4.6 Input logic voltage before apply analog high voltage such as LCD driving voltage when power on. Remove analog high voltage before logic voltage when power off the module. Input each signal after the positive/negative voltage becomes stable.

4.4.7 Please keep the temperature within the specified range for use and storage. Polarization degradation, bubble generation or polarizer peel-off may occur with high temperature and high humidity.

4.5 Safety

4.5.1 It is recommended to crush damaged or unnecessary LCDs into pieces and wash them off with solvents such as acetone and ethanol, which should later be burned.

4.5.2 If any liquid leaks out of a damaged glass cell and comes in contact with the hands, wash off thoroughly with soap and water.

4. 6 Limited Warranty

Unless agreed between Multi-Inno and the customer, Multi-Inno will replace or repair any of its LCD modules which are found to be functionally defective when inspected in accordance with Multi-Inno LCD acceptance standards (copies available upon request) for a period of one year from date of production. Cosmetic/visual defects must be returned to Multi-Inno within 90 days of shipment. Confirmation of such date shall be based on data code on product. The warranty liability of Multi-Inno limited to repair and/or replace on the terms set forth above. Multi-Inno will not be responsible for any subsequent or consequential events.

4.7 Return LCM under warranty

4.7.1 No warranty can be granted if the precautions stated above have been disregarded. The typical examples of violations are :

4.7.1.1 - Broken LCD glass.

4.7.1.2 - PCB eyelet is damaged or modified.

4.7.1.3 -PCB conductors damaged.

4.7.1.4 - Circuit modified in any way, including addition of components.

4.7.1.5 - PCB tampered with by grinding, engraving or painting varnish.

4.7.1.6 - Soldering to or modifying the bezel in any manner.

4.7.2 Module repairs will be invoiced to the customer upon mutual agreement. Modules must be returned with sufficient description of the failures or defects. Any connectors or cable installed by the customer must be removed completely without damaging the PCB eyelet, conductors and terminals.

■ PACKING SPECIFICATION

Please consult our technical department for detail information.

■ PRIOR CONSULT MATTER

1 For Multi-Inno standard products, we keep the right to change material, process ... for improving the product property without prior notice to our customer.

2 For OEM products, if any changes are needed which may affect the product property, we will consult with our customer in advance.

3 If you have special requirement about reliability condition, please let us know before you start the test on our samples.