9.0 inch TFT LCD
without Touch Panel
SPECIFICATION
MODEL NAME: LMMM7090CX51

Date: 2018 / 3 / 13

Customer Signature		
Customer		
Approved Date	**Approved By**	**Reviewed By**

REVISION RECORD

REV NO.	REV DATE	CONTENTS	REVISED PAGE NO.
1.0	2018-03-13	First Release	

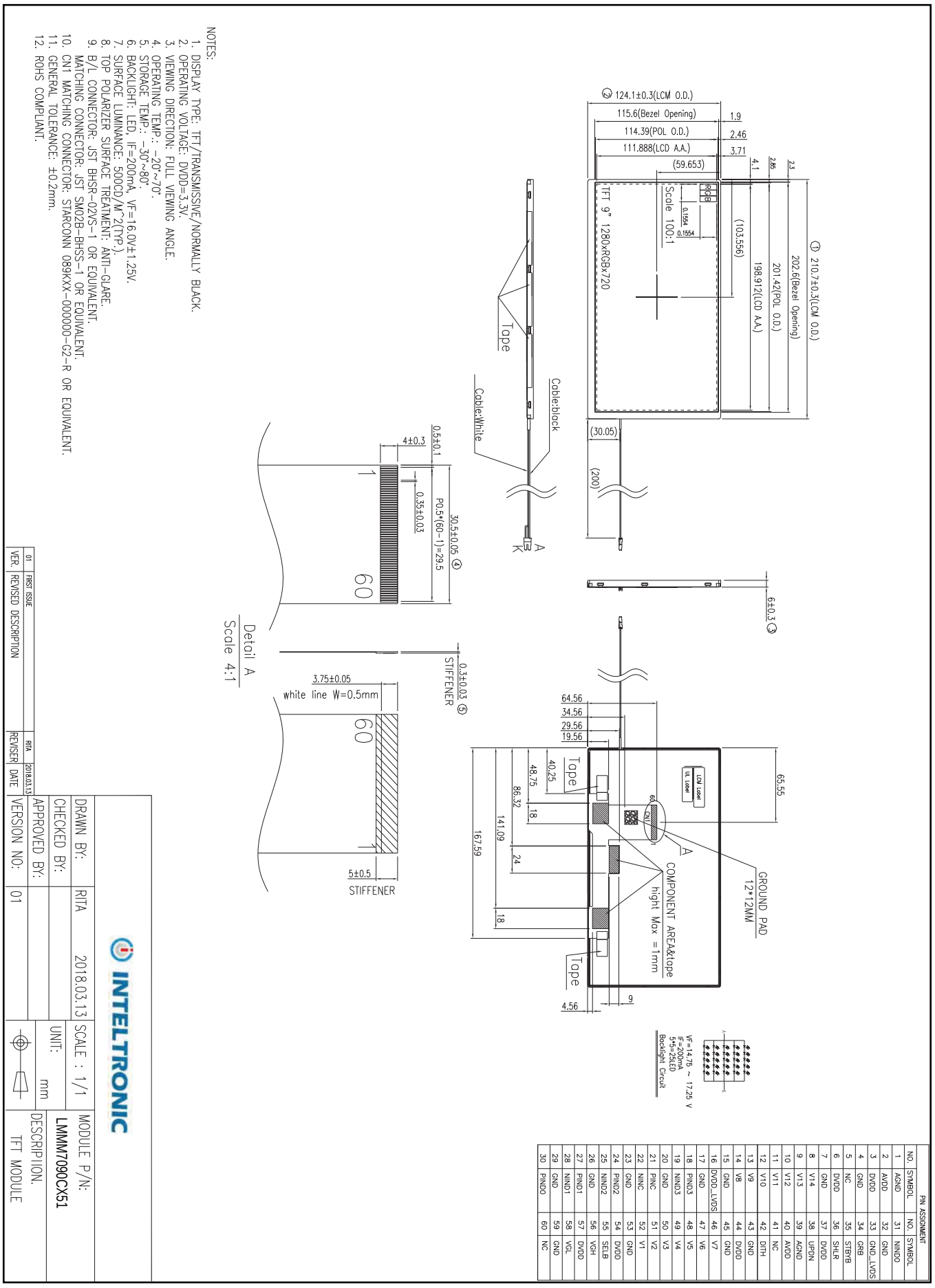
CONTENTS

■ GENERAL INFORMATION

Item	Contents	Unit
LCD type	TFT/Transmissive/Normally black	/
Size	9.0	Inch
Viewingdirection	Full viewing angle	O' Clock
LCM (W × H × D)	210.70×124.10×6.00	mm^3
Active area (W×H)	198.912×111.888	mm^2
Pixel pitch (W×H)	0.1554×0.1554	mm^2
Number of dots	1280(RGB) × 720	/
Backlight type	LED	/
Interface type	LVDS	/
Color depth	262K	/
Pixel configuration	Stripe	/
Surface treatment	Anti-glare	/
Input voltage	3.3	V
With/Without TSP	Without TSP	/
Weight	250	g

Note 1: RoHS compliant;
Note 2: LCM weight tolerance: ± 5% .

■ EXTERNAL DIMENSIONS

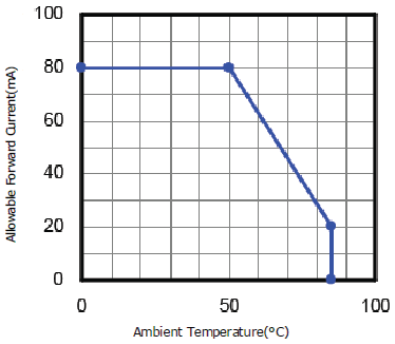


■ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	Min	Max	Unit
Digital supply voltage	DVDD/DVDD_LVDS	-0.3	3.96	V
Analog supply voltage	AVDD	-0.5	14.85	V
Gate on voltage	VGH	-0.3	40	V
Gate off voltage	VGL	-20	0.3	V
Gate on-off voltage	VGH-VGL	12	40	V
Signal input voltage	NIND0~NIND3 PIND0~PIND3 NINC,PINC	-0.5	5	V
Forward current(per LED)	If	-	80	°C
Pulse forward current(per LED)	Ifp	-	240	°C
Operating temperature	TOP	-20	70	°C
Storage temperature	TST	-30	80	°C

Note:

*1) If the product were used out of the operation and storage range, it will have quality issue.
*2) Ifp Conditions: Pulse Width ≦ 10msec, Duty ≦ 1/10.
*3) Each one of LED operation must be follow diagram of Ambient Temperature and Allowable Forward Current.



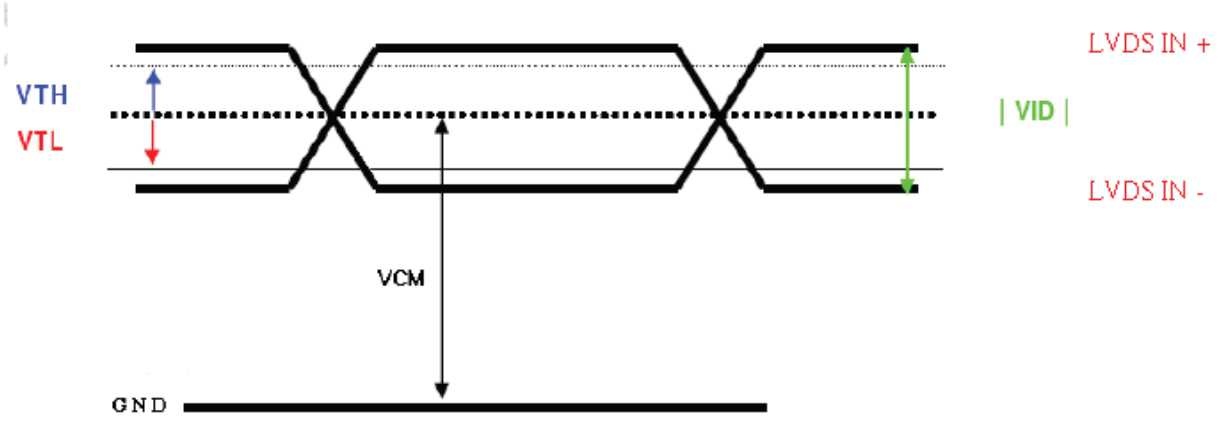
*4)If users use the product out off the environmental operation range (temperature and humidity), it will have visual quality concerns.

■ELECTRICAL CHARACTERISTICS

TFT LCD

Parameter	Symbol	Min	Typ	Max	Unit	Remark
Digital power supply voltage for LCD	DVDD	3.0	3.3	3.6	V	
Logic input voltage (LVDS:IN+,IN-)	VCM	|VID|/2	-	2.4-|VID|/2	V	Note 1
	|VID|	200	-	600	mV	
	VTH	-	-	100	mV	VCM=1.2V Note 1
	VTL	100	-	-	mV	
1 Data time	UI	-	tclk*1/7	-	tclk	Note 3
LVDS clock to data skew	tskew	-	-	300	ps	
Input data eye width	Teyew	1403	-	-	ps	
Analog power supply voltage	AVDD	12.2	12.4	12.6	V	
Gate on power supply voltage	VGH	21	22	23	V	
Gate off power supply voltage	VGL	-6.6	-6	-5.4	V	
Gamma Voltage	V1		12.14		V	Note 2
	V2		11.595		ps	
	V3		9.725		ps	
	V4		8.995		V	
	V5		8.385		V	
	V6		6.93		V	
	V7		6.88		tclk	
	V8		5.88		ps	
	V9		5.71		ps	
	V10		4.25		V	
	V11		3.64		V	
	V12		2.87		V	
	V13		1		V	
	V14		0.34		V	
Logic input voltage	VIH	0.7*DVDD	-	DVDD	V	
	VIL	GND	-	0.3DVDD	V	
ITEM	VIL	GND	-	0.3DVDD	V	Note

Note 1:LVDS signal

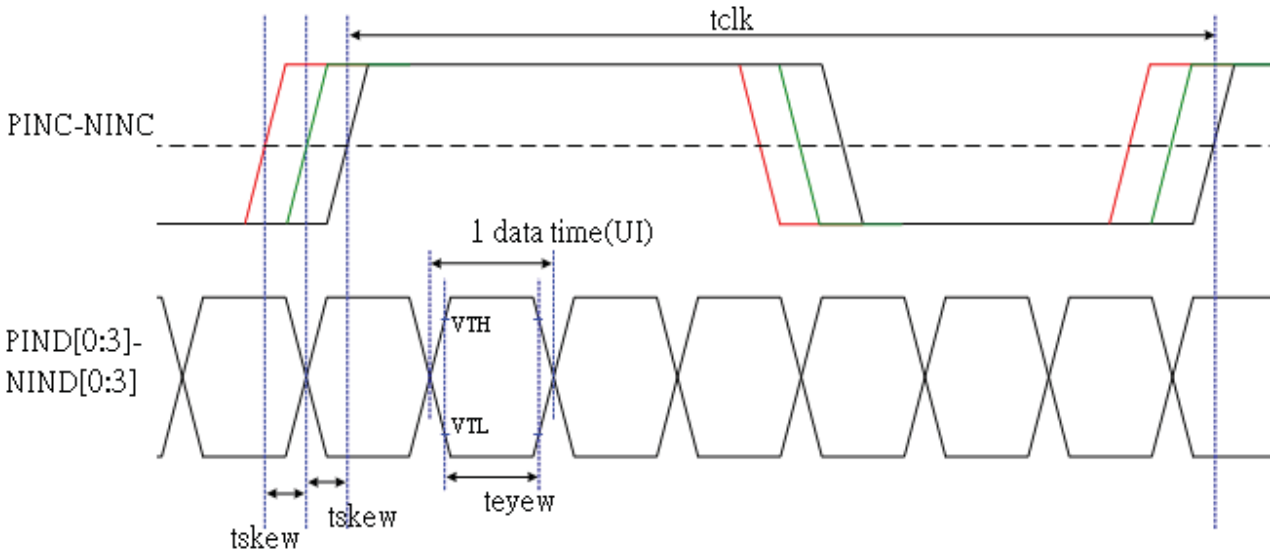


Note 2: (1)Gamma voltage is the reference voltage for customer, it could be adjust by customer.

(2)The voltage of these pins must be: AGND+0.1<V14<V13<V12<V11<V10<V9<V8<V0.6AVDD; V0.4AVDD<V7<V6<V5<V4<V3<V2<V1<AVDD-0.1

Recommend: VCOM must be optimized according to each LCM. Please adjust VR to make the flicker level be minimum for getting excellent image

Note 3: The following condition is base on operation frequency at 71.3MHz



TFT-LCD current consumption

Parameter	Symbol	Min	Typ	Max	Unit	Remark
Gate on current	IVGH(VGH=22V)	-	0.5	1	mA	Note 1
Gate off current	IVGL(VGL=-6V)	-	0.5	1	mA	
Digital current	IDVDD(DVDD=3.3V)	-	36	60	mA	
Analog current	IAVDD(AVDD=12.4V)	-	36	60	mA	
Total power consumption	PC	-	579.2	970	mW	

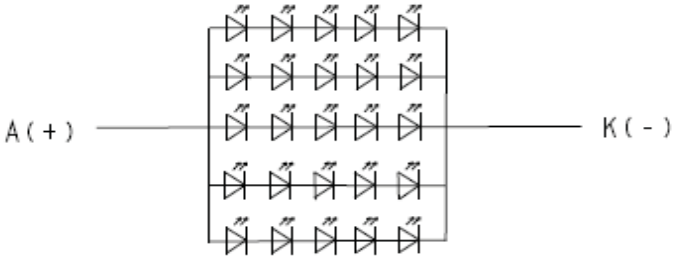
256 gray pattern

White Pattern

■ BACKLIGHT CHARACTERISTICS

Item	Symbol	Min.	Typ.	Max.	Unit	Condition
Voltage for LED backlight	VL	14.75	16.0	17.25	V	Ta=25℃ (40mA/serise)
Current for LED backlight	IL	-	200	-	mA	
Power consumption	-	-	3200	-	mW	
LED life time	-	20000	-	-	Hrs	

Note 1: LED circuit diagram



Note 2: A: Anode(+), K: Cathode(-)

Note 3: Suggestion: Using the constant current control to avoid the leakage light and brightness quality issue.

Note 4: Definition of LED lifetime: Luminance<Initial luminance 50%.

■ELECTRO-OPTICAL CHARACTERISTICS

Item		Symbol	Condition	Min	Typ	Max	Unit	Remark	Note
Response time		Tr+Tf	θ=0° ∅=0° Ta=25℃	-	25	35	ms	FIG 1.	4
Contrast ratio		Cr		600	900	-	---	FIG 2.	1
Luminance uniformity		δ WHITE		70	80	-	%	FIG 2.	3
Surface Luminance		Lv		400	500	-	cd/m^2	FIG 2.	2
Viewing angle range		θ	∅ = 90°	75	85	-	deg	FIG 3.	6
			∅ = 270°	75	85	-	deg	FIG 3.	
			∅ = 0°	75	85	-	deg	FIG 3.	
			∅ = 180°	75	85	-	deg	FIG 3.	
CIE (x, y) chromaticity	Red	x	θ=0° ∅=0° Ta=25℃	0.595	0.645	0.695		FIG 2.	5
		y		0.293	0.343	0.393			
	Green	x		0.256	0.306	0.356			
		y		0.588	0.638	0.688			
	Blue	x		0.095	0.145	0.195			
		y		0.053	0.103	0.153			
	White	x		0.257	0.307	0.357			
		y		0.274	0.324	0.374			

Note 1. Contrast Ratio(CR) is defined mathematically as For more information see FIG 2.

$$\text{Contrast Ratio} = \frac{\text{Average Surface Luminance with all white pixels (P1, P2, P3, P4, P5)}}{\text{Average Surface Luminance with all black pixels (P1, P2, P 3,P4, P5)}}$$

Note 2. 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)

Note 3. 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.

$$\delta\ \text{WHITE} = \frac{\text{Minimum Surface Luminance with all white pixels (P1, P2, P 3, P4, P5)}}{\text{Maximum Surface Luminance with all white pixels (P1, P2, P 3, P4, P5)}}$$

Note 4. 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. The test equipment is Autronic-Melchers's ConoScope. Series.

Note 5. CIE (x, y) chromaticity，The x, y value is determined by measuring luminance at each test position 1 through 5,and then make average value.

Note 6. 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.

Note 7. 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, CIE The test data is base on TOPCON's BM-5 Photo detector.

FIG. 1 The definition of Response Time

The response time is defined as the following figure and shall be measured by switching the input signal for "black" and "white".

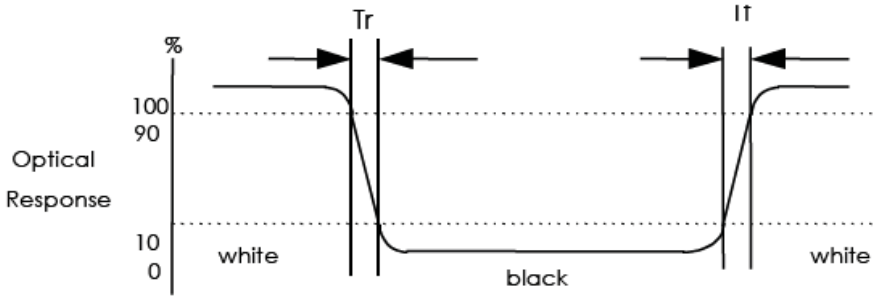
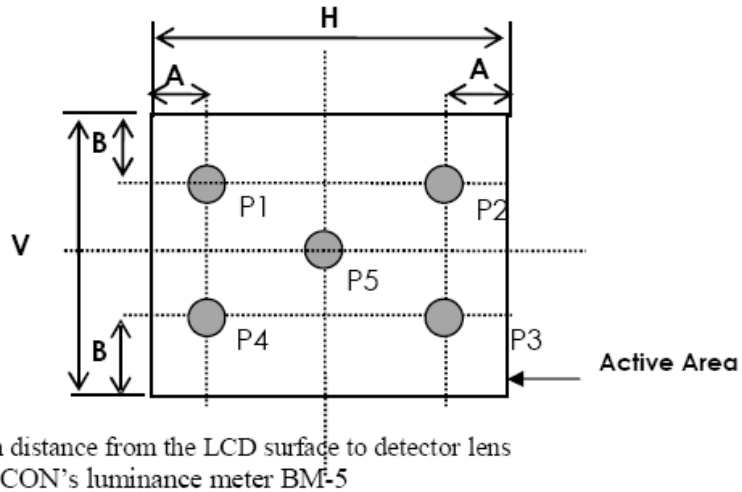
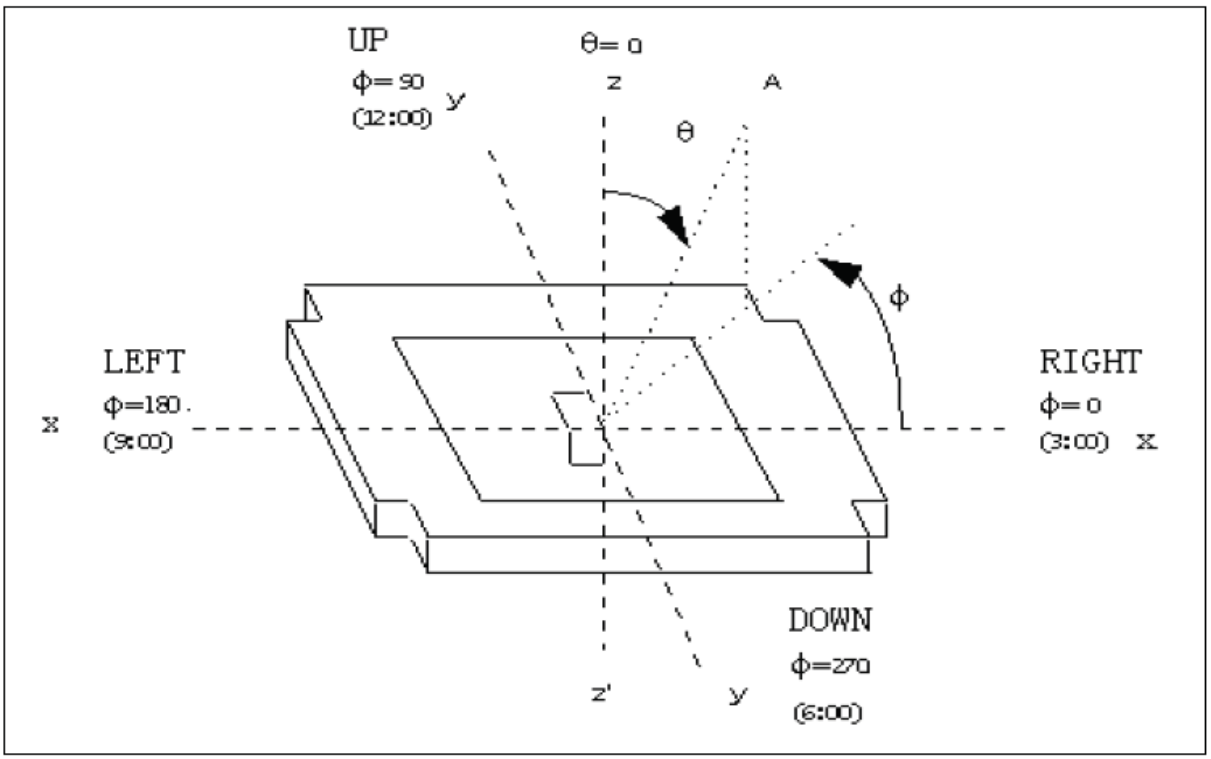


FIG. 2 Measuring method for Contrast ratio, surface luminance, Luminance uniformity , CIE (x, y) chromaticity



A : 5 mm
B : 5 mm
H,V : Active Area
Light spot size ∅=7mm, 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



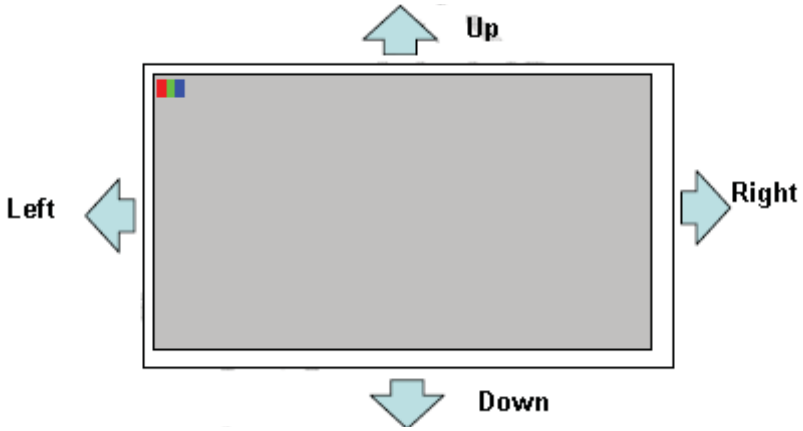
■INTERFACE DESCRIPTION

Pin No.	Symbol	Function	Remark
1	AGND	Analog ground	
2	AVDD	Analog power	
3	DVDD	Digital power	
4	GND	Digital ground	
5	NC	Not connect	
6	DVDD	Digital power	
7	GND	Digital ground	
8	V14	Gamma correction voltage reference	
9	V13	Gamma correction voltage reference	
10	V12	Gamma correction voltage reference	
11	V11	Gamma correction voltage reference	
12	V10	Gamma correction voltage reference	
13	V9	Gamma correction voltage reference	
14	V8	Gamma correction voltage reference	
15	GND	Digital ground	
16	DVDD_LVDS	LVDS power	
17	GND	Digital ground	
18	PIND3	Positive LVDS differential data input	
19	NIND3	Negative LVDS differential data input	
20	GND	Digital ground	
21	PINC	Positive LVDS differential data input	
22	NINC	Negative LVDS differential data input	
23	GND	Digital ground	
24	PIND2	Positive LVDS differential data input	
25	NIND2	Negative LVDS differential data input	
26	GND	Digital ground	
27	PIND1	Positive LVDS differential data input	
28	NIND1	Negative LVDS differential data input	
29	GND	Digital ground	
30	PIND0	Positive LVDS differential data input	
31	NIND0	Negative LVDS differential data input	
32	GND	Digital ground	
33	GND_LVDS	LVDS ground	
34	GRB	Global reset pin. Active low to enter reset state. Suggest to connecting with an RC reset circuit for stability.	

		Normally pull high. (R=10K_ , C=0.1μF)	
35	STBYB	Standby mode, normally pull high STBYB="1", normal operation STBYB="0",timing control, source driver will turn off, all output are high-Z	
36	SHLR	Left or right display control	
37	DVDD	Digital power	
38	UPDN	Up / down display control	
39	AGND	Analog ground	
40	AVDD	Analog power	
41	NC	NC	
42	DITH	Dithering function enable control. Normally pull low DITHER = "1", Enable internal dithering function DITHER = "0", Disable internal dithering function	
43	GND	Digital ground	
44	DVDD	Digital power	
45	GND	Digital ground	
46	V7	Gamma correction voltage reference	
47	V6	Gamma correction voltage reference	
48	V5	Gamma correction voltage reference	
49	V4	Gamma correction voltage reference	
50	V3	Gamma correction voltage reference	
51	V2	Gamma correction voltage reference	
52	V1	Gamma correction voltage reference	
53	GND	Digital ground	
54	DVDD	Digital power	
55	SELB	6bit/8bit mode select, SELB = "0", LVDS input data is 8bits SELB = "1", LVDS input data is 6bits	
56	VGH	Positive power for TFT	
57	DVDD	Digital power for Gate IC	
58	VGL	Negative power for TFT	
59	GND	Digital ground for Gate IC	
60	NC	Not connect	

Note 1：UPDN and SHLR control function

SHLR	UPDN	Data shifting
DVDD	GND	Left→Right，Up→Down(default)
GND	GND	Right→Left，Up→Down
DVDD	DVDD	Left→Right，Down→Up
GND	DVDD	Right→Left，Down→Up



CN2 (backlight)

Pin No.	Symbol	Function
1	A	Anode
2	K	Cathode

Note :
Input connector : BHSR-02VS-1(JST)
Outlet connector: SM02B-BHSS-1(JST)

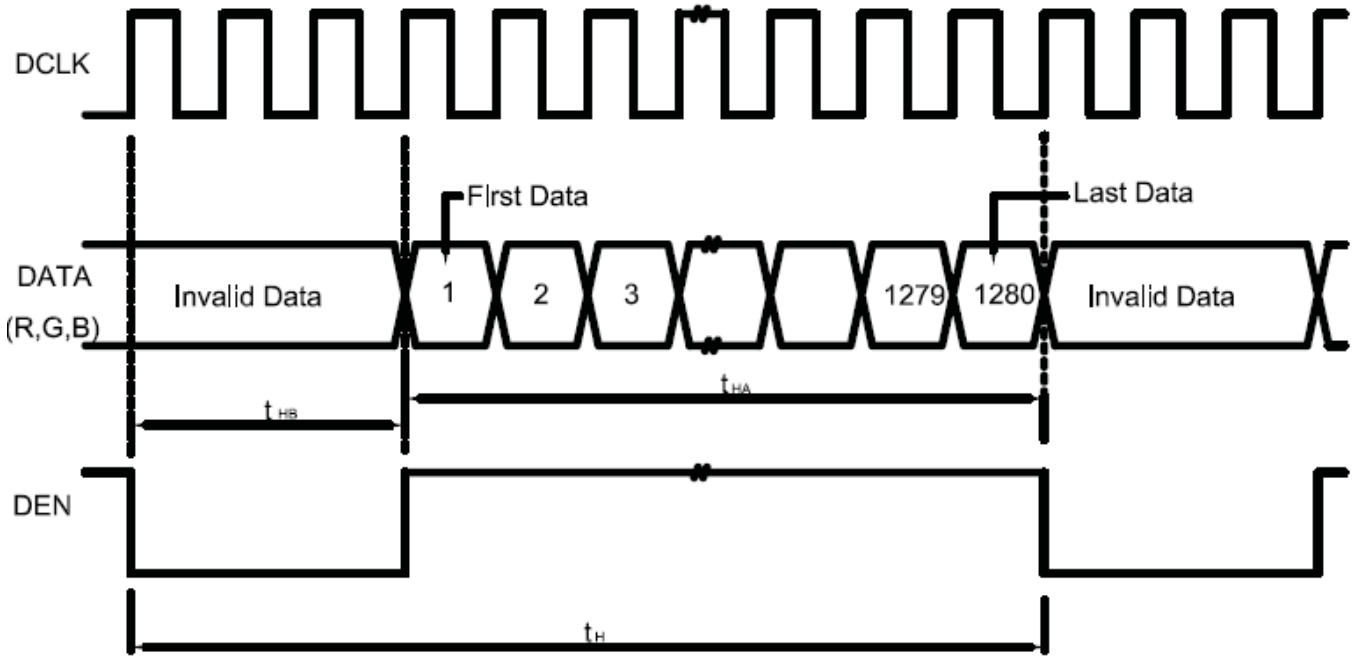
■ APPLICATION NOTES

1. Timing characteristics

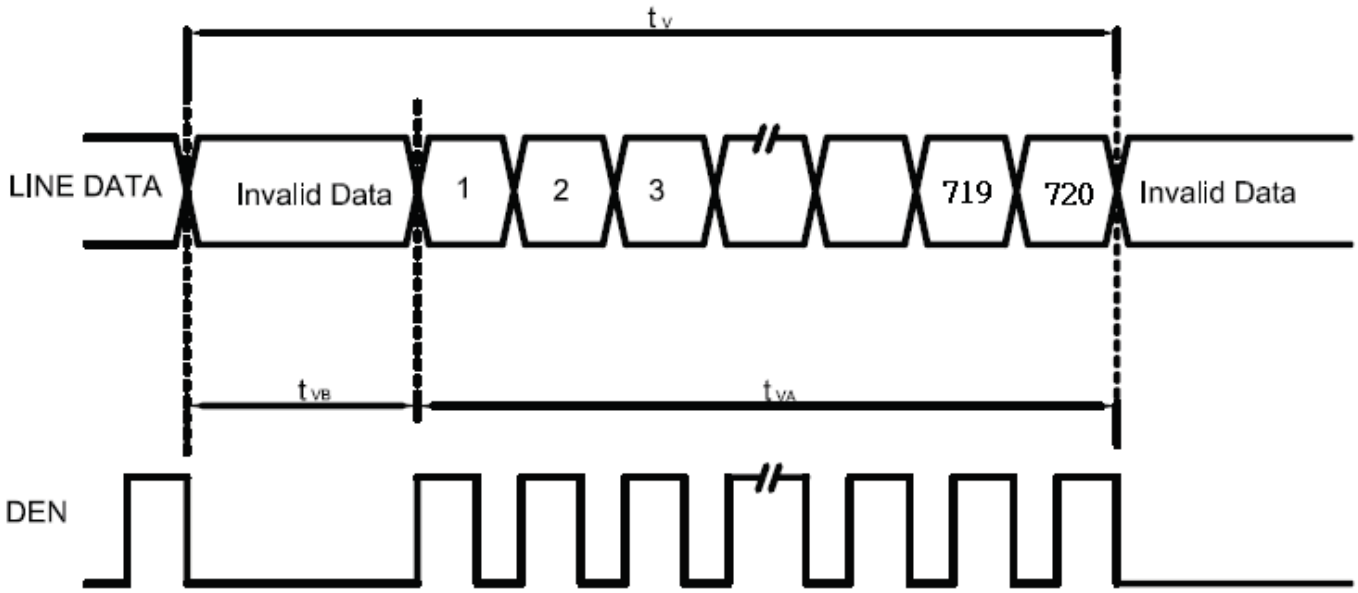
Item				Symbol	Min.	Typ.	Max.	Unit
LVDS input signal sequence	CLK Frequency			1/tclk	63.5	67.3	71.3	MHz
LCD input signal sequence (Input LVDS Transmitter)	DENA	Horizontal	Horizontal total Time	t_H	1450	1480	1500	tCLK
			Horizontal effective Time	t_{HA}		1280		tCLK
			Horizontal Blank Time	t_{HB}	170	200	220	tCLK
		Vertical	Vertical total Time	t_V	730	758	792	t_H
			Vertical effective Time	t_{VA}		720		t_H
			Vertical Blank Time	t_{VB}	10	38	72	t_H

2. Timing sequence(Timing chart)

2.1 Horizontal Timing Sequence

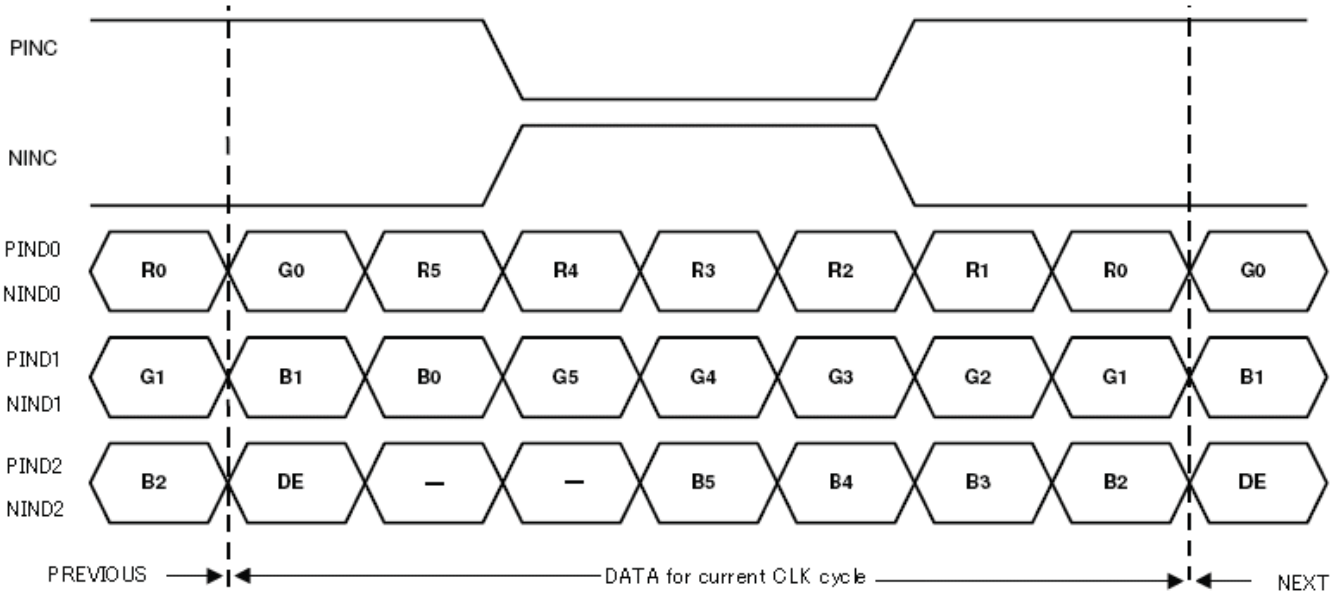


2.2 Vertical Timing Sequence

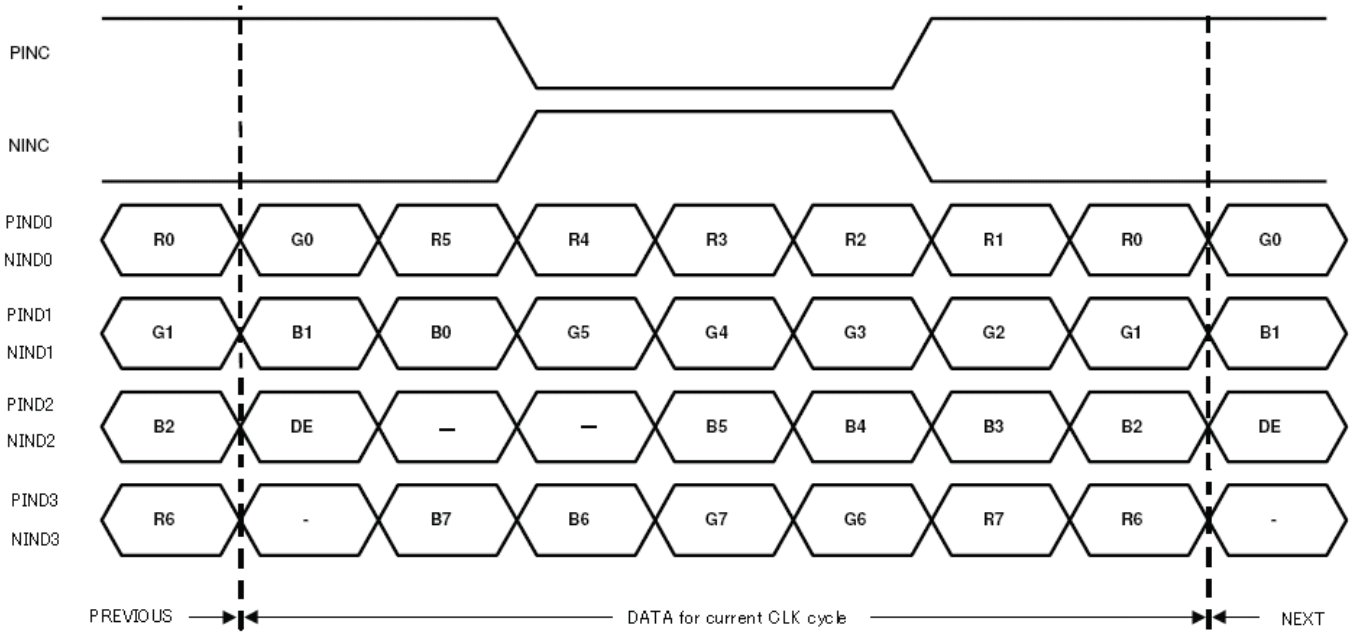


2.3 LVDS Input Data mapping

6 Bit LVDS input



8 Bit LVDS input



2.4 Color Data Reference

COLOR	INPUT DATA	R DATA								G DATA								B DATA							
		R7	R6	R5	R4	R3	R2	R1	R0	G7	G6	G5	G4	G3	G2	G1	G0	B7	B6	B5	B4	B3	B2	B1	B0
		MSB							LSB	MSB							LSB	MSB							LSB
BASIC COLOR	BLACK	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	RED(255)	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	GREEN(255)	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0
	BLUE(255)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1
	CYAN	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	MAGENTA	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1
	YELLOW	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0
	WHITE	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
RED	RED(0)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	RED(1)	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	RED(2)	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	RED(254)	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	RED(255)	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GREEN	GREEN(0)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	GREEN(1)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
	GREEN(2)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
	GREEN(254)	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0
	GREEN(255)	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0
BLUE	BLUE(0)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	BLUE(1)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
	BLUE(2)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
	BLUE(254)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	0
	BLUE(255)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1

【Note】

1) Gray level:

Color(n)：n is level order; higher n means brighter level.

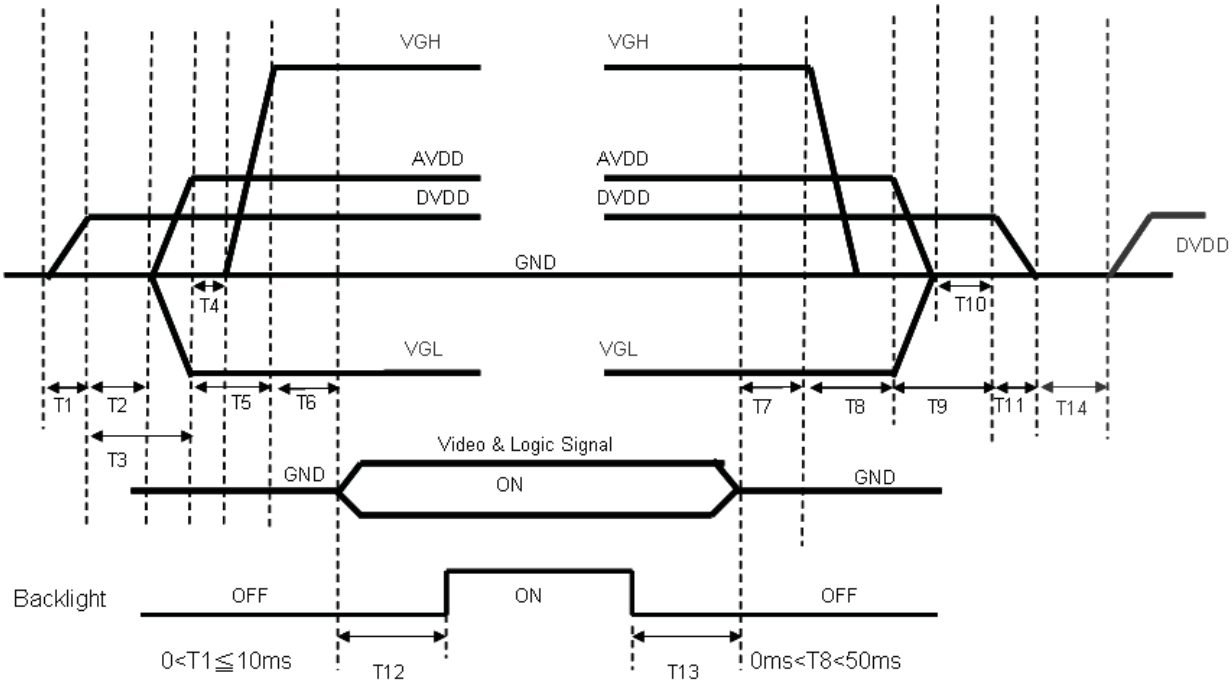
2) DATA:

1: high，0: low

2.4 Power,Signal sequence

Power On： DVDD_AVDD/VGL _VGH _Video &Logic Signal_Backlight

Power Off： Backlight_Video &Logic Signal_ VGH_AVDD/VGL_DVDD



0<T1≦10ms
T2>0ms
T3>20ms
T4>0ms
T5>10ms
0<T6≦10ms
0ms<T7<50ms

0ms<T8<50ms
T9>0ms
T10>0ms
0<T11≦10ms
T12≧200ms
T13≧200ms
T14 ≧200ms

■ RELIABILITY TEST

No.	Test Item	Test Condition	Remarks
1	High Temperature Storage Test	80℃±2℃/240Hrs.	Note2
2	Low Temperature Storage Test	-30℃±2℃/240Hrs.	Note1,2
3	High Temperature Operation Test	70℃±2℃/240Hrs.	
4	Low Temperature Operation Test	-20℃±2℃/240Hrs.	Note1
5	High Temperature and High Humidity Operation Test	60±5℃, 90%RH 240Hrs.	Note1,2
6	Thermal Shock Test (Non-operating)	-30±2℃(30Min.)~25±2℃(5Min.)~80±2℃(30Min.) 100Cycles	
7	Vibration Test (Non-operating)	Frequency:10~55Hz Amplitude: 1.5mm Sweep Time: 11Mins Test Period: 6 Cycles For Each Direction Of X, Y, Z (Packing Condition)	
8	Shock Test (Non-operating)	100G, 6Ms Direction: ±X, ±Y, ±Z Cycle: 3 Times	
9	Electro Static Discharge Test	R:330Ω, C:150pF, 5points/panel Air: ±8KV, 5times; Contact:±4KV, 5times; (Environment:15℃~35℃, 30%~60%, 86Kpa~106Kpa)	

Note 1：Without water condensation

Note 2：The function test shall be conducted after 2 hours storage at the room temperature and humidity after removed from the test chamber.

■ INSPECTION CRITERION

OUTGOING QUALITY STANDARD	PAGE 1 OF 5
TITLE:FUNCTIONAL TEST & INSPECTION CRITERIA	

This specification is made to be used as the standard acceptance/rejection criteria for TFT module.

1 Sample plan

1.1 Lot size: Quantity per shipment lot per model

1.2 Sampling type: Normal inspection,Single sampling

1.3 Inspection level: II

1.4 Sampling table: MIL-STD-105D

1.5 Acceptable quality level (AQL)

Major defect: AQL=0.65

Minor defect: AQL=1.50

2. Inspection condition

2.1 Ambient conditions:

a. Temperature: Room temperature 25± 5℃

b. Humidity: (60± 10) %RH

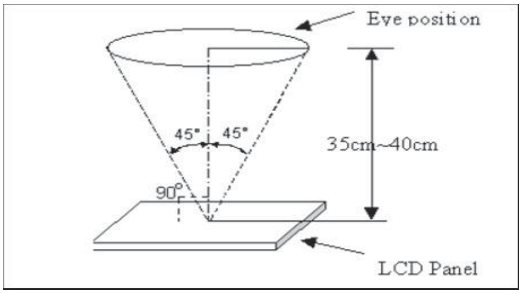
c. Illumination: Single fluorescœnt lamp non-directive (300 to 700 Lux)

2.2 Viewing distance:

The distance between the LCD and the inspector’ s eyes shall be at least 35± 5cm.

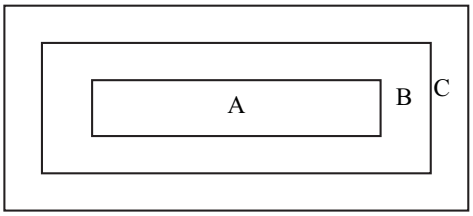
2.3 Viewing Angle

U/D: 45º /45º , L/R: 45º /45º



3. Definition of Inspection Item.

3.1 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.

OUTGOING QUALITY STANDARD	PAGE 2 OF 5
TITLE:FUNCTIONAL TEST & INSPECTION CRITERIA	

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.

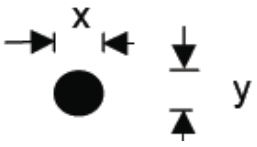
4. Inspection standards

Defects are classified as majot defects and minor defects according to the degree of defectiveness defined herein.

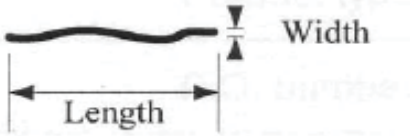
4.1 Major defect

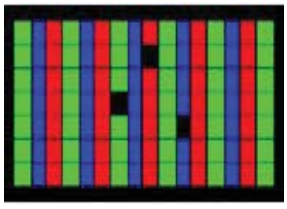
Item No	Items to be inspected	Inspection Standard
4.1.1	All functional defects	1) No display 2) Display abnormally 3) Short circuit 4) Line defect 5) Excess power consumption
4.1.2	Missing	Missing function component
4.1.3	Crack	Glass crack

4.2 Minor defect

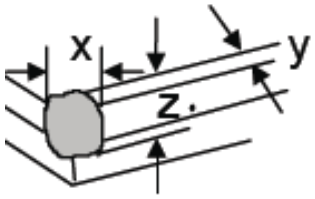
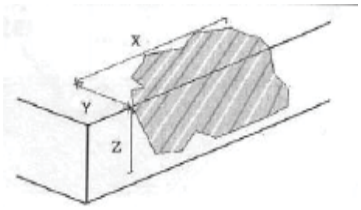
<table>
<tr><th>Item No</th><th>Items to be inspected</th><th colspan="2">Inspection standard</th></tr>
<tr><td rowspan="5">4.2.1</td><td rowspan="5">Spot Defect
Including
Black spot
White spot
Pinhole
Foreign particle
Polarizer dirt</td><td colspan="2">For dark/white spot is defined
$\varphi = (x+y)/2$
  </td></tr>
<tr><td>Size φ(mm)</td><td>Acceptable Quantity</td></tr>
<tr><td>φ≤0.25
2mm(min) apart</td><td>Ignore</td></tr>
<tr><td>0.25 < φ≤ 0.50
5mm(min) apart</td><td>5</td></tr>
<tr><td>0.50< φ</td><td>Not allowed</td></tr>
</table>

OUTGOING QUALITY STANDARD	PAGE 3 OF 5
TITLE:FUNCTIONAL TEST & INSPECTION CRITERIA	

<table>
<tr><td rowspan="5">4.2.2</td><td rowspan="5">Line Defect
Including
Black line
White line
Scratch</td><td colspan="2">Define:
 
</td></tr>
<tr><td>Width(mm)
Length(mm)</td><td>Acceptable Quantity</td></tr>
<tr><td>W≤0.06 and L≤10</td><td>Ignore</td></tr>
<tr><td>0.06 < W≤0.08 and L≤10
5mm(min) apart</td><td>5</td></tr>
<tr><td>0.08 < W≤0.10 and L≤5
5mm(min) apart</td><td>3</td></tr>
<tr><td rowspan="4">4.2.3</td><td rowspan="4">Polarizer
Dent/Bubble</td><td>0.10 < W or 10< L</td><td>Not allowed</td></tr>
<tr><td>Size φ(mm)</td><td>Acceptable Quantity</td></tr>
<tr><td>φ≤0.30</td><td>Ignore</td></tr>
<tr><td>Non visible area</td><td>Ignore</td></tr>
<tr><td rowspan="6">4.2.4</td><td rowspan="6">Electrical Dot
Defect</td><td>0.30< φ≤ 0.50
5mm(min) apart</td><td>5</td></tr>
<tr><td>0.50< φ</td><td>Not allowed</td></tr>
<tr><td colspan="2">Bright and Black dot define:
 

and
  </td></tr>
<tr><td colspan="2">Inspection pattern: Full white, Full black, Red, green and blue screens</td></tr>
<tr><td>Item</td><td>Acceptable Quantity</td></tr>
<tr><td>Black dot defect</td><td>5</td></tr>
<tr><td>Bright dot defect</td><td>2</td></tr>
<tr><td>Total Dot</td><td>5</td></tr>
</table>

OUTGOING QUALITY STANDARD	PAGE 4 OF 5
TITLE:FUNCTIONAL TEST & INSPECTION CRITERIA	

<table>
<tr><td rowspan="6">4.2.5</td><td rowspan="6">Touch panel chips</td><td colspan="2">1.Corner chips:
  </td></tr>
<tr><td>Size(mm)</td><td>Acceptable Quantity</td></tr>
<tr><td>X≤3mm
Y≤3mm
Z≤T</td><td>Ignore
T: Glass thickness
X: Length
Y: Width
Z: thickness</td></tr>
<tr><td colspan="2">2. Side chips:
  </td></tr>
<tr><td>Size(mm)</td><td>Acceptable Quantity</td></tr>
<tr><td>X≤5mm
Y ≤3mm
Z≤T</td><td>Ignore
T: Glass thickness
X: Length
Y: Width
Z: thickness</td></tr>
</table>

OUTGOING QUALITY STANDARD	PAGE 5 OF 5
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Note: 1. Dot defect is defined as the defective area of the dot area is larger than 50% of the dot area.

2. The distance between black dot defects or black and bright dot defects should be more than 5mm apart. The distance between two bright dot defects should be more than 15mm apart

3. Polarizer bubble is defined as the bubble appears on active display area. The defect of polarizer bubble shall be ignored if the polarizer bubble appears on the outside of active display area.

4. Mura is checker by 6% ND filter.

5. Foreign particle on the surface of the LCM should be ignore.

■ PRECAUTIONS FOR USING LCD MODULES

Handing Precautions

(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.

(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.

(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).

(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. 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 is contacting with room temperature air.

(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.

(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 contacting oil and fats.

(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.

(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.

(9) Do not attempt to disassemble or process the LCD module.

(10) NC terminal should be open. Do not connect anything.

(11) If the logic circuit power is off, do not apply the input signals.

(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 remove 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 dried. 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

（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 LCM.

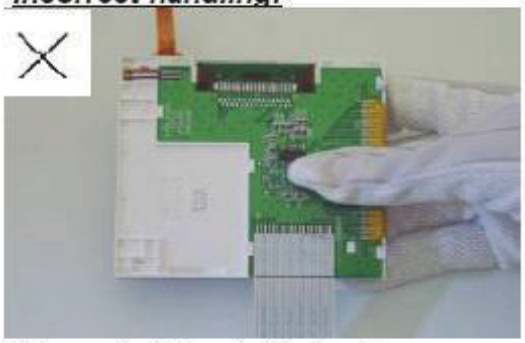
Handling precaution for LCM

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

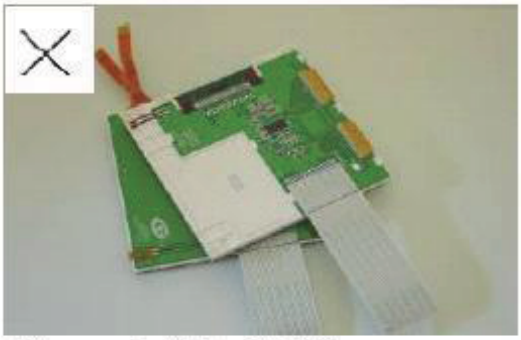
Correct handling:

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

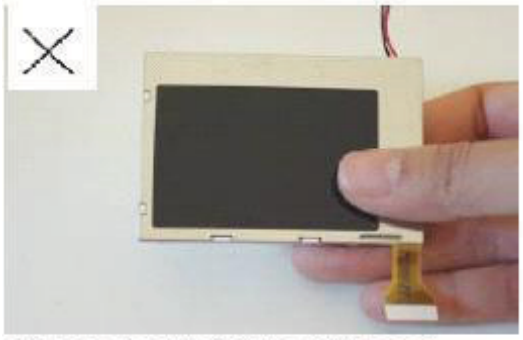
Incorrect handling:



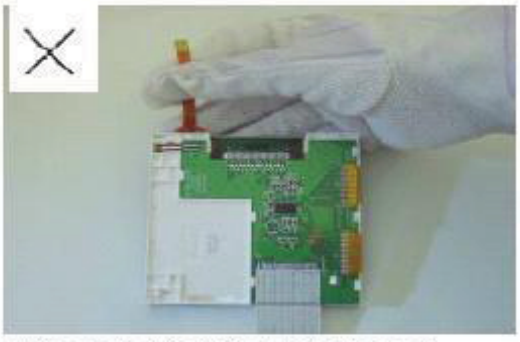
Please don't touch IC directly.



Please don't stack LCM.



Please don't hold the surface of panel.

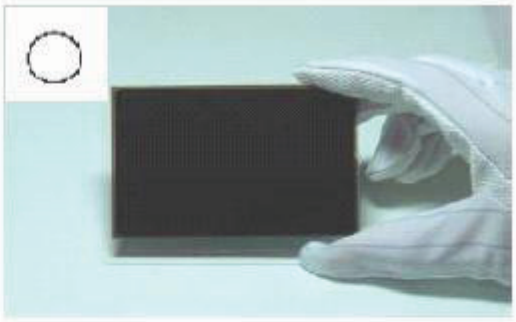


Please don't stretch interface of output, such as FPC cable.

Handling precaution for LCD

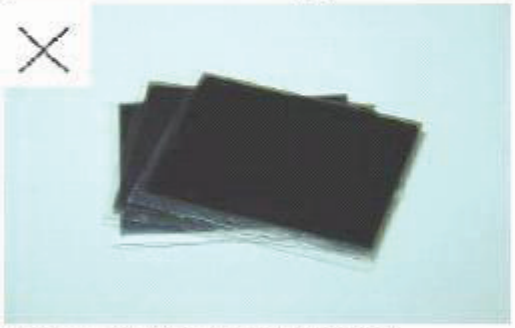
LCD is easy to be damaged.
Please note below and be careful for handling!

Correct handling:



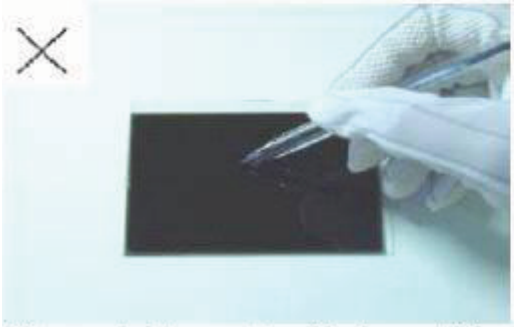
As above photo, please handle with anti-static gloves around LCD edges.

Incorrect handling:

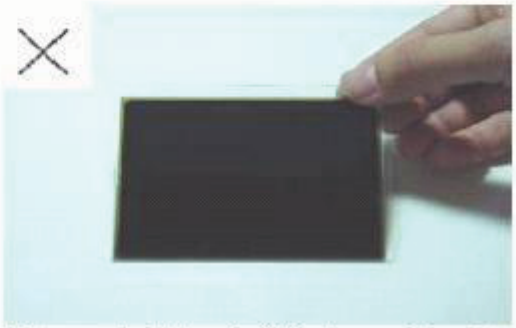


Please don't stack the LCDS.

Please don't hold the surface of LCD.



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



Please don't touch ITO glass without anti-static gloves.

Storage Precautions

When storing the LCD modules, the following precaution is necessary.

(1) Store them in a sealed polyethylene bag. If properly sealed, there is no need for the dessicant.

(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) 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.

Others

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.

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.

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.

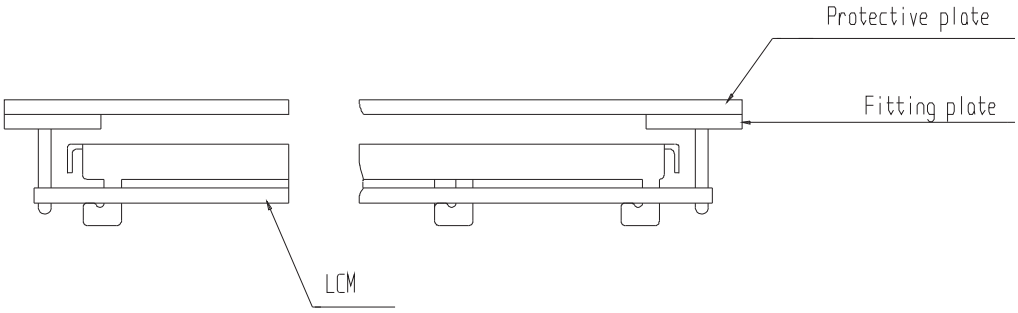
- Exposed area of the printed circuit board.
-Terminal electrode sections.

USING LCD MODULES

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.

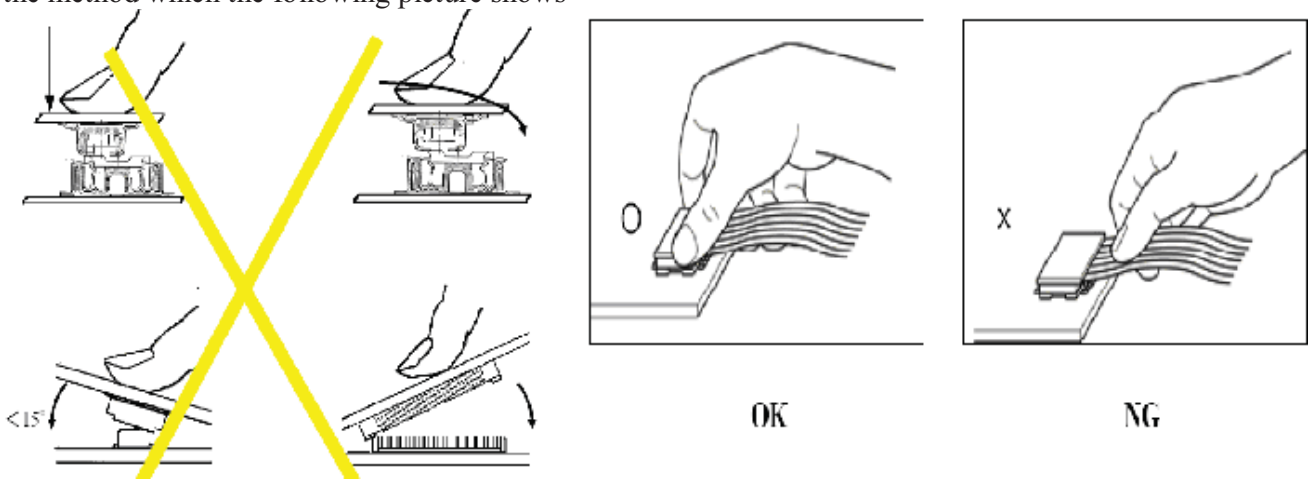
(1) Cover the surface with a transparent protective plate to protect the polarizer and LC cell.



(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.

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



Precaution for soldering to the LCM

	Hand soldering	Machine drag soldering	Machine press soldering
No ROHS product	290°C ~350°C. Time : 3-5S.	330°C ~350°C. Speed : 4-8 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. Time : 4-8 mm/s.	330°C ~360°C. Time : 3-6S. Press: 0.8~1.2Mpa

(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.

(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.

(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.

Precautions for Operation

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

(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.

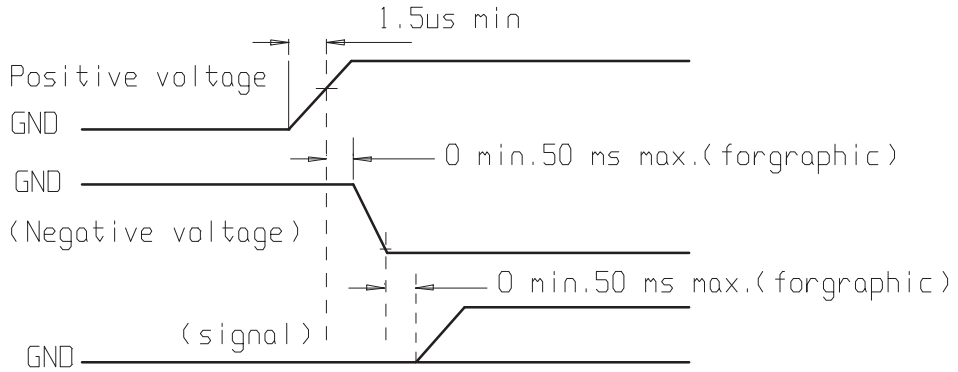
(3) Response time will be extremely delayed at lower temperature than the operating temperature range and on the other hand at higher temperature LCD's show dark color in them. However those phenomena do not mean malfunction or out of order with LCD's, Which will come back in the specified operating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

(4) 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.

(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.

(6) Input each signal after the positive/negative voltage becomes stable.

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



Safety

(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.

(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.

Limited Warranty

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

Return LCM under warranty

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

- Broken LCD glass.
- PCB eyelet is damaged or modified.
- PCB conductors damaged.
- Circuit modified in any way, including addition of components.
- PCB tampered with by grinding, engraving or painting varnish.
- Soldering to or modifying the bezel in any manner.

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.

■ PRIOR CONSULT MATTER

1.①For WAHLEE standard products, we keep the right to change material, process ... for improving the product property without notice on our customer.

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

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

■ Inspection Specifications

The buyer (customer) shall inspect the modules within twenty calendar days since the delivery date (the "inspection period") at its own cost. The results of the inspection (acceptance or rejection) shall be recorded in writing, and a copy of this writing will be promptly sent to the seller.

The buyer may, under commercially reasonable reject procedures, reject an entire lot in the delivery involved if, within the inspection period, such samples of modules within such lot show an unacceptable number of defects in accordance with this incoming inspection standards, provided however that the buyer must notify the seller in writing of any such rejection promptly, and not later than within three business days of the end of the inspection period.

Should the buyer fail to notify the seller within the inspection period, the buyer's right to reject the modules shall be lapsed and the modules shall be deemed to have been accepted by the buyer.

■ Warranty

Inteltronic Inc. warrants to you, the original purchaser, that each of its products will be free from defects in materials and workmanship for one year from the date of purchase.

Inteltronic Inc. will be limited to replace or repair any of its module which is found and confirmed defective electrically or visually when inspected in accordance with Inteltronic Inc. general module inspection standard.

This warranty does not apply to any products which have been on customer’s production line, repaired or altered by persons other than repair personnel authorized by Inteltronic Inc., or which have been subject to misuse, abuse, accident or improper installation. Inteltronic Inc. assumes no liability under the terms of this warranty as a consequence of such events.

If an Inteltronic Inc. product is defective, it will be repaired or replaced at no charge during the warranty period. For out-of-warranty repairs, you will be billed according to the cost of replacement materials, service time and freight. In returning the modules, they must be properly packaged with original package; there should be detailed description of the failures or defect.

■ RMA

Products purchased through Inteltronic Inc. and under warranty may be returned for replacement. Contact support@inteltronicinc.com for RMA number and procedures

Office Locations

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