
Display Elektronik GmbH

DATA SHEET

TFT MODULE

DEM 19201080J VM-PW-N

21,5“ TFT

Product Specification

Version: 0

14.04.2026

Contents

1. Basic Specifications	4
1.1 TFT Features	4
1.2 Mechanical Information	4
2. Block Diagram	5
3. Outline dimension	6
4. Input terminal Pin Assignment	7
4.1 TFT PIN Define	7
4.2 BL PIN Define	8
5. LCD Optical Characteristics	9
5.1 Optical specification	9
6. Electrical Characteristics	12
6.1 Absolute Maximum Ratings	12
6.2 DC Electrical Characteristics	12
6.3 LED Backlight Characteristics	13
7. Signal Timing Specification	15
7.1 The Module is operated by the DE only	15
7.2 LVDS Rx Interface Timing Parameter	12
7.3 Signal Timing Waveforms Of Interface Signal	12
7.3.1 Sync Tining Waveforms	18
7.3.2 Vertical Timing Waveforms	18
7.3.3 Horizontal Timing Waveforms	19
7.4 Input Signals,Basic Display Colors & Gray Scale Of Colors	13
8. Power Sequence	21
9. LCD Module Out-Going Quality Level	21
9.1 VISUAL & FUNCTION INSPECTION STANDARD	21
9.1.1 Inspection conditions	21
9.1.2 Definition Zone D	21
9.1.3 Sampling Plan	22
9.1.4 Criteria (Visual)	23
10. Reliability Test Result	29
11. Cautions and Handling Precautions	30
11.1 Handling and Operating the Module	30
11.2 Storage and Transportation.	30

1. Basic Specifications

* Description

This is a color active matrix TFT (Thin Film Transistor) LCD (liquid crystal display) that uses amorphous silicon TFT as a switching device. This module is composed of a Transmissive type TFT-LCD Panel, driver circuit, back-light unit. The resolution of a 21.5' TFT-LCD contains 1920x1080 Pixels, and can display up to 16.7Million colors.

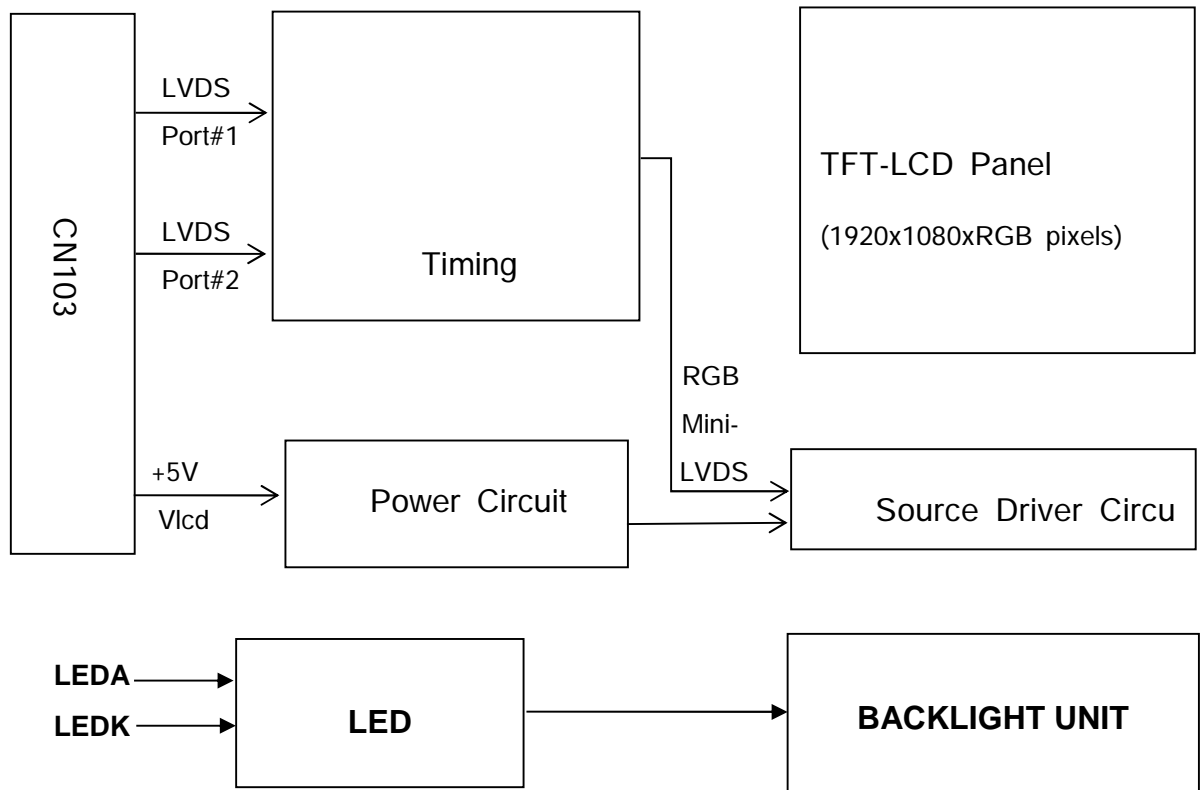
1.1 TFT Features

General Information Items	Specification	Unit	Note
	Main Panel		
Display Area(AA)	478.66 x 261.48 (21.5 Inch)	mm	-
Driver Element	TFT Active Matrix	-	-
Display Colors	16.7 Million	Colors	-
Number of Pixels	1920 x (RGB) x 1080	Dots	-
Pixel Arrangement	RGB Vertical Stripe	-	-
Pixel Pitch	0.2493 x 0.241	mm	-
Viewing Angle	ALL	o'clock	-
LCM Interface	2-Port LVDS	-	-
Display Mode	Transmissive / Normally Black	-	-
Operating Temperature	0 ~ +50	°C	-
Storage Temperature	-20 ~ +60	°C	-

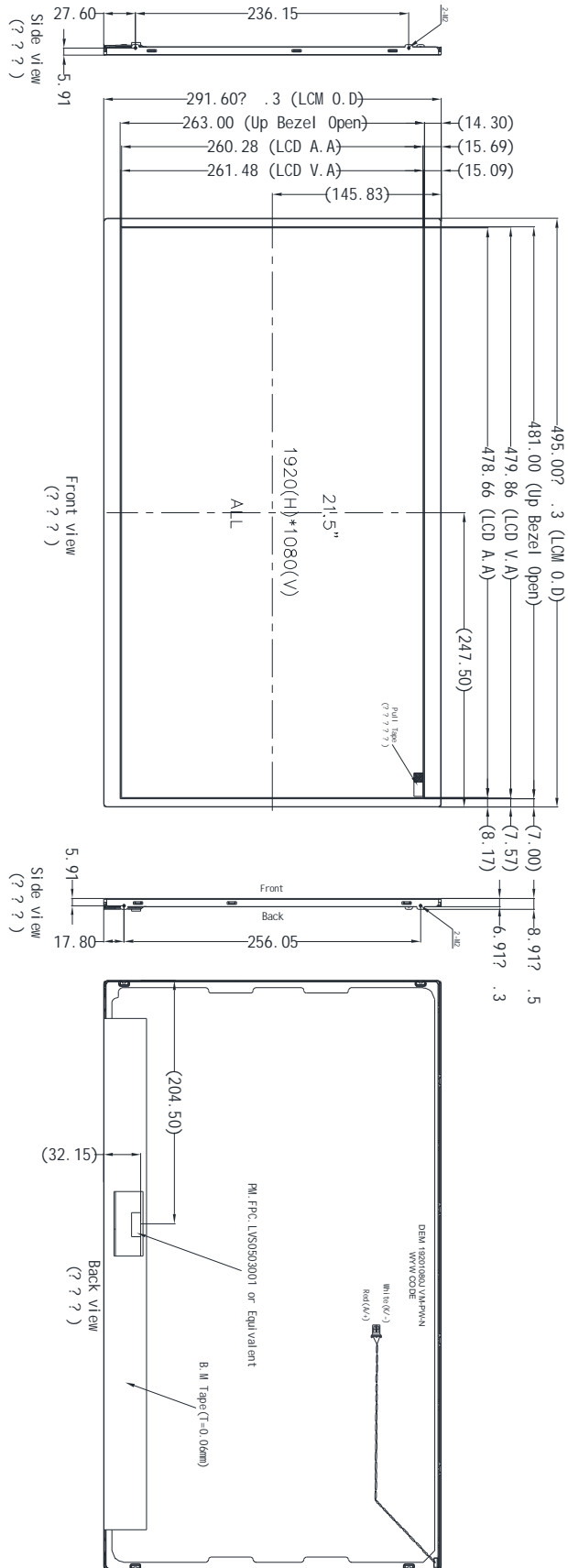
1.2 Mechanical Information

Item		Min.	Typ.	Max.	Unit	Note
Module Size	Horizontal(H)	-	495.00	-	mm	-
	Vertical(V)	-	291.60	-	mm	-
	Depth(D)	-	8.91	-	mm	-
Weight		-	t.b.d.	-	g	-

2. Block Diagram



3. Outline Dimension



- NOTES:
1. DISPLAY TYPE: 21.5", TFT-LCD, 16.7 COLORS
 2. DISPLAY MODE: NORMALLY BLACK/IPS
 3. VIEWING DIRECTION: ALL
 4. LCM Interface: 2-Port LVDS (Surface Treatment: Haze 25%, 3H)
 5. VDD: 5V
 5. OPERATING TEMP: 0°C TO 50°C
 5. STORAGE TEMP: -20°C TO 60°C
 7. BACK LIGHT: 72 LED WHITE, 300mA (constant current), (50.4-54.0)V
 8. RHSS COMPLIANT.
 9. " * " critical dimension; () reference dimension.

Backlight (PH2.0-2P)	Pin	Definitions
1	A(+)	
2	K(-)	

LVDS In:

Pin	Name	Pin	Name	Pin	Name
1	RX00-	11	RX03+	21	RXEC+
2	RX00+	12	RXE0-	22	RXE3-
3	RX01-	13	RXE0+	23	RXE3+
4	RX01+	14	GND	24	GND
5	RX02-	15	RXE1-	25	NC
6	RX02+	16	RXE1+	26	NC
7	NC	17	GND	27	NC
8	RX0C-	18	RXE2-	28	VDD
9	RX0C+	19	RXE2+	29	VDD
10	RX03-	20	RXEC-	30	VDD

30Pin 0.5Pitch (R/L FPC: LV50503001 or Equivalent)

B/L Circuit



4. Input Terminal Pin Assignment

4.1 TFT PIN Definition

Module Side Connector: 30Pin 0.5 Pitch (PM.FPC.LVS0503001 or equivalent)

NO.	SYMBOL	DISCRIPTION	I/O
1	RX00-	Negative Transmission data of Pixel 0(ODD)	I
2	RX00+	Positive Transmission data of Pixel 0(ODD)	I
3	RX01-	Negative Transmission data of Pixel 1(ODD)	I
4	RX01+	Positive Transmission data of Pixel 1(ODD)	I
5	RX02-	Negative Transmission data of Pixel 2(ODD)	I
6	RX02+	Positive Transmission data of Pixel 2(ODD)	I
7	NC	*Reserved for LCD manufa cturer's use(BIST)	--
8	RXOC-	Negative Transmission Clock(ODD)	I
9	RXOC+	Positive Transmission Clock(ODD)	I
10	RX03-	Negative Transmission data of Pixel 3(ODD)	I
11	RX03+	Positive Transmission data of Pixel 3(ODD)	I
12	RXE0-	Negative Transmission data of Pixel 0(EVEN)	I
13	RXE0+	Positive Transmission data of Pixel 0(EVEN)	I
14	GND	Power Ground	P
15	RXE1-	Negative Transmission data of Pixel 1(EVEN)	I
16	RXE1+	Positive Transmission data of Pixel 1(EVEN)	I
17	GND	Power Ground	P
18	RXE2-	Negative Transmission data of Pixel 2(EVEN)	I
19	RXE2+	Positive Transmission data of Pixel 2(EVEN)	I
20	RXEC-	Negative Transmission Clock(EVEN)	I
21	RXEC+	Positive Transmission Clock(EVEN)	I
22	RXE3-	Negative Transmission data of Pixel 3(EVEN)	I
23	RXE3+	Positive Transmission data of Pixel 3(EVEN)	I
24	GND	Power Ground	P
25	NC	*Reserved for LCD manufa cturer's use(SCL)	--
26	NC	*Reserved for LCD manufa cturer's use(SDA)	--
27	NC	No Connection	--
28	VDD	Power Supply:+5V	P
29	VDD		
30	VDD		

4.2 BL PIN Definition

Connector: PH2.0-2P

NO.	SYMBOL	DISCRIPTION	I/O
1	LED(A)	Anode Pin of Backlight.	P
2	LED(K)	Cathode Pin of Backlight.	P

5. LCD Optical Characteristics

5.1 Optical Specification

Item	Symbol	Condition	Min.	Typ.	Max.	Unit.	Note
Contrast Ratio	CR	$\Theta=0$	900	1100	--		(1)(2)
Response Time	Rising	T_{R+T_F}	--	20	--	msec	(1)(3)
	Falling						
Uniformity	S(%)		--	64.9	--	%	
Color Filter Chromaticity ((CIE 1931))	White	W_X	-0.04	0.2936	+0.04		(1)(4) CA-310
		W_Y		0.3263			
	Red	R_X		0.6320			
		R_Y		0.3634			
	Green	G_X		0.3465			
		G_Y		0.6069			
	Blue	B_X		0.1420			
		B_Y		0.0619			
Viewing Angle	Hor.	Θ_L	CR>10	80	89	--	(1)(4)
		Θ_R		80	89	--	
	Ver.	Θ_U		80	89	--	
		Θ_D		80	89	--	
Option View Direction	ALL						

* The data comes from the LCD specification.

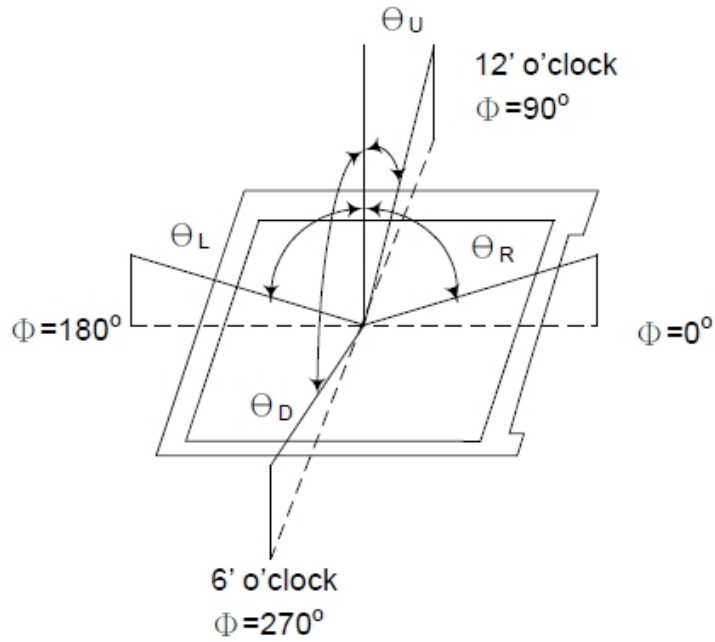
Measuring Condition

Measuring Surrounding: Dark Room
 Ambient Temperature: 25°C±2°C
 15min. warm-up time.

Measuring Equipment

FPM520 of Westar Display technologies, INC., which utilized SR-3 for Chromaticity and BM-5A for other optical characteristics.

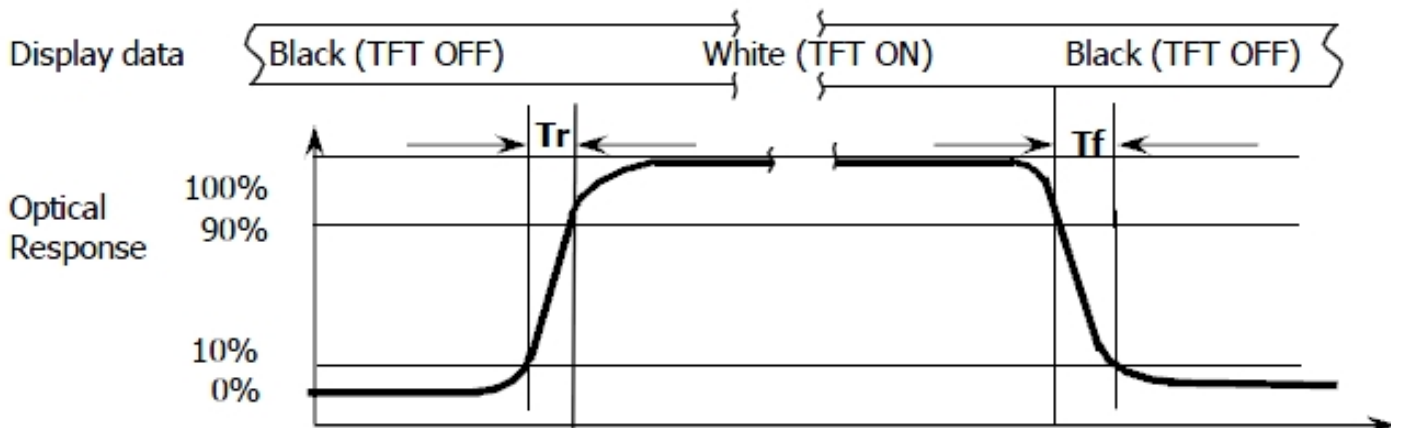
Note (1): Definition of Viewing Angle:



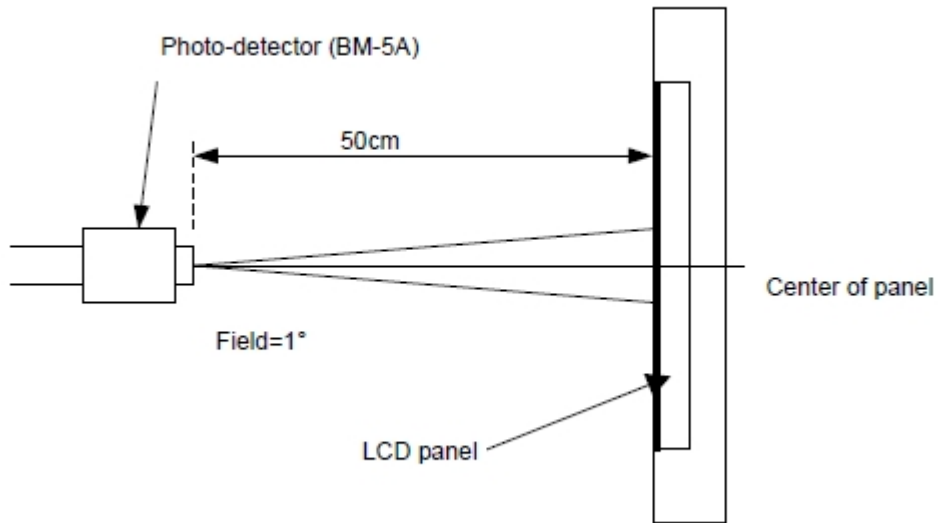
Note (2): Definition of Contrast Ratio(CR): measured at the center point of panel

$$CR = \frac{\text{Luminance with all pixels white}}{\text{Luminance with all pixels black}}$$

Note (3): Response Time



Note (4): Definition of optical measurement setup



6. Electrical Characteristics

6.1 Absolute Maximum Ratings

Characteristics	Symbol	Min.	Max.	Unit	Note
Digital Supply Voltage	VDD	-0.5	5.5	V	Note1
Operating Temperature	T _{OP}	0	50	°C	-
Storage Temperature	T _{ST}	-20	+60	°C	-

NOTE1: If the absolute maximum rating of even is one of the above parameters is exceeded even momentarily, the quality of the product may be degraded. Absolute maximum ratings, therefore, specify the values exceeding which the product may be physically damaged. Be sure to use the product within the range of the absolute maximum ratings.

6.2 DC Electrical Characteristics

Characteristics	Symbol	Min.	Typ.	Max.	Unit	Note
Digital Supply Voltage	VDD	4.5	5.0	5.5	V	--
Normal Mode Current	IDD	--	660	840	mA	--
Level Input Voltage	V _{IH}	0.8*VDD	--	VDD	V	--
	V _{IL}	GND	--	0.2*VDD	V	--

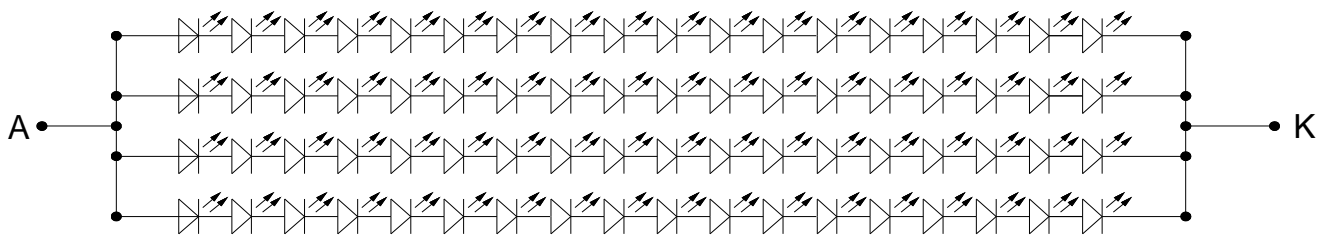
6.3 LED Backlight Characteristics

The Backlight system is edge-lighting type with 40 chips LED

Item	Symbol	Min.	Typ.	Max.	Unit	Note
Forward Current	I _F	--	300	--	mA	--
Forward Voltage	V _F	--	52	--	V	--
LCM Luminance	LV	--	470	520	cd/m ²	I _F =300mA
LED life time	Hr	50000	--	--	Hour	Note1,2
Uniformity	Avg	70	80	--	%	Note3

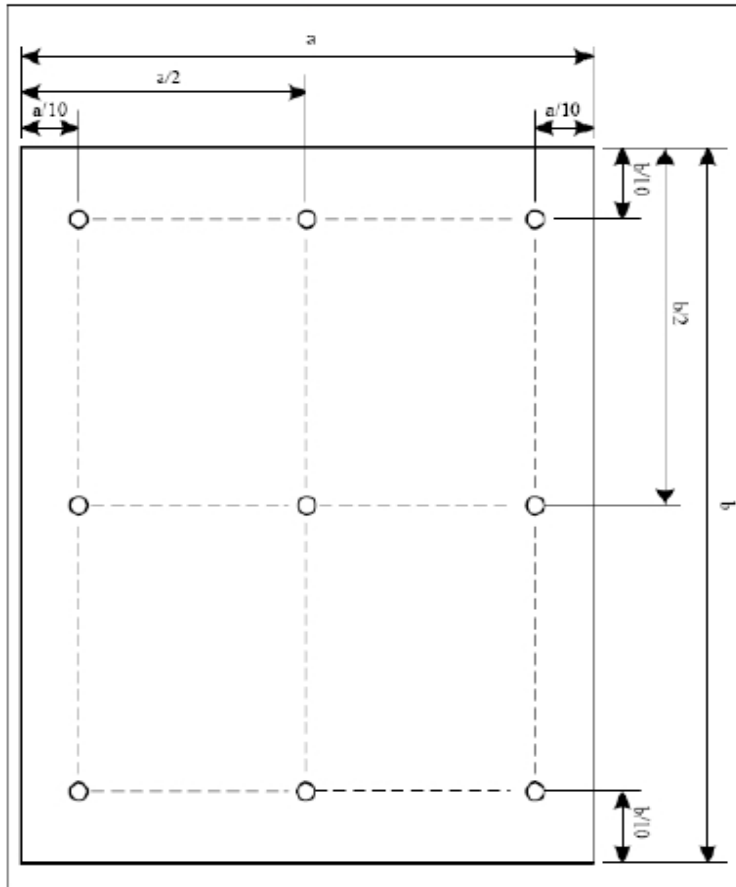
Note1: LED life time (Hr) can be defined as the time in which it continues to operate under the condition: Ta=25°C±3°C, typical IL value indicated in the above table until the brightness becomes less than 50%.

Note 2: The “LED life time” is defined as the module brightness decrease to 50% original brightness at Ta=25°C and IL=300mA. The LED lifetime could be decreased if operating IL is larger than 300mA. The constant current driving method is suggested.



B/ L C i r c u i t

Note (3) Luminance Uniformity of these 9 points is defined as below:



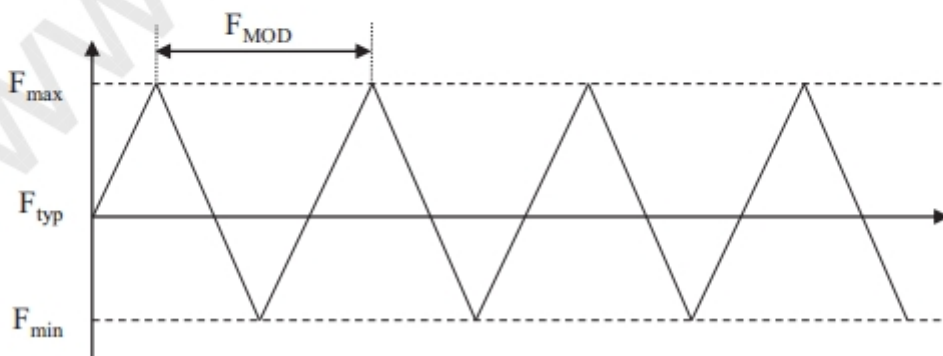
$$\text{Uniformity} = \frac{\text{minimum luminance in 9 points (1-9)}}{\text{maximum luminance in 9 points (1-9)}}$$

$$\text{Luminance} = \frac{\text{Total Luminance of 9 points}}{9}$$

7. Signal Timing Specification

7.1 The Module is operated by the DE only

Item	Symbols		Min	Typ	Max	Unit	Note
DCLK	Period	tCLK	10.4	13.5	16.7	ns	
	Frequency	-	60	74.25	96	MHz	
Hsync	Period	tHP	1050	1100	1174	tCLK	
	Horizontal Valid	tHV	960			tCLK	
	Horizontal Blank	tHB	90	140	214		
	Frequency	fH	54	67.5	84.4	KHz	
Vsync	Period	tVP	1120	1125	1570	tHP	
	Vertical Valid	tVV	1080			tHP	
	Vertical Blank	tVB	40	45	490	tHP	
	Frequency	fV	48	60	75	Hz	
LVDS Receiver clock	Input spread spectrum ratio	SSr	-3	-	+3	%	
	Module Frequency	F _{MOD}	30	-	200	KHz	

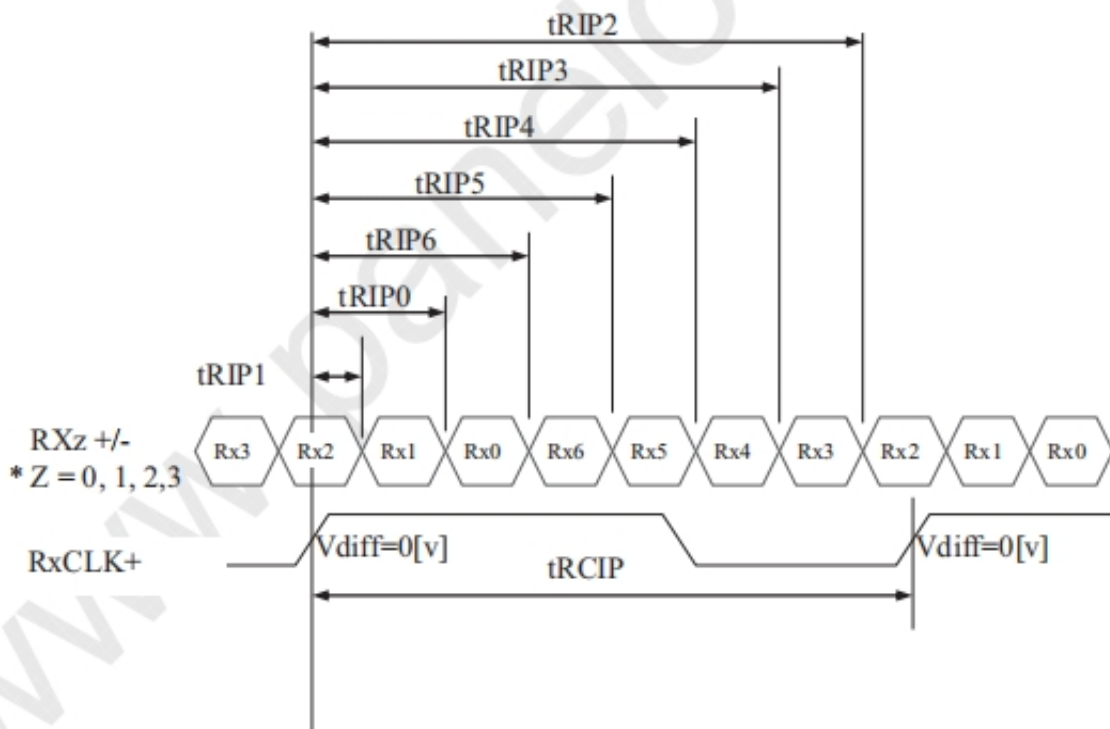


7.2 LVDS Rx Interface Timing Parameter

The specification of the LVDS Rx interface timing parameter is shown in Table 4.

<Table 4. LVDS Rx Interface Timing Specification>

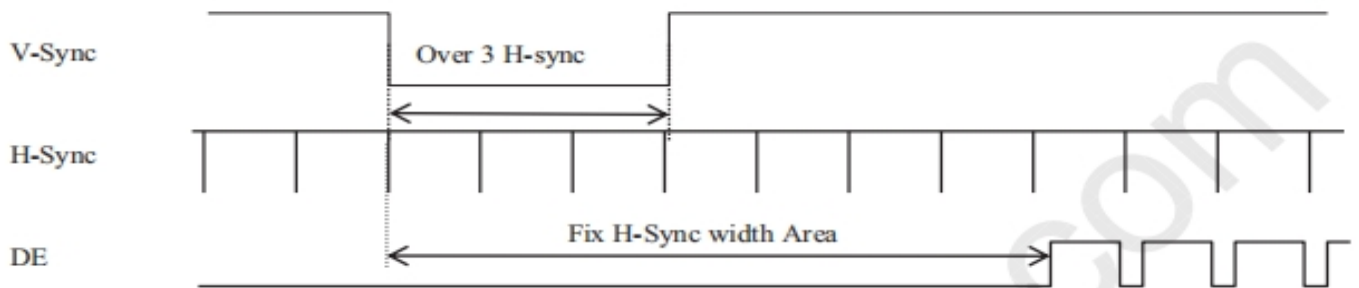
Item	Symbol	Min	Typ	Max	Unit	Remark
CLKIN Period	tRCIP	10.47	13.47	17.7	nsec	
Input Data 0	tRIP1	-0.4	0.0	+0.4	nsec	
Input Data 1	tRIP0	tRCIP/7-0.4	tRCIP/7	tRCIP/7+0.4	nsec	
Input Data 2	tRIP6	2 × tRCIP/7-0.4	2 × tRCIP/7	2 × tRCIP/7+0.4	nsec	
Input Data 3	tRIP5	3 × tRCIP/7-0.4	3 × tRCIP/7	3 × tRCIP/7+0.4	nsec	
Input Data 4	tRIP4	4 × tRCIP/7-0.4	4 × tRCIP/7	4 × tRCIP/7+0.4	nsec	
Input Data 5	tRIP3	5 × tRCIP/7-0.4	5 × tRCIP/7	5 × tRCIP/7+0.4	nsec	
Input Data 6	tRIP2	6 × tRCIP/7-0.4	6 × tRCIP/7	6 × tRCIP/7+0.4	nsec	



* Vdiff = (RXz+)-(RXz-),..., (RXCLK+)-(RXCLK-)

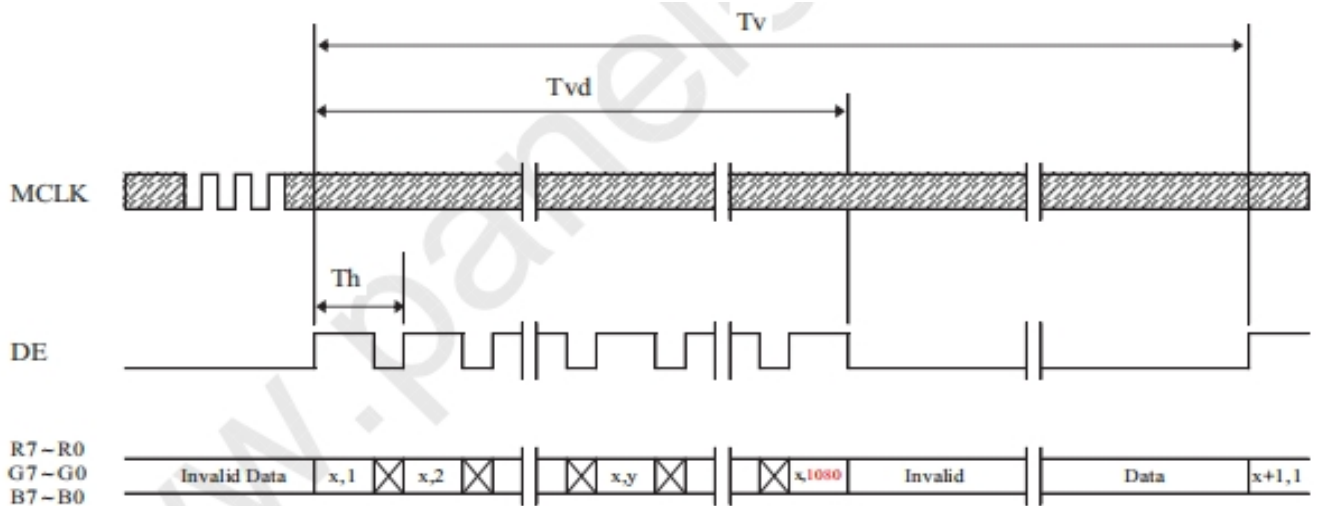
7.3 Signal Timing Waveforms Of Interface Signal

7.3.1 Sync Timing Waveforms

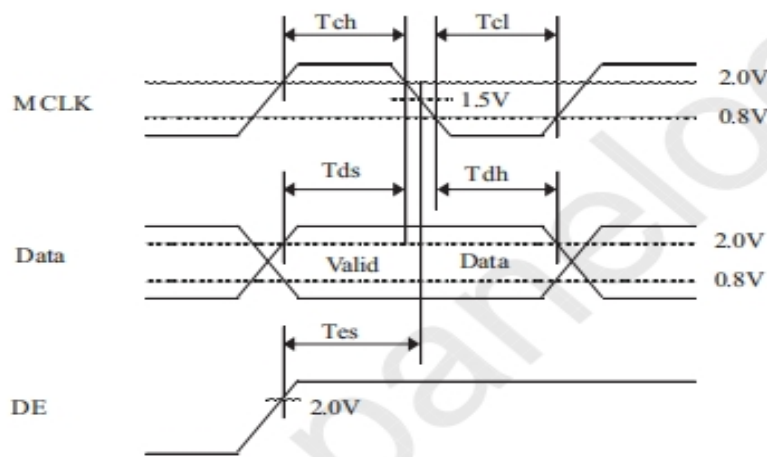
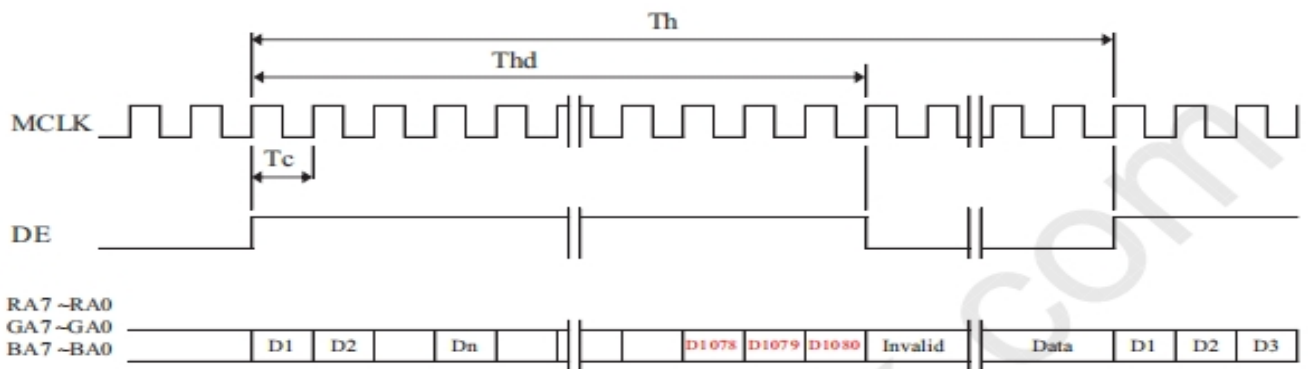


- 1) Need over 3 H-sync during V-Sync Low
- 2) Fix H-Sync width from V-Sync falling edge to first rising edge

7.3.2 Vertical Timing Waveforms



7.3.3 Horizontal Timing Waveforms

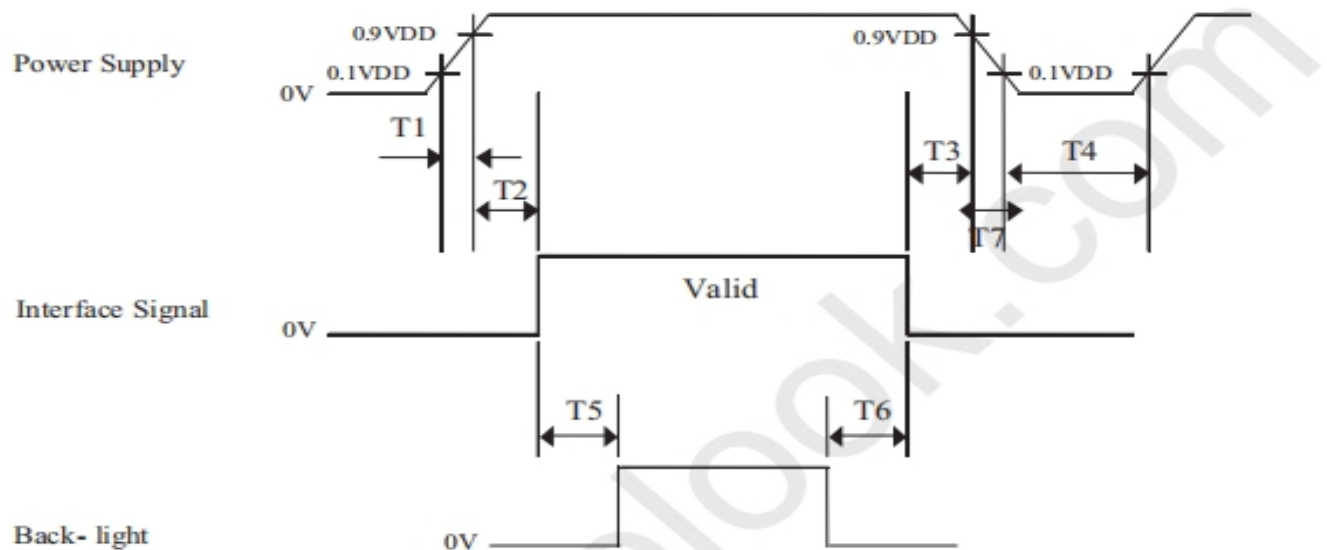


7.4 Input Signals, Basic Display Colors & Gray Scale Of Colors

Color & Gray Scale		RED DATA								GREEN DATA								BLUE 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
Basic Colors	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
	Blue	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1
	Green	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0
	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
	Red	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	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
Gray Scale of RED	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
	△	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Darker	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	△	↑								↑								↑							
	▽	↓								↓								↓							
	Brighter	1	1	1	1	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	▽	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	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gray Scale of GREEN	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
	△	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
	Darker	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
	△	↑								↑								↑							
	▽	↓								↓								↓							
	Brighter	0	0	0	0	0	0	0	0	1	1	1	1	1	1	0	1	0	0	0	0	0	0	0	0
	▽	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	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0
Gray Scale of BLUE	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
	△	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
	Darker	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
	△	↑								↑								↑							
	▽	↓								↓								↓							
	Brighter	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	0	1
	▽	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	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1
Gray Scale of WHITE	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
	△	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	
	Darker	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	
	△	↑								↑								↑							
	▽	↓								↓								↓							
	Brighter	1	1	1	1	1	1	0	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	0	1
	▽	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	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

8 Power Sequence

To prevent a latch-up or DC operation of the LCD module, the power on/off sequence shall be as shown in below.



- $0.5 \text{ ms} \leq T1 \leq 10 \text{ ms}$
- $0 \leq T2 \leq 50 \text{ ms}$
- $0 < T3 \leq 50 \text{ ms}$
- $1 \text{ sec} \leq T4$
- $500 \text{ ms} \leq T5$
- $200 \text{ ms} \leq T6$
- $\text{TBD} \leq T7$

Note :

1. When the power supply V_{DD} is 0V, keep the level of input signals on the low or keep high impedance.
2. Do not keep the interface signal high impedance when power is on.
3. Back Light must be turn on after power for logic and interface signal are valid.
4. T7 decreases smoothly, there is none re-bouncing voltage.
5. If $T3=0\text{ms}$, there is a risk of flicker when power On/Off.
6. If $T6=0\text{ms}$, there is a risk of abnormal display when power off.

9. LCD Module Out-Going Quality Level

9.1 VISUAL & FUNCTION INSPECTION STANDARD

9.1.1 Inspection Conditions

Inspection performed under the following conditions is recommended.

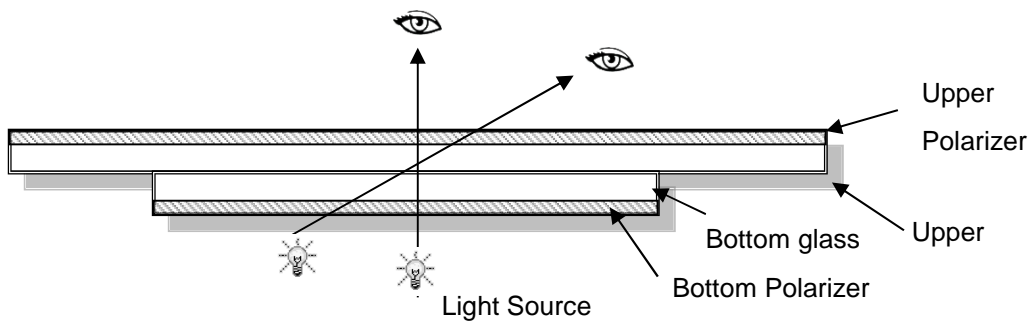
Temperature: 25°C±5°C

Humidity: 65%±10%RH

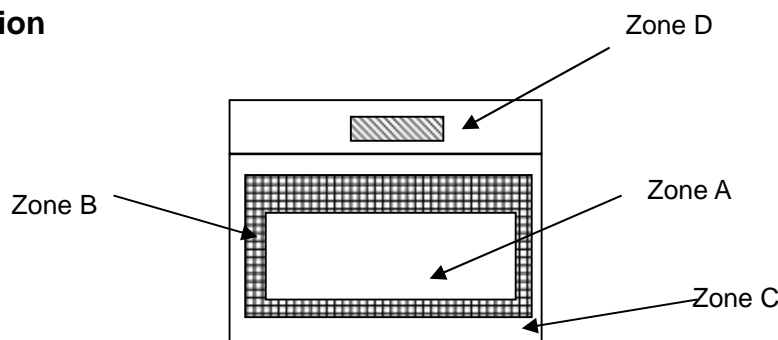
Viewing Angle: Normal Viewing Angle.

Illumination: Single fluorescent lamp (300 to 700Lux)

Viewing distance: 30-50cm



9.1.2 Definition



Zone A: Effective Viewing Area (Character or Digit can be seen)

Zone B: Viewing Area except Zone A

Zone C: Cover (Zone A+Zone B) which cannot be seen after assembly by customer .)

Zone D: IC Bonding Area

Note: As a general rule, visual defects in Zone C can be ignored when it doesn't effect product function or appearance after assembly by customer

9.1.3 Sampling Plan

According to GB/T 2828-2003; Normal Inspection, Class II

AQL:

Major Defect	Minor Defect
0.65	1.5

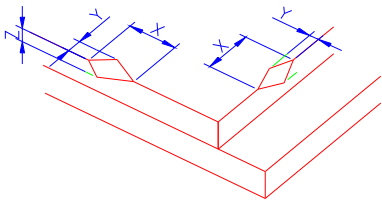
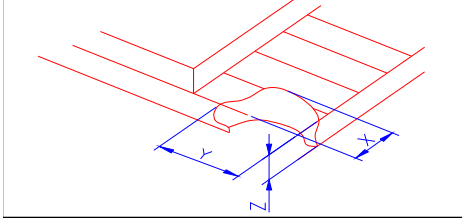
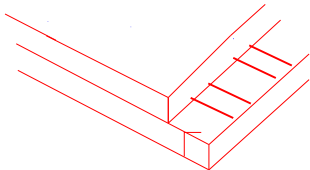
LCD: Liquid Crystal Display, LCM: Liquid Crystal Module, CTP: Capacitive Touch Panel

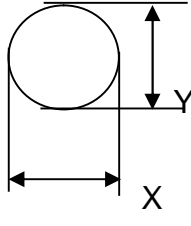
No	Items to be inspected	Criteria	Classification of defects
1	Functional defects	1) No display, Open or miss line 2) Display abnormally, Short 3) Backlight no lighting, abnormal lighting.	Major
2	Missing	Missing component	
3	Outline dimension	Overall outline dimension beyond the drawing is not allowed	
4	Color tone	Color unevenness, refer to limited sample	Minor
5	Spot Line defect	Light dot , Dim spot , Polarizer Bubble ; Polarizer accidented spot.	
6	Soldering appearance	Good soldering , Peeling off is not allowed.	
7	LCD/Polarizer/CTP	Black/White spot/line, scratch, crack, etc.	



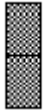
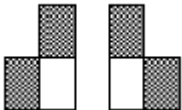
Note1: a) Light dot: Dots appear bright and unchanged in size in which LCD panel is displaying under black pattern.


b) Dim dot: Dots appear dark and unchanged in size in which LCD panel is displaying under pure red, green, blue picture.

9.1.4 Criteria (Visual)

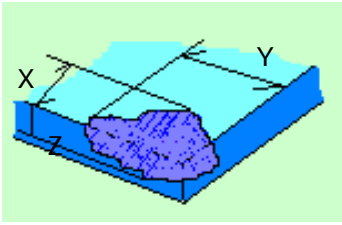
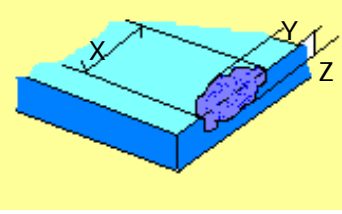
Number	Items	Criteria(mm)						
1.0 LCD Crack/Broken NOTE: X: Length Y: Width Z: Height L: Length of ITO, T: Height of LCD	(1) The edge of LCD broken	 <table border="1" data-bbox="753 577 1452 728"> <thead> <tr> <th>X</th> <th>Y</th> <th>Z</th> </tr> </thead> <tbody> <tr> <td>≤3.0mm</td> <td><Inner border line of the seal</td> <td>≤T</td> </tr> </tbody> </table>	X	Y	Z	≤3.0mm	<Inner border line of the seal	≤T
X	Y	Z						
≤3.0mm	<Inner border line of the seal	≤T						
	(2) LCD corner broken	 <table border="1" data-bbox="833 1034 1372 1137"> <thead> <tr> <th>X</th> <th>Y</th> <th>Z</th> </tr> </thead> <tbody> <tr> <td>≤3.0mm</td> <td>≤L</td> <td>≤T</td> </tr> </tbody> </table>	X	Y	Z	≤3.0mm	≤L	≤T
X	Y	Z						
≤3.0mm	≤L	≤T						
	(3) LCD crack	 <p style="text-align: center;">Crack Not allowed</p>						

2.0	Spot defect	① light dot (black/white spot , pinhole, stain, etc.)																												
	 <p style="text-align: center;">$\Phi=(X+Y)/2$</p>	<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th rowspan="2" style="text-align: center;">Zone Size (mm)</th> <th colspan="3" style="text-align: center;">Acceptable Qty</th> </tr> <tr> <th style="text-align: center;">A</th> <th style="text-align: center;">B</th> <th style="text-align: center;">C</th> </tr> </thead> <tbody> <tr> <td style="text-align: center;">$\Phi \leq 0.15$</td> <td colspan="3" style="text-align: center;">Ignore</td> </tr> <tr> <td style="text-align: center;">$0.15 < \Phi \leq 0.25$</td> <td colspan="3" rowspan="2" style="text-align: center;">Ignore</td> </tr> <tr> <td style="text-align: center;">$0.25 < \Phi \leq 0.4$</td> <td colspan="2" style="text-align: center;">3(distance ≥ 10mm)</td> </tr> <tr> <td style="text-align: center;">$\Phi > 0.4$</td> <td colspan="3" style="text-align: center;">2(distance ≥ 10mm)</td> </tr> <tr> <td style="text-align: center;">$\Phi > 0.4$</td> <td colspan="3" style="text-align: center;">0</td> </tr> </tbody> </table>			Zone Size (mm)	Acceptable Qty			A	B	C	$\Phi \leq 0.15$	Ignore			$0.15 < \Phi \leq 0.25$	Ignore			$0.25 < \Phi \leq 0.4$	3(distance ≥ 10 mm)		$\Phi > 0.4$	2(distance ≥ 10 mm)			$\Phi > 0.4$	0		
	Zone Size (mm)	Acceptable Qty																												
		A	B	C																										
	$\Phi \leq 0.15$	Ignore																												
$0.15 < \Phi \leq 0.25$	Ignore																													
$0.25 < \Phi \leq 0.4$				3(distance ≥ 10 mm)																										
$\Phi > 0.4$	2(distance ≥ 10 mm)																													
$\Phi > 0.4$	0																													
② Dim spot (light leakage, dent, dark spot, etc)		<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th rowspan="2" style="text-align: center;">Zone Size (mm)</th> <th colspan="3" style="text-align: center;">Acceptable Qty</th> </tr> <tr> <th style="text-align: center;">A</th> <th style="text-align: center;">B</th> <th style="text-align: center;">C</th> </tr> </thead> <tbody> <tr> <td style="text-align: center;">$\Phi \leq 0.15$</td> <td colspan="3" style="text-align: center;">Ignore</td> </tr> <tr> <td style="text-align: center;">$0.15 < \Phi \leq 0.25$</td> <td colspan="3" rowspan="2" style="text-align: center;">Ignore</td> </tr> <tr> <td style="text-align: center;">$0.25 < \Phi \leq 0.4$</td> <td colspan="2" style="text-align: center;">3(distance ≥ 10mm)</td> </tr> <tr> <td style="text-align: center;">$\Phi > 0.4$</td> <td colspan="3" style="text-align: center;">2(distance ≥ 10mm)</td> </tr> <tr> <td style="text-align: center;">$\Phi > 0.4$</td> <td colspan="3" style="text-align: center;">0</td> </tr> </tbody> </table>			Zone Size (mm)	Acceptable Qty			A	B	C	$\Phi \leq 0.15$	Ignore			$0.15 < \Phi \leq 0.25$	Ignore			$0.25 < \Phi \leq 0.4$	3(distance ≥ 10 mm)		$\Phi > 0.4$	2(distance ≥ 10 mm)			$\Phi > 0.4$	0		
Zone Size (mm)	Acceptable Qty																													
	A	B	C																											
$\Phi \leq 0.15$	Ignore																													
$0.15 < \Phi \leq 0.25$	Ignore																													
$0.25 < \Phi \leq 0.4$				3(distance ≥ 10 mm)																										
$\Phi > 0.4$	2(distance ≥ 10 mm)																													
$\Phi > 0.4$	0																													
③ Polarizer accidented spot		<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th rowspan="2" style="text-align: center;">Zone Size (mm)</th> <th colspan="3" style="text-align: center;">Acceptable Qty</th> </tr> <tr> <th style="text-align: center;">A</th> <th style="text-align: center;">B</th> <th style="text-align: center;">C</th> </tr> </thead> <tbody> <tr> <td style="text-align: center;">$\Phi \leq 0.2$</td> <td colspan="3" style="text-align: center;">Ignore</td> </tr> <tr> <td style="text-align: center;">$0.2 < \Phi \leq 0.5$</td> <td colspan="2" style="text-align: center;">2(distance ≥ 10mm)</td> <td rowspan="2" style="text-align: center;">Ignore</td> </tr> <tr> <td style="text-align: center;">$\Phi > 0.5$</td> <td colspan="2" style="text-align: center;">0</td> </tr> </tbody> </table>			Zone Size (mm)	Acceptable Qty			A	B	C	$\Phi \leq 0.2$	Ignore			$0.2 < \Phi \leq 0.5$	2(distance ≥ 10 mm)		Ignore	$\Phi > 0.5$	0									
Zone Size (mm)	Acceptable Qty																													
	A	B	C																											
$\Phi \leq 0.2$	Ignore																													
$0.2 < \Phi \leq 0.5$	2(distance ≥ 10 mm)		Ignore																											
$\Phi > 0.5$	0																													
④ Polarizer Bubble		<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th rowspan="2" style="text-align: center;">Zone Size (mm)</th> <th colspan="3" style="text-align: center;">Acceptable Qty</th> </tr> <tr> <th style="text-align: center;">A</th> <th style="text-align: center;">B</th> <th style="text-align: center;">C</th> </tr> </thead> <tbody> <tr> <td style="text-align: center;">$\Phi \leq 0.2$</td> <td colspan="3" style="text-align: center;">Ignore</td> </tr> <tr> <td style="text-align: center;">$0.2 < \Phi \leq 0.4$</td> <td colspan="2" style="text-align: center;">2(distance ≥ 10mm)</td> <td rowspan="2" style="text-align: center;">Ignore</td> </tr> <tr> <td style="text-align: center;">$\Phi > 0.4$</td> <td colspan="2" style="text-align: center;">0</td> </tr> </tbody> </table>			Zone Size (mm)	Acceptable Qty			A	B	C	$\Phi \leq 0.2$	Ignore			$0.2 < \Phi \leq 0.4$	2(distance ≥ 10 mm)		Ignore	$\Phi > 0.4$	0									
Zone Size (mm)	Acceptable Qty																													
	A	B	C																											
$\Phi \leq 0.2$	Ignore																													
$0.2 < \Phi \leq 0.4$	2(distance ≥ 10 mm)		Ignore																											
$\Phi > 0.4$	0																													

3.0	LCD Pixel defect	<p>Pixel bad points</p> <table border="1"> <thead> <tr> <th data-bbox="523 253 715 304">Item</th> <th data-bbox="715 253 1230 304">Zone A</th> <th data-bbox="1230 253 1481 304">Acceptable Qty</th> </tr> </thead> <tbody> <tr> <td data-bbox="523 304 715 465" rowspan="3">Bright dot</td> <td data-bbox="715 304 1230 360">Random</td> <td data-bbox="1230 304 1481 360">N≤2</td> </tr> <tr> <td data-bbox="715 360 1230 416">2 dots adjacent</td> <td data-bbox="1230 360 1481 416">N≤0</td> </tr> <tr> <td data-bbox="715 416 1230 465">3 dots adjacent</td> <td data-bbox="1230 416 1481 465">N≤0</td> </tr> <tr> <td data-bbox="523 465 715 633" rowspan="3">Dark dot</td> <td data-bbox="715 465 1230 521">Random</td> <td data-bbox="1230 465 1481 521">N≤3</td> </tr> <tr> <td data-bbox="715 521 1230 577">2 dots adjacent</td> <td data-bbox="1230 521 1481 577">N≤0</td> </tr> <tr> <td data-bbox="715 577 1230 633">3 dots adjacent</td> <td data-bbox="1230 577 1481 633">N≤0</td> </tr> <tr> <td data-bbox="523 633 715 943">Distance</td> <td data-bbox="715 633 1230 943"> 1. Minimum Distance Between Bright dots. 2. Minimum Distance Between dark dots 3. Minimum Distance Between dark and bright dot. </td> <td data-bbox="1230 633 1481 943">5mm</td> </tr> <tr> <td colspan="2" data-bbox="523 943 1230 999">Total bright and dark dot</td> <td data-bbox="1230 943 1481 999">N≤4</td> </tr> </tbody> </table> <p>Note:</p> <p>A) Bright dot: Dots appear bright and unchanged in size in which LCD panel is displaying under black pattern.</p> <p>B) Dark dot: Dots appear dark and unchanged in size in which LCD panel is displaying under pure red, green, blue picture.</p> <p>C) 2 dot adjacent = 1 pair = 2 dots</p> <p>Picture:</p> <div style="display: flex; justify-content: space-around; align-items: flex-start;"> <div style="text-align: center;">  <p>2 dot adjacent</p> </div> <div style="text-align: center;">  <p>2 dot adjacent</p> </div> <div style="text-align: center;">  <p>2 dot adjacent (vertical)</p> </div> <div style="text-align: center;">  <p>2 dot adjacent (slant)</p> </div> </div>	Item	Zone A	Acceptable Qty	Bright dot	Random	N≤2	2 dots adjacent	N≤0	3 dots adjacent	N≤0	Dark dot	Random	N≤3	2 dots adjacent	N≤0	3 dots adjacent	N≤0	Distance	1. Minimum Distance Between Bright dots. 2. Minimum Distance Between dark dots 3. Minimum Distance Between dark and bright dot.	5mm	Total bright and dark dot		N≤4
Item	Zone A	Acceptable Qty																							
Bright dot	Random	N≤2																							
	2 dots adjacent	N≤0																							
	3 dots adjacent	N≤0																							
Dark dot	Random	N≤3																							
	2 dots adjacent	N≤0																							
	3 dots adjacent	N≤0																							
Distance	1. Minimum Distance Between Bright dots. 2. Minimum Distance Between dark dots 3. Minimum Distance Between dark and bright dot.	5mm																							
Total bright and dark dot		N≤4																							

4.0	Line defect (LCD /Polarizer backlight black/white line, scratch, stain)  W: width, L : length N : Count	<table border="1"> <thead> <tr> <th rowspan="2">Width(mm)</th> <th rowspan="2">Length(mm)</th> <th colspan="3">Acceptable Qty</th> </tr> <tr> <th>A</th> <th>B</th> <th>C</th> </tr> </thead> <tbody> <tr> <td>$\Phi \leq 0.05$</td> <td>Ignore</td> <td colspan="2">Ignore</td> <td rowspan="3">Ignore</td> </tr> <tr> <td>$0.05 < W \leq 0.06$</td> <td>$L \leq 5.0$</td> <td colspan="2">N\leq3</td> </tr> <tr> <td>$0.06 < W \leq 0.08$</td> <td>$L \leq 4.0$</td> <td colspan="2">N\leq2</td> </tr> <tr> <td>$W > 0.08$</td> <td colspan="4">Define as spot defect</td> </tr> </tbody> </table>	Width(mm)	Length(mm)	Acceptable Qty			A	B	C	$\Phi \leq 0.05$	Ignore	Ignore		Ignore	$0.05 < W \leq 0.06$	$L \leq 5.0$	N \leq 3		$0.06 < W \leq 0.08$	$L \leq 4.0$	N \leq 2		$W > 0.08$	Define as spot defect			
		Width(mm)			Length(mm)	Acceptable Qty																						
			A	B		C																						
		$\Phi \leq 0.05$	Ignore	Ignore		Ignore																						
		$0.05 < W \leq 0.06$	$L \leq 5.0$	N \leq 3																								
$0.06 < W \leq 0.08$	$L \leq 4.0$	N \leq 2																										
$W > 0.08$	Define as spot defect																											
5.0	Electronic Components SMT.	Not allow missing parts, solderless connection, cold solder joint, mismatch, The positive and negative polarity opposite																										
6.0	Display color & Brightness.	1. Color: Measuring the color coordinates, The measurement standard according to the datasheet or samples. 2. Brightness: Measuring the brightness of White screen, The measurement standard according to the datasheet or Samples.																										
7.0	LCD Mura/Waving/Hot spot	Not visible through 5% ND filter in 50% gray or judge by limit sample if necessary.																										

8.0	CTP Related	CTP Cover sensor accidented black/white spot	<table border="1"> <thead> <tr> <th rowspan="2">Size Φ(mm)</th> <th colspan="3">Acceptable Qty</th> </tr> <tr> <th>A</th> <th>B</th> <th>C</th> </tr> </thead> <tbody> <tr> <td>$\Phi \leq 0.15$</td> <td colspan="2">Ignore</td> <td rowspan="3">Ignore</td> </tr> <tr> <td>$0.15 < \Phi \leq 0.25$</td> <td colspan="2">4 (distance \geq 10mm)</td> </tr> <tr> <td>$0.25 < \Phi \leq 0.35$</td> <td colspan="2">3 (distance \geq 10mm)</td> </tr> <tr> <td>$\Phi > 0.35$</td> <td colspan="3">0</td> </tr> </tbody> </table>	Size Φ (mm)	Acceptable Qty			A	B	C	$\Phi \leq 0.15$	Ignore		Ignore	$0.15 < \Phi \leq 0.25$	4 (distance \geq 10mm)		$0.25 < \Phi \leq 0.35$	3 (distance \geq 10mm)		$\Phi > 0.35$	0									
			Size Φ (mm)		Acceptable Qty																										
				A	B	C																									
			$\Phi \leq 0.15$	Ignore		Ignore																									
			$0.15 < \Phi \leq 0.25$	4 (distance \geq 10mm)																											
		$0.25 < \Phi \leq 0.35$	3 (distance \geq 10mm)																												
		$\Phi > 0.35$	0																												
		CTP Cover scratch	<table border="1"> <thead> <tr> <th rowspan="2">Width(mm)</th> <th rowspan="2">Ignore(mm)</th> <th colspan="3">Acceptable Qty</th> </tr> <tr> <th>A</th> <th>B</th> <th>C</th> </tr> </thead> <tbody> <tr> <td>$\Phi \leq 0.05$</td> <td>Ignore</td> <td colspan="3">Ignore</td> </tr> <tr> <td>$0.05 < W \leq 0.06$</td> <td>$L \leq 4.0$</td> <td colspan="3">N\leq3</td> </tr> <tr> <td>$0.06 < W \leq 0.08$</td> <td>$L \leq 3.0$</td> <td colspan="3">N\leq2</td> </tr> <tr> <td>$0.08 < W$</td> <td colspan="4">Define as spot defect</td> </tr> </tbody> </table>	Width(mm)	Ignore(mm)	Acceptable Qty			A	B	C	$\Phi \leq 0.05$	Ignore	Ignore			$0.05 < W \leq 0.06$	$L \leq 4.0$	N \leq 3			$0.06 < W \leq 0.08$	$L \leq 3.0$	N \leq 2			$0.08 < W$	Define as spot defect			
			Width(mm)			Ignore(mm)	Acceptable Qty																								
				A	B		C																								
$\Phi \leq 0.05$	Ignore		Ignore																												
$0.05 < W \leq 0.06$	$L \leq 4.0$		N \leq 3																												
$0.06 < W \leq 0.08$	$L \leq 3.0$	N \leq 2																													
$0.08 < W$	Define as spot defect																														

		CTP Cover Pinhole/ Lack of ink	<table border="1"> <thead> <tr> <th rowspan="2">Zone Size (mm)</th> <th colspan="2">Acceptable Qty</th> </tr> <tr> <th colspan="2">C</th> </tr> </thead> <tbody> <tr> <td>$\Phi \leq 0.2$</td> <td colspan="2">Ignore</td> </tr> <tr> <td>$0.2 < \Phi \leq 0.3$</td> <td colspan="2">4(distance ≥ 10mm)</td> </tr> <tr> <td>$0.3 < \Phi \leq 0.4$</td> <td colspan="2">2(distance ≥ 10mm)</td> </tr> <tr> <td>$\Phi > 0.4$</td> <td colspan="2">0</td> </tr> </tbody> </table>	Zone Size (mm)	Acceptable Qty		C		$\Phi \leq 0.2$	Ignore		$0.2 < \Phi \leq 0.3$	4(distance ≥ 10 mm)		$0.3 < \Phi \leq 0.4$	2(distance ≥ 10 mm)		$\Phi > 0.4$	0	
Zone Size (mm)	Acceptable Qty																			
	C																			
$\Phi \leq 0.2$	Ignore																			
$0.2 < \Phi \leq 0.3$	4(distance ≥ 10 mm)																			
$0.3 < \Phi \leq 0.4$	2(distance ≥ 10 mm)																			
$\Phi > 0.4$	0																			
		CTP Bonding bubble/ accidented spot	<table border="1"> <thead> <tr> <th rowspan="2">Size Φ(mm)</th> <th colspan="2">Acceptable Qty</th> </tr> <tr> <th>A</th> <th>B</th> </tr> </thead> <tbody> <tr> <td>$\Phi \leq 0.1$</td> <td colspan="2">Ignore</td> </tr> <tr> <td>$0.1 < \Phi \leq 0.2$</td> <td colspan="2">3(distance ≥ 10mm)</td> </tr> <tr> <td>$0.2 < \Phi \leq 0.3$</td> <td colspan="2">2(distance ≥ 10mm)</td> </tr> <tr> <td>$\Phi > 0.3$</td> <td colspan="2">0</td> </tr> </tbody> </table>	Size Φ (mm)	Acceptable Qty		A	B	$\Phi \leq 0.1$	Ignore		$0.1 < \Phi \leq 0.2$	3(distance ≥ 10 mm)		$0.2 < \Phi \leq 0.3$	2(distance ≥ 10 mm)		$\Phi > 0.3$	0	
Size Φ (mm)	Acceptable Qty																			
	A	B																		
$\Phi \leq 0.1$	Ignore																			
$0.1 < \Phi \leq 0.2$	3(distance ≥ 10 mm)																			
$0.2 < \Phi \leq 0.3$	2(distance ≥ 10 mm)																			
$\Phi > 0.3$	0																			
		Assembly deflection	beyond the edge of backlight ≤ 0.2 mm																	
		CTP cover broken X : length Y : width Z : height	<table border="1"> <thead> <tr> <th>X</th> <th>Y</th> <th>Z</th> </tr> </thead> <tbody> <tr> <td>$X \leq 0.5$mm</td> <td>$Y \leq 0.5$mm</td> <td>$Z < \text{cover thickness}$ s</td> </tr> </tbody> </table> <p>Circuitry broken is not allowed.</p> 	X	Y	Z	$X \leq 0.5$ mm	$Y \leq 0.5$ mm	$Z < \text{cover thickness}$ s											
X	Y	Z																		
$X \leq 0.5$ mm	$Y \leq 0.5$ mm	$Z < \text{cover thickness}$ s																		
		CTP cover broken X : length Y : width Z : height	<table border="1"> <thead> <tr> <th>X</th> <th>Y</th> <th>Z</th> </tr> </thead> <tbody> <tr> <td>$X \leq 0.3$mm</td> <td>$Y \leq 0.3$mm</td> <td>$Z < \text{cover thickness}$</td> </tr> </tbody> </table> <p>* Circuitry broken is not allowed.</p> 	X	Y	Z	$X \leq 0.3$ mm	$Y \leq 0.3$ mm	$Z < \text{cover thickness}$											
X	Y	Z																		
$X \leq 0.3$ mm	$Y \leq 0.3$ mm	$Z < \text{cover thickness}$																		

Criteria (functional items)

Number	Items	Criteria (mm)
1	No display	Not allowed
2	Missing segment	Not allowed
3	Short	Not allowed
4	Backlight no lighting	Not allowed
5	CTP no function	Not allowed

10. Reliability Test Result

Item	Condition	Inspection after test
High Temperature Operating	50°C, 96h	Inspection after 2~4hours storage at room temperature, the sample shall be free from defects: 1. Air bubble in the LCD; 2. Non-display; 3. Missing segments/line; 4. Glass crack; 5. Current IDD is twice higher than initial value.
Low Temperature Operating	0°C, 96h	
High Temperature Storage	60°C, 96h	
Low Temperature Storage	-20°C, 96h	
High Temperature & High Humidity Operating	+60°C, 90% RH ,96h	
Thermal Shock (Non-operation)	0°C, 30 min ↔ 50°C, 30 min, Change time: 5min 20CYC.	
ESD Test	C=150pF, R=330,5points/panel Air:±8kV, 5times; Contact:±6kV, 5 times; (Environment: 15°C~35°C, 30%~60%).	
Vibration (Non-operation)	Frequency range: 10~55Hz, Stroke:1.5mm Sweep:10Hz~55Hz~10Hz 2 hours for each direction of X.Y.Z. (6 hours for total) (Package condition).	
Box Drop Test	1 Corner 3 Edges 6 faces,80cm(MEDIUM BOX)	

Remark:

1. The test samples should be applied to only one test item.
2. Sample size for each test item is 3~10pcs.
3. For Damp Proof Test, Pure water (Resistance > 10MΩ) should be used.
4. In case of malfunction defect caused by ESD damage, if it would be recovered to normal state after resetting, it would be judged as a good part.
5. Failure Judgment Criterion: Basic Specification, Electrical Characteristic, Mechanical Characteristic, Optical Characteristic.
6. The color fading mura of polarizing filter should not care.

11. Cautions and Handling Precautions

11.1 Handling and Operating the Module

- (1) When the module is assembled, it should be attached to the system firmly.
Do not warp or twist the module during assembly work.
- (2) Protect the module from physical shock or any force. In addition to damage, this may cause improper operation or damage to the module and back-light unit.
- (3) Note that polarizer is very fragile and could be easily damaged. Do not press or scratch the surface.
- (4) Do not allow drops of water or chemicals to remain on the display surface.
If you have the droplets for a long time, staining and discoloration may occur.
- (5) If the surface of the polarizer is dirty, clean it using some absorbent cotton or soft cloth.
- (6) The desirable cleaners are water, IPA (Isopropyl Alcohol) or Hexane.
Do not use ketene type materials (ex. Acetone), Ethyl alcohol, Toluene, Ethyl acid or Methyl chloride. It might permanent damage to the polarizer due to chemical reaction.
- (7) If the liquid crystal material leaks from the panel, it should be kept away from the eyes or mouth. In case of contact with hands, legs, or clothes, it must be washed away thoroughly with soap.
- (8) Protect the module from static; it may cause damage to the CMOS ICs.
- (9) Use finger-stalls with soft gloves in order to keep display clean during the incoming inspection and assembly process.
- (10) Do not disassemble the module.
- (11) Protection film for polarizer on the module shall be slowly peeled off just before use so that the electrostatic charge can be minimized.
- (12) Pins of I/F connector shall not be touched directly with bare hands.
- (13) Do not connect, disconnect the module in the "Power ON" condition.
- (14) Power supply should always be turned on/off by the item 6.1 Power On Sequence & 6.2 Power Off Sequence

11.2 Storage and Transportation.

- (1) Do not leave the panel in high temperature, and high humidity for a long time.
It is highly recommended to store the module with temperature from 0°C to 35°C and relative humidity of less than 70%
- (2) Do not store the TFT-LCD module in direct sunlight.
- (3) The module shall be stored in a dark place. When storing the modules for a long time, be sure to adopt effective measures for protecting the modules from strong ultraviolet radiation, sunlight, or fluorescent light.
- (4) It is recommended that the modules should be stored under a condition where no condensation is allowed.
Formation of dewdrops may cause an abnormal operation or a failure of the module.
In particular, the greatest possible care should be taken to prevent any module from being operated where condensation has occurred inside.
- (5) This panel has its circuitry FPC on the bottom side and should be handled carefully in order not to be stressed.