

INDUSTRIAL STRENGTH... Start Your Application From YOURITECH

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EMC tests

on-site service

Optical Bonding

In-house Manufacturing

Cover glass

System solutions

OEM Solutions

Custom Display

Production Custom designs Installation

Mechanical design



SPECIFICATION FOR LCM Module

MODULE No:	ET040HD22-K
CUSTOMER:	

YORITECH	INITIAL	DATE
PREPARED BY		
CHECKED BY		
APPROVED BY		

CUSTOMER	INITIAL	DATE
APPROVED BY		



Revision History

Your Reliable Display Panel and Touch Embedded Solution Enterprise



Contents

1. Block Diagram	5
2. Outline dimension	6
3. Input terminal Pin Assignment	7
4. LCD Optical Characteristics	8
4.1 Optical specification	9
5. TFT Electrical Characteristics	11
5.1 Absolute Maximum Rating (Ta=25 VSS=0V)	12
5.2 DC Electrical Characteristics	12
5.3 LED Backlight Characteristics	12
6. LVDS Interface Characteristics	14
6.1 LVDS AC Characteristics	15
6.2 LVDS DC Characteristics	17
6.3 Timing for LVDS mode	18
7. LCD Module Out-Going Quality Level	19
7.1 VISUAL & FUNCTION INSPECTION STANDARD	19
7.1.1 Inspection conditions	19
7.1.2 Definition	19
7.1.3 Sampling Plan	20
7.1.4 Criteria (Visual)	21
8. Reliability Test Result	25
9. Cautions and Handling Precautions	26
9.1 Handling and Operating the Module	26
9.2 Storage and Transportation	26
10. Packing	27



* 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 model is composed of a Transmissive type TFT-LCD Panel, driver circuit, back-light unit. The resolution of a 4.0" TFT-LCD contains 720x720 pixels, and can display up to 65K/262K/16.7M colors.

* Features

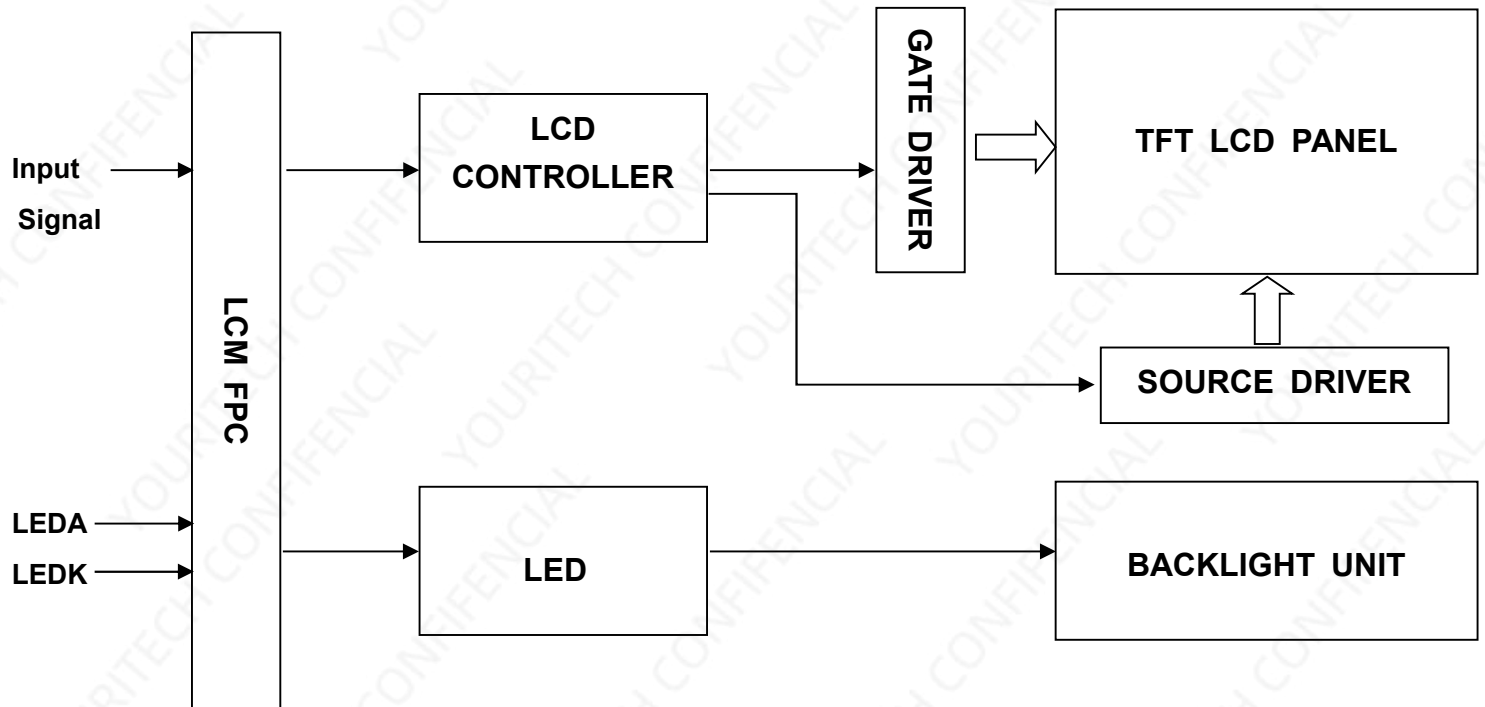
General Information Items	Specification	Unit	Note
	Main Panel		
Display area(AA)	71.928(H)*71.928(V)(4.0inch)	mm	-
Driver element	TFT active matrix	-	-
Display colors	65K/262K/16.7M	colors	-
Number of pixels	720(RGB)*720	dots	-
TFT Pixel arrangement	RGB vertical stripe	-	-
Pixel pitch	0.0999(H)*0.0999(V)	mm	-
Viewing angle	ALL	o'clock	-
TFT Controller IC	NV3051F-L	-	-
LCM Interface	6Bit /8Bit LVDS	-	-
Display mode	Transmissive/Normally Black	-	-
Operating temperature	-30~+80	°C	-
Storage temperature	-30~+85	°C	-

* Mechanical Information

Item		Min.	Typ.	Max.	Unit	Note
Module size	Horizontal(H)		77		mm	-
	Vertical(V)		80		mm	-
	Depth(D)		2.6		mm	-
Weight			33		g	-



1. Block Diagram



3. Input terminal Pin Assignment

3.1 TFT PIN Assignment

NO.	SYMBOL	DISCRIPTION	I/O
1	NC	No connected	--
2	VDD	Power supply for digital circuits	P
3	VDD		P
4	NC	No connected	--
5	NC	No connected	--
6	STBYB	Power ON/OFF PIN, Normally pulled high STBYB = "1", Power ON. STBYB = "0", Power OFF.	I
7	GND	Ground	P
8	RXIN0-	- LVDS differential data input	I/O
9	RXIN0+	+ LVDS differential data input	I/O
10	GND	Ground	P
11	RXIN1-	- LVDS differential data input	I/O
12	RXIN1+	+ LVDS differential data input	I/O
13	GND	Ground	P
14	RXIN2-	- LVDS differential data input	I/O
15	RXIN2+	+ LVDS differential data input	I/O
16	GND	Ground	P
17	RXCLKIN-	- LVDS differential clock input	I/O
18	RXCLKIN+	+ LVDS differential clock input	I/O
19	GND	Ground	P
20	RXIN3-	- LVDS differential data input	I/O
21	RXIN3+	+ LVDS differential data input	I/O
22	GND	Ground	P
23	NC	No connected	--
24	NC	No connected	--
25	GND	Ground	P
26	NC	No connected	--
27	NC	No connected	--
28	NC	No connected	--
29	NC	No connected	--
30	GND	Ground	P
31	LEDK1	LED Cathode	P



32	LEDK2	LED Cathode	P
33	NC	No connected	--
34	NC	No connected	--
35	NC	No connected	--
36	NC	No connected	--
37	NC	No connected	--
38	NC	No connected	--
39	LEDA1	LED anode	P
40	LEDA2	LED anode	P

4. LCD Optical Characteristics



4.1 Optical specification

Item		Symbol	Condition	Min.	Typ.	Max.	Unit.	Note
Contrast Ratio		CR	$\Theta=0$ Normal viewing angle	700	900	--		*(1)(2)
Response time	Rising	T_{R+T_F}		--	25	35	msec	*(1)(3)
	Falling							
Color gamut		S(%)		55	60	--	%	*
Color Filter Chromaticity	White	W_X		0.2656	0.3056	0.3456	-	*(1) (4) CA-310 Test
		W_Y		0.3049	0.3449	0.3849		
	Red	R_X		0.5830	0.6230	0.6630		
		R_Y		0.3117	0.3517	0.3917		
	Green	G_X		0.2703	0.3103	0.3503		
		G_Y		0.5275	0.5675	0.6075		
	Blue	B_X	0.1076	0.1476	0.1876			
		B_Y	0.0251	0.0651	0.1051			
Viewing angle	Hor.	Θ_L	CR>10	80	85	--	-	*(1) (4)
		Θ_R		80	85	--		
	Ver.	Θ_U		80	85	--		
		Θ_D		80	85	--		
Option View Direction		ALL						

*The data comes from the LCD specification.

Measuring Condition

Measuring surrounding : dark room

Ambient temperature : $25\pm 2^\circ\text{C}$

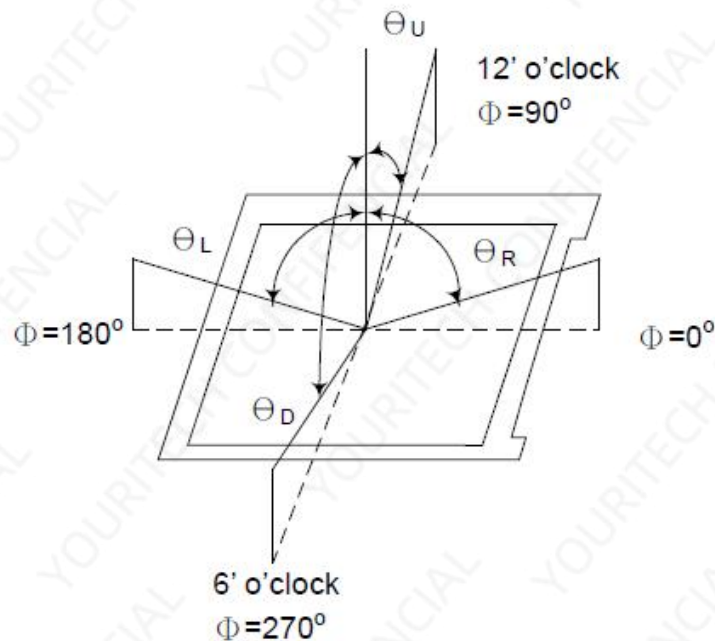
15min. warm-up time.

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 :

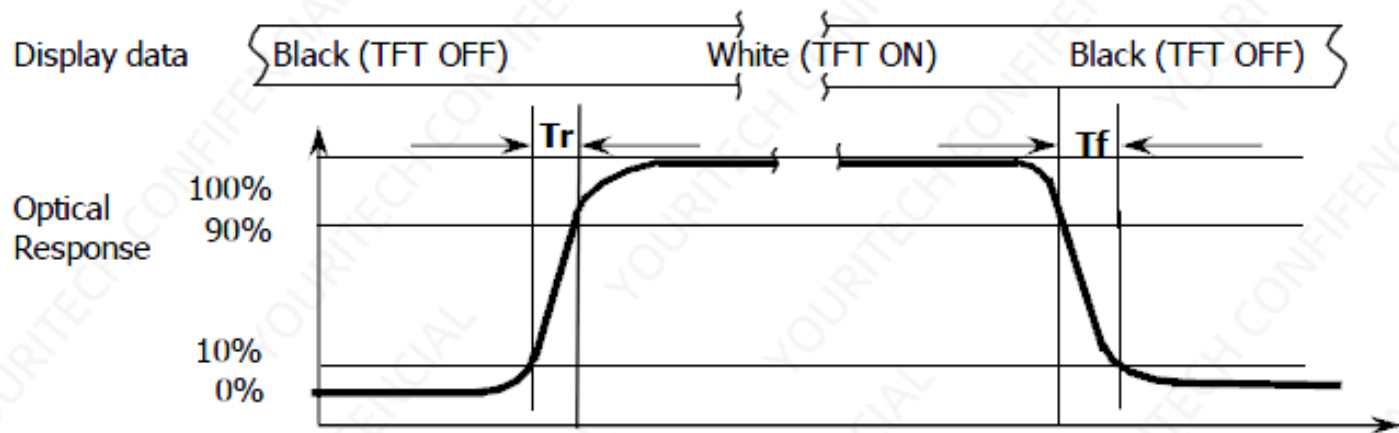




Note (2): Definition of Contrast Ratio(CR) :measured at the center point of panel

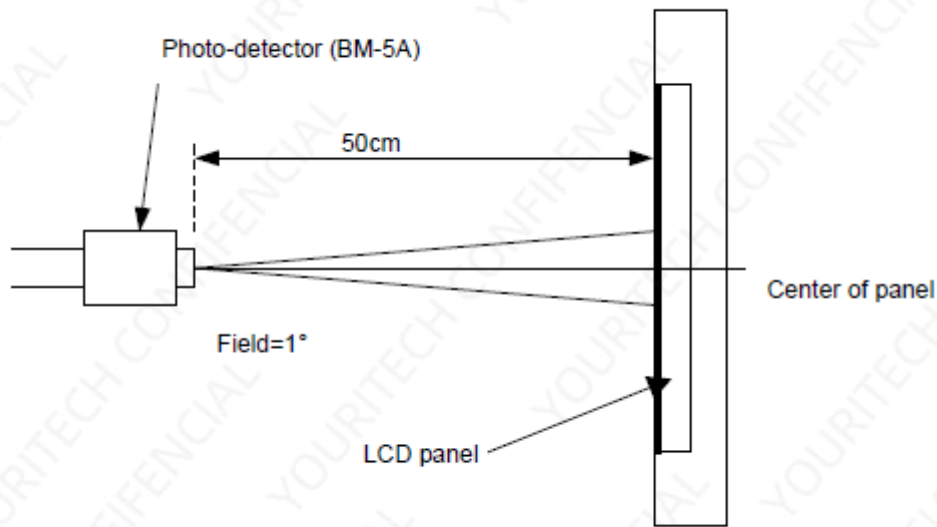
$$CR = \frac{\text{Luminance with all pixels white}}{\text{Luminance with all pixels black}}$$

Note (3): Response Time



Note (4): Definition of optical measurement setup





5. TFT Electrical Characteristics



5.1 Absolute Maximum Rating (Ta=25 VSS=0V)

Characteristics	Symbol	Min.	Max.	Unit	Note
Digital Supply Voltage	VDD	-0.3	4.5	V	Note1
Operating temperature	T _{OP}	-30	+80	°C	
Storage temperature	T _{ST}	-30	+85	°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.

5.2 DC Electrical Characteristics

Characteristics	Symbol	Min.	Typ.	Max.	Unit	Note
Digital Supply Voltage	VDD	2.5	3.3	3.6	V	--
Normal mode Current consumption	IDD	--	35	90	mA	--
Level input voltage	V _{IH}	0.7 VDD	--	VDD	V	--
	V _{IL}	-0.3	--	0.3 VDD	V	--
Level output voltage	V _{OH}	0.8* VDD	--	VDD	V	--
	V _{OL}	GND	--	0.2 VDD	V	--

5.3 LED Backlight Characteristics

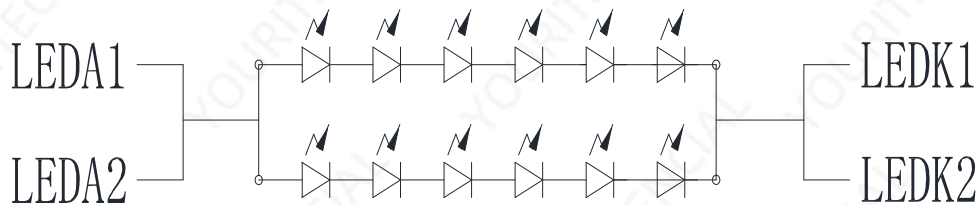
The back-light system is edge-lighting type with 12 chips White LED



Item	Symbol	Min.	Typ.	Max.	Unit	Note
Forward Current	I_F	30	40	--	mA	--
Forward Voltage	V_F	--	18.6	--	V	--
LCM Luminance	L_v	650	700	--	cd/m ²	Note3
LED life time	Hr		50000		Hour	Note1,2
Uniformity	AVg	80	--	--	%	Note3

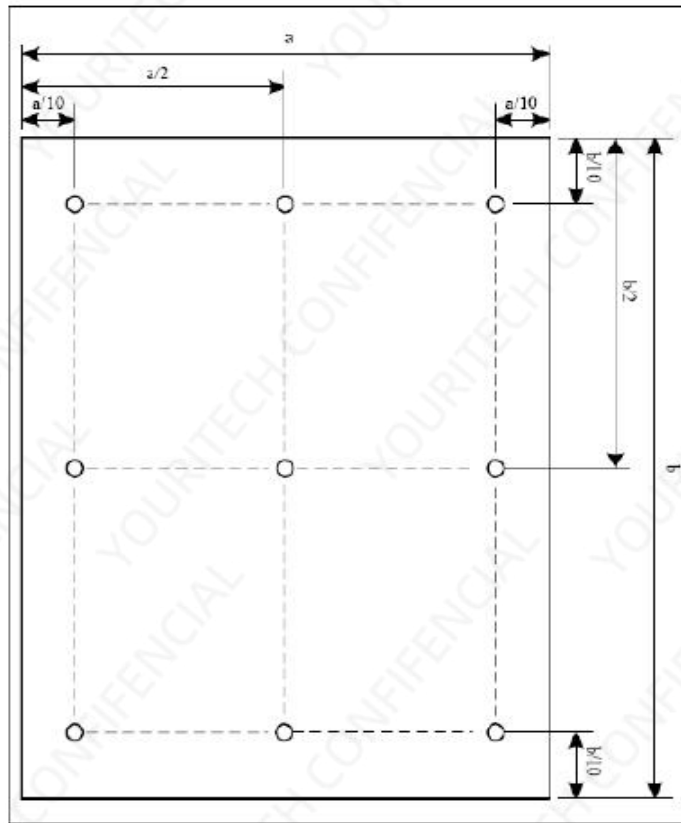
Note (1) LED life time (Hr) can be defined as the time in which it continues to operate under the condition: $T_a=25\pm3\text{ }^{\circ}\text{C}$, typical IL value indicated in the above table until the brightness becomes less than 50%.

Note (2) The "LED life time" is defined as the module brightness decrease to 50% original brightness at $T_a=25^{\circ}\text{C}$ and $I_L=40\text{mA}$. The LED lifetime could be decreased if operating I_L is larger than 40mA. The constant current driving method is suggested.



NOTE 3: Luminance Uniformity of these 9 points is defined as below:





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

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

6. LVDS Interface Characteristics



6.1 LVDS AC Characteristics

Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit
Clock Frequency	RxFCLK	-	30	-	TBD	MHz
Input data skew margin	TRSKM	$ VID = 200\text{mV}$ $RxVCM = 1.2\text{V}$ $RxFCLK = 81\text{MHz}$	500	-	-	ps
Clock High Time	TLVCH	-	-	$4/(7 \cdot RxFCLK)$	-	ns
Clock Low Time	TLVCL	-	-	$3/(7 \cdot RxFCLK)$	-	ns
PLL wake-up-time	TenPLL	-	-	-	150	us

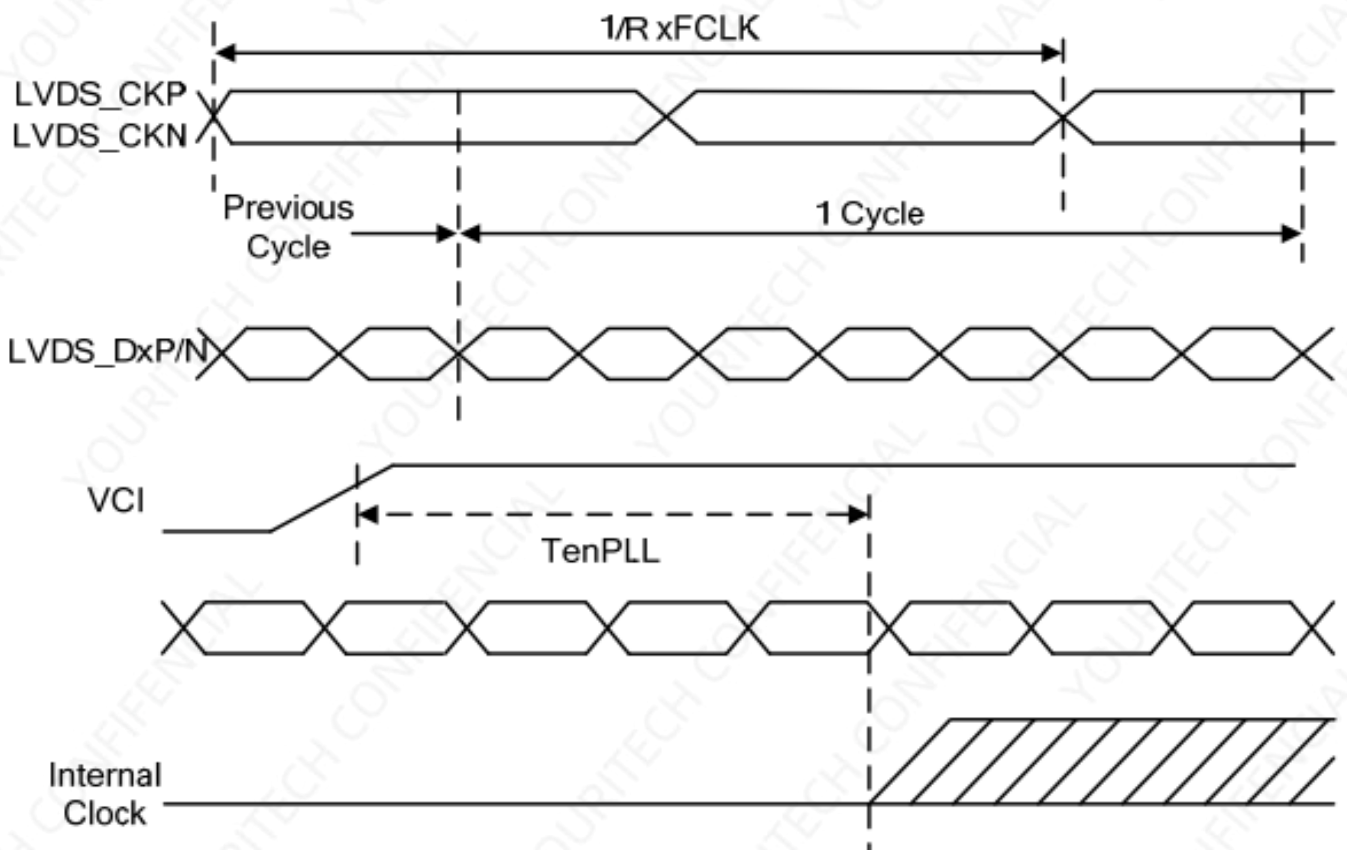
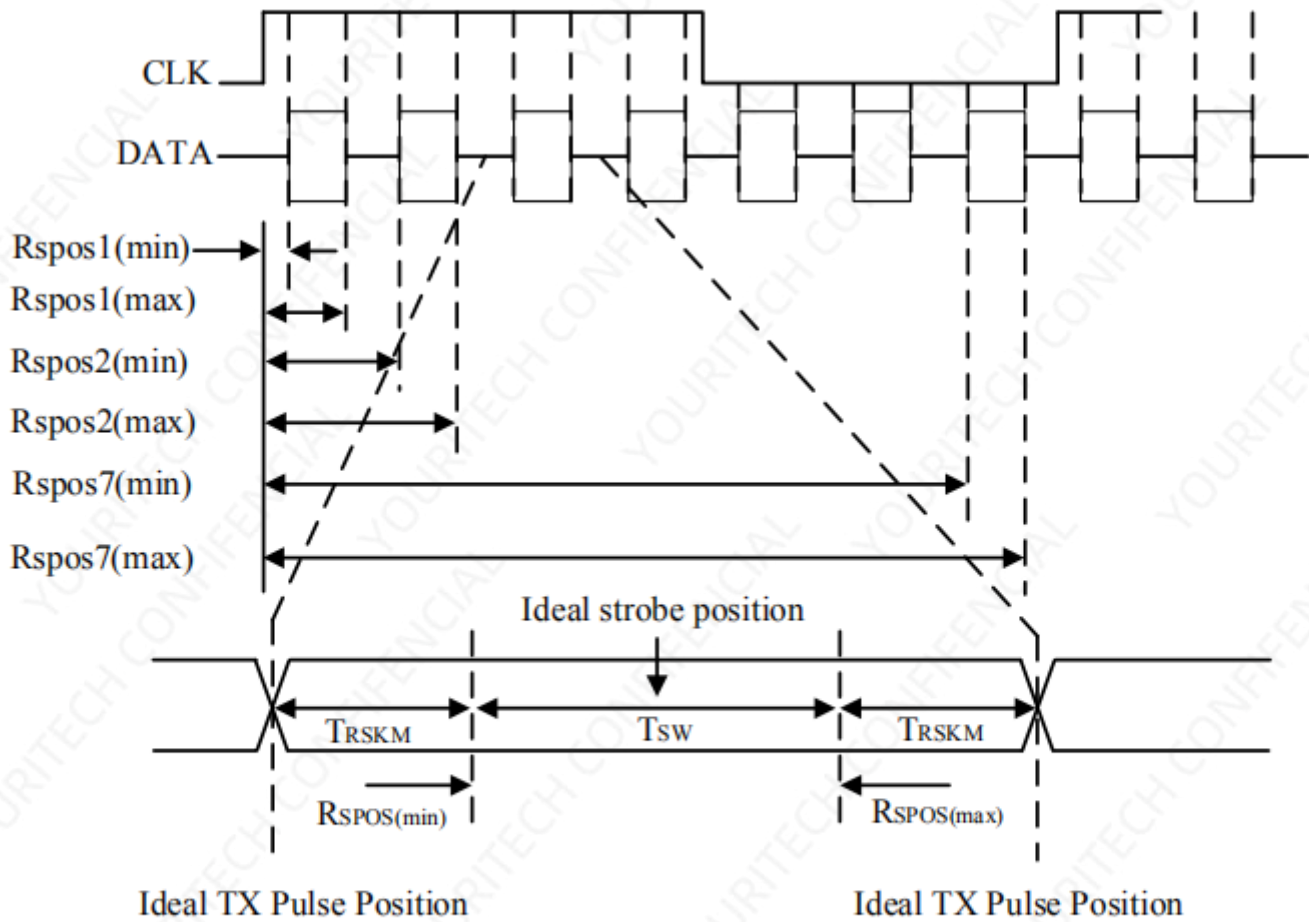


Figure LVDS figure

Parameter	Symbol	Min.	Typ.	Max.	Units	Condition
Modulation Frequency	SSCMF	23	-	93	KHz	
Modulation Rate	SSCMR	-	-	+3	%	





Tsw: Strobe width (Internal data sampling window)

RSPOS: Receiver strobe position

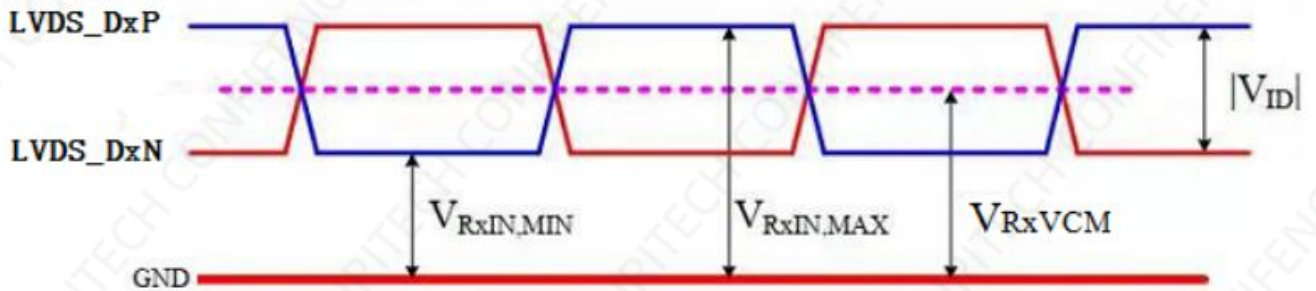
TRSKM: Receiver strobe margin



6.2 LVDS DC Characteristics

Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit
Differential input high threshold voltage	$V_{Rx,TH}$	$V_{RxVCM}=1.2V$	-	0.2	-	V
Differential input low threshold voltage	$V_{Rx,TL}$		-	-0.2	-	V
Input voltage range(single-end)	V_{RxIN}		0	-	1.8	V
Differential input common mode voltage	V_{RxVCM}		$ VID /2$	1.2	$1.8 - VID /2$	V
Differential input voltage	$ VID $		0.2	0.4	0.6	V
Differential input leakage current	I_{LCLVDS}		-10	-	10	μA
Differential input impedance	ZID		80	100	140	Ω

Single-End Signal



Differential Signal

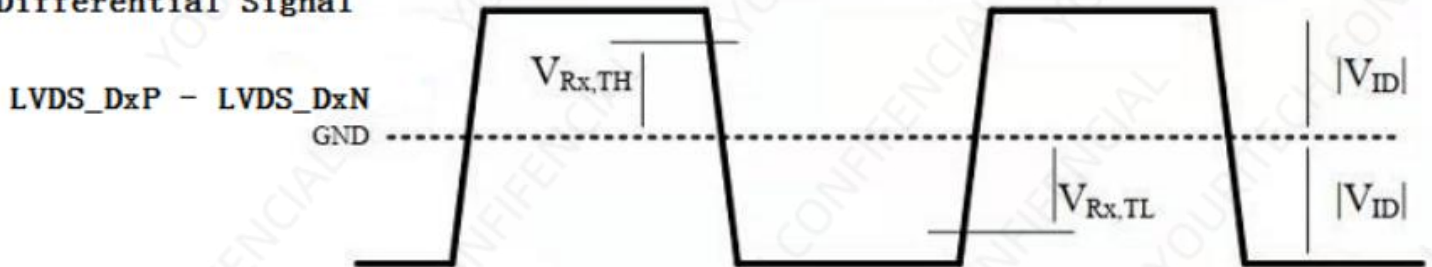
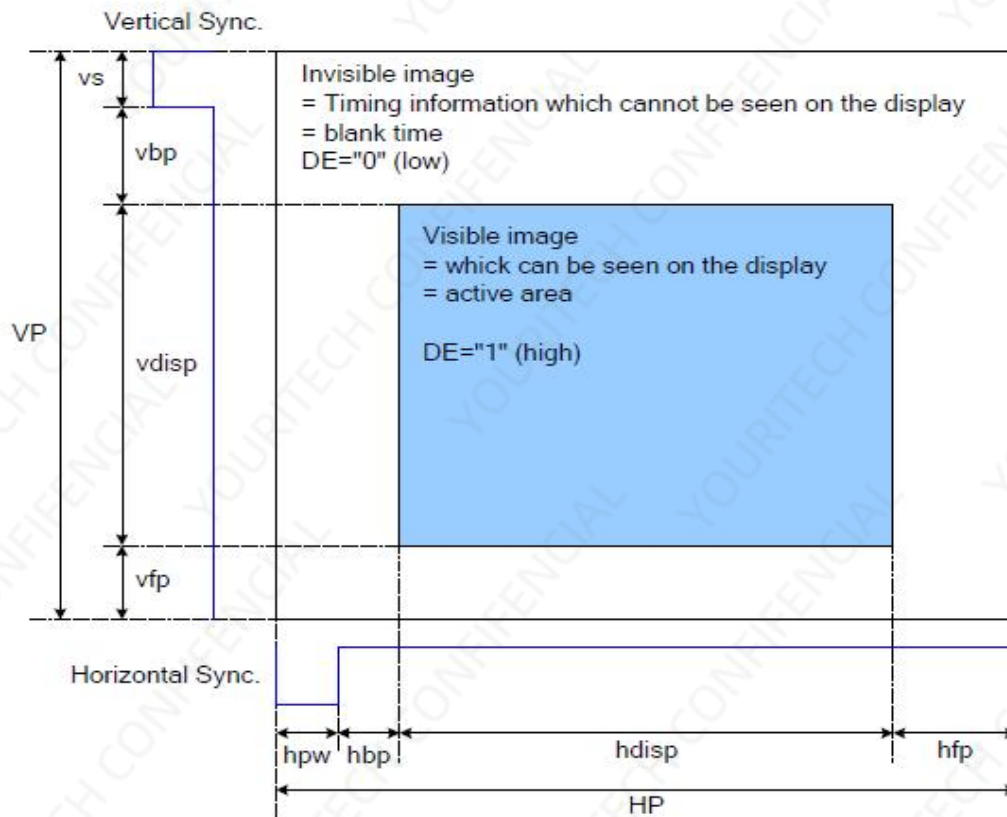


Figure: LVDS Receiver Differential Definition



6.3 Timing for LVDS mode



Parameter	Symbol	Min.	Typ.	Max.	Unit
DCLK frequency	FCLK	--	(63)	--	MHz
Horizontal display area	HDISP	--	720	--	Clock
Horizontal Sync. Width	hpw	1	2	--	Clock
Horizontal Sync. Back Porch	hbp	1	38	-	Clock
Horizontal Sync. Front Porch	hfp	1	40	--	Clock
Vertical display area	VDISP	--	1280	--	Line
Vertical Sync. Width	vs	1	2	--	Line
Vertical Sync. Back Porch	vbp	1	14	--	Line
Vertical Sync. Front Porch	vfp	1	16	--	Line
Frame-Rate		--	60	--	Hz



7. LCD Module Out-Going Quality Level

7.1 VISUAL & FUNCTION INSPECTION STANDARD

7.1.1 Inspection conditions

Inspection performed under the following conditions is recommended.

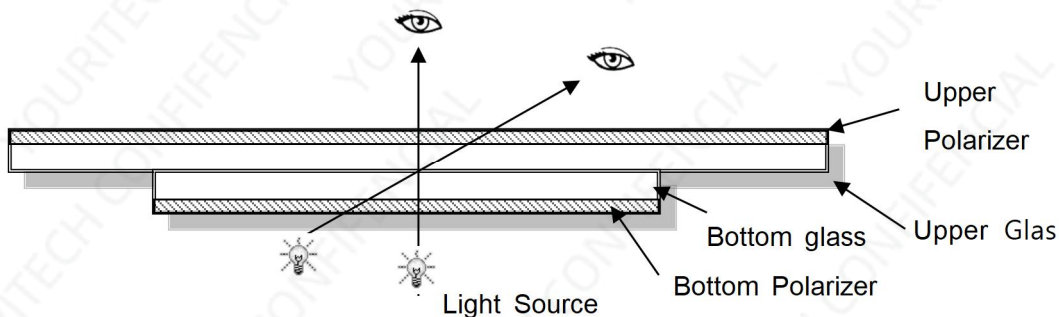
Temperature : $25\pm 5^{\circ}\text{C}$

Humidity : $65\%\pm 10\%\text{RH}$

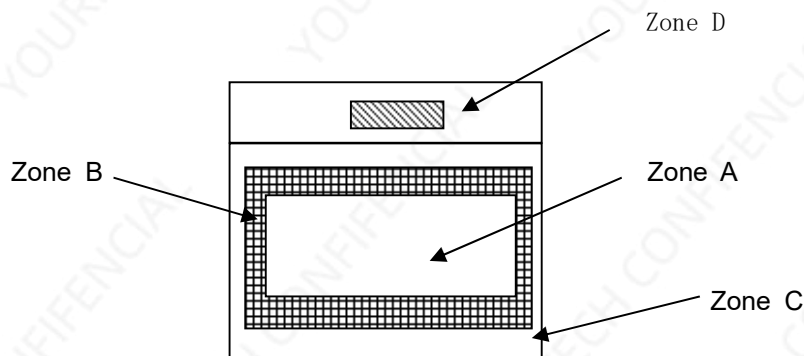
Viewing Angle : Normal viewing Angle.

Illumination: Single fluorescent lamp (300 to 700Lux)

Viewing distance:30-50cm



7.1.2 Definition



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

Zone B : Viewing Area except Zone A

Zone C : Outside (Zone A+Zone B) which can not 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



7.1.3 Sampling Plan

According to GB/T 2828-2012 ; , 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

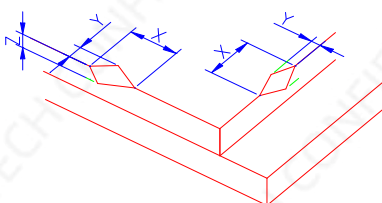
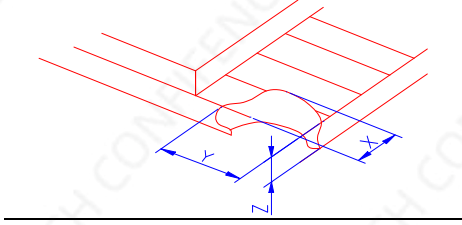
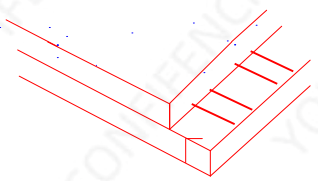
No	Items to be inspected	Criteria	Classification of defects
1	Functional defects	1) No display, Open or miss line 2) Display abnormally, Short 3) Backlight no lighting, abnormal lighting. etc...	Major
2	Missing	Missing components and etc...	
3	Outline dimension	Overall outline dimension beyond the drawing is not allowed, deformation and etc...	
4	Color tone	Color unevenness, refer to limited sample	Minor
5	Spot/Line defect	Light dot, Dim spot, (Note1) Polarizer Air Bubble, Polarizer accidented spot and etc...	
6	Soldering appearance	Good soldering , Peeling off is not allowed and etc...	
7	LCD/Polarizer	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.



7.1.4 Criteria (Visual)

Number	Items	Criteria(mm)						
1.0 LCD Crack/Broken NOTE: X: Length Y: Width Z: Height L: Length of IT O, T: Height of LCD	(1) The edge of LCD broken	 <table><tr><td>X</td><td>Y</td><td>Z</td></tr><tr><td>≤3.0mm</td><td><Inner border line of the seal</td><td>≤T</td></tr></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><tr><td>X</td><td>Y</td><td>Z</td></tr><tr><td>≤3.0mm</td><td>≤L</td><td>≤T</td></tr></table>	X	Y	Z	≤3.0mm	≤L	≤T	
X	Y	Z						
≤3.0mm	≤L	≤T						
(3) LCD crack	 Crack Not allowed							



Spot defect

2.0

$\Phi=(X+Y)/2$

① light dot (black/white spot , pinhole, stain, etc.)

Zone Size (mm)	Acceptable Qty		
	A	B	C
$\Phi \leq 0.15$	Ignore	Ignore	
$0.15 < \Phi \leq 0.25$	3(distance $\geq 10\text{mm}$)		
$0.25 < \Phi \leq 0.4$	2(distance $\geq 10\text{mm}$)		
$\Phi > 0.4$	0		

② Dim spot (light leakage、dent、dark spot, etc)

Zone Size (mm)	Acceptable Qty		
	A	B	C
$\Phi \leq 0.15$	Ignore	Ignore	
$0.15 < \Phi \leq 0.25$	3(distance $\geq 10\text{mm}$)		
$0.25 < \Phi \leq 0.4$	2(distance $\geq 10\text{mm}$)		
$\Phi > 0.4$	0		

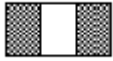
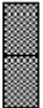
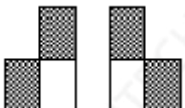
③ Polarizer accidented spot

Zone Size (mm)	Acceptable Qty		
	A	B	C
$\Phi \leq 0.2$	Ignore	Ignore	
$0.2 < \Phi \leq 0.5$	2(distance $\geq 10\text{mm}$)		
$\Phi > 0.5$	0		

④ Polarizer Bubble

Zone Size (mm)	Acceptable Qty		
	A	B	C
$\Phi \leq 0.2$	Ignore	Ignore	
$0.2 < \Phi \leq 0.4$	3(distance $\geq 10\text{mm}$)		
$\Phi > 0.4$	0		



3.0	LCD Pixel defect	Pixel bad points <table border="1" data-bbox="539 376 1497 1122"> <thead> <tr> <th data-bbox="539 376 730 427">Item</th><th data-bbox="730 376 1246 427">Zone A</th><th data-bbox="1246 376 1497 427">Acceptable Qt</th></tr> </thead> <tbody> <tr> <td data-bbox="539 427 730 584" rowspan="3">Bright dot</td><td data-bbox="730 427 1246 479">Random</td><td data-bbox="1246 427 1497 479">$N \leq 2$</td></tr> <tr> <td data-bbox="730 479 1246 530">2 dots adjacent</td><td data-bbox="1246 479 1497 530">$N \leq 0$</td></tr> <tr> <td data-bbox="730 530 1246 584">3 dots adjacent</td><td data-bbox="1246 530 1497 584">$N \leq 0$</td></tr> <tr> <td data-bbox="539 584 730 752" rowspan="3">Dark dot</td><td data-bbox="730 584 1246 636">Random</td><td data-bbox="1246 584 1497 636">$N \leq 3$</td></tr> <tr> <td data-bbox="730 636 1246 687">2 dots adjacent</td><td data-bbox="1246 636 1497 687">$N \leq 0$</td></tr> <tr> <td data-bbox="730 687 1246 752">3 dots adjacent</td><td data-bbox="1246 687 1497 752">$N \leq 0$</td></tr> <tr> <td data-bbox="539 752 730 1066">Distance</td><td data-bbox="730 752 1246 1066"> 1. Minimum Distance Between Bright dots. 2. Minimum Distance Between dark dots 3. Minimum Distance Between dark and bright dot. </td><td data-bbox="1246 752 1497 1066">5mm</td></tr> <tr> <td colspan="2" data-bbox="539 1066 1246 1122">Total bright and dark dot</td><td data-bbox="1246 1066 1497 1122">$N \leq 4$</td></tr> </tbody> </table> Note: A) Bright dot: Dots appear bright and unchanged in size in which LCD panel is displaying under black pattern. B) Dark dot: Dots appear dark and unchanged in size in which LCD panel is displaying under pure red, green, blue picture. C) 2 dot adjacent = 1 pair = 2 dots Picture:  2 dot adjacent  2 dot adjacent  2 dot adjacent (vertical)  2 dot adjacent (slant)	Item	Zone A	Acceptable Qt	Bright dot	Random	$N \leq 2$	2 dots adjacent	$N \leq 0$	3 dots adjacent	$N \leq 0$	Dark dot	Random	$N \leq 3$	2 dots adjacent	$N \leq 0$	3 dots adjacent	$N \leq 0$	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		$N \leq 4$
Item	Zone A	Acceptable Qt																							
Bright dot	Random	$N \leq 2$																							
	2 dots adjacent	$N \leq 0$																							
	3 dots adjacent	$N \leq 0$																							
Dark dot	Random	$N \leq 3$																							
	2 dots adjacent	$N \leq 0$																							
	3 dots adjacent	$N \leq 0$																							
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		$N \leq 4$																							



4.0	Line defect (LCD /Polarizer backlight black/white line, scratch, stain)  W: width, L : length N : Count	Width(mm)	Length(m)	Acceptable Qty			
				A	B	C	
		$\Phi \leq 0.05$	Ignore	Ignore			Ignore
		$0.05 < W \leq 0.06$	$L \leq 4.0$	$N \leq 3$			
		$0.06 < W \leq 0.08$	$L \leq 3.0$	$N \leq 2$			
		$W > 0.08$	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.					

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



8. Reliability Test Result

Item	Condition	Inspection after test
High Temperature Operating	80°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	-30°C, 96HR	
High Temperature Storage	85°C, 96HR	
Low Temperature Storage	-30°C, 96HR	
High Temperature & High Humidity Operating	+60°C, 90% RH ,96 hours.	
Thermal Shock (Non-operation)	-10°C,30 min ↔ +60°C,30 min, Change time:5min 20CYC.	
ESD test	C=150pF, R=330,5points/panel Air:±4KV, 5times; Contact:±2KV, 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 5~10pcs.
- 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.



9. Cautions and Handling Precautions

9.1 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

9.2 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 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.



10. Packing

----TBD----

