7

SPECIFICATION
FOR
LCM Module

MODULE No:	KD050FHFLD079
CUSTOMER:	

STARTEK	INITIAL	DATE
PREPARED BY		
CHECKED BY		
APPROVED BY		

CUSTOMER	INITIAL	DATE
APPROVED BY		

Revision History

Date	Rev. No.	Page	Summary
2022.05.12	V1.0	ALL	FIRST ISSUE

Contents

* Description

This is a color active matrix LTPS LCD using Low Temperature Poly-silicon TFT‘ s (Thin Film Transistors) as an active switching devices. This module is composed of a Transmissive type LTPS-LCD Panel, driver circuit, back-light unit. The resolution of a 5.0 " LTPS-LCD contains 1920X1080 pixels, and can display up to 16.7M colors.

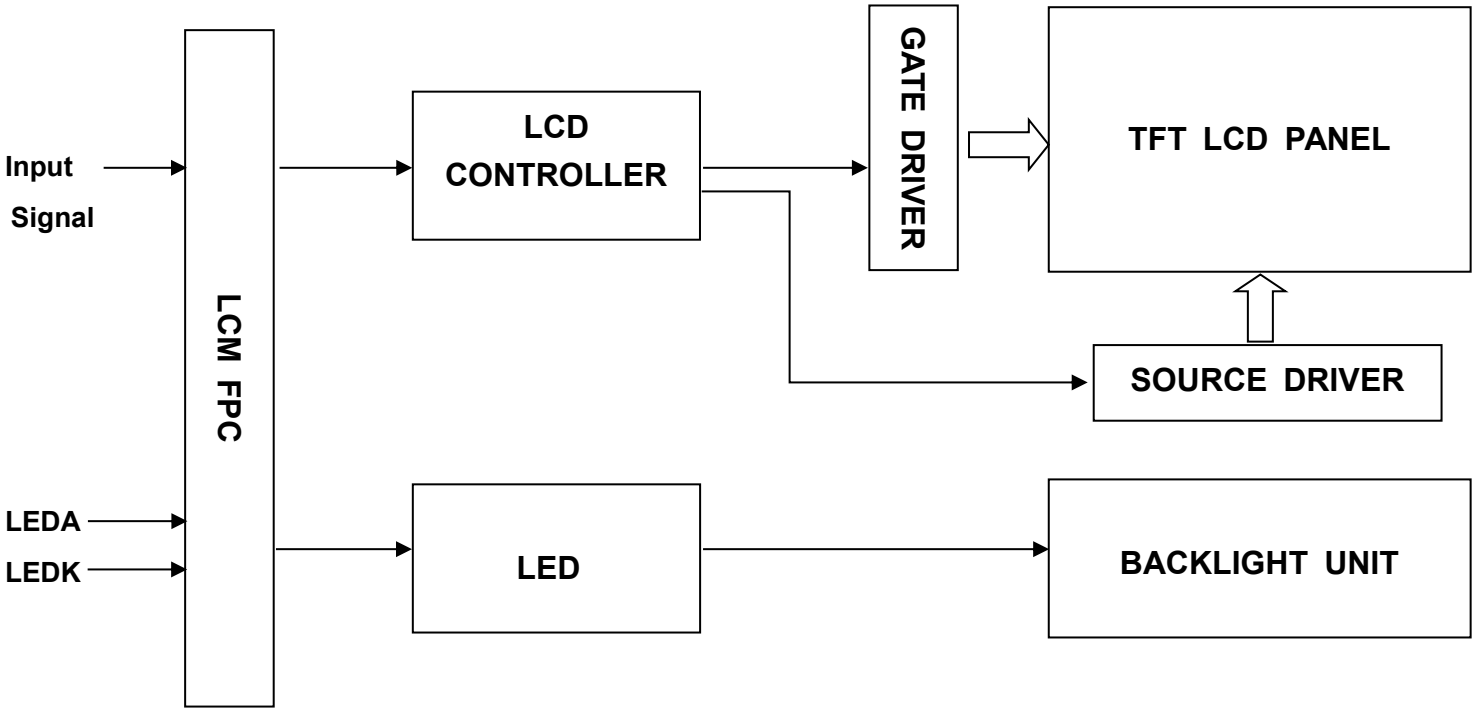
* Features

General Information Items	Specification	Unit	Note
	Main Panel		
Display area(AA)	110.592(H)*62.208(V) (5.0inch)	mm	-
Driver element	LTPS	-	-
Display colors	16.7M	colors	-
Number of pixels	1920(RGB)*1080	dots	-
Pixel arrangement	RGB vertical stripe	-	-
Pixel pitch	0.0576(H)*0.0576(V)	mm	-
Viewing angle	ALL	o'clock	-
Controller IC	SC5010	-	-
LCM Interface	1 or 2-Port LVDS, VESA mode	-	
Display mode	Transmissive/ Normally Black	-	-
Operating temperature	-20～+70	℃	-
Storage temperature	-30～+80	℃	-

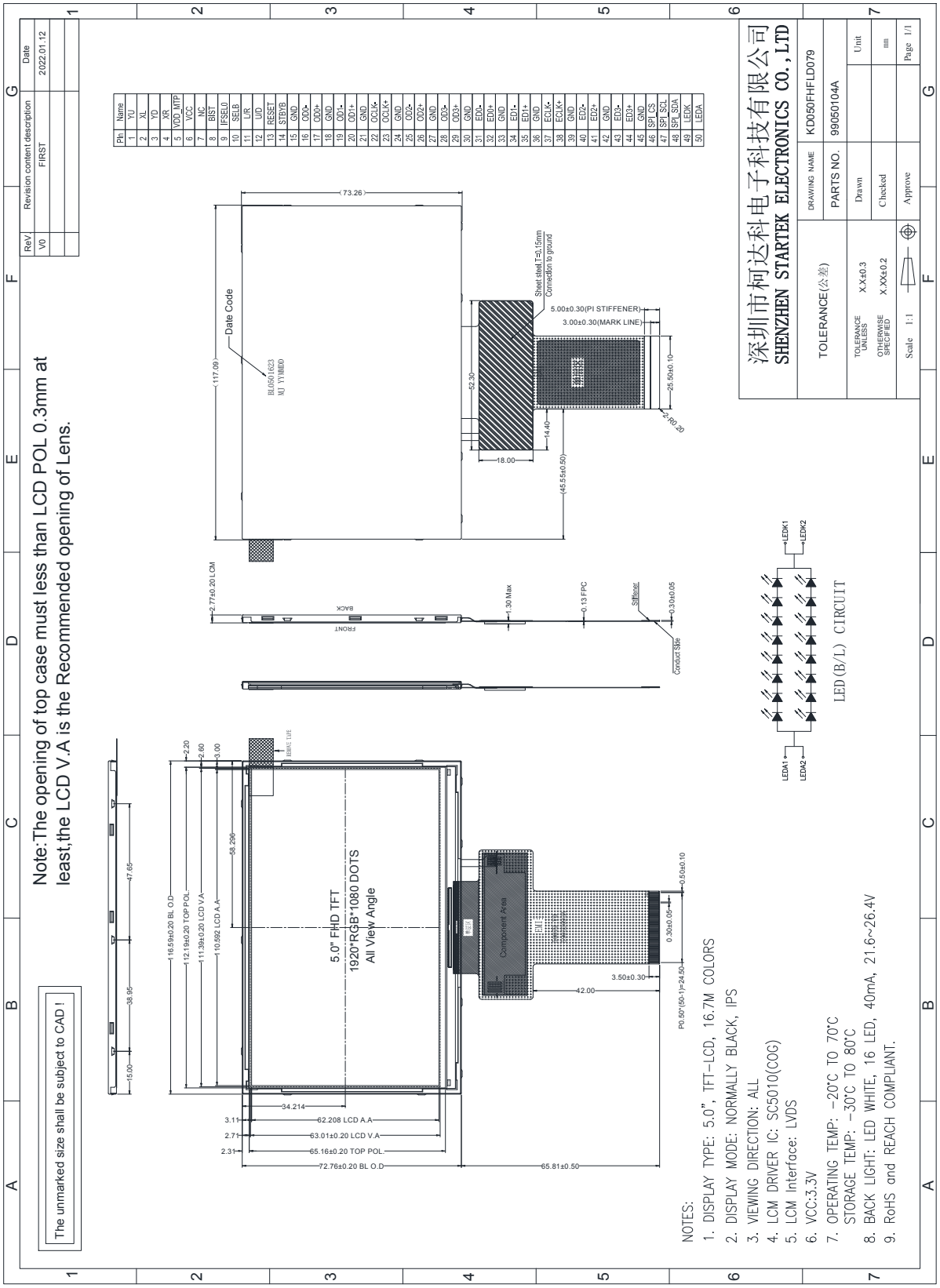
* Mechanical Information

Item		Min.	Typ.	Max.	Unit	Note
Module size	Horizontal(H)		116.59	117.09	mm	-
	Vertical(V)		72.76	73.26	mm	-
	Depth(D)		2.77		mm	-
Weight			49		g	-

1. Block Diagram



2. Outline dimension



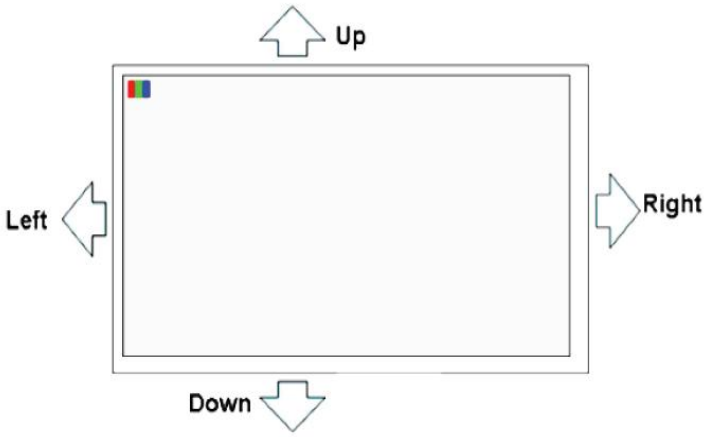
3. Input terminal Pin Assignment

NO.	SYMBOL	DISCRIPTION	I/O
1	YU(NC)	--	--
2	XL(NC)	--	--
3	YD(NC)	--	--
4	XR(NC)	--	--
5	VDD_MTP	Please open this PIN.	--
6	VCC	Power supply for LVDS circuit	P
7	NC	Please open this PIN.(No Connection)	--
8	BIST	Built-in self test function. 'H': Enable. 'L': Disable.(Default)	I
9	IFSEL0	Interface select: 'H': 2-Port LVDS(Default). 'L': 1-Port LVDS	I
10	SELB	Data format: 'H': 8bit (Default) 'L': 6bit.	I
11	L/R	Horizontal shift direction (source output) selection(NOTE1)	I
12	U/D	Vertical shift direction (gate output) selection(NOTE1)	I
13	RESET	Reset Pin. Low active.	I
14	STBYB	Standby mode: 'H': Power on (Default) . 'L': Power off.	I
15	GND	Ground.	P
16	OD0-	Odd LVDS Negative data signal (-)	I
17	OD0+	Odd LVDS Positive data signal (+)	I
18	GND	Ground.	P
19	OD1-	Odd LVDS Negative data signal (-)	I
20	OD1+	Odd LVDS Positive data signal (+)	I

21	GND	Ground.	P
22	OCLK-	Odd LVDS Negative CLK signal (-)	I
23	OCLK+	Odd LVDS Positive CLK signal (+)	I
24	GND	Ground.	P
25	OD2-	Odd LVDS Negative data signal (-)	I
26	OD2+	Odd LVDS Positive data signal (+)	I
27	GND	Ground.	P
28	OD3-	Odd LVDS Negative data signal (-)	I
29	OD3+	Odd LVDS Positive data signal (+)	I
30	GND	Ground.	P
31	ED0-	EVEN LVDS Negative data signal (-)	I
32	ED0+	EVEN LVDS Positive data signal (+)	I
33	GND	Ground.	P
34	ED1-	EVEN LVDS Negative data signal (-)	I
35	ED1+	EVEN LVDS Positive data signal (+)	I
36	GND	Ground.	P
37	ECLK-	EVEN LVDS Negative CLK signal (-)	I
38	ECLK+	EVEN LVDS Positive CLK signal (+)	I
39	GND	Ground.	P
40	ED2-	EVEN LVDS Negative data signal (-)	I
41	ED2+	EVEN LVDS Positive data signal (+)	I
42	GND	Ground.	P
43	ED3-	EVEN LVDS Negative data signal (-)	I
44	ED3+	EVEN LVDS Positive data signal (+)	I
45	GND	Ground.	P
46	SPI_CS	Please open this PIN.	--
47	SPI_SCL	Please open this PIN.	--

48	SPI_SDA	Please open this PIN.	--
49	LEDK	LED Cathode	P
50	LEDA	LED Anode	P

Note1: When L/R="1", set left to right scan direction.
When L/R="0", set right to left scan direction.
When U/D="1", set up to down scan direction.
When U/D="0", set down to up scan direction.



4. LCD Optical Characteristics

4.1 Optical specification

Item		Symbol	Condition	Min.	Typ.	Max.	Unit.	Note
Contrast Ratio		CR	Θ=0 Normal viewing angle	1200	1500	--		(1)(2)
Response time	Rising	$T_{R+}T_F$		--	30	40	msec	(1)(3)
	Falling							
Color gamut		S(%)		38	42	--	%	
Color Filter Chromacicity	White	W_X		0.276	0.316	0.356		(1) (4) CA-310
		W_Y		0.279	0.339	0.379		
	Red	R_X		0.533	0.573	0.613		
		R_Y		0.329	0.369	0.409		
	Green	G_X		0.296	0.336	0.376		
		G_Y		0.489	0.529	0.569		
	Blue	B_X		0.117	0.157	0.197		
		B_Y		0.049	0.089	0.129		
Viewing angle	Hor.	Θ_L	CR>10	80	--	--		(1)(4)
		Θ_R		80	--	--		
	Ver.	Θ_U		80	--	--		
		Θ_D		80	--	--		
Option View Direction		ALL						

*The data comes from the LCD specification.

Measuring Condition

Measuring surrounding : dark room

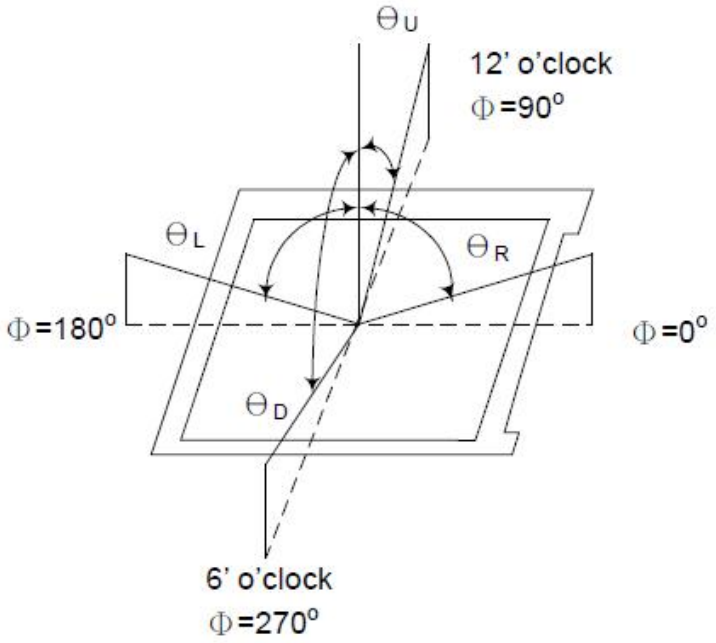
Ambient temperature : 25±2°C

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.

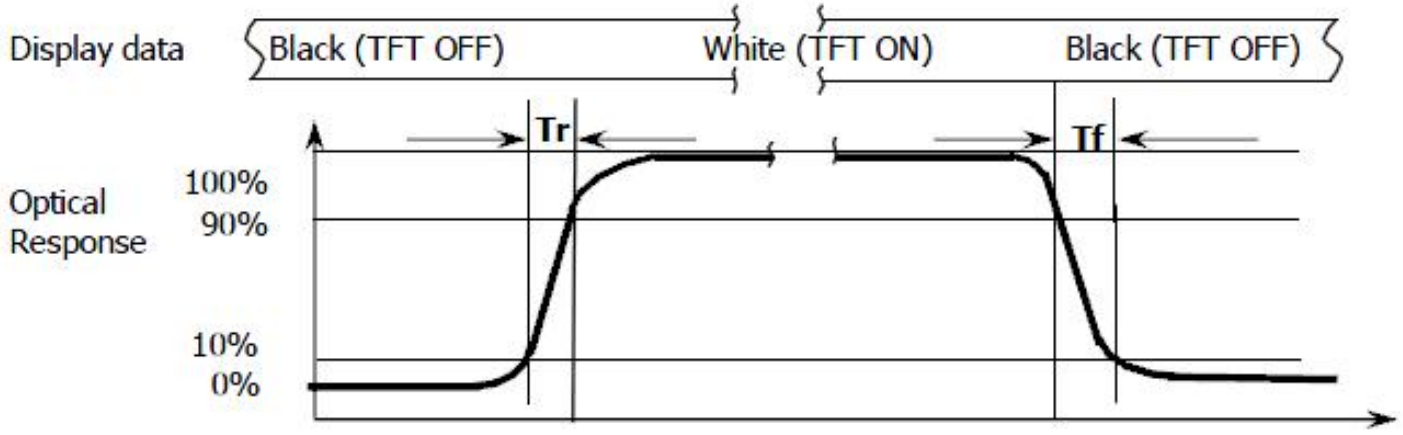
Note (1): Definition of Viewing Angle :



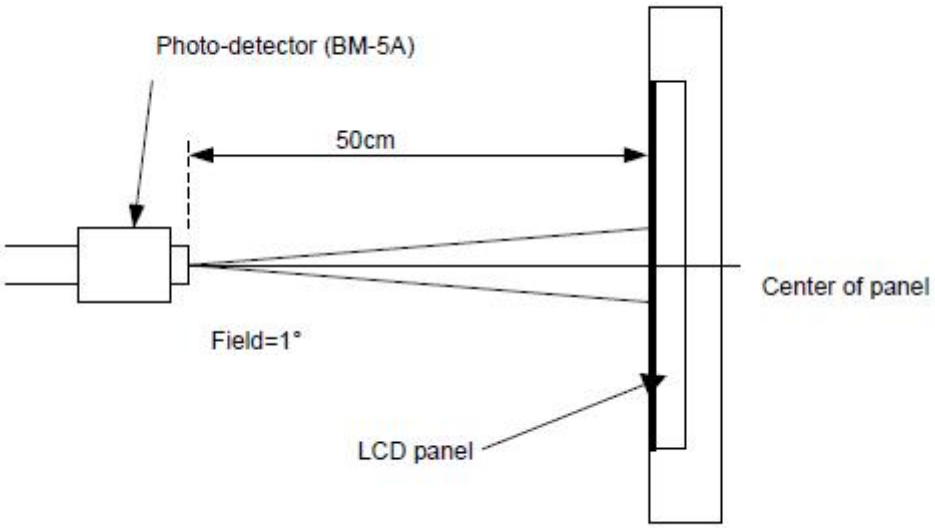
Note (2): Definition of Contrast Ratio(CR) :measured at the center point of panel

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

Note (3): Response Time



Note (4): Definition of optical measurement setup



5. Electrical Characteristics

5.1 Absolute Maximum Rating

Characteristics	Symbol	Min.	Max.	Unit	Note
Digital Supply Voltage	VCC	-0.3	6.0	V	Note1
Operating temperature	T_{OP}	-20	+70	℃	
Storage temperature	T_{ST}	-30	+80	℃	

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	VCC	3.0	3.3	3.6	V	
Normal mode Current	IDD	--	50	100	mA	
Level input voltage	V_{IH}	0.8VCC	--	VCC	V	
	V_{IL}	GND	--	0.2VCC	V	
Level output voltage	V_{OH}	0.8VCC	--	VCC	V	
	V_{OL}	GND	--	0.2VCC	V	

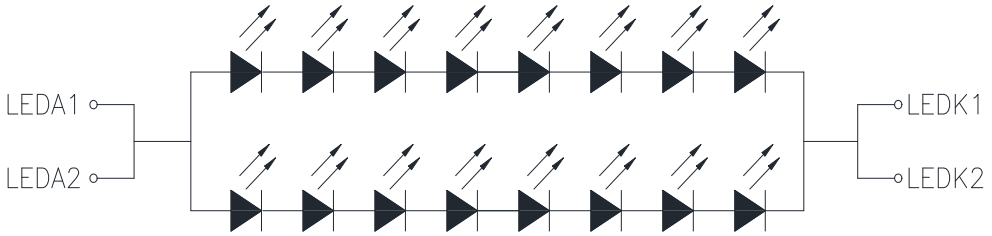
5.3 LED Backlight Characteristics

The back-light system is edge-lighting type with 16 chips LED

Item	Symbol	Min.	Typ.	Max.	Unit	Note
Forward Current	I_F	30	40	--	mA	
Forward Voltage	V_F	21.6	--	26.4	V	
LCM Luminance	LV	900	950	--	cd/m2	Note3
LED life time	Hr	50000	--	--	Hour	Note1,2
Uniformity	Avg	80	--	--	%	Note3

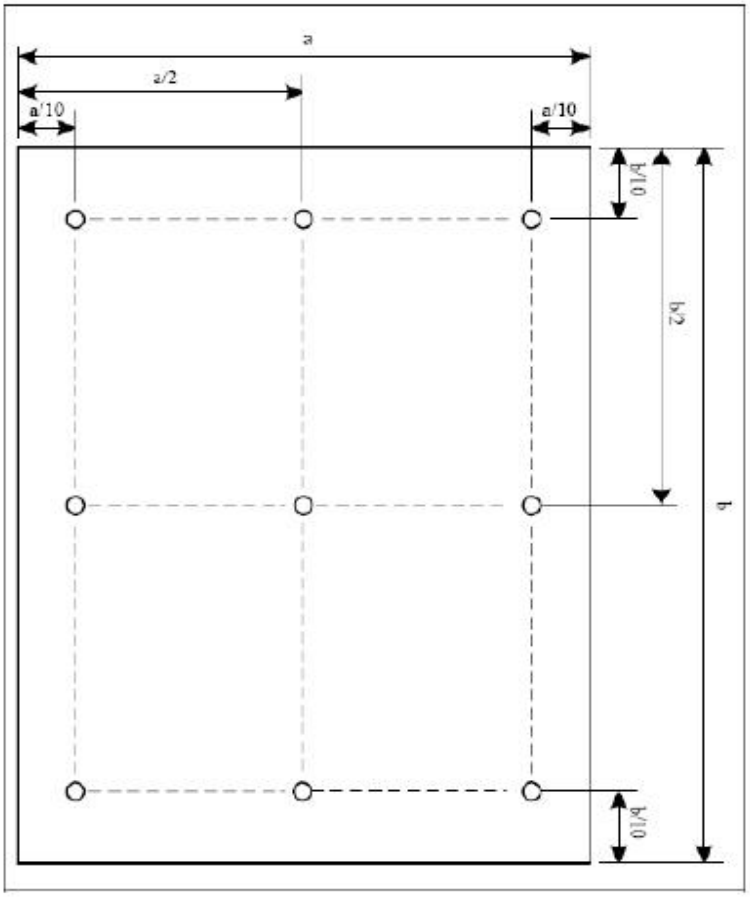
Note1: LED life time (Hr) can be defined as the time in which it continues to operate under the condition: Ta=25±3 ℃, typical IL value indicated in the above table until the brightness becomes less than 50%.

Note 2: The “LED life time” is defined as the module brightness decrease to 50% original brightness at Ta=25℃ and IL=40mA. The LED lifetime could be decreased if operating IL is larger than 40mA. The constant current driving method is suggested.



LED(B/L) CIRCUIT

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



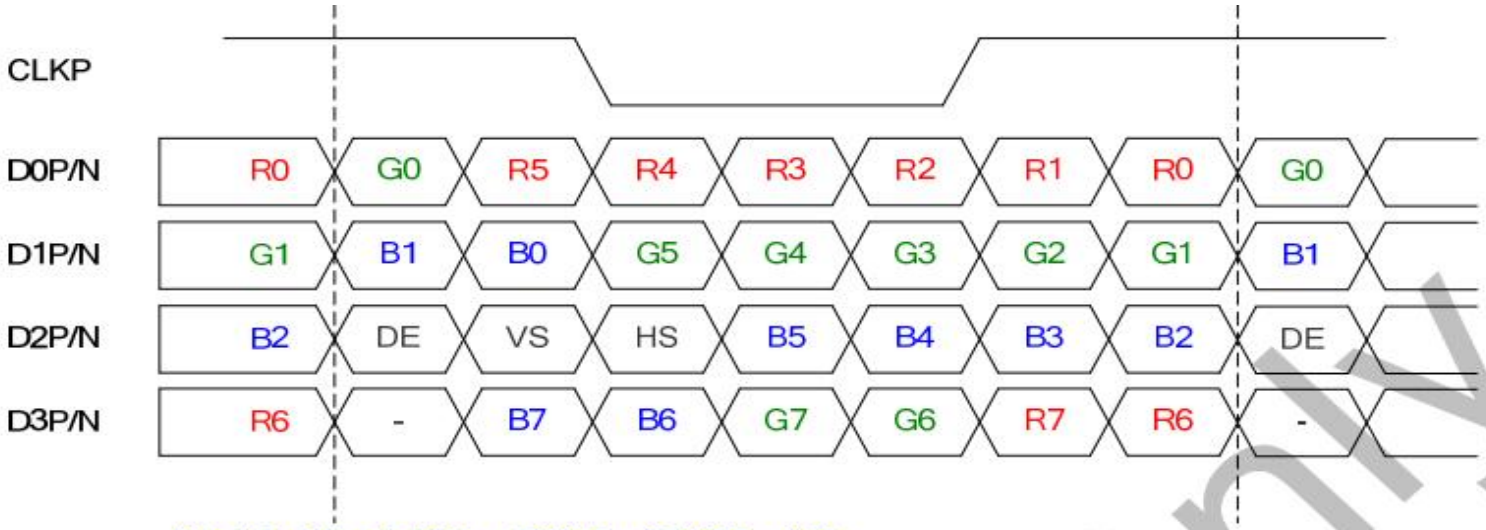
$$\text{Uniformity} = \frac{\text{minimum luminance in 9 points (1-9)}}{\text{maximum luminance in 9 points (1-9)}}$$

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

6. AC Characteristic

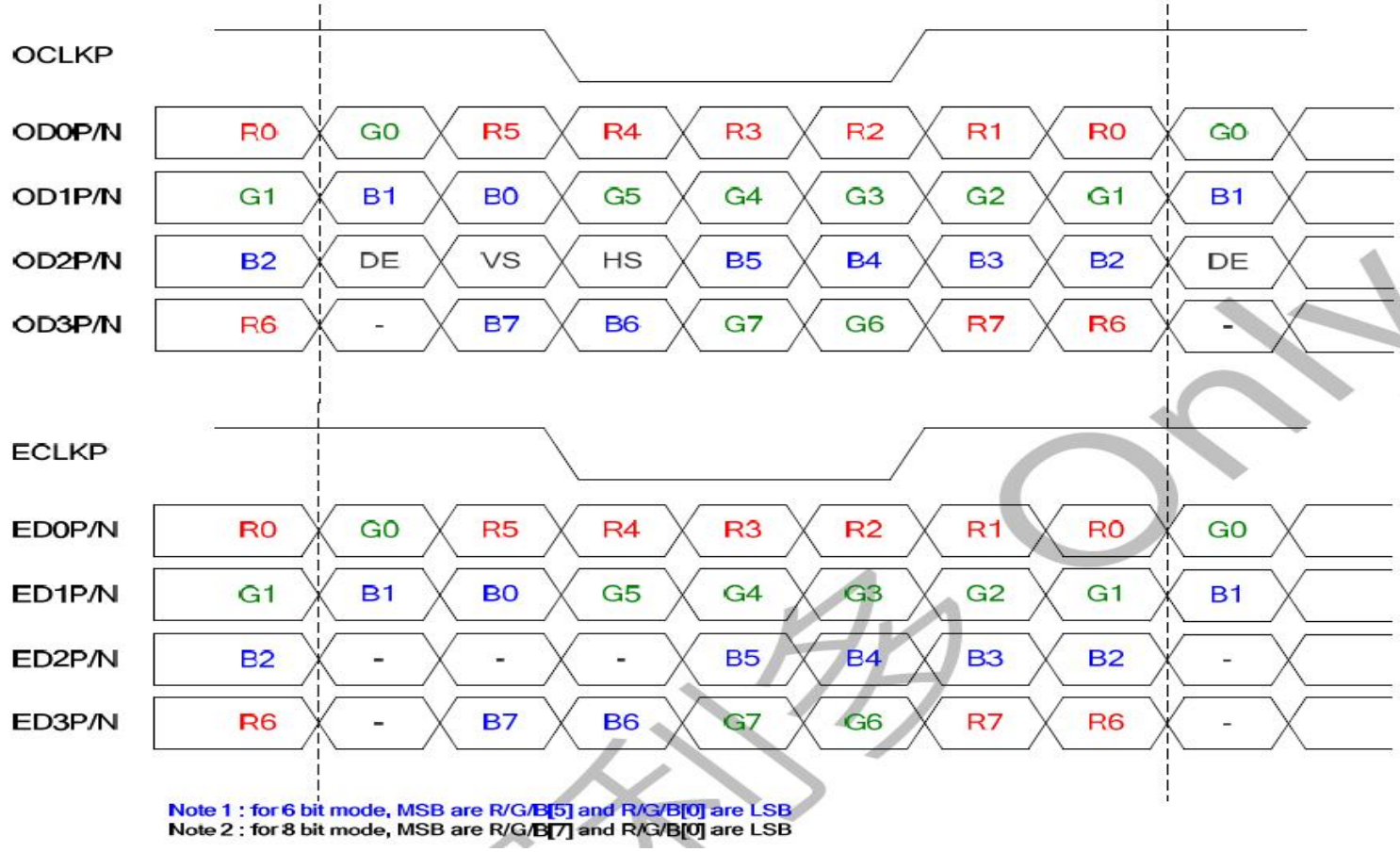
6.1 LVDS Interface

6.1.1 1-Port LVDS VESA Data Mapping



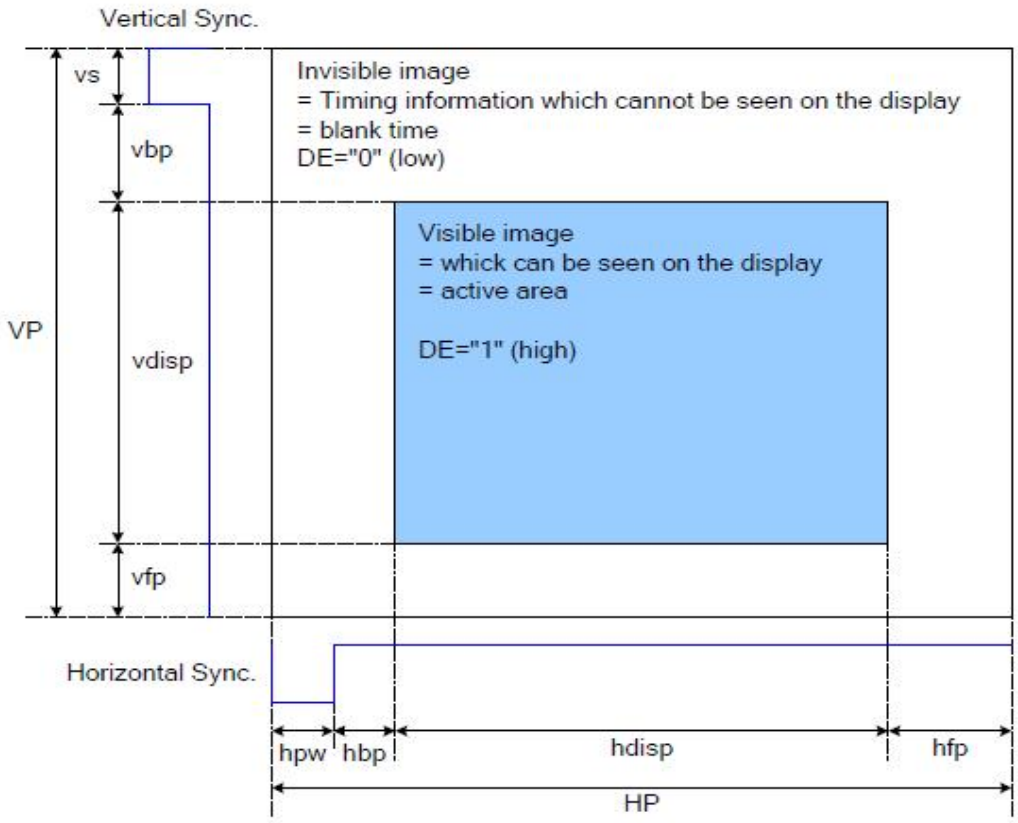
Note 1 : for 6 bit mode, MSB are R/G/B[5] and R/G/B[0] are LSB
Note 2 : for 8 bit mode, MSB are R/G/B[7] and R/G/B[0] are LSB

6.1.2 2-Port LVDS VESA Data Mapping



Note 1 : for 6 bit mode, MSB are R/G/B[5] and R/G/B[0] are LSB
Note 2 : for 8 bit mode, MSB are R/G/B[7] and R/G/B[0] are LSB

6.2 Timing for LVDS mode



DRAM Access Area by RGB Interface

Please refer to the following table for the setting limitation of LVDS interface signals.(Only 2-Port LVDS)

Parameter	Symbol	Min.	Typ.	Max.	Unit
DCLK frequency	FCLK	--	(132)	--	MHz
Horizontal display area	HDISP	--	1920	--	Clock
Horizontal Sync. Width	hpw	1	4	--	Clock
Horizontal Sync. Back Porch	hbp	1	10	-	Clock
Horizontal Sync. Front Porch	hfp	1	40	--	Clock
Vertical display area	VDISP	--	1080	--	Line
Vertical Sync. Width	vs	2	4	--	Line
Vertical Sync. Back Porch	vbp	2	10	--	Line
Vertical Sync. Front Porch	vfp	2	20	--	Line
Frame-Rate		--	60	--	Hz

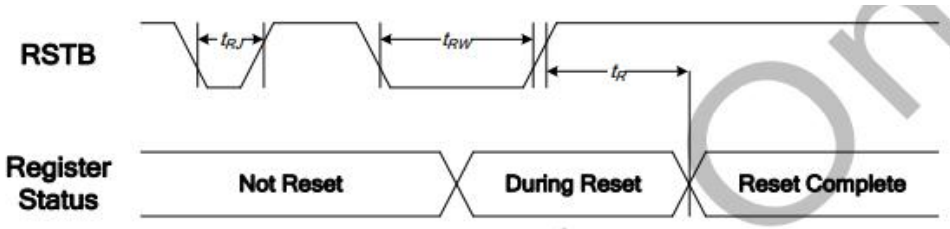
Note: Typical value are related to the setting frame rate is 60Hz.

Please refer to the following table for the setting limitation of LVDS interface signals.(Only 1-Port LVDS)

Parameter	Symbol	Min.	Typ.	Max.	Unit
DCLK frequency	FCLK	--	(90)	(100)	MHz
Horizontal display area	HDISP	--	1920	--	Clock
Horizontal Sync. Width	hpw	1	4	--	Clock
Horizontal Sync. Back Porch	hbp	1	10	-	Clock
Horizontal Sync. Front Porch	hfp	1	40	--	Clock
Vertical display area	VDISP	--	1080	--	Line
Vertical Sync. Width	vs	2	4	--	Line
Vertical Sync. Back Porch	vbp	2	10	--	Line
Vertical Sync. Front Porch	vfp	2	20	--	Line
Frame-Rate		--	40	45	Hz

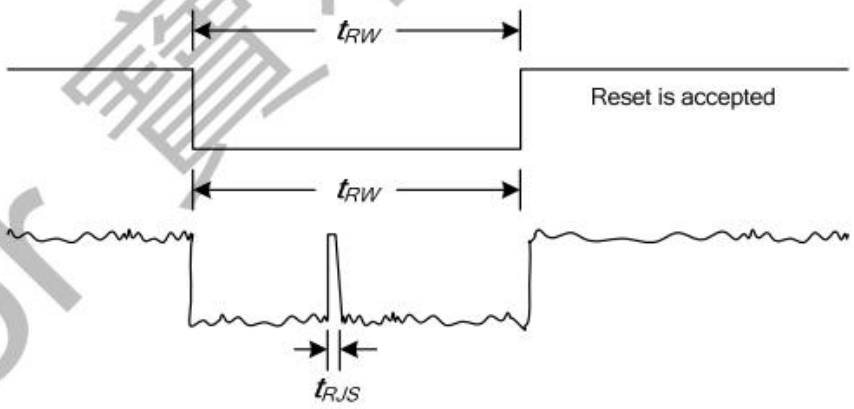
Note: 1-port LVDS can not support 60HZ refresh.

6.3 Hardware Reset Timing



VSSI = VSSRX = VSSP = 0V, VDDI = VDDP= VDDRX = 3.0 ~ 3.3V, Ta = -40 ~ 85°C

Item	Signal	Symbol	Condition	Rating		Unit
				Min.	Max.	
Reset time	RSTB	t_R		—	5	us
Reset "L" pulse width		t_{RW}		15	—	
Reset rejection		t_{RJ}		—	5	
Reset rejection (for noise spike)		t_{RJS}		—	10	ns



Note:

1. For PROM related operation, it takes 50ms at least for PROM Registers to load PROM contents. Do not use any PROM related command during this period.
2. When the system issues a RSTB low pulse, the reset procedure of IC will start if the low pulse is longer than t_{RW} specified above. If the low pulse is less than t_{RJ} specified above, the reset procedure of IC will not start. If the low pulse is longer than t_{RJ} and less than t_{RW}, the reset procedure of IC is not guaranteed.

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.

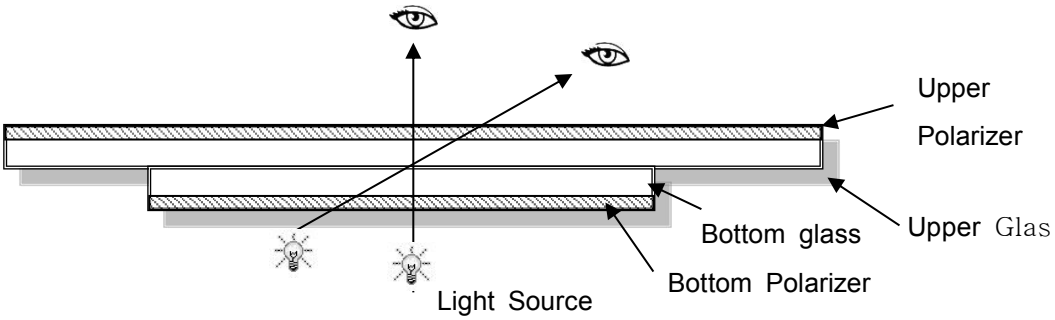
Temperature : 25±5℃

Humidity : 65%±10%RH

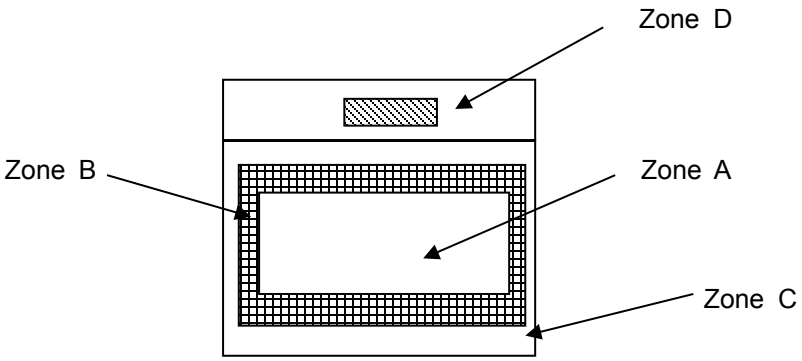
Viewing Angle : Normal viewing Angle.

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 2828-2003 ; , normal inspection, Class Ⅱ

AQL:

Major defect	Minor defect
0.65	1.5

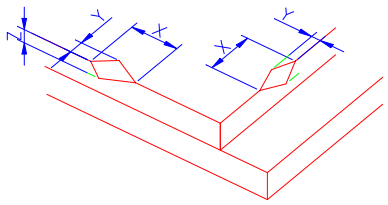
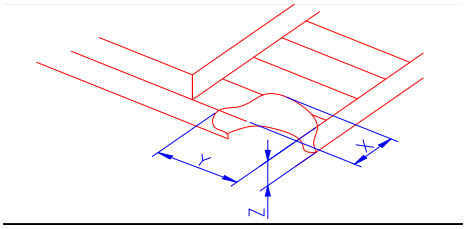
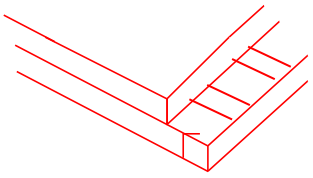
LCD: Liquid Crystal Display , LCM: Liquid Crystal Module, CTP: Capacitive Touch Panel

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. 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/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.

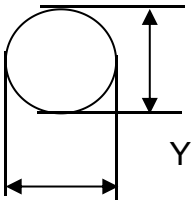
b) Dim dot: Dots appear dark and unchanged in size in which LCD panel is displaying under pure red, green, blue picture.

7.1.4 Criteria (Visual)

<table>
<tr><th>Number</th><th>Items</th><th>Criteria(mm)</th></tr>
<tr><td rowspan="3">1.0 LCD Crack/Broken
NOTE:
X: Length
Y: Width
Z: Height
L: Length of ITO,
T: Height of LCD</td><td>(1) The edge of LCD broken</td><td> 
<table><tr><th>X</th><th>Y</th><th>Z</th></tr><tr><td>≤3.0mm</td><td><Inner border line of the seal</td><td>≤T</td></tr></table></td></tr>
<tr><td>(2)LCD corner broken</td><td> 
<table><tr><th>X</th><th>Y</th><th>Z</th></tr><tr><td>≤3.0mm</td><td>≤L</td><td>≤T</td></tr></table></td></tr>
<tr><td>(3) LCD crack</td><td> 
Crack
Not allowed</td></tr>
</table>

2.0

Spot defect



Φ=(X+Y)/2

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

Zone / Size (mm)	Acceptable Qty		
	A	B	C
Φ≤0.15	Ignore	Ignore	
0.15<Φ≤0.25	3(distance≧10mm)		
0.25<Φ≤0.4	2(distance≧10mm)		
Φ>0.4	0		

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

Zone / Size (mm)	Acceptable Qty		
	A	B	C
Φ≤0.15	Ignore	Ignore	
0.15<Φ≤0.25	3(distance≧10mm)		
0.25<Φ≤0.4	2(distance≧10mm)		
Φ>0.4	0		

③ Polarizer accidented spot

Zone / Size (mm)	Acceptable Qty		
	A	B	C
Φ≤0.2	Ignore		Ignore
0.2<Φ≤0.5	2(distance≧10mm)		
Φ>0.5	0		

④Polarizer Bubble

Zone / Size (mm)	Acceptable Qty		
	A	B	C
Φ≤0.2	Ignore		Ignore
0.2<Φ≤0.4	2(distance≧10mm)		
Φ>0.4	0		

3.0 LCD Pixel defect

Pixel bad points

Item	Zone A	Acceptable Qt
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

Note:

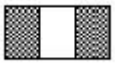
A) Bright dot：Dots appear bright and unchanged in size in which LCD panel is displaying under black pattern.

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

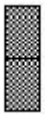
C) 2 dot adjacent = 1 pair = 2 dots

Picture:

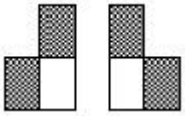
2 dot adjacent



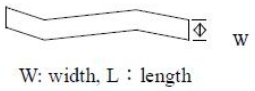
2 dot adjacent



2 dot adjacent (vertical)



2 dot adjacent (slant)

<table>
<tr>
<td>4.0</td>
<td>Line defect (LCD /Polarizer backlight black/white line, scratch, stain)
 

N：Count</td>
<td>
<table>
<tr><td rowspan="2">Width(mm)</td><td rowspan="2">Length(mm)</td><td colspan="3">Acceptable Qty</td></tr>
<tr><td>A</td><td>B</td><td>C</td></tr>
<tr><td>Φ≤0.05</td><td>Ignore</td><td colspan="2">Ignore</td><td rowspan="3">Ignore</td></tr>
<tr><td>0.05<W≤0.06</td><td>L≤5.0</td><td colspan="2">N≤3</td></tr>
<tr><td>0.06<W≤0.08</td><td>L≤4.0</td><td colspan="2">N≤2</td></tr>
<tr><td>W>0.08</td><td colspan="4">Define as spot defect</td></tr>
</table>
</td>
</tr>
<tr>
<td>5.0</td>
<td>Electronic Components SMT.</td>
<td>Not allow missing parts，solderless connection，cold solder joint，mismatch，The positive and negative polarity opposite</td>
</tr>
<tr>
<td>6.0</td>
<td>Display color& Brightness.</td>
<td>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.</td>
</tr>
<tr>
<td>7.0</td>
<td>LCD Mura/Waving/ Hot spot</td>
<td>Not visible through 5% ND filter in 50% gray or judge by limit sample if necessary.</td>
</tr>
</table>

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

8. Reliability Test Result

Item	Condition	Inspection after test
High Temperature Operating	70℃,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	-20℃, 96HR	
High Temperature Storage	80℃, 96HR	
Low Temperature Storage	-30℃, 96HR	
High Temperature & High Operating	+60℃, 90% RH ,96 hours.	
Thermal Shock (Non-operation)	-10℃,30 min ↔60℃,30 min, Change time:5min 20CYC.	
ESD test	C=150pF, R=330,5points/panel Air:±8KV, 5times; Contact:±6KV, 5 times; (Environment: 15℃~35℃, 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,80㎝(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 ℃ 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----------