SPECIFICATION
FOR
LCM Module

MODULE No:	KD070HDFLD070
CUSTOMER:	

STARTEK	INITIAL	DATE
PREPARED BY		
CHECKED BY		
APPROVED BY		

CUSTOMER	INITIAL	DATE
APPROVED BY		

Revision History

Date	Rev. No.	Page	Summary
2022.04.11	V1.0	ALL	FIRST ISSUE
2023.07.07	V1.1	9,12	Modify optical and electrical characteristics
2023.07.10	V1.2	6	Update structure diagram
2023.10.13	V1.3	9	Update optical data
2024.10.22	V1.4	6	Update structure diagram

Contents

* Description

This is a color active matrix TFT (Thin Film Transistor) LCD (liquid crystal display) that uses amorpho us silicon TFT as a switching device. This module is composed of a Transmissive type TFT-LCD Pan el, driver circuit, back-light unit. The resolution of a 7.0'' TFT-LCD contains 1280x768 pixels, and can display up to 16.7M colors.

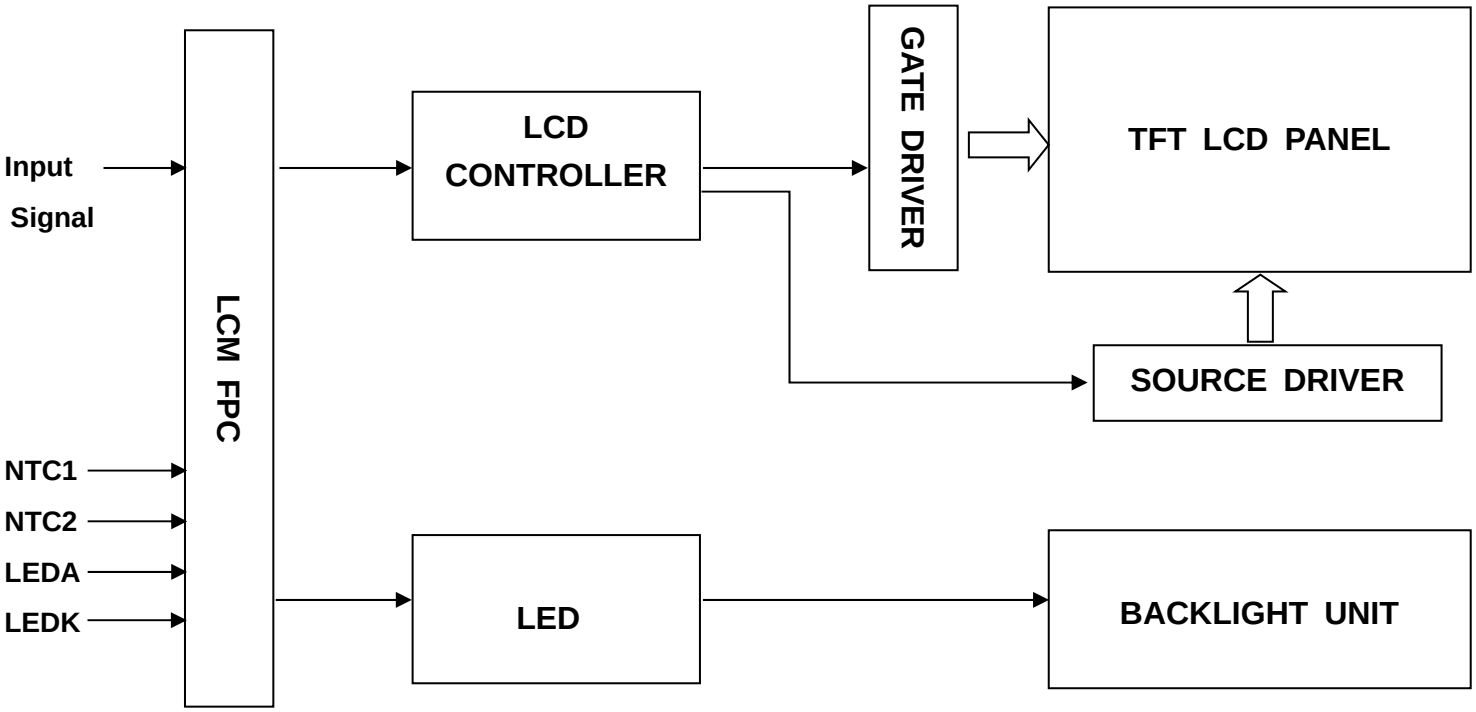
* Features

General Information Items	Specification	Unit	Note
	Main Panel		
Display area(AA)	152.45(H)*91.47(V) (7.0inch)	mm	-
Driver element	TFT active matrix	-	-
Display colors	16.7M	colors	-
Number of pixels	1280(RGB)*768	dots	-
TFT Pixel arrangement	RGB vertical stripe	-	-
Pixel pitch	0.1191 (W)*0.1191(H)	mm	-
Viewing angle	ALL	o'clock	-
TFT Controller IC	HX8298-Ax3 + HX8695Ex1	-	-
LCM Interface	1-port LVDS	-	
Display mode	Transmissive/Normally Black	-	-
Operating temperature	-30～+85	℃	-
Storage temperature	-40～+90	℃	-

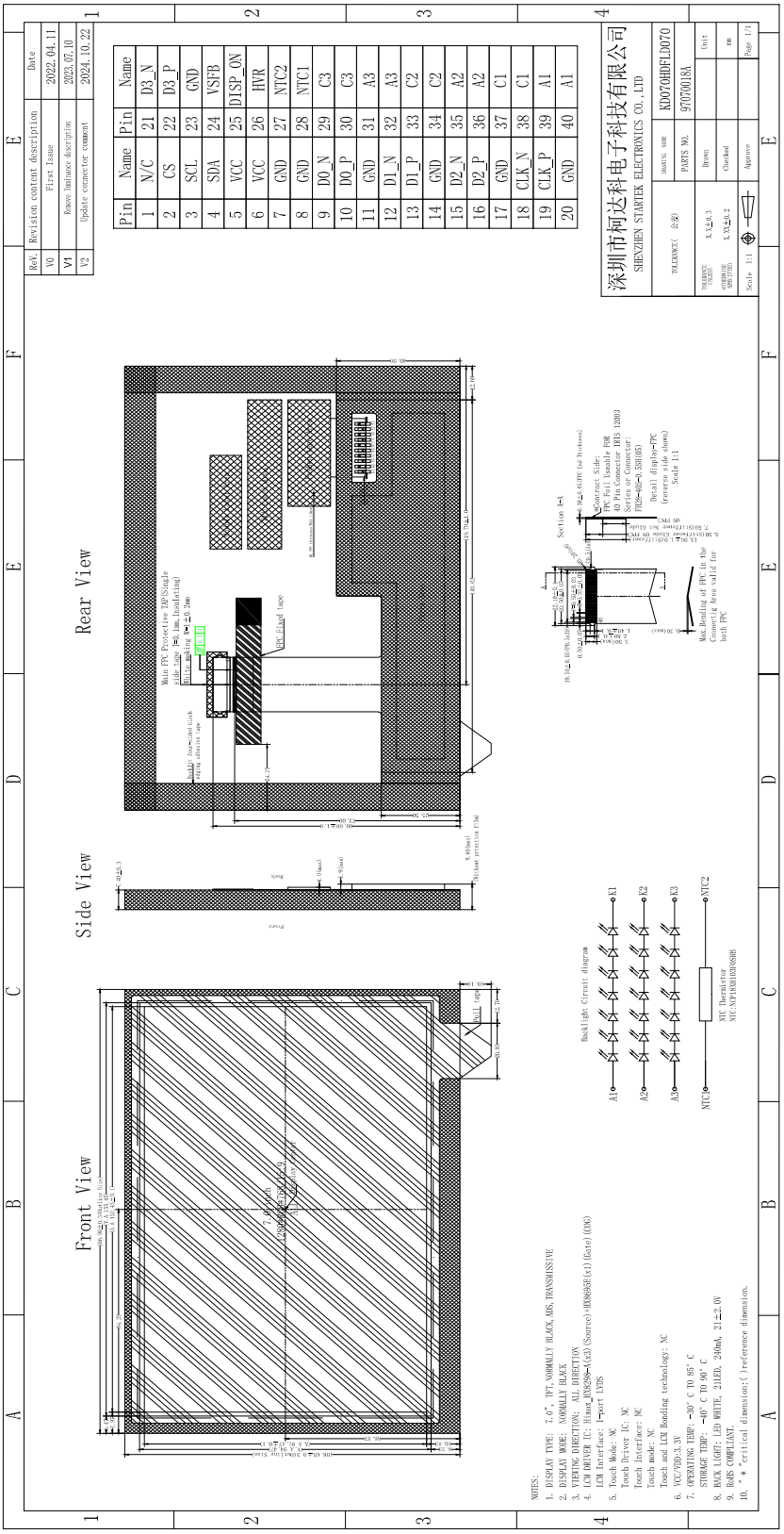
* Mechanical Information

Item		Min.	Typ.	Max.	Unit	Note
Module size	Horizontal(H)		166.9		mm	-
	Vertical(V)		108.65		mm	-
	Depth(D)		7.4		mm	-
Weight			179		g	-

1. Block Diagram



2. Outline dimension



Pin	Name	Pin	Name
1	V/C	21	D3_N
2	CS	22	D3_P
3	SCL	23	GND
4	SDA	24	VSFB
5	VCC	25	DISP_ON
6	VCC	26	HVR
7	GND	27	NTC2
8	GND	28	NTC1
9	DO_N	29	C3
10	DO_P	30	C3
11	GND	31	A3
12	D1_N	32	A3
13	D1_P	33	C2
14	GND	34	C2
15	D2_N	35	A2
16	D2_P	36	A2
17	GND	37	C1
18	CLK_N	38	C1
19	CLK_P	39	A1
20	GND	40	A1

Rev.	Revision content description	Date
V0	First Issue	2022.04.11
V1	Remove luminance description	2023.07.10
V2	Update connector comment	2024.10.22

3. Input terminal Pin Assignment

NO.	SYMBOL	DISCRIPTION	I/O
1	NC	Reserved for supplier test, NC for customer	
2	CS	SPI interface for supplier online test and programming use (Pull high for customer)	I
3	SCL	SPI interface for supplier online test and programming use (NC for customer)	I
4	SDA	SPI interface for supplier online test and programming use (NC for customer)	I
5	VCC	Power supply (3.3V)	P
6	VCC	Power supply (3.3V)	P
7	GND	Ground	P
8	GND	Ground	P
9	D0_N	LVDS data 0-	I
10	D0_P	LVDS data 0+	I
11	GND	Ground	P
12	D1_N	LVDS data 1-	I
13	D1_P	LVDS data 1+	I
14	GND	Ground	P
15	D2_N	LVDS data 2-	I
16	D2_P	LVDS data 2+	I
17	GND	Ground	P
18	CLK_N	LVDS clock-	I
19	CLK_P	LVDS clock +	I
20	GND	Ground	P
21	D3_N	LVDS data 3-	I
22	D3_P	LVDS data 3+	I
23	GND	Ground	P
24	VSFB	VSYNC waveform feedback	I

25	DISP_ON	Display on/off (black display),	I
26	HVR	Horizontally and Vertically Inverted	I
27	NTC2	Temperature Sensor Pin2	P
28	NTC1	Temperature Sensor Pin1	P
29	C3	Backlight Cathode 3	P
30	C3	Backlight Cathode 3	P
31	A3	Backlight Anode 3	P
32	A3	Backlight Anode 3	P
33	C2	Backlight Cathode 2	P
34	C2	Backlight Cathode 2	P
35	A2	Backlight Anode 2	P
36	A2	Backlight Anode 2	P
37	C1	Backlight Cathode 1	P
38	C1	Backlight Cathode 1	P
39	A1	Backlight Anode 1	P
40	A1	Backlight Anode 1	P

4. LCD Optical Characteristics

4.1 Optical specification

Item		Symbol	Condition	Min.	Typ.	Max.	Unit.	Note
Contrast Ratio		CR	Θ=0 Normal viewing angle	800	1000	--		(1)(2)
Response time	Rising	$T_{R+}T_F$		--	--	40	msec	
	Falling							(1)(3)
Color Gamut		S(%)		65	70	--	%	
	White	W_X		0.270	0.300	0.330		(1)(4) CF glass
		W_Y		0.290	0.320	0.350		
	Red	R_X		0.610	0.640	0.670		
		R_Y		0.312	0.342	0.372		
	Green	G_X		0.293	0.323	0.353		
		G_Y		0.596	0.626	0.656		
	Blue	B_X		0.116	0.146	0.176		
		B_Y		0.046	0.076	0.106		
Viewing angle	Hor.	ΘL	CR>10	--	80	--		(1)(4)
		ΘR		--	80	--		
	Ver.	ΘU		--	80	--		
		ΘD		--	80	--		
Option View Direction		ALL						

*The data comes from the LCD specification.

Measuring Condition

Measuring surrounding : dark room

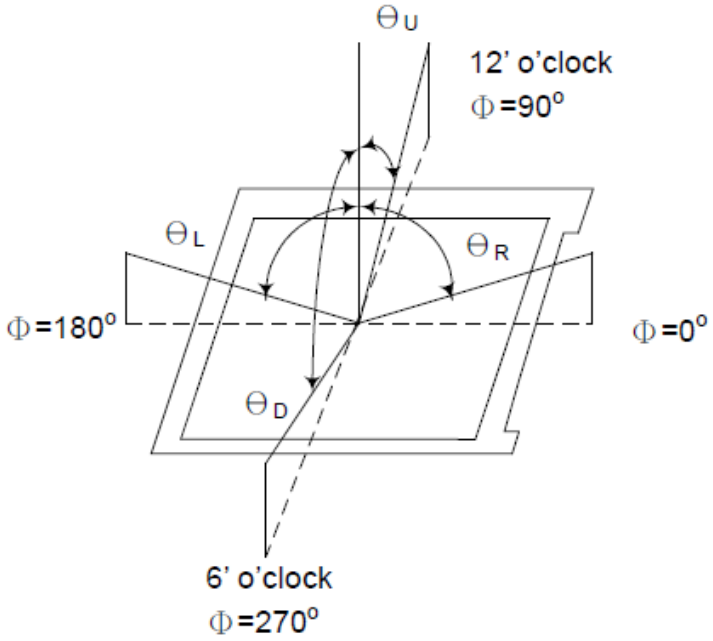
Ambient temperature : 25±2oC

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.

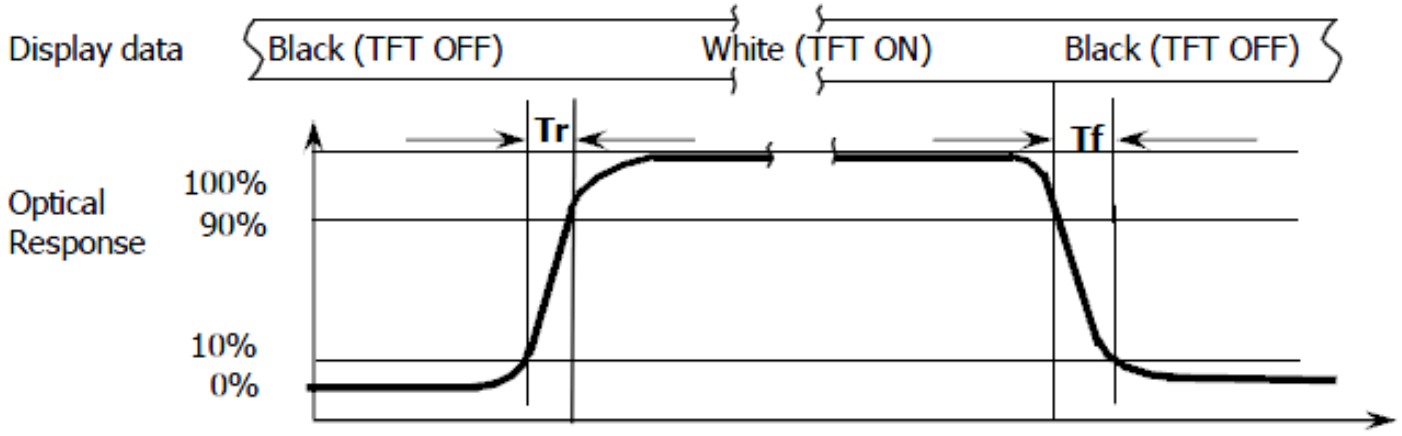
Note (1): Definition of Viewing Angle :



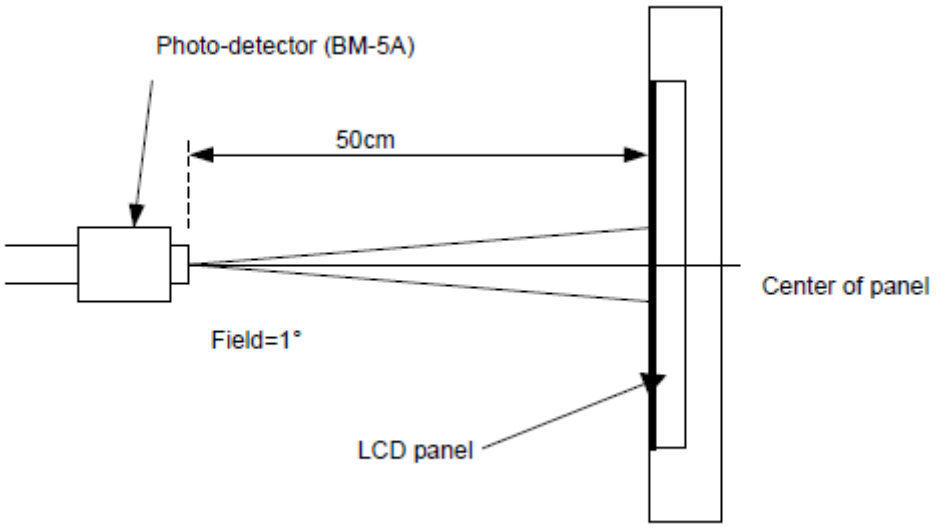
Note (2): Definition of Contrast Ratio(CR) :measured at the center point of panel

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

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	VCC	-0.3	+3.96	V	Note1
Operating temperature	T_{OP}	-30	+85	℃	
Storage temperature	T_{ST}	-40	+90	℃	

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 consumption	IDD	--	150	300	mA	--
Driver input high signal voltage	VIH	0.7*VCC	-	VCC	V	
Driver input low signal voltage	VIL	GND	-	0.3*VCC	V	

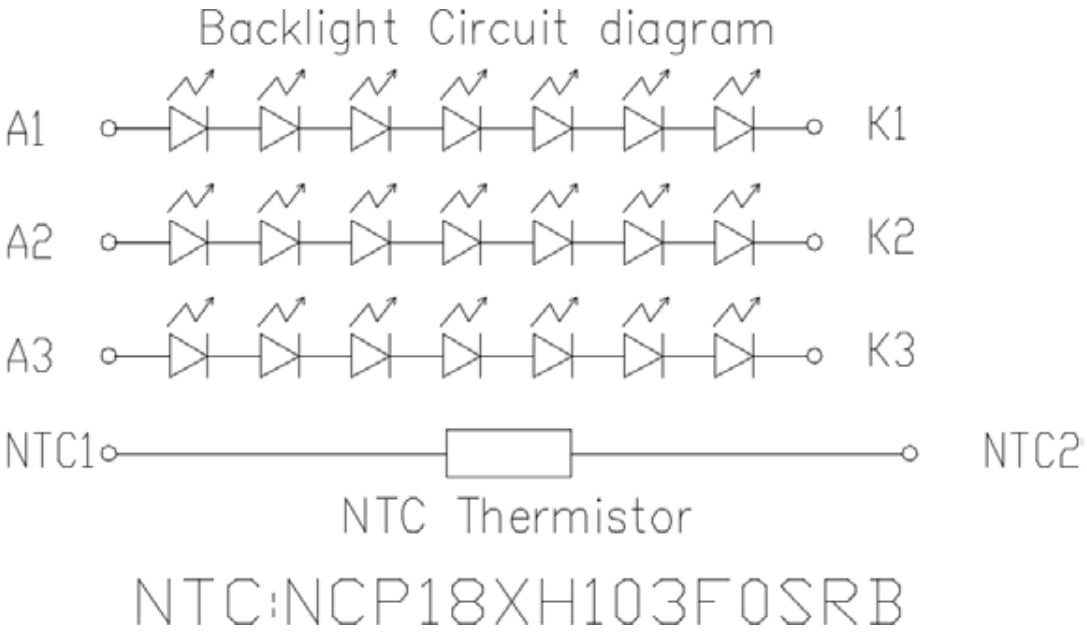
5.3 LED Backlight Characteristics

The back-light system is edge-lighting type with 21 chips White LED

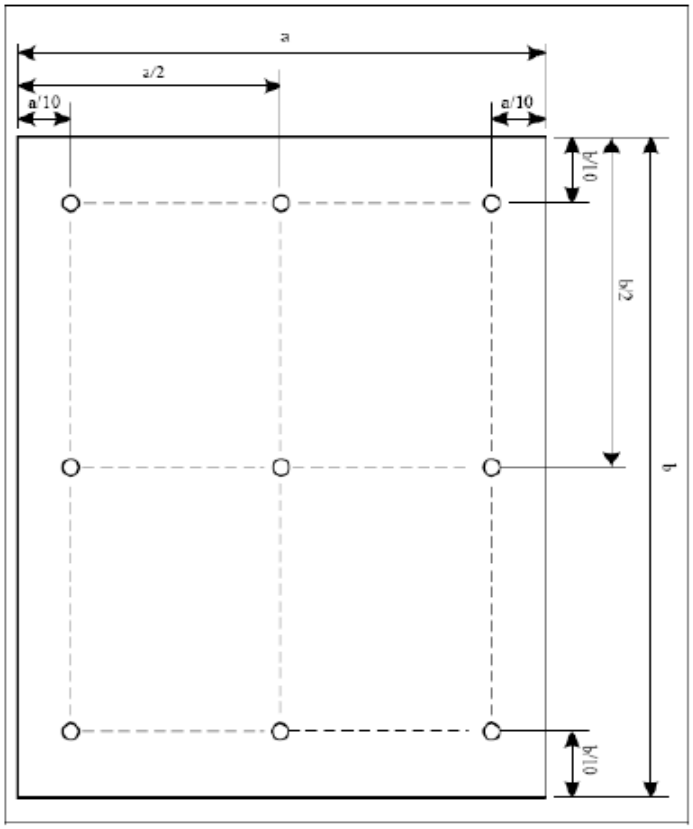
Item	Symbol	Min.	Typ.	Max.	Unit	Note
Forward Current	I_F	--	240	--	mA	
Forward Voltage	V_F	18.9	21	23.8	V	--
LCM Luminance	L_V	1000	1100	--	cd/m2	IF=240mA
LED life time	Hr	30000	--	--	Hour	Note1,2
Uniformity	AVg	80	--	--	%	Note3

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=240mA. The LED lifetime could be decreased if operating IL is larger than 240mA. The constant current driving method is suggested.



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



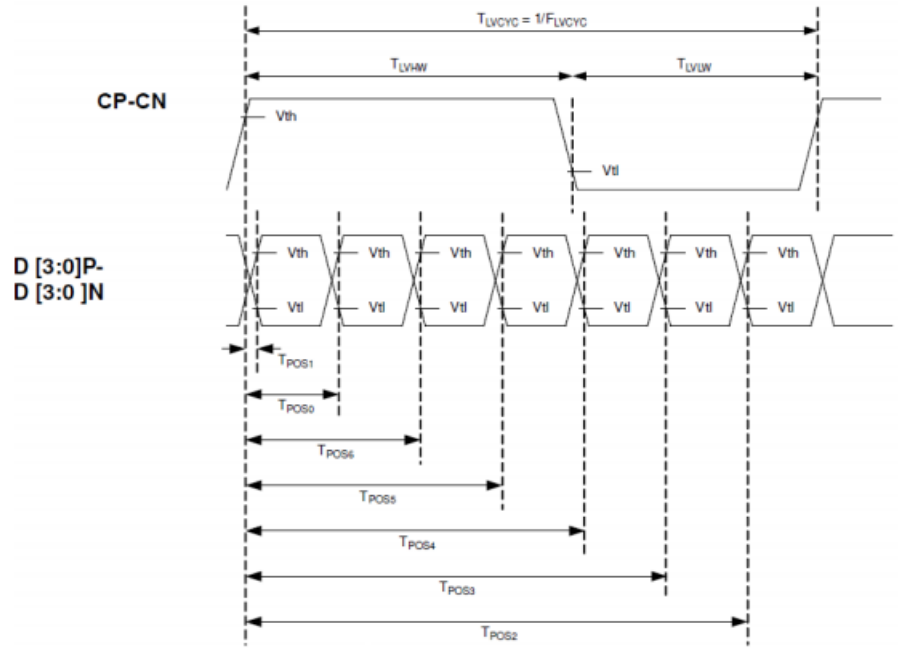
$$\text{Uniformity} = \frac{\text{minimum luminance in 9 points (1-9)}}{\text{maximum luminance in 9 points (1-9)}}$$

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

6. AC Characteristic

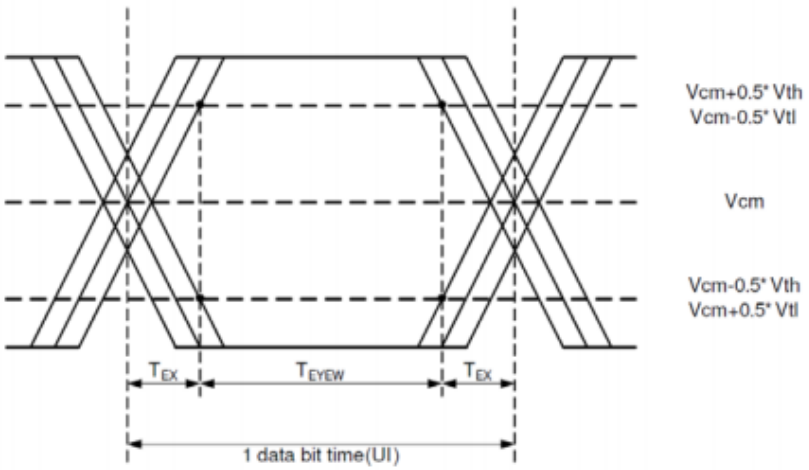
6.1. LVDS mode AC Electrical Characteristic

Parameter	Symbol	Min	Typ	Max	Unit
Clock frequency	F_{LVCYC}	61.6	66.4	74.6	MHz
Clock period	T_{LVCYC}	13.4	-	16.2	ns
1 data bit time	UI	-	1/7	-	T_{LVCYC}
Clock high time	T_{LVCH}	2.45	4	4.55	UI
Clock low time	T_{LVCL}	2.45	3	4.55	UI
Position 1	T_{POS1}	-0.2	0	0.2	UI
Position 0	T_{POS0}	0.8	1	1.2	UI
Position 6	T_{POS6}	1.8	2	2.2	UI
Position 5	T_{POS5}	2.8	3	3.2	UI
Position 4	T_{POS4}	3.8	4	4.2	UI
Position 3	T_{POS3}	4.8	5	5.2	UI
Position 2	T_{POS2}	5.8	6	6.2	UI
Input eye width	T_{EYEW}	0.6	-	-	UI
Input eye border	T_{EX}	-	-	0.2	UI
LVDS wake up time	T_{ENLVDS}	-	-	150	us
Differential input common Mode voltage	VCM	1	1.2	1.7-|Vid|/2	V
Differential input high Threshold voltage	Vth	-	-	+0.1	V
Differential input low threshold voltage	Vtl	-0.1	-	-	V
Differential input voltage	|Vid|	0.2		0.6	V

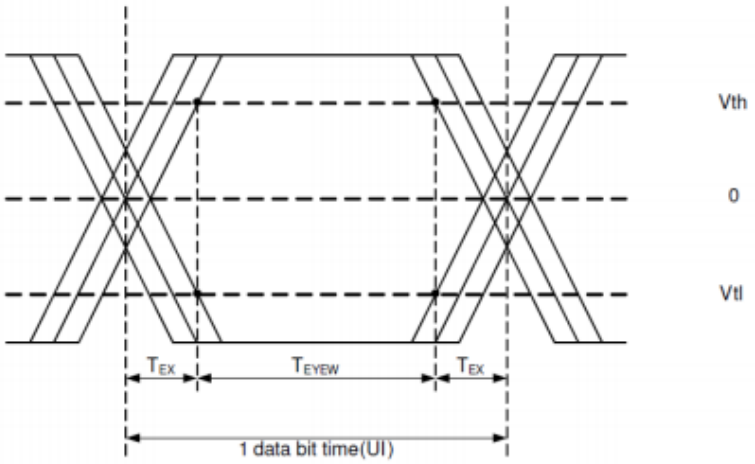


LVDS input timing

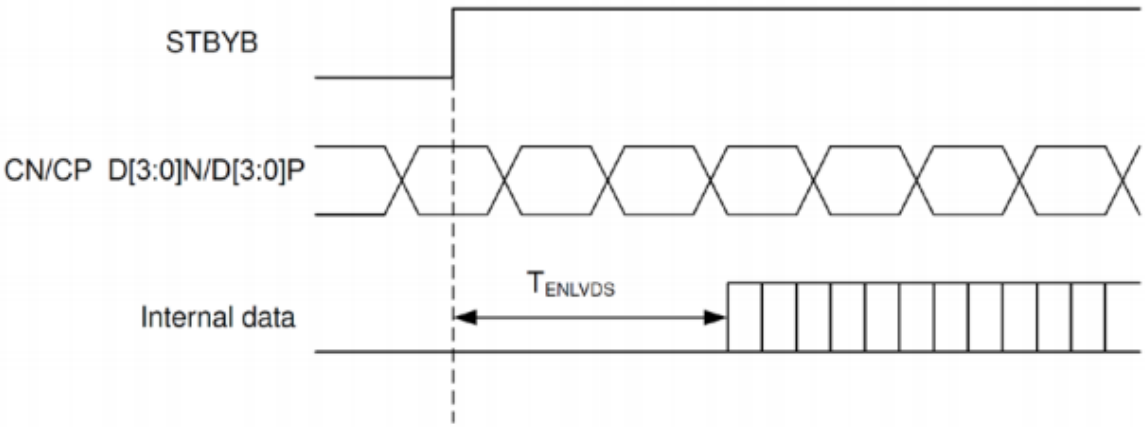
Single-ended:
D[3 :0]P,
D[3 :0]N



Differential:
D[3 :0]P-D[3:0]N



LVDS input eye diagram



LVDS wake up time

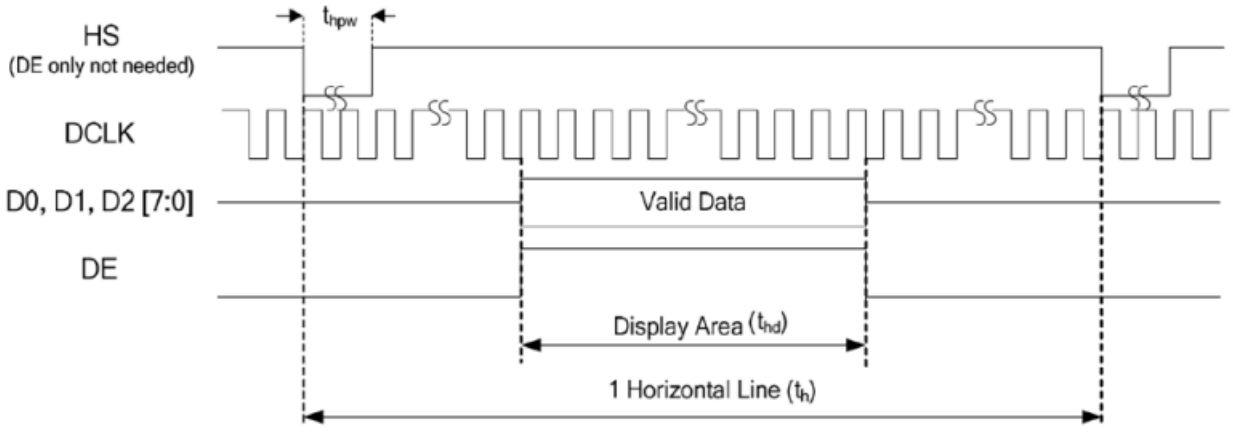
6.2. LVDS signal timing

Parameter	Symbol	Value			Unit
		Min	Typ	Max	
DCLK frequency	Fdclk	61.6	66.4	74.6	MHz
Horizontal valid area	thd		1280		DCLK
1 horizontal line	th	1320	1364	1458	DCLK
Vertical valid area	tvd		768		H
1 vertical field	tv	778	811	853	H
Frame rate	FR		60		Hz

DE Mode

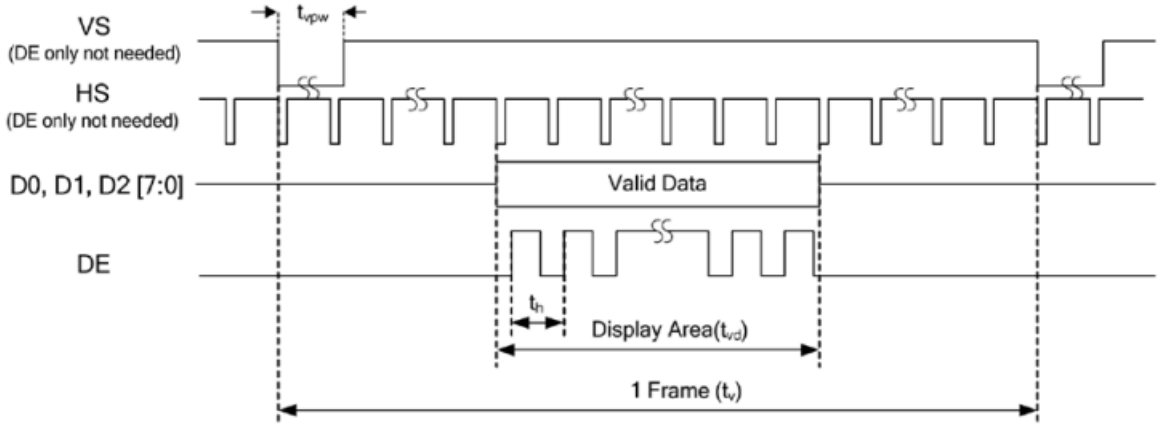
It just needs DE signal only, when DE only mode enable

- **Horizontal**

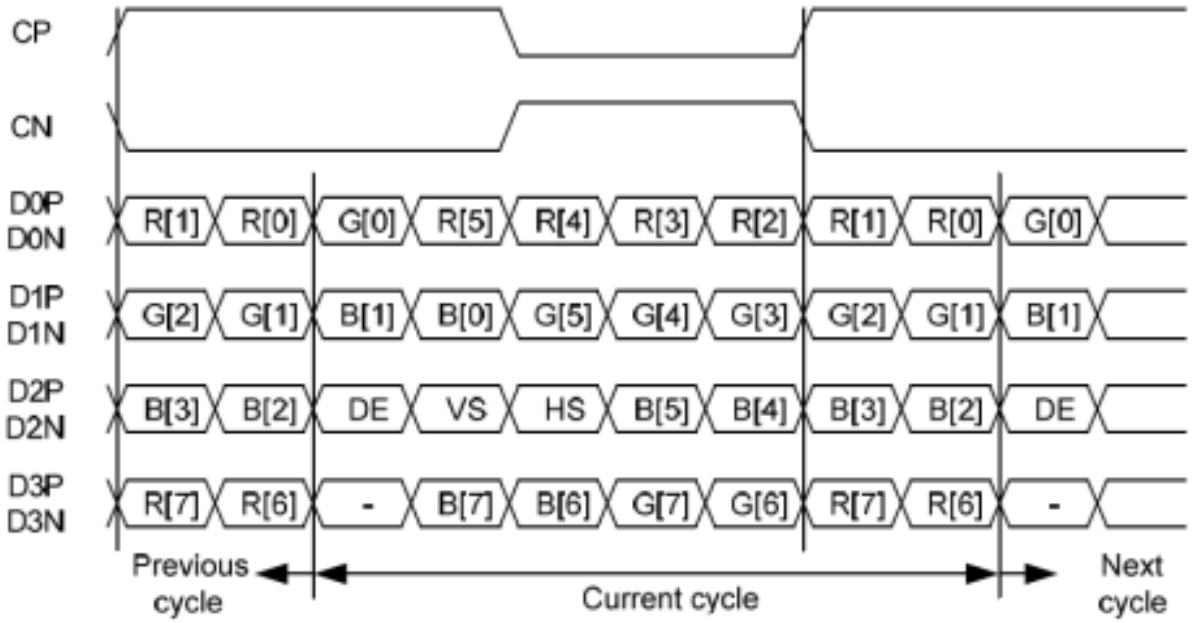


Horizontal input timing at DE only mode

- **Vertical**

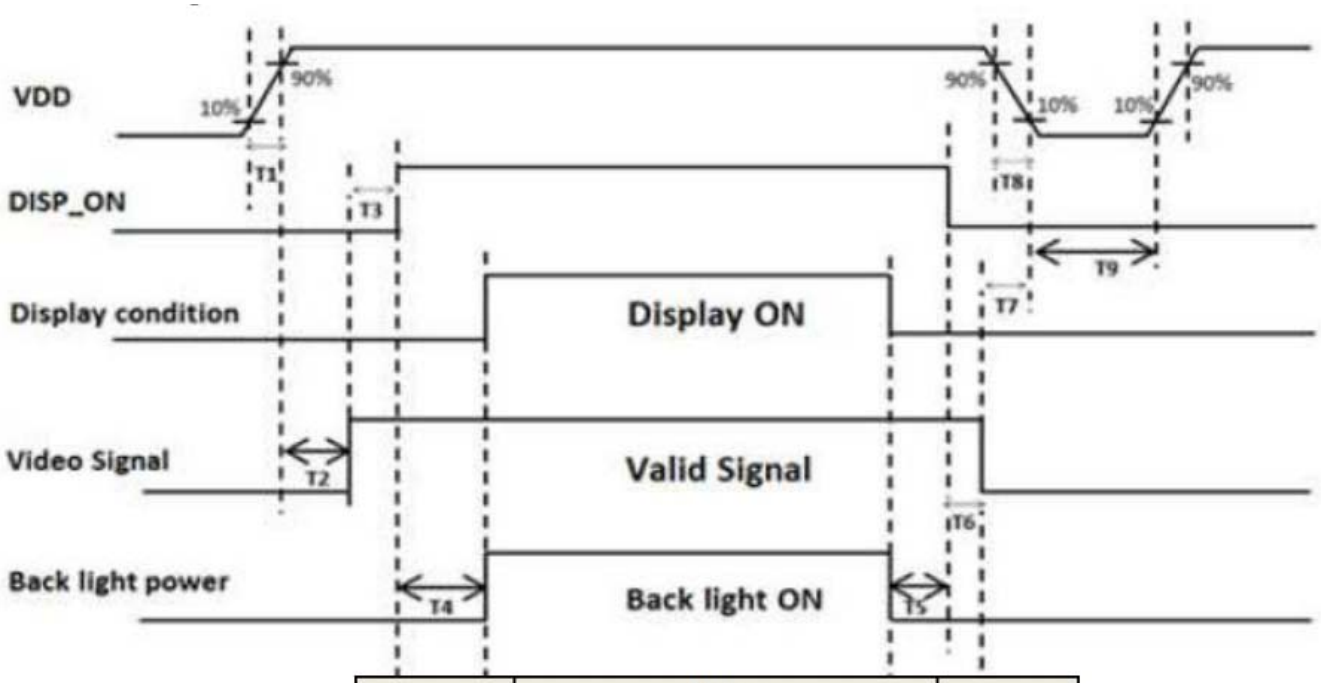


Vertical input timing at DE only mode



LVDS Input signal VESA format:

6.3.Power on sequence



Parameter	Value			Unit
	Min.	Typ.	Max.	
T1	0.5	-	10	ms
T2	0	-	-	ms
T3	100	-	-	ms
T4	150	-	-	ms
T5	200	-	-	ms
T6	200	-	-	ms
T7	0	-	-	ms
T8	0	-	10	ms
T9	400	-	-	ms

DISP_ON is an active high signal.When this signal is low,the display will be in standby mode and nothing displayed on the screen.

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.

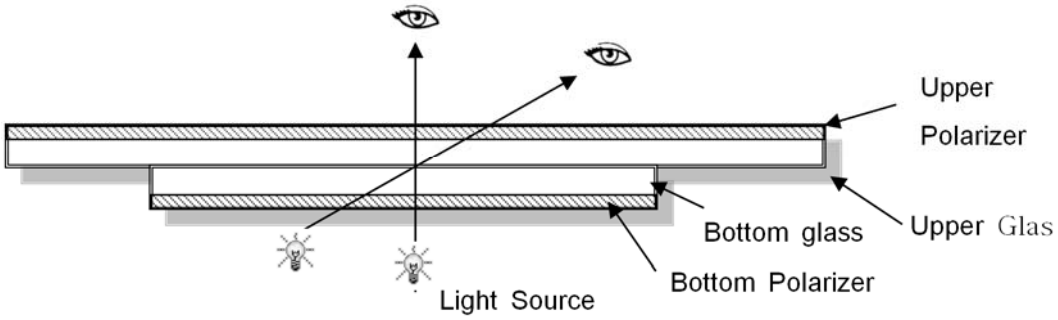
Temperature : 25±5℃

Humidity : 65%±10%RH

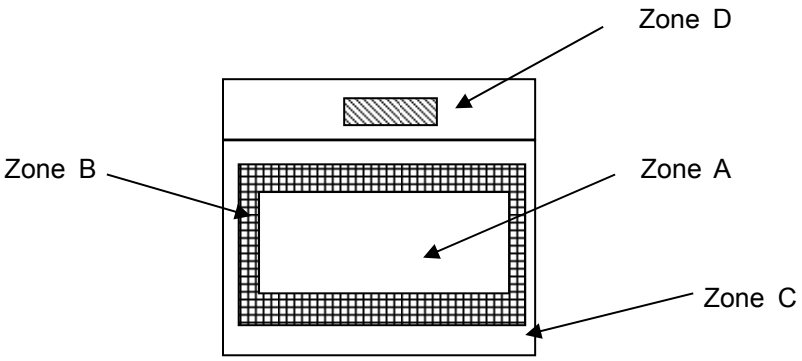
Viewing Angle : Normal viewing Angle.

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

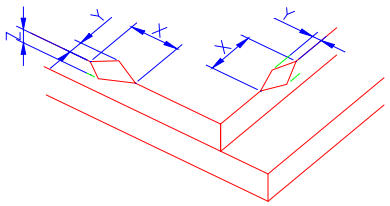
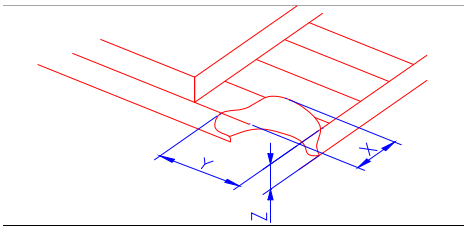
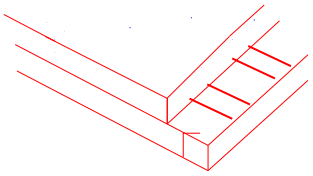
LCD: Liquid Crystal Display , LCM: Liquid Crystal Module

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.	

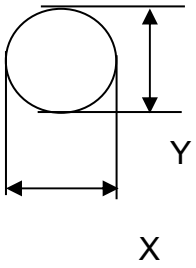
Note1: a) Light dot：Dots appear bright and unchanged in size in which LCD panel is displaying under black pattern.

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)

<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)		
0.4<Φ≤0.5	1		
Φ>0.5	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:

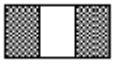
A) Bright dot：Dots appear bright and unchanged in size in which LCD panel is displaying under black pattern.

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

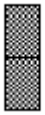
C) 2 dot adjacent = 1 pair = 2 dots

Picture:

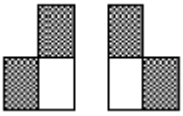
2 dot adjacent



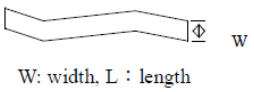
2 dot adjacent



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

8. Reliability Test Result

Item	Condition	Inspection after test
High Temperature Operating	85℃,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℃, 96HR	
High Temperature Storage	90℃, 96HR	
Low Temperature Storage	-40℃, 96HR	
High Temperature & High Humidity Operating	+60℃, 90% RH ,96 hours.	
Thermal Shock (Non-operation)	-30℃,30 min ↔ +85℃,30 min, Change time:5min 20CYC.	
ESD test	C=150pF, R=330,5points/panel Air:±15KV, 5times; Contact:±8KV, 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----------