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SPECIFICATION FOR LCM Module

MODULE No:	ET156FH04-K
CUSTOMER:	

YOURITECH	INITIAL	DATE
PREPARED BY		
CHECKED BY		
APPROVED BY		

CUSTOMER	INITIAL	DATE
APPROVED BY		

Revision History

Date	Rev. No.	Page	Summary
2023.10.12	V1.0	ALL	FIRST ISSUE

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* 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 15.6 " TFT-LCD contains 1920X1080 pixels, and can display up to 16.2M colors.

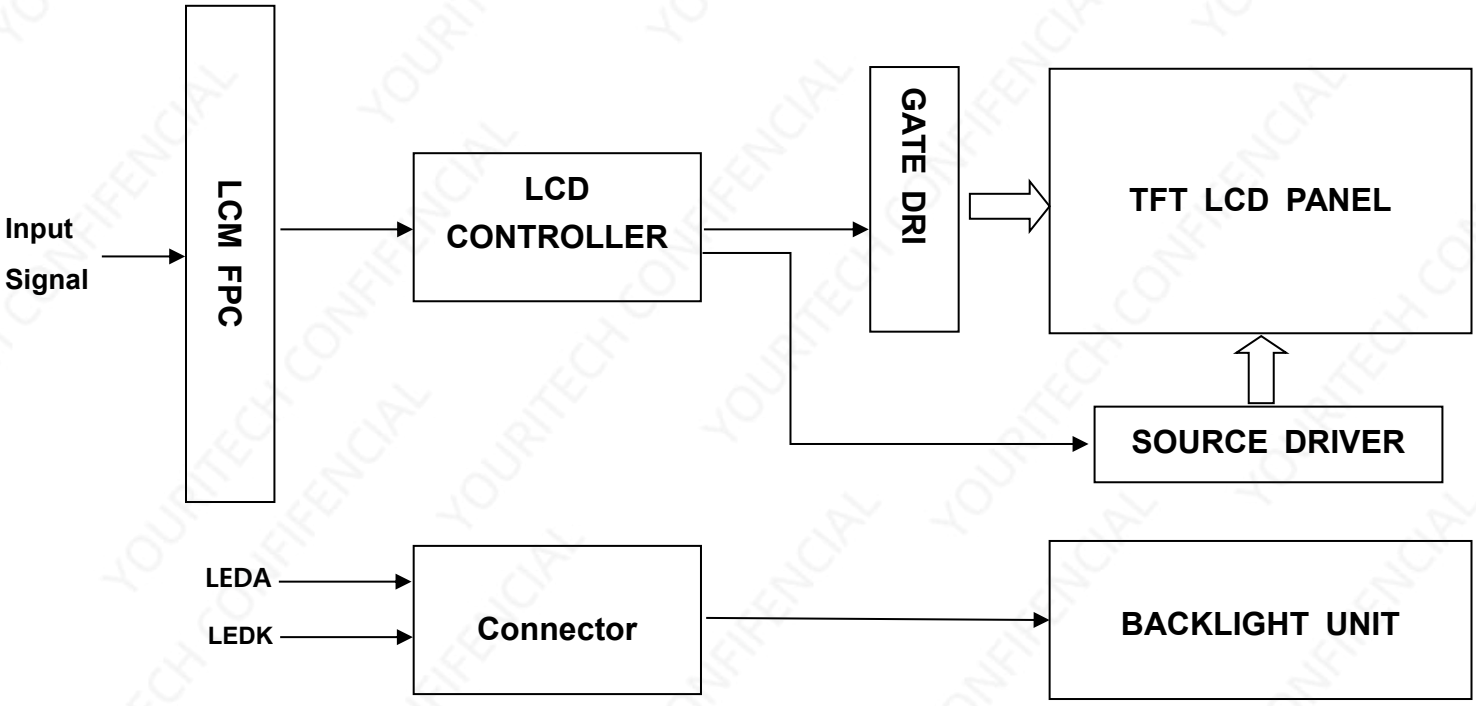
* Features

General Information Items	Specification	Unit	Note
	Main Panel		
Display area(AA)	344.16(H)* 193.59(V) (15.6 inch)	mm	
Driver element	TFT active matrix	-	
Display colors	16.2M	colors	
Number of pixels	1920(RGB)*1080	dots	
Pixel arrangement	RGB Vertical Stripe	-	
Pixel pitch	0.17925(H)* 0.17925(V)	mm	
Viewing angle	ALL	o'clock	
Display mode	Transmissive /Normally Black	-	
LCM Interface	2-Port LVDS	-	
Operating temperature	-30～+85	℃	
Storage temperature	-40～+90	℃	

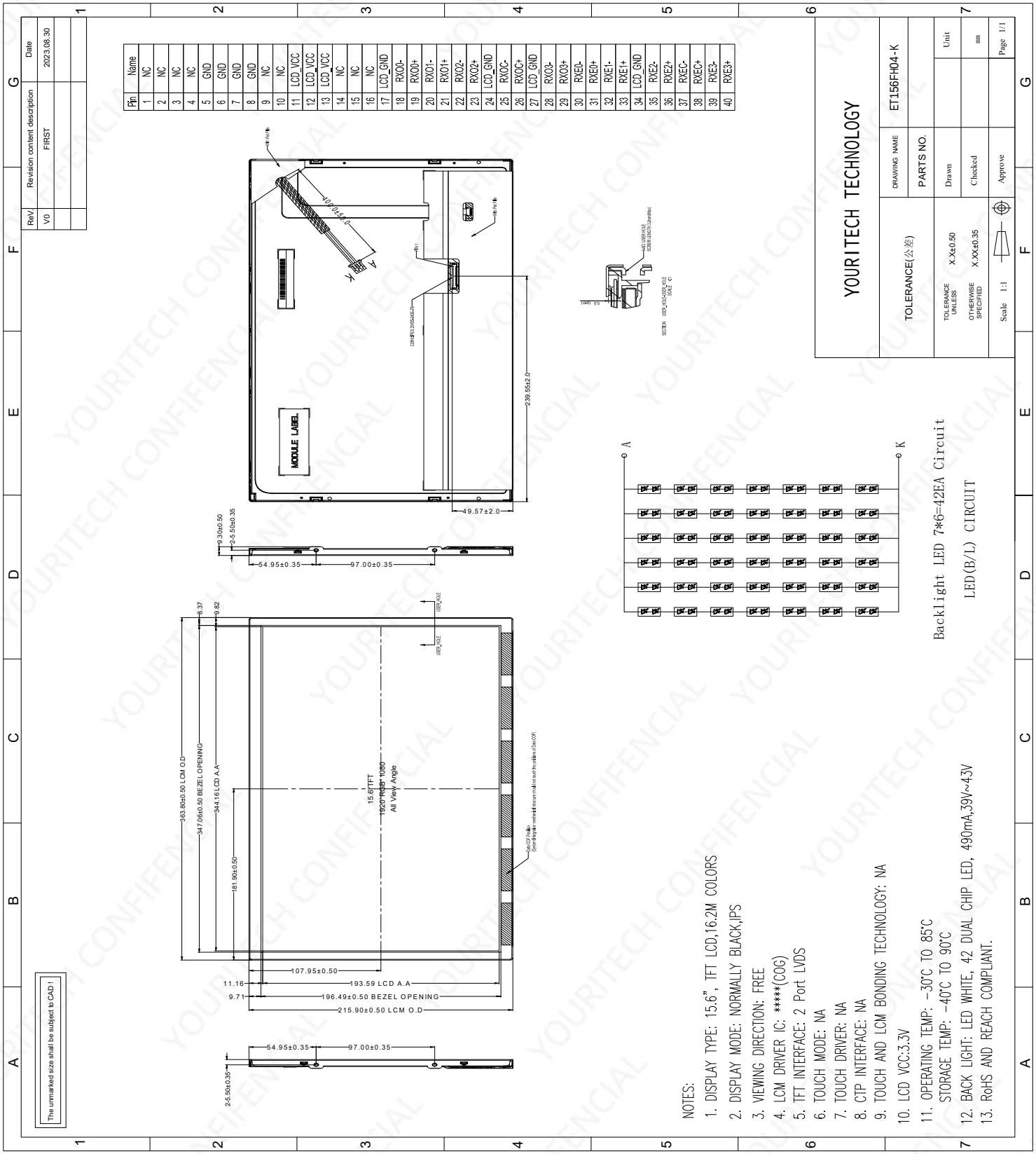
* Mechanical Information

Item		Min.	Typ.	Max.	Unit	Note
Module size	Horizontal(H)	-	363.80	-	mm	
	Vertical(V)	-	215.90	-	mm	
	Depth(D)	-	9.30	-	mm	
Weight		-	1042	-	g	

1. Block Diagram



2. Outline dimension



3. Input terminal Pin Assignment

3.1 Interface Pin Assignment

NO.	SYMBOL	DISCRIPTION	I/O
1	NC	--	--
2	NC	--	--
3	NC	--	--
4	NC	--	--
5	GND	Ground	P
6	GND	Ground	P
7	GND	Ground	P
8	GND	Ground	P
9	NC	--	--
10	NC	--	--
11	LCD_VCC	LCD Logic and driver power 3.3V	P
12	LCD_VCC	LCD Logic and driver power 3.3V	P
13	LCD_VCC	LCD Logic and driver power 3.3V	P
14	NC	--	--
15	NC	--	--
16	NC	--	--
17	LCD_GND	Ground	P
18	RxO0-	Negative LVDS differential data input (Odd data)	I
19	RxO0+	Positive LVDS differential data input (Odd data)	I
20	RxO1-	Negative LVDS differential data input (Odd data)	I
21	RxO1+	Positive LVDS differential data input (Odd data)	I
22	RxO2-	Negative LVDS differential data input (Odd data)	I
23	RxO2+	Positive LVDS differential data input (Odd data)	I

24	LCD_GND	Ground	P
25	RxOCLK-	Negative LVDS differential clock input (Odd clock)	I
26	RxOCLK+	Positive LVDS differential clock input (Odd clock)	I
27	LCD_GND	Ground	P
28	RxO3-	Negative LVDS differential data input (Odd data)	I
29	RxO3+	Positive LVDS differential data input (Odd data)	P
30	RxE0-	Negative LVDS differential data input (Even data)	I
31	RxE0+	Positive LVDS differential data input (Even data)	P
32	RxE1-	Negative LVDS differential data input (Even data)	I
33	RxE1+	Positive LVDS differential data input (Even data)	I
34	LCD_GND	Ground	P
35	RxE2-	Negative LVDS differential data input (Even data)	P
36	RxE2+	Positive LVDS differential data input (Even data)	I
37	RxECLK-	Negative LVDS differential clock input (Even clock)	P
38	RxECLK+	Positive LVDS differential clock input (Even clock)	I
39	RxE3-	Negative LVDS differential data input (Even data)	P
40	RxE3+	Positive LVDS differential data input (Even data)	I

3.2 BL Pin Assignment

2-pin connector is used for input power & control signals for BL converter power IC

NO.	SYMBOL	DISCRIPTION	I/O
1	LEDA	LED power supply	P
2	LEDK	LED current sense for string	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	900	1100	--		(1)(2)
Response time	Rising	$T_{R+}T_F$		--	25	35	msec	(1)(3)
	Falling							
Color Gamut		S(%)		--	64.59	--	%	
Color Filter Chromacicity	White	W_X		-0.03	0.2908	+0.03		(1)(4) CA-310
		W_Y			0.3235			
	Red	R_X			0.6385			
		R_Y			0.3487			
	Green	G_X			0.3115			
		G_Y			0.5730			
	Blue	B_X			0.1453			
		B_Y			0.0620			
Viewing angle	Hor.	ΘL	CR>10	80	85	--		(1)(4)
		ΘR		80	85	--		
	Ver.	ΘU		80	85	--		
		ΘD		80	85	--		
Option View Direction		ALL						

*The data comes from the LCD specification.

Measuring Condition

Measuring surrounding : dark room

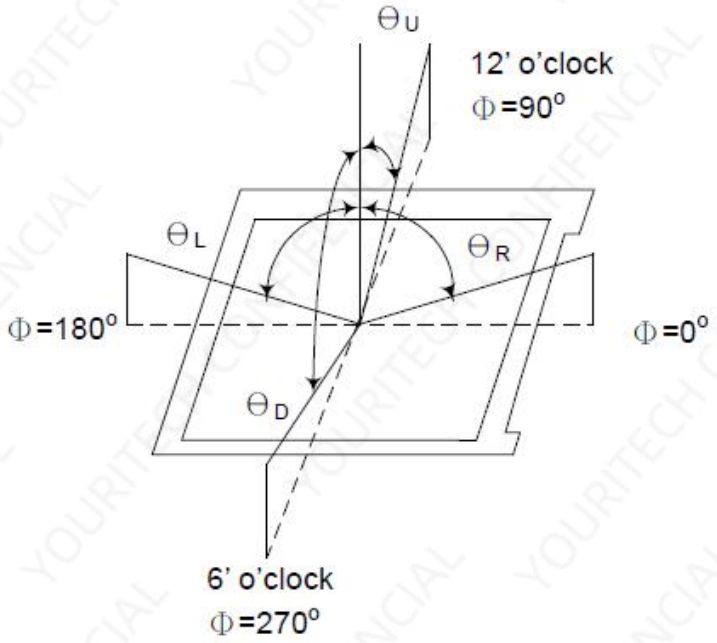
Ambient temperature : 25±2oC

15min. warm-up time.

Measuring Equipment

FPM520 , which utilized SR-3 for Chromaticity and BM-5A for other optical characteristics.

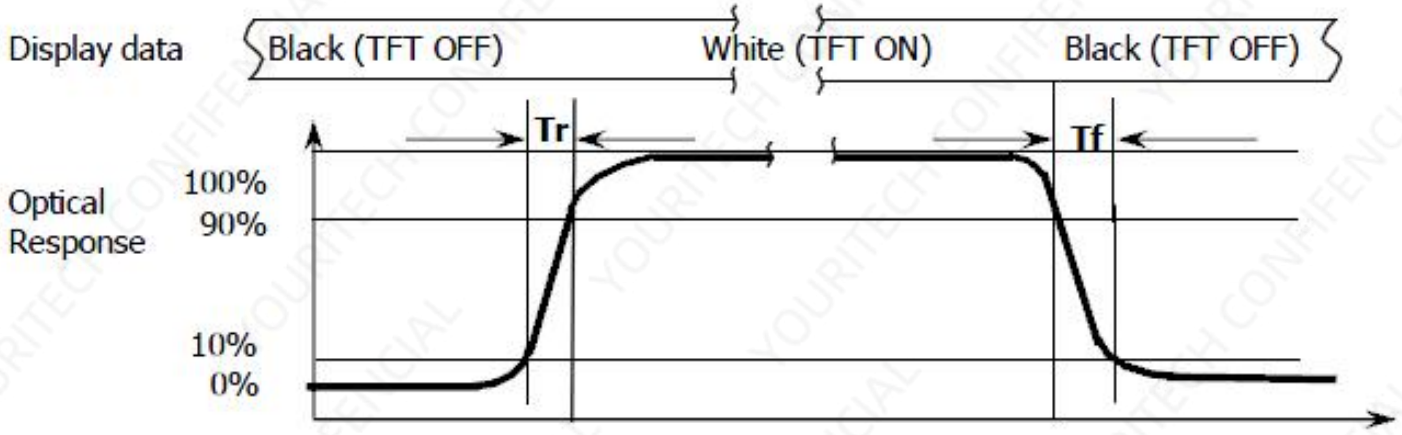
Note (1): Definition of Viewing Angle :



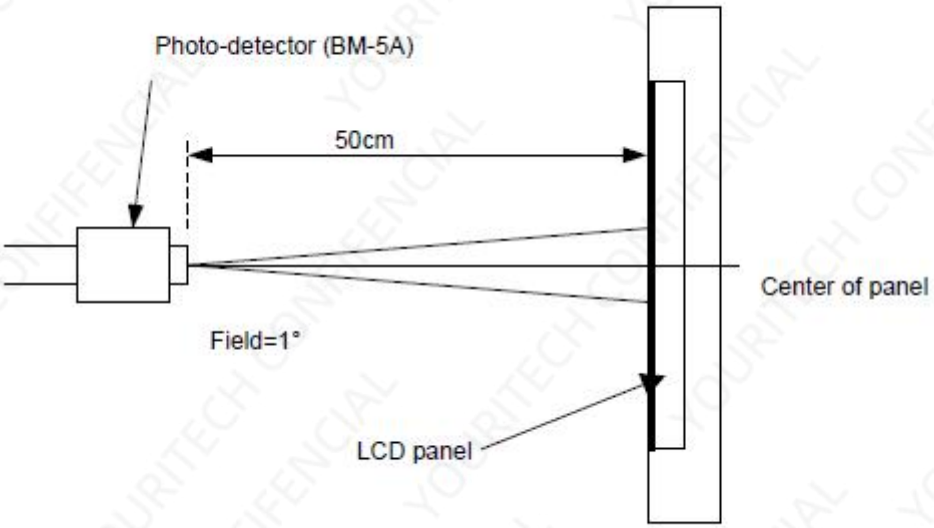
Note (2): Definition of Contrast Ratio(CR) :measured at the center point of panel

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

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	LCD_VCC	-0.3	3.6	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	LCD_VCC	3.0	3.3	3.6	V	
Normal mode Current	IDD	--	240	480	mA	
Level input voltage	V_{IH}	0.7VCC			VCC	
	V_{IL}	GND		0.3VCC	V	
Level output voltage	V_{OH}	VCC-0.4		--	V	
	V_{OL}	GND		GND+0.4	V	

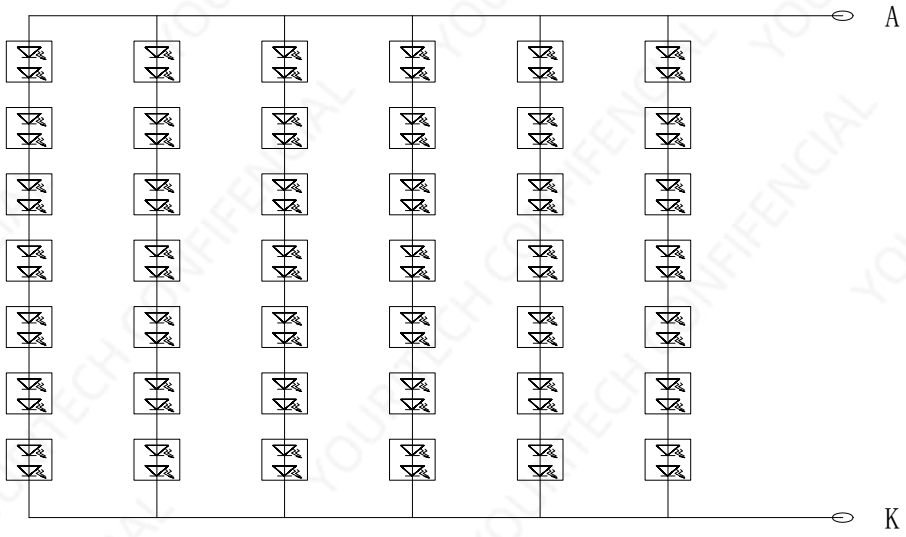
5.3 LED Backlight Characteristics

The back-light system is edge-lighting type with 42 Dual chips LED

Item	Symbol	Min.	Typ.	Max.	Unit	Note
Forward Current	I_F	--	490	--	mA	
Forward Voltage	V_F	39	39.2	43	V	
LCM Luminance	LV	1200	1300	--	cd/m2	IF=490mA
LED life time	Hr	20000	30000	--	Hour	Note1,2
Uniformity	Avg	75	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%.

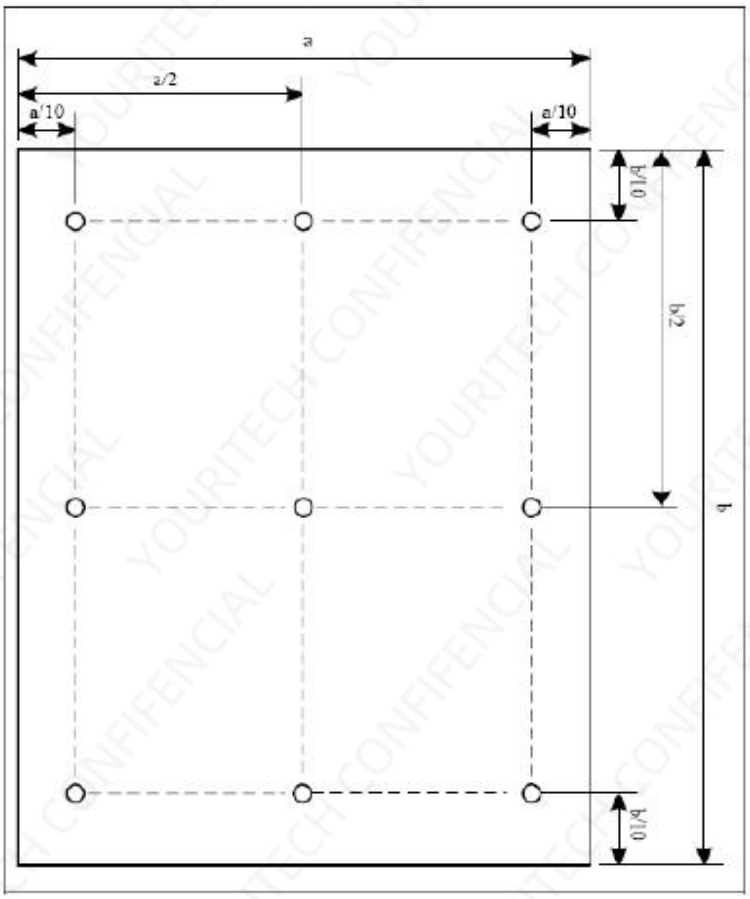
Note 2: The “LED life time” is defined as the module brightness decrease to 50% original brightness at Ta=25℃ and IL=490mA. The LED lifetime could be decreased if operating IL is larger than 490mA. The constant current driving method is suggested.



Backlight LED 7*6=42EA Circuit

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. LVDS Input Signal Specifications

6.1 LVDS Data Mapping Table

LVDS Channel O0	LVDS output	D7	D6	D4	D3	D2	D1	D0
	Data order	OG0	OR5	OR4	OR3	OR2	OR1	OR0
LVDS Channel O1	LVDS output	D18	D15	D14	D13	D12	D9	D8
	Data order	OB1	OB0	OG5	OG4	OG3	OG2	OG1
LVDS Channel O2	LVDS output	D26	D25	D24	D22	D21	D20	D19
	Data order	DE	NA	NA	OB5	OB4	OB3	OB2
LVDS Channel O3	LVDS output	D23	D17	D16	D11	D10	D5	D27
	Data order	NA	OB7	OB6	OG7	OG6	OR7	OR6
LVDS Channel E0	LVDS output	D7	D6	D4	D3	D2	D1	D0
	Data order	EG0	ER5	ER4	ER3	ER2	ER1	ER0
LVDS Channel E1	LVDS output	D18	D15	D14	D13	D12	D9	D8
	Data order	EB1	EB0	EG5	EG4	EG3	EG2	EG1
LVDS Channel E2	LVDS output	D26	D25	D24	D22	D21	D20	D19
	Data order	DE	NA	NA	EB5	EB4	EB3	EB2
LVDS Channel E3	LVDS output	D23	D17	D16	D11	D10	D5	D27
	Data order	NA	EB7	EB6	EG7	EG6	ER7	ER6

6.2 Display Timing Specifications

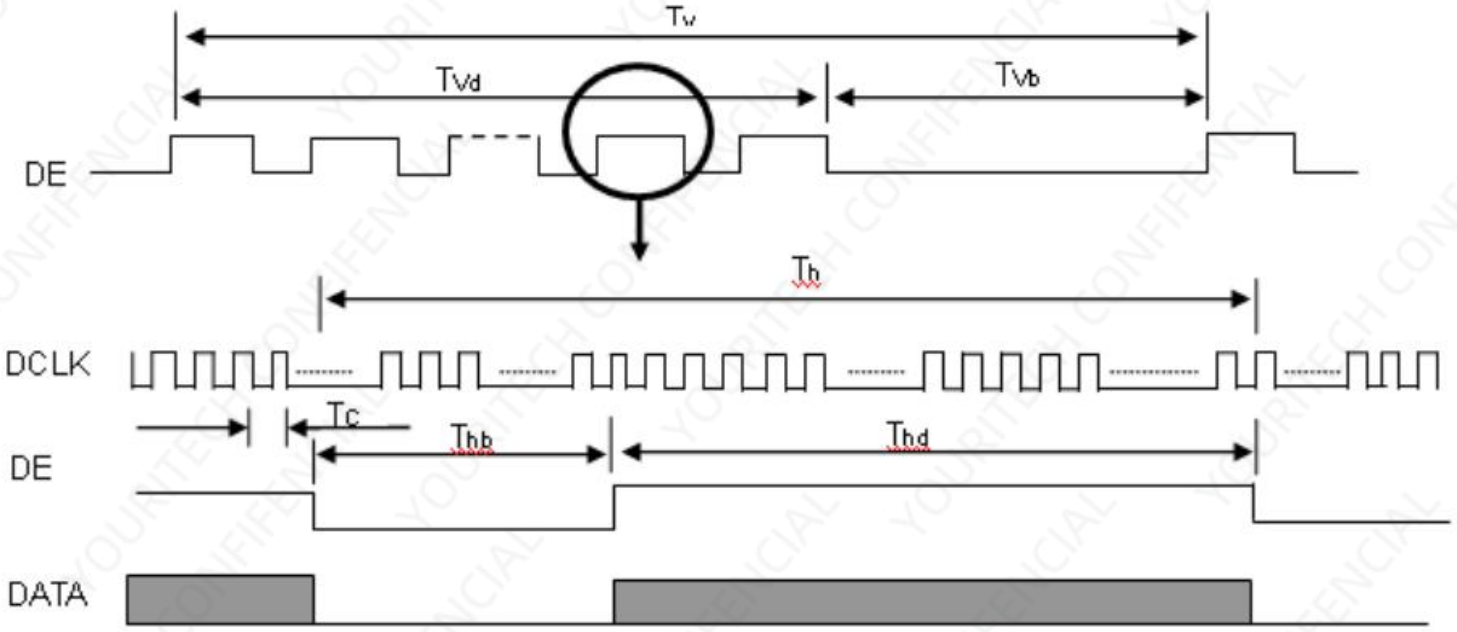
The input signal timing specifications are shown as the following table and timing diagram.

Signal	Item	Symbol	Min.	Typ.	Max.	Unit	Note
LVDS Clock	Frequency	Fc	(60)	70.93	(75)	MHz	-
	Period	Tc		14.1		ns	
	Input cycle to cycle jitter	T_{rcl}	-0.02*Tc		0.02*Tc	ns	(3)
	Input clock to data skew	TLVCCS	-0.02*Tc		0.02*Tc	ns	(4)
	Spread spectrum modulation range	Fclkin_mod	FC*98%		FC*102%	MHz	(5)
	Spread spectrum modulation frequency	F_{SSM}			200	KHz	
Vertical Display Term	Frame Rate	Fr	(50)	60	60	Hz	Tv=Tvd+Tvb
	Total	Tv	(1090)	1110	(1130)	Th	-
	Active Display	Tvd	1080	1080	1080	Th	-
	Blank	Tvb	Tv-Tvd	30	Tv-Tvd	Th	-
Horizontal Display Term	Total	Th	(1050)	1065	(1075)	Tc	Th=Thd+Thb
	Active Display	Thd	960	960	960	Tc	-
	Blank	Thb	Th-Thd	105	Th-Thd	Tc	-

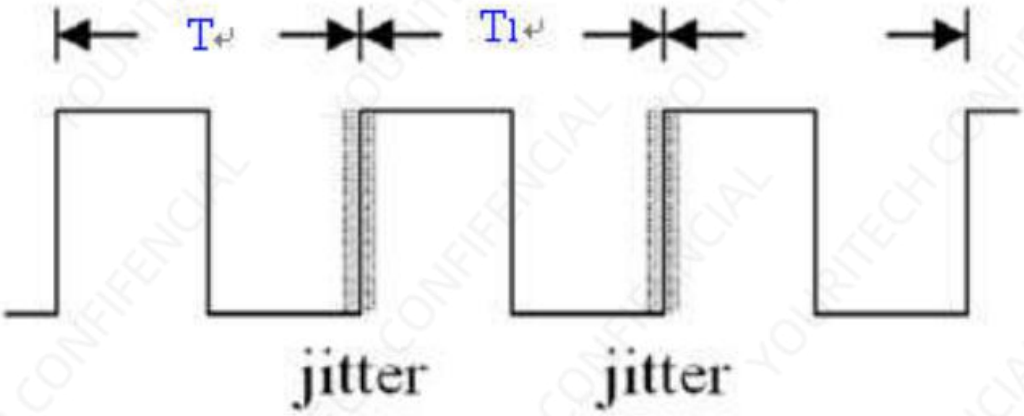
Note (1) Because this module is operated by DE only mode, Hsync and Vsync input signals are ignored.

Note (2) The Tv(Tvd+Tvb) must be integer, otherwise, this module would operate abnormally.

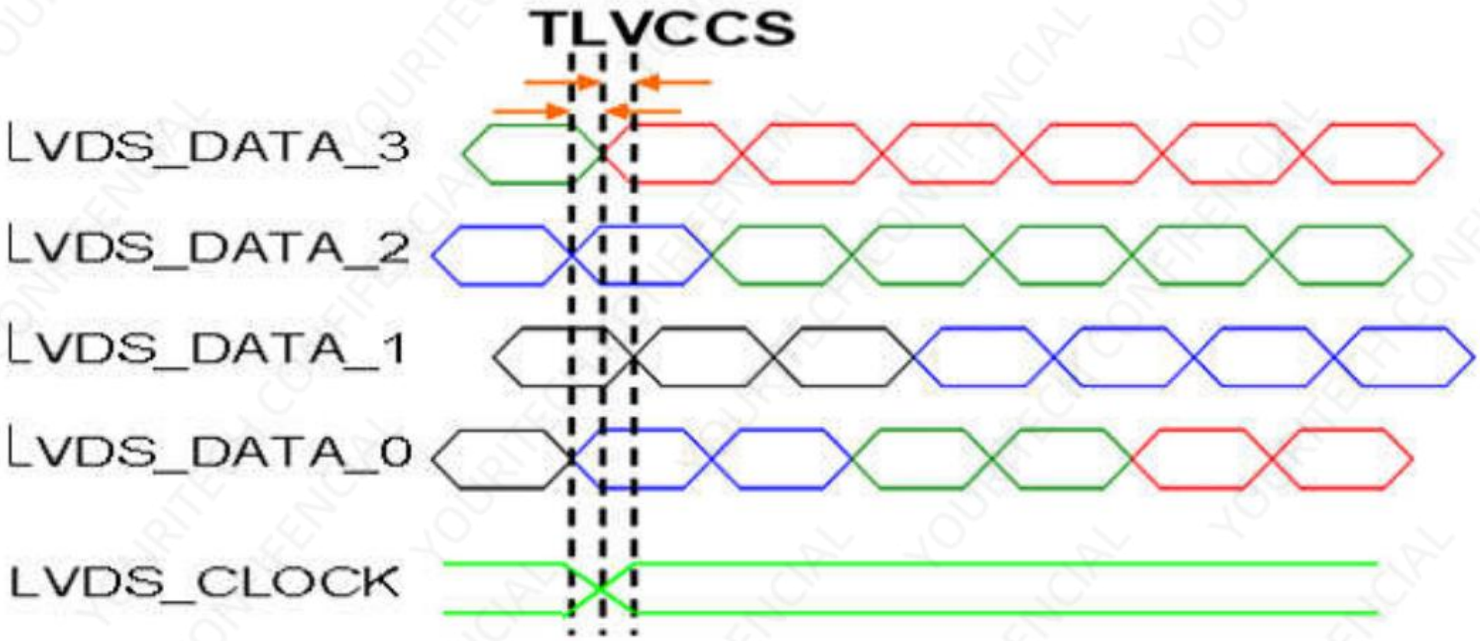
INPUT SIGNAL TIMING DIAGRAM



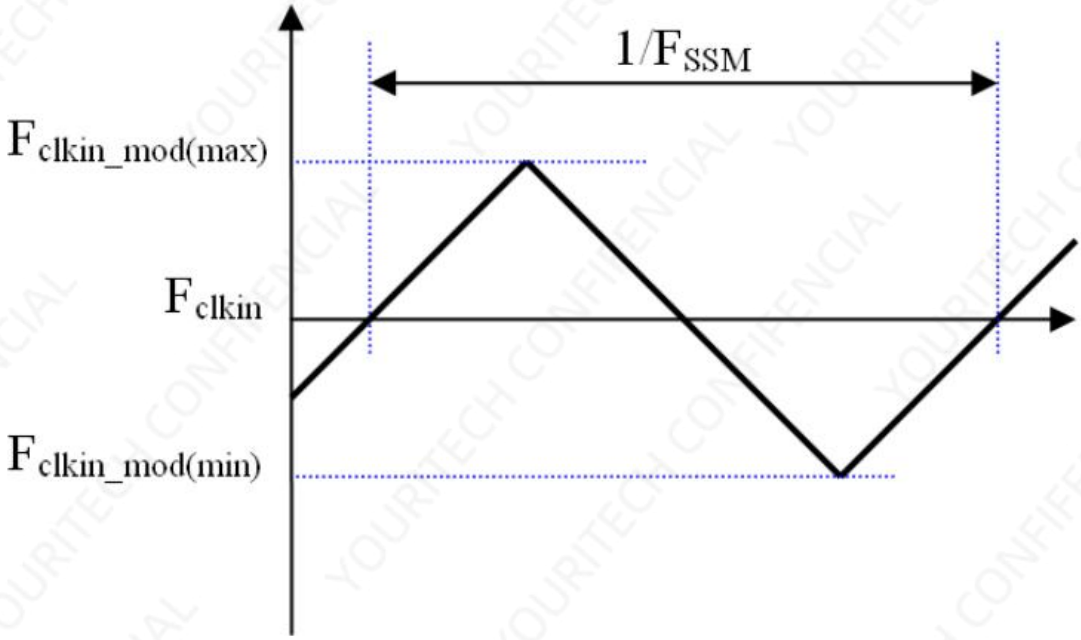
Note (3) The input clock cycle-to-cycle jitter is defined as below figures. Trcl = I T_1 – TI



Note (4) Input Clock to data skew is defined as below figures.

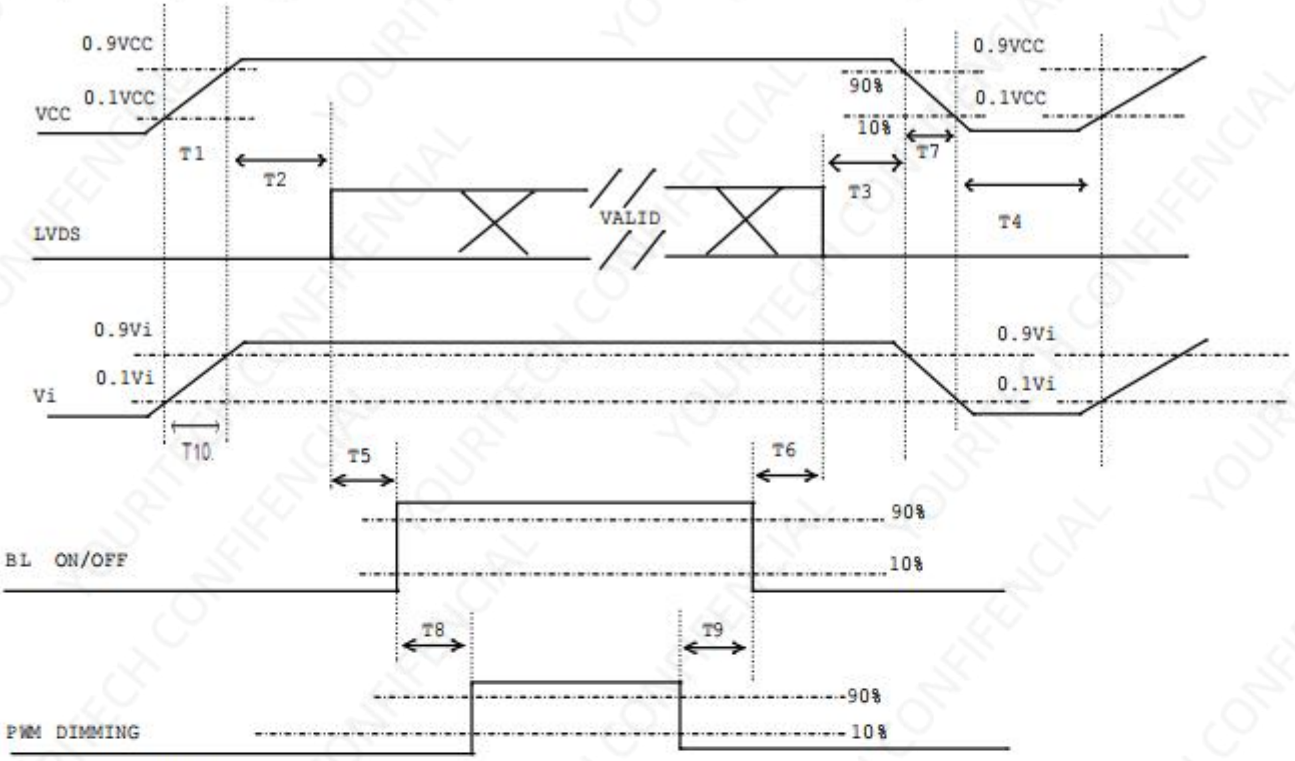


Note (5) The SSCG (Spread spectrum clock generator) is defined as below figures.



6.3 Power ON/OFF Sequence

The power sequence specifications are shown as the following table and diagram.



Timing Specifications:

Parameter	Value			Units
	Min	Typ	Max	
T1	0.5	-	10	ms
T2	0	-	50	ms
T3	0	-	50	ms
T4	500	-	-	ms
T5	200	-	-	ms
T6	20	-	-	ms
T7	5	-	300	ms
T8	10	-	-	ms
T9	10	-	-	ms
T10	20	--	--	ms

Note (1) Please avoid floating state of interface signal at invalid period.

Note (2) When the interface signal is invalid, be sure to pull down the power supply of LCD VCC to 0 V.

Note (3) The Backlight converter power must be turned on after the power supply for the logic and the interface signal is valid. The Backlight converter power must be turned off before the power supply for the logic and the interface signal is invalid.

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.

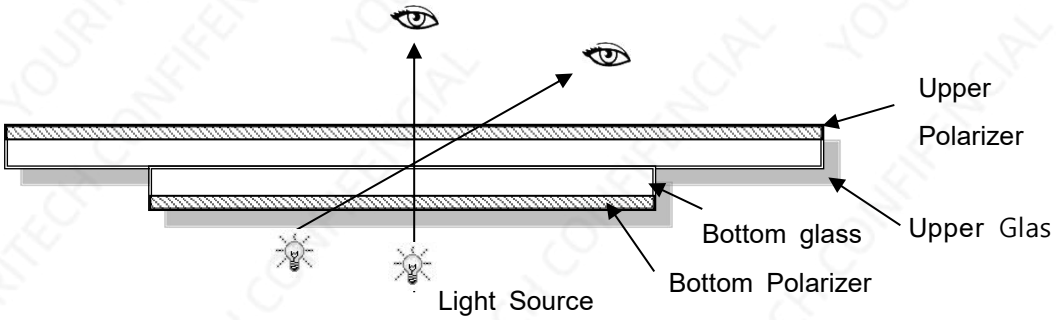
Temperature : 25±5℃

Humidity : 65%±10%RH

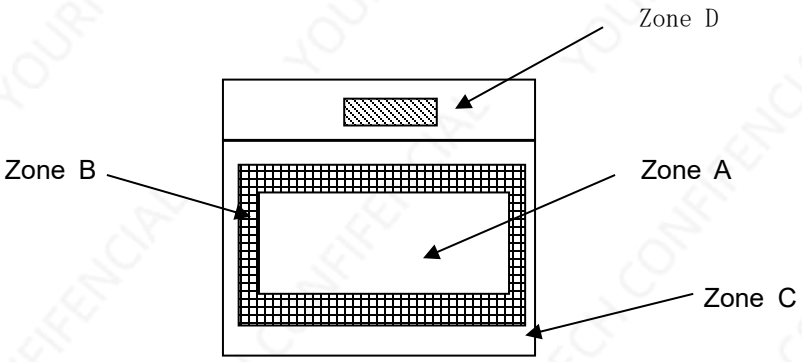
Viewing Angle : Normal viewing Angle.

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

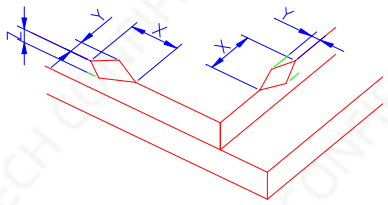
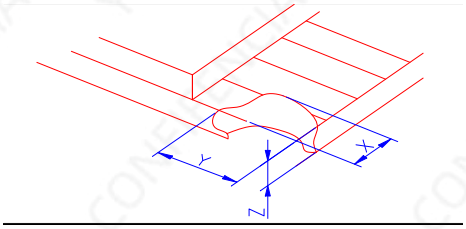
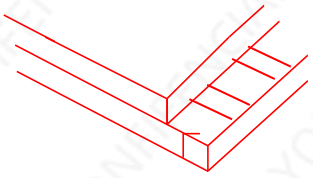
LCD: Liquid Crystal Display , LCM: Liquid Crystal Module

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.

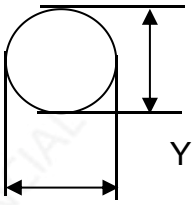
b) Dim dot: Dots appear dark and unchanged in size in which LCD panel is displaying under pure red, green, blue picture.

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:

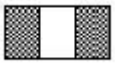
A) Bright dot：Dots appear bright and unchanged in size in which LCD panel is displaying under black pattern.

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

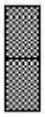
C) 2 dot adjacent = 1 pair = 2 dots

Picture:

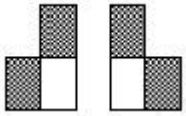
2 dot adjacent



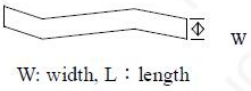
2 dot adjacent



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)
 

W: width, L：length
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)	-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.