SPECIFICATION
FOR
LCM Module

MODULE No:	KD058HDFLA001
CUSTOMER:	

STARTEK	INITIAL	DATE
PREPARED BY	*FIRST*	2020.06.30
CHECKED BY		
APPROVED BY		

CUSTOMER	INITIAL	DATE
APPROVED BY		

Revision History

Date	Rev. No.	Page	Summary
2020.06.30	V1.0	ALL	FIRST ISSUE
2021.01.20	V1.1	6	Outline dimension

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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 5.8 " TFT-LCD contains 1280X768 pixels, and can display up to 16.7M colors.

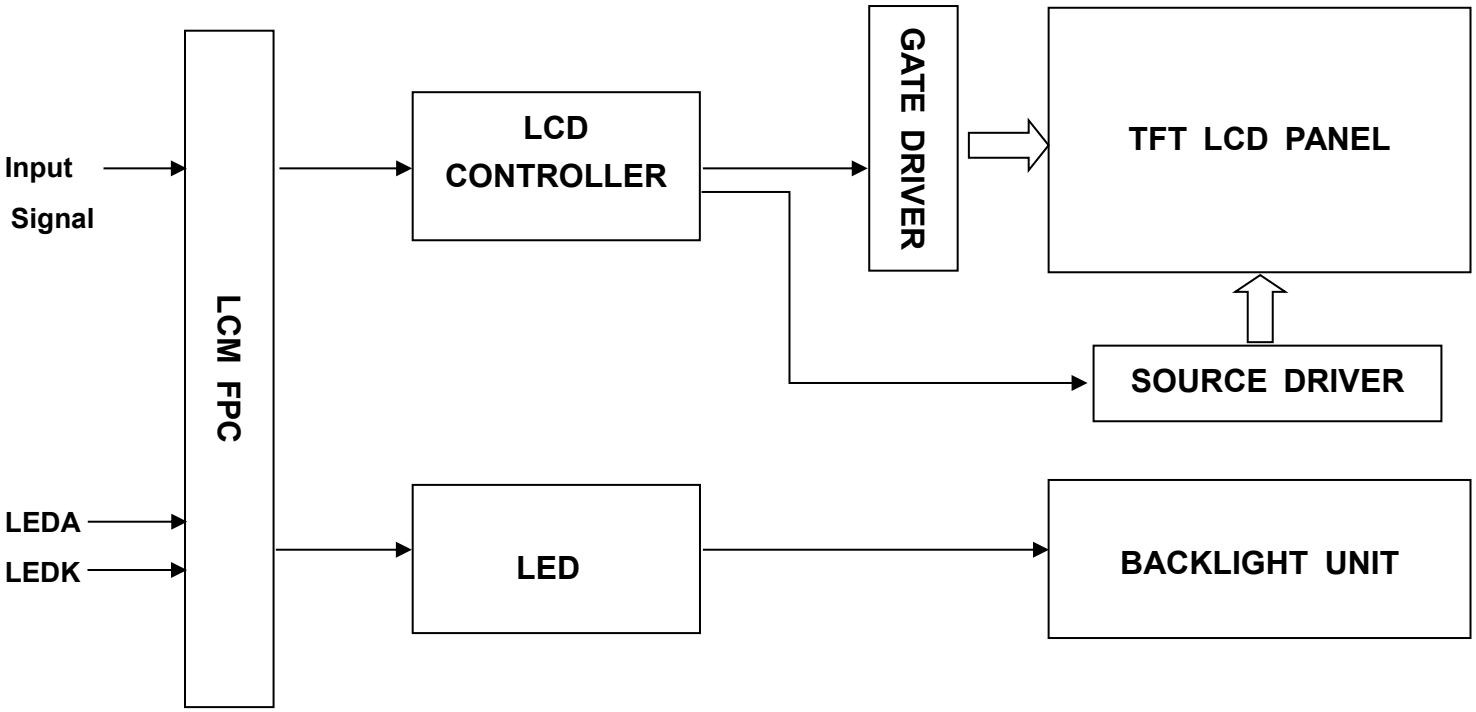
* Features

General Information Items	Specification	Unit	Note
	Main Panel		
Display area(AA)	126.72(H)*74.88(V) (5.8 inch)	mm	
Driver element	TFT active matrix	-	
Display colors	16.7M	colors	
Number of pixels	1280(RGB)*768	dots	
Pixel arrangement	RGB vertical stripe	-	
Pixel pitch	0.0990(H)*0.0975(V)	mm	
Viewing angle	ALL	o'clock	
Display mode	Transmissive/Normally Black	-	
D-IC	HX8286*3 HX8695*1		
LCM Interface	MINI LVDS	-	
Operating temperature	-20～+70	℃	
Storage temperature	-30～+80	℃	

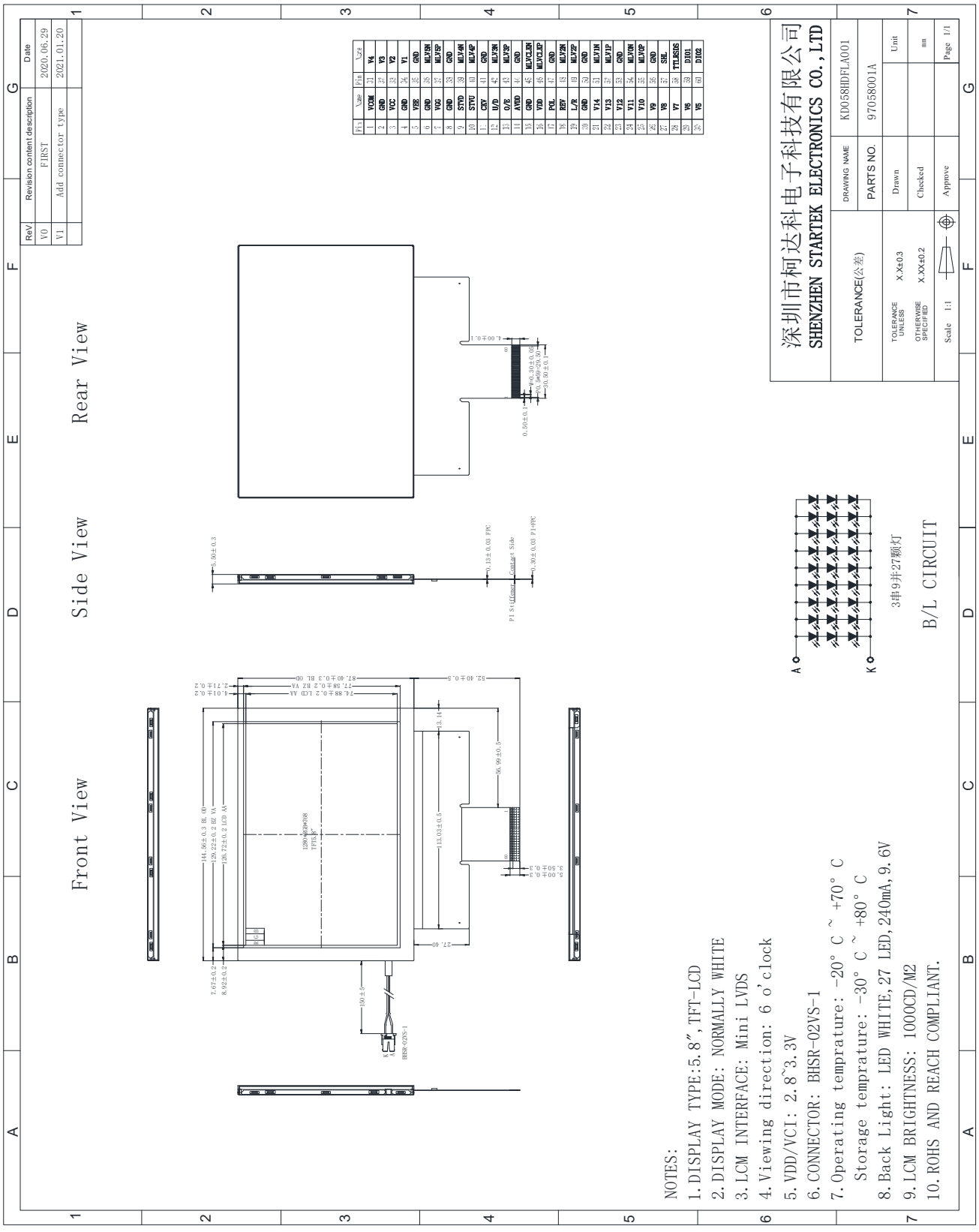
* Mechanical Information

Item		Min.	Typ.	Max.	Unit	Note
Module size	Horizontal(H)	-	144.56	-	mm	
	Vertical(V)	-	87.40	-	mm	
	Depth(D)	-	5.50	-	mm	
Weight		-	TBD	-	g	

1. Block Diagram



2. Outline dimension



3. Input terminal Pin Assignment

NOTE: 1. Connector Model Number: BHSR-02VS-1

2.Manufacturer: Hirose

NO.	SYMBOL	DISCRIPTION	I/O
1	VCOM	Common Voltage (3.8V可调)	P
2	GND	Ground.	P
3	VCC	Power supply	P
4	GND	Ground.	P
5	VEE/VGL	Low voltage level for gate control signals and gate circui	P
6	GND	Ground.	P
7	VGG/VGH	High voltage level for gate control signals and gate circui	P
8	GND	Ground.	P
9	STVD	Vertical shift pulse signal input or output	I
10	STVU	Vertical shift pulse signal input or output	I
11	CKV	Vertical shift clock	I
12	U/D	Up/down selection	I
13	O/E	Otuput enable	I
14	AVDD	Power supply	P
15	GND	Ground.	P
16	VDD	Voltage for digital circuit	I
17	POL	Polarity selection	
18	REV	Data invert control	
19	L/R	Load output signal	I
20	GND	Ground.	P
21	V14	Gamma voltage	
22	V13	Gamma voltage	

23	V12	Gamma voltage	
24	V11	Gamma voltage	
25	V10	Gamma voltage	
26	V9	Gamma voltage	
27	V8	Gamma voltage	
28	V7	Gamma voltage	
29	V6	Gamma voltage	
30	V5	Gamma voltage	
31	V4	Gamma voltage	
32	V3	Gamma voltage	
33	V2	Gamma voltage	
34	V1	Gamma voltage	
35	GND	Ground.	P
36	MLV5N	Mini-LVDS data input	I
37	MLV5P	Mini-LVDS data input	I
38	GND	Ground.	P
39	MLV4N	Mini-LVDS data input	I
40	MLV4P	Mini-LVDS data input	I
41	GND	Ground.	P
42	MLV3N	Mini-LVDS data input	I
43	MLV3P	Mini-LVDS data input	I
44	GND	Ground.	P
45	MLVCLKN	Mini-LVDS data input	I
46	MLVCLKP	Mini-LVDS data input	I
47	GND	Ground.	P
48	MLV2N	Mini-LVDS data input	I
49	MLV2P	Mini-LVDS data input	I

50	GND	Ground.	P
51	MLV1N	Mini-LVDS data input	I
52	MLV1P	Mini-LVDS data input	I
53	GND	Ground.	P
54	MLV0N	Mini-LVDS data input	I
55	MLV0P	Mini-LVDS data input	I
56	GND	Ground.	P
57	SHL	Left/right selection	I
58	TTLRSDS	Mini-LVDS 3/6 pair input mode	I
59	DI01	Horizontal start pulse signal input or output	I
60	DI02	Horizontal start pulse signal input or output	I

Note1

1	VCOM=3.8V(typical)可调
2	VGG:18~22V
3	VEE:-8~-11V
4	The Pin Assignments is calculated by IC-driver(HX8286*3 HX8695*1),it maybe changed if customer use other IC.

4. LCD Optical Characteristics

4.1 Optical specification

Item		Symbol	Condition	Min.	Typ.	Max.	Unit.	Note
Contrast Ratio		CR	Θ=0 Normal viewing angle	350	500	--		(1)(2)
Response time	Rising	$T_{R+}T_F$		--	40	--	msec	(1)(3)
	Falling							
Color Gamut		S(%)		--	27	--	%	C-light
Color Filter Chromacicity	White	W_X		-0.02	0.297	+0.02		(1)(4) CF glass
		W_Y			0.324			
	Red	R_X			0.594			
		R_Y			0.301			
	Green	G_X			0.305			
		G_Y			0.495			
	Blue	B_X			0.160			
		B_Y			0.297			
Viewing angle	Hor.	ΘL	CR>10	--	45	--		(1)(4)
		ΘR		--	45	--		
	Ver.	ΘU		--	20	--		
		ΘD		--	50	--		
Option View Direction		ALL						

*The data comes from the LCD specification.

Measuring Condition

Measuring surrounding : dark room

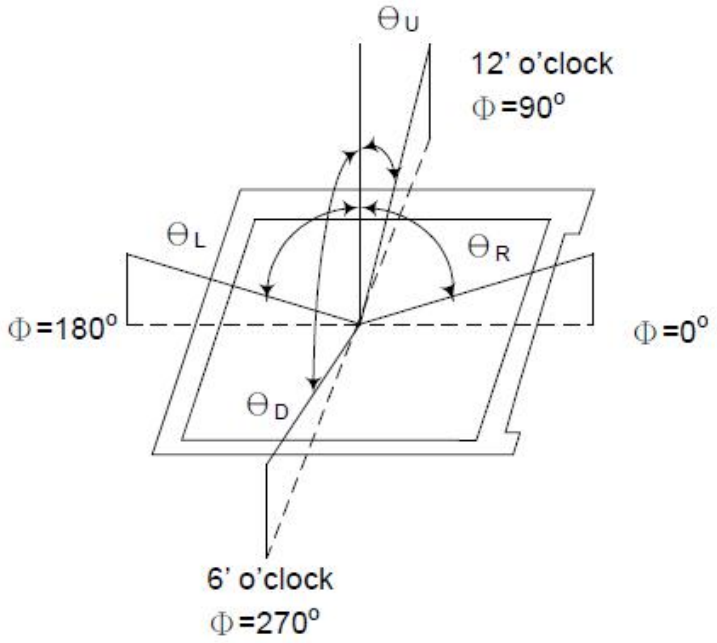
Ambient temperature : 25±2oC

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.

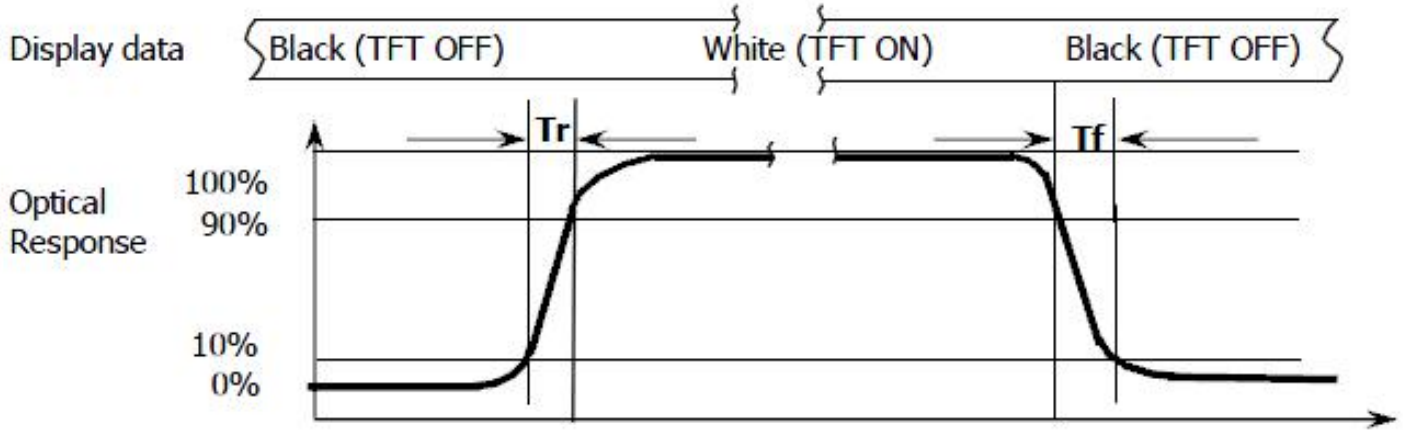
Note (1): Definition of Viewing Angle :



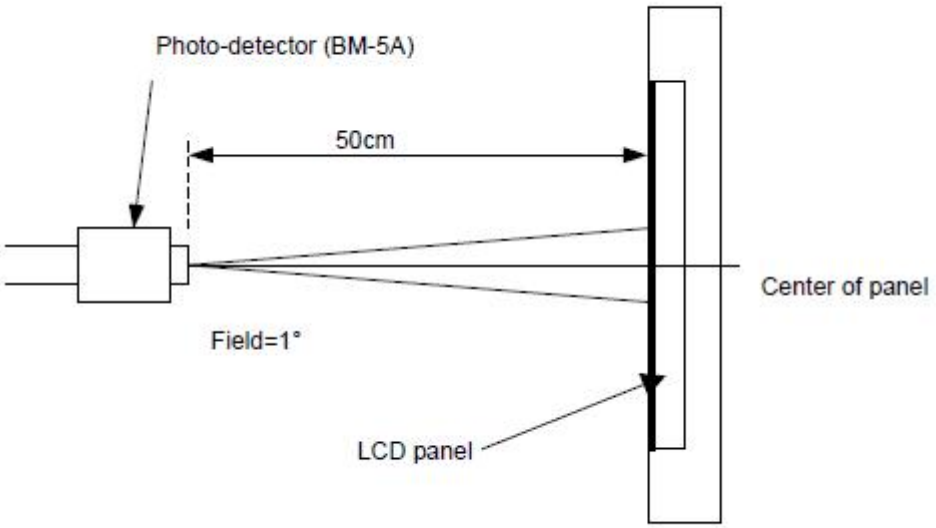
Note (2): Definition of Contrast Ratio(CR) :measured at the center point of panel

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

Note (3): Response Time



Note (4): Definition of optical measurement setup



5. Electrical Characteristics

5.1 Absolute Maximum Rating

The followings are maximum values which, if exceed, may cause faulty operation or damage to the unit. Make sure all the design characteristics are adequate before the panel is initialed. All the measurements should be operated with driver IC and FPC mounted.

Parameter	Symbol	Min	Max	Unit	Remark
LC Operating Voltage *1)	V_{op}	TBD	TBD	V	Ta= 25℃
Operating Temperature	T_{OP}	-20	+70	℃	
Storage Temperature	T_{ST}	-30	+80	℃	
Operating Ambient Humidity *2)	Hop	10	*3)	%RH	*3)
Storage Humidity	Hst	10	*3)	%RH	*3)

Note: **[VSS = GND = 0V]**

1. Liquid Crystal driving voltage: Due to the characteristics of LC Material, this voltage varies with environmental temperature
2. Temp≤60℃ 90% RH MAX
3. Non-condensation

5.2 DC Electrical Characteristics

GND=0V, VDD=3.3V, Ta = 25℃

Item		Symbol	MIN	TYP	MAX	Uni	Remar
Logic Supply Voltage		VDD	2.3	3.3	3.6	tV	k
Input Signal Voltage	High Level	VIH	0.7*VDD	-	VDD	V	
	Low Level	VIL	0	-	0.3*VDD	V	
Output Signal Voltage	High Level	VOH	VDD-0.4	-	VDD	V	
	Low Level	VOL	0	-	0.4	V	
Mini-LVDS	High Level	VIHLVDS	200	-	400	mV	
	Low Level	VILLVDS	-200	-	400	mV	
	Com Level	VCMLVDS	GND+0.8	1.2	VDD-1.5	V	
Logic Supply Voltage		AVDD	(10.7)	(10.9)	(11.1)	V	
		VGH	(19.0)	(20.0)	(21.0)	V	
		VGL	(-6.5)	(-7.0)	(-7.5)	V	
		Vcom	(3.4)	(3.92)	(4.8)	V	
Power Consumption		Black Mode	-	TBD	-	m W	

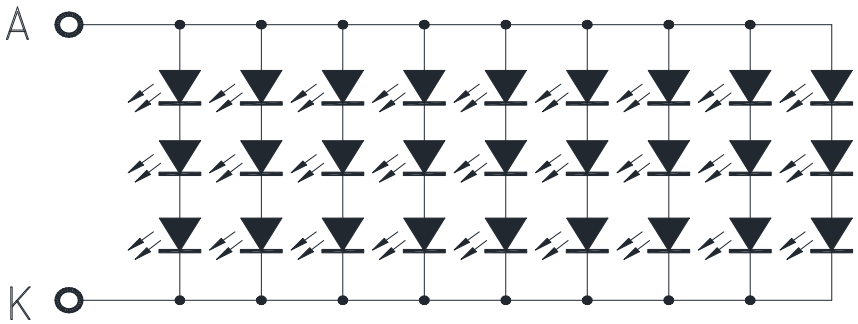
5.3 LED Backlight Characteristics

The back-light system is edge-lighting type with 27 chips LED

Item	Symbol	Min.	Typ.	Max.	Unit	Note
Forward Current	I_F	--	240	--	mA	
Forward Voltage	V_F	--	9.6	--	V	
LCM Luminance	LV	--	900	--	cd/m2	Note3
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%.

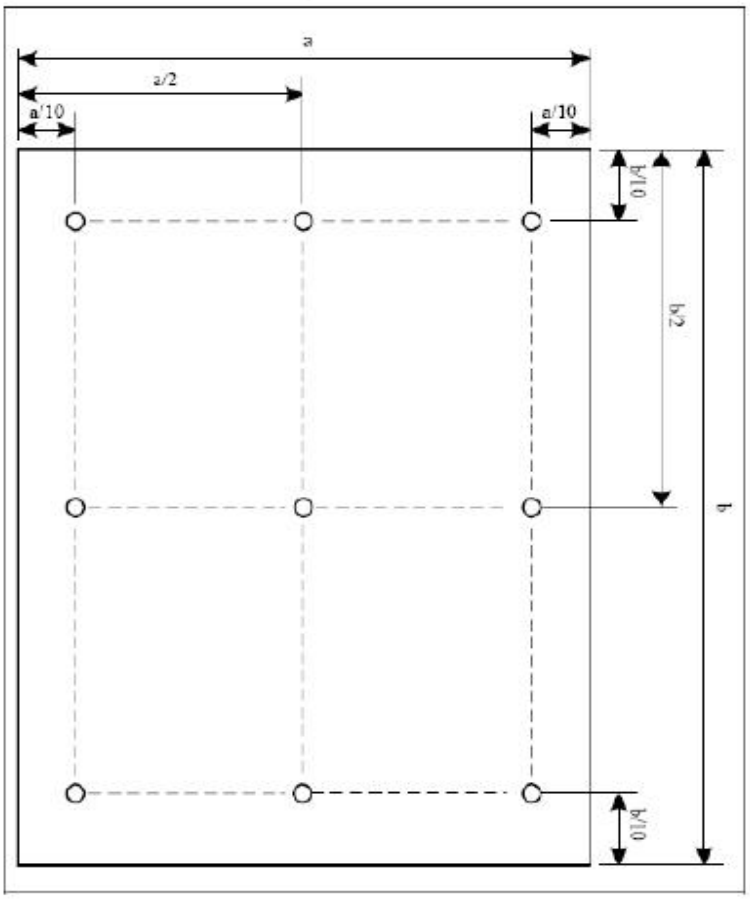
Note 2: The “LED life time” is defined as the module brightness decrease to 50% original brightness at Ta=25℃ and IL=240mA. The LED lifetime could be decreased if operating IL is larger than 240mA. The constant current driving method is suggested.



3串9并27颗灯

B/L CIRCUIT

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



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

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

5.4 Operating Principle & Methods

5.4.1 AC Electrical Characteristics

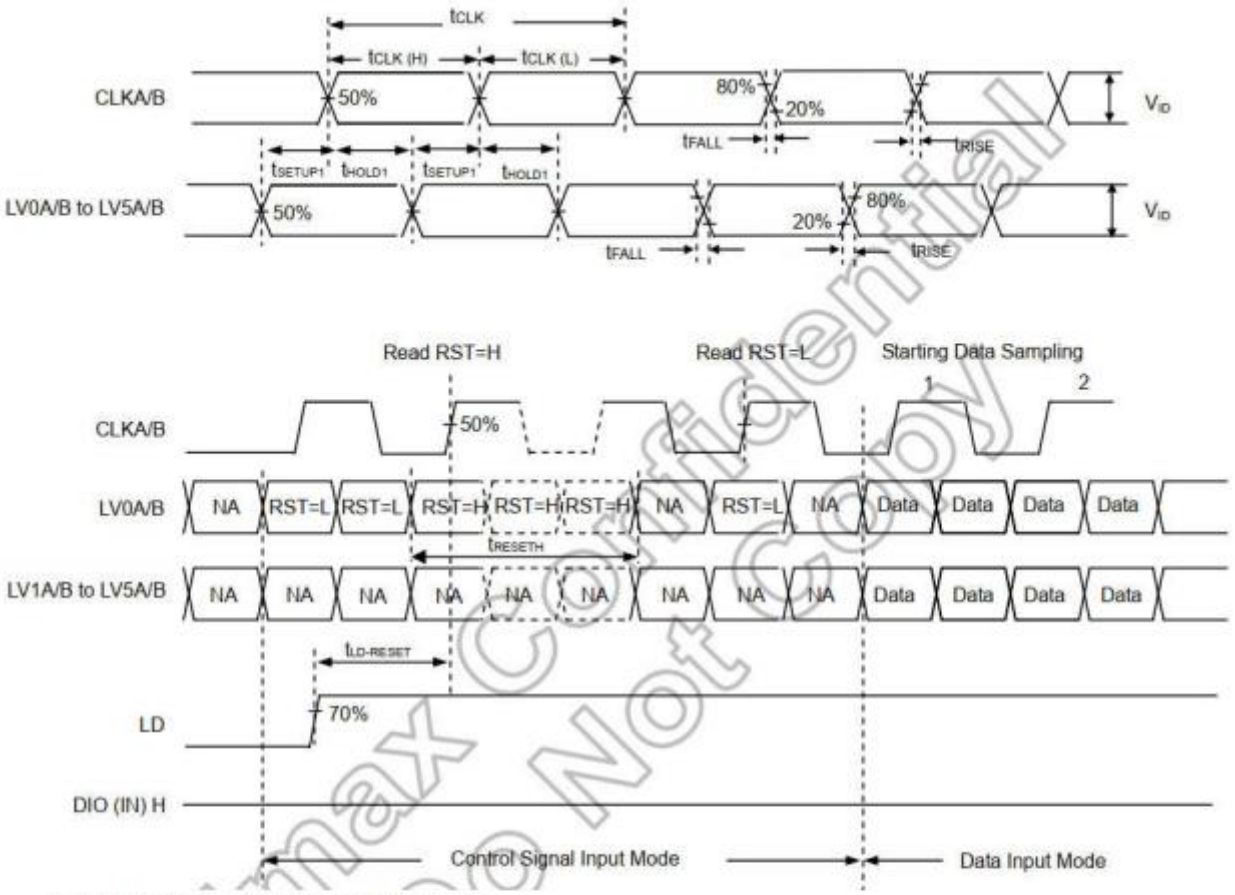
(For mini-LVDS input mode)

Parameter	Symbol	Spec			Unit	Condition
		Min.	Typ.	Max.		
Clock period	t_{CLK}	4.8	-	-	ns	2.3≤VCC<2.7V
		4(1)	-	-	ns	2.7≤VCC≤3.6V
Clock low pulse width	$t_{CLK(L)}$	1.9	-	-	ns	2.3≤VCC<2.7V
		1.6	-	-	ns	2.7≤VCC≤3.6V
Clock high pulse width	$t_{CLK(H)}$	1.9	-	-	ns	2.3≤VCC<2.7V
		1.6	-	-	ns	2.7≤VCC≤3.6V
Data setup time	t_{SETUP1}	1.1	-	-	ns	2.3≤VCC<2.7V
		0.7	-	-	ns	2.7≤VCC≤3.6V
Data hold time	t_{HOLD1}	1.1	-	-	ns	2.3≤VCC<2.7V
		0.7	-	-	ns	2.7≤VCC≤3.6V
CLK,LV[5:0] rising time	t_{RISE}	-	-	0.48	ns	2.3≤VCC<2.7V
		-	-	0.4	ns	2.7≤VCC≤3.6V
CLK,LV[5:0] falling time	t_{FALL}	-	-	0.48	ns	2.3≤VCC<2.7V
		-	-	0.4	ns	2.7≤VCC≤3.6V
Start pulse delay time	t_{PLH1}	-	-	13	ns	2.3≤VCC<2.7V Loading=15pF
		-	-	11	ns	2.7≤VCC≤3.6V Loading=15pF
	t_{PHL1}	-	-	13	ns	2.3≤VCC<2.7V Loading=15pF
		-	-	11	-	2.7≤VCC≤3.6V Loading=15pF
Reset(RST) high period	t_{RESETH}	3	-	-	CLK	-
LD high period	$T_{LD(H)}$	6(2)	-	-	CLK	-
POL to LD setup time	t_{POL-LD}	5	-	-	ns	POL toggle to LD rising
LD to POL hold time	T_{LD-POL}	5	-	-	ns	LD rising to POL toggle
Receiver off to LD timing	$t_{REC-OFF}$	8	-	-	CLK	-
LD to reset input time	$T_{LD-RESET}$	5	-	-	ns	-
Output stable time	T_{st}	-	-	6	μs	10% or 90% target voltage CL=60pF, R=2kΩ
Repair output delay time	T_{st1}	-	-	20	μs	10% or 90% target voltage CL=190pF, R=2kΩ

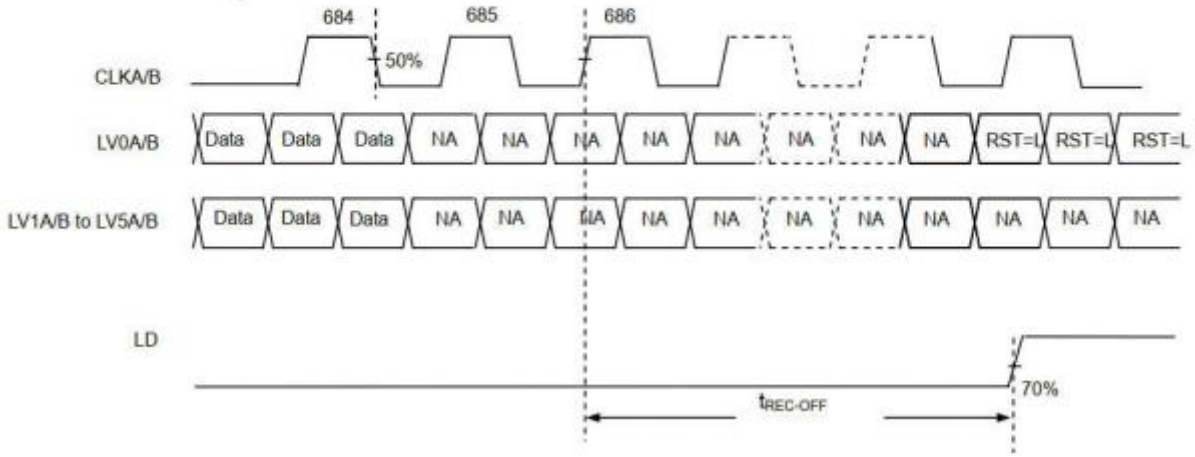
Note: (1) When operation frequency=250MHz.
(2) Recommand over 500ns for better charge sharing

AC electrical characteristics of mini-LVDS input mode

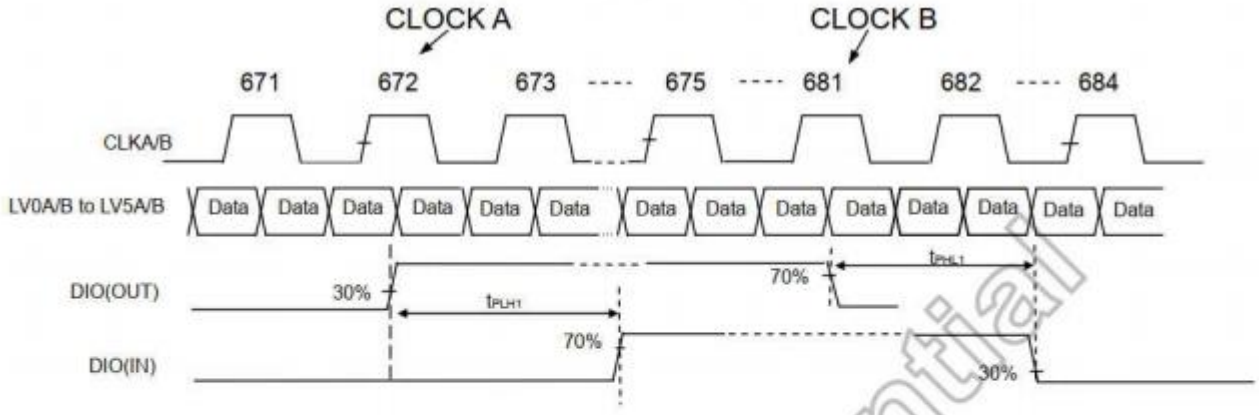
Timing diagram1



Last data sampling to LD timing



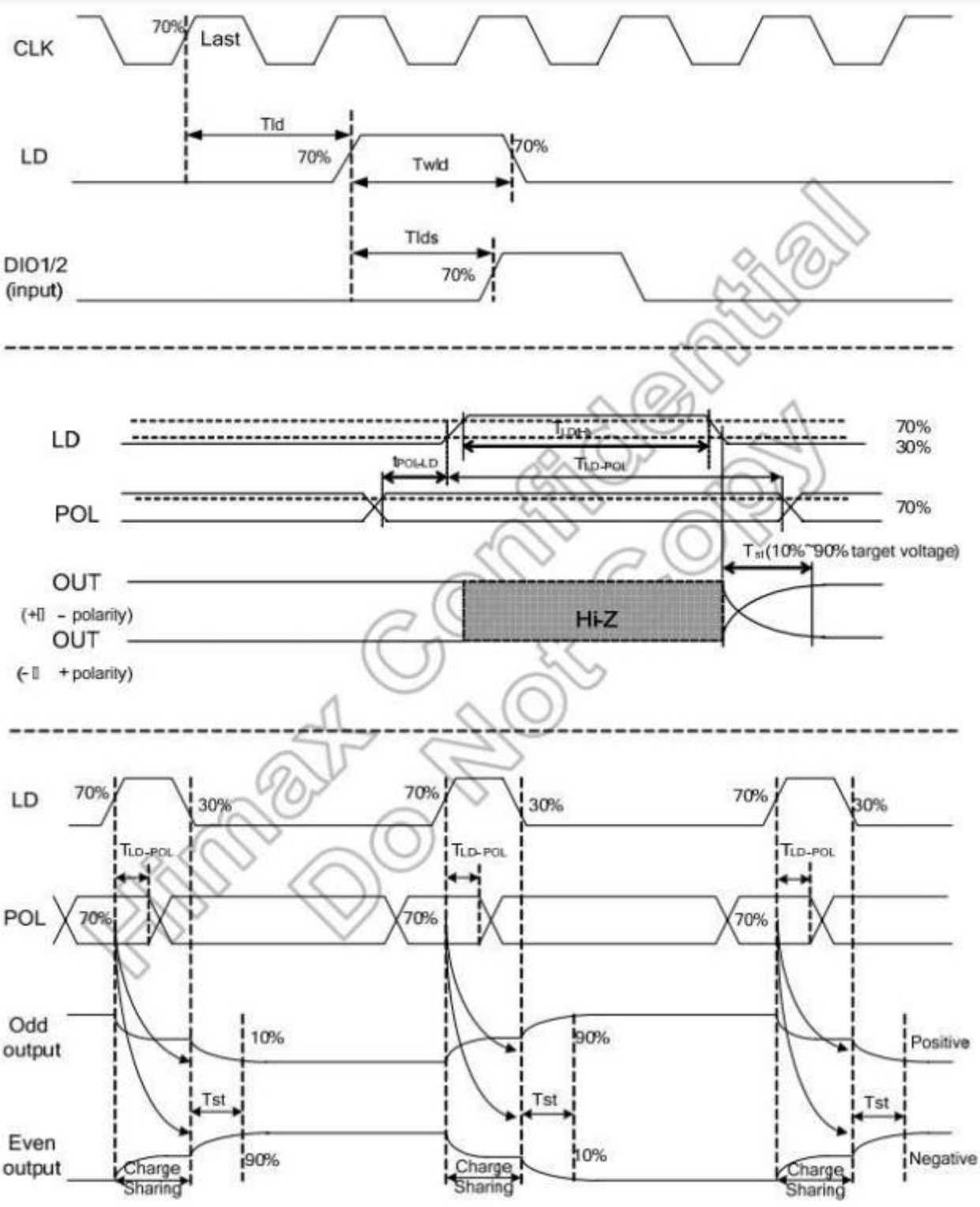
5.4.2 Relationship between DIO(OUT)and DIO(IN) timing:



CH	CLOCK A	CLOCK B
1368	672	681
1362	669	678
1284	630	639
1278	627	636

Note: The parameters indicated above are for 6-pair mini-LVDS data.

Timing diagram2



Timing diagram 2

6. LCD Module Out-Going Quality Level

6.1 VISUAL & FUNCTION INSPECTION STANDARD

6.1.1 Inspection conditions

Inspection performed under the following conditions is recommended.

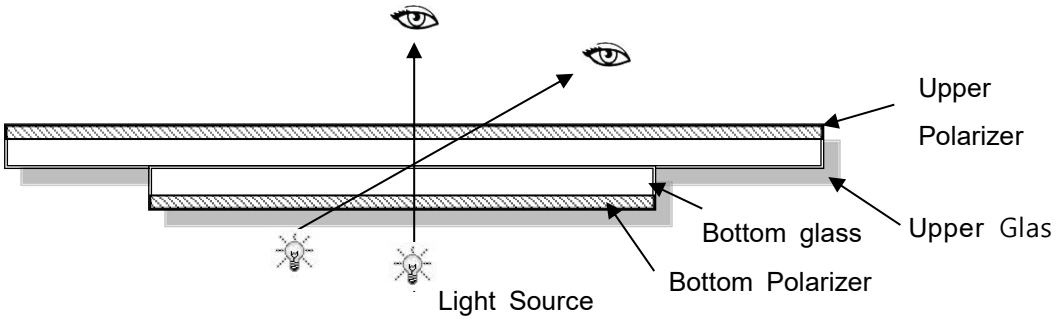
Temperature : 25±5℃

Humidity : 65%±10%RH

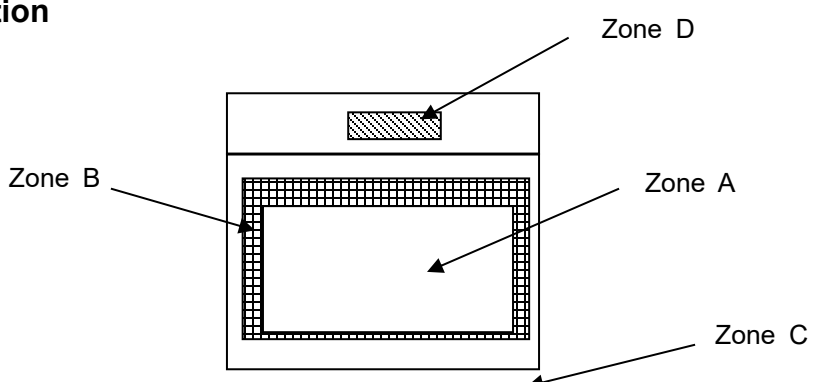
Viewing Angle : Normal viewing Angle.

Illumination: Single fluorescent lamp (300 to 700Lux)

Viewing distance:30-50cm



6.1.2 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 ap pearance after assembly by customer

6.1.3 Sampling Plan

According to GB/T 2828-2003 ; , normal inspection, Class Ⅱ

AQL:

Major defect	Minor defect
0.65	1.5

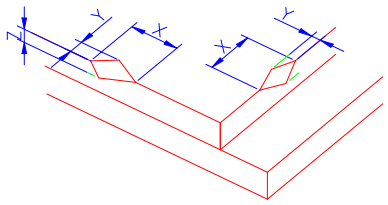
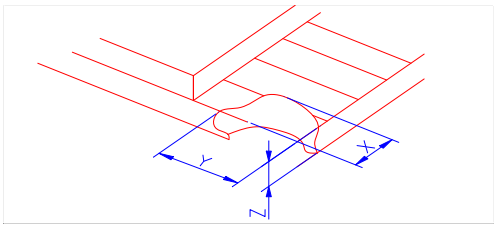
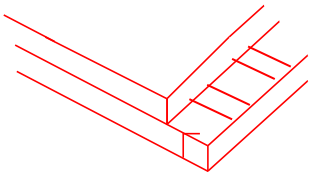
LCD: Liquid Crystal Display , LCM: Liquid Crystal Module

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.

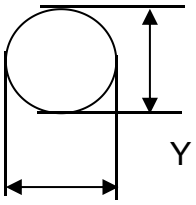
b) Dim dot: Dots appear dark and unchanged in size in which LCD panel is displaying under pure red, green, blue picture.

6.1.4 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:

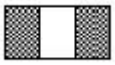
A) Bright dot：Dots appear bright and unchanged in size in which LCD panel is displaying under black pattern.

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

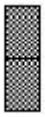
C) 2 dot adjacent = 1 pair = 2 dots

Picture:

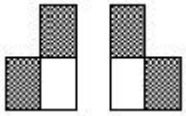
2 dot adjacent



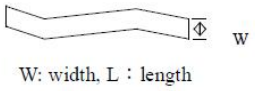
2 dot adjacent



2 dot adjacent (vertical)



2 dot adjacent (slant)

<table>
<tr>
<td>4.0</td>
<td>Line defect (LCD/RTP /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

7. 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 Humidity Operating	+60℃, 90% RH ,96 hours.	
Thermal Shock (Non-operation)	-40℃,30 min ↔ 85℃,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.

8. Cautions and Handling Precautions

8.1 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

8.2 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.

9. Packing

----TBD------