深圳市一众显示科技有限公司

SHEN ZHEN TEAM SOURCE DISPLAY TECH. CO, TD.

TFT-LCD Module Specification

Module NO.: TST146FHBH-V05

Version: V1.0

☐ APPROVAL FOR SPECIFICATION ☐ APPROVAL FOR SAMPLE

For Customer's Acceptance:	
Approved by	**Comment**

Team Source Display:		
Presented by	**Reviewed by**	**Organized by**

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1. GENERAL DESCRIPTION

1.1 Introduction

This LCD-module is a color active matrix TFT-LCD Panel using amorphous silicon TFT's (Thin Film Transistors) as the active switching devices. This model is composed of a TFT-LCD Panel, a driving circuit and a back light system. It is a transmissive type display operating in normal black mode. This TFT-LCD has a 14.6 inch diagonally measured active area with resolutions 1920 horizontal by 1080 vertical pixel array. Each pixel is divided into Red, Green, Blue dots which are arranged in 2 domain stripe and this panel can display 16.7M colors.

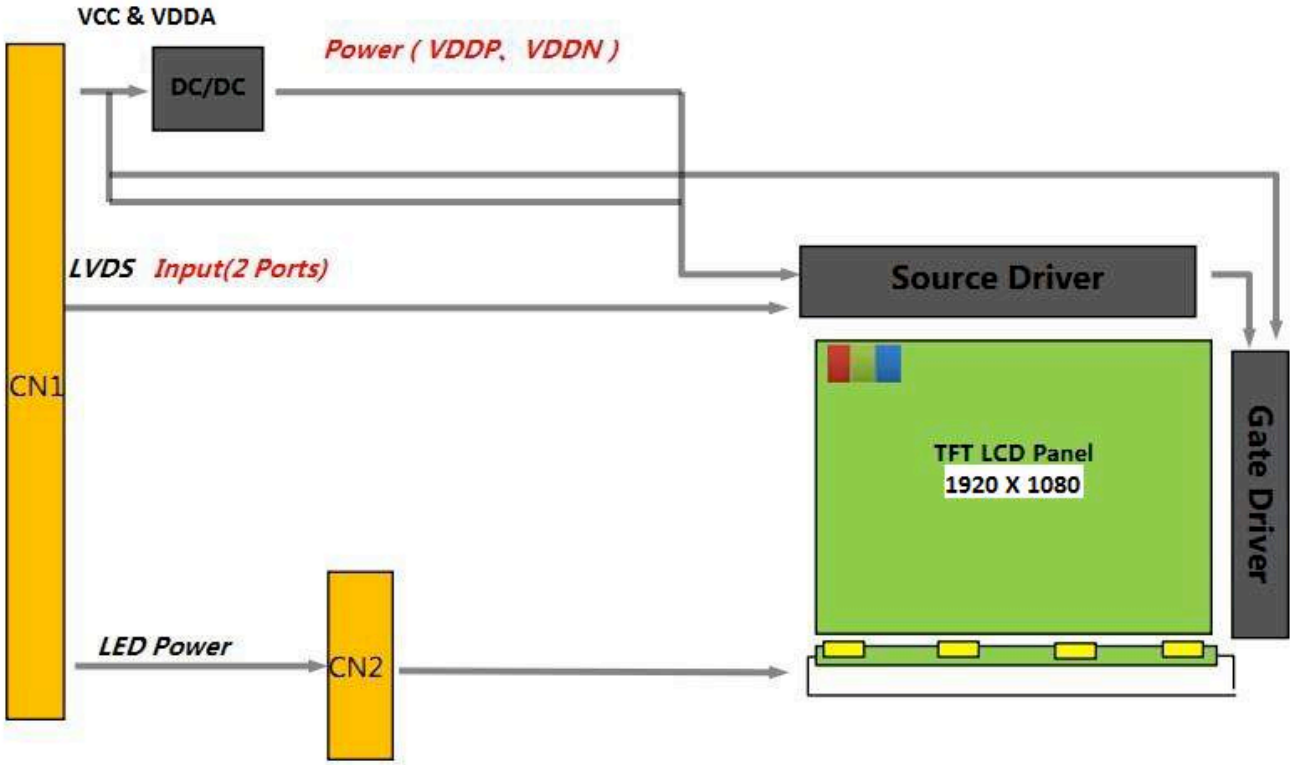


Figure 1: Function Diagram

1.2 Features

- 0.5t Glass (Single)
- Thin and light weight
- High luminance and contrast ratio, low reflection and wide viewing angle
- Module Design
- RoHS Compliant

1.3 Application

- Automotive

1.4 General Specifications

The followings are general specifications of module TST146FHBH-V05. (listed in Table 1.)

Table 1: General Specifications

Parameter	Specification	Unit	Remarks
Active area	323.136(H) x 181.764(V)	mm	
Number of pixels	1920(H) x RGB x 1080(V)	pixels	
Pixel pitch	0.1683(H) x 0. 1683 (V)	mm	
Pixel arrangement	RGB 2domain stripe		
Display colors	16.7M	colors	
Color gamut	70% (typ.)		
Display mode	Normally black, Transmissive mode		
Dimensional outline	336.249(H) x 198.46(V) x 7.73(D)(Exclude nut pole)	mm	Module
Viewing direction (Human eye)	U/D/L/R free viewing direction		Note 1, 2
Driver IC	Source: HX8298-C/Gate: HX8691-A		
Weight	Approx. ~703	gram	

Note:

1. At the U/D/L/R direction, the viewing angle is same;
2. The TFT and CF Align Direction;

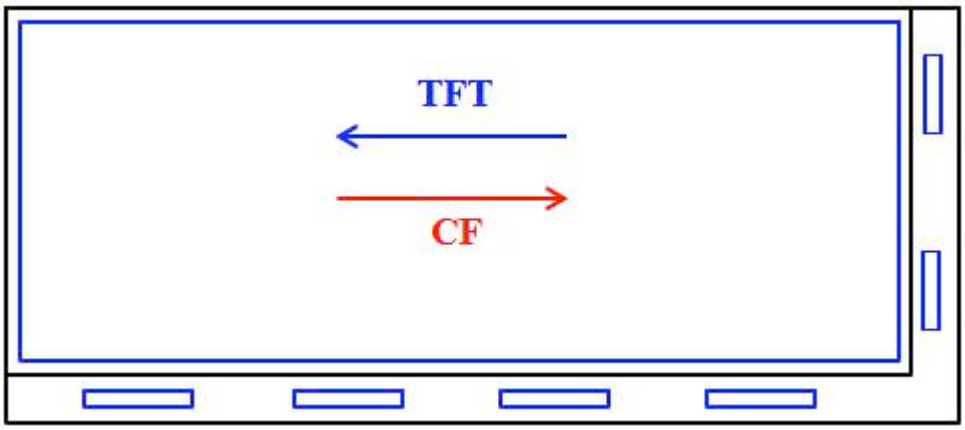


Figure 2: The TFT and CF Align Direction

2. MECHANICAL SPECIFICATION

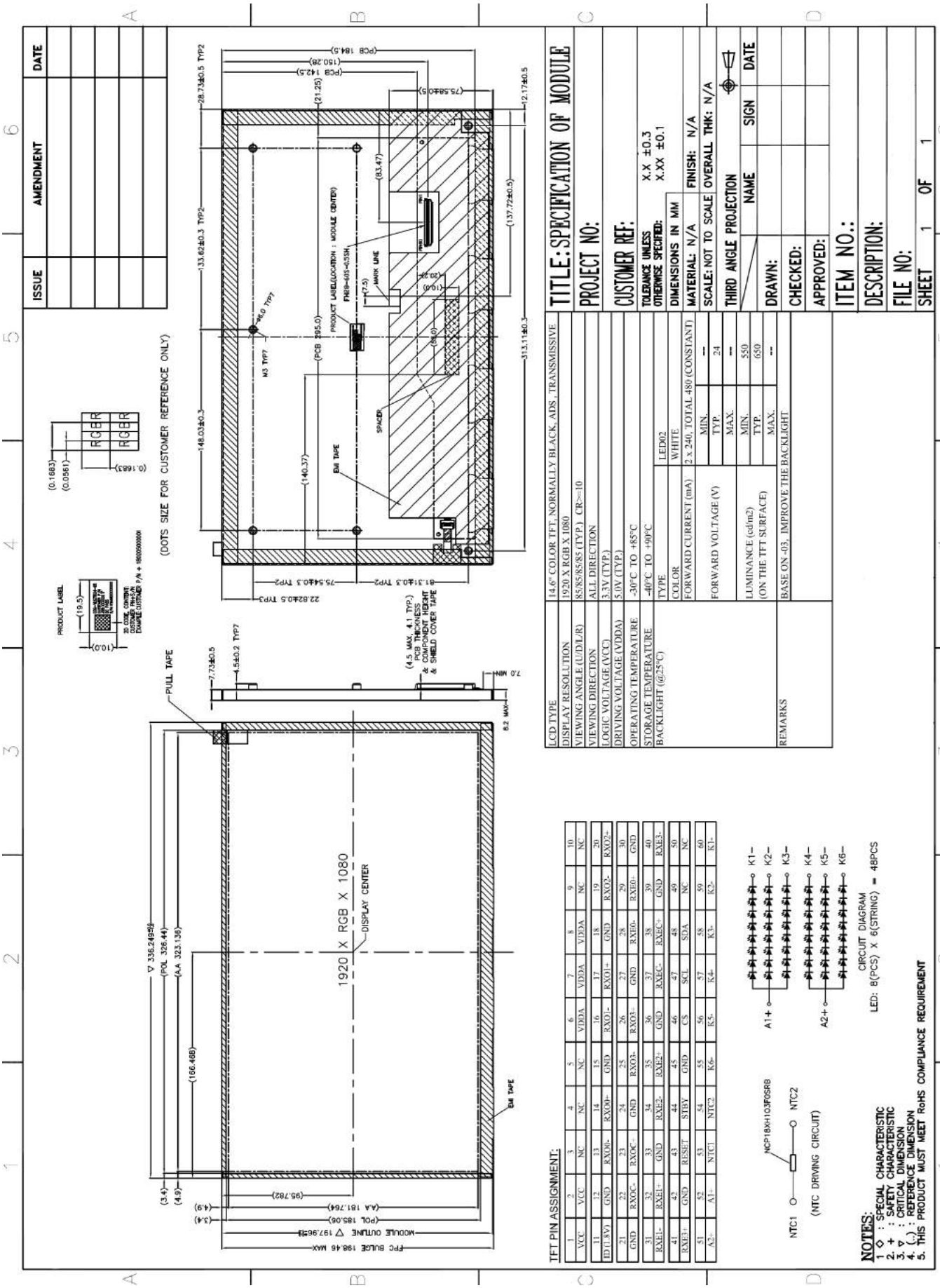


Figure 3: Outline Dimension (unit: mm)

3. INTERFACE CONNECTION

3.1 The LCD Module Electrical Interface Connection

Table 2(a): Pin Assignments for the LCM Connector

Pin No.	Symbol	I/O	Description	Remarks
1	VCC	P	Power pin	3.3V (typ)
2	VCC	P	Power pin	3.3V (typ)
3	NC		No connection	
4	NC		No connection	
5	NC		No connection	
6	VDDA	P	Power pin	5.0V (typ)
7	VDDA	P	Power pin	5.0V (typ)
8	VDDA	P	Power pin	5.0V (typ)
9	NC		No connection	
10	NC		No connection	
11	ID (1.8V)	P	ID Pin, 1.8V read	1.8V (typ)
12	GND	P	Ground	
13	RXO0-	I	Odd Data channel 0 -	
14	RXO0+	I	Odd Data channel 0 +	
15	GND	P	Ground	
16	RXO1-	I	Odd Data channel 1 -	
17	RXO1+	I	Odd Data channel 1 +	
18	GND	P	Ground	
19	RXO2-	I	Odd Data channel 2 -	
20	RXO2+	I	Odd Data channel 2 +	
21	GND	P	Ground	
22	RXOC-	I	Odd Clock channel -	
23	RXOC+	I	Odd Clock channel +	
24	GND	P	Ground	
25	RXO3-	I	Odd Data channel 3 -	
26	RXO3+	I	Odd Data channel 3 +	
27	GND	P	Ground	
28	RXE0-	I	Even Data channel 0 -	
29	RXE0+	I	Even Data channel 0 +	
30	GND	P	Ground	
31	RXE1-	I	Even Data channel 1 -	
32	RXE1+	I	Even Data channel 1 +	
33	GND	P	Ground	
34	RXE2-	I	Even Data channel 2 -	
35	RXE2+	I	Even Data channel 2 +	
36	GND	P	Ground	
37	RXEC-	I	Even Clock channel -	
38	RXEC+	I	Even Clock channel +	
39	GND	P	Ground	
40	RXE3-	I	Even Data channel 3 -	

Table 2(b): Pin Assignments for the LCM Connector

Pin No.	Symbol	I/O	Description	Remarks
41	RXE3+	I	Even Data channel 3 +	
42	GND	P	Ground	
43	RESET	I	Reset pin, active low.	H: Normal operating L: Reset state
44	STBY	I	Standby mode setting pin, active low. Timing controller, output buffer, DAC and power circuit all off when STBY is low.	H: Normal operating L: Standby state
45	GND	P	Ground	
46	CS	I	SPI interface chip select	If no used keep it to VCC
47	SCL	I	SPI interface clock	If no used keep it to GND
48	SDA	I/O	SPI interface data bus	If no used keep it to GND
49	NC		No connection	
50	NC		No connection	
51	A2+	P	LED Anode2	
52	A1+	P	LED Anode1	
53	NTC1		NTC thermistor terminal	
54	NTC2		NTC thermistor terminal	
55	K6-	P	LED Cathode6	
56	K5-	P	LED Cathode5	
57	K4-	P	LED Cathode4	
58	K3-	P	LED Cathode3	
59	K2-	P	LED Cathode2	
60	K1-	P	LED Cathode1	

Remarks: “I” is Input; “O” is Output; “P” is Power; “C” is passive component.

4. ABSOLUTE MAXIMUM RATINGS

The product or its functions may subject to permanent damage if it's stressed beyond those absolute maximum ratings listed below. Exposure to absolute maximum rating conditions for extended periods may affect display module reliability.

Table 3: Absolute Maximum Ratings & Environmental Conditions

Item	Symbol	Min.	Max.	Unit
Supply voltage	VCC	-0.3	+4.0	V
Input signal (LVDS, RESET, STBYB)	V_{IO}	-0.3	VCC+0.3	V
Total LED forward current	IF (Total)	-	480	mA
Relative Humidity (at 60°C, Note 3)	RH		90	%
Operating Temperature (Note 2)	T_{opr}	-30	+85	°C
Storage Temperature	T_{stg}	-40	+90	°C

Note 1: GND =0V.

Note 2: Panel surface temperature should not exceed 85°C.

Note 3: No condensation allowed under any condition.

[Caution]

Do not display fixed pattern for prolonged hours because it may develop image sticking on the display.

5. ELECTRICAL SPECIFICATIONS

5.1 TFT LCD Module DC Characteristics

Table 4: Electrical specifications

Parameter	Symbol	Min.	Typ.	Max.	Unit
Power supply voltage	VCC (Note 1)	3.1	3.3	3.5	V
Power supply voltage	VDDA (Note 1)	4.8	5.0	5.2	V
Power supply current	I_{VCC} (Note 2)	-	60	90	mA
Power supply current	I_{VDDA} (Note 2)	-	60	90	mA
High level input voltage (RESET, STBYB)	V_{IH}	0.7*VCC	-	VCC+0.3	V
Low level input voltage (RESET, STBYB)	V_{IL}	GND-0.3	-	0.3*VCC	V

Note 1: The supply voltage is measured and specified at the interface connector of LCM.

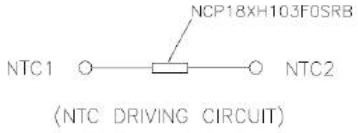
Note 2: All white pattern, Frame rate =60Hz.

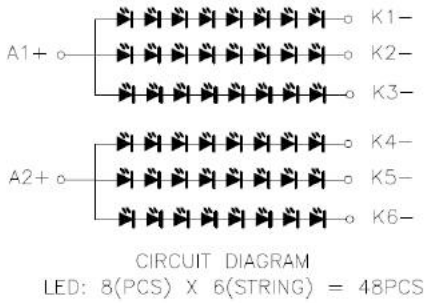
5.2 Backlight Driving Conditions

Table 5: LED Driving specifications (Ta = 25°C)

Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit	Remark
Supply voltage of LED backlight	V_{LED}	Backlight current = 480 mA Number of LED dies = 48 pcs	-	24.0	-	V	Note 1
Supply current of LED backlight (1 String)	$I_{LED\ 1..6}$	Per LED string	-	80	-	mA	Note 2
Total Supply current of LED backlight	$I_{LEDTotal}$	$I_{LED1} + \ldots + I_{LED6}$	-	480	-	mA	Note 2
Backlight Power Consumption	P_{LED}	-	-	11.5	-	W	Note 3
LED life time	LIFE	80mA/LED, 25°C	-	30000	-	Hrs	Note 4

Note 1: Backlight Circuit Diagram



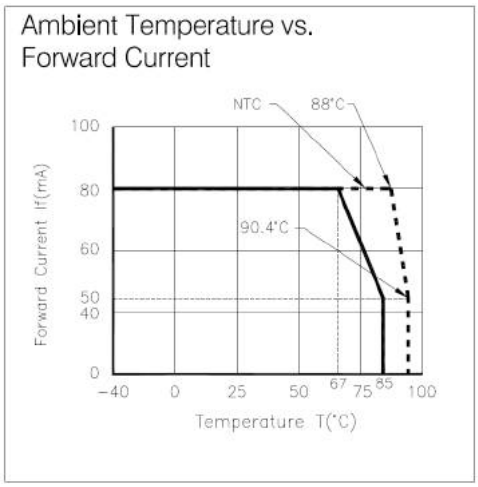


Note 2: The LED driving condition is defined for each LED string.
Total input current = 2 x 240 = 480 mA

Note 3: Backlight power consumption is calculated by I_{LED} (Total) x V_{LED}

Note 4: The LED Life-time define as the estimated time to 50% degradation of initial luminous.

Note 5: Recommended derating curve (current per LED string) for backlight driving



5.3 LVDS DC Characteristics

Table 6: LVDS DC Specifications

Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit
Differential input high threshold voltage	V_{TH}	V_{CM}=1.2V	+0.1	-	-	V
Differential input low threshold voltage	V_{TL}	-	-	-	-0.1	V
Differential input common mode voltage	V_{CM}	-	1	1.2	1.7-|V_{ID}|/2	V
LVDS input voltage (single end)	V_{INLV}	-	0.7	-	1.7	V
Differential input voltage	|V_{ID}|	-	0.1	-	0.6	V

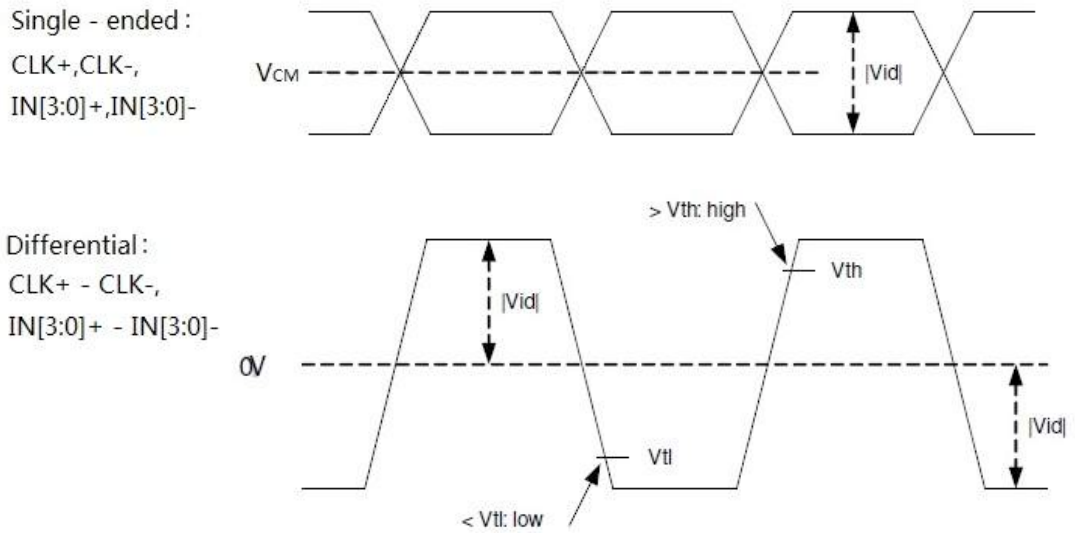


Figure 4:

5.4 LVDS AC Characteristics

Table 7: LVDS AC Specification

Parameter	Symbol	Min.	Typ.	Max.	Unit
Clock frequency	F_{LVCYC}	14	-	85	MHz
Clock period	T_{LVCYC}	11.76	-	71.43	ns
1 data bit time	UI	-	1/7	-	T_{LVCYC}
Clock high time	T_{LVCH}	3	4	4	UI
Clock low time	T_{LVCL}	3	3	4	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

Table 8: SSC table

Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit
Modulation frequency	SSC_{MF}	-	23	-	200	KHz
Modulation rate	SSC_{MR}	LVDS clock=85MHz center spread	-	-	+/-3	%

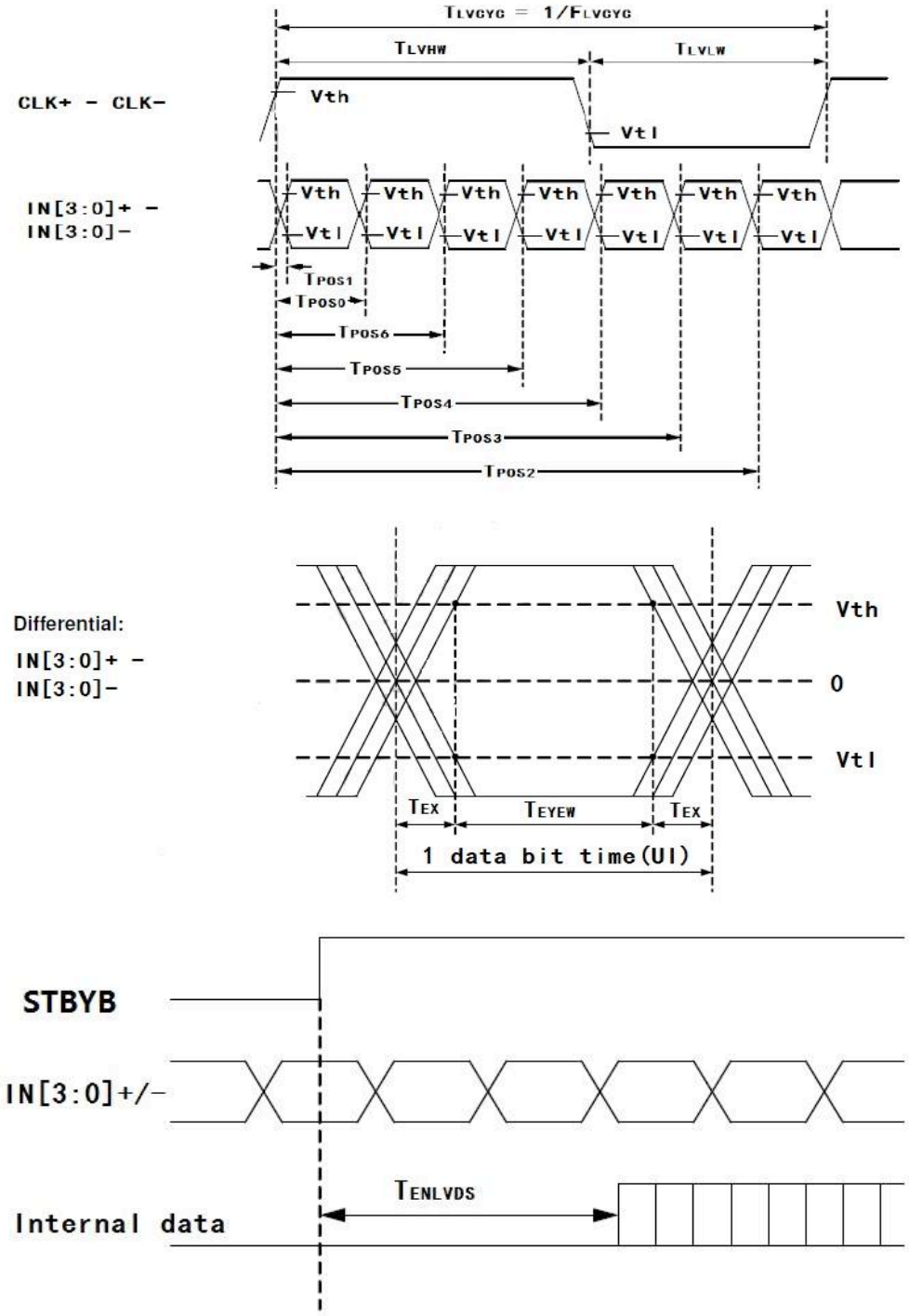


Figure 5:

5.5 Reset timing

Table 9: Reset timing

Signal	Parameter	Symbol	Spec.			Unit
			Min.	Typ.	Max.	
RESETB	Reset pulse width	tRW	10	-	-	μs
	Reset complete time	tRT	-	-	5	μs
	Negative spike noise width	tNNS	-	-	100	μs

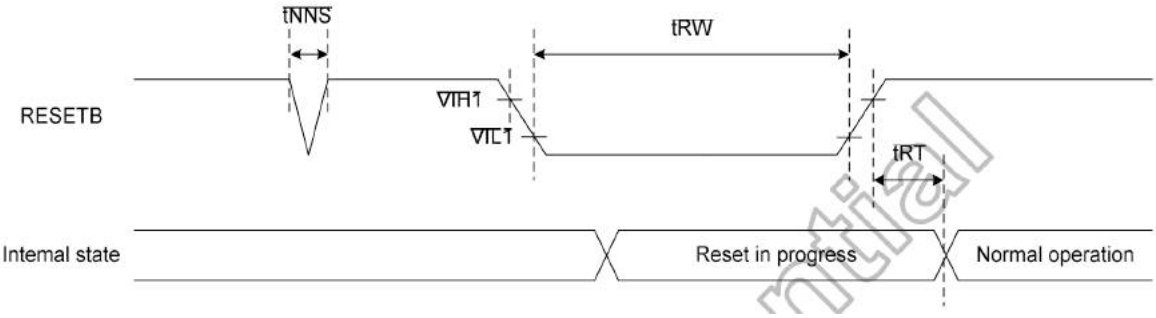
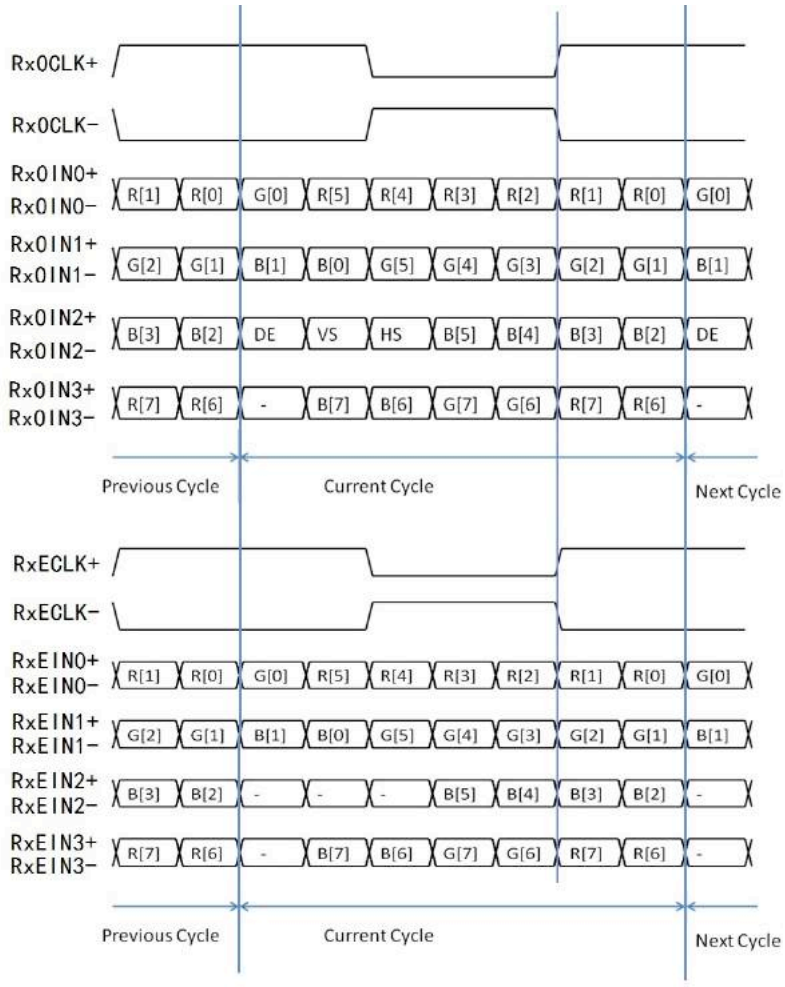


Figure 6: Reset timing

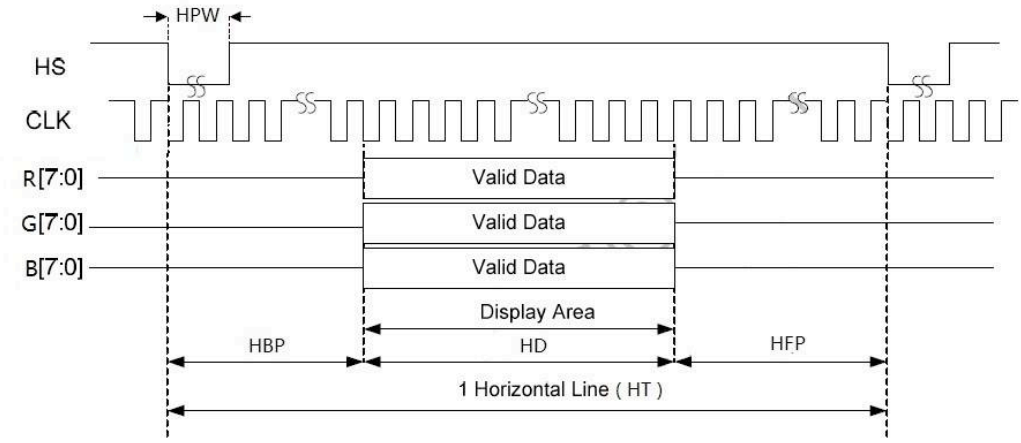
5.6 LVDS Input Format (VESA 8bit)



5.7 Video Signal Timing

Table 10: Video signal timing (Sync mode)

- **Horizontal**



- **Vertical**

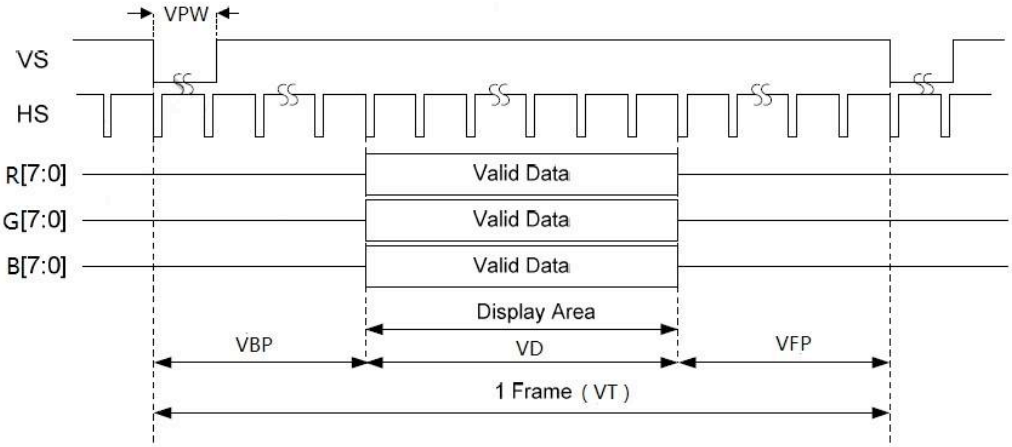
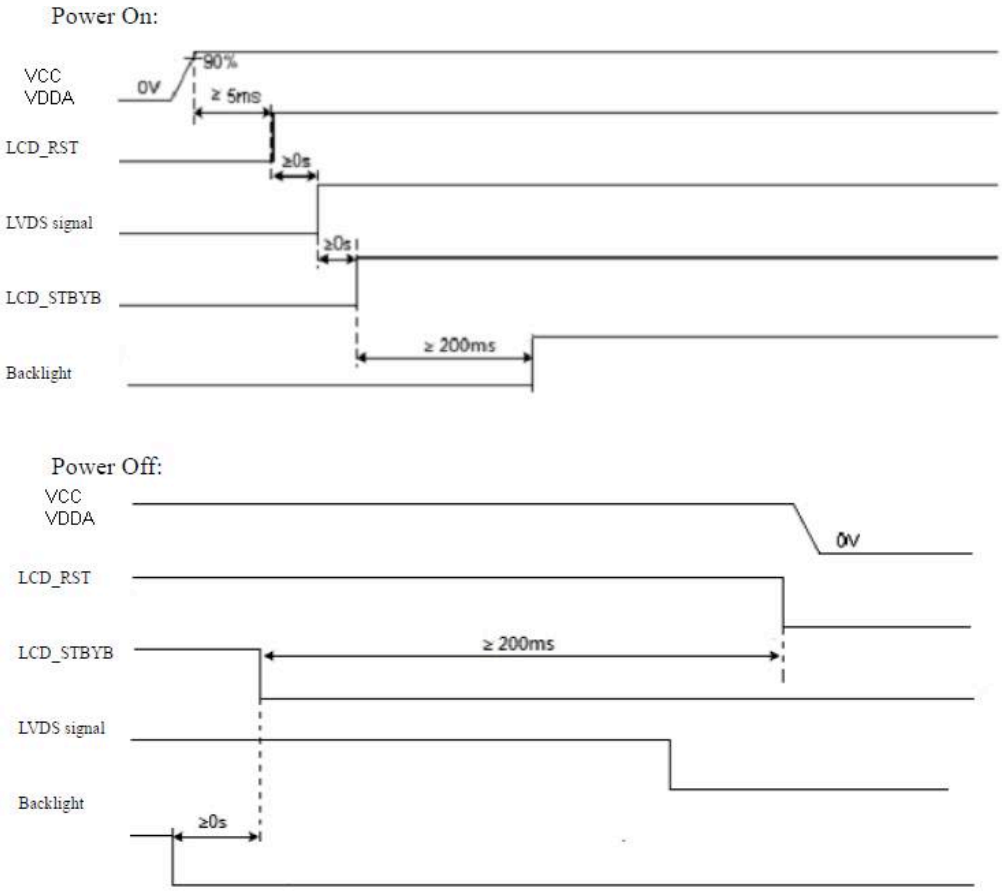


Figure 7:

5.8 POWER ON/OFF SEQUENCE



Note 1: When STBYB rise high, it take 10 display data frame for internal power step up.

Note 2: During power off sequence, STBYB must pull low at least 10 display data frame before shut down LVDS signal and pull low RESET. In this period, driver IC will discharge the residual charge in panel to avoid image residue.

6. OPTICAL SPECIFICATION

6.1 Overview

The test of Optical specifications shall be measured in a dark room(ambient luminance≤ 1 lux and temperature = 25±2℃) with the equipment of Luminance meter system (Topcon SR-UL1R and Westar TRD-100A) and test unit shall be located at an approximate distance 50cm from the LCD surface at a viewing angle of θ and Φ equal to 0°.The center of the measuring spot on the Display surface shall stay fixed.
The backlight should be operating for 30 minutes prior to measurement.

6.2 Optical Specifications

Table 11: Optical Specifications

Parameter		Symbol	Condition	Min.	Typ.	Max.	Unit	Remark
Viewing Angle	Horizontal	Θ3	CR>10	70	85		°	
		Θ9		70	85		°	
	Vertical	Θ12		70	85		°	
		Θ6		70	85		°	
Contrast Ratio		CR	Θ= 0°	900	1000			Note 1
Luminance		cd/m2	Θ= 0°	550	650		cd/m2	Note 2
Uniformity		%	Θ= 0°	75	80			Note 3
Reproduction Of color	Red	Rx	Θ= 0°	0.610	0.640	0.670		Note 4 * Module
		Ry		0.311	0.341	0.371		
	Green	Gx		0.287	0.317	0.347		
		Gy		0.600	0.630	0.660		
	Blue	Bx		0.121	0.151	0.181		
		By		0.044	0.074	0.104		
White		Wx	Θ= 0°	0.270	0.300	0.330		
		Wy		0.300	0.330	0.360		
Response Time		Tr+Tf	Θ= 0°		30	40	ms	Note 5
Image Sticking		LEVEL				2		Note 6

Note:1. Contrast measurements shall be made at viewing angle of Θ= 0 and at the center of the LCD surface.
Luminance shall be measured with all pixels in the view field set first to white, then to the dark (black) state.
Luminance Contrast Ratio (CR) is defined mathematically.

$$CR = \frac{\text{Luminance when displaying a white raster}}{\text{Luminance when displaying a black raster}}$$

2. Surface luminance is the center point across the LCD surface 50cm from the surface with all pixels displaying white. This measurement shall be taken at the locations shown in FIG. 8.

3. Uniformity measurement shall be taken at the locations shown in FIG. 9, for a total of the measurements per display, measure surface luminance of these nine points across the LCD surface 50cm from the surface with all pixels displaying white.

$$\text{Uniformity} = \frac{\text{Min Luminance of 9 points}}{\text{Max Luminance of 9 points}} \times 100\%$$

4. The color chromaticity coordinates specified in Table11 shall be calculated from The spectral data measured with all pixels first in red, green, blue and white. Measurements shall be made at the center of the Module.

5. The electro-optical response time measurements shall be made as FIG.10 by switching the “data” input signal ON and OFF.The times needed for the luminance to change from 10% to 90% is Tr and 90% to 10% is Tf.

6. Image Sticking<LEVEL 2

60degC,1hr,<Level2. Test pattern: Chess, Inspection pattern: 50% grey. (FIG.11)

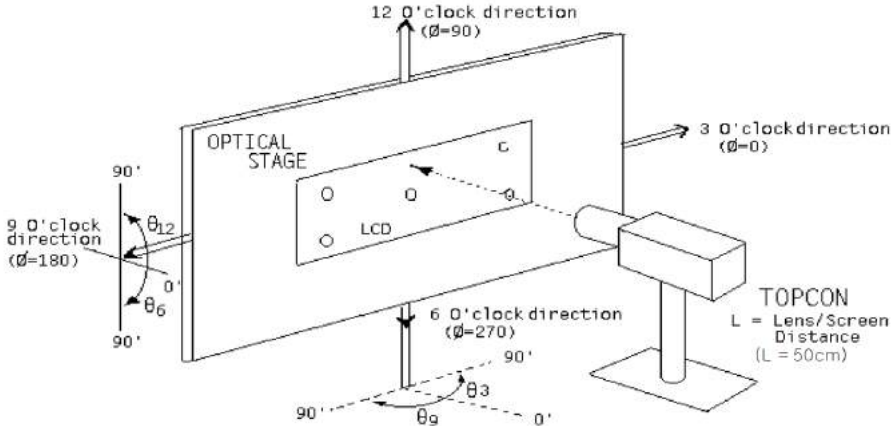


Figure 8: Measurement Set Up

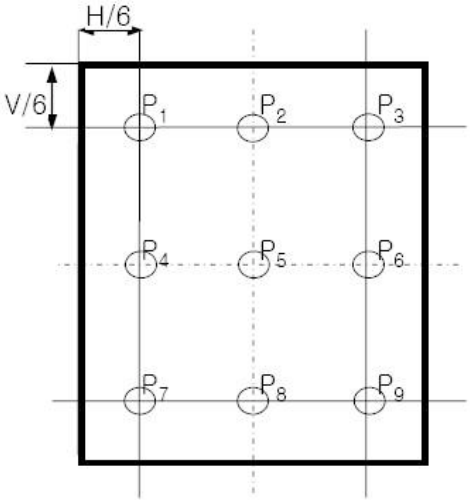


Figure 9: Uniformity Measurement Locations

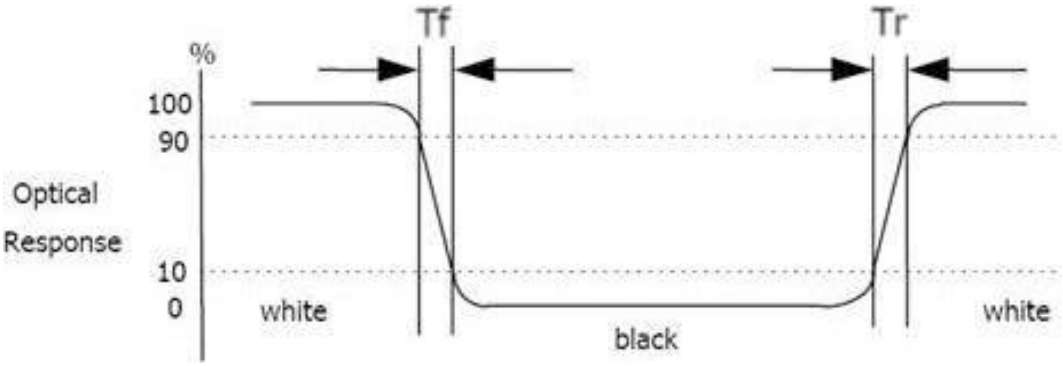


Figure 10: Response Time Testing

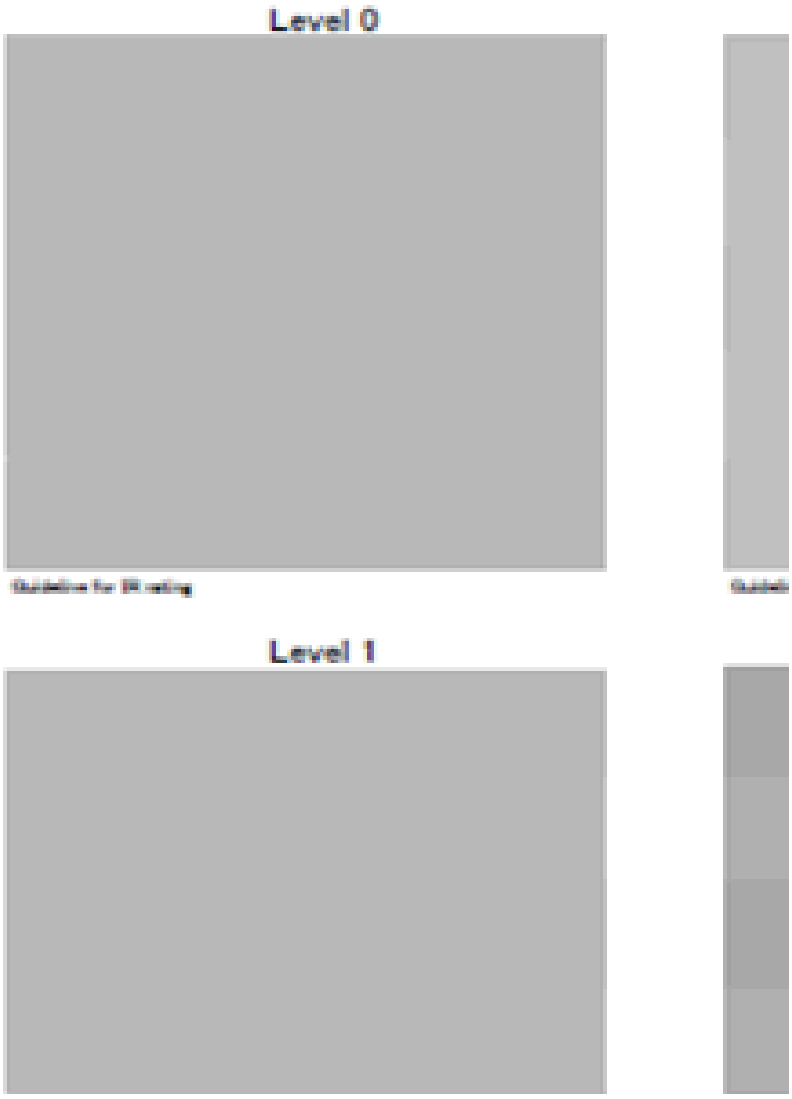


Figure 11: Image Sticking

7. RELIABILITY TEST

Table 12: Reliability Test

NO.	Test Item	Test Condition	Duration	Sample Qty.
1	Low temperature operation test(LTO)	-30℃	240hrs	4pcs
2	High temperature operation test(HTO)	85℃	240hrs	4pcs
3	High temperature storage test(HTS)	90℃	240hrs	4pcs
4	Low temperature storage test(LTS)	-40℃	240hrs	4pcs
5	Thermal shock test (TST)	-40°C<>+85°C, 30min/5min/30min,	100cycles	4pcs
6	Accelerated Humidity Test Operating	+60°C / 90% RH	240 hrs	4pcs
7	ESD	150pF, 330Ω, ±15KV (air) ,Class B		4pcs

8. PACKING METHOD

TBD

9. INCOMING INSPECTION SPECIFICATION

Please refer to IIS from TSD.

10. HANDLING & CAUTIONS

10.1 Mounting Method

- The panel of the LCM consists of two thin glasses with polarizer which easily get damaged. So extreme care should be taken when handling the LCM.
- Excessive stress or pressure on the glass of the LCM should be avoided. Care must be taken to insure that no torsional or compressive forces are applied to the LCM unit when it is mounted.
- If the customer's set presses the main parts of the LCM, the LCM may show the abnormal display. But this phenomenon does not mean the malfunction of the LCM and should be pressed by the way of mutual agreement.
- To determine the optimum mounting angle, refer to the viewing angle range in the specification for each model.
- Mount a LCM with the specified mounting parts.

10.2 Caution of LCM Handling and Cleaning

- Since the LCM is made of glass, do not apply strong mechanical impact or static load onto it. Handling with care since shock, vibration, and careless handling may seriously affect the product. If it falls from a high place or receives a strong shock, the glass maybe broken.
- The polarizer on the surface of panel are made from organic substances. Be very careful for chemicals not to touch the polarizer or it leads the polarizer to be deteriorated.
- If the use of a chemical is unavoidable, use soft cloth with solvent recommended below to clean the LCM's surface with wipe lightly. -IPA (Isopropyl Alcohol), Ethyl Alcohol, Tri-chloro, tri-florothane.
- Do not wipe the LCM's surface with dry or hard materials that will damage the polarizer and others. Do not use the following solvent—Water, acetone, Aromatics.
- It is recommended that the LCM be handled with soft gloves during assembly, etc.The polarizer on the LCM's surface are vulnerable to scratch and thus to be damaged by shape particles.
- Do not drop water or any chemicals onto the LCM's surface.
- A protective film is supplied on the LCM and should be left in place until the LCM is required for operation.
- The ITO pad area needs special careful caution because it could be easily corroded. Do not contact the ITO pad area with HCFC, Soldering flux, Chlorine, Sulfur, saliva or fingerprint. To prevent from the ITO corrosion, customers are recommended that the ITO area would be covered by UV or silicon.
- Please handle FPC with care.

10.3 Caution Against Static Charge

- The LCM use C-MOS LSI drivers, so customers are recommended that any unused input terminal would be connected to Vdd or Vss, do not input any signals before power is turn on, and ground you body, work/assembly area, assembly equipments to protect against static electricity.
- Remove the protective film slowly, keeping the removing direction approximate 30-degree not vertical from panel surface, if possible, under ESD control device like ion blower, and the humidity of working room should be kept over 50%RH to reduce the risk of static charge.

- Avoid the use work clothing made of synthetic fibers. We recommend cotton clothing or other conductivity-treated fibers.
- In handling the LCM, wear non-charged material gloves. And the conducting wrist to the earth and the conducting shoes to the earth are necessary.

10.4 Caution For Operation

- It is indispensable to drive the LCM within the specified voltage limit since the higher voltage than the limit causes LCM's life shorter. An electro-chemical reaction due to DC causes undesirable deterioration of the LCM so that the use of DC drive should avoid.
- Do not connect or disconnect the LCM to or from the system when power is on.
- Never use the LCM under abnormal conditions of high temperature and high humidity.
- When expose to drastic fluctuation of temperature(hot to cold or cold to hot), the LCM may be affected; Specifically, drastic temperature fluctuation from cold to hot, produces dew on the LCM's surface which may affect the operation of the polarizer on the LCM.
- Response time will be extremely delay at lower temperature than the operating temperature range and on the other hand LCM may turn black at temperature above its operational range. However those phenomenon do not mean malfunction or out of order with the LCM. The LCM will revert to normal operation once the temperature returns to the recommended temperature range for normal operation.
- Do not display the fixed pattern for a long time because it may develop image sticking due to the LCM structure. If the screen is displayed with fixed pattern, use a screen saver.
- Do not disassemble and/or re-assemble LCM module

10.5 Packaging

- Modules use LCM element, and must be treated as such.

-Avoid intense shock and falls from a height.

-To prevent modules from degradation, do not operate or store them exposed directly to sunshine or high temperature/humidity for long periods.

10.6 Storage

- A slight dew depositing on terminals is a cause for electro-chemical reaction resulting in terminal open circuit. Relative humidity of the environment should therefore be kept below 60%RH.
- Original protective film should be used on LCM’s surface (polarizer). Adhesive type protective film should be avoided, because it may change color and/or properties of the polarizer.
- Do not store the LCM near organic solvents or corrosive gasses.
- Keep the LCM safe from vibration, shock and pressure.
- Black or white air-bubbles may be produced if the LCM is stored for long time in the lower temperature or mechanical shocks are applied onto the LCM.

• In the case of storing for a long period of time for the purpose or replacement use, the following ways are recommended.

-Store in a polyethylene bag with sealed so as not to enter fresh air outside in it.

-Store in a dark place where neither exposure to direct sunlight nor light is.

-Keep temperature in the specified storage temperature range.

-Store with no touch on polarizer surface by the anything else. If possible, store the LCM in the packaging situation when it was delivered.

10.7 Safety

• For the crash damaged or unnecessary LCM, it is recommended to wash off liquid crystal by either of solvents such as acetone and ethanol an should be burned up later.

• In the case of LCM is broken, watch out whether liquid crystal leaks out or not. If your hands touch the liquid crystal, wash your hands cleanly with water and soap as soon as possible.

• If you should swallow the liquid crystal, first, wash your mouth thoroughly with water, then drink a lot of water and induce vomiting, and then, consult a physician.

• If the liquid crystal get in your eyes, flush your eyes with running water for at least fifteen minutes.

• If the liquid crystal touches your skin or clothes, remove it and wash the affected part of your skin or clothes with soap and running water.

11. Applicable Scope

• This product specification only applies to the products manufactured and sold by TSD.

• Any specification, quality etc. about other parts mentioned in this product spec are no concern of our company.