CUSTOMER APPROVE

SPECIFICATION

Edition : **Preliminary spec 1.0**

Date of issue : **2022-05-03**

ProductNo.: PV156009Y0640K

APPROVED	CHECKED	PREPARED

Revision History

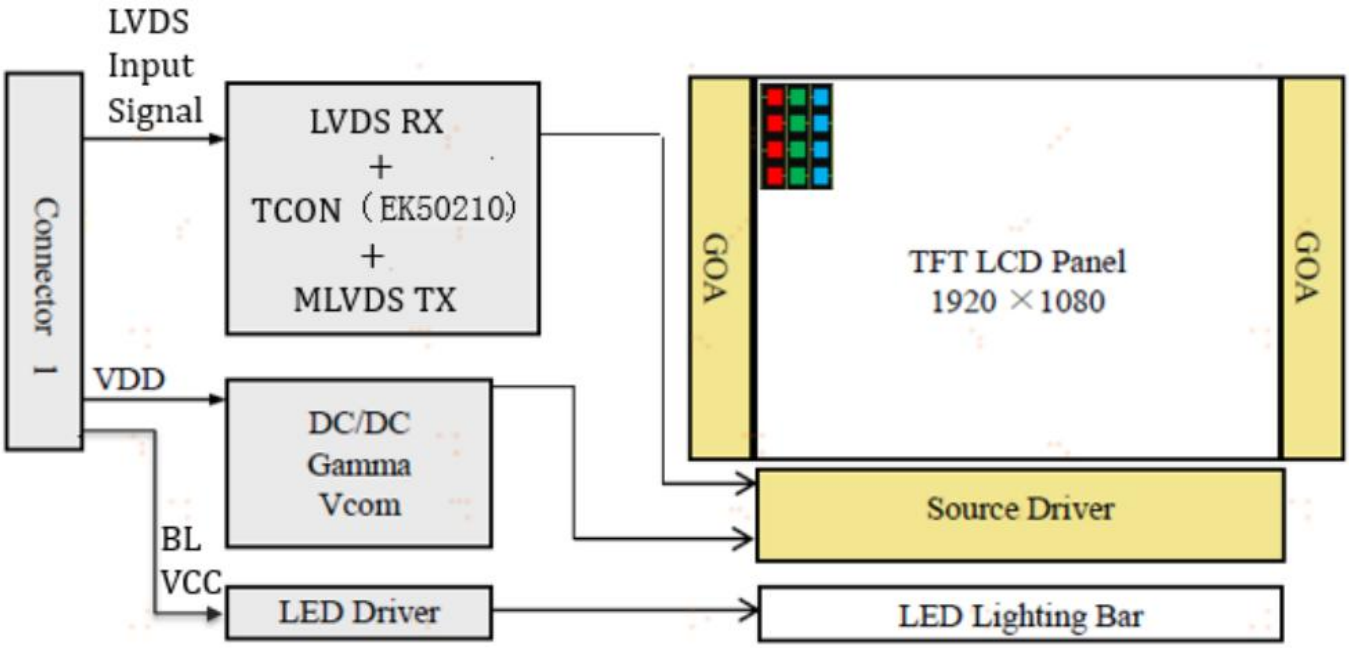
Date	Rev.	Page	Old Description	New Description	Remark
2022-05-03	1.0	All	The specification was first issued		

CONTENTS

1.General Description

1.1 Product Features

-FHD Resolution (1920 * 1080)
-Very High Contrast Ratio: 3000:1
-Ultra Wide Viewing Angle: 178°(H)/178°(V) (CR 10)
-DE (Data Enable)Mode
-LVDS (Low Voltage Differential Signaling) Interface



1.2 Overview

PV156009Y0640Kisacoloractivematrixliquidcrystaldisplay.Thematrixemploysa-Sithinfilmtransistor as the active element. This module is a diagonal 15.6” color active matrix LCD open cell with 2ch-LVDS interface, which open cell is a transmissive type display operating in the normally black mode. It supports 1920 * 1080 FHD
resolution and can display up to 16.7M colors (8bit). Each pixel is divided into Red, Green and Blue sub-pixels which are arranged in vertical stripe.

This module dedicates for Public information display products and provides excellent performance which includes high contrast ratio, high color saturation and high color depth. CSOT open cell comply with RoHS for identification.

1.3 General Information

The following items are characteristics summary on the table under 25℃condition:

Items	Unit	Specifications
Active Area	[mm]	344.16 (H) * 193.59 (V)
Number of Pixels	[pixel]	1920 * 1080
Pixel Pitch (Sub Pixel)	[um]	59.75*179.25
Pixels Arrangement	-	RGB Vertical Stripe
White Luminance(Center)	[cd/m²]	750（Typ.）
Color Chromaticity		NTSC 72% (typ)
Contrast Ratio	-	3000 （Typ.）
Response Time	[msec]	30ms (Typ.)(Tr+Td) ms
Viewing Angle	[degree]	89/89/89/89
Outline Dimension	[mm]	359.4(H) x 209.6(V) x 10.1(D) (Typ.)
Electrical Interface	-	Dual Channel LVDS
Support Color		16.7M colors
Surface Treatment		Anti-glare, Haze 25%, Hard Coating (3H)
Temperature Range Operating Storage(Shipping)	 [oC] [oC]	 0 to +50℃ -20 to+60℃

2 Absolute Maximum Ratings

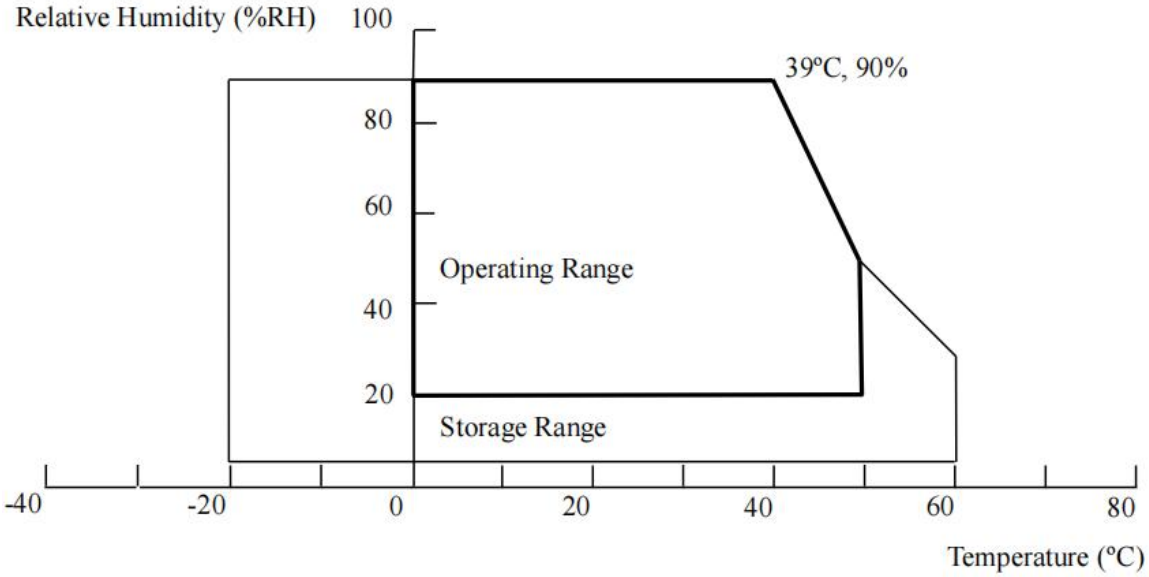
2.1 Absolute Maximum Ratings (TA = 25 ± 2 °C)

The followings are maximum values which, if exceeded, may cause damage to the unit.

Item	Symbol	Value		Unit
		Min.	Max.	
Power Supply Voltage	V_{CC}	-0.3	13.2	V
Input Signal Voltage	V_{IN}	-0.3	3.6	V

2.2 Environment Requirement (Based on CSOT's BLU)

(1) Temperature and relative humidity range are shown as below.



(a) 90%RH maximum (TA ≤ 39 ºC).

(b) Wet-bulb temperature should be 39ºC maximum (TA > 39 ºC).

(c) No condensation.

(2) The storage temperature is between - 20 ºC to 60 ºC, and the operating ambient temperature is between 0 ºC to 50 ºC

The maximum operating temperature is based on the test condition that the surface temperature of display area is less than or equal to 65ºC with LCD module in a temperature controlled chamber alone. Thermal management should be considered in final product design to prevent the surface temperature of display area from being over 65ºC. The range of operating temperature may degrade in case of improper thermal management in the end product design.

(3) The rating of environment is based on LCD module. Leave LCD cell alone, this environment condition can't be guaranteed. Except LCD cell, the customer has to consider the ability of other parts of LCD module and LCD module process.

2.3 Absolute Ratings of Environment

When storing open cell as spares for a long time, please follow the precaution instructions:

(1) Do not store the open cell in high temperature and high humidity for a long time. It is highly recommended to store the open cell with temperature from 20ºC to 30ºC in normal humidity (50 ±10%RH) with shipping package.

(2) The open cell should be kept within one month shelf life.

3.Electrical Specifications

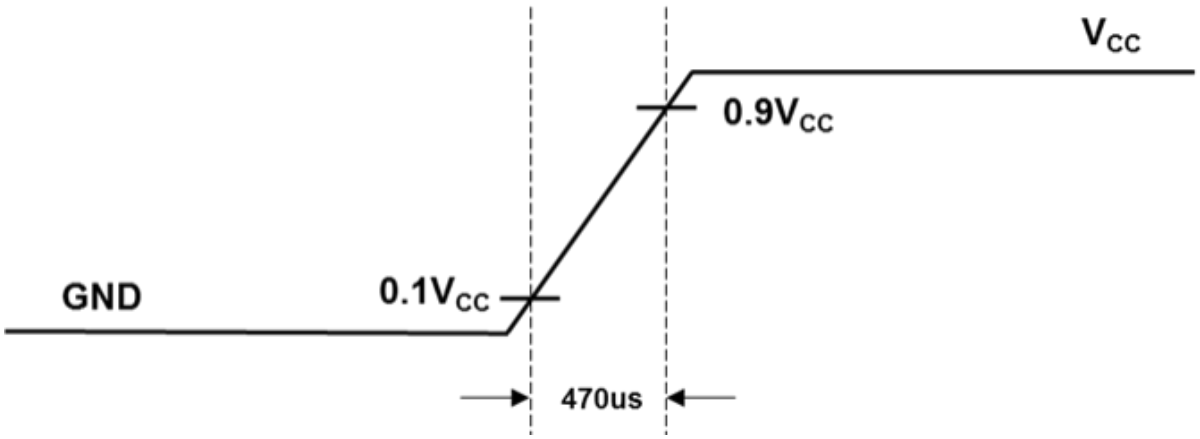
3.1 Open Cell Power Consumption (TA=25 ±2℃)

Parameter		Symbol	Value			Unit	Note
			Min.	Typ.	Max.		
Power Supply Voltage		Vcc	10.8	12	13.2	V	(1)
Rush Current		Irush	-	-	3	A	(2)
Power Supply Current	White Pattern	Icc	-	0.209	0.269	A	(3) 60Hz
	Horizontal Stripe		-	0.251	0.311	A	
	Black Pattern		-	0.2	0.26	A	
	Mosaic Patern		-	0.204	0.264	A	
Power Consumption (Mosaic Pattern)		Poc	-	2.448	3.168	Watt	60Hz

Note:

(1) The ripple voltage should be controlled less than 10% of VCC.

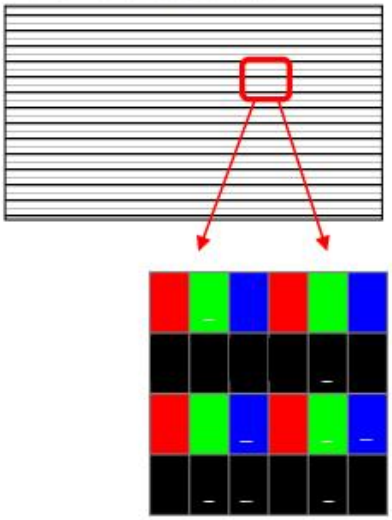
(2) Measurement condition: VCC rising time = 470μs.



(3) Measurement condition: VCC = 12 V, Ta = 25 ± 2 ºC. The test patterns are shown as below.

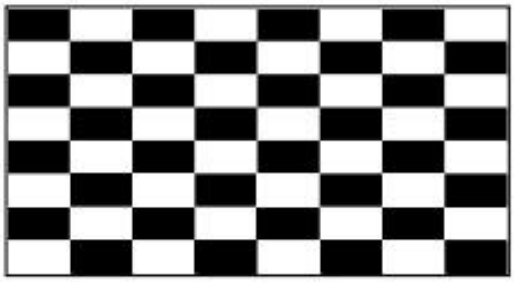
A. White Pattern

B. Horizontal Stripe Pattern



C. Black Pattern

D.Mosaic Pattern



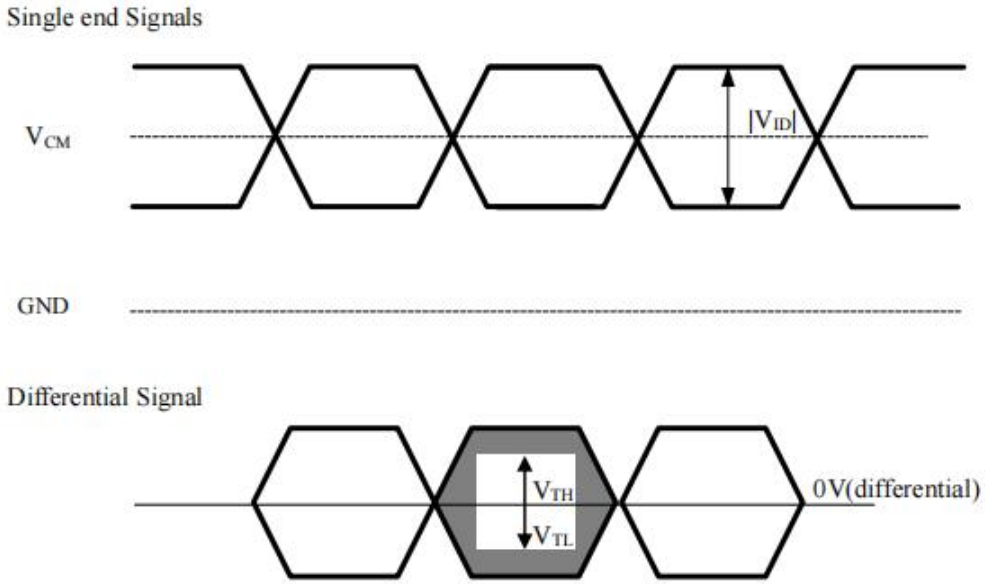
3.2 LVDS Characteristics

Parameter		Symbol		Value		Unit	Note
LVDS Interface	Differential Input High Threshold Voltage	VTH	-	-	+100	mV	(1)
	Differential Input Low Threshold Voltage	VTL	-100	-	-	mV	
	Common Input Voltage	VCM	1.0	1.2	1.4	V	
	Differential Input Voltage	|VID|	100-	-	600	mV	
	Terminating Resistor	RT	87.5	100	112.5	ohm	
CMOS Interface	Input High Threshold Voltage	VIH	2.7	-	3.3	V	
	Input Low Threshold Voltage	VIL	0	-	0.7	V	

Note:

(1) The product should be always operated within above ranges.

(2) The LVDS input signal has been defined as follows:



3.3 Temperature Specifications

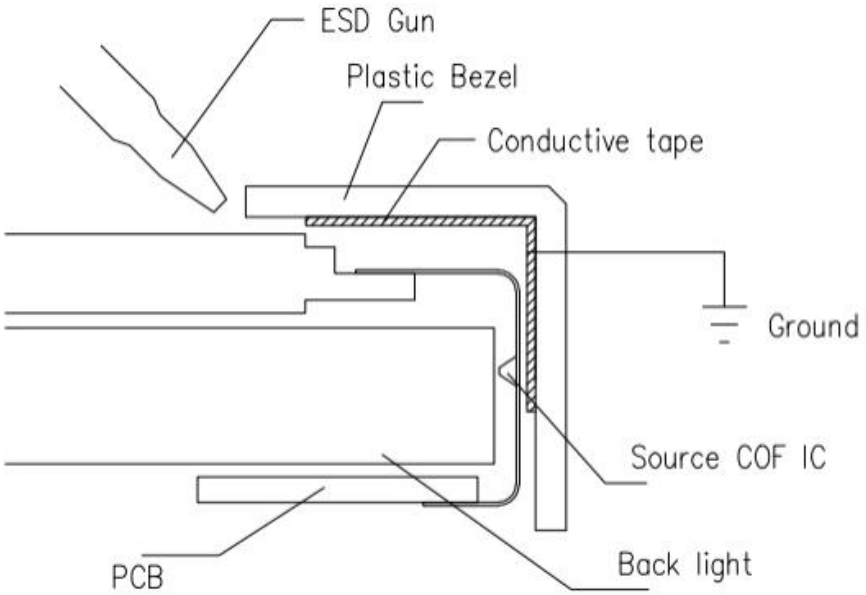
Parameter	Symbol	Spec			Unit	Note
		Min.	Typ.	Max.		
Source driver	T_{DRIVER}	-	-	115	℃	(1)
PMIC	T_{PMIC}	-	-	100	℃	(1)
TCON	T_{TCON}	-	-	105	℃	(1)

Note:

(1) Any point on the IC surface must be less than Max. specification under any condition ,If the surface temperature is out of the specification, thermal solutions should be applied to avoid to be damaged.

3.4 Driver IC ESD Specification

The Electro-Static Discharge tolerance of Source COF IC is ±2KV tested by ESD Gun. Especially if the LCD module is designed with the Plastic Bezel, we suggest ESD protection solutions should be applied to avoid be damaged,



4. Input Terminal Pin Assignment

4.1 Interface Pin Assignment

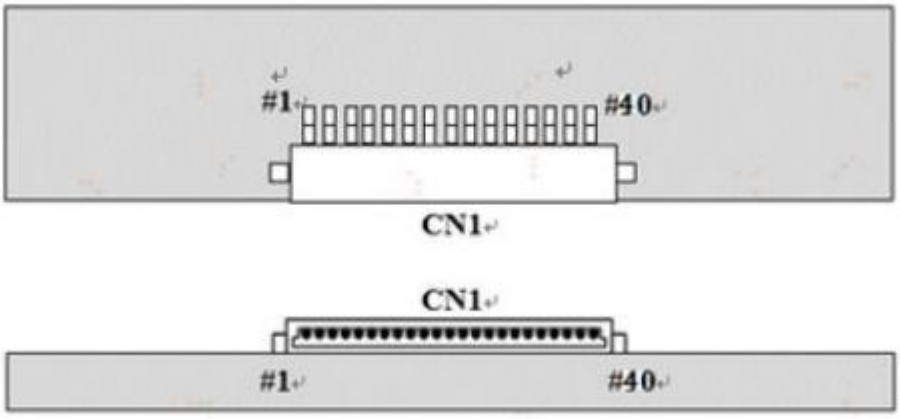
CN1: 300E40-0010RA-G3-D (CT) or equivalent (see Note (1))

Pin No.	Symbol	I/O	Description	Note
1	RxO0-	I	Negative LVDS differential data input (Odd data)	
2	RxO0+	I	Positive LVDS differential data input (Odd data)	
3	RxO01-	I	Negative LVDS differential data input (Odd data)	
4	RxO01+	I	Positive LVDS differential data input (Odd data)	
5	RxO02-	I	Negative LVDS differential data input (Odd data)	
6	RxO02+	I	Positive LVDS differential data input (Odd data)	
7	GND	P	Ground	
8	RxOCLK-	I	Negative LVDS differential clock input (Odd clock)	
9	RxOCLK+	I	Positive LVDS differential clock input (Odd clock)	
10	GND	P	Ground	
11	RxO3-	I	Negative LVDS differential data input (Odd data)	
12	RxO3+	I	Positive LVDS differential data input (Odd data)	
13	GND	P	Ground	
14	RxE0-	I	Negative LVDS differential data input (Even data)	
15	RxE0+	I	Positive LVDS differential data input (Even data)	
16	RxE1-	I	Negative LVDS differential data input (Even data)	
17	RxE1+	I	Positive LVDS differential data input (Even data)	
18	RxE2-	I	Negative LVDS differential data input (Even data)	
19	RxE2+	I	Positive LVDS differential data input (Even data)	
20	GND	P	Ground	
21	RxECLK-	I	Negative LVDS differential clock input (Even clock)	
22	RxECLK+	I	Positive LVDS differential clock input (Even clock)	
23	GND	P	Ground	
24	RxE3-	I	Negative LVDS differential data input (Even data)	
25	RxE3+	I	Positive LVDS differential data input (Even data)	
26	GND	P	Ground	
27	LCD_VCC	P	LCD VCC(12V)	

28	LCD_VCC	P	LCD VCC(12V)	
29	BIST	I	LCD self-test（Normal mode: NC or pull L；BIST mode: pull H）	
30	BL_ENABLE	I	Backlight on/off	
31	BL_PWM_DIM	I	System PWM	
32	BL_POWER	P	LED Power Supply Input Voltage(12V)	
33	BL_POWER	P	LED Power Supply Input Voltage(12V)	
34	BL_POWER	P	LED Power Supply Input Voltage(12V)	
35	BL_POWER	P	LED Power Supply Input Voltage(12V)	
36	GND	P	Ground	
37	GND	P	Ground	
38	GND	P	Ground	
39	ID1	O	Reserved PIN, Default ‘H’， Recommend NC	(2)
40	ID2	O	Reserved PIN, Default ‘L’， Recommend NC	(2)

Note:

(1)The direction of pin assignment is shown as below:



(2)Please let it open if it do not used

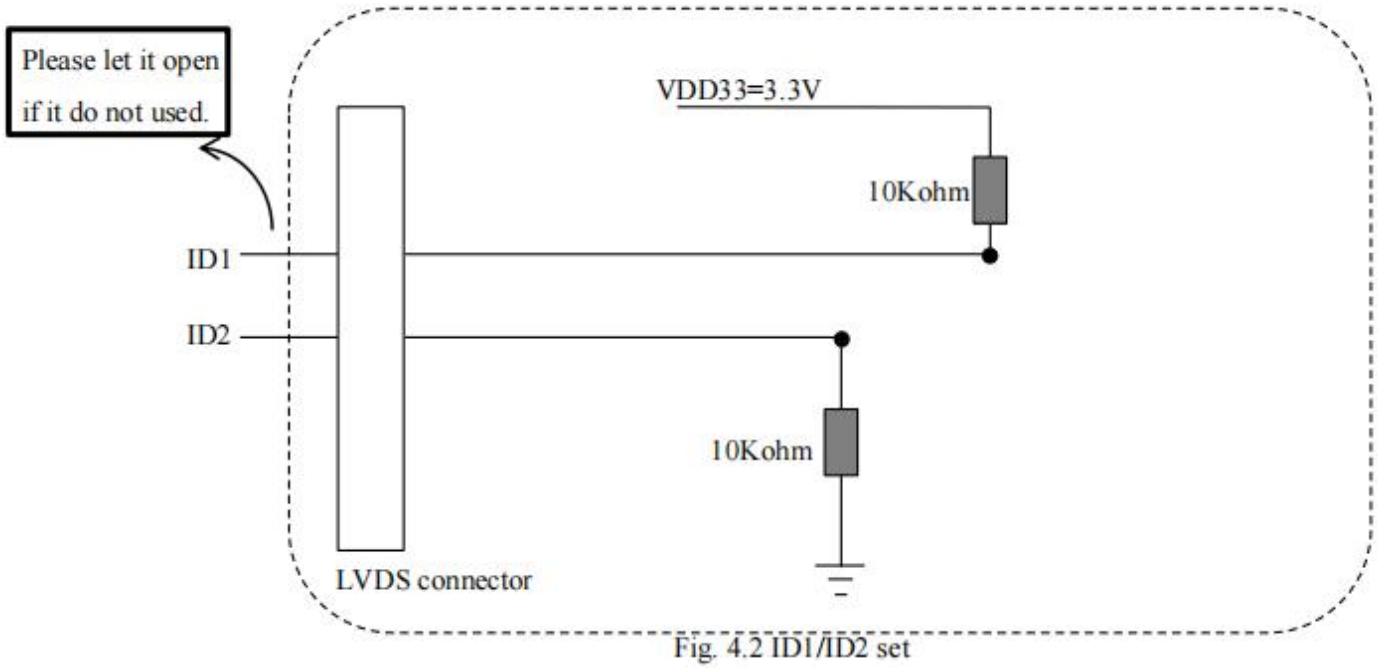
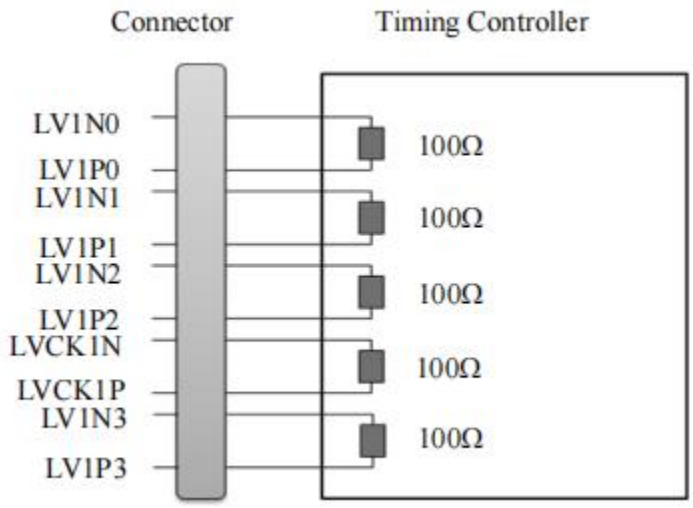


Fig. 4.2 ID1/ID2 set

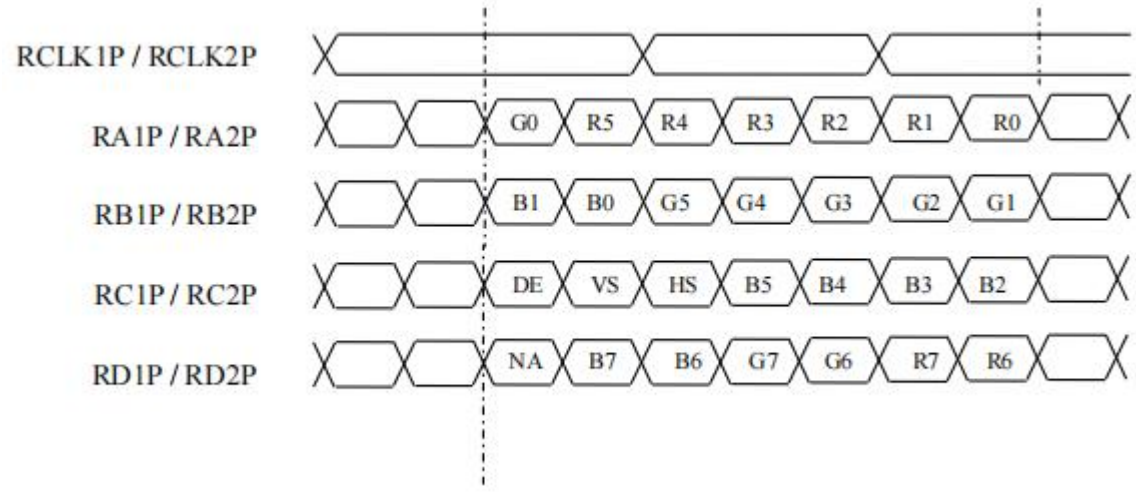
4.2 Block Diagram of Interface



Attention:
(1) This open cell uses a 100 ohms (Ω) resistor between positive and negative lines of each receiver input.
(2) LVDS cable impedance shall be 50 ohms per signal line or about 100 ohms per twist-pair line respectivel

4.3 LVDS Interface

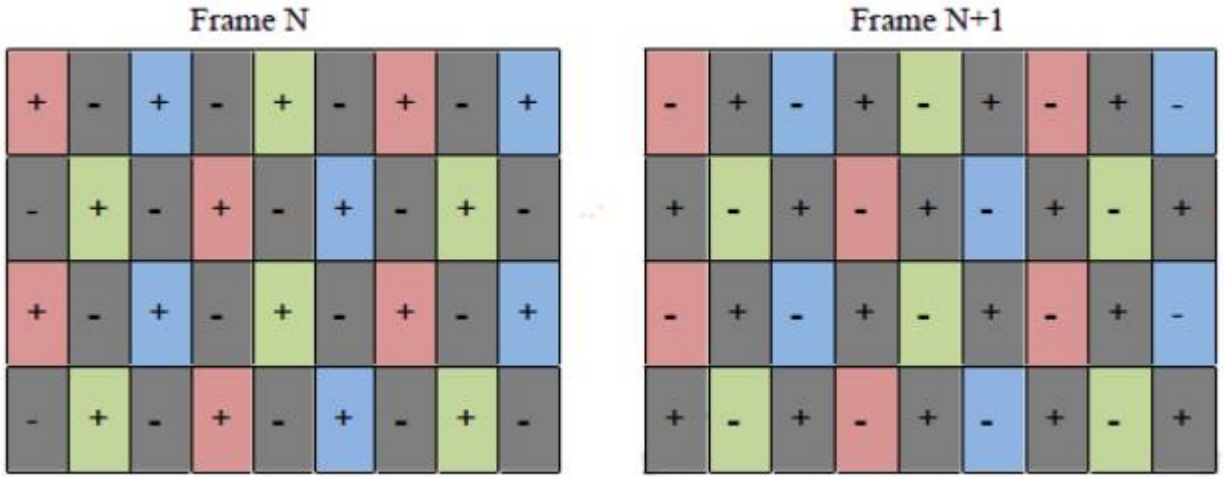
4.3.1 VESA Format



4.4 Flicker Pattern

Flicker should be adjusted by the Dot on/off pattern, where are displayed alternately at vertical line. (Dot inversion)

Dot inversion pattern



5. Interface Timing

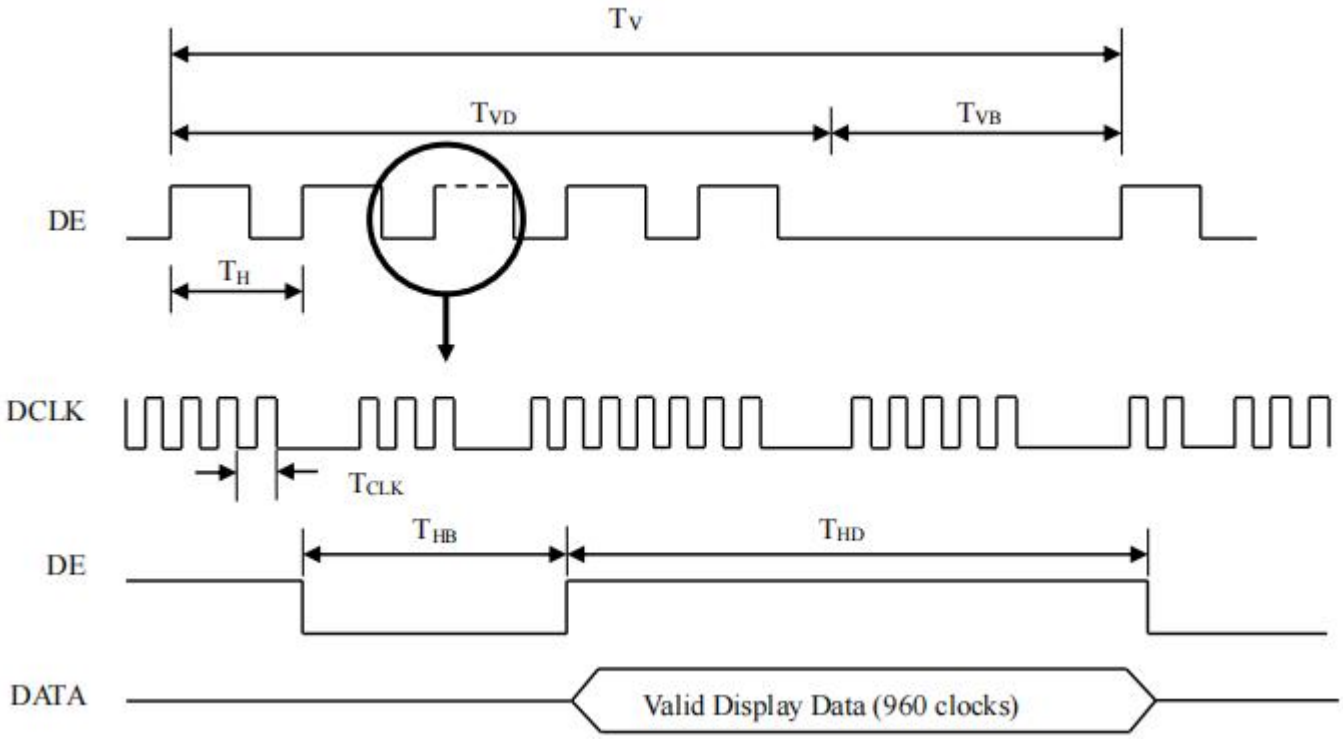
5.1 Timing Table (DE Only Mode)

Signal	Item	Symbol	Min.	Typ.	Max.	Unit	Note
LVDS Receiver Clock	Frequency	Fclkin (=1/TClk)	59.4	74.25	77.34	MHz	(1) (2)
	Input cycle to cycle jitter	Trcl	-	-	200	ps	(3)
	Spread spectrum modulation range	Fclkin_mod	Fclkin-2%	-	Fclkin+2%	MHz	(4)
	Spread spectrum modulation frequency	FSSM	60	-	200	KHz	
LVDS Receiver Data	Receiver Skew Margin	TRSM	-400	-	400	Ps	(5)
Vertical Active Display Term	Frame Rate	F	48	60	62.5	Hz	
	Total	TV	1092	1125	1380	TH	TV=TVD+TVB
	Display	TVD		1080			
	Blank	TVB	12	45	300	TH	
Horizontal Active Display Term	Total	TH	1046	1100	1174	TCLK	TH=THD+THB
	Display	THD		960			960=1920/2port
	Blank	THB	86	140	214	TCLK	

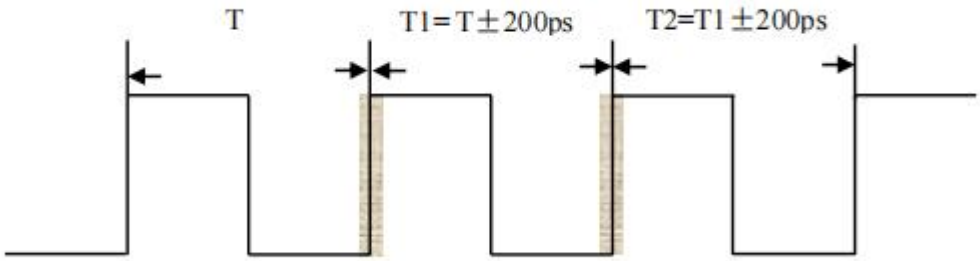
Note:

(1) The TFT LCD open cell is operated in DE only mode, H sync and V sync input signal have no effect on normal operation.

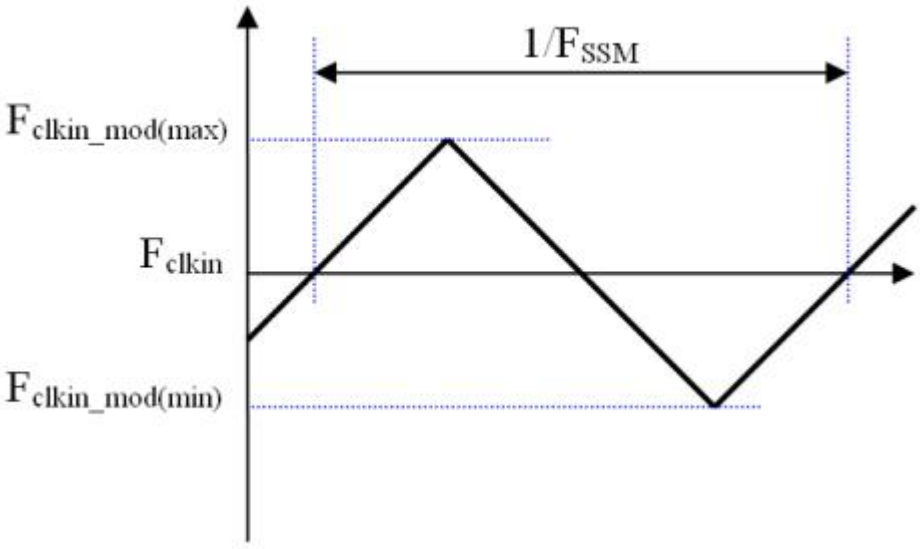
(2) Please make sure the range of pixel clock follows the following equations:
Fclkin(max) ≥ Fmax ×Tv ×Th Fmin ×Tv ×Th ≥ Fclkin(min) 74.25MHZ=148.5/2port LVDS



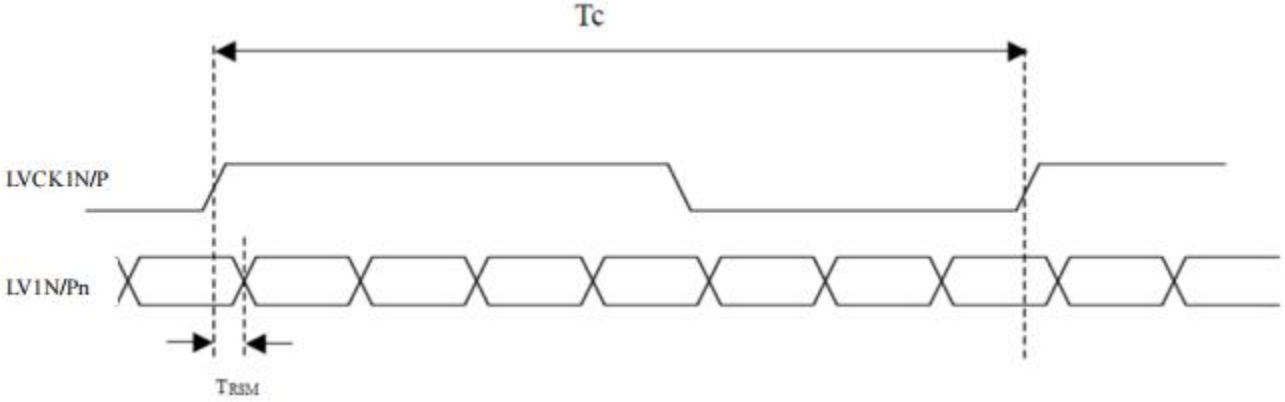
(3)The input clock cycle-to-cycle is defined as below figures.



(4) The SSM (Spread Spectrum Modulation) is defined as the following figure.
The LVDS SSM 's suggestion is off by default, SOC board must test all validation if SOC board open the LVDS SSM.

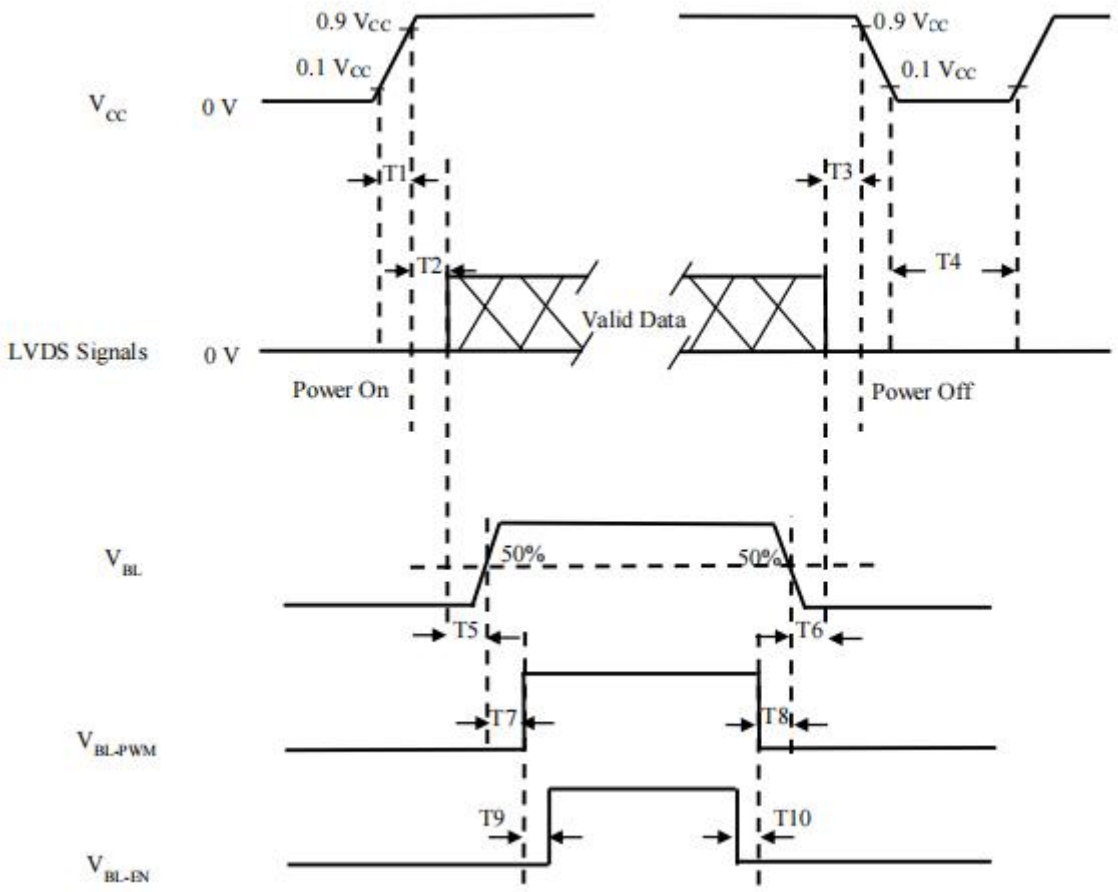


(5) The LVDS timing diagram and setup/hold time is defined and showed as the following figure.



5.2 Power On/Off Sequence

To prevent a latch-up or DC operation of the Open cell, the power on/off sequence should be as the diagram below



Parameter	Values			Unit	Note
	Min.	Typ.	Max.		
T1	0.5	-	10.0	ms	
T2	0.0	50	200	ms	
T3	0.0	50	200	ms	
T4	1000.0	-	-	ms	
T5	500.0	-	-	ms	
T6	100.0	-	-	ms	

T7	0	-	-	ms	
T8	0	-	-	ms	
T9	0	-	-	ms	
T10	0	-	-	ms	

Attention:

(1) The supply voltage of the external system for the open cell input should follow the definition of VCC.

(2) When the customer's backlight turns on before the LCD operation or the LCD turns off before the backlight turns off, the display may momentarily become abnormal screen.

(3) In case that VCC is in off level, please keep the level of input signals on the low or high impedance. If T2 < 0, that may cause electrical overstress.

(4) T4 should be measured after the module has been fully discharged between power off and on period.

(5) Interface signal shall not be kept at high impedance when the power is on

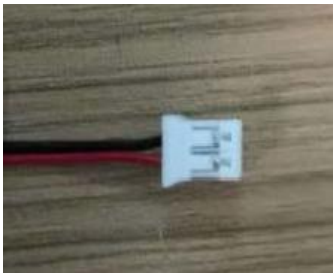
6 Backlight Unit

6.1 Connector Pin Assignment

The following shows the block diagram of the 15.6 inch Backlight Unit. It includes 60（4014） pcs LED in the LED lightbar.(6 strings and 10 pcs LED in one string)

connector CN2 : PH- 2P *1

Pin	Signal Name
1	VDD- （Black)
2	VDD+ (Red)



6.2 Recommednded Operating Condition

(Ta=25℃)

Item	Symbol	Min.	Typ.	Max.	Unit
LED operation Voltage	V led	44.8	-	52.8	V
LED operation Curent	I led	-	360	-	mA
BackLinght Power	P_{BL}	10.75	-	12.67	W
Luminance	L	600	750		nit
LED Life Time		30,000			Hrs
Luminance uniformity	△L	75	80		%

7. Optical Characteristics

7.1 Measurement Conditions

The table below is the test condition of optical measurement.

Item	Symbol	Value	Unit
Ambient Temperature	T_A	25± 2	ºC
Ambient Humidity	H_A	50± 10	%RH
Driving Signal	Refer to the typical value in Chapter 3: Electrical Specification		
Vertical Refresh Rate	F_R	60	Hz

To avoid abrupt temperature change during optical measurement, it's suggested to warm up the LCD module more than 20 minutes after lighting the backlight and in the windless environment.
To measure the LCD Module, it is suggested to set up the standard measurement system as Fig. 7.1. The measuring area S should contain at least 500 pixels of the LCD cell as illustrated in Fig.7.2 (A means the area allocated to one pixel). In this model, for example, the minimum measuring distance Z is 370mm when is 2 degree. Hence, 500mm is the typical measuring distance. This measuring condition is referred to 301-2H of VESA FPDM 2.0 about viewing distance, angle, and angular field of view definition.

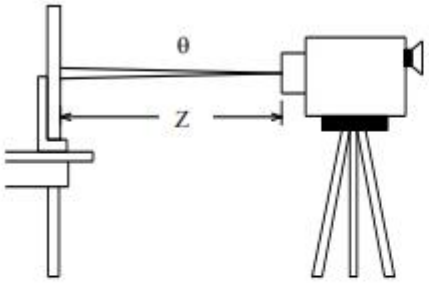


Fig. 7.1 The standard set-up system of measurement

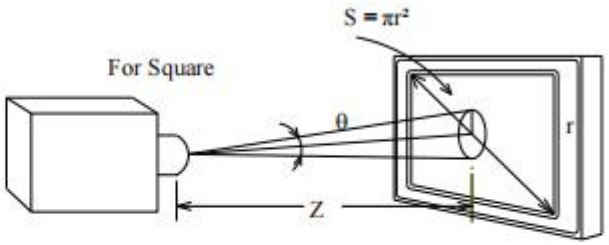


Fig. 7.2 The area S contains at least 500 pixels to be measured

$$N = \frac{S}{A} \geqslant 500 \text{ pixels}$$

N means the actual number of the pixels in the area S.

7.2 Optical Specifications

The table below of optical characteristics is measured by MINOLTA CS2000, ELDIM OPTI Scope-SA and ELDIM EZ
contrast in dark room

Item		Symbol	Condition	Min.	Typ.	Max.	Unit	Note
Static Contrast Ratio		CR	H = 0 , V = 0 Normal direction at center point with CSOT's BLU		3000	-	-	(1) (2)
Response Time		Ton+Toff			30	35	ms	(3)
Crosstalk		CT-127		-	-	1.2	-	(2)(5)
Center Transmittance		Tr%		-	3.8	-	%	(2)(4)
Color Chromaticity (CIE1931)	White	WX		Typ. - 0.03	0.313	Typ. + 0.03	-	(2) (6)
		WY			0.329		-	
	Red	RX			0.650		-	
		RY			0.338		-	
	Green	GX			0.312		-	
		GY			0.615		-	
	Blue	BX			0.150		-	
		BY			0.071		-	
	Color Gamut	CG		68	72	-	%NTSC	
Viewing Angle	Horizontal	H+	CR 10	80	89	-	Deg.	(7)
		H-		80	89	-		
	Vertical	V+		80	89	-		
		V-		80	89	-		

Note:

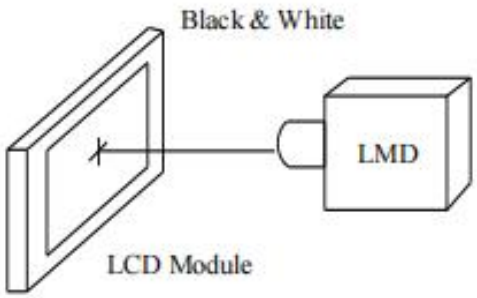
(1) Definition of static contrast ratio (CR):

It's necessary to switch off all the dynamic and dimming function when measuring the static contrast ratio.

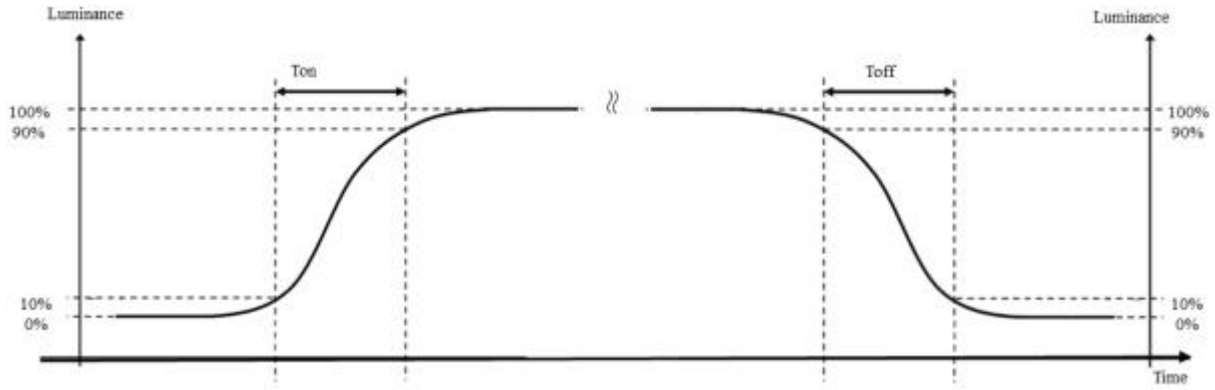
$$\text{Static Contrast Ratio (CR)} = \frac{\text{CR-W}}{\text{CR-D}}$$

CR-Wis the luminance measured by LMD (light-measuring device) at the center point of the LCD module with full-screen displaying white. The standard setup of measurement is illustrated in Fig. 7.3; CR-D is the luminance measured by LMD at the center point of the LCD module with full-screen displaying black. The LMD in this item is CS2000.

(2) The LMD in the item could be a spectrometer such as (KONICA MINOLTA) CS2000, CS1000 (TOPCON), SR-UL2 or the same level spectrometer. Other display color analyzer (KONICA MINOLTA) CA210, CA310 or (TOPCON) BM-7 could be involved after being calibrated with a spectrometer on each stage of a product.



(3) The electro-optical response time measurements shall be made as Figure 7.4 by switching the "data" input signal ON and OFF. The times needed for the luminance to change from 10% to 90% is Ton, and 90% to 10% is Toff.



All the transition time is measured at the center point of the LCD module by ELDIM OPTI Scope-SA.

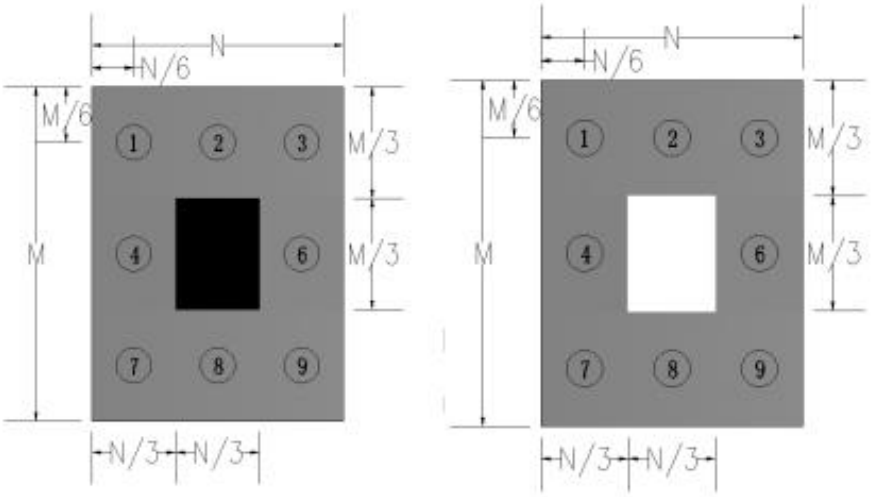
(4) Definition of center Transmittance (Tr %):

The transmittance is measured with full white pattern (Gray 255)

$$\text{Transmittance (Tr\%)} = \frac{\text{Luminance of LCD module}}{\text{Luminance of backlight}}$$

(5) Definition of the crosstalk:

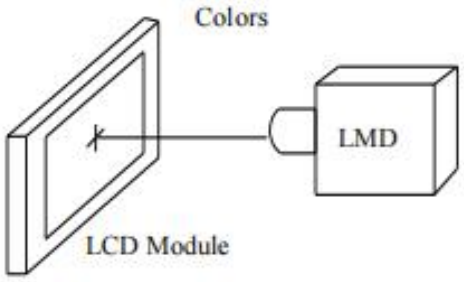
- The point should be marked is, the background of Cross-talk Test Pattern-"gray " are defined as 50% gray scale .
- △Bpn = Bpn (gray) / Bpn (white)
- Which n means the dot No. In the Cross-talk Test Pattern ;
  Bpn (gray) means the brightness of the No.n spots in Cross-talk Test Pattern;
  Bpn (white) means the brightness of the No.n spots in Full white Test Pattern;
- △Bp (Max.) = Maximum value in △Bp1~△Bp9, except the No. 5 spot.
- △Bp (Min.) = Minimum value in △Bp1~△Bp9, except the No.5 spot.
- △CT=△Bp (Max.)/△Bp(Min.)



Cross-talk Test Pattern

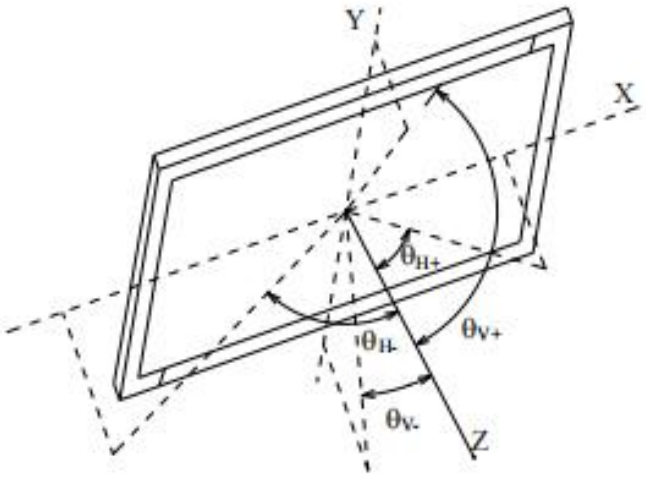
(6) Definition of color chromaticity:

Each chromaticity coordinates (x, y) are measured in CIE1931 color space when full-screen displaying primary color R, G, B and white. The color gamut is defined as the fraction in percent of the area of the triangle bounded by R, G, B coordinates and the area is defined by NTSC 1953 color standard in the CIE color space. Chromaticity coordinates are measured by CS2000 and the standard setup of measurement is shown in Fig. 7.6.



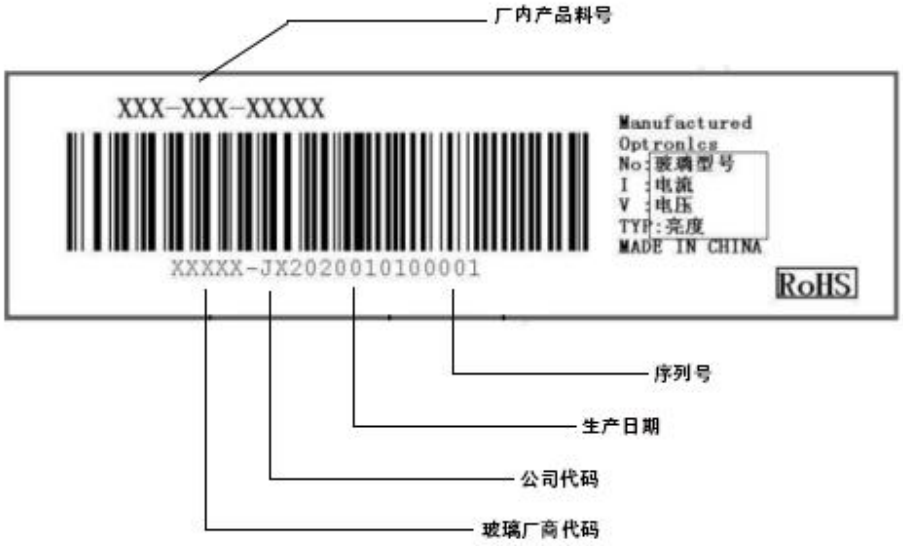
(7) Definition of viewing angle coordinate system (H, V):

The contrast ratio is measured at the center point of the LCD module. The viewing angles are defined at the angle that the contrast ratio is larger than 10 at four directions relative to the perpendicular direction of the LCD module (two vertical angles: up V+ and down V-; and two horizontal angles: right H+ and left H-) as illustrated in Fig. 7.7. The contrast ratio is measured by ELDIM EZ Contrast.

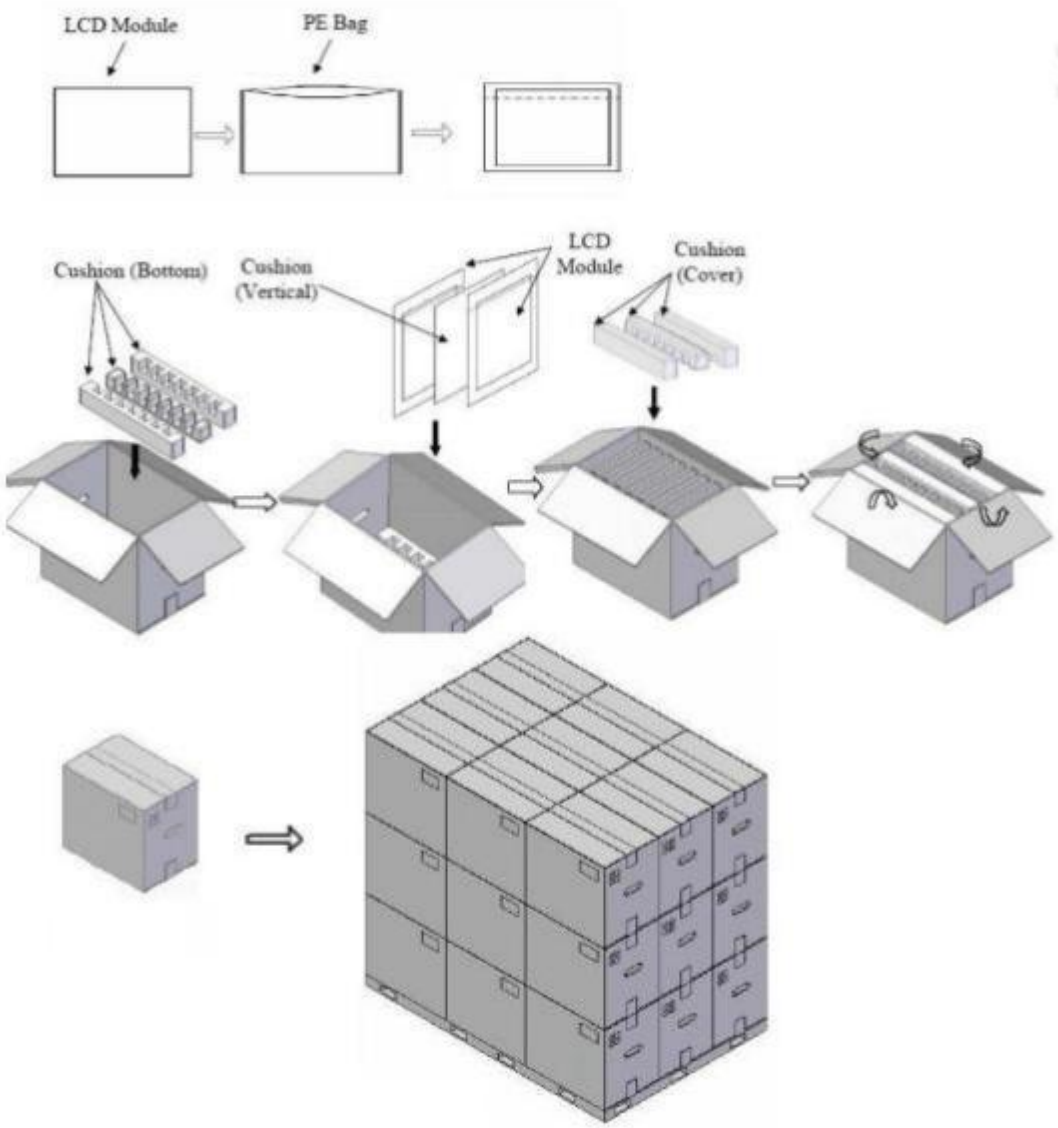


8. Shipping Label

The label is on the panel as shown below



Parameter	Packing box	Unit
Size	455(L)x 396(W)x 290(H)(typ.)	mm
Weight	-(typ.)	kg
Total weight	-(typ.) (with 10 products)	kg



9. Precaution

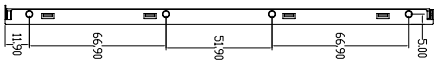
9.1 Assembly and handling precautions

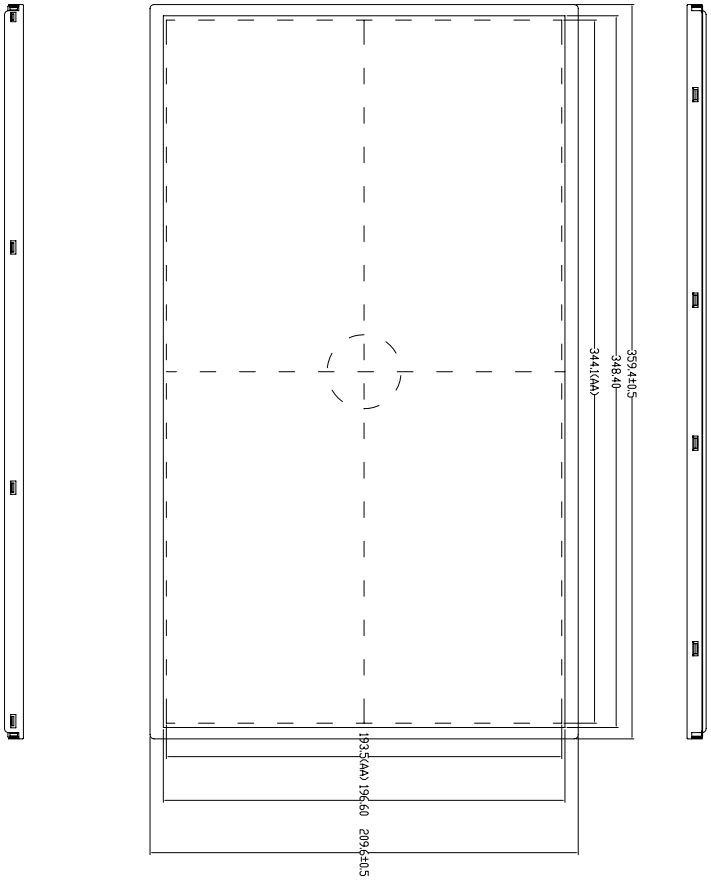
1. Do not apply rough force such as bending or twisting to the module during assembly.
2. To assemble or install module into user's system can be in clean working areas. The dust and oil may cause electrical short or worsen the polarizer.
3. It's not permitted to have pressure or impulse on the module because the LCD panel and Bac- klight will will be damaged.
4. Always follow the correct power sequence when LCD module is connecting and operating. This can prevent damage to the CMOS LSI chips during latch- up.
5. Do not pull the I/F connector in or out while the module is operating . 6 6. Do not disassemble themodule. Use a soft dry cloth without chemicals for cleaning, because the surface of polarizer is very
6. soft and easily scratched.

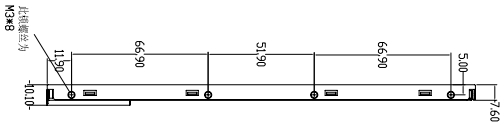
7. It is dangerous that moisture come into or contacted the LCD module, because moisture may damage LCD module when it is operating.
8. High temperature or humidity may reduce the performance of module. Please store LCD mo- dule within the specified storage conditions.
9. When ambient temperature is lower than 10 ℃ may reduce the display quality. For example, the response time will become slowly.

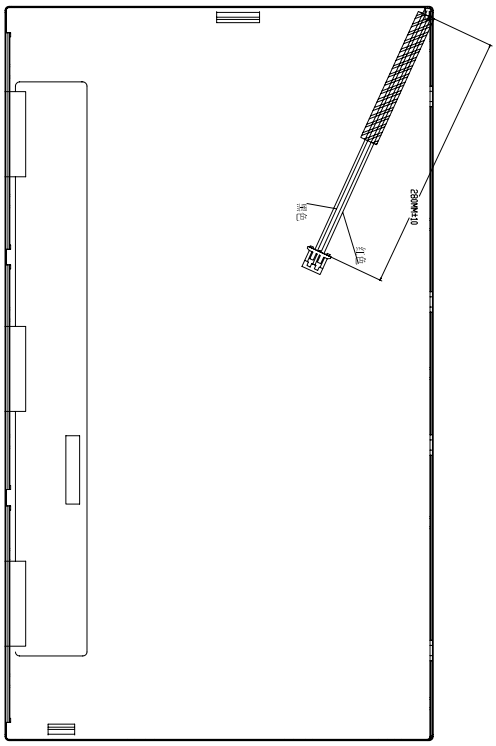
9.2 Safety precautions

1. It is dangerous that moisture come into or contacted the LCD module, because the moisture may damage LCD module when it is operating.
2. 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, skin or clothes, it has to be washed away thoroughly with soap.
3. After the modlule's end of life, it is not harmful in case of normal operation and stora.


11.90
66.90
51.90
66.90
5.00


359.4±0.5
348.40
344.1(AA)
193.5(AA)
196.60
209.6±0.5


M3*8
11.90
66.90
51.90
66.90
5.00
10.10
7.60


260MM±10