MODEL: MT4601B02-2

Ver. 1.1

Date: 18.Jun.2012

Customer's Approval	CSOT
Signature Date	Approved By Product Director Date Name: Signature:
	Reviewed By PM Manager Date Name: Signature:
	Reviewed By Project Leader Date Name: Signature:
	Reviewed By PM Date Name: Signature:

Contents

Revision History

Version	Date	Page (New)	Section	Description	Revision by
Ver. 0.1	26.Apr.2012	36	10	Tentative Specification was First Issued.	Wu Chenguo
Ver. 1.1	18.Jun.2012	36	10	Updated Optical Characteristics	Wu Chenguo

1. General Description

1.1 Product Features

- **FHD Resolution (1920 x 1080)**
- **High Brightness: 400 cd/m²**
- **Very High Contrast Ratio: 4000:1**
- **Fast Response Time**
- **High Color Saturation: 72% NTSC**
- **Ultra Wide Viewing Angle: 178° (H)/178° (V) (CR ≥ 10)**
- **Low Power Consumption: Typ. 76.7 W**
- **DE (Data Enable) Mode**
- **LVDS (Low Voltage Differential Signaling) Interface**

1.2 Overview

MT4601B02-2 is a diagonal 46.0" color active matrix LCD module with edge LED backlight and 4ch-LVDS interface. This module is a transmissive type display operating in the normally black mode. It supports 1920 x 1080 FHD resolution and can display up to 1073.7M colors (8bit+FRC). Each pixel is divided into Red, Green and Blue sub-pixels which are arranged in vertical stripe. The converter of backlight is built-in.

This module dedicates for LCD TV products and provides excellent performance which includes high brightness, ultra wide viewing angle, high color saturation and high color depth.

1.3 General Information

Item	Specification	Unit	Note
Active Area	1018.08 (H) x 572.67 (V)	mm	
Bezel Opening Area	1024.9 (H) x 579.3 (V)	mm	
Outline Dimension	1054.9 (H) x 610.8(V) x 10.8 (D)	mm	D: From Bezel to Rear
Weight	9.5	kg	Max.
Driving Scheme	a-Si TFT Active Matrix	-	
Number of Pixels	1920 x 1080	pixel	
Pixel Pitch (Sub Pixel)	0.17675 (H) x 0.53025 (V)	mm	
Pixel Arrangement	RGB Vertical Stripe	-	
Display Colors	1073.7 M	color	8bit+FRC
Display Mode	Transmissive Mode, Normally Black	-	
Surface Treatment	Anti-glare, Haze 2%,Hard Coating (3H)	-	
Luminance of White	400	cd/m²	Center Point, Typ.

2. Absolute Maximum Ratings

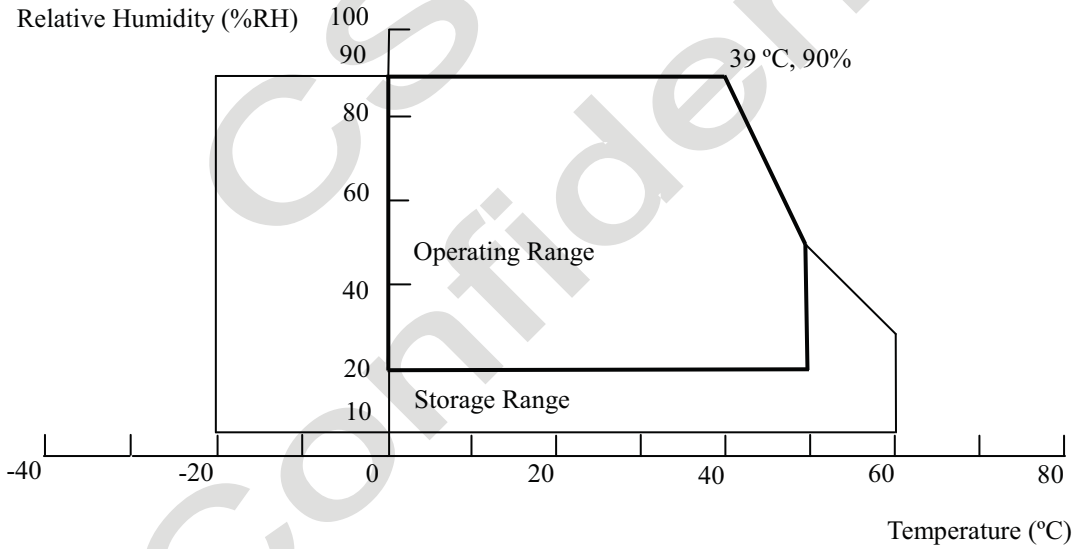
2.1 Absolute Maximum Ratings (Ta = 25 ± 2 °C)

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	13.8	V
Input Signal Voltage	V_{IN}	- 0.3	3.6	V
Light Bar Voltage	$V_{W(2D)}$	45.8	53.4	V_{RMS}
	$V_{W(3D)}$	51	60	
Converter Input Voltage	V_{BL}	0	30	V
Control Signal Level	-	-0.3	3.6	V

2.2 Environment Requirement

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



(a) 90%RH maximum (Ta ≤ 39 ºC).

(b) Wet-bulb temperature should be 39 ºC 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 65 ºC 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 65 ºC. The range of operating temperature may degrade in case of improper thermal management in the end product design.

(3) The TFT module including glass should be avoided any shock or vibration.

While testing shock and vibration, the fixture holding the module should be assured to be hard and rigid enough to prevent

the module twisted or bent by the fixture. The test conditions should be less than:

Shock (Non-operating): 35 G, 11 ms, half sine wave, 1 time for ± X, ± Y, ± Z.

Vibration (Non-operating): Random 1.0 Grms, 10 ~ 200 Hz, 10 min, 1 time for each X, Y, Z.

2.3 Package Storage

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

(1) Do not store the module in high temperature and high humidity for a long time. It is highly recommended to store the module with temperature from 0 ºC to 35 ºC in normal humidity.

(2) The module shall be stored in a dark area and avoided to be exposed in direct sunlight or fluorescent light.

3. Electrical Specification

3.1 Electrical Characteristics

3.1.1 Power Consumption (Ta = 25 ± 2 ºC)

Parameter		Symbol	Value			Unit	Note
			Min.	Typ.	Max.		
Power Supply Voltage		V_{CC}	10.8	12.0	13.2	V	(1)
Rush Current		I_{RUSH}	-	-	2.3	A	(2)
Power Supply Current	White Pattern	I_{CC}	-	0.39	0.5	A	(3)
	Horizontal Stripe	I_{CC}	-	0.91	1.2	A	
	Black Pattern	I_{CC}	-	0.37	0.5	A	

Note:

(1) The ripple voltage should be controlled less than 10% of V_{CC}.

(2) Measurement condition: V_{CC} rising time = 470 μs.

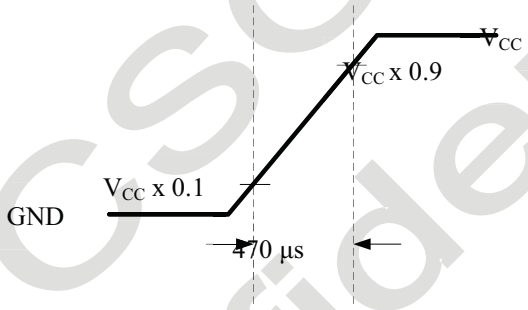
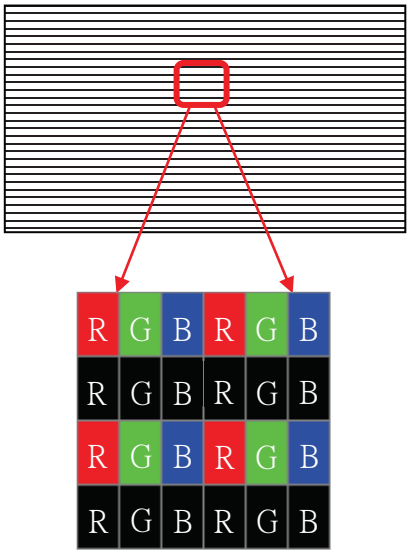


Fig. 3.1 V_{CC} rising time condition

(3) Measurement condition: V_{CC} = 12 V, Ta = 25 ± 2 ºC, F = 120 Hz. The test patterns are shown as below.

A. White Pattern

B. Horizontal Pattern



C. Black Pattern

Fig. 3.2 Test patterns

3.1.2 LVDS Characteristics

Parameter		Symbol	Value			Unit	Note
			Min.	Typ.	Max.		
LVDS Interface	Differential Input High Threshold Voltage	V_{TH}	+ 100	-	-	mV	(1)
	Differential Input Low Threshold Voltage	V_{TL}	-	-	- 100	mV	
	Common Input Voltage	V_{CM}	1.0	1.2	1.4	V	
	Differential Input Voltage	$\|V_{ID}\|$	200	400	600	mV	
	Terminating Resistor	R_T	80	100	120	ohm	
CMOS Interface	Input High Threshold Voltage	V_{IH}	2.7	-		V	
	Input Low Threshold Voltage	V_{IL}		-	0.7	V	

Note:

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

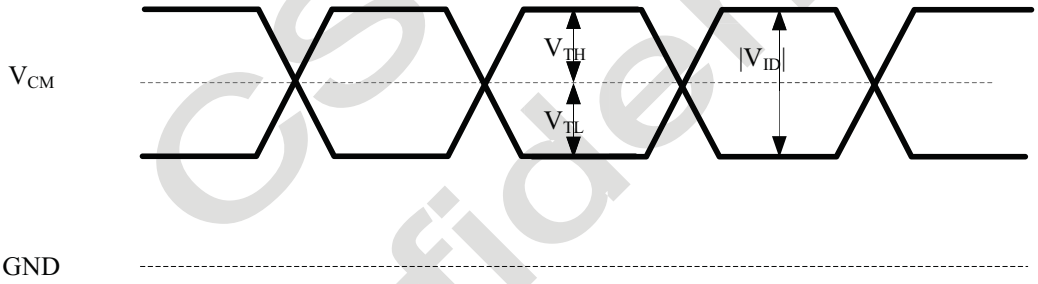


Fig. 3.3 LVDS input signal

3.2 Backlight Converter Unit

3.2.1 LED Converter Electrical Characteristics (Ta = 25 ± 2 ºC)

Parameter		Symbol	Value			Unit	Note
			Min.	Typ.	Max.		
Power Consumption		$P_{BL(2D)}$	-	72	-	W_{att}	(1),
		$P_{BL(3D)}$	-	34		W_{att}	(2)
Input Voltage		V_{BL}	22.8	24.0	25.2	V	
Input Current		$I_{BL(2D)}$	-	3		A	(1),
		$I_{BL(3D)}$	-	1.41		A	(2)
Input Inrush Current		$I_{RS\ (2D)}$		-	5.23	A	Vbl=22.8V
		$I_{RS\ (3D)}$		-	8.3	A	Vbl=22.8V
On/Off Control Voltage	On	V_{BLON}	2.5	-	5.0	V	
	Off		0.0	-	0.8	V	
On/Off Control Current	-	I_{BLON}	-	-	1.5	mA	
PWM Dimming Control Voltage	Max.	V_{PDIM}	2.5	-	3.3	V	
	Min.		0.0	-	0.8	V	
External PWM Control Current		I_{P-DIM}	-	-	2	mA	
PWM Dimming Frequency		F_{PWM}	160	180	200	Hz	
Dimming Duty Ratio		D_{DIM}	10	-	100	%	
DET Status Signal		DET HI	Open Collector				
		DET Low	0		0.8	V	
Input Impedance		R_{IN}	200			Kohm	

Note:

(1) Dimming ratio = 100% (Max.) (T_A = 25 ± 5 ºC, Turn on for 45minutes)

(2) T_A = 25 ± 5 ºC, Turn on for 45minutes

3.2.2 LED Converter Power Sequence

No	ITEM	SYMBOL	MIN.	TYP.	MAX.	UNIT	Remark
1	V_{BL} Rising Time	T_r	20	—	—	ms	See Fig.3.5
2	V_{BL} Falling Time Time	T_f	20	—	—	ms	
3	V_{BLON} Rising Time	T_{r1}	—	—	100	ms	
4	V_{BLON} Falling Time	T_{f1}	—	—	100	ms	
5	VBL to V_{P_DIM} Delay Time	T_1	500	—	—	ms	
6	BLON Delay Time	T_2	250	—	—	ms	
7	BLON Off Time	T_3	0	—	—	ms	
8	V_{P_DIM} Off Time	T_4	250	—	—	ms	

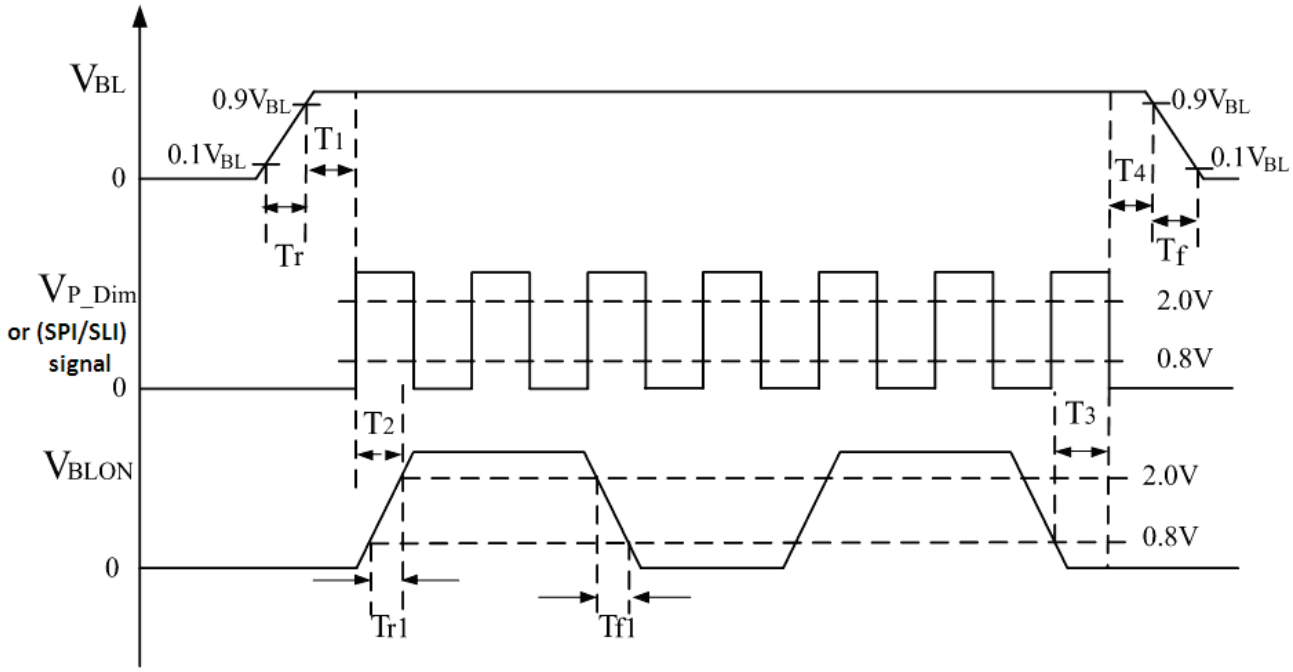
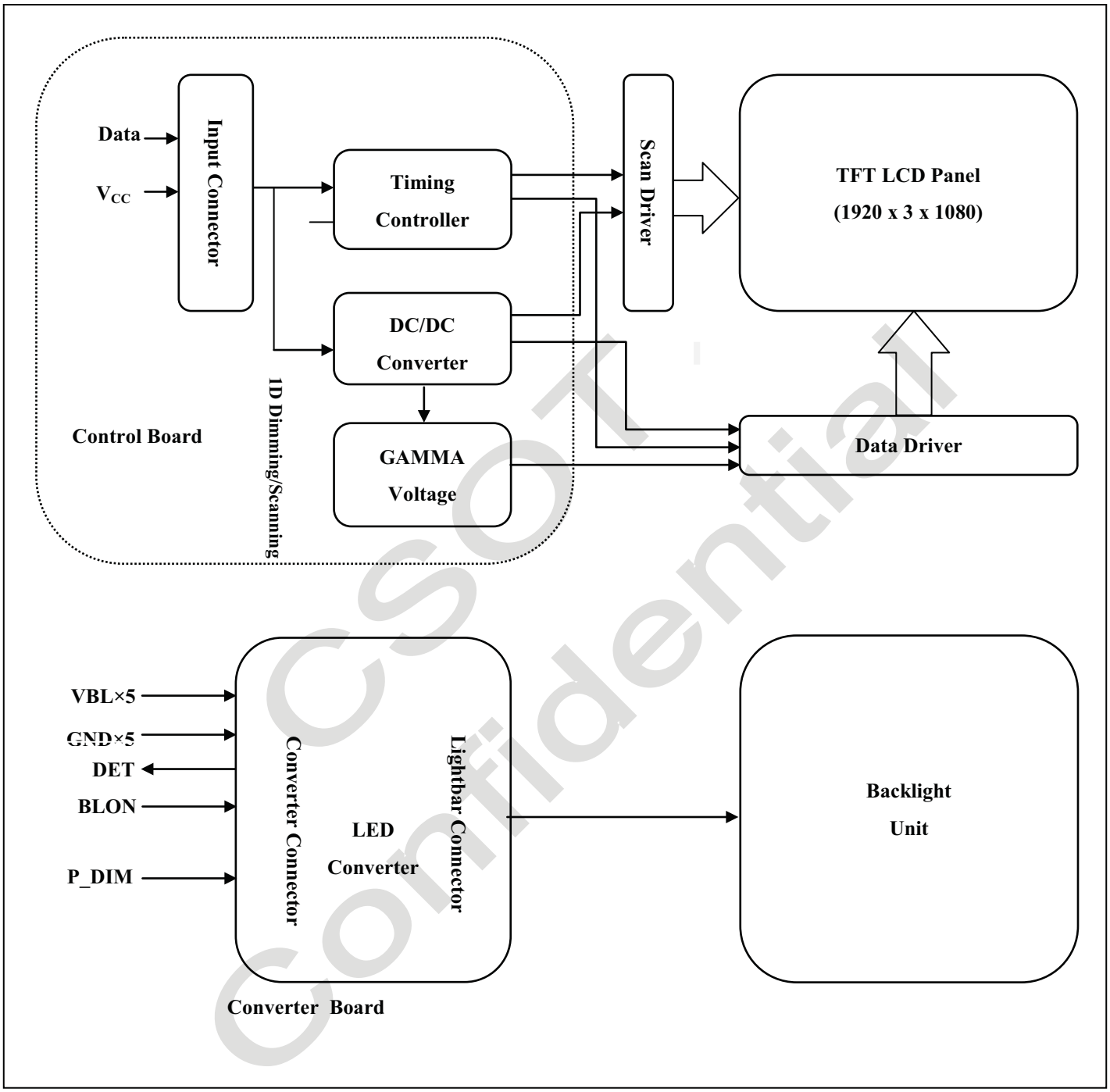


Fig. 3.4 The Power Sequence of V_{BL} , VP_Dim and V_{BLON}

4. Electrical Block Diagram



5. Input Terminal Pin Assignment

5.1 TFT LCD Module

CN3: 300C51-0000RA-G(STARCONN)or equivalent (see Note (1))

Pin No.	Symbol	Description	Note
1	Vdd（12）	Power Supply, + 12 V DC Regulated	
2	Vdd（12）	Power Supply, + 12 V DC Regulated	
3	Vdd（12）	Power Supply, + 12 V DC Regulated	
4	Vdd（12）	Power Supply, + 12 V DC Regulated	
5	Vdd（12）	Power Supply, + 12 V DC Regulated	
6	SEL_LVDS	LVDS Data Format Selection	(2)
7	GND	Ground	
8	GND	Ground	
9	GND	Ground	
10	Rx2［0］N	EVEN LVDS SIGNAL	
11	Rx2［0］P		
12	Rx2［1］N		
13	Rx2［1］P		
14	Rx2［2］N		
15	Rx2［2］P		
16	GND		
17	Rx2CLK-		
18	Rx2CLK+		
19	GND		
20	Rx2［3］N		
21	Rx2［3］P		
22	Rx2［4］N		
23	Rx2［4］P		
24	GND		
25	Rx4［0］N		
26	Rx4［0］P		
27	Rx4［1］N		
28	Rx4［1］P		
29	Rx4［2］N		
30	Rx4［2］P		
31	GND		
32	Rx4CLK-		
33	Rx4CLK+	EVEN LVDS SIGNAL	

34	GND		
35	Rx4［3］N		
36	Rx4［3］P		
37	Rx4［4］N		
38	Rx4［4］P		
39	GND	Ground	
40	NC	No Connection	(3)
41	NC	No Connection	(3)
42	3D_EN signal	3D Enable signal，H for 3D mode，L for 2D mode	
43	NC	No Connection	(3)
44	NC	No Connection	(3)
45	GND	Ground	
46	NC	No Connection	(3)
47	NC	No Connection	(3)
48	3D_SYNC_I	Shutter glass Sync input signal	
49	3D_SYNC_O	Shutter glass Sync Signal	
50	NC	No Connection	(3)
51	NC	No Connection	(3)

CN2: 300C41-0000RA-G4 (STARCONN) or equivalent (see Note (1))

Pin No.	Symbol	Description	Note
1	Vdd（12）	Power Supply, + 12 V DC Regulated	
2	Vdd（12）	Power Supply, + 12 V DC Regulated	
3	Vdd（12）	Power Supply, + 12 V DC Regulated	
4	Vdd（12）	Power Supply, + 12 V DC Regulated	
5	Vdd（12）	Power Supply, + 12 V DC Regulated	
6	NC	No Connection	(3)
7	GND	Ground	
8	GND	Ground	
9	GND	Ground	(2)
10	Rx1［0］N	ODD LVDS SIGNAL	
11	Rx1［0］P		
12	Rx1［1］N		
13	Rx1［1］P		
14	Rx1［2］N		
15	Rx1［2］P		
16	GND		

17	Rx1CLK-	ODD LVDS SIGNAL	
18	Rx1CLK+		
19	GND		
20	Rx1［3］N		
21	Rx1［3］P		
22	Rx1［4］N		
23	Rx1［4］P		
24	GND		
25	Rx3［0］N		
26	Rx3［0］P		
27	Rx3［1］N		
28	Rx3［1］P		
29	Rx3［2］N		
30	Rx3［2］P		
31	GND		
32	Rx3CLK-		
33	Rx3CLK+		
34	GND		
35	Rx3［3］N		
36	Rx3［3］P		
37	Rx3［4］N		
38	Rx3［4］N		
39	GND	Ground	
40	NC	No Connection	(3)
41	NC	No Connection	(3)

Note:

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

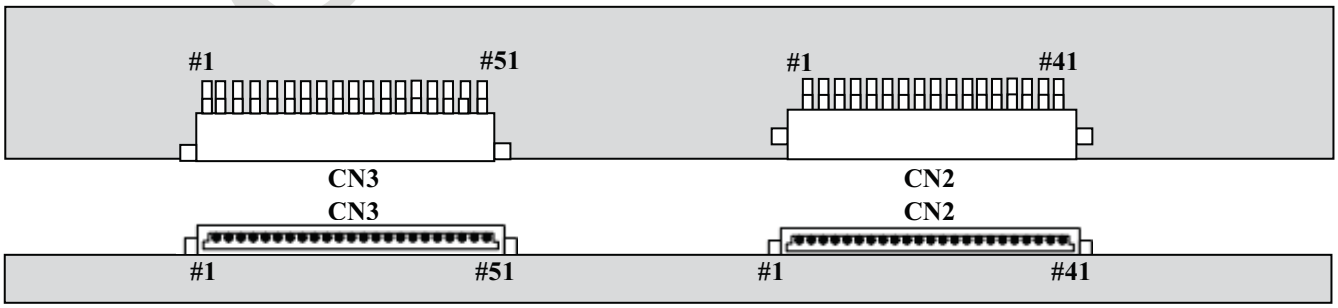


Fig. 5.1 LVDS connector direction sketch map

(2) High: connect to + 3.3 V → NSformat; Low: connect to GND or Open → JEIDA format.

(3) For CSOT internal only, please let it open.

5.2 Converter Unit

5.2.1 Converter Input Connector Pin Definition

CN1: CI1114M1HR0-NH (Cvilux) or equivalent (see 5.2 Note (1))

Pin No.	Symbol	Feature
1	V_{BL}	Power Supply, + 24 V DC Regulated
2		
3		
4		
5		
6	GND	GND
7		
8		
9		
10		
11	DET	Normal (0 ~ 0.8 V), Abnormal (Open Collector)
12	BLON	BLON/OFF, BLON Floating: BLU ON
13	NC	NC
14	P_DIM	PWM Dimming Control (Open for 100%)

Note (1):

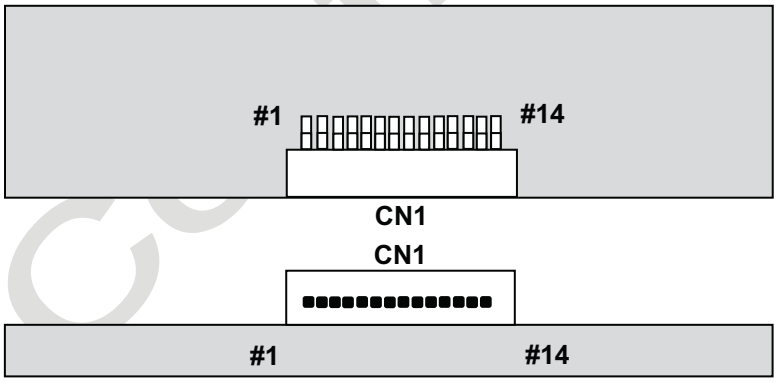


Fig. 5.2 Power input connector direction sketch map

5.3 Block Diagram of Interface

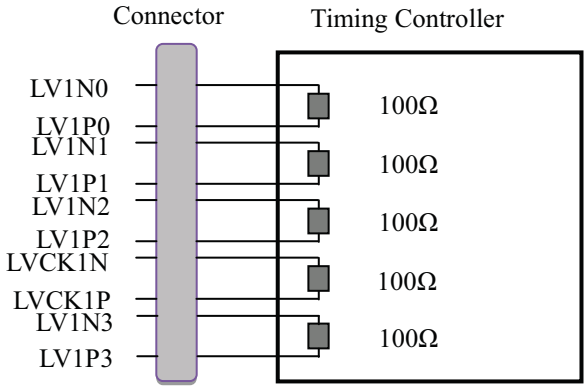


Fig. 5.3 Block diagram of interface

Attention:

(1) LCD module 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 respectively.

5.4 LVDS Interface

5.4.1 NS Format (SELLVDS = H)

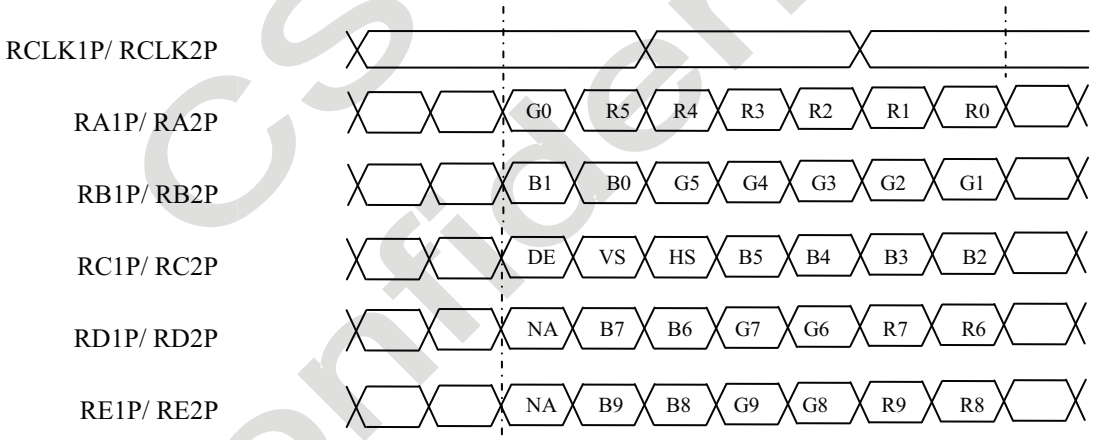


Fig. 5.4 NS format

5.4.2 JEIDA Format (SELLVDS = L or Open)

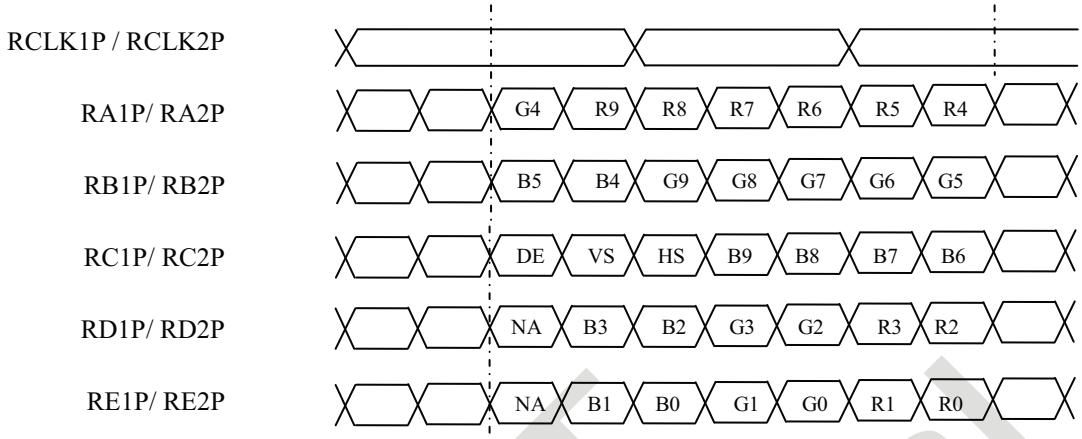


Fig. 5.5 JEIDA format

5.5 Color Data Input Assignment

The brightness of each primary color is based on the 10-bit gray scale data input for each color. The higher the binary input, the brighter the color. The table below provides the assignment of the color versus.

Data Input Color		Data Signal																													
		Red										Green										Blue									
		MSB									LSB	MSB									LSB	MSB									LSB
		R9	R8	R7	R6	R5	R4	R3	R2	R1	R0	G9	G8	G7	G6	G5	G4	G3	G2	G1	G0	B9	B8	B7	B6	B5	B4	B3	B2	B1	B0
Basic Colors	Black	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Red (1023)	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Green (1023)	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0
	Blue (1023)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1
	Cyan	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	Magenta	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1
	Yellow	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0
	White	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Gray Scale of Red	Red (000)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Red (001)	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
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	Red (1022)	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Red (1023)	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gray Scale of Green	Green (000)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Green (001)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
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	Green (1022)	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0
	Green (1023)	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0
Gray Scale of Blue	Blue (000)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Blue (001)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
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	Blue (1022)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	0
	Blue (1023)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1

Attention:

0: Low level voltage; 1: High level voltage.

6. Interface Timing

6.1 Timing Table (DE Only Mode)

Signal	Item	Symbol	Min.	Typ.	Max.	Unit	Note
LVDS Clock	Frequency	F_{CLK} (= 1 / T_{CLK})	64.80	74.25	80.74	MHz	
Vertical Term	Frame Rate	F	-	120	-	Hz	
	Total	T_V	1092	1125	1392	T_H	$T_V = T_{VD} + T_{VB}$
	Display	T_{VD}	1080			T_H	
	Blank	T_{VB}	12	45	312	T_H	
Horizontal Term	Total	T_H	540	570	580	T_{CLK}	$T_H = T_{HD} + T_{HB}$
	Display	T_{HD}	480			T_{CLK}	
	Blank	T_{HB}	60	90	100	T_{CLK}	

Attention:

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

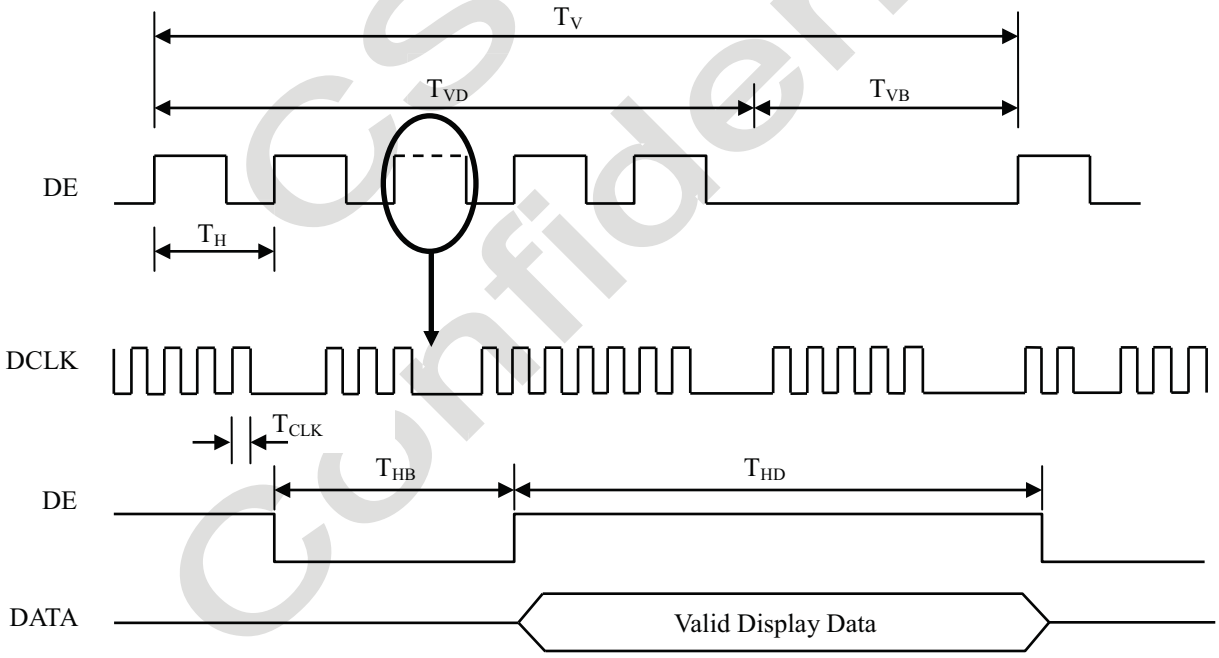
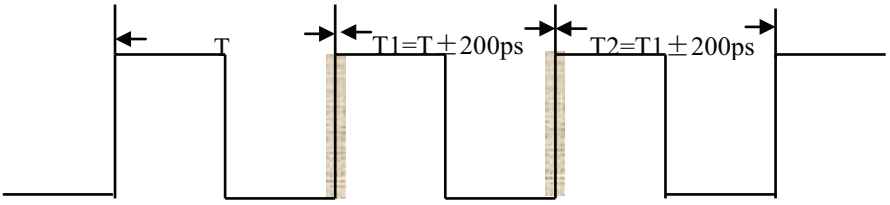


Fig. 6.1 Interface signal timing diagram

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



jitter

6.2 Power On/Off Sequence

6.2.1 Power On/Off Sequence

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

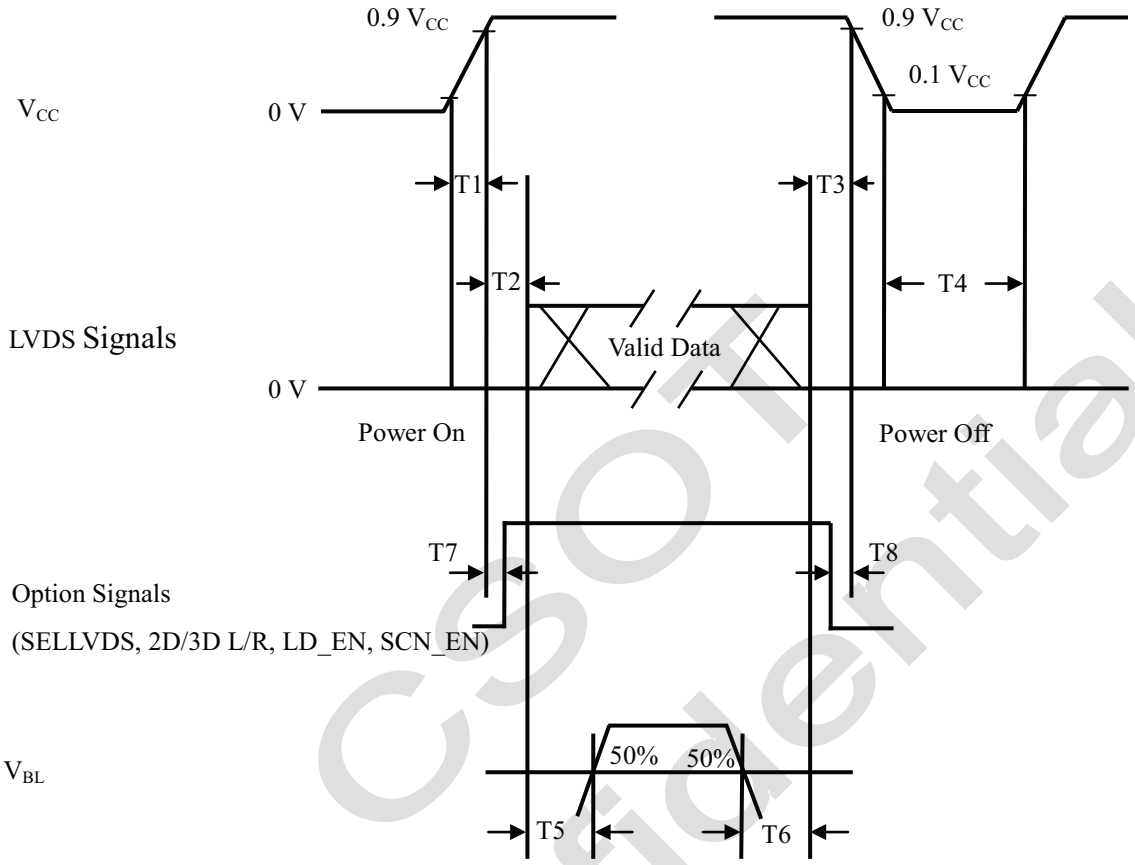
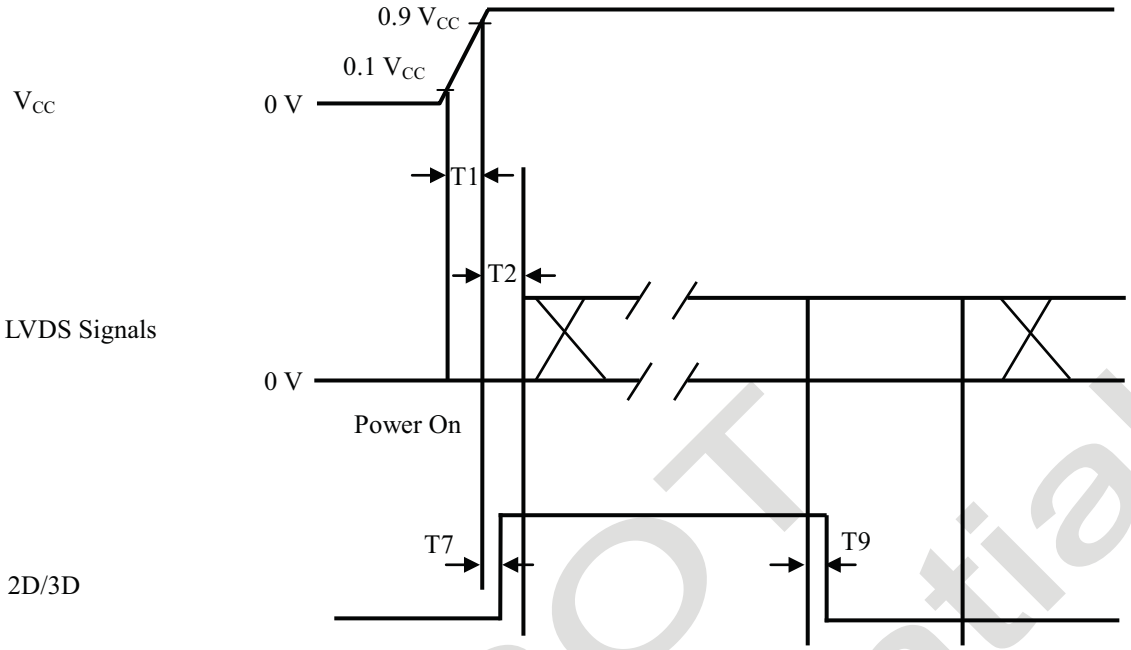


Fig. 6.2 Power on/off sequence

6.2.2 2D/3D Change Signal Sequence without Vcc Turn off and Turn on



Parameter	Values			Unit
	Min.	Typ.	Max.	
T1	0.5	-	10.0	ms
T2	0.0	-	-	ms
T3	0.0	-	-	ms
T4	1000.0	-	-	ms
T5	500.0	-	-	ms
T6	100.0	-	-	ms
T7	-	-	T2	ms
T8	-	-	T3	ms
T9	0.0	-	10.0	ms

Attention:

(1) The supply voltage of the external system for the module input should follow the definition of V_{CC}.

(2) Apply the lightbar voltage within the LCD operation range. When the 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 V_{CC} 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.

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
Supply Voltage	V_{CC}	12	V
Driving Signal	Refer to the typical value in Chapter 3: Electrical Specification		
Light Source Current (Each Unit)	I_L	84	mA
Vertical Refresh Rate	F_R	120	Hz

To avoid abrupt temperature change during optical measurement, it's suggested to warm up the LCD module more than 60 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 module 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 370 mm when θ is 2 degree. Hence, 500 mm 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.

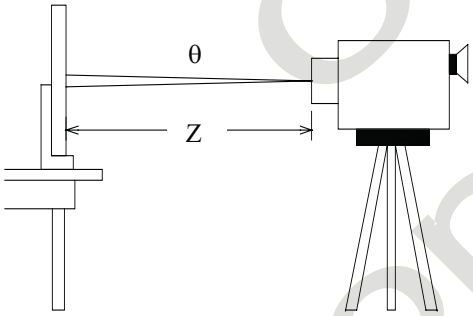


Fig. 7.1 The standard set-up system of measurement

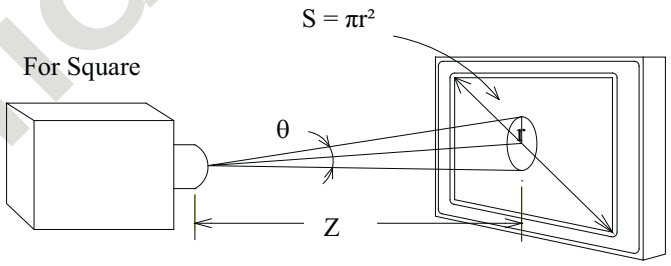


Fig. 7.2 The area S contains at least 500 pixels to be measured

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

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, MINOLTA CA310, ELDIM OPTI Scope-SA and ELDIM EZContrast in dark room.

Item		Symbol	Condition	Min.	Typ.	Max.	Unit	Note
Static Contrast Ratio		CR	$\theta_H = 0°$, $\theta_V = 0°$ Normal direction at center point of the LCD module.	-	4000	-	-	(1) (2)
Response Time		T_L		-	6.5	-	ms	(3) OPTI Scope-SA
Center Luminance		L_{W-2D}		320	400	-	cd/m^2	(2) (4)
		L_{W-3D}		-	50	-	-	(8)
3D Crosstalk		CT-3D		-	4%	-	-	(8)
Uniformity of White Screen		-		75	-	-	%	(2) (5)
Color Chromaticity (CIE1931)	Red	R_X		Typ. - 0.03	0.640	Typ. + 0.03	-	(2) (6)
		R_Y			0.337		-	
	Green	G_X			0.325		-	
		G_Y			0.625		-	
	Blue	B_X			0.154		-	
		B_Y			0.055		-	
	White	W_X			0.280		-	
		W_Y			0.290		-	
	Color Gamut	CG		-	72	-	% NTSC	
Viewing Angle	Horizontal	θ_{H+}	CR ≥ 10	-	89	-	Deg.	(7) ELDIM EZContrast
		θ_{H-}		-	89	-		
	Vertical	θ_{V+}		-	89	-		
		θ_{V-}		-	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-W is 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.

(2) The LMD in the item could be a spectroradiometer such as (KONICA MINOLTA) CS2000, CS1000, (TOPCON) SR-UL2

or the same level spectroradiometer. Other display color analyzer (KONICA MINOLTA) CA210, CA310 or (TOPCON) BM-7 could be involved after being calibrated with a spectroradiometer on each stage of a product.

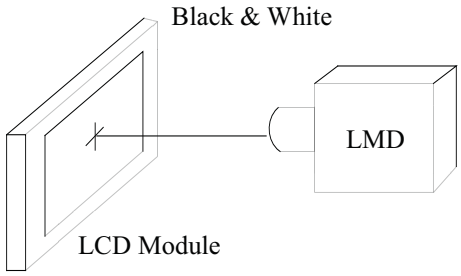


Fig. 7.3 The standard setup of CR measurement

(3) Response time T_L is defined as the average transition time in the response time matrix. The table below is the response time matrix in which each element $t_{X\ to\ Y}$ is the transition time from luminance ratio X to Y. X and Y are two different luminance ratios among 0%, 25%, 50%, 75%, and 100% luminance. The transition time $t_{X\ to\ Y}$ is defined as the time taken from 10% to 90% of the luminance difference between X and Y (X < Y) as illustrated in Fig.3. When X > Y, the definition of $t_{X\ to\ Y}$ is the time taken from 90% to 10% of the luminance difference between X and Y. The response time is optimized on refresh rate F_R = 60Hz.

Measured Transition Time		Luminance Ratio of Previous Frame				
		0%	25%	50%	75%	100%
Luminance Ratio of Current Frame	0%		$t_{25\%\ to\ 0\%}$	$t_{50\%\ to\ 0\%}$	$t_{75\%\ to\ 0\%}$	$t_{100\%\ to\ 0\%}$
	25%	$t_{0\%\ to\ 25\%}$		$t_{50\%\ to\ 25\%}$	$t_{75\%\ to\ 25\%}$	$t_{100\%\ to\ 25\%}$
	50%	$t_{0\%\ to\ 50\%}$	$t_{25\%\ to\ 50\%}$		$t_{75\%\ to\ 50\%}$	$t_{100\%\ to\ 50\%}$
	75%	$t_{0\%\ to\ 75\%}$	$t_{25\%\ to\ 75\%}$	$t_{50\%\ to\ 75\%}$		$t_{100\%\ to\ 75\%}$
	100%	$t_{0\%\ to\ 100\%}$	$t_{25\%\ to\ 100\%}$	$t_{50\%\ to\ 100\%}$	$t_{75\%\ to\ 100\%}$	

$t_{X\ to\ Y}$ means the transition time from luminance ratio X to Y.

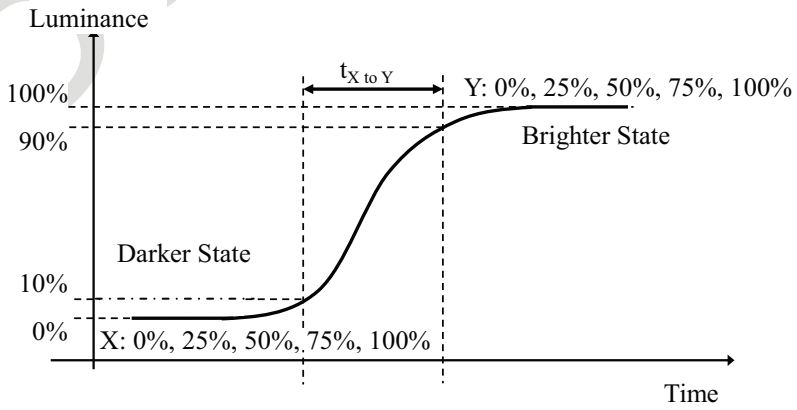


Fig. 7.4 The definition of $t_{X\ to\ Y}$

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

(4) Definition of center luminance (L_W):

The luminance is measured at the center point of the LCD module with full-screen displaying white. Fig. 7.5 shows the standard setup of luminance measurement.

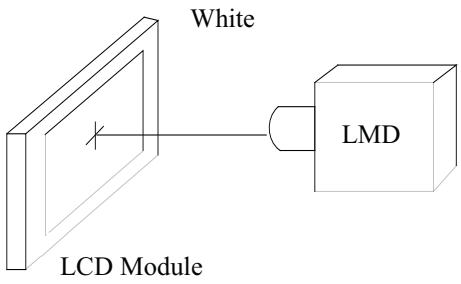


Fig. 7.5 The standard setup of luminance measurement

(5) Definition of uniformity of white screen:

The luminance Li (i from 1 to 9) is measured at the 9 points defined in Fig. 7.6. H and V indicate active area.

From the measured set of luminance values Li (i from 1 to 9), the minimum luminance is denoted as L_{min} and the maximum luminance is denoted as $L_{max.}$ .The uniformity of white screen is defined according to

Uniformity = L_{min} / L_{max} x 100%.

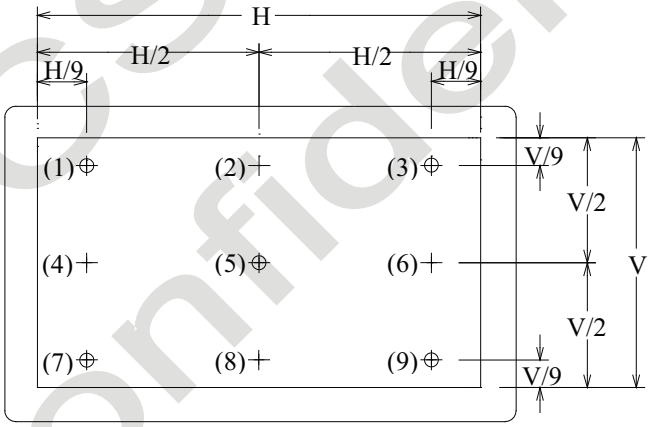


Fig. 7.6 Symbol " + " defines the 9 measuring locations (1), (2), (3) ⋯ (9)

(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. 7.7.

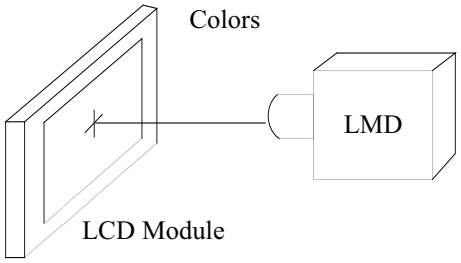


Fig. 7.7 The standard setup of color chromaticity measurement

(7) Definition of viewing angle coordinate system (θ_H, θ_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 θ_{V+} and down θ_{V-}; and two horizontal angles: right θ_{H+} and left θ_{H-}) as illustrated in Fig. 7.8. The contrast ratio is measured by ELDIM EZ Contrast.

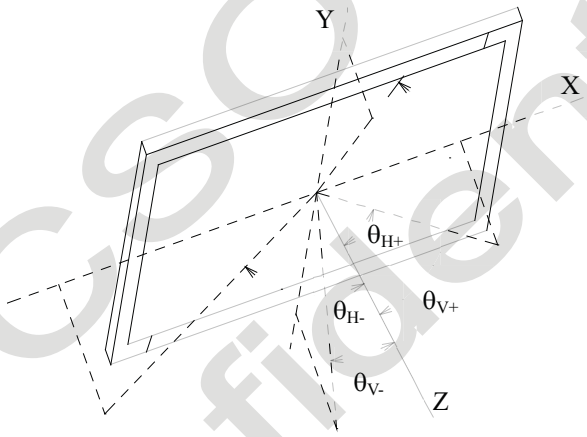


Fig. 7.8 Viewing angle coordination system

(8) Definition of the 3D mode performance:

Test pattern

Pattern	Left eye image	Right eye image	remark
WW			Left eye image: L255 Right eye image:L255 L(WW) is denoted as the luminance of "WW"
WB			Left eye image: L255 Right eye image:L0 L(WB) is denoted as the luminance of "WB"
BW			Left eye image: L0 Right eye image:L255 L(BW) is denoted as the luminance of "BW"

BB			Left eye image: L0 Right eye image:L0 L(BB) is denoted as the luminance of "BB"

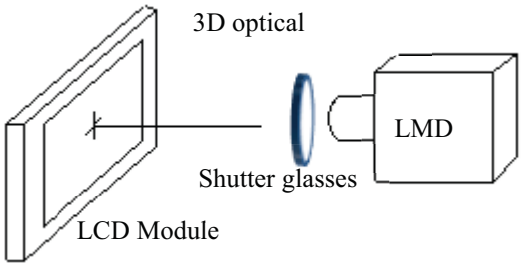


Fig. 7.9 3D optical measurement system

Measure the center point of the LCD module through the shutter glasses under 3D mode operation.

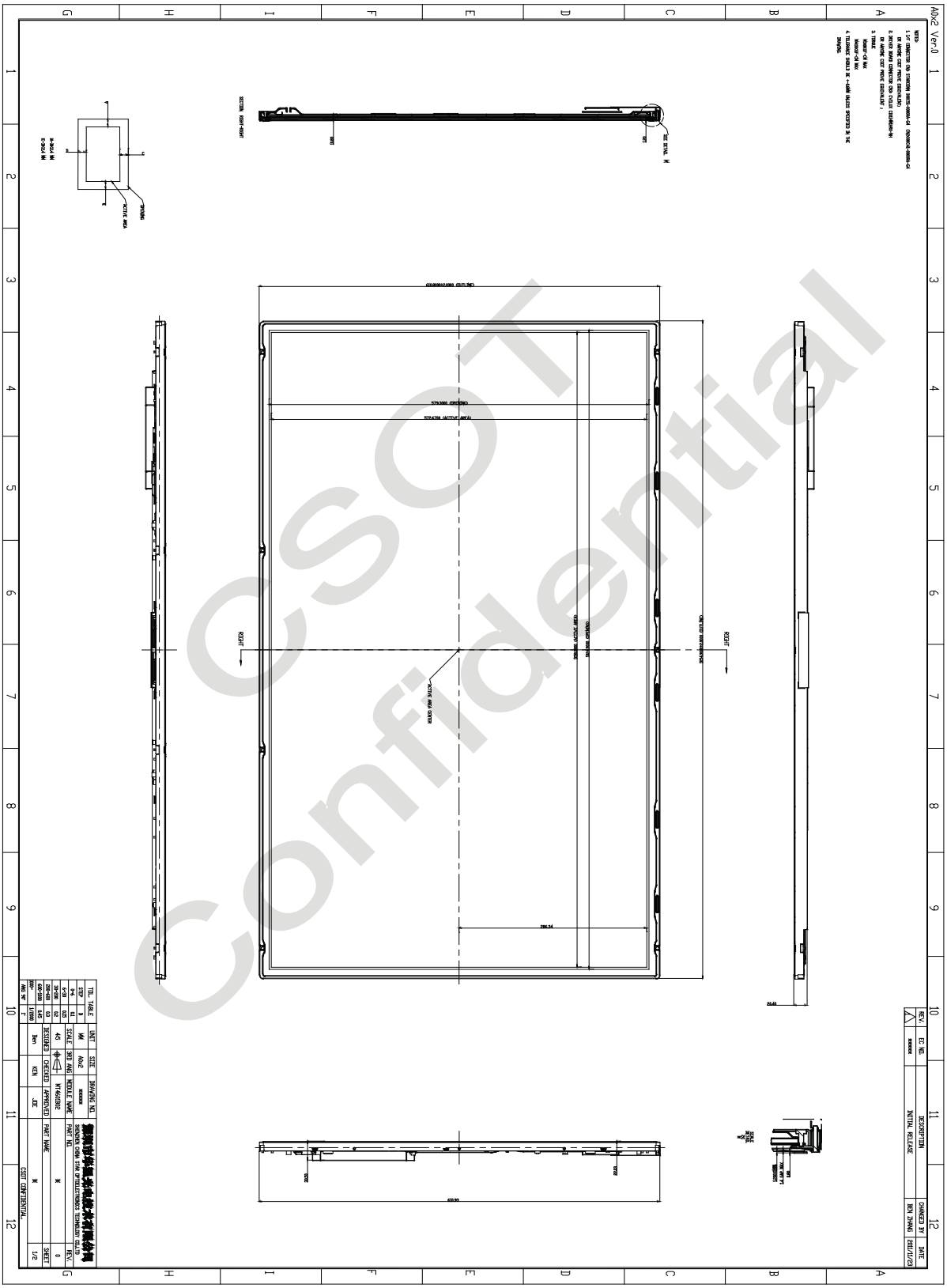
The 3D luminance (Lw-3D) is the luminance measured by LMD with well controlled shutter glasses at the center point of the LCD module with test pattern L(WW).

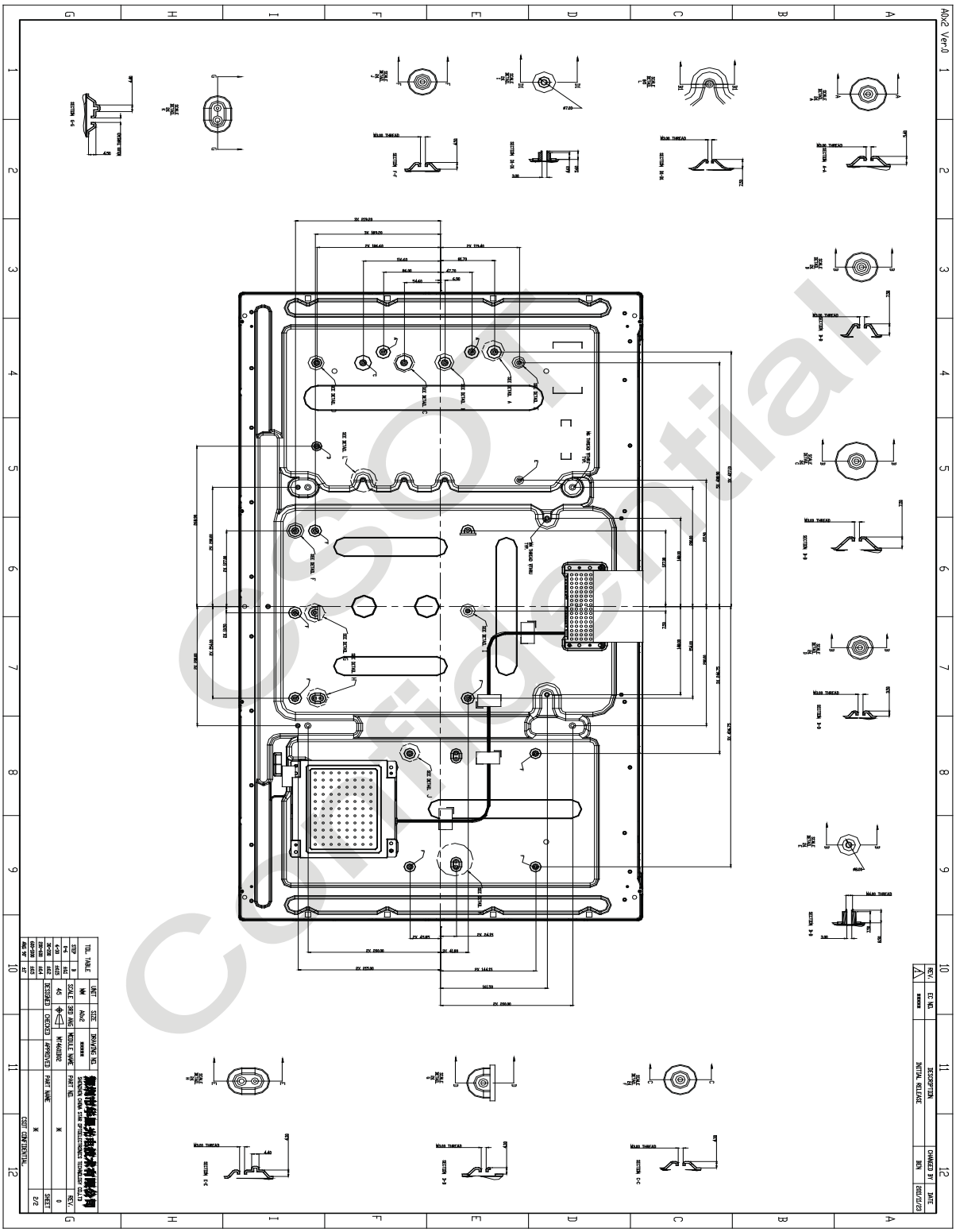
The 3D crosstalk is measuremd at the center point of the LCD modeule through right-eye glasses..

Definition of the 3D mode crosstalk: $CT\text{-}3D = \frac{L(WB)-L(BB)}{L(BW)-L(BB)}$

8. Mechanical Characteristics

8.1 Mechanical Specification





8.2 Packing

8.2.1 Packing Specifications

Item	Specification		
	Quantity	Dimension (mm)	Weight (kg)
Packing Box	22pcs / box	1157.0 (L) x 1066.0 (W) x 675.0 (H)	Net Weight: 209.0 Gross Weight: 223.0
Pallet	1	1200 (L) x 1100 (W) x 175 (H)	Net Weight: 19
Stack Layer	3		
Boxes per Pallet	1 box / pallet		
Pallet after Packing	22 pcs / pallet	1200 (L) x 1120 (W) x 850(H)	Gross Weight: 242

8.2.2 Packing Method

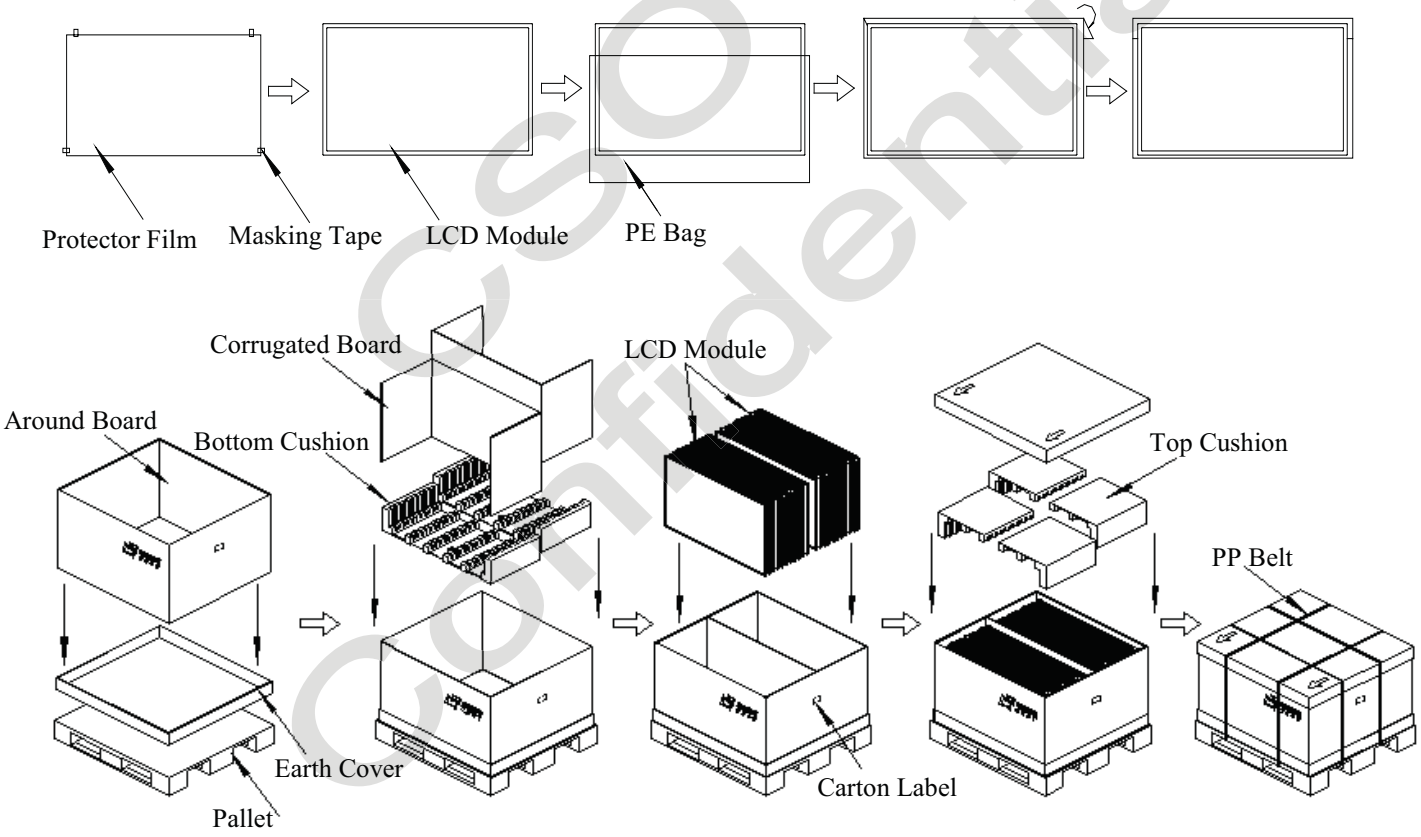
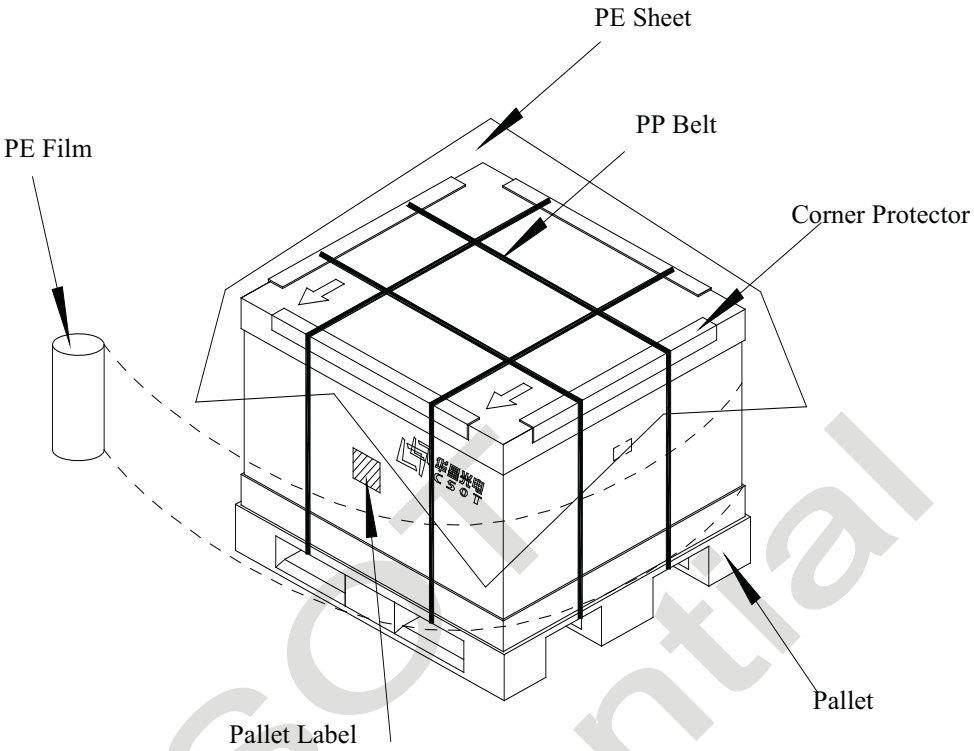


Fig. 8.1 Packing method (protector film stick on the front of the LCD module)



2 pcs Pallet label stick on the PE Film.

Relative to the two sides.

Fig. 8.2 Shipping method

9. Definition of Labels

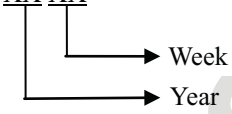
9.1 Module Label

For RoHs compatible products, CSOT will add RoHS for identification.

Model Name: MT4601B02-2

Ver.X.X: Version, for example: 0.1, 0.2, … , 1.1, 1.2, …, 2.1, 2.2, …

WC (Week Code): XX XX



Year: 2010 = 10, 2011 = 11 … 2020 = 20, 2021 = 21…

Week: 01, 02, 03 …

Serial Number: XXXXXXXXXXXX XXXXXXXX

9.2 Carton Label

Model Name: MT4601B02-3

Serial Number: XXXXX XX XXXXX XXXXX

- XXXXX → CSOT Internal Use
- XXXXX → Year, Month, Date
- XX → Model Version Code
- XXXXX → CSOT Internal Use

Manufactured Date:

Year: 2010 = 10, 2011 = 11…2020 = 20, 2021 = 21…

Month: 1~9, A~C, for Jan. ~ Dec.

Date: 01~31, for 1st to 31st

Model Version Code: Version of product, for example: 01, 02, 11, 12…

9.3 Pallet Label

Model Name: MT4601B02-3

Serial Number: XXX XX XXX XXXXX

- XXX → CSOT Internal Use
- XXX → Year, Month
- XX → Model Version Code
- XXXXX → CSOT Internal Use

10. Precautions

10.1 Assembly and Handling Precautions

(1) Do not apply rough force such as bending or twisting to the LCD module during assembly.

(2) It is recommended to assemble or install a LCD module into the user's system in clean working areas. The dust and oil may cause electrical short or damage the polarizer.

(3) Do not apply pressure or impulse to the LCD module to prevent the damage to LCD panel and backlight.

(4) Always follow the correct power-on sequence. This can prevent the damage and latch-up to the LSI chips.

(5) Do not plug in or pull out the interface connector while the module is in operation.

(6) Do not disassemble the LCD module.

(7) Use soft dry cloth without chemicals for cleaning because the surface of polarizer is very soft and easily be scratched.

(8) Moisture can easily penetrate into the LCD module and may cause the damage during operation.

(9) High temperature or humidity may deteriorate the performance of the LCD module. Please store LCD modules in the specified storage conditions.

(10) When ambient temperature is lower than 10ºC, the display quality might be deteriorated. For example, the response time will become slow, and the starting voltage of LED light bar will be higher than that in room temperature.

10.2 Safety Precautions

(1) 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.

(2) After the LCD module's end of life, it is not harmful in case of normal operation and storage.