MODEL: MT5461D01-1

Ver. 2.1

Date:29.April.2013

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Revision History

Version	Date	Page	Section	Description	Revision by
Ver. 0.1	15.Oct.2012	-	All	Tentative Specification was First Issued.	Chenguo Wu
Ver. 1.1	1.Dec.2012	-	All	Preliminary Specification was First Issued	Chenguo Wu
Ver. 1.2	12.Dec.2012	26	6.2	Modify Center Luminance.	Chenguo Wu
Ver. 1.3	09.Jan.2013	31	7.1	Update Mechanical Specification.	Chenguo Wu
Ver.1.4	15.Jan.2013	11&16	3.1&4.1	Update Electrical Specification	Chenguo Wu
Ver.1.5	31.Jan.2013	14-27	4.1-6.2	Update Electrical and Optical Specification	Chenguo Wu
Ver.1.6	22.Mar.2013	11	3.1.3	Update V by One Input Signal Timing	Chenguo Wu
Ver.2.1	29.Apr.2013	-	All	Approval Specification was First Issued.	Chenguo Wu

1. General Description

1.1 Product Features

- **QFHD Resolution (3840 x 2160)**
- **High Brightness: 400 cd/m²—2D,50 cd/m²—3D**
- **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. 135 W**
- **DE (Data Enable) Mode**
- **V by One Interface**

1.2 Overview

MT5461D01-1 is a diagonal 54.6”color active matrix LCD module with edge LED backlight and 8 lanes V by one interface. This module is a transmissive type display operating in the normally black mode. It supports 3840 x 2160 QFHD resolution and can display up to 1.07G 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	1209.6 (H) x 680.4 (V)	mm	
Bezel Opening Area	1215.8 (H) x 686.6 (V)	mm	
Outline Dimension	1225.8 (H) x 696.6 (V) x 15.1 (D)	mm	D: From Bezel to Rear
Weight	17	kg	Max.
Driving Scheme	a-Si TFT Active Matrix	-	
Number of Pixels	3840 x 2160	pixel	
Pixel Pitch (Sub Pixel)	0.105 (H) x 0.315 (V)	mm	
Pixel Arrangement	RGB Vertical Stripe	-	
Display Colors	1.07G	color	8bit+FRC
Display Mode	Transmissive Mode, Normally Black	-	
Surface Treatment	Anti-glare, Haze 2%, Hard Coating (3H)	-	
Luminance of White	400—2D,50—3D	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	13.5	V
Input Signal Voltage	V_{IN}	-0.3	3.6	V
Light Bar Voltage	$V_{W(2D)}$	55	70	V_{RMS}
	$V_{W(3D)}$	65	81	
Converter Input Voltage	V_{BL}	0	30	V
Control Signal Level	-	-0.3	7.0	V

2.2 Environment Requirement

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

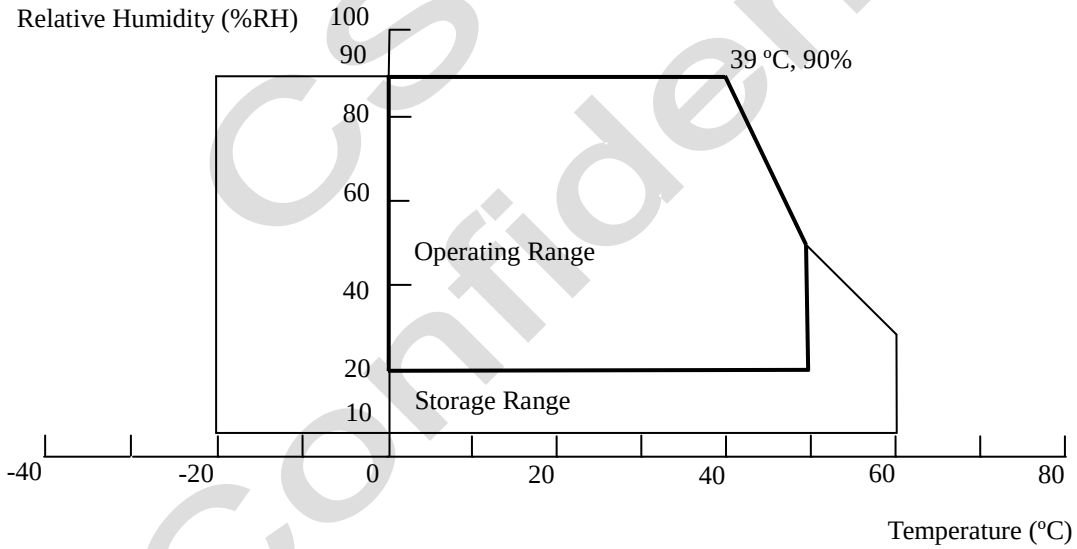


Fig. 2.1 Operating and storage environment

(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 °C)

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}	-	-	4	A	(2)
Power Supply Current	White Pattern	Icc	-	0.73	1.1	A	(3)
	Horizontal Stripe	Icc	-	2.07	2.80	A	
	Black Pattern	Icc	-	0.66	1.00	A	

Note:

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

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

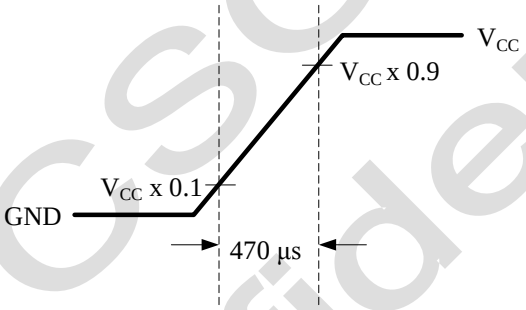
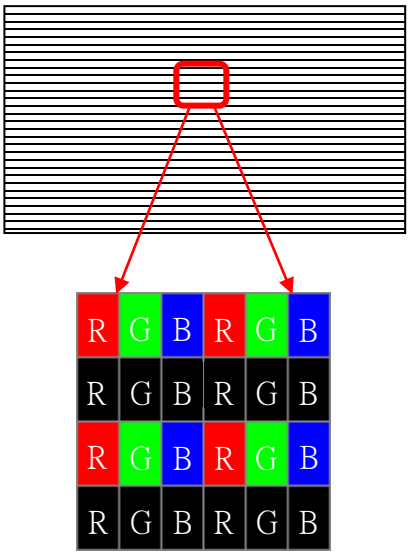


Fig. 3.1 V_{CC} rising time condition

(3) Measurement condition: V_{CC} = 12 V, Ta = 25 ± 2 °C, F = 60 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 V by O ne Characteristics

Parameter		Symbol	Value			Unit	Note
			Min.	Typ.	Max.		
V by one Interface	Differential Input High Threshold Voltage	V_{TH}	-	-	+50	mV	
	Differential Input Low Threshold Voltage	V_{TL}	- 50	-	-	mV	
	Intra-pair Skew	TTOSK_intra	-0.3	-	0.3	UI	(1)
	Inter-pair Skew	TTOSK_inter	-500	-	500	UI	(2)
	Data skew between each area	TBLOCK	-	-	0.06	H	(3)
	Spread Spectrum Modulation range	30KHz modulation	-0.5		+0.5	%	
	Differential Input Swing Voltage	V	100		400	mV	
CMOS Interface	Input High Threshold Voltage	V_{IH}	2.4	-	3.3	V	
	Input Low Threshold Voltage	V_{IL}	0	-	0.6	V	

Note:

(1) Intra-pair skew

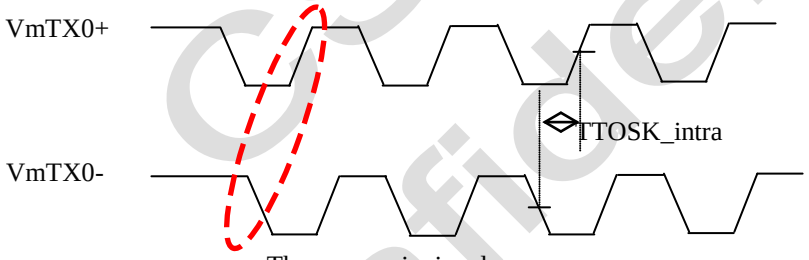


Fig. 3.3 V by one Intra-pair skew

(2) Inter-pair skew

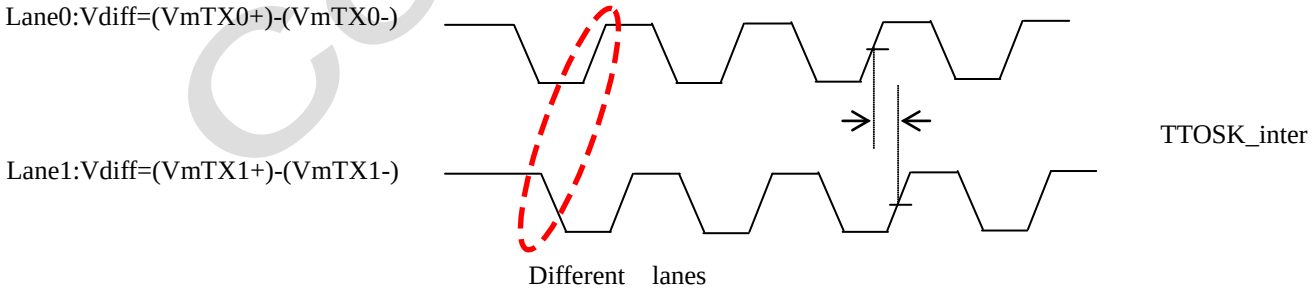


Fig. 3.4 V by one Inter-pair skew

(3) Data skew between each area

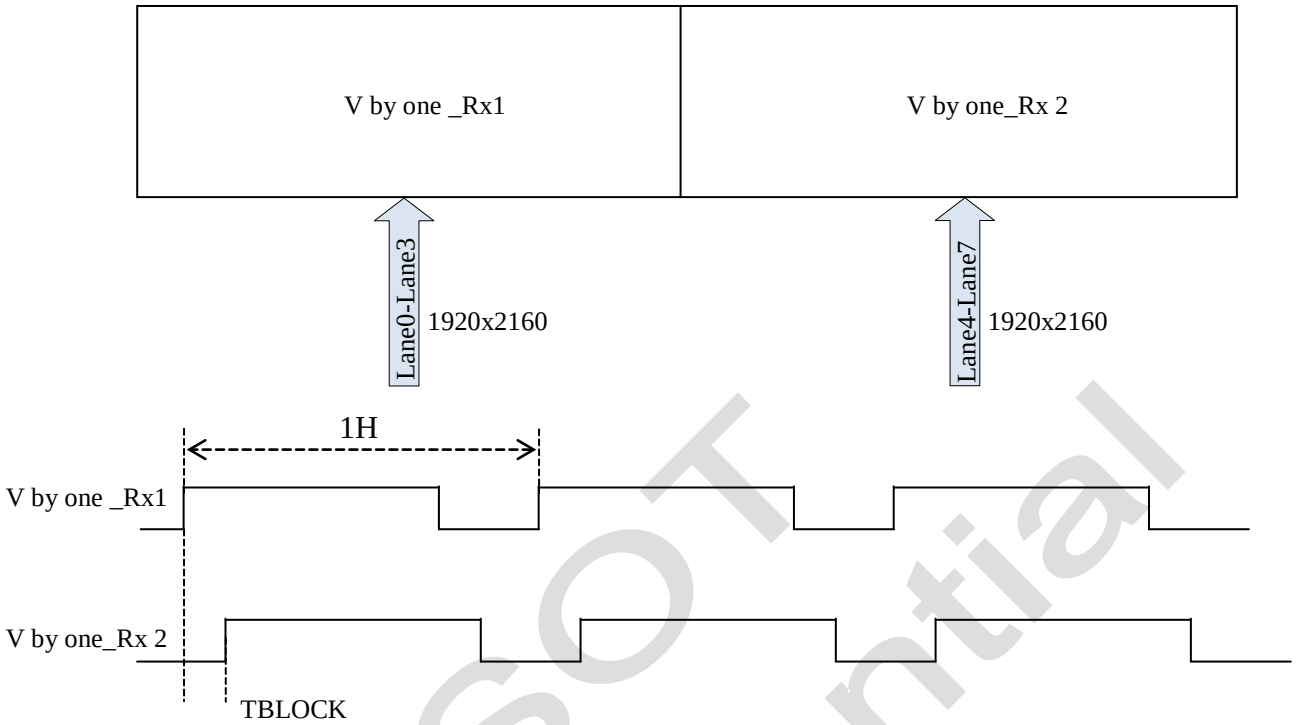


Fig. 3.5 Data skew between each area

3.1.3 V by One Input Signal Timing

Item	X(UI)	Y(mV)	Note
A	0.25	0	(1)
B	0.3	50	(1)
C	0.7	50	(1)
D	0.75	0	(1)
E	0.7	-50	(1)
F	0.3	-50	(1)

Note:

(1)

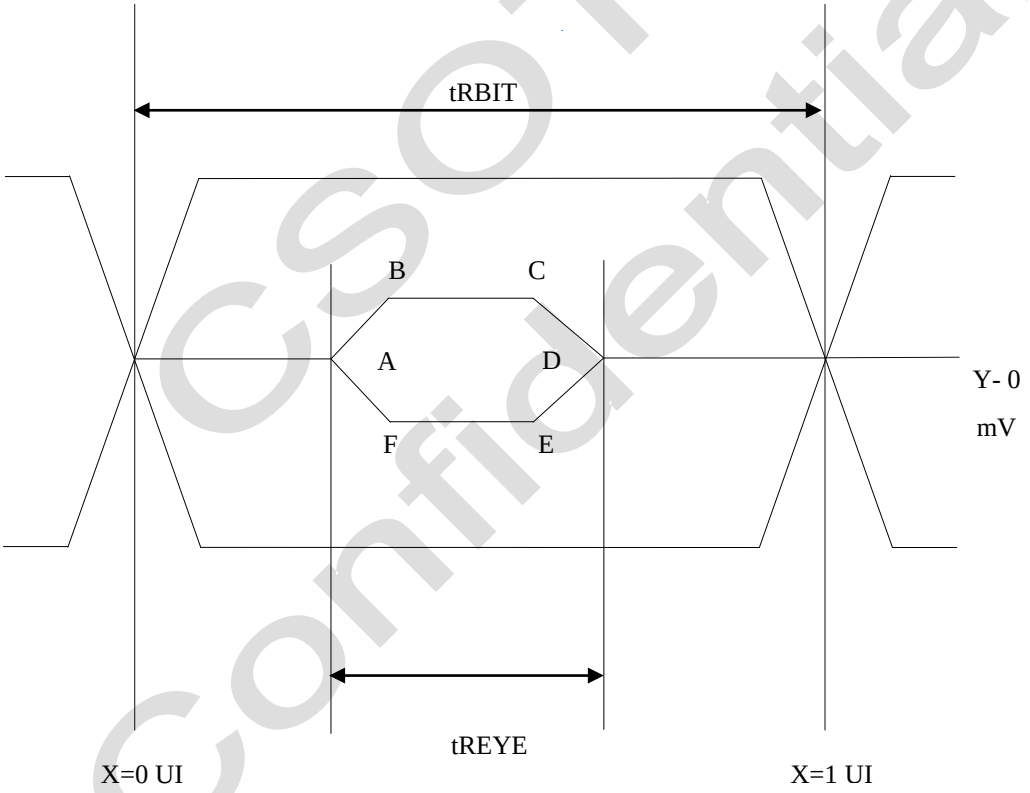


Fig. 3.6 V by one input signal timing

3.2 Backlight Converter Unit

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

Parameter		Symbol	Value			Unit	Note
			Min.	Typ.	Max.		
Power Consumption		$P_{BL(2D)}$	-	115.2	132.1	W_{att}	No dimming
		$P_{BL(3D)}$	-	84.3	96.9	W_{att}	
Input Voltage		V_{BL}	22.8	24.0	25.2	V	
Input Current		$I_{BL(2D)}$	-	4.80	6.12	A	No dimming
		$I_{BL(3D)}$	-	3.51	4.25	A	
Input Inrush Current		I_{RS-VIN}	-	-	5	A	(1)
		I_{RS-EN}	-	-	12	A	(2)
On/Off Control Voltage	On	V_{BLON}	2.5	3.3	3.6	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	3.6	V	
	Min.		0.0	-	0.8	V	
External PWM Control Current		I_{P-DIM}	-	-	2	mA	
PWM Dimming Frequency		F_{PWM}	150	160	170	Hz	
Dimming Duty Ratio		D_{DIM}	10	-	100	%	(3)
DET Status Signal		DET HI	Open Collector				
		DET Low	0		0.8	V	
Input Impedance		R_{IN}	300			Kohm	

Note:

(1) The measurement condition: V_{BL} rising time is 20 ms. (V_{BL} from 10% ~ 90%)

(2) The measurement condition: the V_{BL} = 24V, and then on the V_{BLON} = 3.3V.

(3) Less than 10% dimming control is functional well and no backlight happens to shut down.

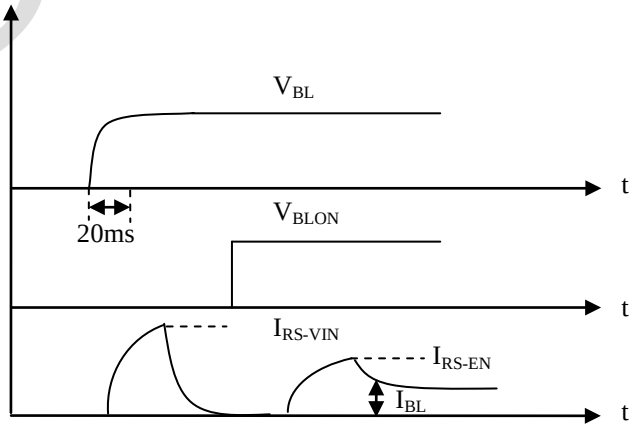


Fig. 3.7 The timing sequence diagram of inrush current measurement

3.2.2 LED Converter Power Sequence

No	ITEM	SYMBOL	MIN.	TYP.	MAX.	UNIT	REMARK
1	VBL Rising Time	Tr	20	-	-	ms	See Fig.3.5
2	VBL Falling Time	Tf	20	-	-	ms	
3	VBLON Rising Time	Tr1	-	-	100	ms	
4	VBLON Falling Time	Tf1	-	-	100	ms	
5	VBL to VP_DIM Delay Time	T1	500	-	-	ms	
6	BLON Delay Time	T2	250	-	-	ms	
7	BLON Off Time	T3	0	-	-	ms	
8	VP_DIM Off Time	T4	250	-	-	ms	

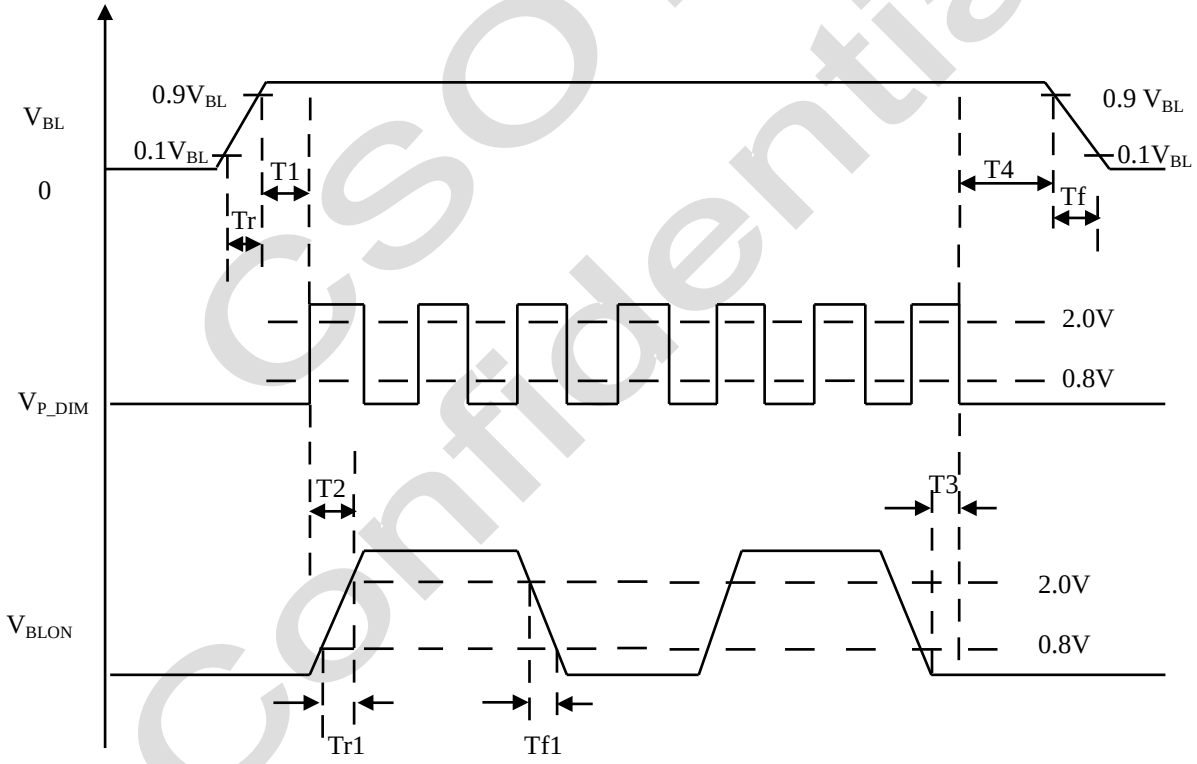


Fig. 3.8 The power sequence of V_{BL} and V_{BLON}

Note: The power sequence:

POWER ON: $V_{BL} > V_{P\_DIM} > V_{BLON}$

$V_{BL} >$ any other single(sync, 3D_EN,2D/3D)

POWER OFF: $V_{BLON} >= V_{P\_DIM} > V_{BL}$

Any other single(sync, 3D_EN,2D/3D)>VBL

4. Input Terminal Pin Assignment

4.1 TFT LCD Module

CN1: 0-511037-5 (XINDAYITONG) or equivalent

Pin No.	Symbol	Description	Note
1	VCC	Power 12V in	
2	VCC	Power 12V in	
3	VCC	Power 12V in	
4	VCC	Power 12V in	
5	VCC	Power 12V in	
6	VCC	Power 12V in	
7	VCC	Power 12V in	
8	NC	No Connection	
9	GND	Ground	
10	GND	Ground	
11	Rx0N	Vx1 Lane0-	
12	Rx0P	Vx1 Lane0+	
13	GND	Ground	
14	Rx1N	Vx1 Lane1-	
15	Rx1P	Vx1 Lane1+	
16	GND	Ground	
17	Rx2N	Vx1 Lane2-	
18	Rx2P	Vx1 Lane2+	
19	GND	Ground	
20	Rx3N	Vx1 Lane3-	
21	Rx3P	Vx1 Lane3+	
22	GND	Ground	
23	HTPDN	Hot Plug Detect	
24	LOCKN	Lock Detect	
25	GND	Ground	
26	Rx4N	Vx1 Lane4-	
27	Rx4P	Vx1 Lane4+	
28	GND	Ground	
29	Rx5N	Vx1 Lane5-	
30	Rx5P	Vx1 Lane5+	
31	GND	Ground	
32	Rx6N	Vx1 Lane6-	
33	Rx6P	Vx1 Lane6+	

34	GND	Ground	
35	Rx7N	Vx1 Lane7-	
36	Rx7P	Vx1 Lane7+	
37	GND	Ground	
38	L/R_I	Input Signal for Left/Right synchronous Signal	(2)
39	L/R_O	Output Signal for Glasses Left/Right Signal	(3)
40	3D_EN	3D_EN Signal	(4)
41	NC	No Connection	(5)
42	NC	No Connection	(5)
43	NC	No Connection	(5)
44	NC	No Connection	(5)
45	NC	No Connection	(5)
46	NC	No Connection	(5)
47	NC	No Connection	(5)
48	NC	No Connection	(5)
49	NC	No Connection	(5)
50	NC	No Connection	(5)
51	NC	No Connection	(5)

Note:

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

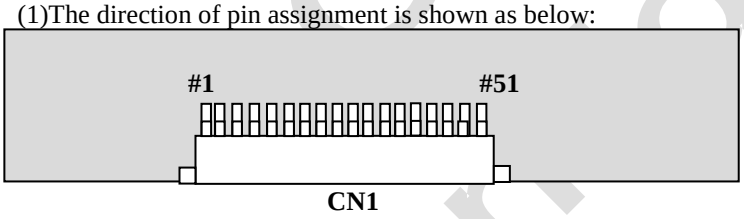


Fig. 4.1 Connector direction sketch map

(2) Shutter Glass Sync Input Signal

L = Connect to GND, H =Connect to +3.3V

L/R_I	Note
L	Right synchronous signal
H	Left synchronous signal

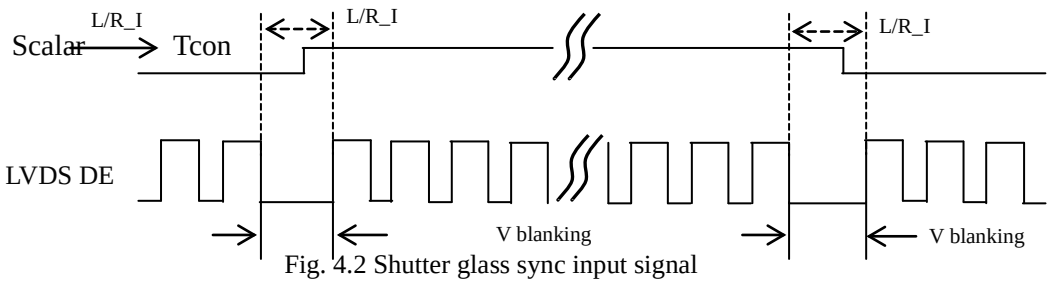
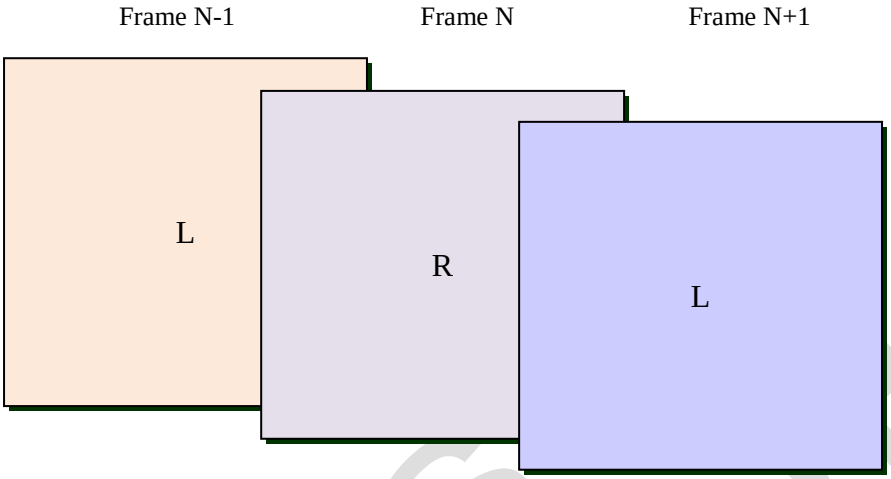


Fig. 4.2 Shutter glass sync input signal

(3)Shutter Glass Sync Output Signal

L = Connect to GND, H =Connect to +3.3V

L/R_O	Note
L	Right Glasses synchronous signal
H	Left Glasses synchronous signal



(4)3D_EN Signal

L = Connect to GND, H =Connect to +3.3V

3D_EN	Note
L	2D Mode
H	3D Mode

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

Attention: Default JEDIA mode

4.2 Converter Unit

4.2.1 Converter Input Connector Pin Definition

CN1: CT000019-143N(FCN) or equivalent (see 4.2 Note (1))

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

Note (1):

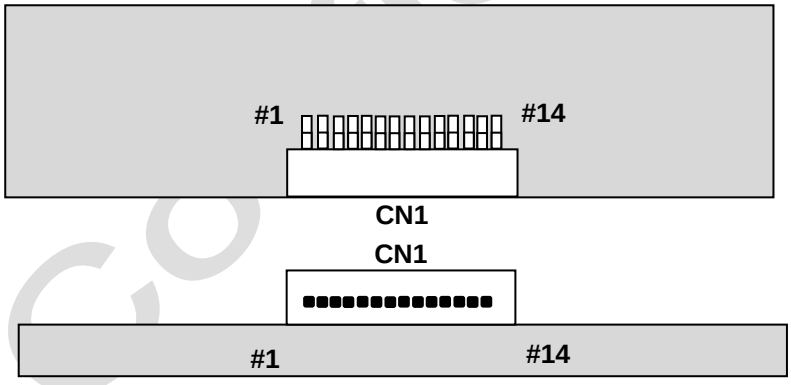
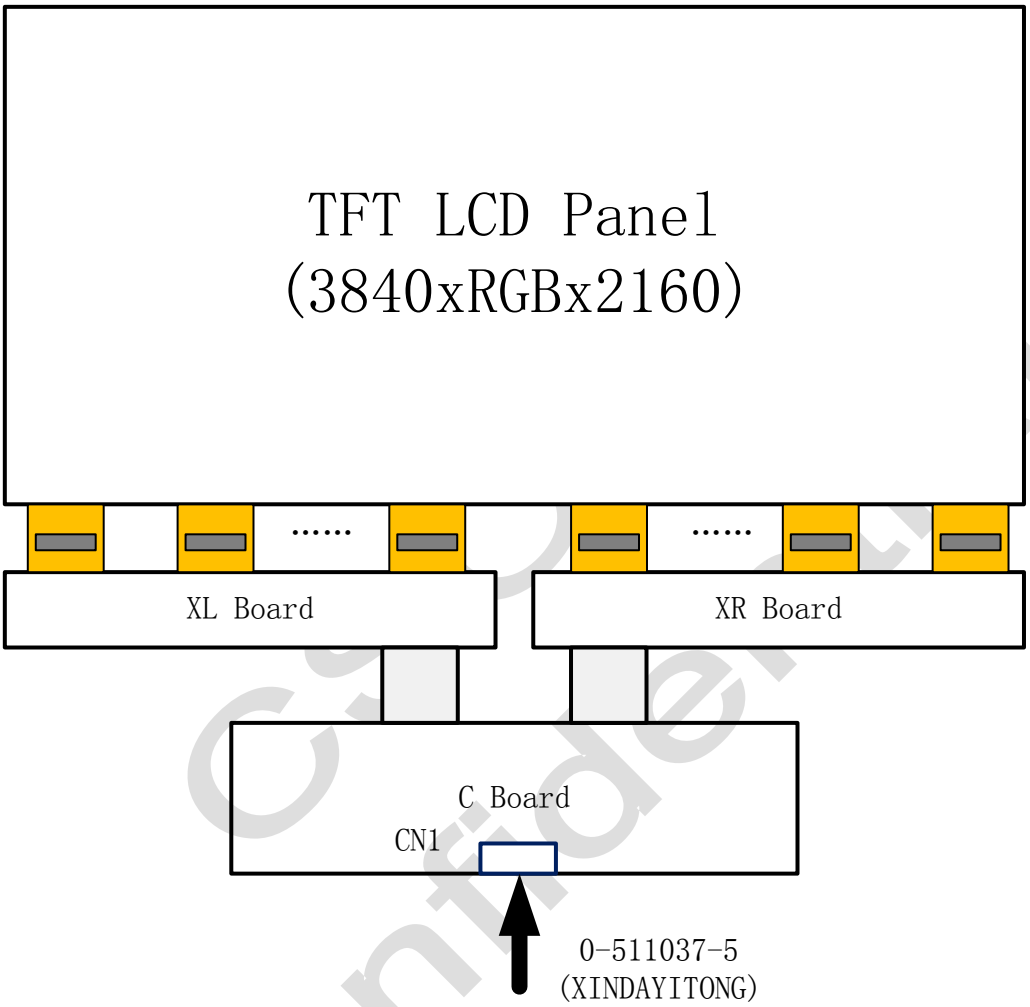


Fig. 4.3 Power input connector direction sketch map

4.3 Block Diagram of Interface

4.3.1 TFT LCD Module



4.4 4K2K Data Format

2D Mode:

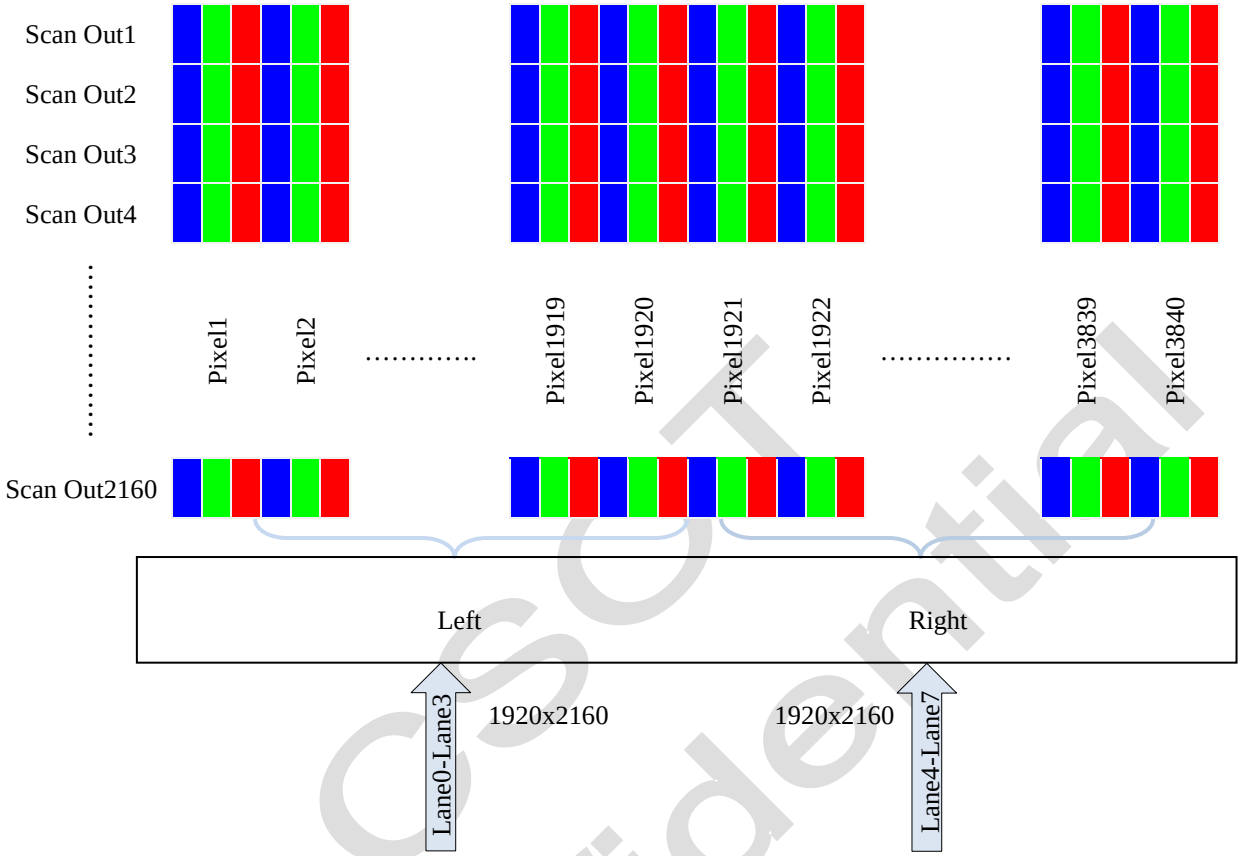


Fig. 4.4 2D data format

3D Mode:

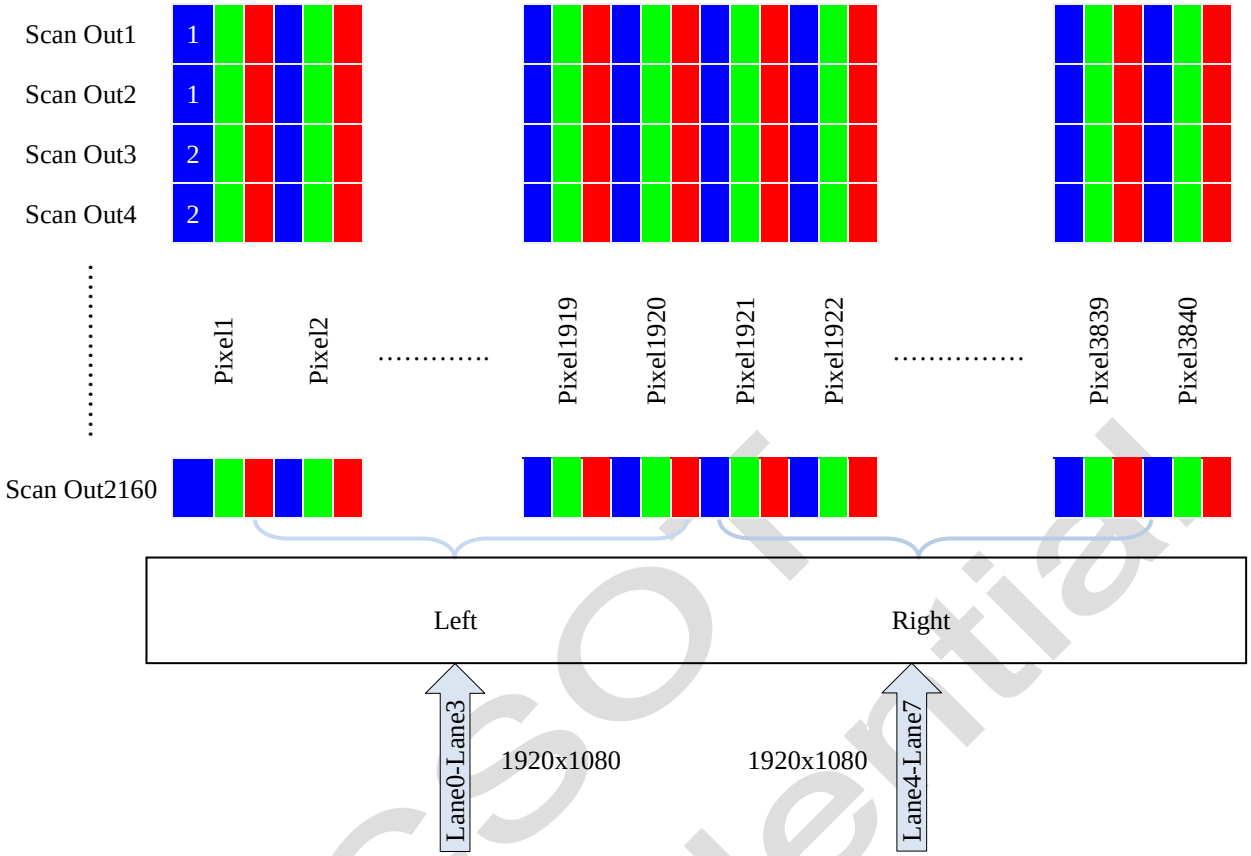


Fig. 4.5 3D data format

4.5 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
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
	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
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
	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
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
	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.

5. V-by-One Each Lane Timing Spec

5.1 Timing Table (DE Only Mode)

2D Mode,Frame Rate=60Hz

Signal	Item	Symbol	Min.	Typ.	Max.	Unit	Note
Frequency		F_{CLK} (= 1 / T_{CLK})	60	74.25	78.5	MHz	(1)
Frame Rate		F	57	60	63	Hz	
Vertical Term	Total	T_V	2172	2250	2450	T_H	$T_V = T_{VD} + T_{VB}$
	Display	T_{VD}	2160			T_H	
	Blank	T_{VB}	12	90	290	T_H	
Horizontal Term	Total	T_H	530	550	720	T_{CLK}	$T_H = T_{HD} + T_{HB}$
	Display	T_{HD}	480			T_{CLK}	
	Blank	T_{HB}	50	70	240	T_{CLK}	

2D Mode,Frame Rate=50Hz

Signal	Item	Symbol	Min.	Typ.	Max.	Unit	Note
Frequency		F_{CLK} (= 1 / T_{CLK})	60	61.88	78.5	MHz	(1)
Frame Rate		F	47	50	53	Hz	
Vertical Term	Total	T_V	2172	2250	2450	T_H	$T_V = T_{VD} + T_{VB}$
	Display	T_{VD}	2160			T_H	
	Blank	T_{VB}	12	90	290	T_H	
Horizontal Term	Total	T_H	530	550	720	T_{CLK}	$T_H = T_{HD} + T_{HB}$
	Display	T_{HD}	480			T_{CLK}	
	Blank	T_{HB}	50	70	240	T_{CLK}	

3D Mode ,Frame Rate=120Hz

Signal	Item	Symbol	Min.	Typ.	Max.	Unit	Note
Frequency		F_{CLK} (= 1 / T_{CLK})	74.25			MHz	(1)
Frame Rate		F	120			Hz	

Vertical Term	Total	TV	1125	TH	$T_V = T_{VD} + T_{VB}$
	Display	T_{VD}	1080	T_H	
	Blank	T_{VB}	45	T_H	
Horizontal Term	Total	T_H	550	T_{CLK}	$T_H = T_{HD} + T_{HB}$
	Display	T_{HD}	480	T_{CLK}	
	Blank	T_{HB}	70	T_{CLK}	

Attention:

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

Note:

(1) Please make sure the range of pixel clock follows the following equations:

Fclkin(max) ≥Fmax × Tv× Th

Fmin × Tv × Th ≥ Fclkin(min)

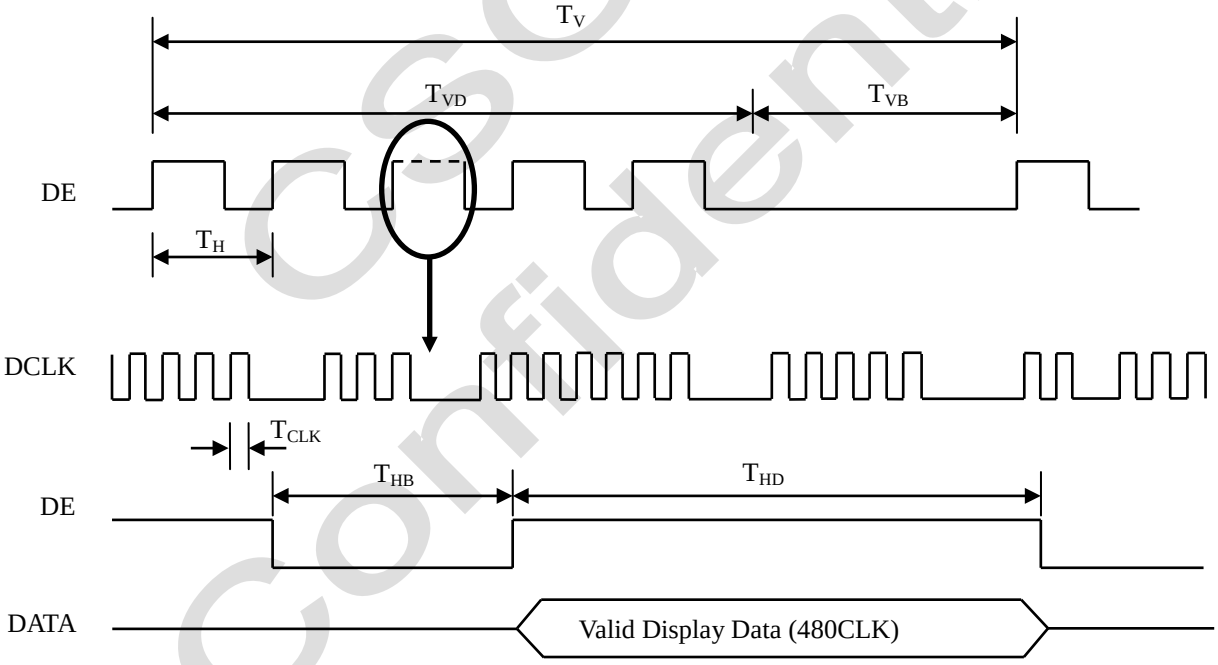


Fig. 5.1 Interface signal timing diagram

5.2 Power On/Off Sequence

5.2.1 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.

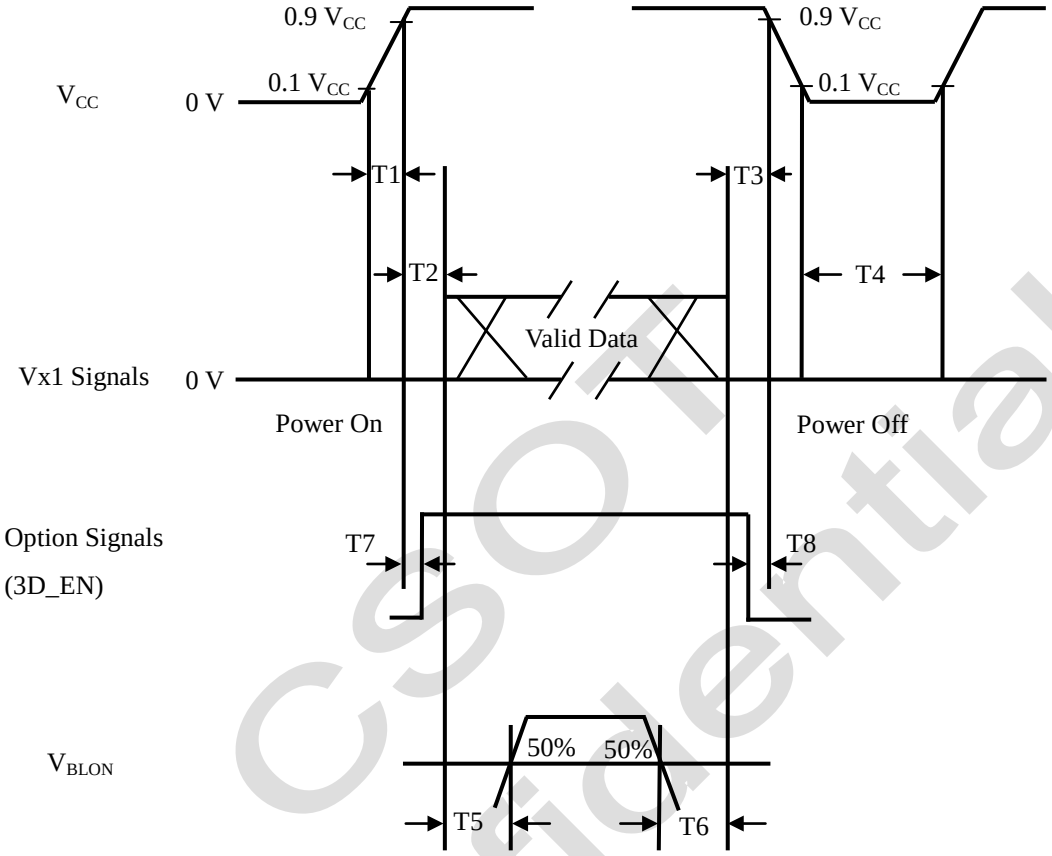


Fig. 5.2 Power on/off sequence

5.2.2 2D/3D Change Signal Sequence without Vcc Turn off and Turn on

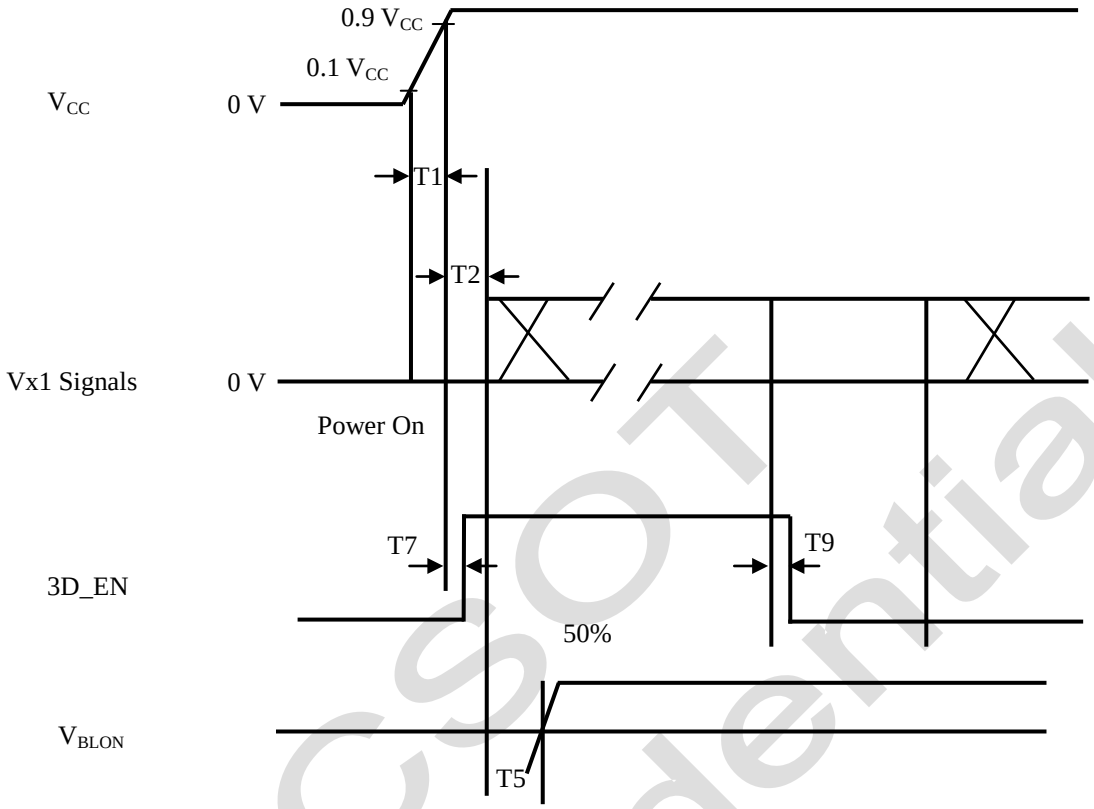


Fig. 5.3 2D/3D power on/off sequence

Parameter	Values			Unit
	Min.	Typ.	Max.	
T1	0.5	-	10.0	ms
T2	0.0	-	50	ms
T3	0.0	-	-	ms
T4	1000	-	-	ms
T5	500	-	-	ms
T6	100	-	-	ms
T7	-	-	T2	ms
T8	-	-	T3	ms
T9	0.0	-	10.0	ms

Attention:

(1)While system turn from 2D/3D function to 3D/2D function,the V_{BLON} signal should be always high .

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

(3) 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.

(4) 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.

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

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

6. Optical Characteristics

6.1 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}	63	V
Driving Signal	Refer to the typical value in Chapter 3: Electrical Specification		
Light Source Current (Each Unit)	I_L	110	mA
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 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.

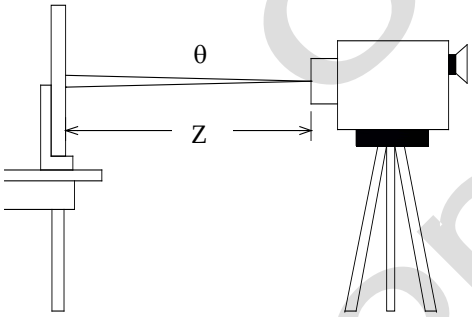


Fig. 6.1 The standard set-up system of measurement

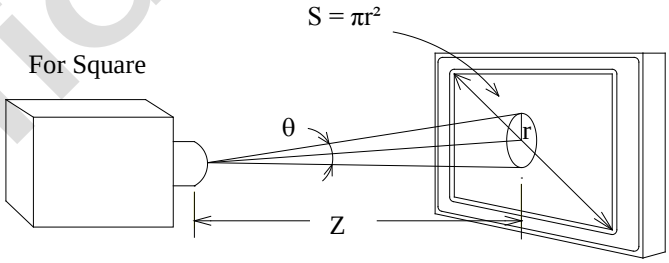


Fig. 6.2 The area S contains at least 500 pixels to be measured

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

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

6.2 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}		-	400	-	cd/m^2	(2) (4)
		L_{W-3D}		-	50	-	-	(6)
Crosstalk		CT-2D		-	-	4%	-	(2) (5)
		CT-3D		-	3.5%	-	-	(6)
Uniformity of White Screen		-		70	75	-	%	(2) (7)
Color Chromaticity (CIE1931)	Red	R_X		Typ. - 0.03	0.638	Typ. + 0.03	-	(2) (8)
		R_Y			0.335		-	
	Green	G_X			0.323		-	
		G_Y			0.628		-	
	Blue	B_X			0.157		-	
		B_Y			0.055		-	
	White	W_X			0.280		-	
		W_Y			0.290		-	
	Color Gamut	CG		-	72	-	% NTSC	(2) (8)
Viewing Angle	Horizontal	θ_{H+}	CR ≥ 10	-	89	-	Deg.	(9)
		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. 6.3; 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.

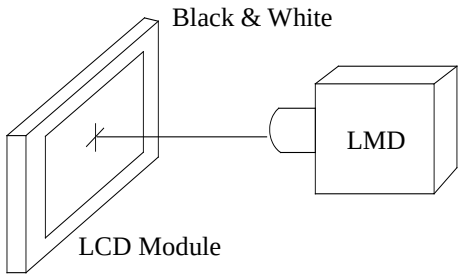


Fig. 6.3 The standard setup of CR measurement

(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 Fig6.4. 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.

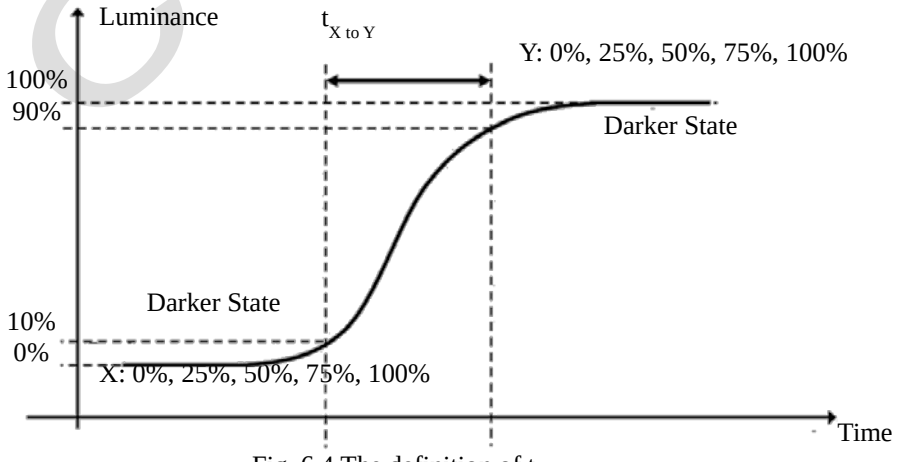


Fig. 6.4 The definition of $t_{X\ to\ Y}$

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. 6.5 shows the standard setup of luminance measurement.

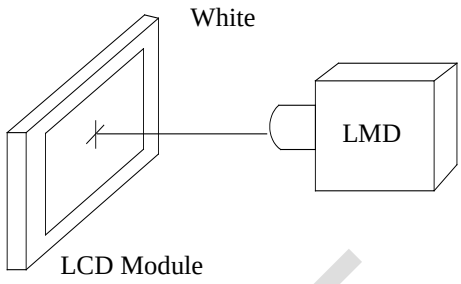


Fig. 6.5 The standard setup of luminance measurement

(5) Definition of the 2D mode crosstalk(CT-2D):

$$CT\text{-}2D = \frac{|Y_B - Y_A|}{YA} \times 100(\%)$$

YA = Luminance of measured location without gray level 1023 pattern (cd/m^2)

YB = Luminance of measured location with gray level 1023 pattern(cd/m^2)

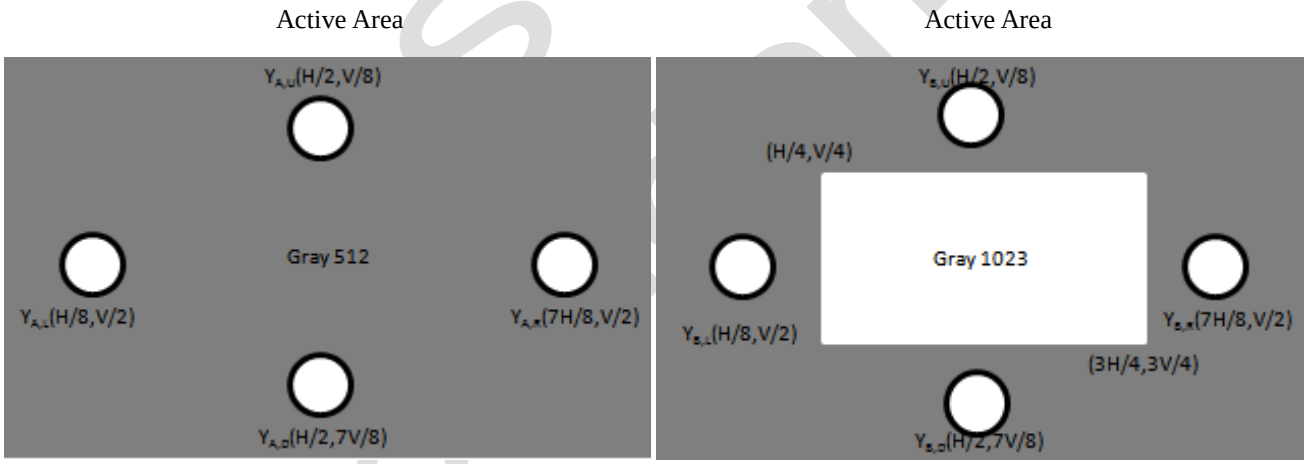


Fig. 6.6 The definition of 2D mode crosstalk

(6) 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”

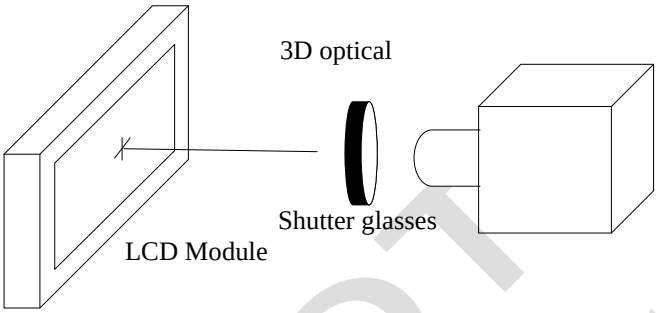


Fig. 6.7 3D optical measurement system

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 module through right-eye glasses..

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

(7) Definition of uniformity of white screen:

The luminance Li (i from 1 to 9) is measured at the 9 points defined in Fig. 6.8. 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%.

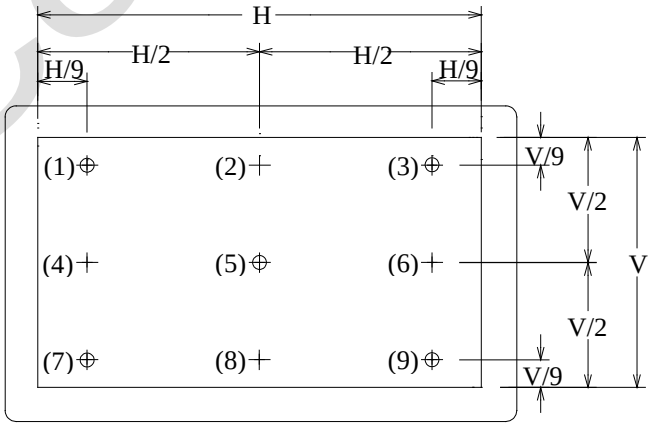


Fig. 6.8 Symbol “ + ” defines the 9 measuring locations (1), (2), (3) ⋯ (9)

(8) 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. 6.9.

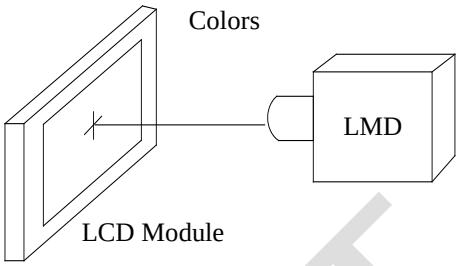


Fig. 6.9 The standard setup of color chromaticity measurement

(9) 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. 6.10. The contrast ratio is measured by ELDIM EZ Contrast.

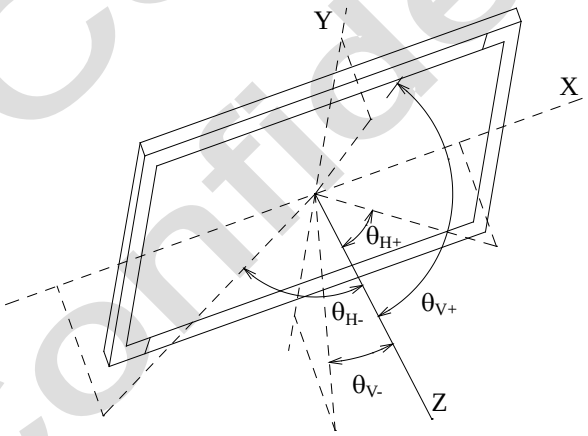
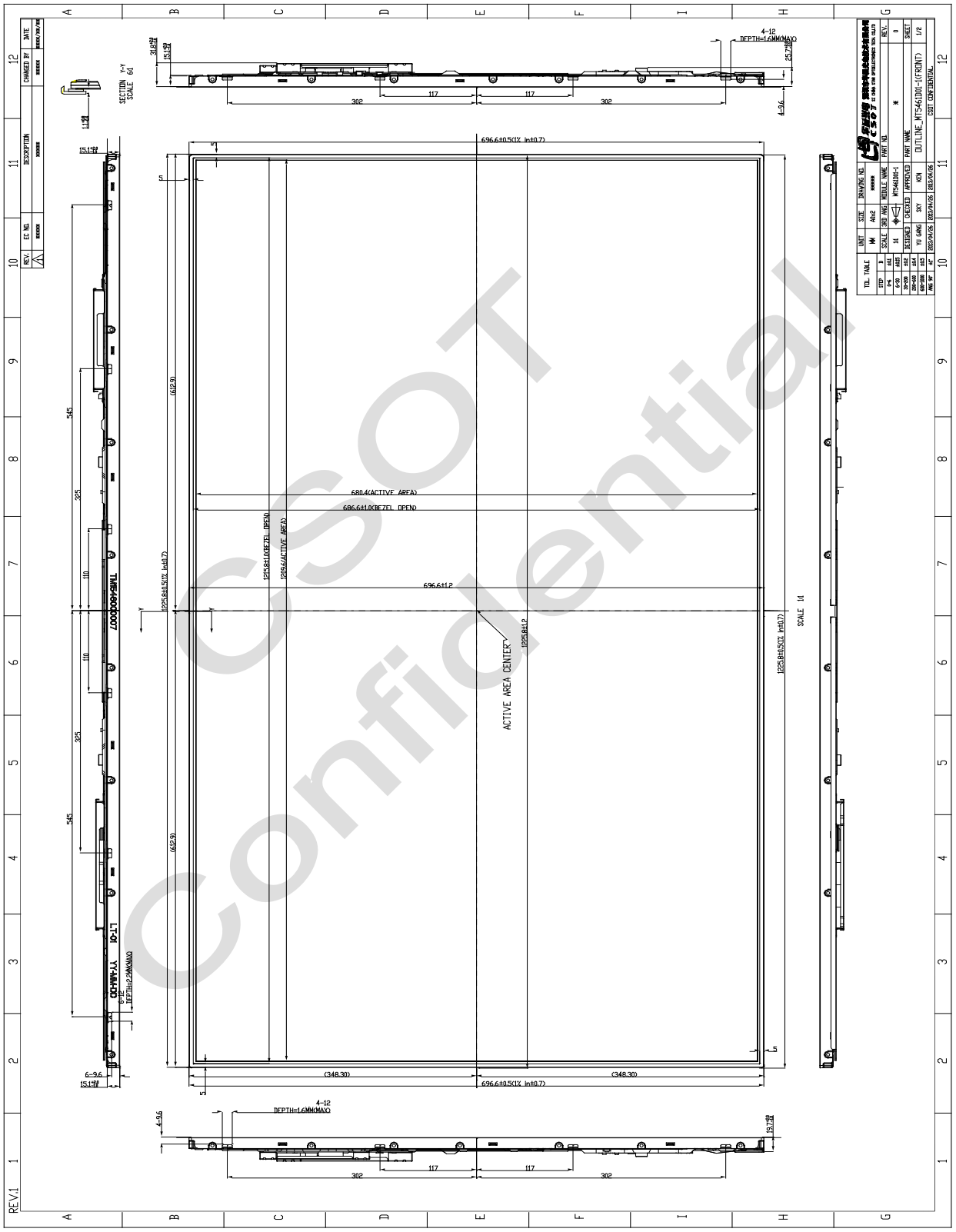
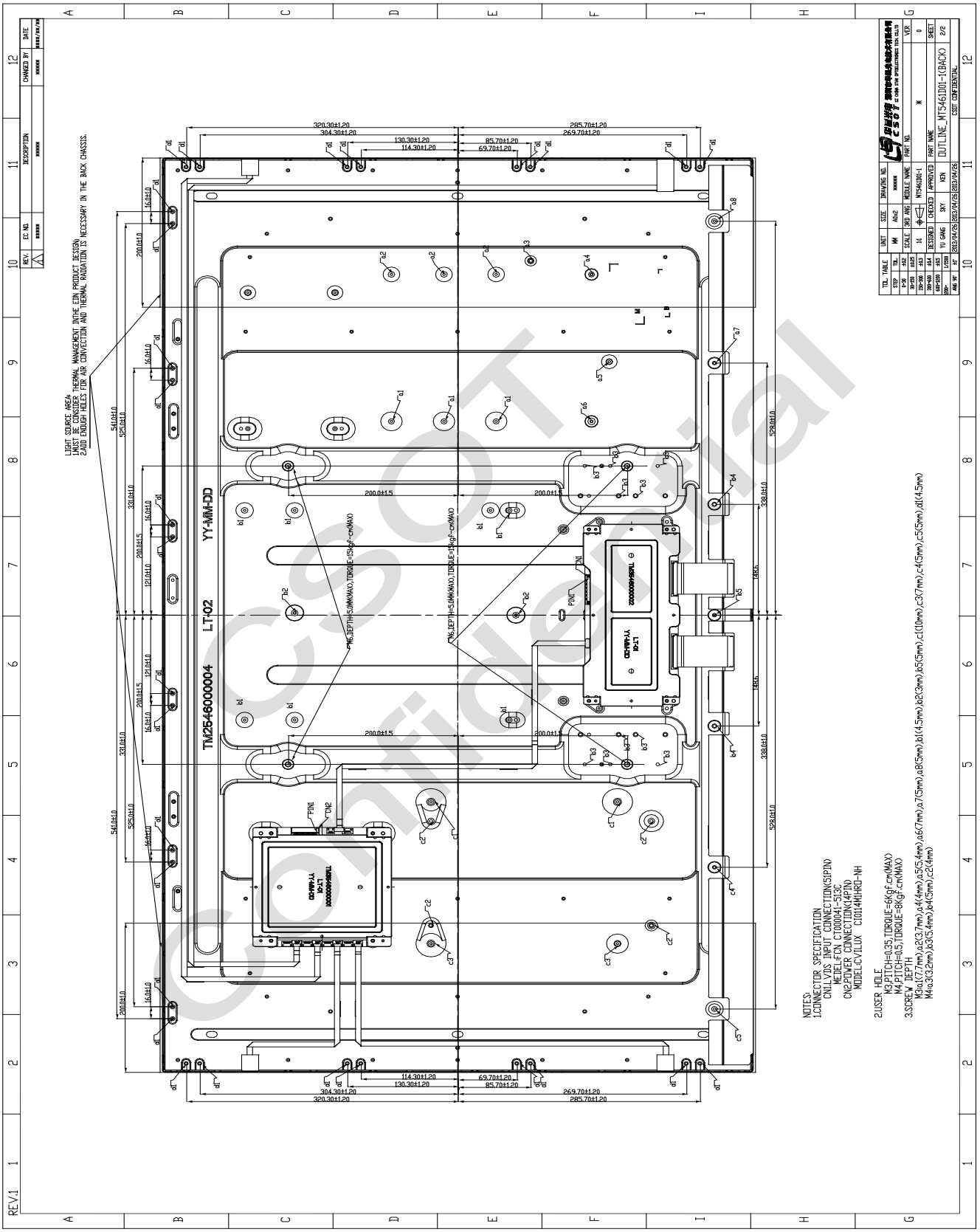


Fig. 6.10 Viewing angle coordination system

7. Mechanical Characteristics

7.1 Mechanical Specification





7.2 Packing

7.2.1 Packing Specifications

Item	Specification		
	Quantity	Dimension (mm)	Weight (kg)
Packing Box	5 pcs / box	1357.0 (L) x 365.0 (W) x 798.0 (H)	Net Weight: 85.0 Gross Weight:93.7
Pallet	1	1420 (L) x 1120 (W) x 150 (H)	Net Weight:32
Stack Layer	1		
Boxes per Pallet	3 boxes / pallet		
Pallet after Packing	15 pcs / pallet	1420 (L) x 1120 (W) x951(H)	Gross Weight: 314

7.2.2 Packing Method

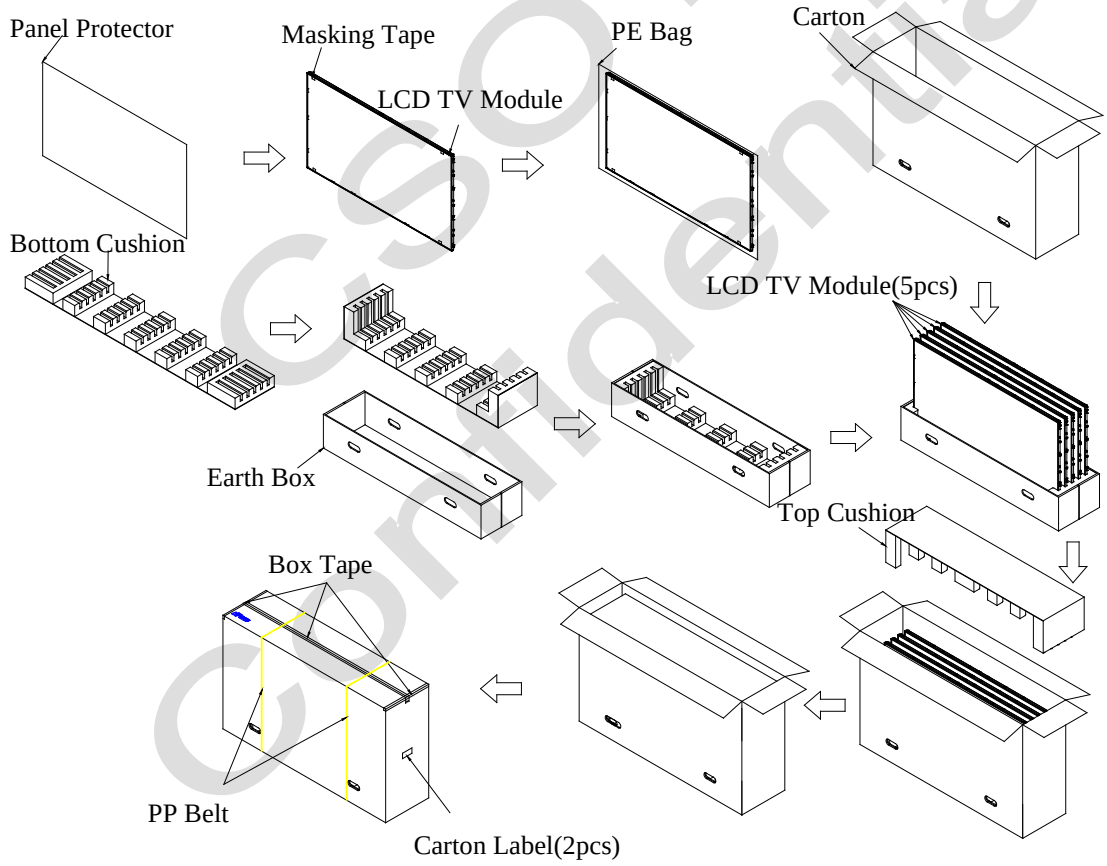


Fig. 7.1 Packing method (protector film stick on the front of the LCD module)

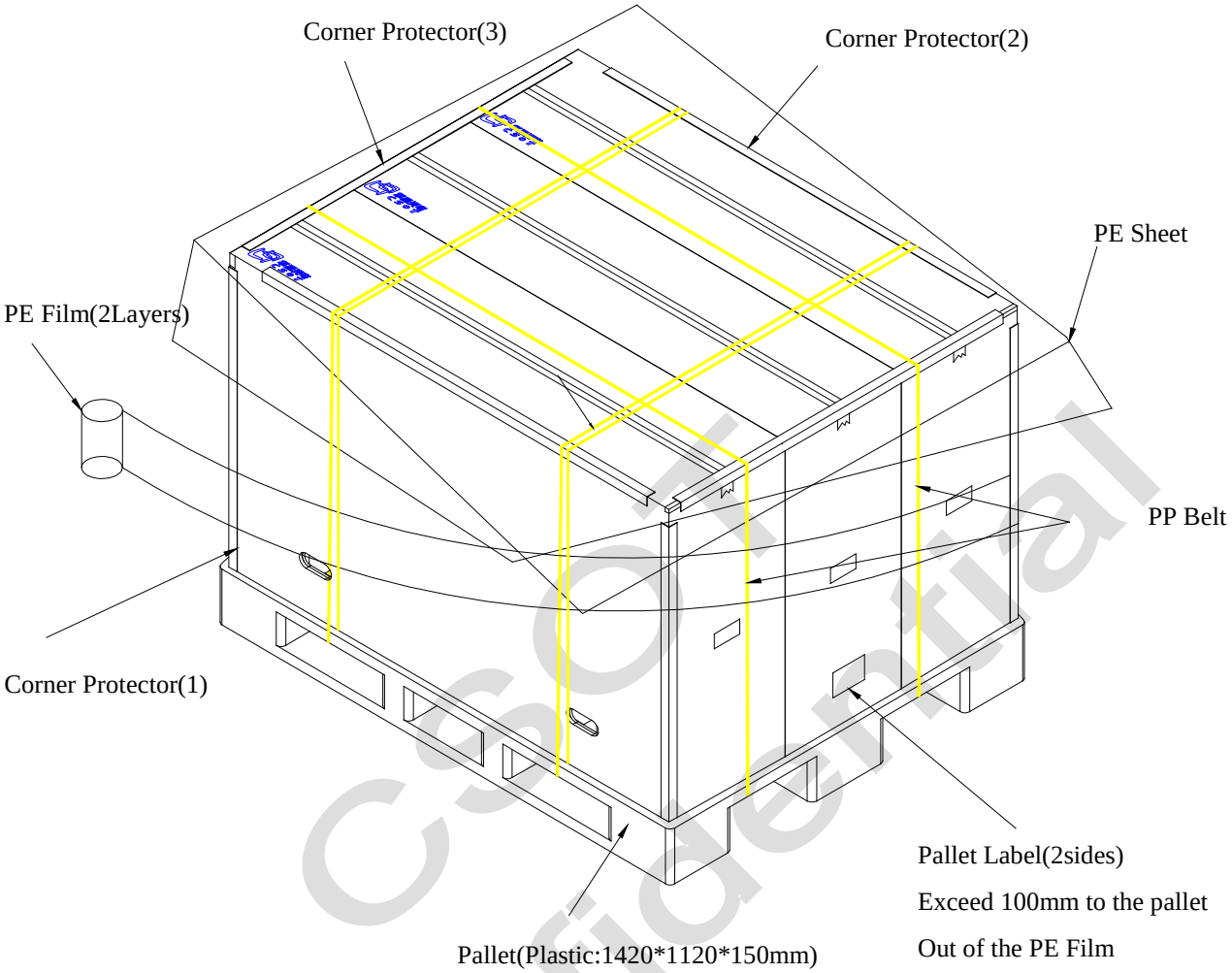
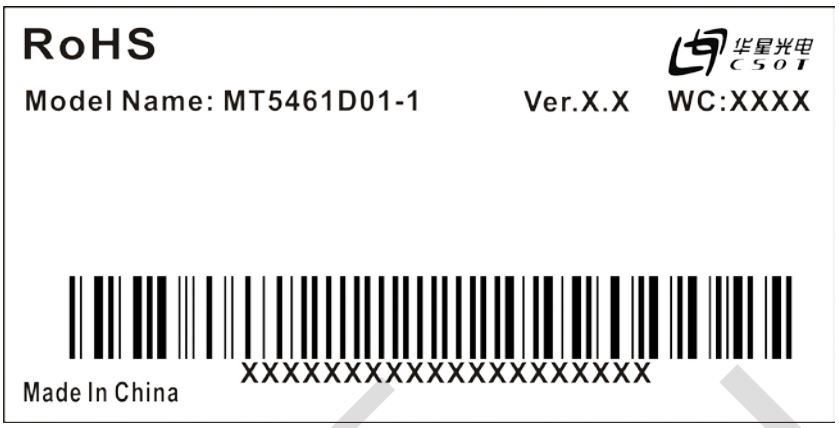


Fig. 7.2 Shipping method

8. Definition of Labels

8.1 Module Label

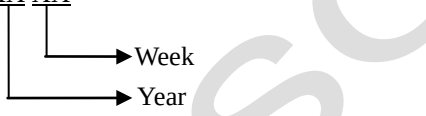


For RoHs compatible products, CSOT will add RoHS for identification.

Model Name: MT5461D01-1

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

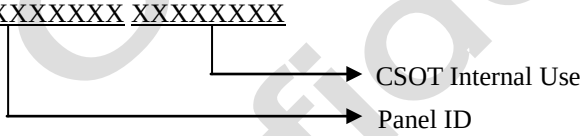
WC (Week Code): XX XX



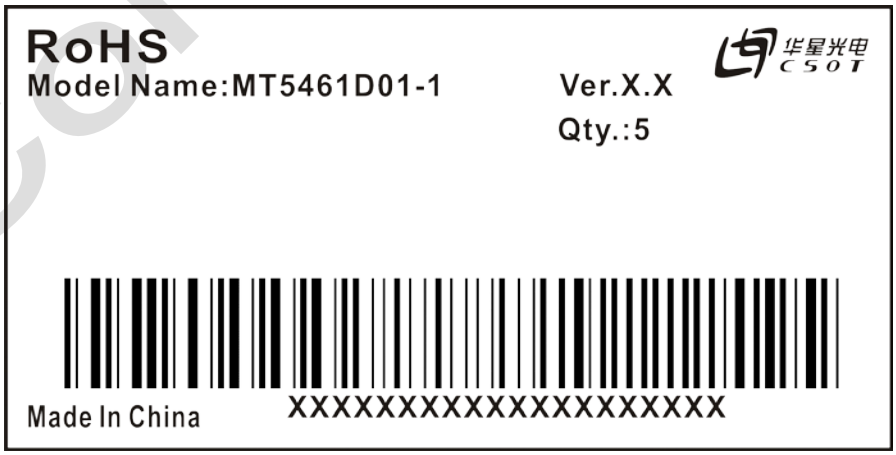
Year: 2010 = 10, 2011 = 11 … 2020 = 20, 2021 = 21…

Week: 01, 02, 03 …

Serial Number: XXXXXXXXXXXX XXXXXXXX

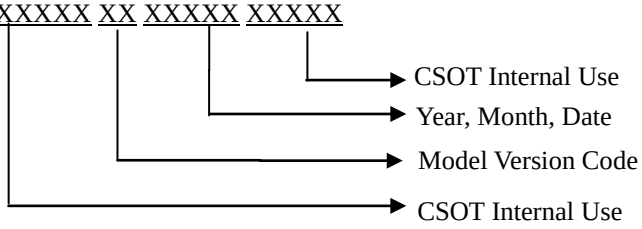


8.2 Carton Label



Model Name: MT5461D01-1

Serial Number: XXXXXXXX XX XXXXX XXXXX



Manufactured Date:

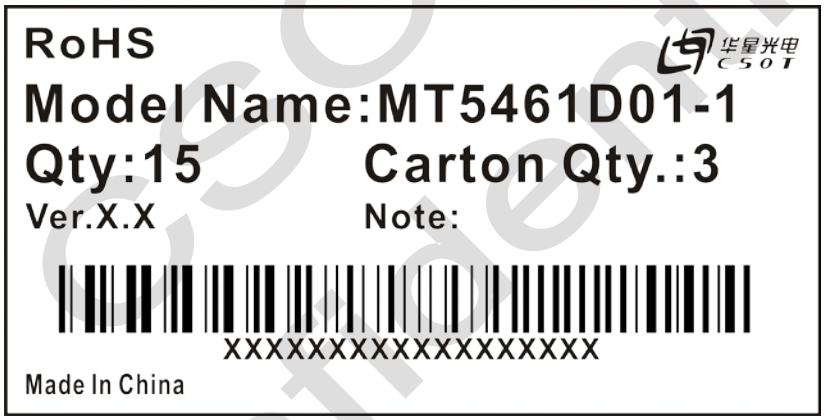
Year: 2010 = 10, 2011 = 11…2020 = 20, 2021 = 21…

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

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

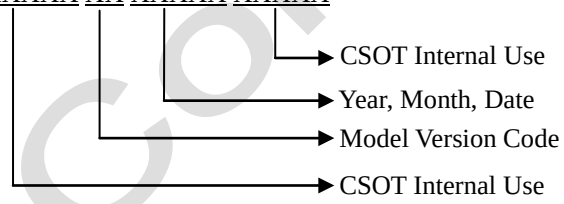
Model Version Code: Version of product, for example: 01, 02, 11, 12…

8.3 Pallet Label



Model Name: MT5461D01-1

Serial Number: XXXXXX XX XXXXX XXXXX



9. Precautions

9.1 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.

9.2 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.