华星光电 CSOT

MODEL: MTB001D01-1

Ver. 1.1

Date: 15.Nov.2012

Customer's Approval	CSOT
Signature Date	Approved By Product Director Date Name: Signature:
	Reviewed By PM Manager Date Name: Thorold Signature:
	Reviewed By Project Leader Date Name: Makka Lin Signature:
	Reviewed By PM Date Name: Yuming Mo Signature:

Contents

Revision History

Version	Date	Page	Section	Description	Revision by
Ver. 0.1	18.June.2012	All	All	Tentative Specification was First Issued.	Yuming Mo
Ver. 0.1	12.July.2012	10	3	Modify Input Voltage Range	Yuming Mo
		29	8	Update Packing Method	Yuming Mo
Ver. 0.1	26.Sep.2012	17	6	Update Timing Table	Yuming Mo
		19	6	Update 2D/3D Change Signal Sequence	Yuming Mo
Ver. 0.1	06.Nov.2012	28	8	Update Packing	Yuming Mo

1. General Description

1.1 Product Features

- **QFHD Resolution (3840 x 2160)**
- **Brightness: 1000 cd/m²**
- **High Contrast Ratio: 4000:1**
- **Fast Response Time: 6.5 ms**
- **Color Saturation: 92% NTSC**
- **Ultra Wide Viewing Angle: 178° (H)/178° (V) (CR ≥ 10)**
- **Low Power Consumption: Typ. 1300W**
- **RoHS Compliance**

1.2 Overview

MTB001D01-1 is a diagonal 110.06" color active matrix LCD module with direcet LED backlight and 2ch-DVI 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 16.7M colors (8-bit). Each pixel is divided into Red, Green and Blue sub-pixels which are arranged in vertical stripe. The converters of backlight are built-in. Central Control Board with FPGA is built-in.

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

1.3 General Information

Item	Specification	Unit	Note
Active Area	2436.48 (H) x 1370.52 (V)	mm	
Bezel Opening Area	2446.5 (H) x 1380.5 (V)	mm	
Outline Dimension	2495.5 (H) x 1429.5 (V) x 49.4 (D)	mm	D: From Bezel to Rear
Weight	110	kg	Max.
Driving Scheme	a-Si TFT Active Matrix	-	
Number of Pixels	3840 x 2160	pixel	
Pixel Pitch (Sub Pixel)	0.2115 (H) x 0.6345 (V)	mm	
Pixel Arrangement	RGB Vertical Stripe	-	
Display Colors	16.7 M	color	8-bit
Display Mode	Transmissive Mode, Normally Black	-	
Surface Treatment	Anti-glare, Haze 2%	-	
Luminance of White	1000	cd/m²	Center Point, Typ.

2. Absolute Maximum Ratings

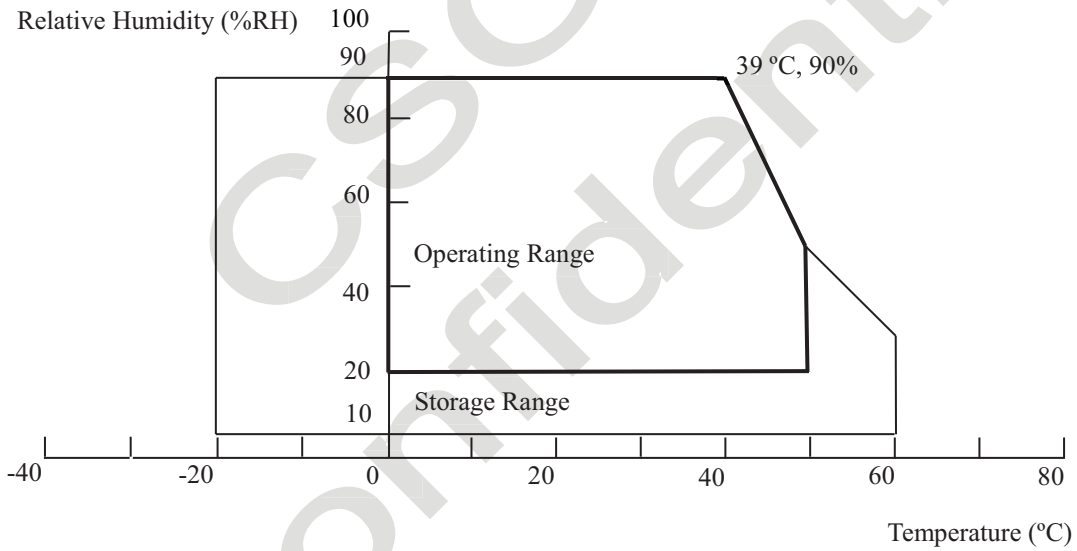
2.1 Absolute Maximum Ratings (T_A = 25 ± 2 °C)

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

Item	Symbol	Value		Unit
		Min.	Max.	
Power Supply Voltage	V_{CC1} V_{CC2}	- 0.3	13.5	V
Input Signal Voltage	V_{IN}	- 0.3	3.6	V
Converter Input Voltage	V_{BL}	48.0	58.0	V
Control Signal Level	-	- 0.3	7.0	V

2.2 Environment Requirement

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



(a) 90%RH maximum (T_A < 39 ºC).

(b) Wet-bulb temperature should be 39 ºC maximum (T_A > 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): (TBD)

Vibration (Non-operating): (TBD)

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 (T_A = 25 ± 2 ºC)

Parameter		Symbol	Value			Unit	Note
			Min.	Typ.	Max.		
Power Supply Voltage		V_{CC1}	10.8	12.0	13.2	V	(1)
Rush Current		I_{RUSH1}	-	-	5	A	(2)
Power Supply Current	White Pattern	I_{CC1}	-	1.36	1.52	A	
	Horizontal Stripe	I_{CC1}	-	1.60	1.82	A	
	Black Pattern	I_{CC1}	-	1.33	1.50	A	

Parameter		Symbol	Value			Unit	Note
			Min.	Typ.	Max.		
Power Supply Voltage		V_{CC2}	10.8	12.0	13.2	V	(1)
Rush Current		I_{RUSH2}	-	-	6	A	
Power Supply Current	White Pattern	I_{CC2}	-	1.00	1.20	A	(2)
	Horizontal Stripe	I_{CC2}	-	2.40	2.80	A	
	Black Pattern	I_{CC2}	-	1.12	1.20	A	

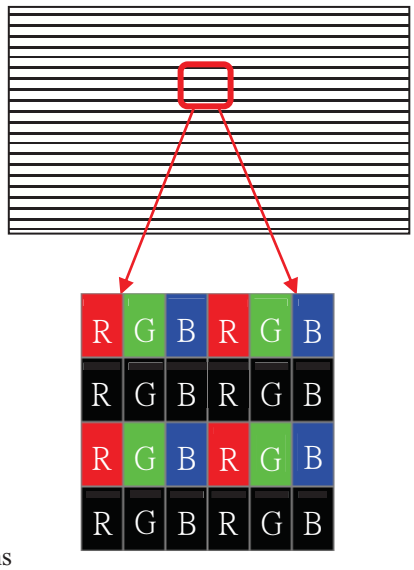
Note:

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

(2) Measurement condition: V_{CC} = 12 V, T_A = 25 ± 2 ºC, F = 60 Hz. The test patterns are shown as below.

A. White Pattern

B. Horizontal Pattern



C. Black Pattern

Fig. 3.1 Test patterns

3.1.2 TMDS Characteristics

Parameter		Symbol	Value			Unit	Note
			Min.	Typ.	Max.		
Dual link TMDS Interface	Differential Input High Threshold Voltage	V_{TH}	290	-	-	mV	(1)
	Differential Input Low Threshold Voltage	V_{TL}	-	-	10	mV	
	Common Input Voltage	V_{CM}	3.00	-	3.26	V	
	Differential Input Voltage	$\|V_{ID}\|$	150	-	1200	mV	
	2Port DE Skew (2)	T_R	-	-	230	uS	

Note:

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

(2) The DE(Data Enable) signal's phase delay of the two ports TMDS must be less than 230us to make the image synchronous.

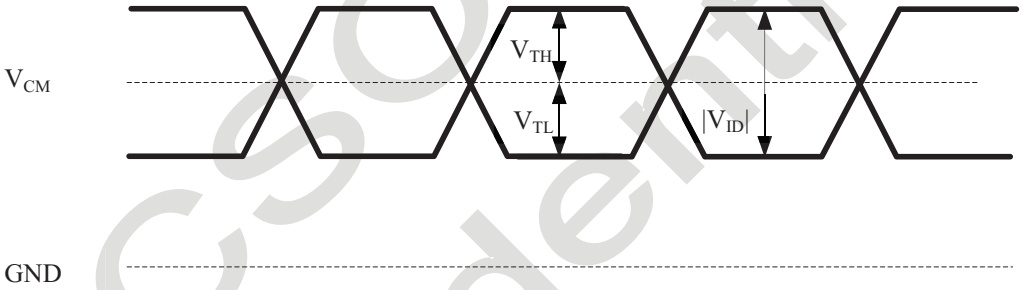


Fig. 3.2 TMDS signal

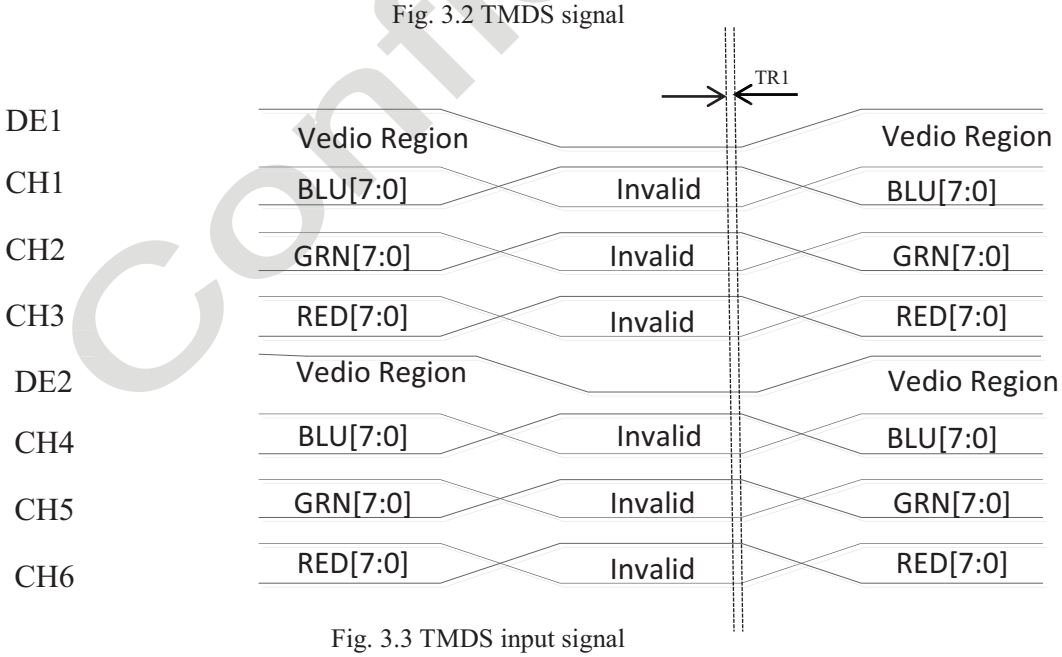


Fig. 3.3 TMDS input signal

3.2 Backlight Converter Unit

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

No.	Item	Symbol	Condition	Min.	Typ.	Max.	Unit	Remark
1	Power Consumption	PBL(2D)	100% Brightness	-	324	358	W	(Note 1)
		PBL(3D)		-	309	358	W	
2	Input Voltage Range	VBL	Continuously	51.0	53.0	55.0	VDC	
3	Input Current	IBL(2D)	53VDC Full Load	-	6.11	6.75	A	
		IBL(3D)		-	5.83	6.75	A	
4	Inrush current	Irs_en(2D)	51VDC Full Load	-	-	35	A	(Note 2)
		Irs_en(3D)		-	-	35	A	
		Irs_vin(2D)	55VDC Full Load	-	-	20	A	
5	BLU On/Off Control Voltage	VBLON	ON	2.5	3.3	3.6	V	
			OFF	0	-	0.8	V	
6	On/Off Control	IBLON	VBL = 53V			1.5	mA	
7	Status Signal	DET	Abnormal	—	—	—	V	(Open Collector)
			Normal	0	—	0.8	V	
8	PWM Dimming Control Voltage	VP_DIM	ON Duration	2.5	3.3	3.6	V	
			OFF Duration	0	—	0.8	V	
9	External PWM Control Current	IP-DIM				2	mA	
10	PWM Dimming Frequency	FPWM	Continuously	140	180	240	Hz	
11	Dimming Duty Ratio	DDIM	—	10	-	100	%	
12	Input Interface impedance	RIN	-	300	-	-	kΩ	

Note:

(1) Dimming ratio = 100% (Max.) (T_A = 25 ± 5 ºC, Turn on for 45minutes), One converter's power consumption.,total converter is 4 Pcs.

(2) The measurement condition: VBL rising time is 20 ms. (V_{BL} from 10% ~ 90%), the sequence diagram is shown as Fig. 3.4.

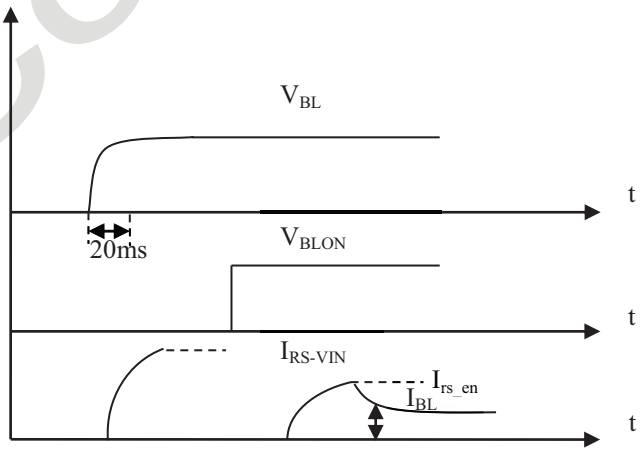


Fig. 3.4 The timing sequence diagram of inrush current measurement

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 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	

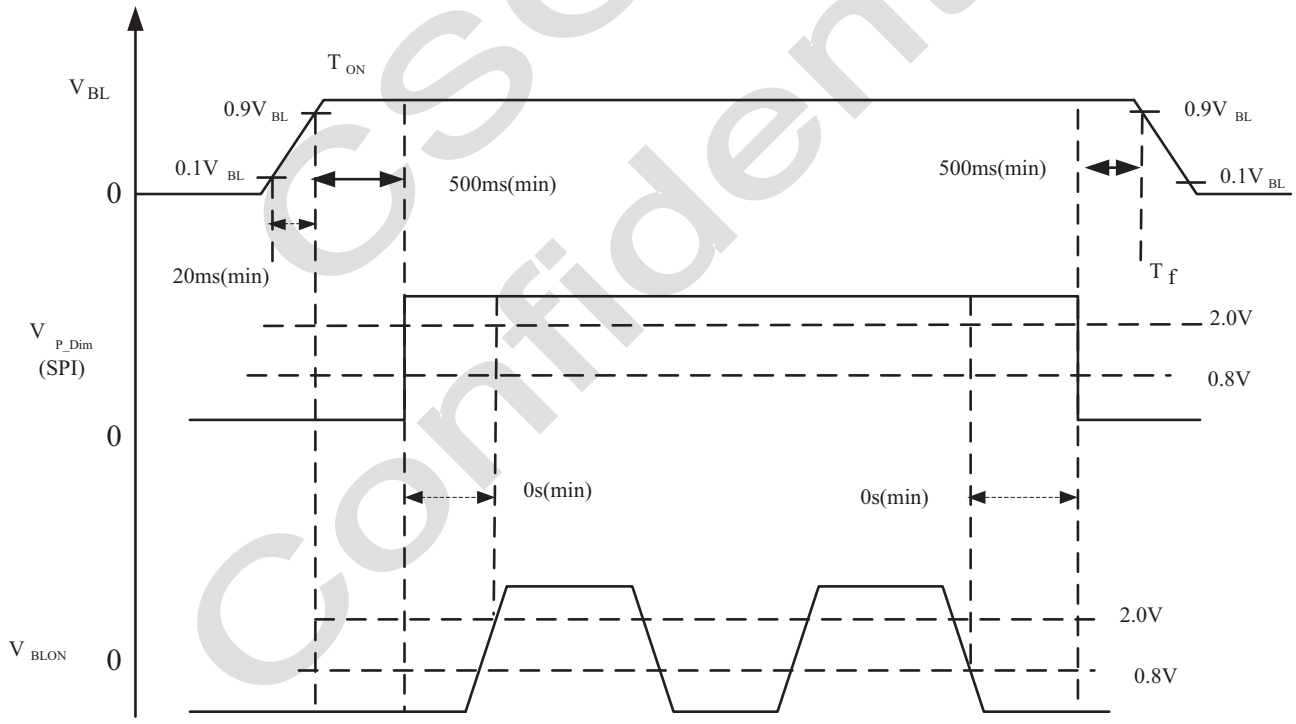
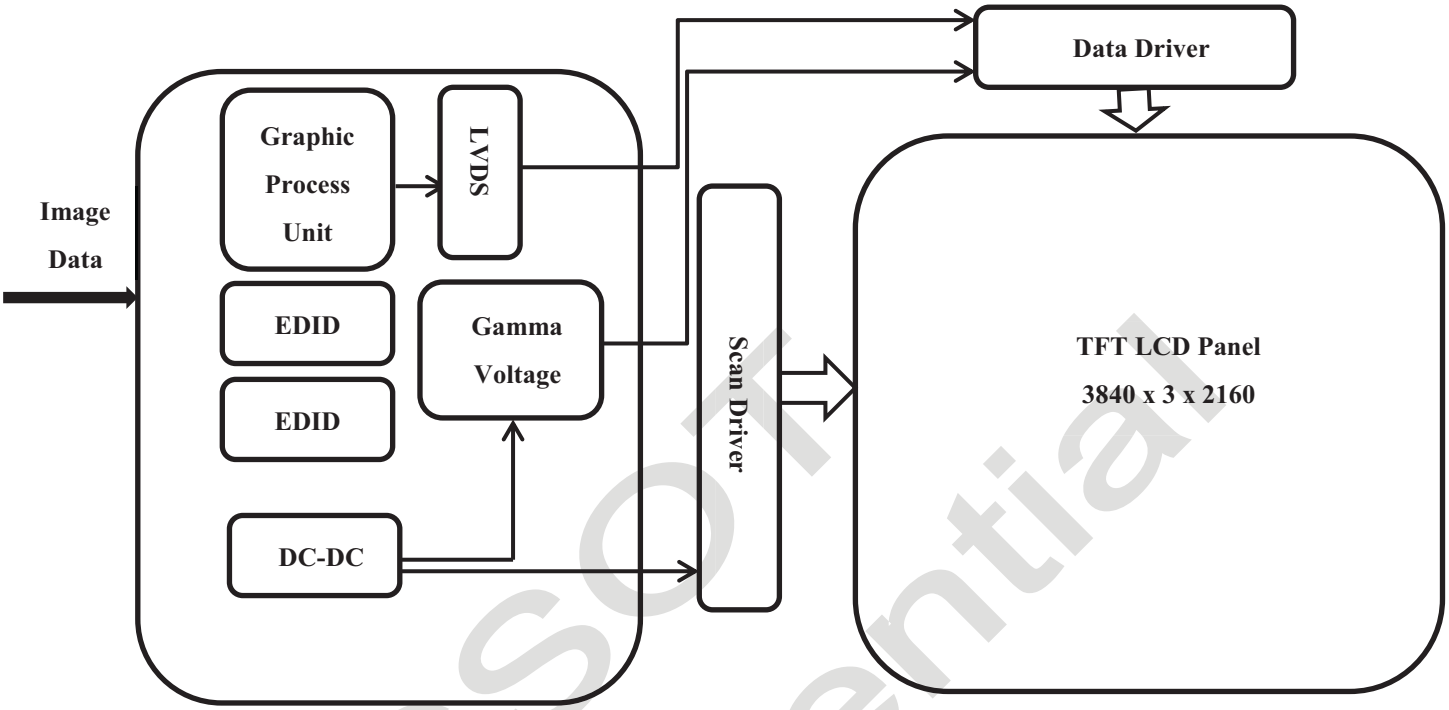


Fig. 3 .5The power sequence of VBL and VBLON

4. Electrical Block Diagram



5. Input Terminal Pin Assignment

5.1 TFT LCD Module

5.1.1 Signal Input Connector

CC Board CN1 & CN2: CU0724SAHDG (Cvilux) or equivalent (see Note (1))

Pin	Signal Assignment	Pin	Signal Assignment	Pin	Signal Assignment
1	T.M.D.S. Data2-	9	T.M.D.S. Data1-	17	T.M.D.S. Data0-
2	T.M.D.S. Data2+	10	T.M.D.S. Data1+	18	T.M.D.S. Data0+
3	T.M.D.S. Data2/4 Shield	11	T.M.D.S. Data1/3 Shield	19	T.M.D.S. Data0/5 Shield
4	T.M.D.S. Data4-	12	T.M.D.S. Data3-	20	T.M.D.S. Data5-
5	T.M.D.S. Data4+	13	T.M.D.S. Data3+	21	T.M.D.S. Data5+
6	DDC Clock	14	+5V Power	22	T.M.D.S. Clock Shield
7	DDC Data	15	Ground (for +5V)	23	T.M.D.S. Clock+
8	No Connect	16	Hot Plug Detect	24	T.M.D.S. Clock-

Note:

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

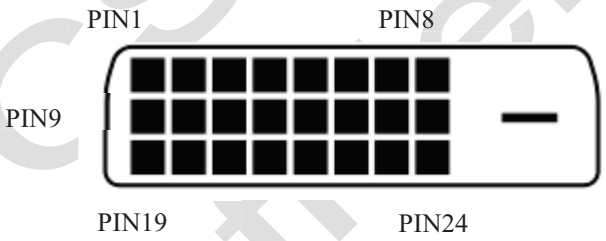


Fig. 5.1 Dual-link DVI-D connector direction sketch map

5.1.2 Power Input Connector

CC Board CN3&CN4 Connector: CI0114M1HRL-NH(Cvilux)

Pin No.	Symbol	Feature
1	VCC	Power Supply, + 12V DC Regulated
2		
3		
4		
5		
6		
7		
8	GND	GND
9		
10		
11		
12		
13		
14		

Note:

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

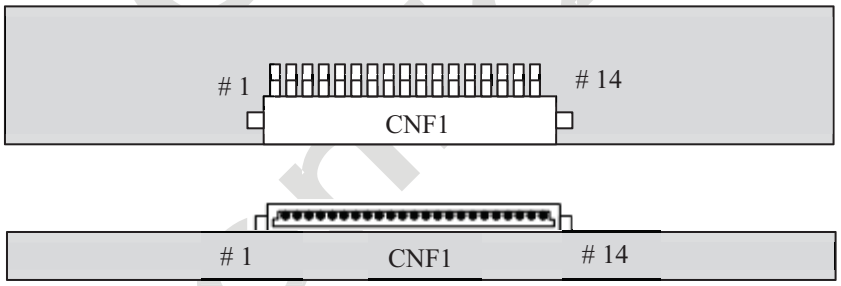


Fig. 5.2 VCC connector direction sketch map

5.2 Converter Unit

5.2.1 Converter Input Connector Pin Definition

Converter Board CNF1:CI0114M1HRL-NH (Cvilux)or equivalent (see 5.2 Note (1))

Pin No.	Symbol	Feature
1	V_{BL}	Power Supply, + 53V DC Regulated
2		
3		
4		
5		
6	GND	GND
7		
8		
9		
10		
11	DET	Normal (0 ~ 0.8V), Abnormal (Open Collector) (Recommend Pull high R > 10K, VDD = 3.3V)(Note (2))
12	BLON	Back Light On: High (2.5 ~ 3.6V); Back Light Off: Low (0 ~ 0.8V/GND)
13	NC	No Connection
14	P_DIM	PWM Dimming Control

Attention:

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

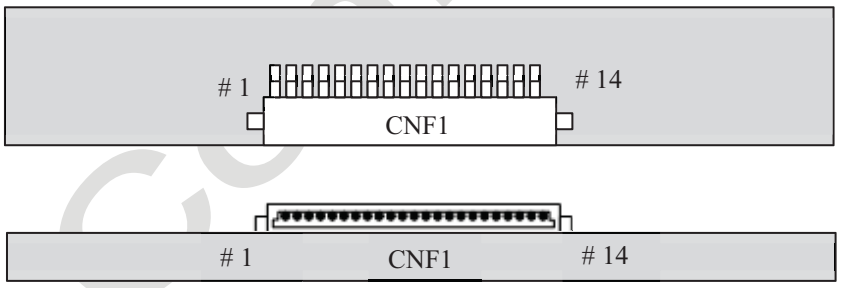


Fig. 5.3 Converter connector direction sketch map

(2) When open collector occur, the limit current resistor need to be connected to DET pin to prevent MOSFET from damage, the maximum drain current of MOSFET is 100mA.

5.3 Color Data Input Assignment

The brightness of each primary color is based on the 8-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
		R7	R6	R5	R4	R3	R2	R1	R0	G7	G6	G5	G4	G3	G2	G1	G0	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
	Red	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Green	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0
	Blue	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1
	Cyan	0	0	0	0	0	0	0	0	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	0	0	0	0	0	0	0	0	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	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
Gray Scale of Red	Red (0) / Dark	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 (1)	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
	Red (254)	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Red (255)	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gray Scale of Green	Green (0) / Dark	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 (1)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
	Green (254)	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0
	Green (255)	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0
Gray Scale of Blue	Blue (0) / Dark	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 (1)	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 (254)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	0
	Blue (255)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	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)

6.1.1 2D Timing Table

Signal	Item	Symbol	Min.	Typ.	Max.	Unit	Note
TMDS Clock	Frequency	F_{CLK} (= 1 / T_{CLK})	145	145	165	MHz	
Vertical Term	Frame Rate	F	57	60	61	Hz	
	Total	T_V	2250	2250	2250	T_H	$T_V = T_{VD} + T_{VB}$
	Display	T_{VD}		2160		T_H	
	Blank	T_{VB}	90	90	90	T_H	
Horizontal Term	Total	T_H	4400	4400	4400	T_{CLK}	$T_H = T_{HD} + T_{HB}$
	Display	T_{HD}		3840		T_{CLK}	
	Blank	T_{HB}	600	600	600	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.

6.1.2 3D Timing Table

Signal	Item	Symbol	Min.	Typ.	Max.	Unit	Note
TMDS Clock	Frequency	F_{CLK} (= 1 / T_{CLK})	145	145	165	MHz	
Vertical Term	Frame Rate	F	100	120	120	Hz	
	Total	T_V	1125	1125	1125	T_H	$T_V = T_{VD} + T_{VB}$
	Display	T_{VD}		1080		T_H	
	Blank	T_{VB}	45	45	45	T_H	
Horizontal Term	Total	T_H	2200	2200	2200	T_{CLK}	$T_H = T_{HD} + T_{HB}$
	Display	T_{HD}		1920		T_{CLK}	
	Blank	T_{HB}	300	300	300	T_{CLK}	

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.

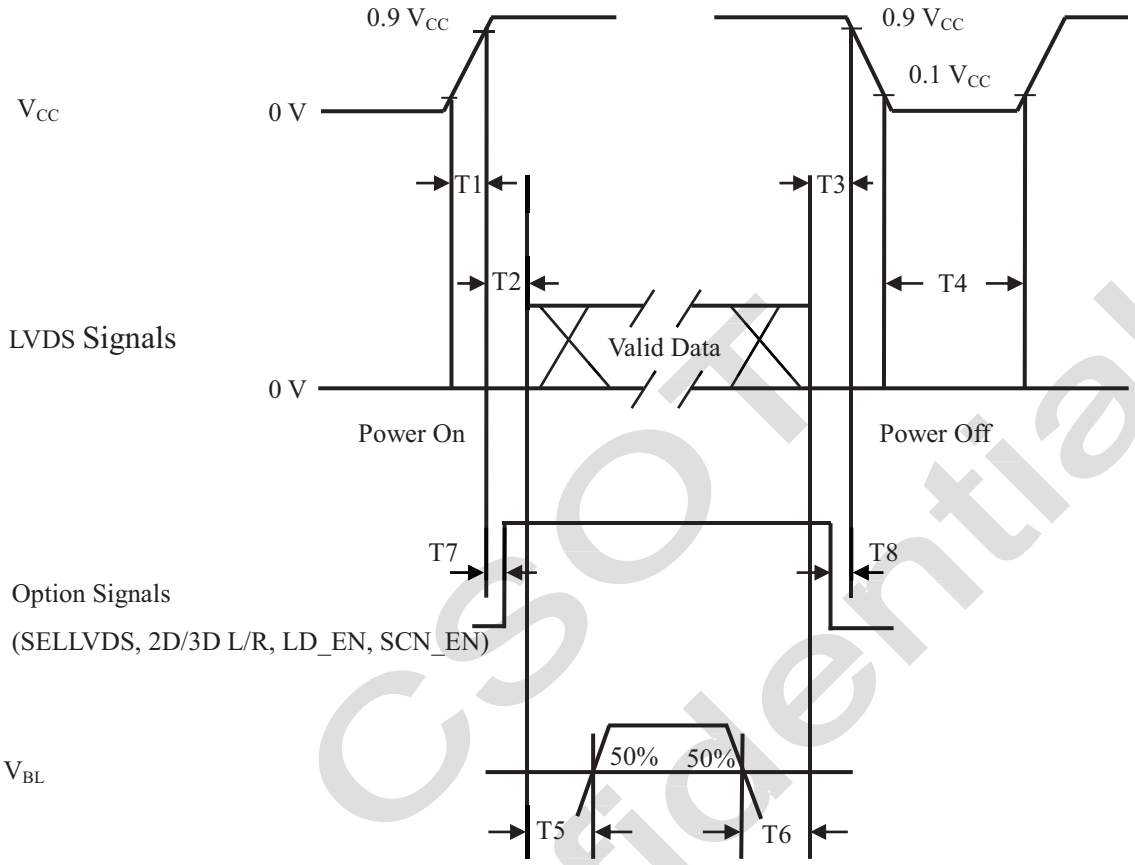
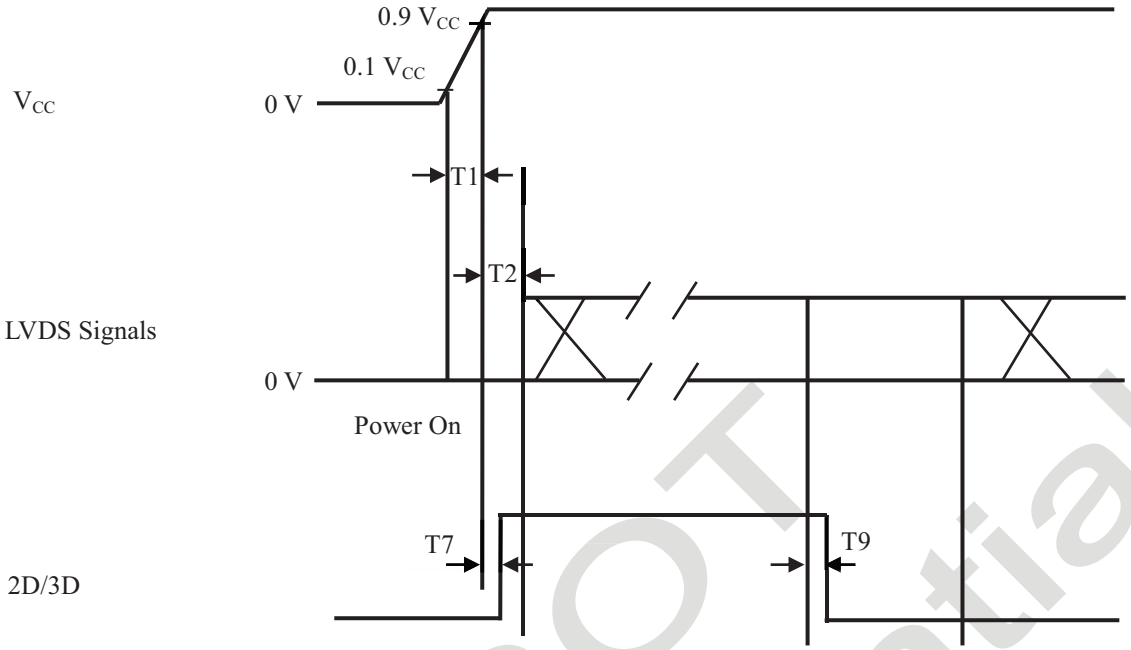


Fig. 6.2 Power on/off sequence

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	ms
T2	0.0	-	-	ms
T3	0.0	-	-	ms
T4	1000	-	-	ms
T5	500	-	-	ms
T6	100	-	-	ms
T7	-	-	T2	ms
T8	-	-	T3	ms
T9	TBD	-	TBD	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
LVDS Supply Voltage	V_{CC}	12	V
Driving Signal	Refer to the typical value in Chapter 3: Electrical Specification		
LED Driving Current	I_L	42	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 459 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.

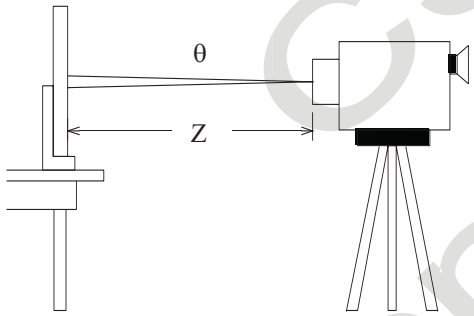


Fig. 7.1 The standard set-up system of measurement

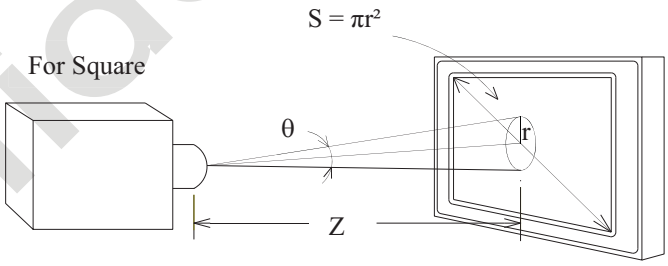


Fig. 7.2 The area S contains at least 500 pixels to be measured

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

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}		-	1000	-	cd/m^2	(2) (4)
		L_{W-3D}		-	TBD	-	-	(5)
3D Crosstalk		CT-3D		-	TBD	-	-	(5)
Uniformity of White Screen		-		-	-	-	%	(2) (6)
Color Chromaticity (CIE1931)	Red	R_X		Typ. - 0.03	0.680	Typ. + 0.03	-	(2) (7)
		R_Y			0.316		-	
	Green	G_X			0.286		-	
		G_Y			0.654		-	
	Blue	B_X			0.147		-	
		B_Y			0.047		-	
	White	W_X			0.280		-	
		W_Y			0.290		-	
	Color Gamut	CG		-	92	-	% NTSC	
Viewing Angle	Horizontal	θ_{H+}	CR ≥ 10	-	89	-	Deg.	(8) 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.

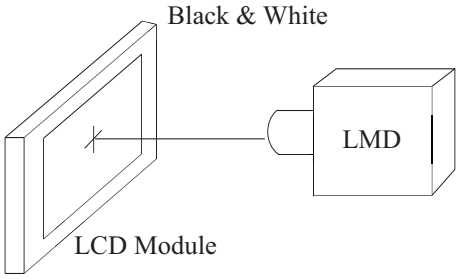


Fig. 7.3 The standard setup of CR measurement

(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.

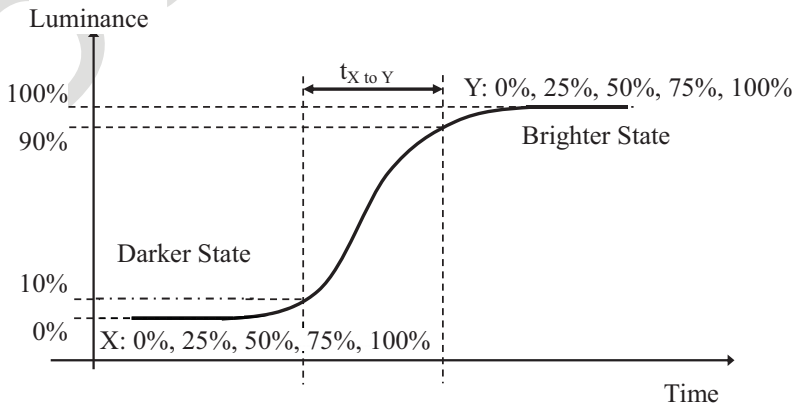


Fig. 7.4 The definition of $t_{X\ to\ Y}$

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.

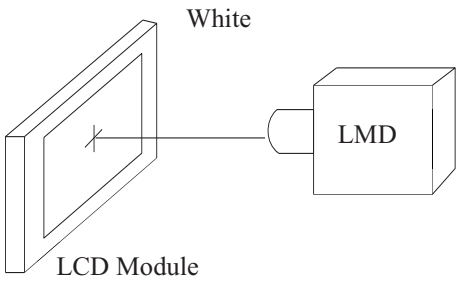


Fig. 7.5 The standard setup of luminance measurement

(5) Definition of 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"

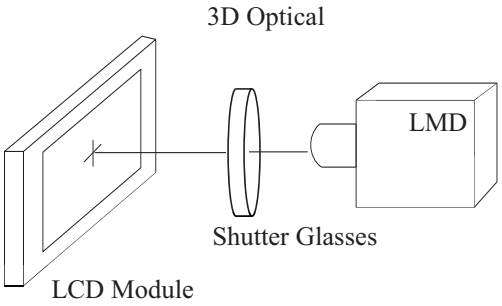


Fig. 7.6 3D optical measurement system

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: $CT\text{-}3D = \frac{L(WB)-L(BB)}{L(BW)-L(BB)}$

(6) 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%.

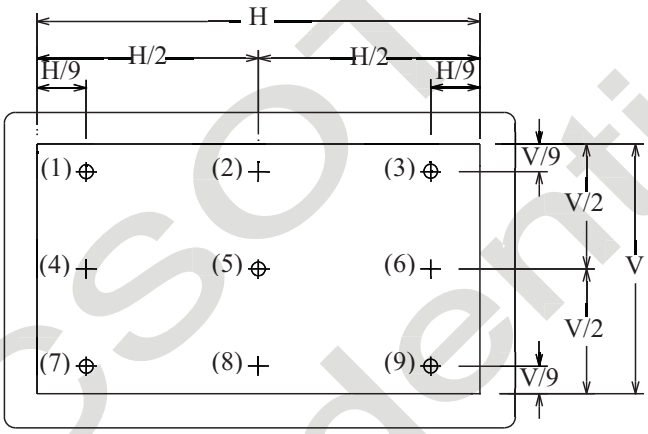


Fig. 7.7 Symbol " + " defines the 9 measuring locations (1), (2), (3) ⋯ (9)

(7) 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.

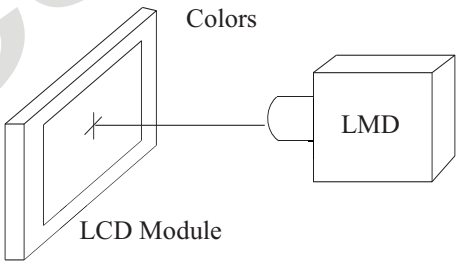


Fig. 7.8 The standard setup of color chromaticity measurement

(8) 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.

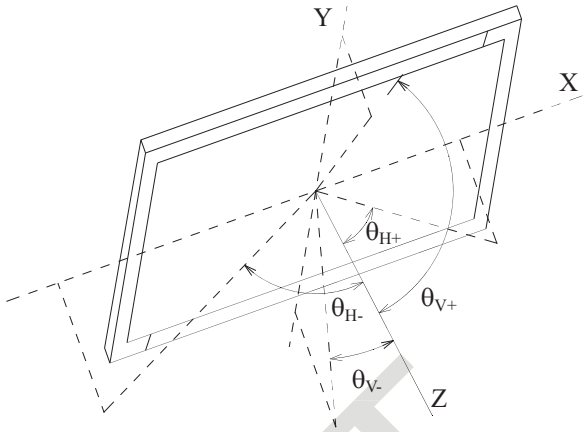
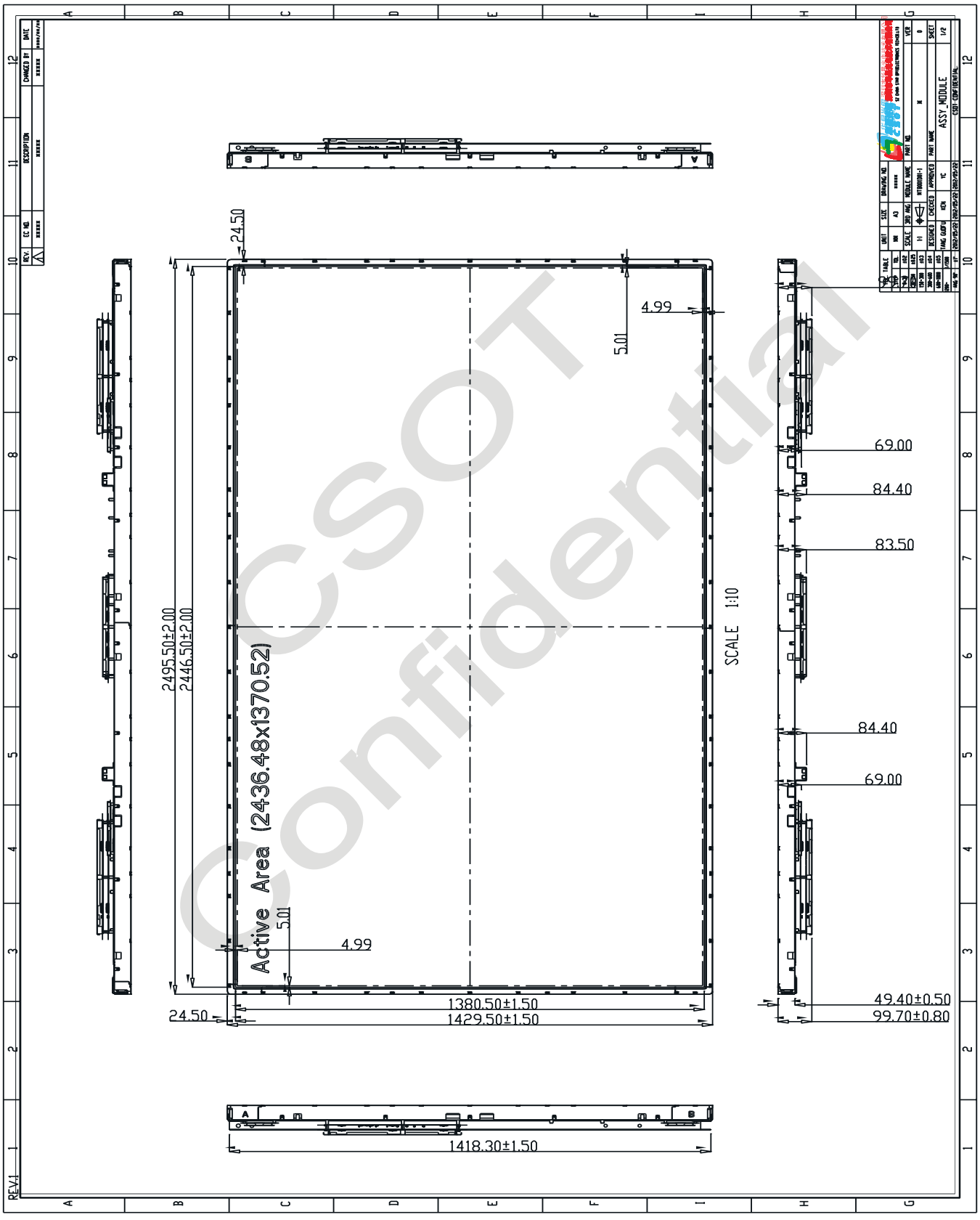
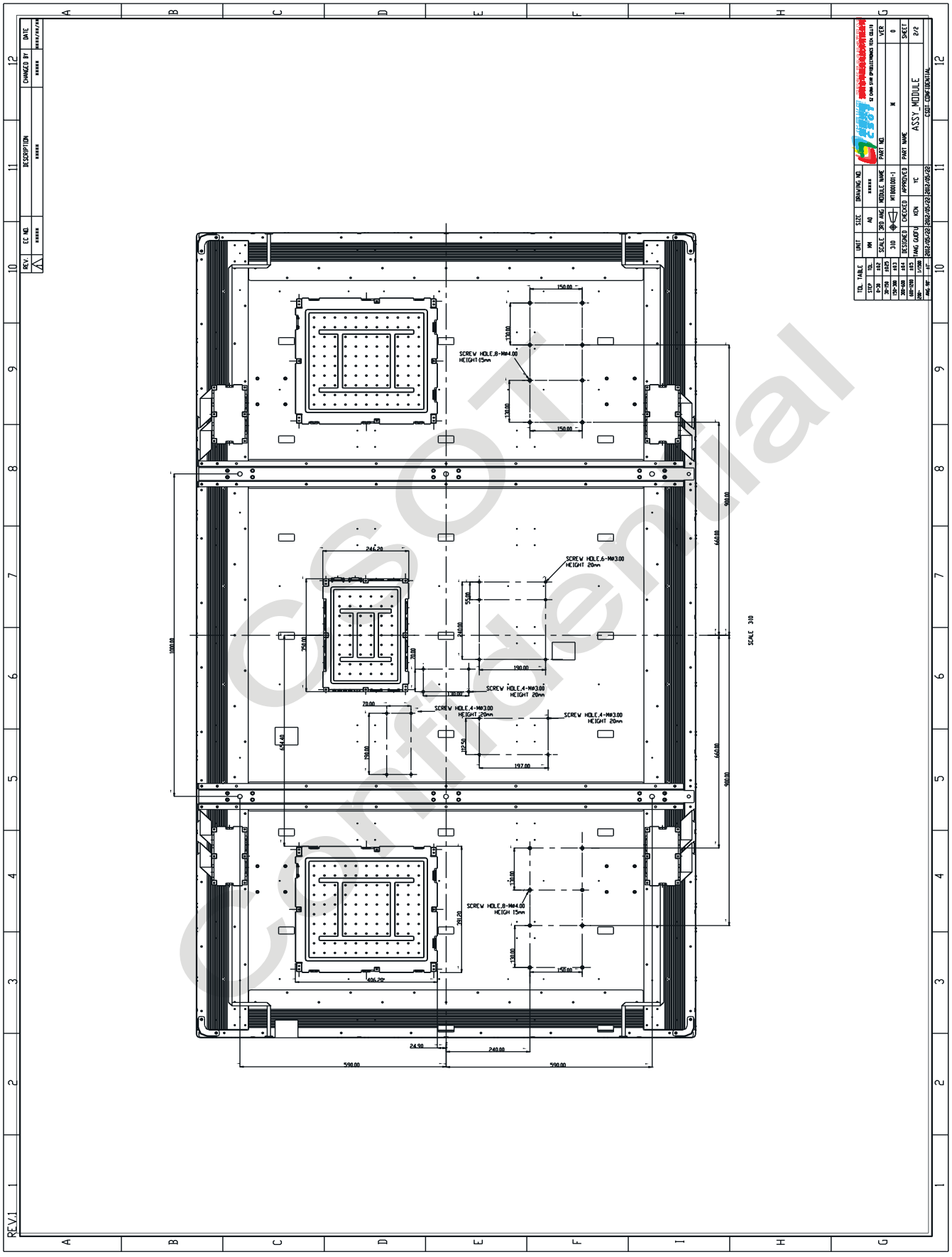


Fig. 7.9 Viewing angle coordination system

8. Mechanical Characteristics

8.1 Mechanical Specification



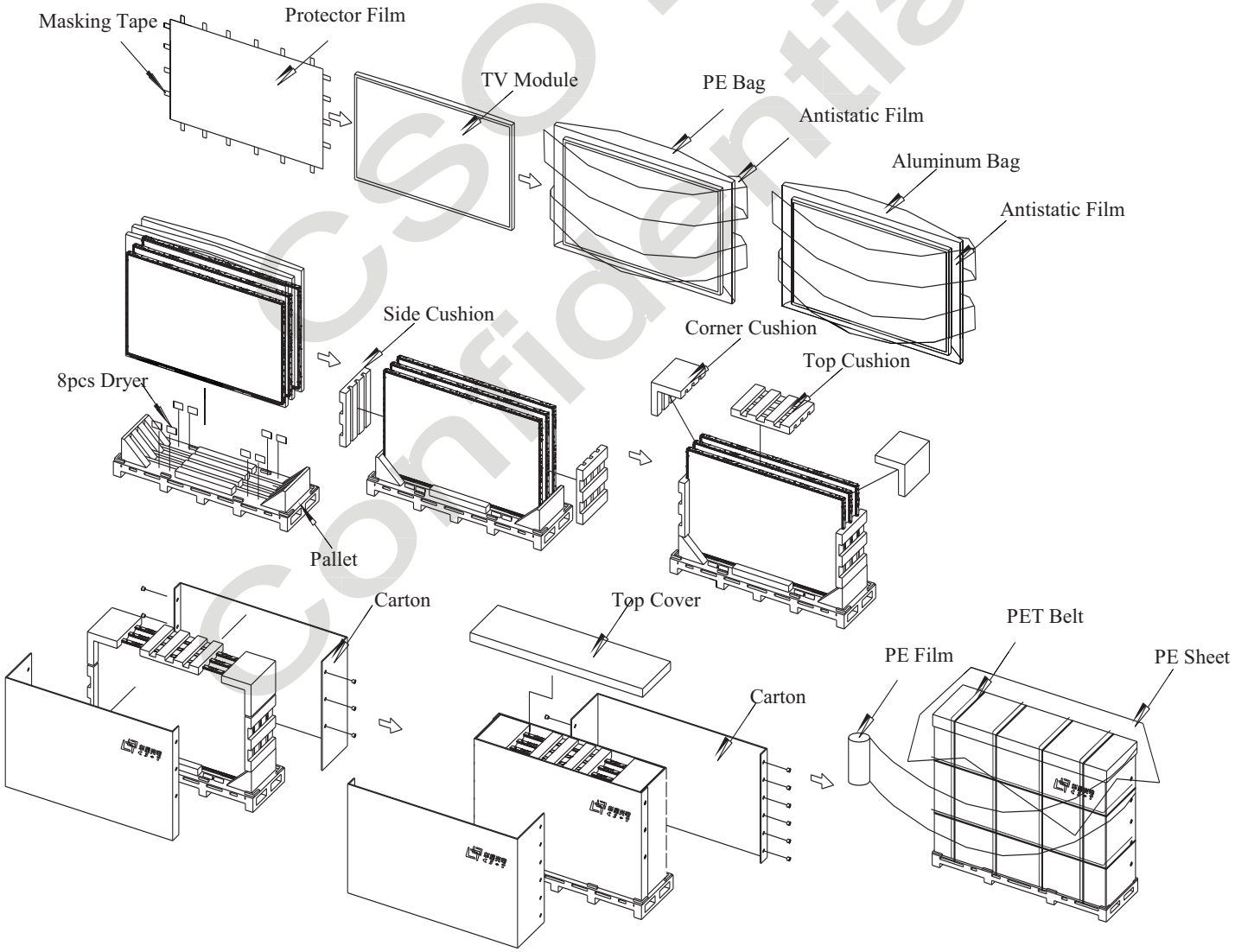


8.2 Packing

8.2.1 Packing Specifications

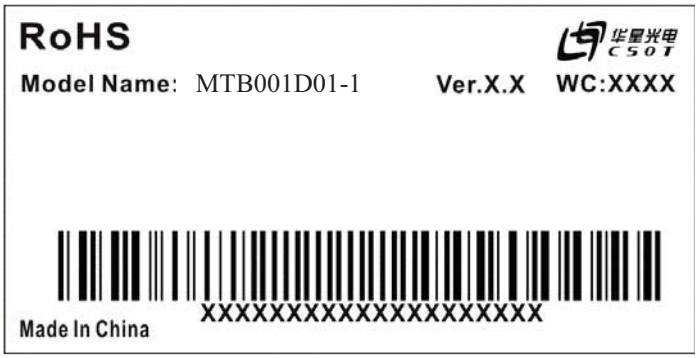
Item	Specification		
	Quantity	Dimension (mm)	Weight (kg)
Packing Box	3pcs / box	2770(L) x870 (W) x 1555(H)	Net Weight: 360 (Max.) Gross Weight: 240(Max.)
Pallet	1	2770.00 (L) x 870.00 (W) x 195.00 (H)	Net Weight: 145
Stack Layer	1		
Boxes per Pallet	1 box / pallet		
Pallet after Packing	3 pcs / pallet	2770.00 (L) x 870.00 (W) x1750 (H)	Gross Weight:566KG/ pallet

8.2.2 Packing Method



9. Definition of Labels

9.1 Module Label



For RoHS compliant products, CSOT will add RoHS for identification.

Model Name: MTB001D01-1

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

WC (Week Code): XX XX

- XX → Week
- XX → Year

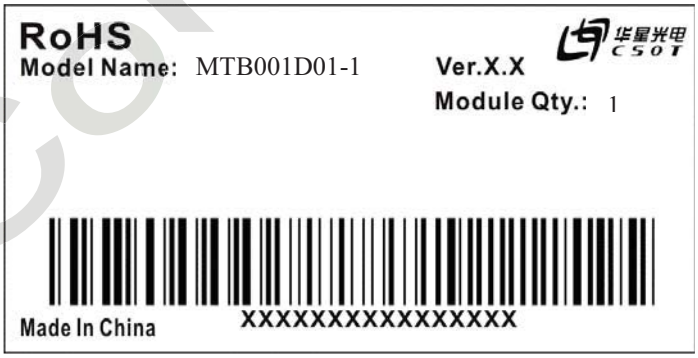
Year: 2010 = 10, 2011 = 11 … 2020 = 20, 2021 = 21…

Week: 01, 02, 03 …

Serial Number: XXXXXXXXXXXX XXXXXXXX

- XXXXXXXX → CSOT Internal Use
- XXXXXXXXXXXX → Panel ID

9.2 Carton Label



Serial Number: XXXX XX XXXXX XXXXX

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

Serial Number: XXX XX XXX XXXXX

- XXX → CSOT Internal Use
- XX → Year, Month
- XXX → 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 module during assembly.

(2) It is recommended to assemble or install a 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 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 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 10 ºC, 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 module's end of life, it is not harmful in case of normal operation and storage.