MODEL: MT3151A04-1

Ver. 1.1

Date: 14.Nov.2011

Customer's Approval	CSOT
Signature Date	Approved By Product Director Date Name:Richard Lung Signature:
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	Reviewed By Project Leader Date Name:Joe Kuo Signature:
	Reviewed By PM Date Name:Charles Chin Signature:

Contents

Revision History

Version	Date	Page (New)	Section	Description	Revision by
Ver. 1.0	14.Nov.2011	26	All	Tentative Specification was First Issued.	Charles Chin

1. General Description

1.1 Product Features

- **HD Resolution (1366 x 768)**
- **High Brightness: 350 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. 35W**
- **DE (Data Enable) Mode**
- **LVDS (Low Voltage Differential Signaling) Interface**

1.2 Overview

MT3151A04-1 is a diagonal 31.5" color active matrix LCD module with edge LED backlight and 1ch-LVDS interface. This module is a transmissive type display operating in the normally black mode. It supports 1366 x 768 HD 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 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	697.6845 (H) x 392.2560 (V)	mm	
Bezel Opening Area	705.4 (H) x 400.0 (V)	mm	
Outline Dimension	735.4 (H) x 433.0 (V) x 16.2 (D)	mm	D: From Bezel to Rear
Weight	5.2	kg	Max.
Driving Scheme	a-Si TFT Active Matrix	-	
Number of Pixels	1366 x 768	pixel	
Pixel Pitch (Sub Pixel)	0.17025 (H) x 0.51075 (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 12%, Hard Coating (3H)	-	
Luminance of White	350	cd/m²	Center Point, Typ.

2. Electrical Specification

2.1 Electrical Characteristics

2.1.1 Power Consumption (TA = 25 ± 2 °C)

Parameter		Symbol	Value			Unit	Note
			Min.	Typ.	Max.		
Power Supply Voltage		V_{CC}	TBD	12.0	TBD	V	(1)
Rush Current		I_{RUSH}	-	-	3	A	(2)
Power Supply Current	White Pattern	I_{CC}	-	0.27	0.35	A	(3)
	Horizontal Stripe	I_{CC}	-	0.24	0.32	A	
	Black Pattern	I_{CC}	-	0.15	0.2	A	

Note:

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

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

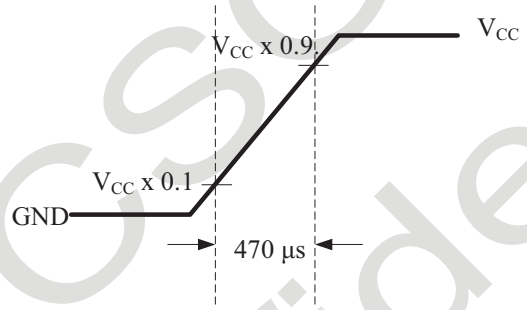


Fig. 2.1 V_{CC} rising time condition

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

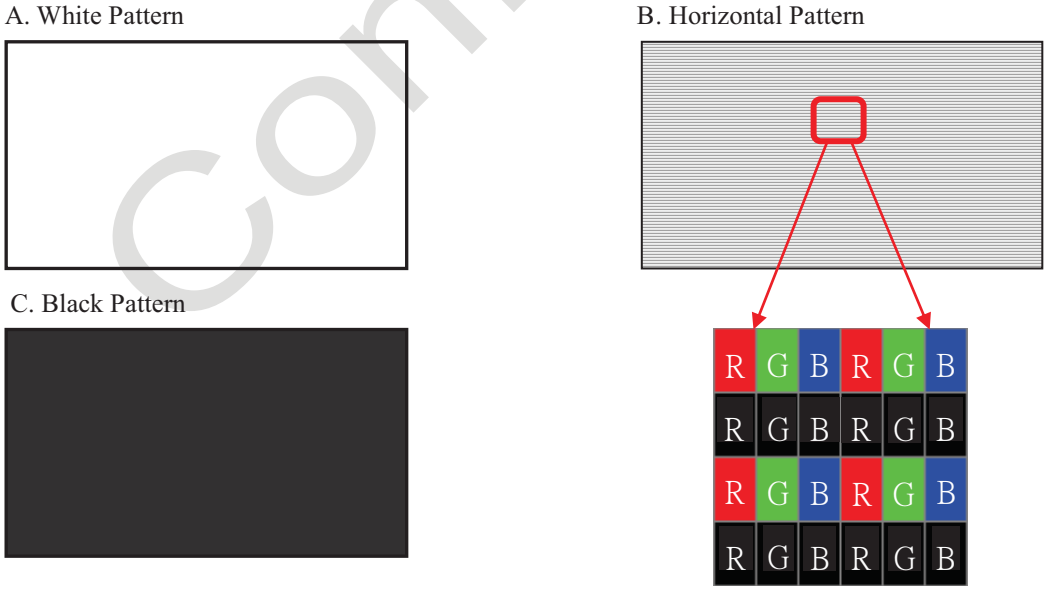


Fig. 2.2 Test patterns

2.1.2 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	-	600	mV	
	Terminating Resistor	R_T	-	100	-	ohm	
CMOS Interface	Input High Threshold Voltage	V_{IH}	2.7	-	3.3	V	
	Input Low Threshold Voltage	V_{IL}	0.0	-	0.6	V	

Note:

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

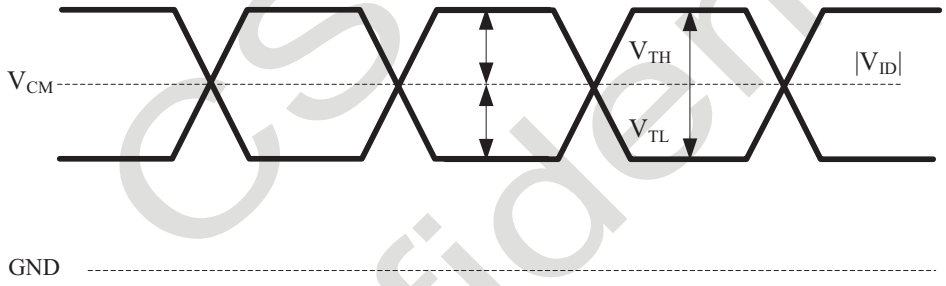


Fig. 2.3 LVDS input signal

3. Backlight Converter Unit

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

Parameter		Symbol	Condition	Value			Unit	Note
				Min.	Typ.	Max.		
Power Consumption		P_{BL}	V_{BL} = 24V	-	27.6	37	Watt	(1)
Input Voltage		V_{BL}	-	22.8	24.0	25.2	V	
Input Current		I_{BL}	V_{BL} = 24V	-	1.15	1.70	A	
Input Inrush Current		I_{RS-VIN}	V_{BL} = 24V	-	-	2.7	A	(2)
				-	-	5	A	
On/Off Control Voltage	On	V_{BLON}	V_{BL} = 24V	2.4	-	5.0	V	
	Off		V_{BL} = 24V	0.0	-	0.8	V	
On/Off Control	-	I_{BLON}	V_{BL} = 24V	-	-	1.5	mA	
PWM Dimming Control Voltage	Max.	V_{P-DIM}	V_{BL} = 24V	2.4	-	5.0	V	
	Min.		V_{BL} = 24V	0.0	-	0.8	V	
External PWM Control Current		I_{P-DIM}	V_{BL} = 24V		-	2	mA	
PWM Dimming Frequency		F_{P-DIM}	V_{BL} = 24V	140	180	240	Hz	
Min Dimming Duty Ratio		D_{P-DIM}	V_{BL} = 24V	5	10		%	(3)
DET Status Signal		DET HI	V_{BL} = 24V	Open Collector			-	
		DET Low	V_{BL} = 24V	0	-	0.8	V	
Input Impedance		R_{IN}	V_{BL} = 24V	300	-	-	Kohm	

Note:

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

(2) The measurement condition: VBL rising time is 20 ms. (VBL from 10% ~ 90%), the sequence diagram is shown as Fig.3.1.

(3) 5% ~10%minimum duty ratio is only valid for electrical operation.

(4) Normal: 0 ~ 0.8V; Abnormal: Open collector.

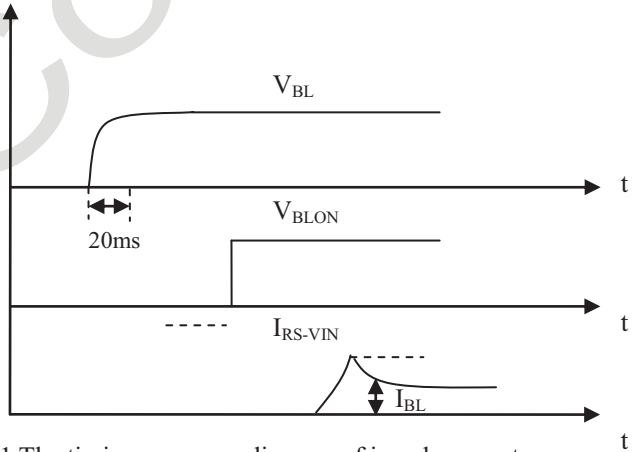


Fig. 3.1 The timing sequence diagram of inrush current measurement

3.2 LED Converter Power Sequence

No.	Symbol	Min.	Typ.	Max.	Unit	Remark
1	T1	20	-	-	ms	See Fig. 3.2
2	T2	500	-	-	ms	
3	T3	250	-	-	ms	
4	T4	0	-	-	ms	
5	T5	250	-	-	ms	

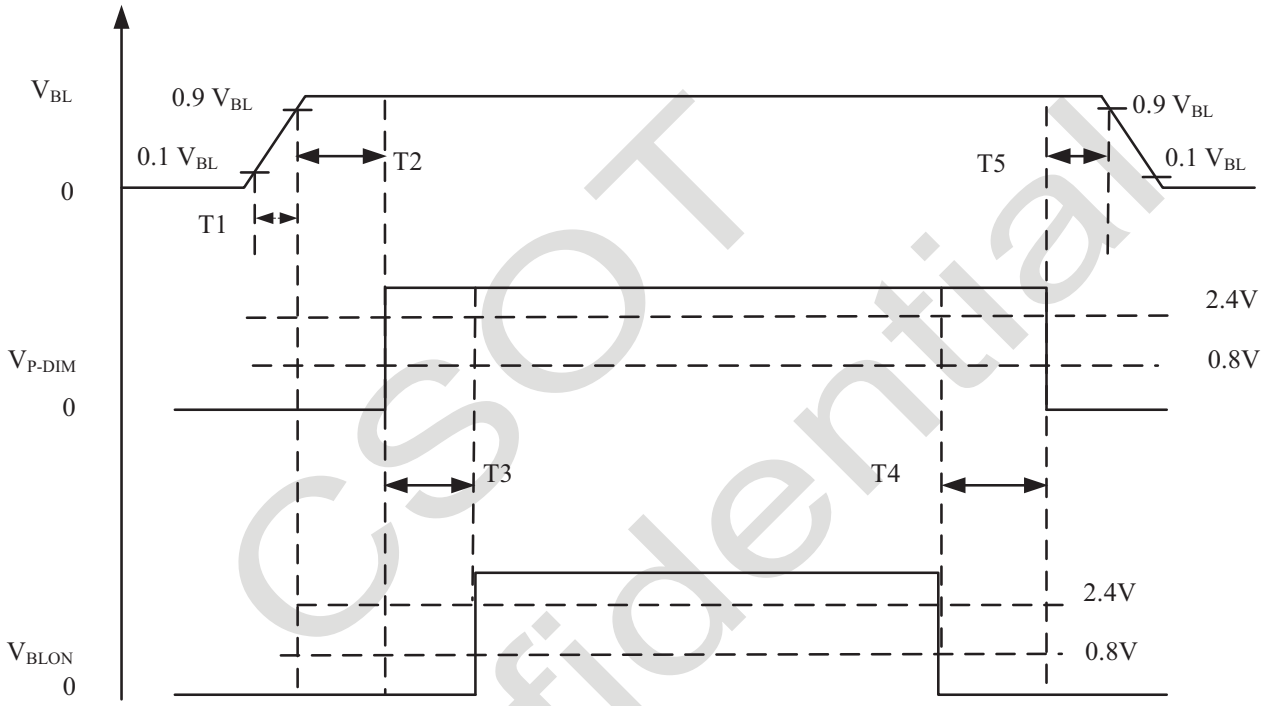


Fig. 3.2 The power sequence of V_{BL} and V_{BLON}

Attention:

The power sequence:

On = V_{BL} > V_{P-DIM}>= V_{BLON}

Off = V_{BLON} >= V_{P-DIM} > V_{BL}

4. Input Terminal Pin Assignment

4.1 TFT LCD Module

CN1: 300B30-0000RA-M4 (STARCONN) or equivalent (see Note (1))

Pin No.	Symbol	Description	Note
1	V_{CC}	Power Supply ,+ 12 V DC Regulated	
2	V_{CC}	Power Supply ,+ 12 V DC Regulated	
3	V_{CC}	Power Supply ,+ 12 V DC Regulated	
4	V_{CC}	Power Supply ,+ 12 V DC Regulated	
5	GND	Ground	
6	GND	Ground	
7	GND	Ground	
8	GND	Ground	
9	LVDS SEL	LVDS Data Format Selection	(2)
10	NC	For CSOT Users Only	
11	GND	Ground	
12	LV1N0	1st Channel LVDS Data Input (0-)	
13	LV1P0	1st Channel LVDS Data Input (0+)	
14	GND	Ground	
15	LV1N1	1st Channel LVDS Data Input (1-)	
16	LV1P1	1st Channel LVDS Data Input (1+)	
17	GND	Ground	
18	LV1N2	1st Channel LVDS Data Input (2-)	
19	LV1P2	1st Channel LVDS Data Input (2+)	
20	GND	Ground	
21	LVCK1N	1st Channel LVDS Clock Input (-)	
22	LVCK1P	1st Channel LVDS Clock Input (+)	
23	GND	Ground	
24	LV1N3	1st Channel LVDS Data Input (3-)	
25	LV1P3	1st Channel LVDS Data Input (3+)	
26	GND	Ground	
27	NC	For CSOT Users Only	(3)
28	NC	For CSOT Users Only	(3)
29	NC	For CSOT Users Only	(3)
30	GND	Ground	

Note:

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

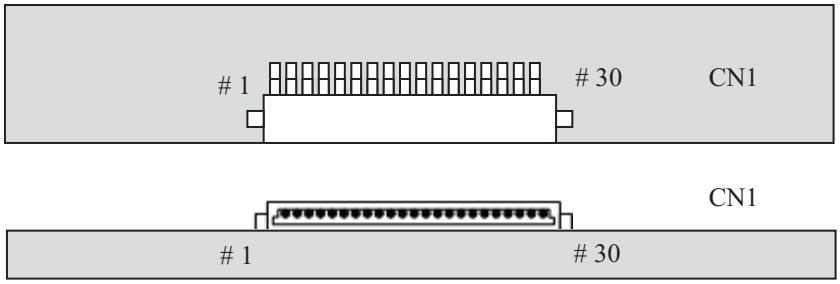


Fig. 4.1 LVDS direction sketch map

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

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

4.2 Converter Unit

4.2.1 Converter Input Connector Pin Definition

CNF1: CI0114M1HR0-NHC (Cvilux) or equivalent (see 4.1 Note (1))

Pin No.	Symbol	Feature
1	VBL	Power Supply, + 24 V 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/Off: Back Light On :High(2 ~ 5V) /Open (NC) ; Back Light Off: Low (0 ~ 0.8V/GND)
13	NC	No Connection
14	P_DIM	PWM Dimming Control (Open for 100%)

Attention:

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

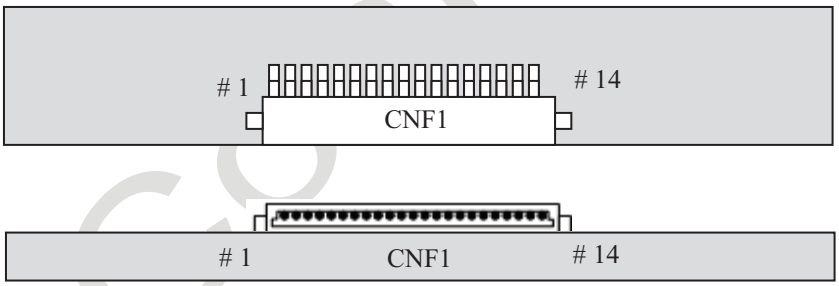
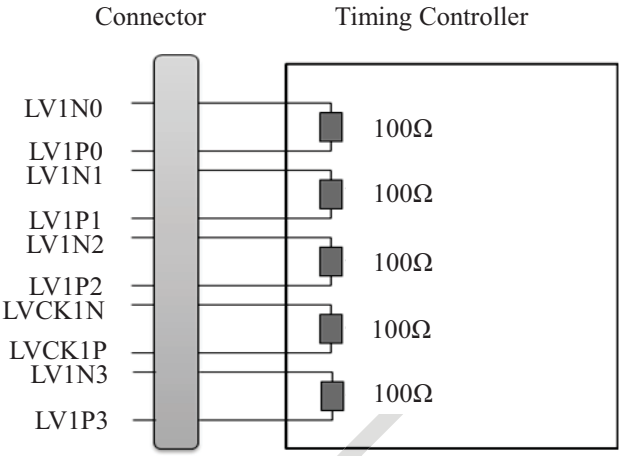


Fig. 4.2 Converter connector direction sketch map

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

4.3 Block Diagram of Interface



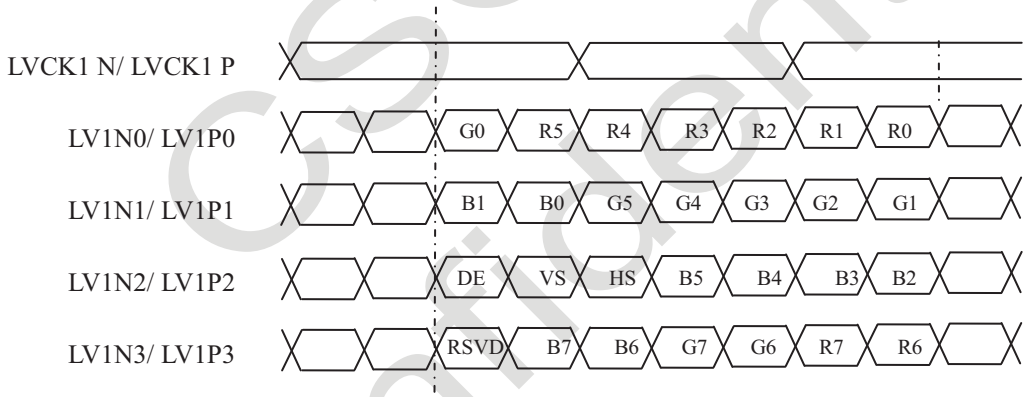
Attention:

(1) LCD module uses a 100 ohms (Ω) resistor between positive and negative lines of each receiver input.

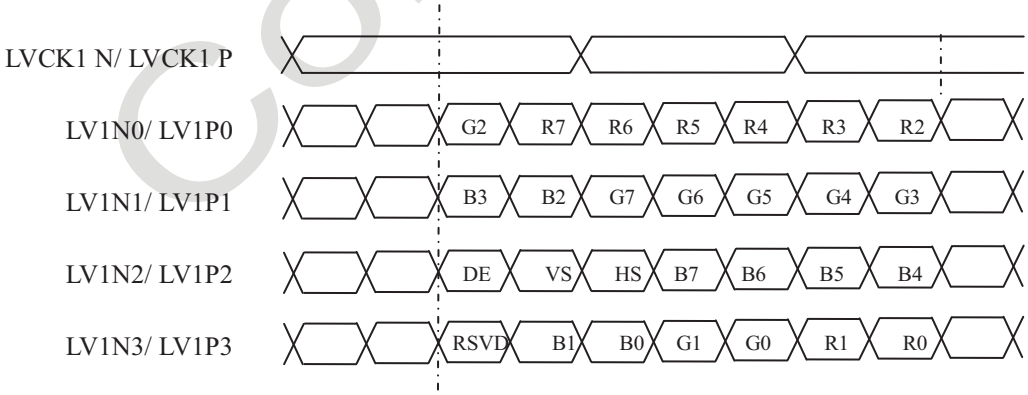
(2) LVDS cable impedance shall be 50 ohms per signal line or about 100 ohms per twist-pair line respectively.

4.4 LVDS Interface

4.4.1 VESA Format (SELLVDS = L or Open)



4.4.2 JEIDA Format (SELLVDS = H)



5. Interface Timing

5.1 Timing Table (DE Only Mode)

Signal	Item	Symbol	Min.	Typ.	Max.	Unit	Note
LVDS Clock	Frequency	F_{clk} (= 1 / T_{clk})	50.0	75.4	85.0	MHz	
Vertical Term	Frame Rate	F	TBD.	60	TBD.	Hz	
	Vertical Frequency	F_v	47.0	48.4	60.9	KHz	
	Total	T_v	784	806	1015	T_h	$T_v = T_{vd} + T_{vb}$
	Display	T_{vd}		768		T_h	
	Blank	T_{vb}	16	38	247	T_h	
Horizontal Term	Total	T_h	1460	1560	2000	T_{clk}	$T_h = T_{hd} + T_{hb}$
	Display	T_{hd}		1366		T_{clk}	
	Blank	T_{hb}	94	194	634	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.

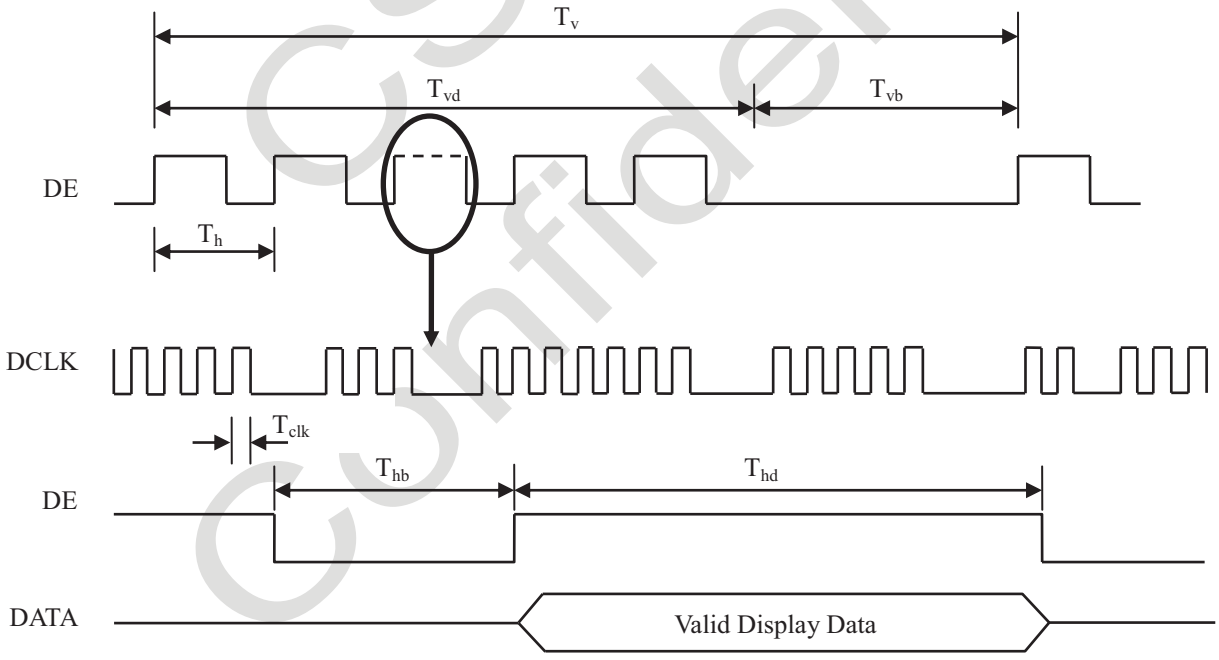


Fig. 5.1 Interface signal timing diagram

5.2 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.

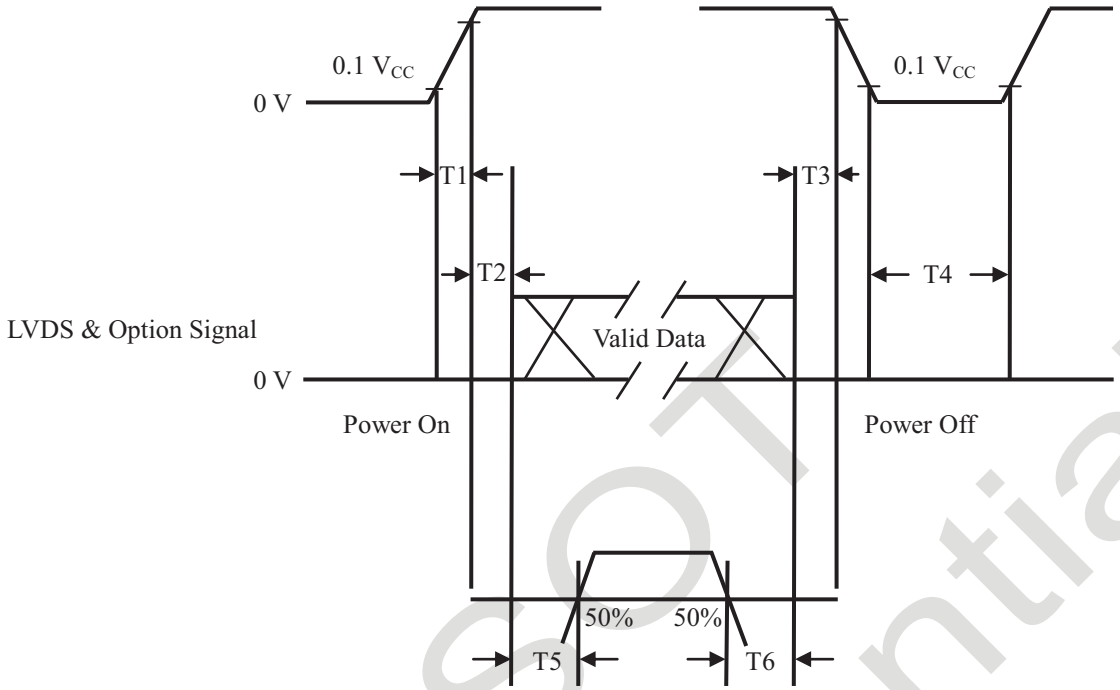


Fig. 5.2 Power On/Off

Parameter	Values			Unit
	Min.	Typ.	Max.	
T1	0.5	-	10	ms
T2	0	-	50	ms
T3	0	-	50	ms
T4	1000	-	-	ms
T5	500	-	-	ms
T6	100	-	-	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.

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}	12	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 45 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. 6.1. The measuring area S should contain at least 500 pixels of the LCD module as illustrated in Fig.6.2 (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.

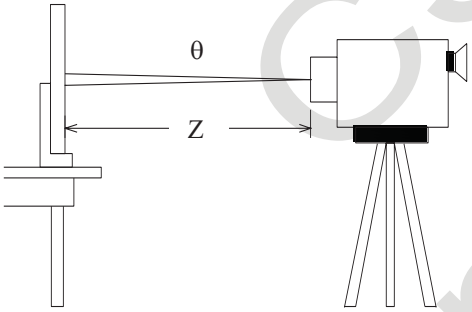


Fig. 6.1 The standard set-up system of measurement

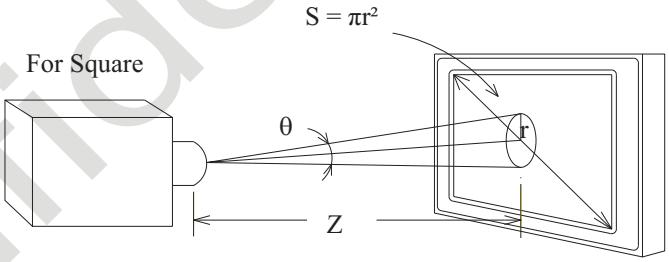


Fig. 6.2 The area S contains at least 500 pixels to be measured

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

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 EZ Contrast 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	12	ms	(3)
Center Luminance		L_W		280	350	-	cd/m^2	(2) (4)
Uniformity of White Screen		-		75	-	-	%	(2) (5)
Color Chromaticity (CIE1931)	Red	R_X		Typ. - 0.03	0.638	Typ. + 0.03	-	(2) (6)
		R_Y			0.335		-	
	Green	G_X			0.323		-	
		G_Y			0.621		-	
	Blue	B_X			0.156		-	
		B_Y			0.054		-	
	White	W_X			0.280		-	
		W_Y			0.290		-	
	Color Gamut	CG		68	72	-	% NTSC	
Viewing Angle	Horizontal	θ_{H+}	CR ≥ 10	-	89	-	Deg.	(7)
		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. The LMD in this item is CS2000.

(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.

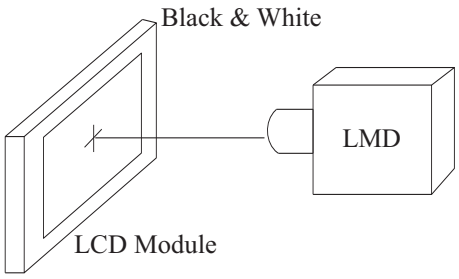


Fig. 6.3 The standard setup of CR measurement

(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 Fig.6.4. 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.

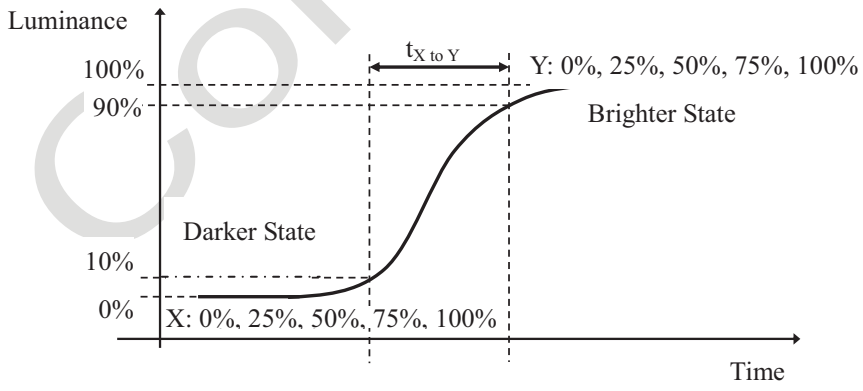


Fig. 6.4 The definition of $t_{X\ to\ Y}$

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.

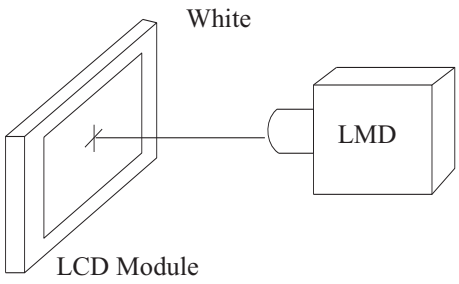


Fig. 6.5 The standard setup of luminance measurement

(5) Definition of uniformity of white screen:

The luminance Li (i from 1 to 9) is measured at the 9 points defined in Fig. 6.6. 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%.

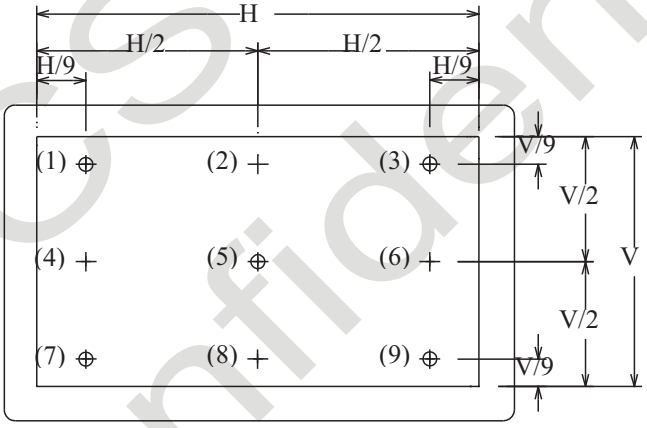


Fig. 6.6 Symbol " + " defines the 9 measuring locations (1), (2), (3) ⋯ (9)

(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. 6.7.

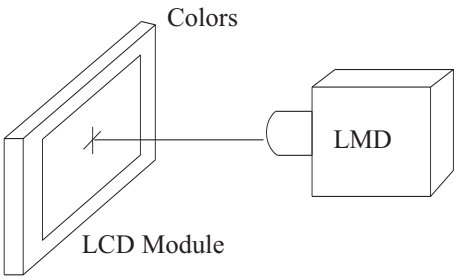


Fig. 6.7 The standard setup of color chromaticity measurement

(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. 6.8. The contrast ratio is measured by ELDIM EZ Contrast.

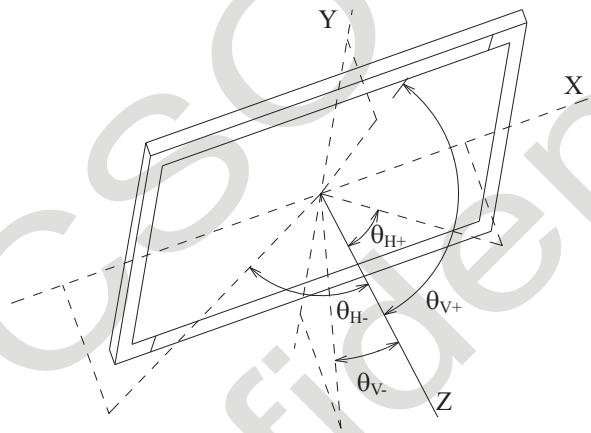
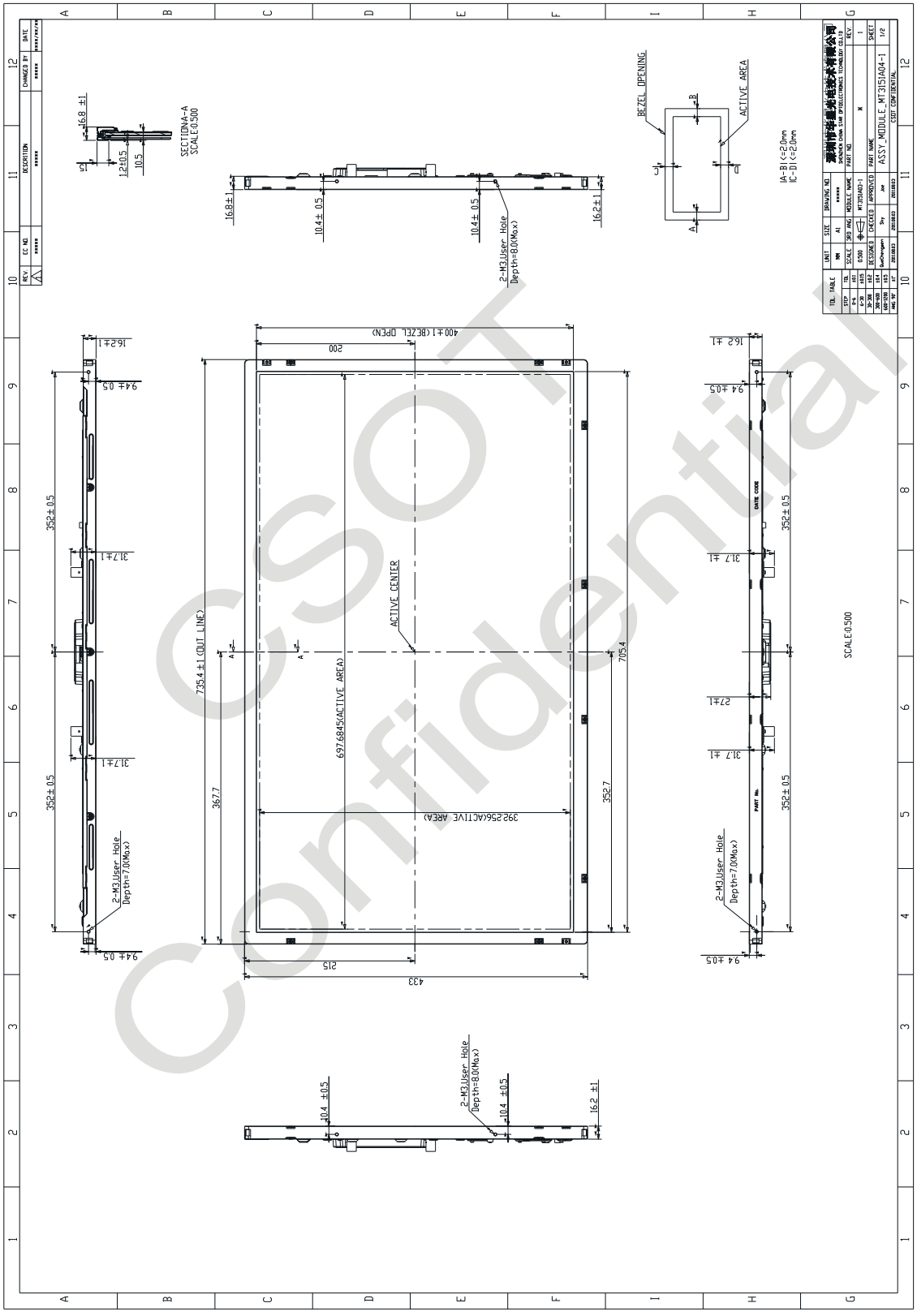
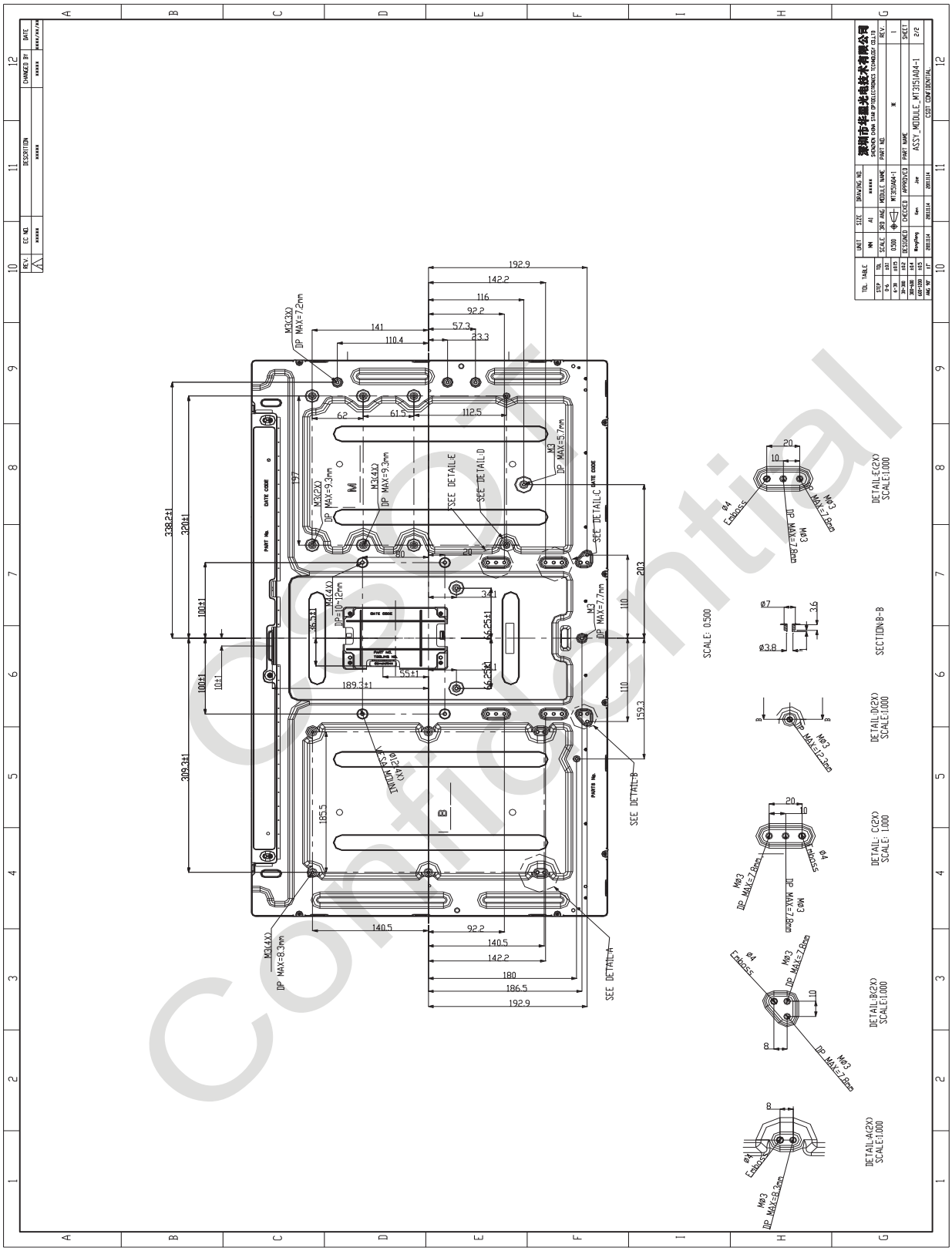


Fig. 6.8 Viewing angle coordination system

7. Mechanical Characteristics

7.1 Mechanical Specification





7.2 Packing

7.2.1 Packing Specifications

Item	Specification		
	Quantity	Dimension (mm)	Weight (kg)
Packing Box	7 pcs / box	830.00 (L) x 380.00 (W) x 523.00 (H)	Net Weight: 36.40 (Max.) Gross Weight: 42.40 (Max.)
Pallet	1	1150.00 (L) x 850.00 (W) x 120.00 (H)	Net Weight: 5.04
Stack Layer	2		
Boxes per Pallet	6 boxes / pallet		
Pallet after Packing	42 pcs / pallet	1150.00 (L) x 850.00 (W) x1169.00(H)	Gross Weight:246

7.2.2 Packing Method

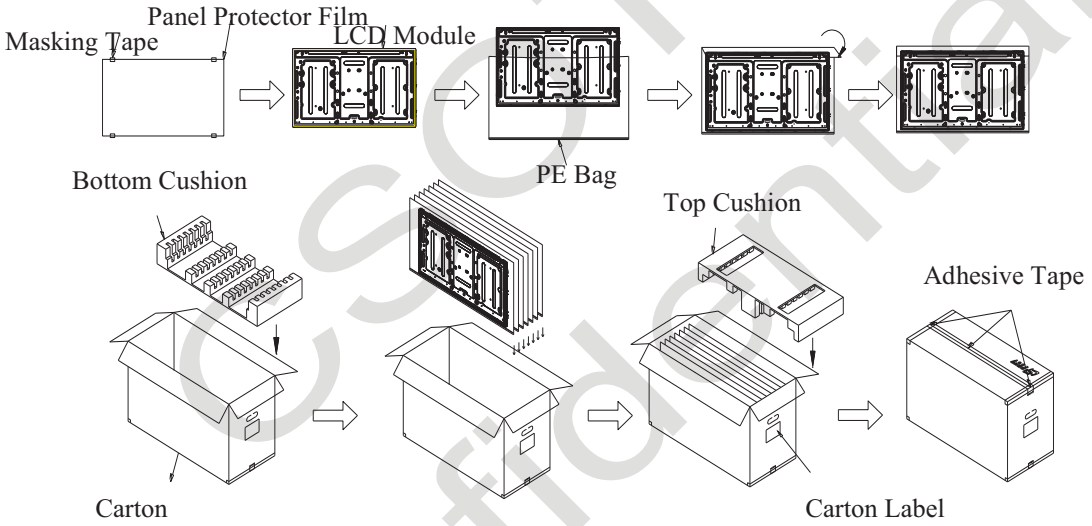


Fig. 7.1 Packing method (protector film stick on the front of the LCD module)

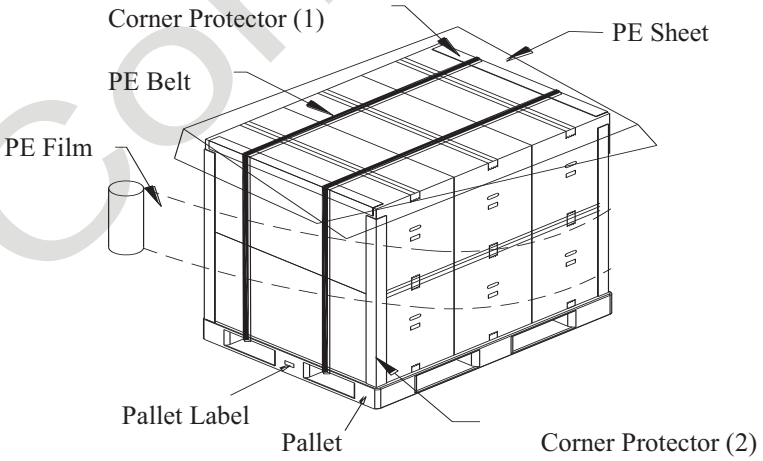
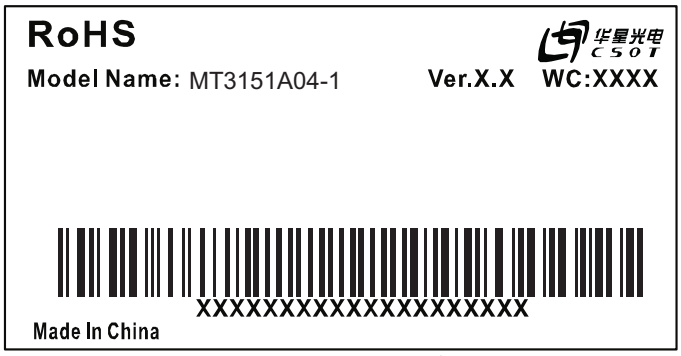


Fig.7.2 Package

8. Definition of Labels

8.1 Module Label



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

Model Name: MT3151A04-1

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

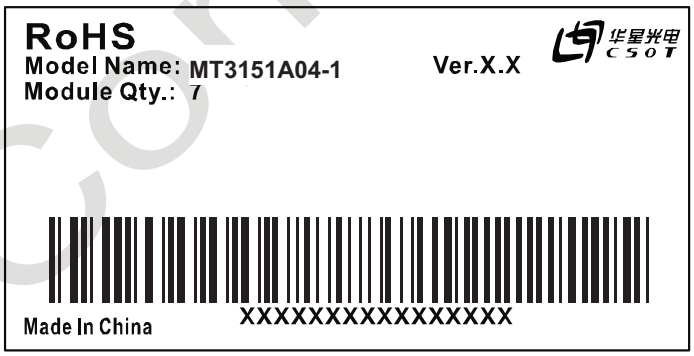
Year: 2010 = 10, 2011 = 11 … 2020 = 20, 2021 = 21…

Week: 01, 02, 03 …

Serial Number: XXXXXXXXXXXX XXXXXXXX

- XXXXXXXXXXXX → CSOT Internal Use
- XXXXXXXX → Panel ID

8.2 Carton Label



Serial Number: XXXX XX XXXXX XXXXX

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

Manufactured Date:

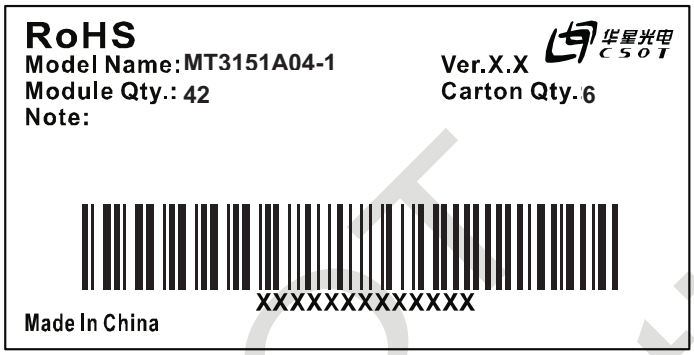
Year: 2010 = 10, 2011 = 11…2020 = 20, 2021 = 21…

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…

8.3 Pallet Label



Serial Number: XXX XX XXX XXXXX

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

9. Precautions

9.1 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 LCD 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.

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.