

## TFT LCD Tentative Specification

# MODEL NO.: M240J2- L01

Customer: \_\_\_\_\_

Approved by: \_\_\_\_\_

Note: **For Reference Only**

記錄	工作	審核	角色	投票
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**REVISION HISTORY**

Version	Date	Section	Description
Ver. 0.0	Aug. 16, 06'	-	M240J2 -L01 tentative specifications was first issued.

## 1. GENERAL DESCRIPTION

### 1.1 OVERVIEW

M240J2-L01 is an 24.0" TFT Liquid Crystal Display module with 6 CCFL Backlight unit and 30 pins 2ch-LVDS interface. This module supports 1920 x 1200 WUXGA mode and can display up to 16.7M colors. The inverter module for Backlight is not built in.

### 1.2 FEATURES

- Extra-wide viewing angle.
- High contrast ratio.
- Fast response time.
- High color saturation.
- WUXGA (1920 x 1200 pixels) resolution.
- DE (Data Enable) only mode.
- LVDS (Low Voltage Differential Signaling) interface.
- RoHS compliance.
- TCO'03 compliance.

### 1.3 APPLICATION

- TFT LCD Monitor

### 1.4 GENERAL SPECIFICATIONS

Item	Specification	Unit	Note
Active Area	518.4 (H) x 324 (V) (24.0" diagonal)	mm	(1)
Bezel Opening Area	522.4 (H) x 328.0 (V)	mm	
Driver Element	a-si TFT active matrix	-	-
Pixel Number	1920 x R.G.B. x 1200	pixel	-
Pixel Pitch	0.270 (H) x 0.270 (V)	mm	-
Pixel Arrangement	RGB vertical stripe	-	-
Display Colors	16.7M	color	-
Transmissive Mode	Normally White	-	-
Surface Treatment	AG type: 3H hard coating, Haze 25	-	-

### 1.5 MECHANICAL SPECIFICATIONS

Item	Min.	Typ.	Max.	Unit	Note	
Module Size	Horizontal(H)	545.9	546.4	546.9	mm	(1)
	Vertical(V)	351.5	352.0	352.5	mm	
	Depth(D)		35.36	35.86	mm	
Weight	-	-	2800	g	-	

Note (1) Please refer to the attached drawings for more information of front and back outline dimensions.

## 2. ABSOLUTE MAXIMUM RATINGS

### 2.1 ABSOLUTE RATINGS OF ENVIRONMENT

Item	Symbol	Value		Unit	Note
		Min.	Max.		
Storage Temperature	$T_{ST}$	-20	60	°C	(1)
Operating Ambient Temperature	$T_{OP}$	0	50	°C	(1), (2)
Shock (Non-Operating)	$S_{NOP}$	-	50	G	(3), (5)
Vibration (Non-Operating)	$V_{NOP}$	-	1.5	G	(4), (5)

Note (1) Temperature and relative humidity range is shown in the figure below.

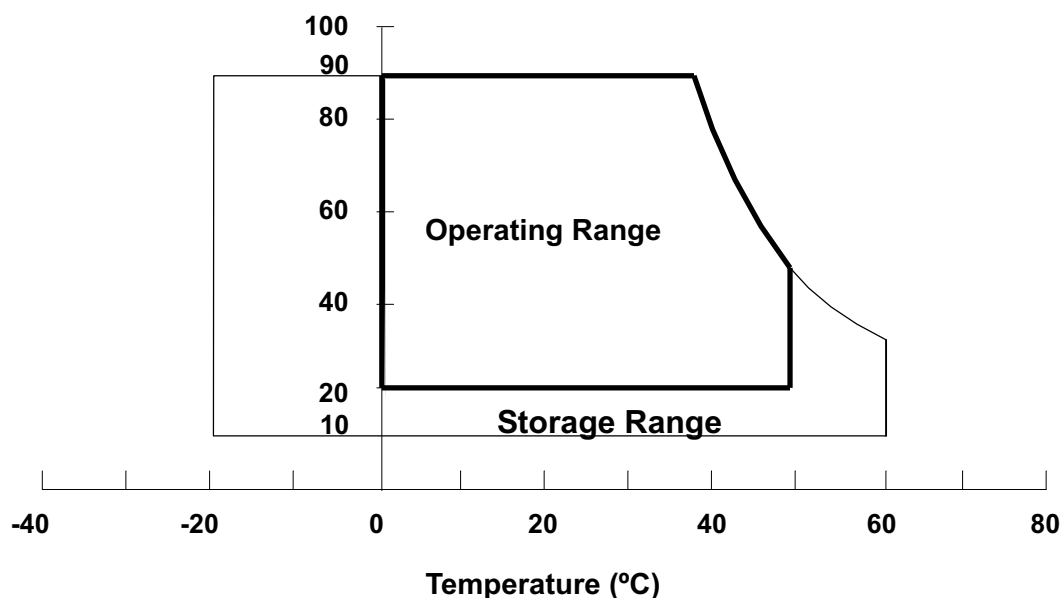
(a) 90 %RH Max. ( $T_a \leq 40$  °C).

(b) Wet-bulb temperature should be 39 °C Max. ( $T_a > 40$  °C).

(c) No condensation.

Note (2) The temperature of panel display surface area should be 0 °C Min. and 60 °C Max.

#### Relative Humidity (%RH)



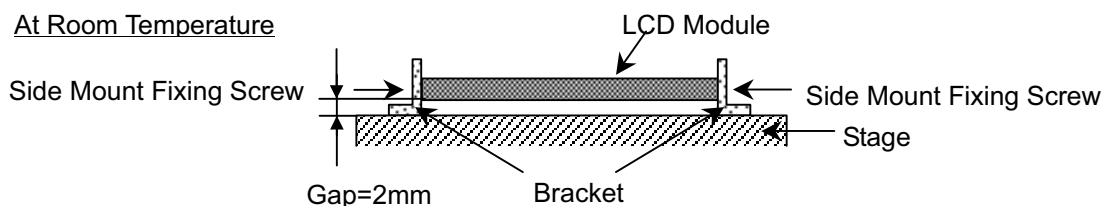
Note (3) 11ms, half sine wave, 1 time for  $\pm X$ ,  $\pm Y$ ,  $\pm Z$ .

Note (4) 10 ~ 300 Hz, 10min/cycle, 3 cycles each X, Y, Z.

Note (5) At testing Vibration and Shock, the fixture in holding the module has to be hard and rigid enough so that the module would not be twisted or bent by the fixture.

The fixing condition is shown as below:

#### At Room Temperature



## 2.2 ELECTRICAL ABSOLUTE RATINGS

### 2.2.1 TFT LCD MODULE

Item	Symbol	Value		Unit	Note
		Min.	Max.		
Power Supply Voltage	V <sub>CC</sub>	-0.3	+6.0	V	(1)
Logic Input Voltage	V <sub>IN</sub>	-0.3	4.3	V	

### 2.2.2 BACKLIGHT UNIT

Item	Symbol	Value		Unit	Note
		Min.	Max.		
Lamp Voltage	V <sub>L</sub>	-	4.5K	V <sub>RMS</sub>	(1), (2)
Lamp Current	I <sub>L</sub>	4.0	7.0	mA <sub>RMS</sub>	(1), (2)
Lamp Frequency	F <sub>L</sub>	40	80	KHZ	

Note (1) Permanent damage to the device may occur if maximum values are exceeded. Function operation should be restricted to the conditions described under Normal Operating Conditions.

Note (2) Specified values are for lamp (Refer to 3.2 for further information).

### 3. ELECTRICAL CHARACTERISTICS

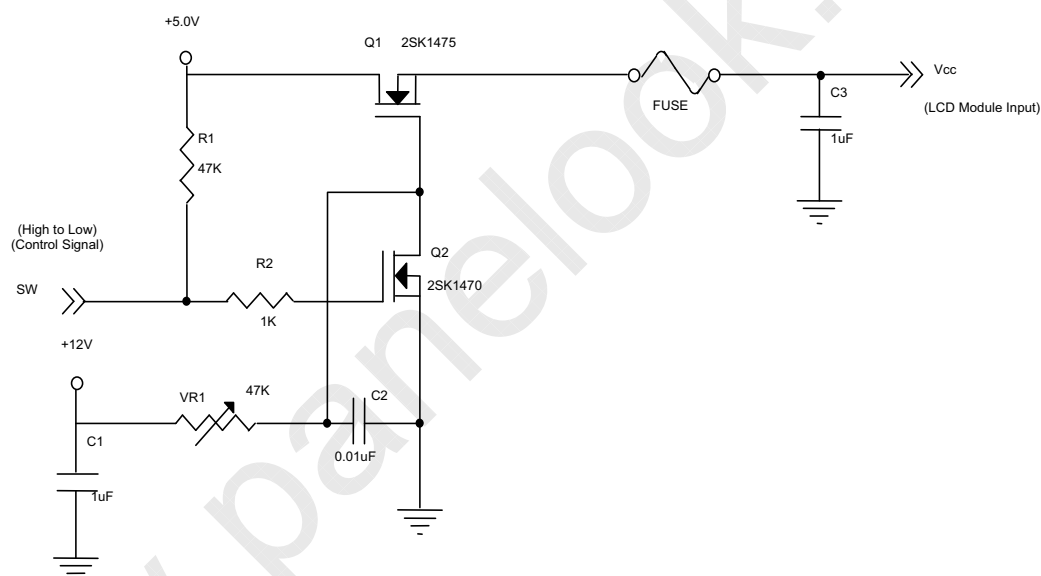
#### 3.1 TFT LCD MODULE

 $T_a = 25 \pm 2 \text{ }^\circ\text{C}$ 

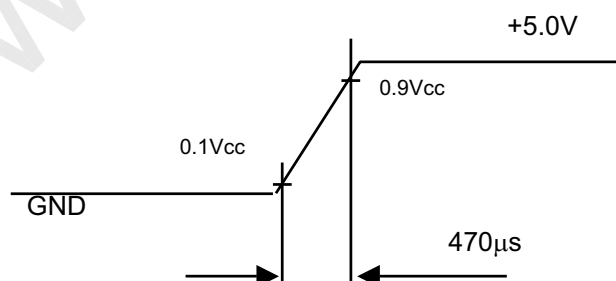
Parameter	Symbol	Value			Unit	Note
		Min.	Typ.	Max.		
Power Supply Voltage	V <sub>CC</sub>	4.5	5.0	5.5	V	-
Ripple Voltage	V <sub>RP</sub>	-	-	100	mV	-
Rush Current	I <sub>RUSH</sub>	-	TBD	TBD	A	(2)
Power Supply Current	White	-	TBD	TBD	A	(3)a
	Black	-	TBD	TBD	A	(3)b
	Vertical Stripe	-	TBD	TBD	A	(3)c
LVDS differential input voltage	V <sub>id</sub>	100	-	600	mV	
LVDS common input voltage	V <sub>ic</sub>	-	1.2	-	V	
Logic "L" input voltage	V <sub>il</sub>	V <sub>SS</sub>	-	0.8	V	

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

Note (2) Measurement Conditions:

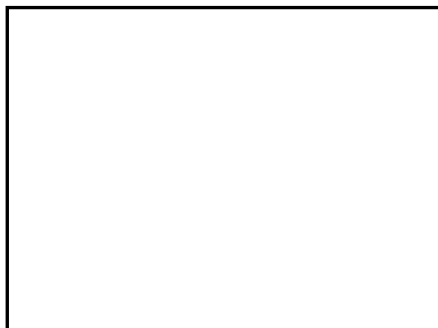


**V<sub>CC</sub> rising time is 470 $\mu$ s**



Note (3) The specified power supply current is under the conditions at  $V_{cc} = 5.0\text{ V}$ ,  $T_a = 25 \pm 2\text{ }^\circ\text{C}$ ,  $f_v = 60\text{ Hz}$ , whereas a power dissipation check pattern below is displayed.

a. White Pattern



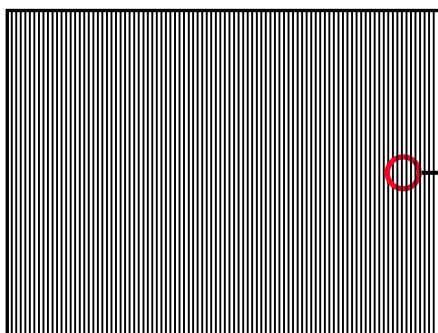
Active Area

b. Black Pattern

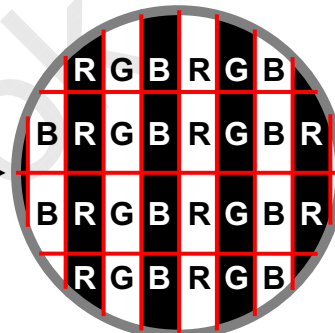


Active Area

c. Vertical Stripe Pattern



Active Area



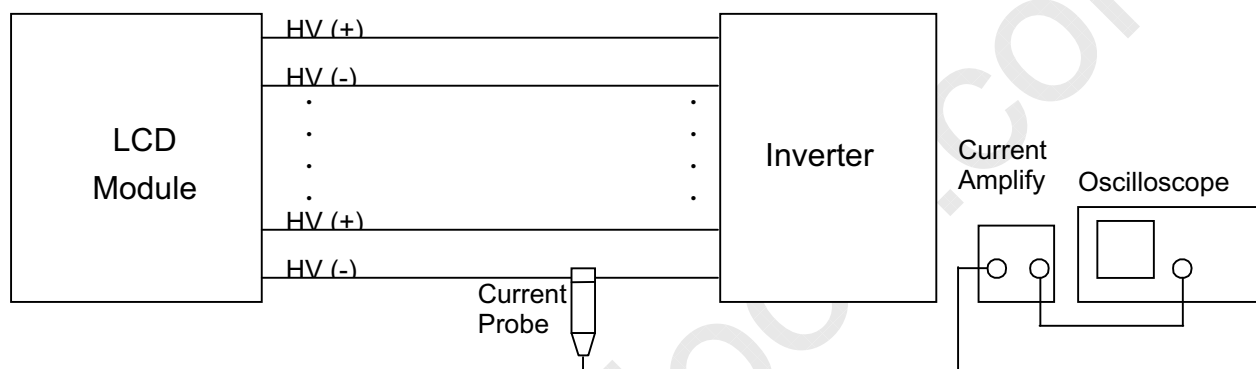


## 3.2 BACKLIGHT UNIT

Ta = 25 ± 2 °C

Parameter	Symbol	Value			Unit	Note
		Min.	Typ.	Max.		
Lamp Input Voltage	V <sub>L</sub>	1683	1870	2057	V <sub>RMS</sub>	I <sub>L</sub> = 6.0 mA
Lamp Current	I <sub>L</sub>	4.0	6.0	7.0	mA <sub>RMS</sub>	(1)
Lamp Turn On Voltage	V <sub>S</sub>	---	---	3670 (25 °C)	V <sub>RMS</sub>	(2)
		---	---	4280 (0 °C)	V <sub>RMS</sub>	(2)
Operating Frequency	F <sub>L</sub>	40	---	80	KHz	(3)
Lamp Life Time	L <sub>BL</sub>	50,000	---	---	Hrs	(5), I <sub>L</sub> = 6.0 mA
Power Consumption	P <sub>L</sub>	---	67.32	---	W	(4), I <sub>L</sub> = 6.0 mA

Note (1) Lamp current is measured by current amplify & oscilloscope as shown below:



Measure equipment:  
 Current Amplify: Tektronix TCPA300  
 Current probe: Tektronix TCP312  
 Oscilloscope: TDS3054B

Note (2) The voltage that must be larger than V<sub>s</sub> should be applied to the lamp for more than 1 second after startup. Otherwise, the lamp may not be turned on normally.

Note (3) The lamp frequency may produce interference with horizontal synchronization frequency from the display, which might cause line flow on the display. In order to avoid interference, the lamp frequency should be detached from the horizontal synchronization frequency and its harmonics as far as possible.

Note (4) P<sub>L</sub> = I<sub>L</sub> × V<sub>L</sub> × 6

Note (5) The lifetime of lamp can be defined as the time in which it continues to operate under the condition Ta = 25 ± 2 °C and I<sub>L</sub> = 6.0 mA<sub>RMS</sub> until one of the following events occurs:

- When the brightness becomes or lower than 50% of its original value.
- When the effective ignition length becomes or lower than 80% of its original value. (Effective ignition length is defined as an area that has less than 70% brightness compared to the brightness in the center point.)

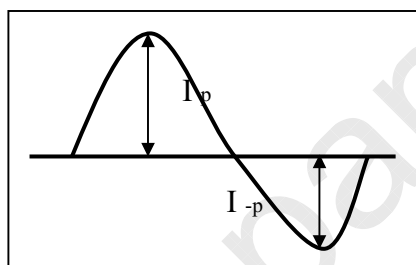
Note (6) The waveform of the voltage output of inverter must be area-symmetric and the design of the inverter must have specifications for the modularized lamp. The performance of the Backlight, such as lifetime or brightness, is greatly influenced by the characteristics of the DC-AC inverter for the lamp. All the parameters of an inverter should be carefully designed to avoid producing too

much current leakage from high voltage output of the inverter. When designing or ordering the inverter please make sure that a poor lighting caused by the mismatch of the Backlight and the inverter (miss-lighting, flicker, etc.) never occurs. If the above situation is confirmed, the module should be operated in the same manners when it is installed in your instrument.

The output of the inverter must have symmetrical (negative and positive) voltage waveform and symmetrical current waveform. (Unsymmetrical ratio is less than 10%) Please do not use the inverter which has unsymmetrical voltage and unsymmetrical current and spike wave. Lamp frequency may produce interface with horizontal synchronous frequency and as a result this may cause beat on the display. Therefore lamp frequency shall be as away possible from the horizontal synchronous frequency and from its harmonics in order to prevent interference.

Requirements for a system inverter design, which is intended to have a better display performance, a better power efficiency and a more reliable lamp. It shall help increase the lamp lifetime and reduce its leakage current.

- The asymmetry rate of the inverter waveform should be 10% below;
- The distortion rate of the waveform should be within  $\sqrt{2} \pm 10\%$ ;
- The ideal sine wave form shall be symmetric in positive and negative polarities



\* Asymmetry rate:

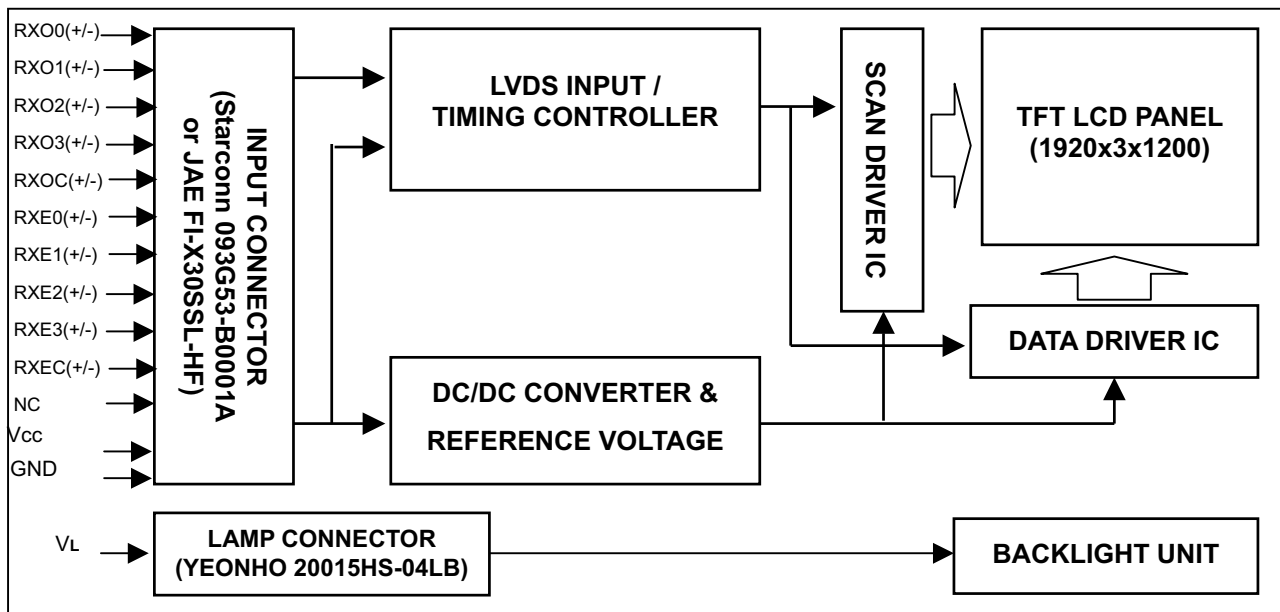
$$\frac{|I_p - I_{-p}|}{I_{rms}} * 100\%$$

\* Distortion rate

$$I_p \text{ (or } I_{-p}) / I_{rms}$$

## 4. BLOCK DIAGRAM

### 4.1 TFT LCD MODULE



### 4.2 BACKLIGHT UNIT



## 5. INPUT TERMINAL PIN ASSIGNMENT

### 5.1 TFT LCD MODULE

Pin	Name	Description
1	RXO0-	Negative LVDS differential data input. Channel O0 (odd)
2	RXO0+	Positive LVDS differential data input. Channel O0 (odd)
3	RXO1-	Negative LVDS differential data input. Channel O1 (odd)
4	RXO1+	Positive LVDS differential data input. Channel O1 (odd)
5	RXO2-	Negative LVDS differential data input. Channel O2 (odd)
6	RXO2+	Positive LVDS differential data input. Channel O2 (odd)
7	GND	Ground
8	RXOC-	Negative LVDS differential clock input. (odd)
9	RXOC+	Positive LVDS differential clock input. (odd)
10	RXO3-	Negative LVDS differential data input. Channel O3(odd)
11	RXO3+	Positive LVDS differential data input. Channel O3 (odd)
12	RXE0-	Negative LVDS differential data input. Channel E0 (even)
13	RXE0+	Positive LVDS differential data input. Channel E0 (even)
14	GND	Ground
15	RXE1-	Negative LVDS differential data input. Channel E1 (even)
16	RXE1+	Positive LVDS differential data input. Channel E1 (even)
17	GND	Ground
18	RXE2-	Negative LVDS differential data input. Channel E2 (even)
19	RXE2+	Positive LVDS differential data input. Channel E2 (even)
20	RXEC-	Negative LVDS differential clock input. (even)
21	RXEC+	Positive LVDS differential clock input. (even)
22	RXE3-	Negative LVDS differential data input. Channel E3 (even)
23	RXE3+	Positive LVDS differential data input. Channel E3 (even)
24	GND	Ground
25	NC	No connection
26	TST_AGE	CMO internal use
27	VCC	+5.0V power supply
28	VCC	+5.0V power supply
29	VCC	+5.0V power supply
30	VCC	+5.0V power supply

Note (1) Connector Part No.: Starconn 093G53-B0001A or JAE FI-X30SSL-HF.

Note (2) The first pixel is odd.

Note (3) Input signal of even and odd clock should be the same timing.

SELLVDS = Low or Open								
LVDS Channel E0	LVDS output	D7	D6	D4	D3	D2	D1	D0
	Data order	EG0	ER5	ER4	ER3	ER2	ER1	ER0
LVDS Channel E1	LVDS output	D18	D15	D14	D13	D12	D9	D8
	Data order	EB1	EB0	EG5	EG4	EG3	EG2	EG1
LVDS Channel E2	LVDS output	D26	D25	D24	D22	D21	D20	D19
	Data order	DE	NA	NA	EB5	EB4	EB3	EB2
LVDS Channel E3	LVDS output	D23	D17	D16	D11	D10	D5	D27
	Data order	NA	EB7	EB6	EG7	EG6	ER7	ER6
LVDS Channel O0	LVDS output	D7	D6	D4	D3	D2	D1	D0
	Data order	OG0	OR5	OR4	OR3	OR2	OR1	OR0
LVDS Channel O1	LVDS output	D18	D15	D14	D13	D12	D9	D8
	Data order	OB1	OB0	OG5	OG4	OG3	OG2	OG1
LVDS Channel O2	LVDS output	D26	D25	D24	D22	D21	D20	D19
	Data order	DE	NA	NA	OB5	OB4	OB3	OB2
LVDS Channel O3	LVDS output	D23	D17	D16	D11	D10	D5	D27
	Data order	NA	OB7	OB6	OG7	OG6	OR7	OR6

## 5.2 BACKLIGHT UNIT:

Pin	Symbol	Description	Remark
1-1	HV	High Voltage	Pink
1-2	HV	High Voltage	White
2-3	HV	High Voltage	Pink
2-4	HV	High Voltage	White
3-5	HV	High Voltage	Pink
3-6	HV	High Voltage	White
4-7	HV	High Voltage	Pink
4-8	HV	High Voltage	White
5-9	HV	High Voltage	Pink
5-10	HV	High Voltage	White
6-11	HV	High Voltage	Pink
6-12	HV	High Voltage	White

Note (1) Connector Part No.: 20015HS-04LB (YEONHO) or equivalent



**Tentative**

### 5.3 COLOR DATA INPUT ASSIGNMENT

The brightness of each primary color (red, green and blue) is based on the 8-bit gray scale data input for the color. The higher the binary input, the brighter the color. The table below provides the assignment of color versus data input.

Color		Data Signal																							
		Red								Green								Blue							
		R7	R6	R5	R4	R3	R2	R1	R0	R7	R6	G5	G4	G3	G2	G1	G0	R7	R6	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(2)	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
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	Red(253)	1	1	1	1	1	1	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	1	0	0	0	0	0	0	0	0	0
	Green(2)	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
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	Green(253)	0	0	0	0	0	0	0	1	1	1	1	1	1	1	0	1	0	0	0	0	0	0	0	0
	Green(254)	0	0	0	0	0	0	0	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0
Green(255)	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	0	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(2)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
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	Blue(253)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	0	1
	Blue(254)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	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	1	1	1	1	1	1	1	1	1	

Note (1) 0: Low Level Voltage, 1: High Level Voltage

## 6. INTERFACE TIMING

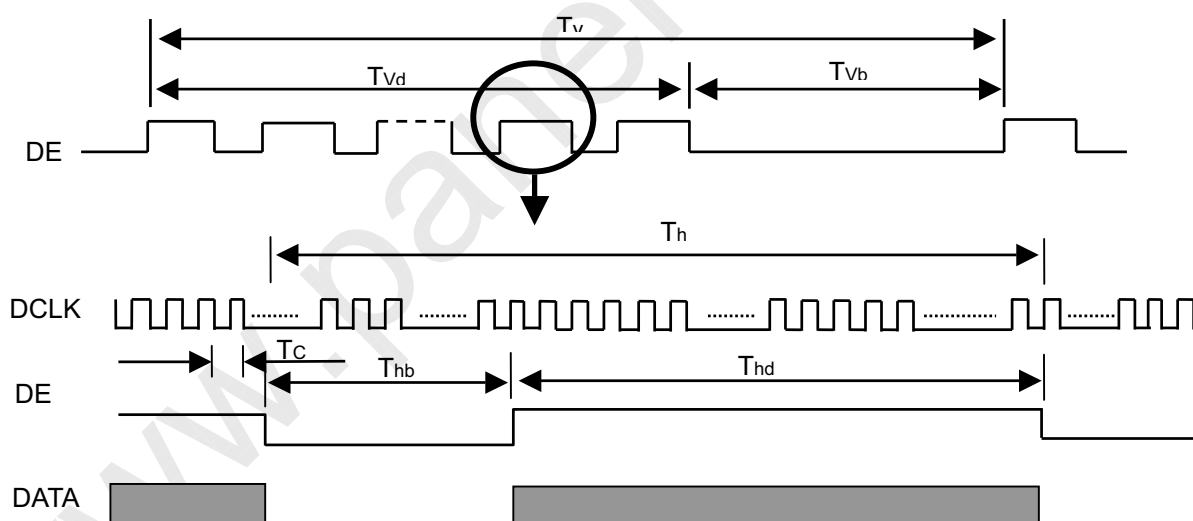
### 6.1 INPUT SIGNAL TIMING SPECIFICATIONS

The input signal timing specifications are shown as the following table and timing diagram.

Signal	Item	Symbol	Min.	Typ.	Max.	Unit	Note
LVDS Clock	Frequency	$F_c$	50.0	77	83.0	MHz	-
	Period	$T_c$	-	13.0	-	ns	-
	High Time	$T_{ch}$	-	4/7	-	$T_c$	-
	Low Time	$T_{cl}$	-	3/7	-	$T_c$	-
LVDS Data	Setup Time	$T_{lvs}$	600	-	-	ps	-
	Hold Time	$T_{lvh}$	600	-	-	ps	-
Vertical Active Display Term	Frame Rate	$F_r$	TBD	60	TBD	Hz	$T_v = T_{vd} + T_{vb}$
	Total	$T_v$	TBD	1235	TBD	$T_h$	-
	Display	$T_{vd}$	TBD	1200	TBD	$T_h$	-
	Blank	$T_{vb}$	TBD	35	TBD	$T_h$	-
Horizontal Active Display Term	Total	$T_h$	TBD	1040	TBD	$T_c$	$T_h = T_{hd} + T_{hb}$
	Display	$T_{hd}$	TBD	960	TBD	$T_c$	-
	Blank	$T_{hb}$	TBD	80	TBD	$T_c$	-

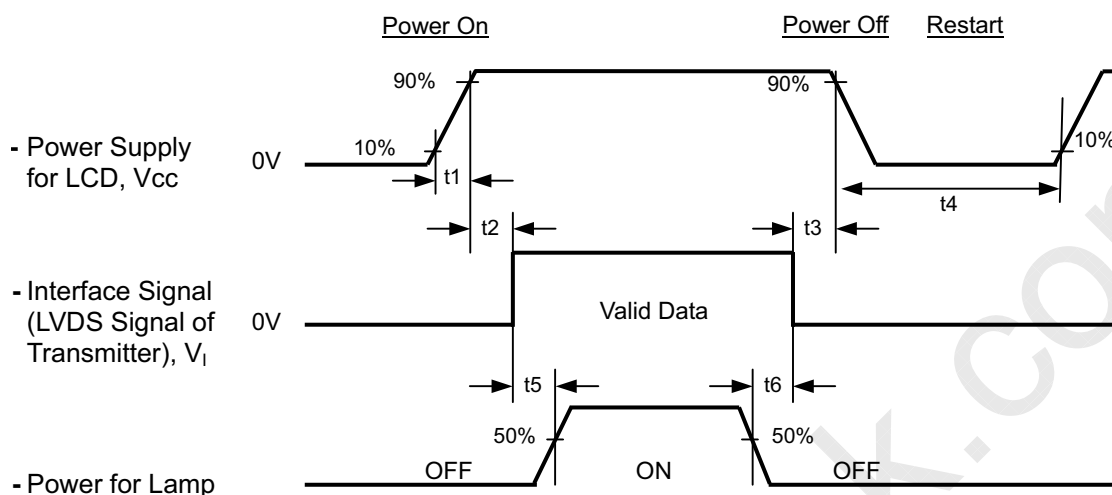
Note: Because this module is operated by DE only mode, Hsync and Vsync input signals should be set to low logic level or ground. Otherwise, this module would operate abnormally.

#### INPUT SIGNAL TIMING DIAGRAM



## 6.2 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.



### Timing Specifications:

$$0.5 < t_1 \leq 10 \text{ msec}$$

$$0 < t_2 \leq 50 \text{ msec}$$

$$0 < t_3 \leq 50 \text{ msec}$$

$$t_4 \geq 500 \text{ msec}$$

$$t_5 \geq 500 \text{ msec}$$

$$t_6 \geq 90 \text{ msec}$$



## 7. OPTICAL CHARACTERISTICS

### 7.1 TEST CONDITIONS

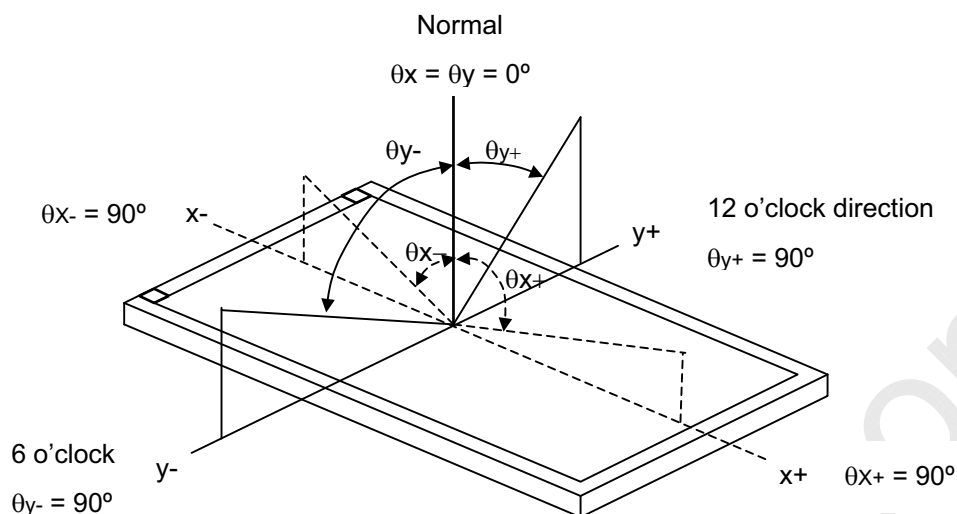
Item	Symbol	Value	Unit
Ambient Temperature	Ta	25±2	°C
Ambient Humidity	Ha	50±10	%RH
Supply Voltage	V <sub>CC</sub>	5.0	V
Input Signal	According to typical value in "3. ELECTRICAL CHARACTERISTICS"		
Lamp Current	I <sub>L</sub>	6.0	mA
Inverter Operating Frequency	F <sub>L</sub>	50	KHz
Inverter	DARFON VK88070F02		

### 7.2 OPTICAL SPECIFICATIONS

The relative measurement methods of optical characteristics are shown in 7.2. The following items should be measured under the test conditions described in 7.1 and stable environment shown in Note (5).

Item	Symbol	Condition	Min.	Typ.	Max.	Unit	Note	
Color Chromaticity (CIE 1931)	Red	Rx	$\theta_x=0^\circ, \theta_y=0^\circ$ CS-1000T	Typ - 0.03	0.640	Typ + 0.03	-	(1), (5)
		Ry			0.348			
	Green	Gx			0.293			
		Gy			0.585			
	Blue	Bx			0.143			
		By			0.075			
	White	Wx			0.313			
		Wy			0.329			
Center Luminance of White (Center of Screen)	L <sub>C</sub>		350	450	-	cd/m <sup>2</sup>	(4), (5)	
Contrast Ratio	CR		600	900	-	-	(2), (5)	
Response Time	T <sub>R</sub>	$\theta_x=0^\circ, \theta_y=0^\circ$	-	1.3	6.3	ms	(3)	
	T <sub>F</sub>		-	3.7	8.7			
White Variation	$\delta W$	$\theta_x=0^\circ, \theta_y=0^\circ$ CA-210	-	1.25	1.40	-	(5), (6)	
Viewing Angle	Horizontal	$\theta_{x+}$	CR $\geq$ 10 CA-210	75	85	-	Deg.	(1), (5)
		$\theta_{x-}$		75	85	-		
	Vertical	$\theta_{y+}$		70	80	-		
		$\theta_{y-}$		70	80	-		
Safety	Luminance uniformity – Angular dependence		CS-1000T R=G=B=255 Grayscale R=G=B= 0 Grayscale	---	---	1.7	---	(7)
	Luminance contrast – Angular dependence			0.8	---	---	---	(8)
	Colour uniformity – Angular dependence			---	---	0.025	---	(7)(9)

Note (1) Definition of Viewing Angle ( $\theta_x$ ,  $\theta_y$ ):



Note (2) Definition of Contrast Ratio (CR):

The contrast ratio can be calculated by the following expression.

$$\text{Contrast Ratio (CR)} = L_{255} / L_0$$

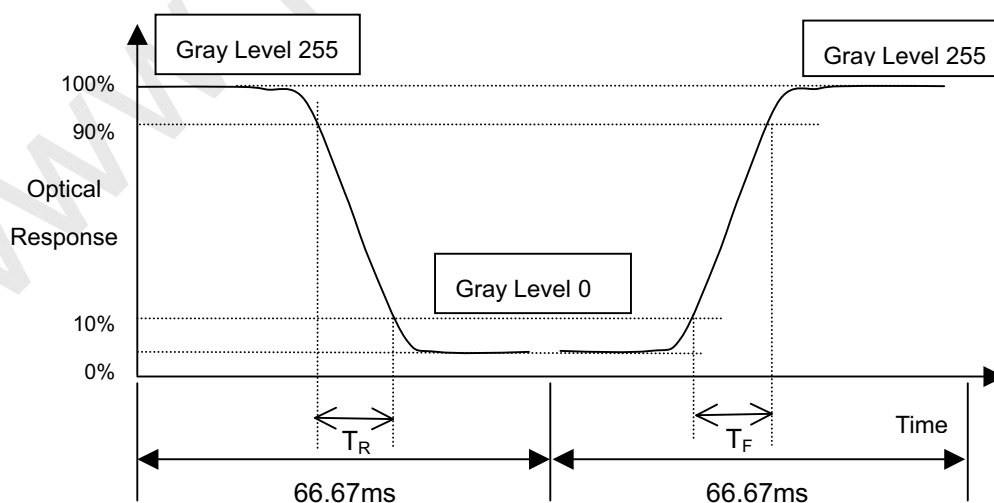
L255: Luminance of gray level 255

L 0: Luminance of gray level 0

$$\text{CR} = \text{CR (1)}$$

CR (X) is corresponding to the Contrast Ratio of the point X at Figure in Note (6).

Note (3) Definition of Response Time ( $T_R$ ,  $T_F$ ):



**Note (4) Definition of Luminance of White ( $L_C$ ):**

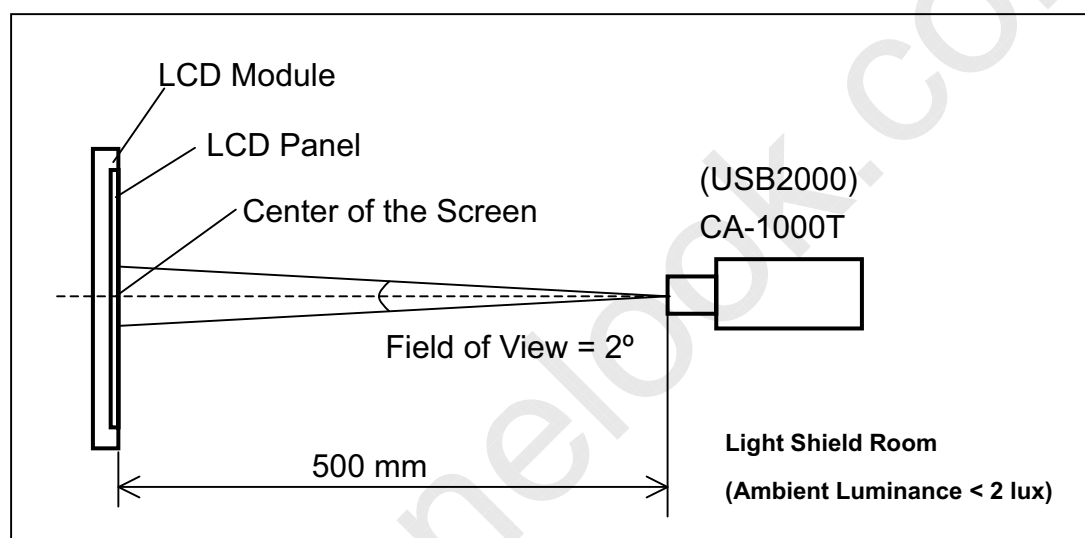
Measure the luminance of gray level 255 at center point

$$L_C = L(1)$$

$L(x)$  is corresponding to the luminance of the point X at Figure in Note (6).

**Note (5) Measurement Setup:**

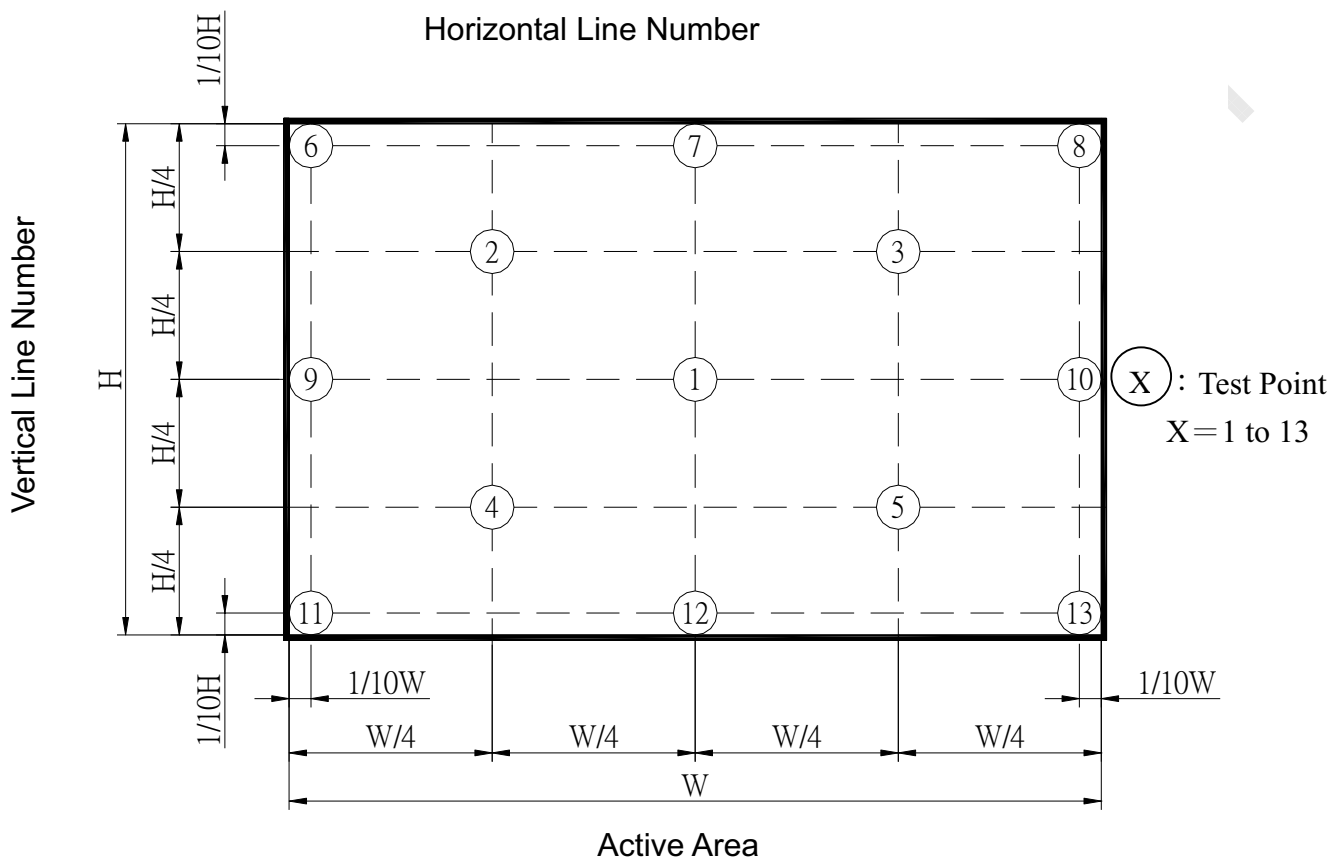
The LCD module should be stabilized at given temperature for 20 minutes to avoid abrupt temperature change during measuring. In order to stabilize the luminance, the measurement should be executed after lighting Backlight for 20 minutes in a windless room.



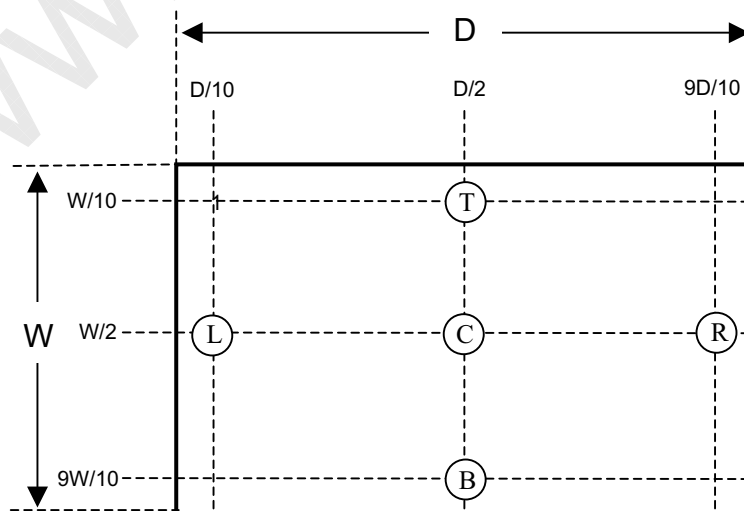
Note (6) Definition of White Variation ( $\delta W$ ):

Measure the luminance of gray level 255 at 13 points

$$\delta W = \frac{\text{Maximum } [L(1), L(2), L(3), L(4), L(5), L(6), L(7), L(8), L(9), L(10), L(11), L(12), L(13)]}{\text{Minimum } [L(1), L(2), L(3), L(4), L(5), L(6), L(7), L(8), L(9), L(10), L(11), L(12), L(13)]}$$



Note (7) Definition of Luminance Uniformity – Angular dependent :

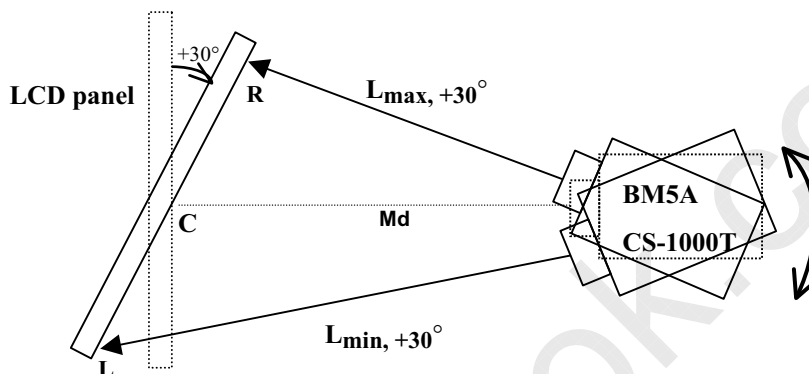


Active Area

Luminance is measured at the center measurement position "C" on the LCD panel. The optical axis of meter shall be aligned with the normal of the panel surface. The measuring distance between the meter and the surface of the panel is defined as:

$$Md \text{ (cm)} = \text{diagonal of the panel (cm)} \times 1.5 \quad \text{with minimum distance 50 cm.}$$

a. Horizontal - mode

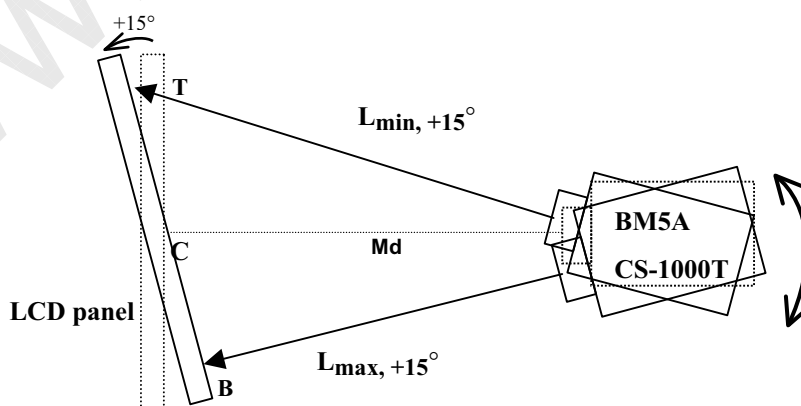


The LCD panel is then rotated to another azimuthal angle to  $-30^\circ$ ; and  $L_{\min, -30^\circ}$  and  $L_{\max, -30^\circ}$  are obtained by using the same procedure.

The Luminance Uniformity is calculated as follow:

$$((L_{\max, +30^\circ} / L_{\min, +30^\circ}) + (L_{\max, -30^\circ} / L_{\min, -30^\circ})) / 2.$$

b. Vertical - mode



The LCD panel is then rotated to another azimuthal angle to  $-15^\circ$ ; and  $L_{\min, -15^\circ}$  and  $L_{\max, -15^\circ}$  are obtained by using the same procedure.

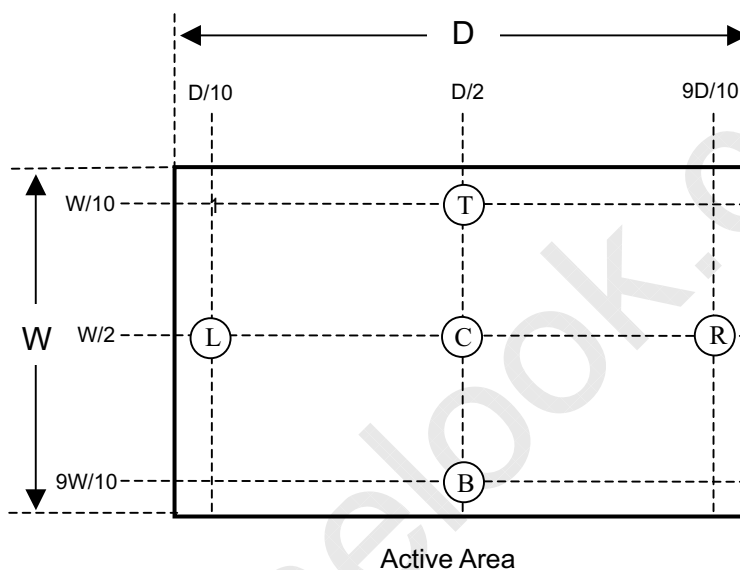
The Luminance Uniformity is calculated as follow:

$$L_{\max, +15^\circ} / L_{\min, +15^\circ}$$

$$L_{\max, -15^\circ} / L_{\min, -15^\circ}$$

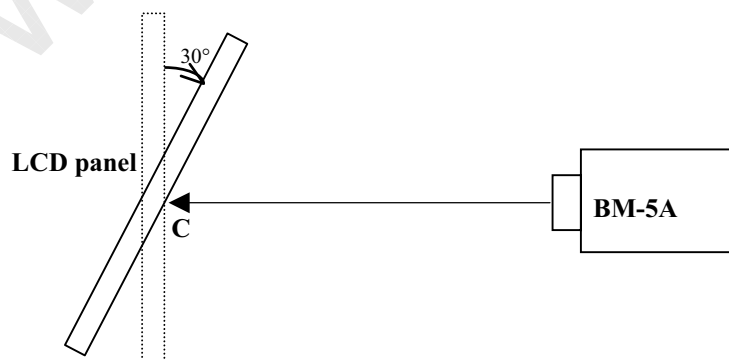
The largest value shall be reported.

Note (8) Definition of Luminance Contrast – Angular dependent :



Luminance contrast is measured at the center point of the LCD panel “C” along with the normal of the display with the same distance described in Note 7. The display is then rotated around the vertical axis by changing its azimuthal axis to +30°; and this gives:

$$L_{255 \text{ G.L., } +30^\circ} \text{ and } L_0 \text{ G.L., } +30^\circ.$$



The LCD panel is then rotated to azimuthal angle to -30°; and  $L_0 \text{ G.L., } -30^\circ$  and  $L_{63 \text{ G.L., } -30^\circ}$  are obtained by using the same procedure. The Luminance Contrast is calculated:

$$(L_{255\text{ G.L.}} - L_{0\text{ G.L.}}) / (L_{255\text{ G.L.}} + L_{0\text{ G.L.}})$$

For both +30° and -30°. The lowest value shall be reported.

Note (9) Definition of Colour uniformity – Angular dependence :

From Note (7), it can measure the data as below chart.

	Measuring point R		Measuring point L		$\Delta u'v'$
	$u'_R$	$v'_R$	$u'_L$	$v'_L$	
+30°					
-30°					

$$\Delta u'v' = \sqrt{(u'_R - u'_L)^2 + (v'_R - v'_L)^2}$$

For both +30° and -30°. The largest value in  $\Delta u'v'$  shall be reported.

## 8. PACKAGING

### 8.1 PACKING SPECIFICATIONS

- (1) 5 LCD modules / 1 Box
- (2) Box dimensions: 645(L) X 377(W) X 470(H) mm
- (3) Weight: approximately 16.5Kg (5 modules per box)

### 8.2 PACKING METHOD

- (1) Carton Packing should have no failure in the following reliability test items.

Test Item	Test Conditions	Note
Vibration	ISTA STANDARD Random, Frequency Range: 1 – 200 Hz Top & Bottom: 30 minutes (+Z), 10 min (-Z), Right & Left: 10 minutes (X) Back & Forth 10 minutes (Y)	Non Operation
Dropping Test	1 Angle, 3 Edge, 6 Face, 60cm	Non Operation

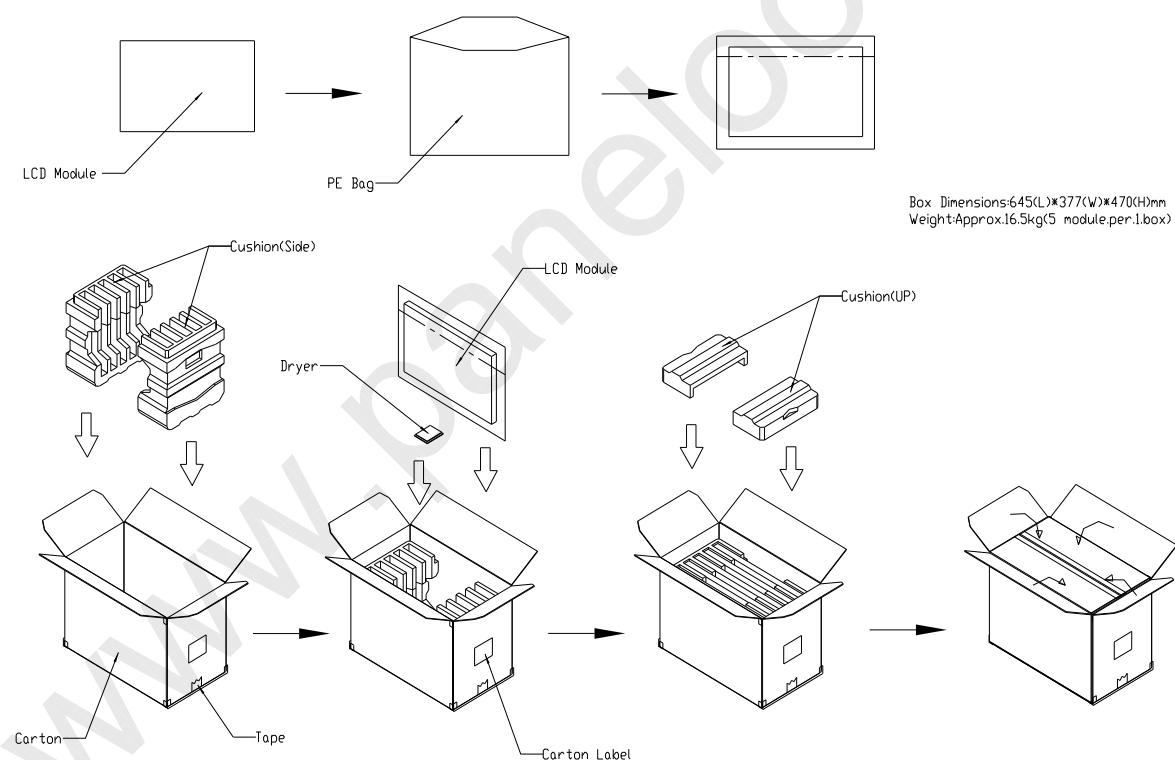
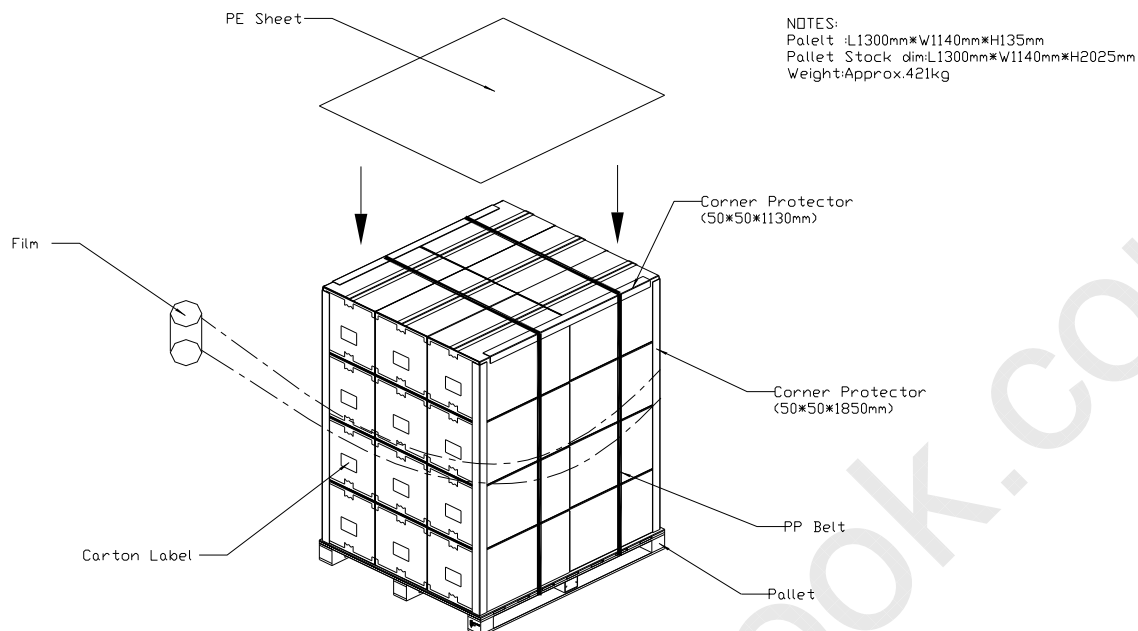
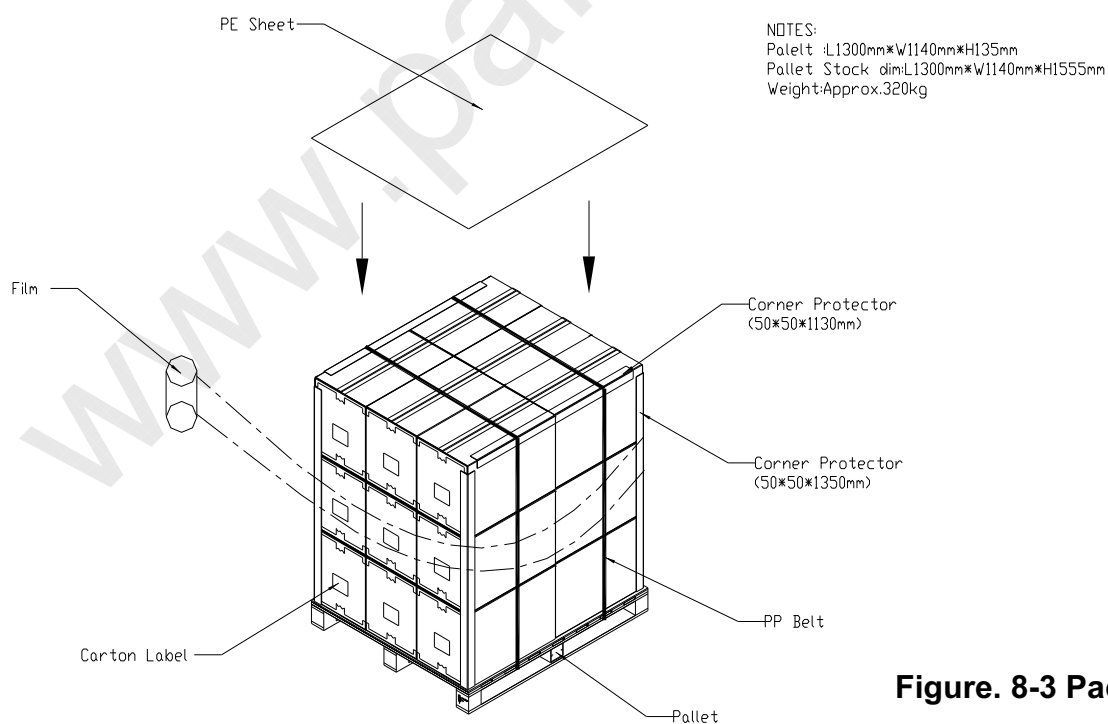


Figure. 8-1 Packing method

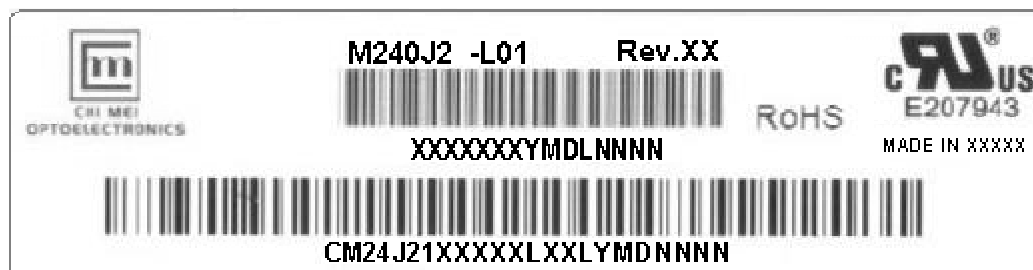


**For ocean shipping****Figure. 8-2 Packing method****For air transport****Figure. 8-3 Packing method**

## 9. DEFINITION OF LABELS

### 9.1 CMO MODULE LABEL

The barcode nameplate is pasted on each module as illustration, and its definitions are as following explanation.



- (a) Model Name: M240J2-L01
- (b) Revision: Rev. XX, for example: A0, A1... B1, B2... or C1, C2...etc.
- (c) CMO barcode definition:

Serial ID: XX-XX-X-XX-YMD-L-NNNN

Code	Meaning	Description
XX	CMO internal use	-
XX	Revision	Cover all the change
X	CMO internal use	-
XX	CMO internal use	-
YMD	Year, month, day	Year: 2001=1, 2002=2, 2003=3, 2004=4... Month: 1~12=1, 2, 3, ~, 9, A, B, C Day: 1~31=1, 2, 3, ~, 9, A, B, C, ~, W, X, Y, exclude I, O, and U.
L	Product line #	Line 1=1, Line 2=2, Line 3=3, ...
NNNN	Serial number	Manufacturing sequence of product

- (d) Customer's barcode definition:

Serial ID: CM-24J21-X-X-X-XX-L-XX-L-YMD-NNNN

Code	Meaning	Description
CM	Supplier code	CMO=CM
24J21	Model number	M240J2-L01 = 24J21
X	Revision code	Non ZBD: 1,~,9,0 / ZBD: A~Z
X	Source driver IC code	Century=1, CLL=2, Demos=3, Epson=4, Fujitsu=5, Himax=6, Hitachi=7, Hynix=8, LDI=9, Matsushita=A, NEC=B, Novatec=C, OKI=D, Philips=E, Renasas=F, Samsung=G, Sanyo=H, Sharp=I, TI=J, Topro=K, Toshiba=L, Windbond=M
X	Gate driver IC code	
XX	Cell location	Tainan Taiwan=TN, Ningbo China=CN
L	Cell line #	1~12=0~C
XX	Module location	Tainan Taiwan=TN, Ningbo China=CN
L	Module line #	1~12=0~C
YMD	Year, month, day	Year: 2001=1, 2002=2, 2003=3, 2004=4... Month: 1~12=1, 2, 3, ~, 9, A, B, C Day: 1~31=1, 2, 3, ~, 9, A, B, C, ~, T, U, V
NNNN	Serial number	By LCD supplier

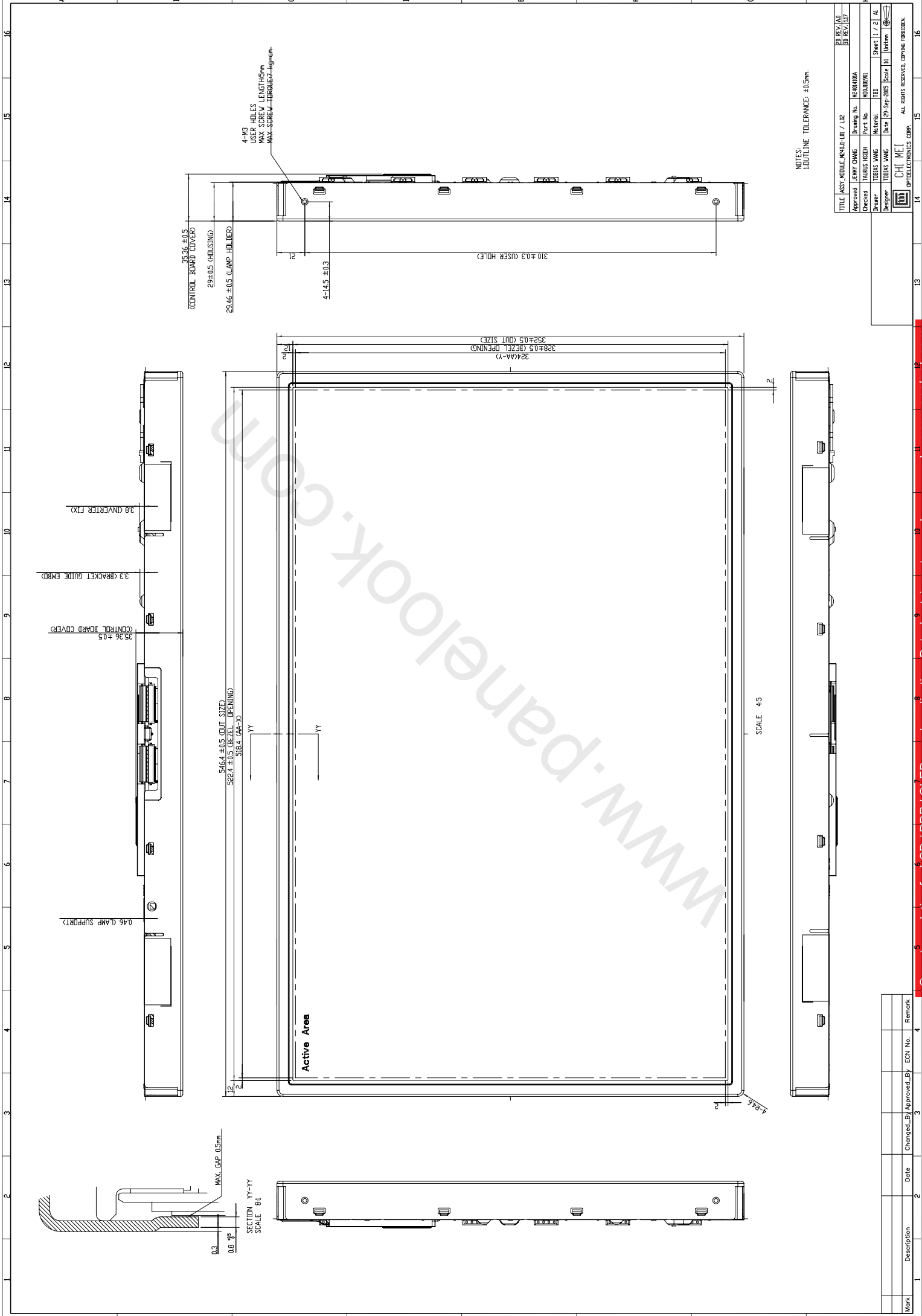
## 10. PRECAUTIONS

### 10.1 ASSEMBLY AND HANDLING PRECAUTIONS

- (1) Do not apply rough force such as bending or twisting to the module during assembly.
- (2) To assemble or install module into user's system can be only in clean working areas. The dust and oil may cause electrical short or worsen the polarizer.
- (3) It's not permitted to have pressure or impulse on the module because the LCD panel and Backlight will be damaged.
- (4) Always follow the correct power sequence when LCD module is connecting and operating. This can prevent damage to the CMOS LSI chips during latch-up.
- (5) Do not pull the I/F connector in or out while the module is operating.
- (6) Do not disassemble the module.
- (7) Use a soft dry cloth without chemicals for cleaning, because the surface of polarizer is very soft and easily scratched.
- (8) It is dangerous that moisture come into or contacted the LCD module, because moisture may damage LCD module when it is operating.
- (9) High temperature or humidity may reduce the performance of module. Please store LCD module within the specified storage conditions.
- (10) When ambient temperature is lower than 10°C may reduce the display quality. For example, the response time will become slowly, and the starting voltage of CCFL will be higher than room temperature.

### 10.2 SAFETY PRECAUTIONS

- (1) The startup voltage of Backlight is approximately 1000 Volts. It may cause electrical shock while assembling with inverter. Do not disassemble the module or insert anything into the Backlight unit.
- (2) If the liquid crystal material leaks from the panel, it should be kept away from the eyes or mouth. In case of contact with hands, skin or clothes, it has to be washed away thoroughly with soap.
- (3) After the module's end of life, it is not harmful in case of normal operation and storage.



NOTES:  
1. OUTLINE TOLERANCE: ±0.5mm.

TITLE	INSTR. MIDDLE, M540H-01 / 02	PT. REV. A/D
Approved	LEMY CHANG	Drawing No.
Checked	TANGSIEH HSIEH	Part No.
Drawn	DOBAS WANG	Material
Designer	DOBAS WANG	Date
		Scale
		Sheet 1 / 2
		Bottom

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Mark	Description	Date	Changed By	Approved By	ECN No.	Remark
4						

