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# Datasheet

## **Apollo Display Technologies**

G154I1-L01-V538

CH-03-032

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## REVISION HISTORY

Version	Date	Section	Description
Ver 1.0	Jul 05, 2011		

## 1. GENERAL DESCRIPTION

### 1.1 OVERVIEW

G15411-L01-V538 is a 15.4" transfective TFT Liquid Crystal Display module and 20 pins LVDS interface. This module supports 1280 x 800 WXGA mode and can display 262,144 colors. The inverter module for the LED-Backlight is not built in.

### 1.2 FEATURES

- DE only mode
- Fast Response Time
- Wide Operation Temperature
- LED rail Replaceable
- Sunlight Readable
- Reverse Scan
- based on CMI G154I-L01 with transfective upgrade

### 1.3 APPLICATION

- TFT LCD Monitor
- Industrial Application
- Amusement
- Vehicle

### 1.4 GENERAL SPECIFICATIONS

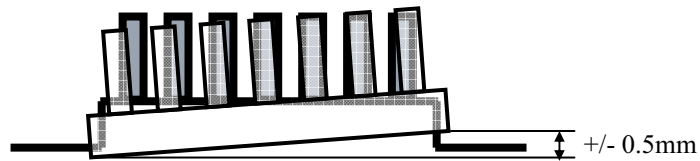
Item	Specification	Unit	Note
Active Area	331.2 x 207.0	mm	(1)
Bezel Opening Area	334.5 x 210.3	mm	
Driver Element	a-si TFT active matrix	-	-
Pixel Number	1280xR.G.Bx800	pixel	-
Pixel Pitch	0.259(H) x 0.259(V)	mm	-
Pixel Arrangement	RGB vertical stripe	-	-
Display Colors	262,144	color	-
Transmissive Mode	Normally white	-	-
Surface Treatment	Glare,3H, LR	-	-

## 1.5 MECHANICAL SPECIFICATIONS

Item	Min.	Typ.	Max.	Unit	Note	
Module Size	Horizontal(H)	351.5	352	352.5	mm	(1)
	Vertical(V)	229.5	230	230.5	mm	
	Depth(D)	15.5	15.8	16.3	mm	
Weight	--	1290	1350	g	-	
I/F connector mounting position	The mounting inclination of the connector makes the screen center within $\pm 0.5\text{mm}$ as the horizontal.				(2)	

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

Note (2) Connector mounting position



## 2. ABSOLUTE MAXIMUM RATINGS

### 2.1 ABSOLUTE RATINGS OF ENVIRONMENT

Item	Symbol	Value		Unit	Note
		Min.	Max.		
Operating Ambient Temperature	T <sub>OP</sub>	-30	+80	°C	(1)
Storage Temperature	T <sub>ST</sub>	-40	+85	°C	(1)

Test Item	Test Condition	Note
High Temperature Storage Test	85°C, 240hours	(1) (3)
Low Temperature Storage Test	-40°C, 240hours	
Thermal Shock Storage Test	-30°C, 0.5hour~85°C, 0.5hour, 100 cycles	
High Temperature Operation Test	80°C, 240hours	
Low Temperature Operation Test	-30°C, 240hours	
High Temperature & High Humidity Operation Test	60°C 90%RH, 240hours	
ESD Test (Operation)	±8KV	(1)
Shock (Non-Operating)	50G/11ms	(1)(2)
Vibration (Non-Operating)	1.5G	(1)(2)

Note (1) No display malfunctions.

Note (2) 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.

Note (3) Temperature of panel display surface area should be 85 °C Max.

Note (4) In the standard conditions, there is no function failure issue occurred. All the cosmetic specification is judged before the reliability test

### 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	+ 4.0	V	(1)
Logic Input Voltage	V <sub>IN</sub>	-0.3	V <sub>CC</sub> +0.3	V	

## 3. ELECTRICAL CHARACTERISTICS

### 3.1 TFT LCD MODULE

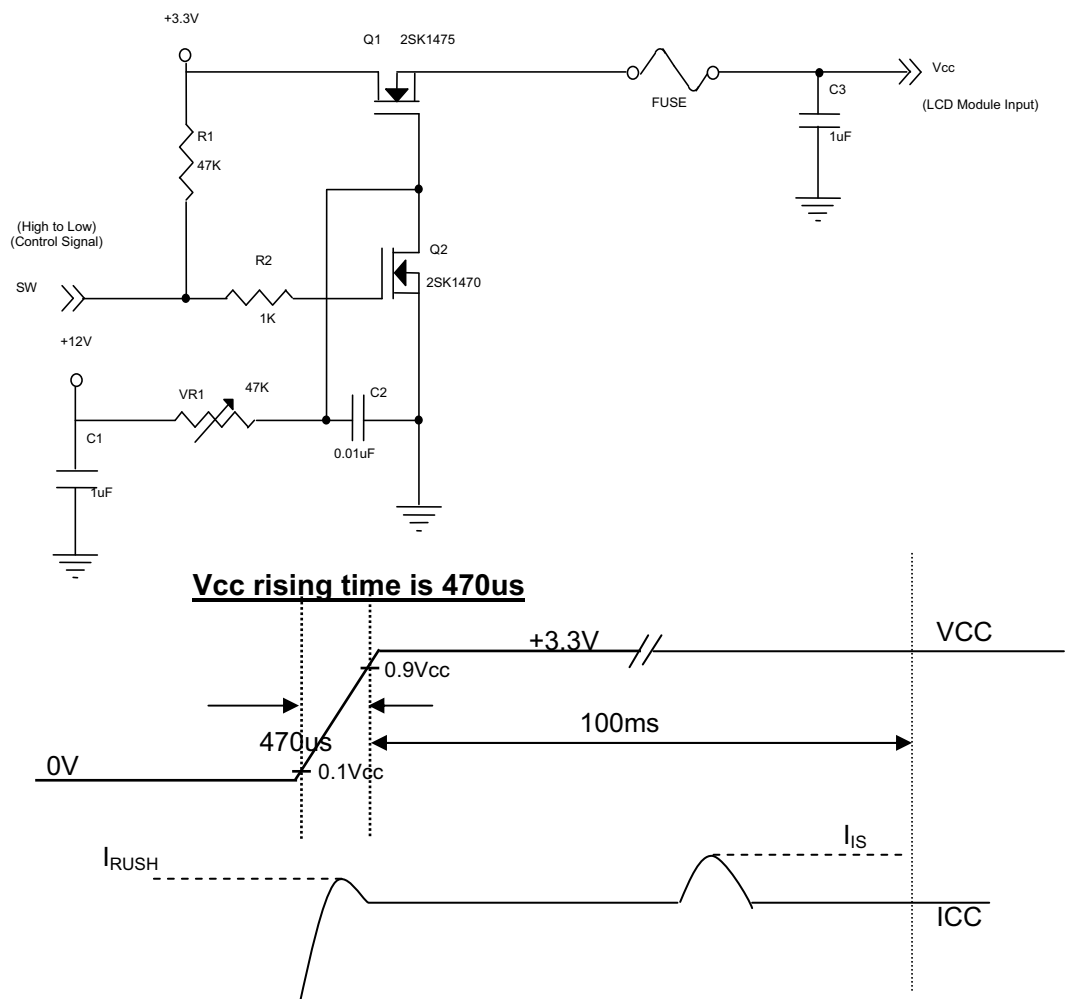
Parameter	Symbol	Value			Unit	Note	
		Min.	Typ.	Max.			
Power Supply Voltage	V <sub>CC</sub>	3.0	3.3	3.6	V	--	
Permissible Ripple Voltage	V <sub>RP</sub>	--	50	--	mV	--	
Rush Current	I <sub>RUSH</sub>	--	--	1.5	A	(2)	
Initial Stage Current	I <sub>IS</sub>	--	--	1.0	A	(2)	
Power Supply Current	White	I <sub>CC</sub>	--	360	400	mA	(3)a
	Black		--	460	500	mA	(3)b
LVDS Differential Input High Threshold	V <sub>TH(LVDS)</sub>	--	--	+100	mV	(4), V <sub>CM</sub> =1.2V	
LVDS Differential Input Low Threshold	V <sub>TL(LVDS)</sub>	-100	--	--	mV	(4) V <sub>CM</sub> =1.2V	
LVDS Common Mode Voltage	V <sub>CM</sub>	1.125	--	1.375	V	(4)	
LVDS Differential Input Voltage	V <sub>ID</sub>	100	--	600	mV	(4)	
Terminating Resistor	R <sub>T</sub>	--	100	--	Ohm	--	

Note (1) The ambient temperature is  $T_a = 25 \pm 2 \text{ }^\circ\text{C}$ .

Note (2) I<sub>RUSH</sub>: the maximum current when VCC is rising

I<sub>IS</sub>: the maximum current of the first 100ms after power-on

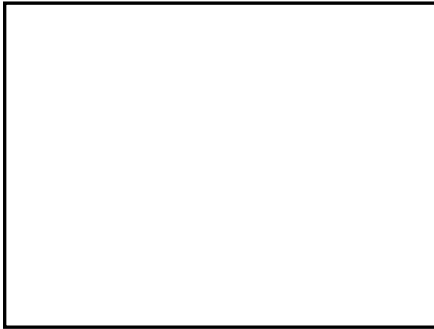
Measurement Conditions: Shown as the following figure. Test pattern: black.





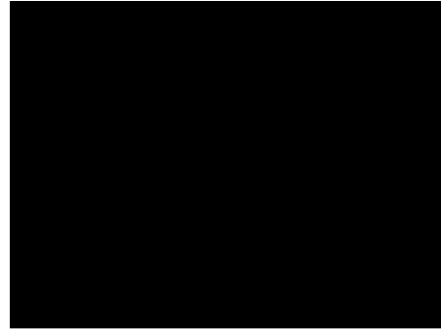
Note (3) The specified power supply current is under the conditions at  $V_{CC} = 3.3\text{ V}$ ,  $T_a = 25 \pm 2\text{ }^\circ\text{C}$ ,  $f_v = 60\text{ Hz}$ , whereas a power dissipation check pattern below is displayed.

a. White Pattern



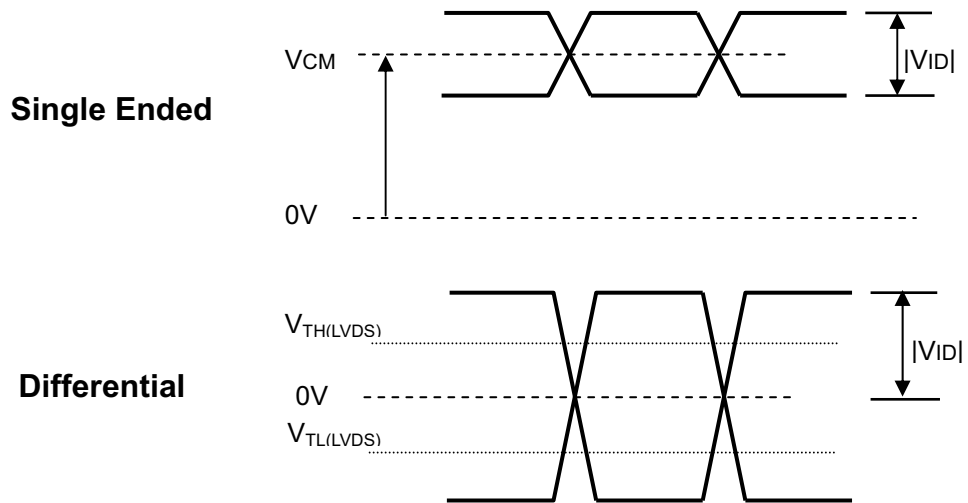
Active Area

b. Black Pattern



Active Area

Note (4) The parameters of LVDS signals are defined as the following figures.



## 3.2 BACKLIGHT UNIT

T<sub>a</sub> = 25°C

ITEM	SYMBOL	MIN	TYP.	MAX.	UNIT	Remarks
LED Forward Voltage	VL	--	8.69	9.3	V	*1), IL = 1100mA
LED Forward Current	IL	--	--	1100	mA	*2) per rail
Power Consumption	WL	--	7.12	--	W	IL = 1100mA
Backlight Lifetime	BL	50,000	--	--	h	*3), *4), IL = 1100mA

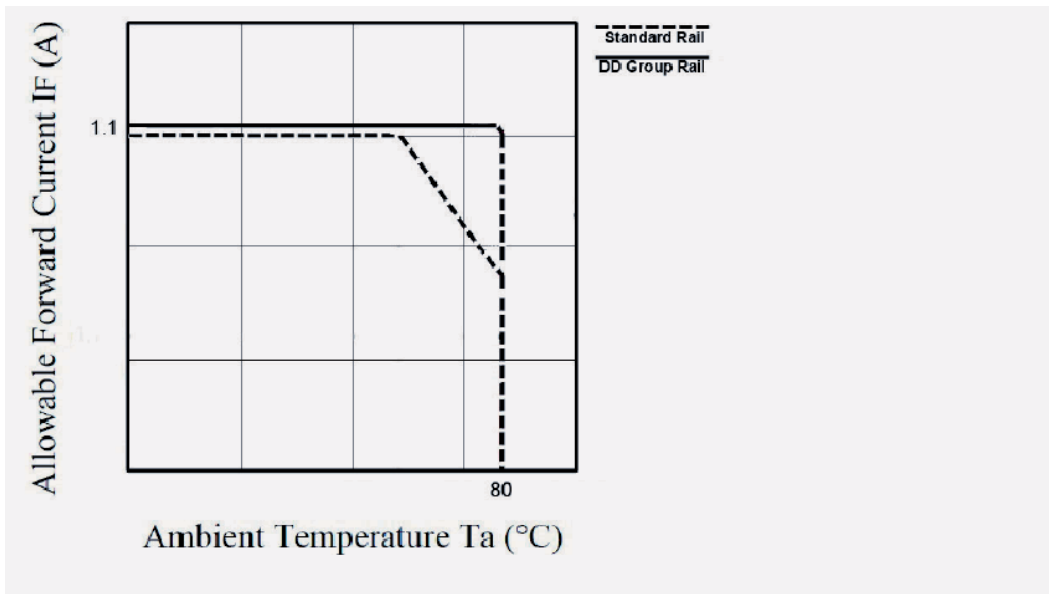
\*1) VL is specified as the sum of the white LED forward voltages.

\*2) LEDs are best driven using a constant current source. To avoid chromaticity shifts while dimming pulse-width modulation (PWM) techniques may be employed (0-100% duty cycle).

\*3) Backlight lifetime is defined as the time when the brightness becomes 50% of the initial value.

\*4) The lifetime of the backlight is independent of the ambient temperature stated in the display specification.

\*5) LED forward current derating curve:



\*6) Recommended backlight power supply:

PART NUMBER	MANUFACTURER
SmartLED 2 x 1.1A IN-50-008 - analog IN-51-008 - PWM	Apollo Displays Technologies, Corp.

CN2, CN3 (backlight)

backlight-side connector: 22-01-3027 (Molex)

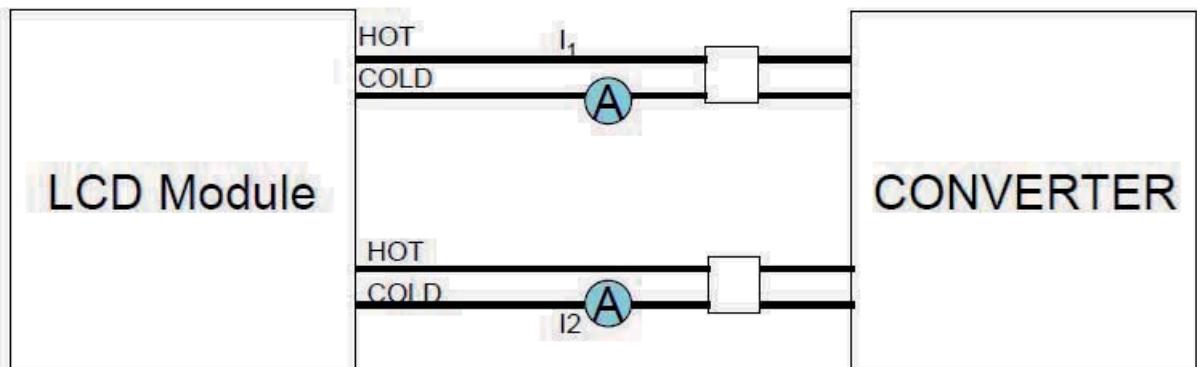
converter-side connector: 22-05-3021 (Molex)

Pin No.	Symbol	Function
1	LRH1,2	VBLH (High voltage)
2	LRL1,2	VBLL (Low voltage)

Note:  $VBLH - VBLL = VL$

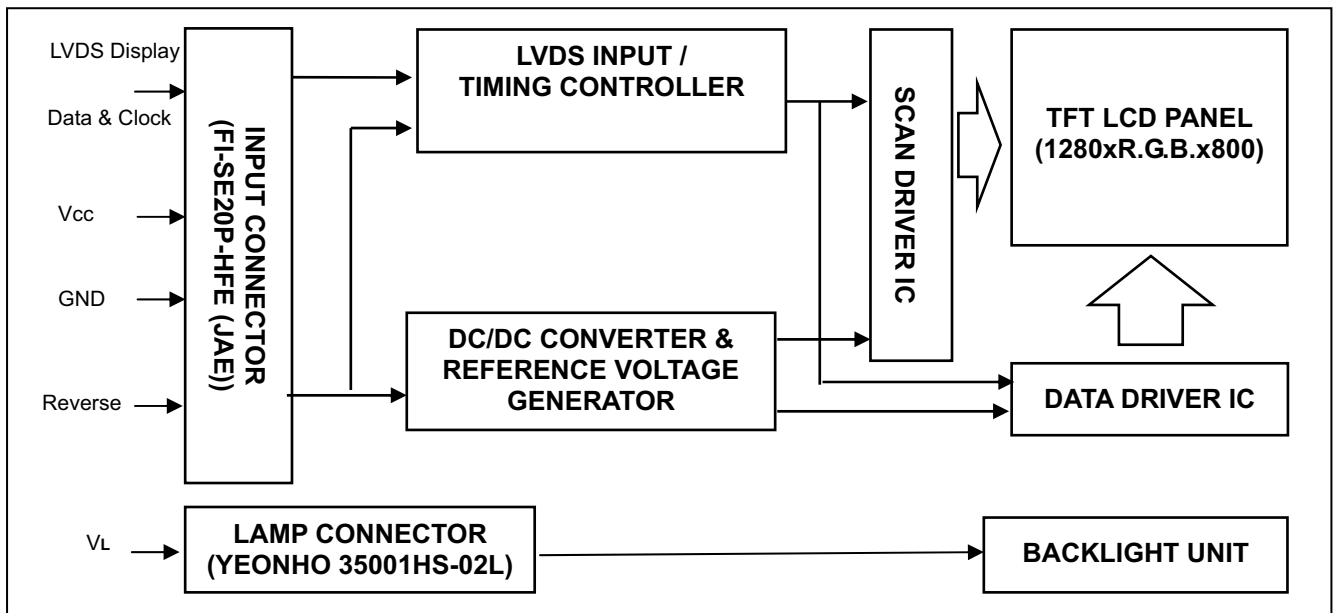
Note (1) Specified values are for a single lamp.

Refer to the following block diagram of the back light unit for more information.



## 4. BLOCK DIAGRAM

### 4.1 TFT LCD MODULE



## 5. INPUT TERMINAL PIN ASSIGNMENT

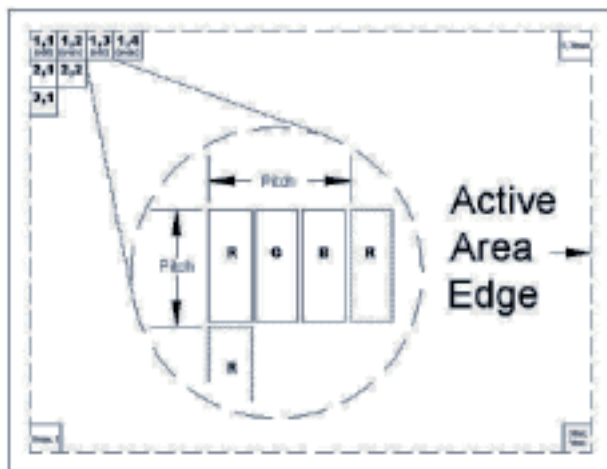
### 5.1 TFT LCD MODULE

Pin	Symbol	Description	Polarity	Remark
1	VCCS	Power Supply +3.3 V (typical)	--	--
2	VCCS	Power Supply +3.3 V (typical)	--	--
3	GND	Ground	--	--
4	GND	Ground	--	--
5	RX0-	LVDS Differential Data Input	Negative	R0~R5,G0
6	RX0+	LVDS Differential Data Input	Positive	--
7	GND	Ground	--	G1~G5, B0, B1
8	RX1-	LVDS Differential Data Input	Negative	--
9	RX1+	LVDS Differential Data Input	Positive	--
10	GND	Ground	--	B2~B5, DE, Hsync, Vsync
11	RX2-	LVDS Differential Data Input	Negative	--
12	RX2+	LVDS Differential Data Input	Positive	--
13	GND	Ground	--	--
14	CLK-	LVDS Clock Data Input	Negative	LVDS Level Clock
15	CLK+	LVDS Clock Data Input	Positive	--
16	GND	Ground	--	--
17	NC	Non-Connection	--	--
18	NC	Non-Connection	--	--
19	Reverse	+3.3VReverse, GND/NC No Reverse	--	Refer to 6.2 POWER ON/OFF SEQUENCE Note(5)
20	NC	Non-Connection	--	--

Note (1) Connector Part No.: FI-SE20P-HFE(JAE) or equivalent

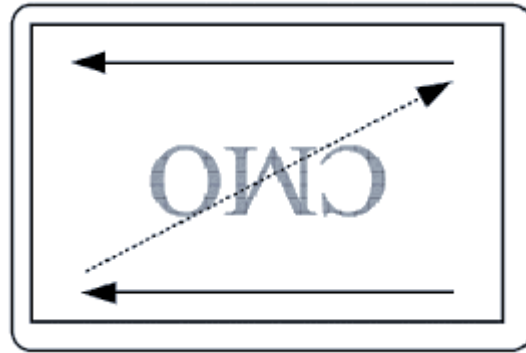
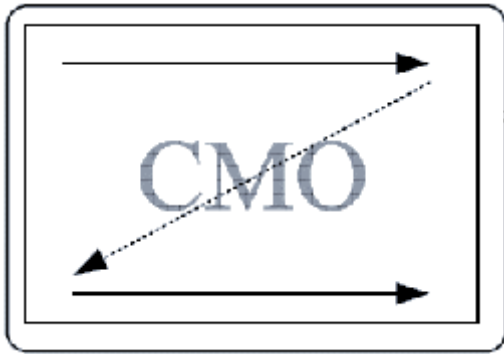
Note (2) User's connector Part No: FI-SE20ME (JAE) or equivalent

Note (3) The first pixel is odd as shown in the following figure.



## 5.2 SCANNING DIRECTION

The following figures are seen from a front view and the arrow shows the direction of scan.



Reverse = GND/NC : normal display (default)

Reverse = High : display with 180 degree rotation

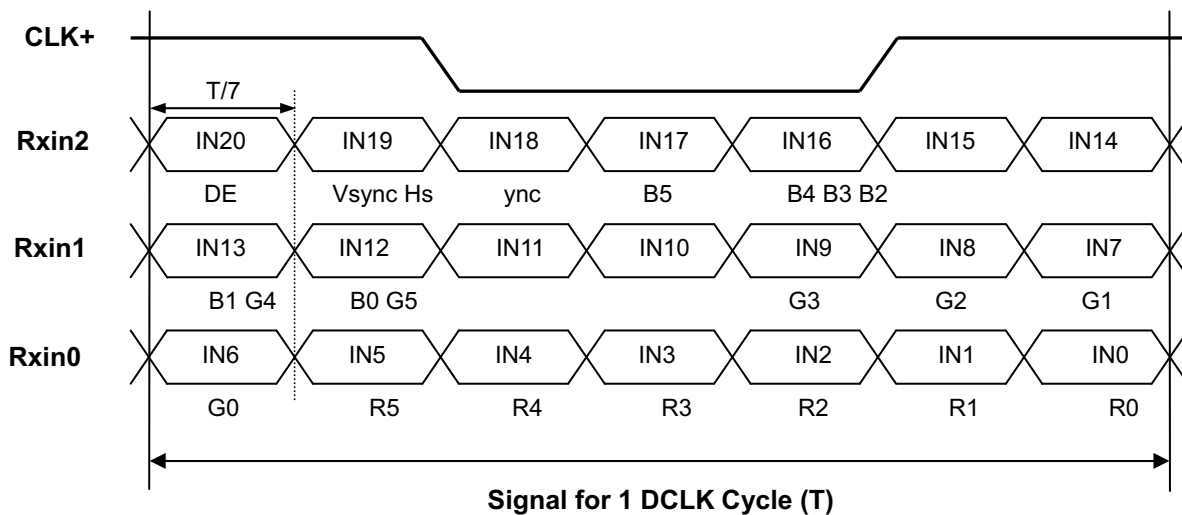
## 5.3 BACKLIGHT UNIT

Pin	Symbol	Description	Color
1	HV	High Voltage	Pink
2	LV	Ground	White

Note (1) Connector Part No.: YEONHO 35001HS-02L or equivalent

Note (2) User's connector Part No.: YEONHO 35001 WR-02L or equivalent

## 5.4 TIMING DIAGRAM OF LVDS INPUT SIGNAL



## 5.5 COLOR DATA INPUT ASSIGNMENT

The brightness of each primary color (red, green and blue) is based on the 6-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					
		R5	R4	R3	R2	R1	R0	G5	G4	G3	G2	G1	G0	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
	Red	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
	Green	0	0	0	0	0	0	1	1	1	1	1	1	0	0	0	0	0	0
	Blue	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1
	Cyan	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1
	Magenta	1	1	1	1	1	1	0	0	0	0	0	0	0	1	1	1	1	1
	Yellow	1	1	1	1	1	1	1	1	1	1	1	1	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
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
	Red(1)	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
	Red(2)	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
	Red(61)	1	1	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0
	Red(62)	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Red(63)	1	1	1	1	1	1	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
	Green(1)	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
	Green(2)	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
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	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
	Green(61)	0	0	0	0	0	0	1	1	1	1	0	1	0	0	0	0	0	0
	Green(62)	0	0	0	0	0	0	1	1	1	1	1	0	0	0	0	0	0	0
Green(63)	0	0	0	0	0	0	1	1	1	1	1	1	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
	Blue(1)	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	1	0
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
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	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
	Blue(61)	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	0	1	0
	Blue(62)	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	0
Blue(63)	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	

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

## 6. INTERFACE TIMING

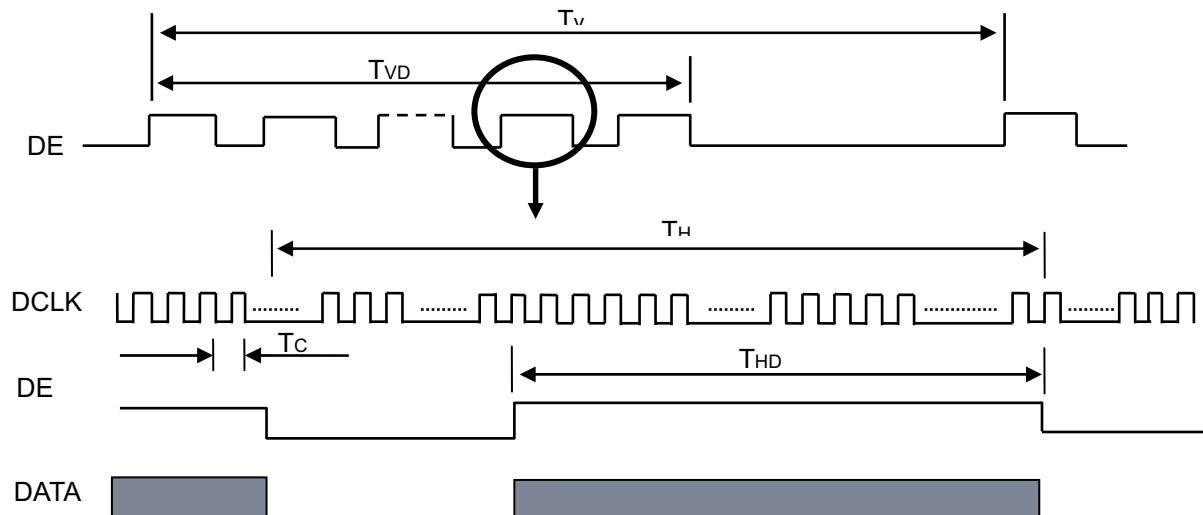
### 6.1 INPUT SIGNAL TIMING SPECIFICATIONS

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

Signal	Item	Symbol	Min.	Typ.	Max.	Unit	Note
DCLK	Frequency	1/Tc	63.9	71	74.5	MHz	-
DE	Vertical Total Time	TV	802	823	1030	TH	-
	Vertical Active Display Period	TVD	800	800	800	TH	-
	Vertical Active Blanking Period	TVB	TV-TVD	23	TV-TVD	TH	
	Horizontal Total Time	TH	1360	1440	1600	Tc	-
	Horizontal Active Display Period	THD	1280	1280	1280	Tc	-
	Horizontal Active Blanking Period	THB	TH-THD	160	TH-THD	Tc	

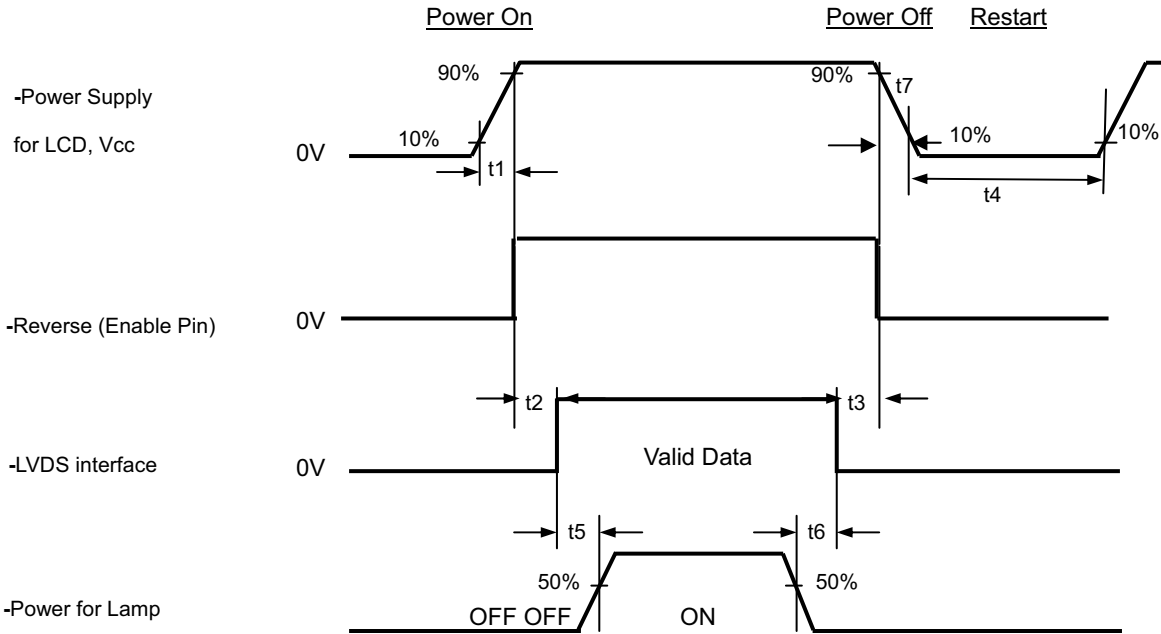
Note (1) Because this module is operated by DE only mode, Hsync and Vsync are ignored.

#### INPUT SIGNAL TIMING DIAGRAM





## 6.2 POWER ON/OFF SEQUENCE



### Timing Specifications:

- $0.5 \leq t1 \leq 10 \text{ ms}$
- $0 \leq t2 \leq 50 \text{ ms}$
- $0 \leq t3 \leq 50 \text{ ms}$
- $t4 \geq 500 \text{ ms}$
- $t5 \geq 200 \text{ ms}$
- $t6 \geq 200 \text{ ms}$

Note (1) Please follow the power on/off sequence described above. Otherwise, the LCD module might be damaged.

Note (2) Please avoid floating state of interface signal at invalid period. When the interface signal is invalid, be sure to pull down the power supply of LCD Vcc to 0 V.

Note (3) The Backlight inverter power must be turned on after the power supply for the logic and the interface signal is valid. The Backlight inverter power must be turned off before the power supply for the logic and the interface signal is invalid.

Note (4) So metimes some slight noise shows when LCD is turned off (even backlight is a lready off). To avoid this phenomenon, we suggest that the Vcc falling time is better to follow  $(5) \leq t7 \leq (300) \text{ ms}$ .

Note (5) Reverse Pin not change signal when Panel Normal Displaying.

## 7. OPTICAL CHARACTERISTICS

### 7.1 TEST CONDITIONS

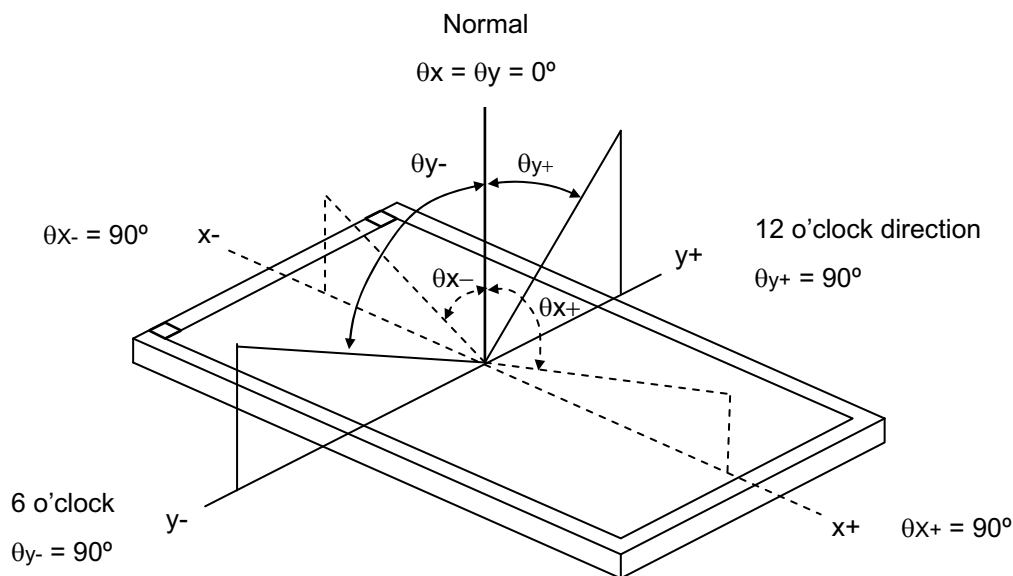
Item	Symbol	Value	Unit
Ambient Temperature	T <sub>a</sub>	25±2	°C
Ambient Humidity	H <sub>a</sub>	50±10	%RH
Supply Voltage	V <sub>CC</sub>	3.3	V
Input Signal	According to typical value in "3. ELECTRICAL CHARACTERISTICS"		
Inverter Current	I <sub>L</sub>	7.0	mA
Inverter Driving Frequency	F <sub>L</sub>	61	KHz
Inverter	Darfon VK13165.101		

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 (6).

### 7.2 OPTICAL SPECIFICATIONS

Item		Symbol	Condition	Min.	Typ.	Max.	Unit	Note
Contrast Ratio		CR	$\theta_x=0^\circ, \theta_y=0^\circ$ Viewing Normal Angle	500	700	--	-	(2),(5)
Response Time		T <sub>R</sub>		--	5	10	ms	(3)
		T <sub>F</sub>		--	11	16	ms	
Center Luminance of White		L <sub>CEN</sub>		1000	1200	--	cd/m <sup>2</sup>	(4),(5)
White Variation		δW		--	1.25	1.4	-	(5),(6)
Color Chromaticity	Red	R <sub>x</sub>	$\theta_x=0^\circ, \theta_y=0^\circ$ Viewing Normal Angle	Typ- 0.03	Typ+ 0.03	-	(1)	
		R <sub>y</sub>						
	Green	G <sub>x</sub>						
		G <sub>y</sub>						
	Blue	B <sub>x</sub>						
		B <sub>y</sub>						
	White	W <sub>x</sub>						
		W <sub>y</sub>						
Viewing Angle	Horizontal	θ <sub>x+</sub>	CR≥10	70	80	--	Deg.	
		θ <sub>x-</sub>						
	Vertical	θ <sub>y+</sub>						
		θ <sub>y-</sub>						
Contrast Ratio in daylight		CR	Sun lamp	100	120	--	--	(7)

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.

$$\text{Contrast Ratio (CR)} = L_{63} / L_0$$

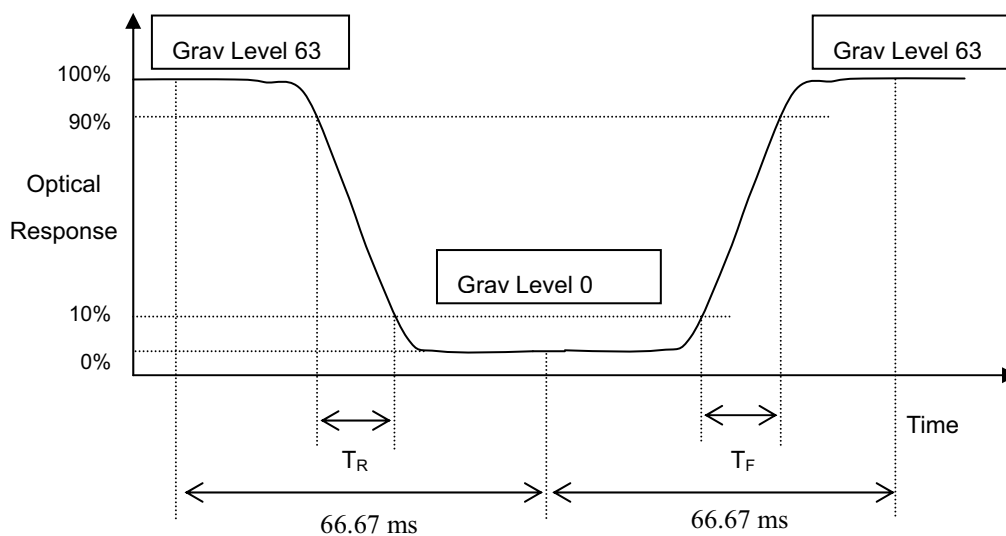
$L_{63}$ : Luminance of gray level 63

$L_0$ : Luminance of gray level 0

$$CR = CR(5)$$

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

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



Note (4) Definition of Average Luminance of White ( $L_{CEN}$ ):

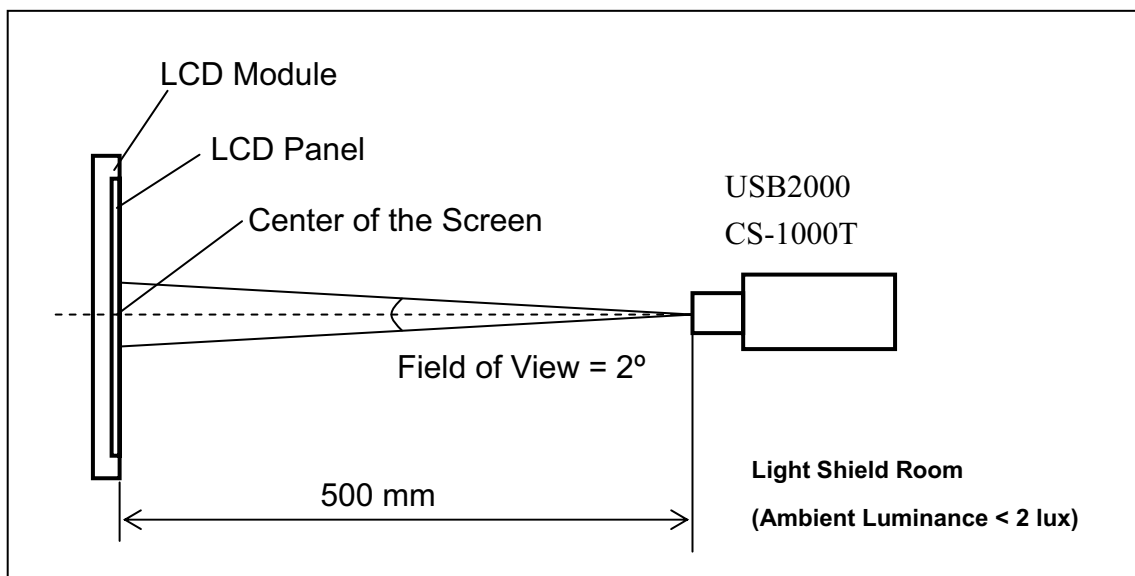
Measure the luminance of gray level 63 at 5 points

$$L_{CEN} = L(5)$$

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

Note (5) Measurement Setup:

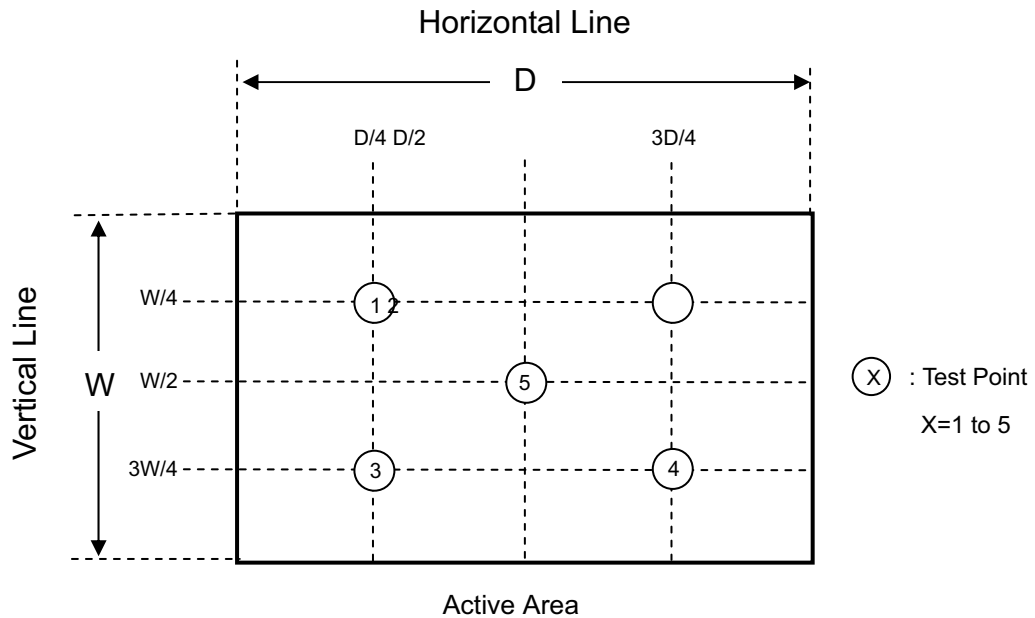
The LCD module should be stabilized at given temperature for 20 minutes to avoid abrupt temperature change during measuring. In order to stabilize the luminance, the measurement should be executed after lighting Backlight for 20 minutes in a windless room.



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

Measure the luminance of gray level 63 at 5 points

$$\delta W = \text{Maximum [L (1), L (2), L (3), L (4), L (5)]} / \text{Minimum [L (1), L (2), L (3), L (4), L (5)]}$$

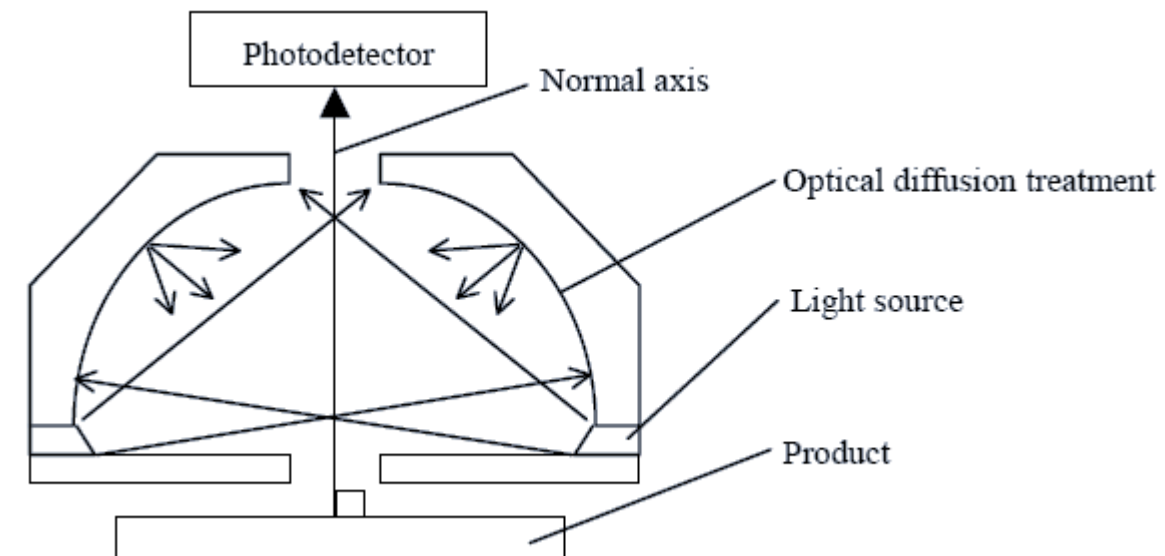


Note (7) Contrast Ratio in daylight:

Measuring method base on BLU ON

Sun lamp:10000 Lux

Contrast Ratio in daylight=Luminance of white screen/ Luminance of black screen



## 8. PRECAUTIONS

### 8.1 ASSEMBLY AND HANDLING PRECAUTIONS

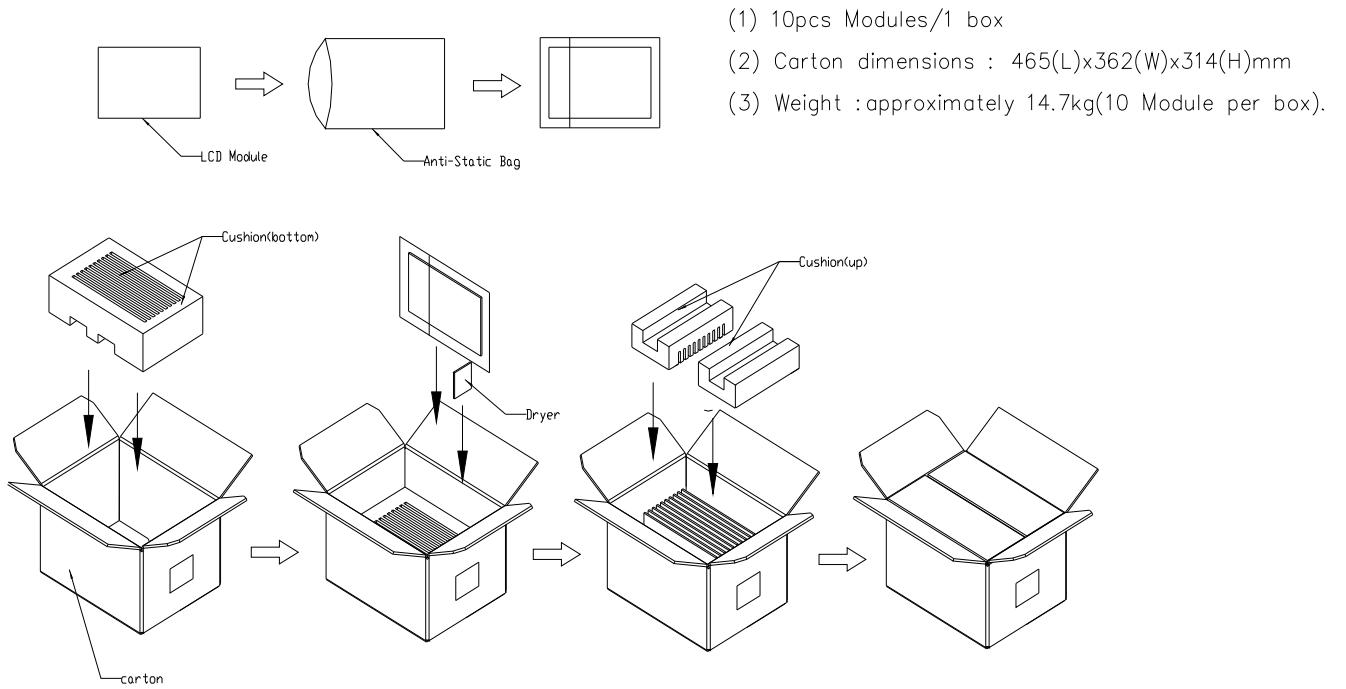
- (1) Do not apply rough force such as bending or twisting to the module during assembly.
- (2) To assemble or install module into user's system can be only in clean working areas. The dust and oil may cause electrical short or worsen the polarizer.
- (3) It's not permitted to have pressure or impulse 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.
- (11) Do not keep same pattern in a long period of time. It may cause image sticking on LCD

### 8.2 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.

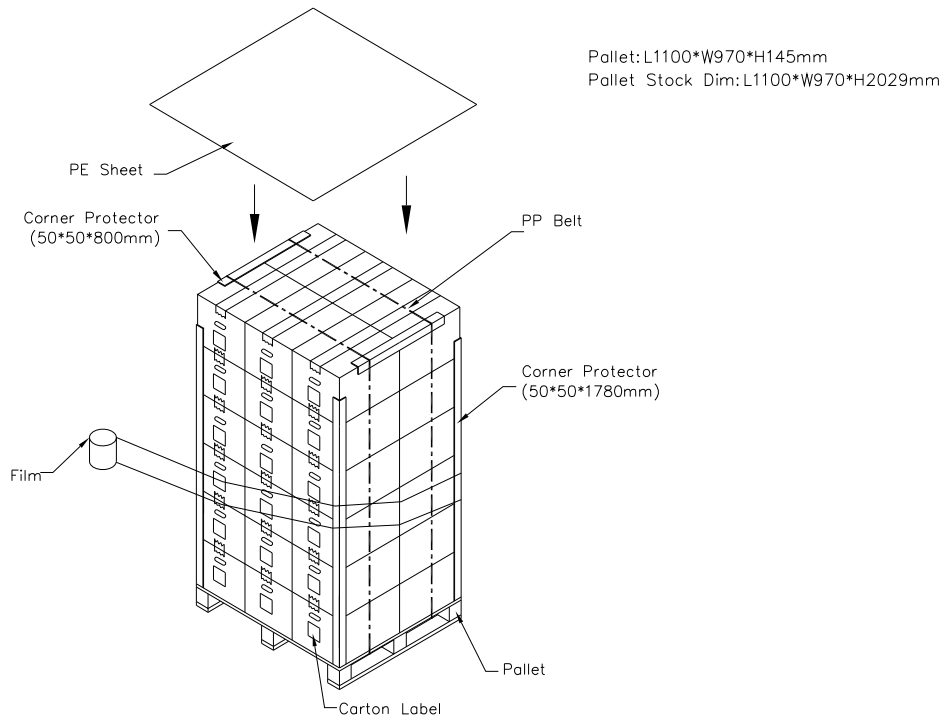
## 9. PACKAGING

### 9.1 CARTON

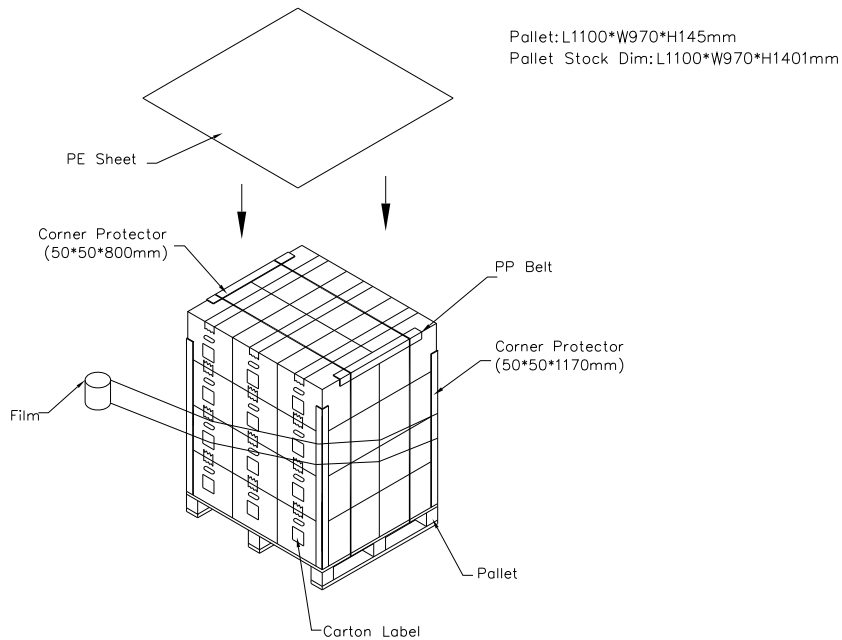


**Figure. 8-1 Packing method**

## 9.2 PALLET



**Figure. 9-2 Packing method**



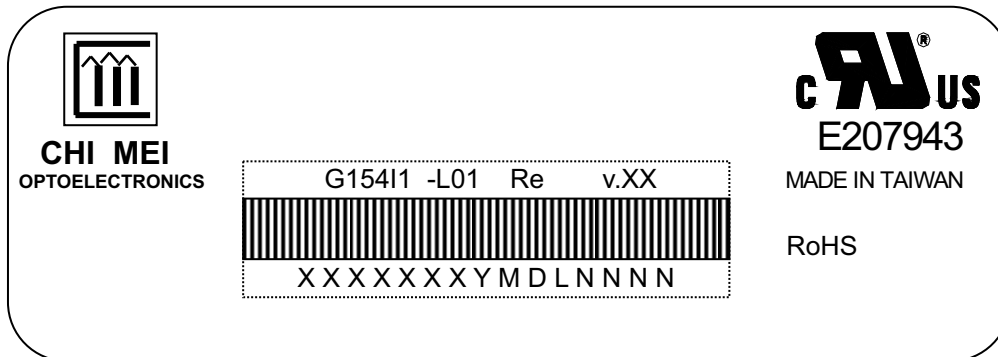
**Figure. 9-3 Packing method**



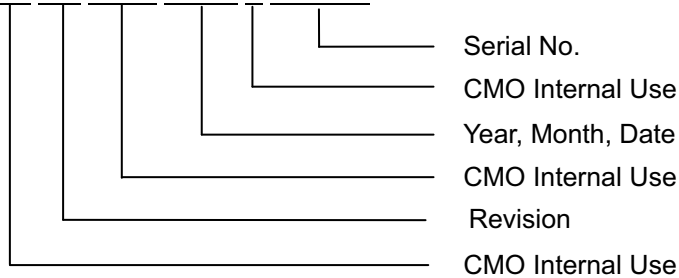
## 10. DEFINITION OF LABELS

### 10.1 CMO MODULE LABEL

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



- (a) Model Name: G154I1-L01-V538
- (b) Revision: Rev. XX, for example: A1, ...C1, C2 ...etc.
- (c) Serial ID: XXXXXXXYMDXXXX

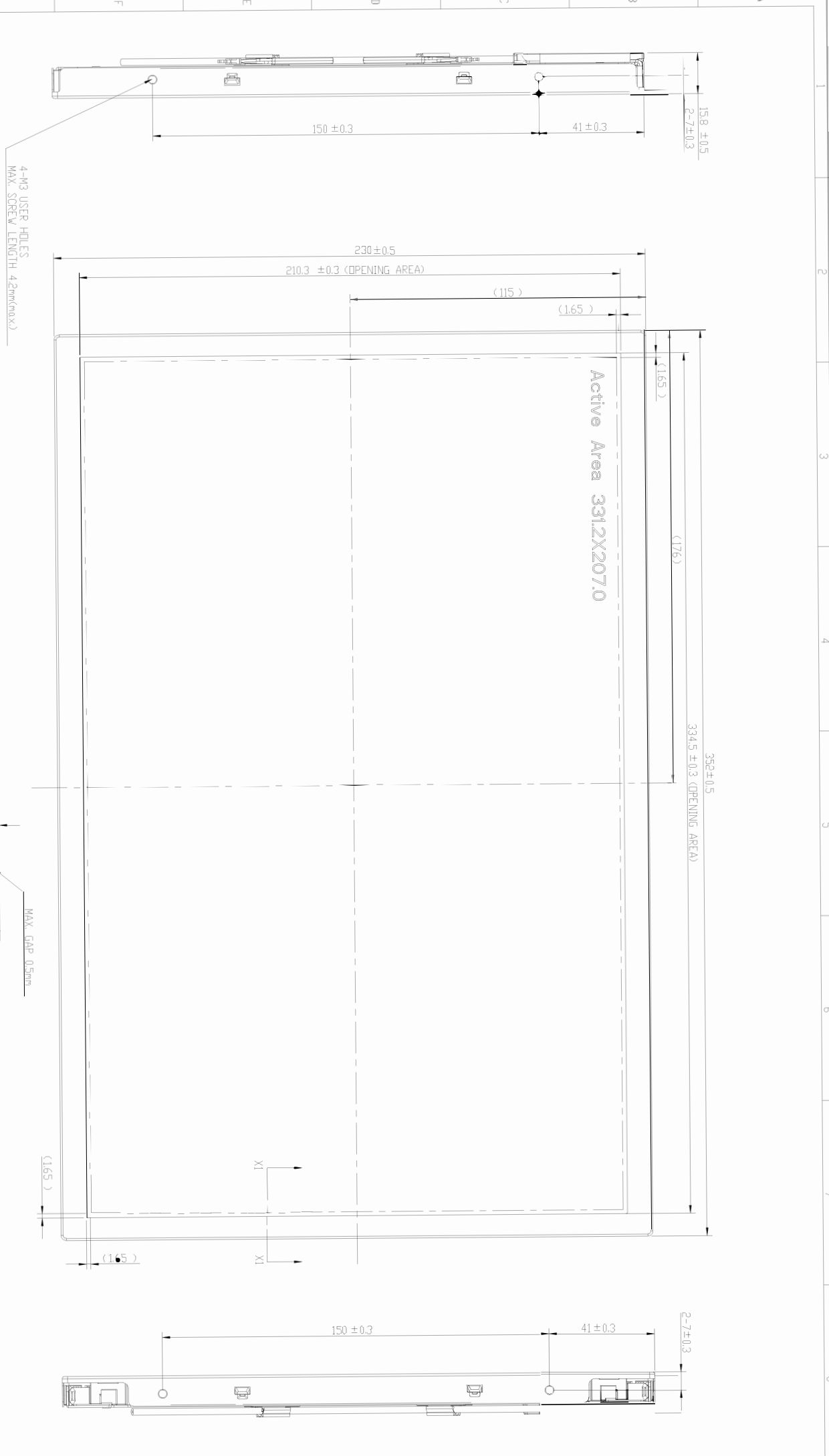


Serial ID includes the information as below:

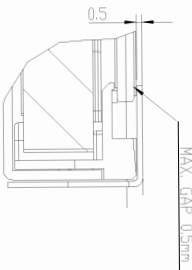
- (a) Manufactured Date: Year: 1~9, for 2001~2009  
 Month: 1~9, A~C, for Jan. ~ Dec.  
 Day: 1~9, A~Y, for 1<sup>st</sup> to 31<sup>st</sup>, exclude I , O and U
- (b) Revision Code: cover all the change
- (c) Serial No.: Manufacturing sequence of product

### 10.2 CMO CARTON LABEL





- NOTES:
1. OUTLINE TOLERANCE: ±0.5mm.
  2. I/F CONNECTOR SPEC. FT-SE20P-HFE (JAE) OR EQUIVALENT.
  3. I/F CONNECTOR YOUNG LOCKING TYPE 3500HS-02L OR EQUIVALENT.
  4. SIDE MOUNT HOLE TORQUE : 5kgf-cm (MAX.).

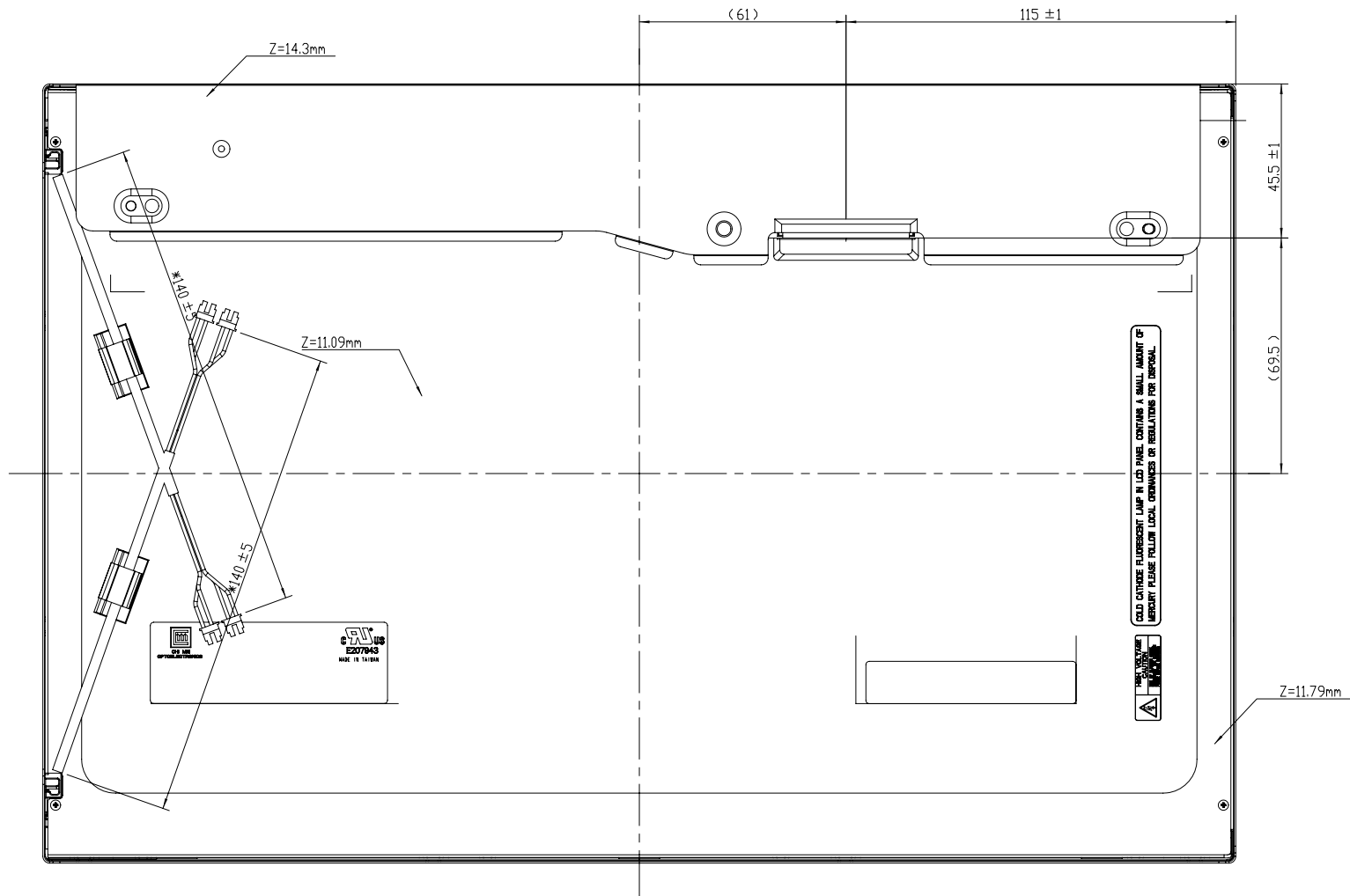


SECTION X1-X1  
SCALE 3:1

Mark	Description	Date	Changed By	Approved By	ECN No.	Remark
2						
3						
4						
5						
6						
7						
8						

TITLE	ASSY_MODULE_G15411.L01	Drawing No.	G1541101A
Approved	Tiger Chang	Part No.	TBD
Checked	Aden Von	Material	
Designer	Aden Von	Date	2008-Mar-04
 CHI MEI OPTOELECTRONICS CORP.		Scale	1:1
		Sheet	1 / 2
		Unit	mm
		Revision	30 REV.1/21
ALL RIGHTS RESERVED. COPYING PROHIBITED.			



NOTES:  
 1. OUTLINE TOLERANCE: ±0.5mm.  
 2. I/F CONNECTOR SPEC: FI-SE20P-HFE (JAE) OR EQUIVALENT.  
 3. LAMP CONNECTOR: YEONHO\_LOCKING\_TYPE\_35001HS-02L OR EQUIVALENT.  
 4. SIDE MOUNT HOLE TORQUE: 5Kgf-cm(MAX.).

TITLE	ASSY_MODULE_G15411_L01			2D REV.1A
Approved	Yule Lin	Drawing No.	G15414101A	
Checked	Tiger Chang	Part No.	TBD	
Drawer	Aiden Wan	Material	TBD	Sheet 2 / 2 A2
Designer	Aiden Wan	Date	2008-Mar.-04	Scale 1:1 Unit:mm
		ALL RIGHTS RESERVED, COPYING FORBIDDEN.		

Mark	Description	Date	Changed_By	Approved_By	ECN No.	Remark
1		2			3	
4		5				
6		7				
8						

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