

Doc. Number :

- Tentative Specification
- Preliminary Specification
- Approval Specification

MODEL NO.: M215HGE  
SUFFIX: L21

<b>Customer: Common Model</b>	
<b>APPROVED BY</b>	<b>SIGNATURE</b>
<u>Name / Title</u> _____	_____
Note	
<u>Product version C1/C2</u> _____	
Please return 1 copy for your confirmation with your signature and comments.	

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**CONTENTS**

<b>1. GENERAL DESCRIPTION .....</b>	<b>5</b>
1.1 OVERVIEW.....	5
1.2 GENERAL SPECIFICATIONS .....	5
<b>2. MECHANICAL SPECIFICATIONS.....</b>	<b>5</b>
<b>3. ABSOLUTE MAXIMUM RATINGS .....</b>	<b>5</b>
3.1 ABSOLUTE RATINGS OF ENVIRONMENT .....	5
3.2 ELECTRICAL ABSOLUTE RATINGS .....	6
3.2.1 TFT LCD MODULE .....	6
3.2.2 BACKLIGHT UNIT.....	6
<b>4. ELECTRICAL SPECIFICATIONS .....</b>	<b>7</b>
4.1 FUNCTION BLOCK DIAGRAM.....	7
4.2. INTERFACE CONNECTIONS .....	7
4.3 ELECTRICAL CHARACTERISTICS .....	9
4.3.1 LCD ELETRONICS SPECIFICATION .....	9
4.3.2 Vcc Power Dip Condition.....	11
4.3.3 BACKLIGHT UNIT.....	11
4.3.4 LIGHTBAR Connector Pin Assignment .....	12
4.4 LVDS INPUT SIGNAL SPECIFICATIONS.....	13
4.4.1 LVDS DATA MAPPING TABLE .....	13
4.4.2 COLOR DATA INPUT ASSIGNMENT .....	14
4.5 DISPLAY TIMING SPECIFICATIONS .....	15
<b>5. OPTICAL CHARACTERISTICS .....</b>	<b>18</b>
5.1 TEST CONDITIONS .....	18
5.2 OPTICAL SPECIFICATIONS .....	18
<b>6. RELIABILITY TEST ITEM.....</b>	<b>21</b>
<b>7. PACKING .....</b>	<b>22</b>
7.1 PACKING SPECIFICATIONS .....	22
7.2 PACKING METHOD.....	22
7.3 PALLET.....	23
<b>8. CMI MODULE LABEL .....</b>	<b>24</b>
<b>9. PRECAUTIONS .....</b>	<b>25</b>
9.1 ASSEMBLY AND HANDLING PRECAUTIONS.....	25
9.2 STORAGE PRECAUTIONS.....	25
9.3 OPERATION PRECAUTIONS .....	25
9.4 SAFETY PRECAUTIONS .....	26

9.5 SAFETY STANDARDS .....	26
9.6 OTHER .....	26
<b>Appendix. OUTLINE DRAWING .....</b>	<b>26</b>

**REVISION HISTORY**

Version	Date	Page	Description																																				
1.0	Jun,08,2011	All	Spec Ver.1.0 was first issued.																																				
3.0	July,29,2011	8	Note (1) Add LDVS connector type & vendor: WF13-422-3033(Fullconn) or 187098-30091(Ptwo) or GS23302-0311R-7H(Foxconn)																																				
		9	4.3.1 LCD ELETRONICS SPECIFICATION Modify LVDS common input voltage spec Min: 1 → 0.05 Typ: 1.2 → ---- Max:1.4 → 2.35																																				
		15	4.5 DISPLAY TIMING SPECIFICATIONS Modify Input Clock to data skew Max:400 →350 ps																																				
		18	5.2 OPTICAL SPECIFICATIONS Modify Color Chromaticity spec (typ) Rx: 0.637 ->0.635 Ry:0.351 ->0.352 Gx: 0.319 ->0.321 Gy:0.626 ->0.633 Bx: 0.145 ->0.151 By:0.061 ->0.052																																				
3.1	Aug.25,2011	16	4.5 DISPLAY TIMING SPECIFICATIONS Add Note (4) (The DCLK range at last line of V-blanking should be set in 0 to Hdisplay/2)																																				
3.2	Nov.18,2011	9	4.3.1 LCD ELETRONICS SPECIFICATION Update Power supply current: <table border="0" style="margin-left: 20px;"> <tr> <td>Pattern</td> <td>typ</td> <td>max</td> <td>→</td> <td>typ</td> <td>max</td> </tr> <tr> <td>White</td> <td>0.42</td> <td>0.47</td> <td></td> <td>0.39</td> <td>0.45</td> </tr> <tr> <td>Black</td> <td>1.2</td> <td>1.4</td> <td></td> <td>1.17</td> <td>1.45</td> </tr> <tr> <td>Vertical</td> <td>0.69</td> <td>0.71</td> <td></td> <td>0.75</td> <td>1.0</td> </tr> </table> Power consumption: <table border="0" style="margin-left: 20px;"> <tr> <td>PLCD</td> <td>typ</td> <td>max</td> <td>→</td> <td>typ</td> <td>max</td> </tr> <tr> <td></td> <td>6.0</td> <td>7.7</td> <td></td> <td>5.85</td> <td>7.97</td> </tr> </table>	Pattern	typ	max	→	typ	max	White	0.42	0.47		0.39	0.45	Black	1.2	1.4		1.17	1.45	Vertical	0.69	0.71		0.75	1.0	PLCD	typ	max	→	typ	max		6.0	7.7		5.85	7.97
Pattern	typ	max	→	typ	max																																		
White	0.42	0.47		0.39	0.45																																		
Black	1.2	1.4		1.17	1.45																																		
Vertical	0.69	0.71		0.75	1.0																																		
PLCD	typ	max	→	typ	max																																		
	6.0	7.7		5.85	7.97																																		

## 1. GENERAL DESCRIPTION

### 1.1 OVERVIEW

M215HGE-L21 is a 21.5" TFT Liquid Crystal Display module with WLED Backlight unit and 30 pins 2ch-LVDS interface. This module supports 1920 x 1080 Full HD mode and can display up to 16.7M colors. The converter module for Backlight is not built in.

### 1.2 GENERAL SPECIFICATIONS

Item	Specification	Unit	Note
Screen Size	21.53" real diagonal		
Driver Element	a-si TFT active matrix	-	-
Pixel Number	1920 x R.G.B. x 1080	pixel	-
Pixel Pitch	0.2482 (H) x 0.2482 (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	-	-
Luminance, White	250	Cd/m2	
Color Gamut	72% of NTSC(Typ.)	-	-
TCO	TCO 5.0 compliance		
Power Consumption	Total 18.29W (Max.) @ cell 7.97W (Max.), BL:10.32W (Max.)		(1)

Note (1) The specified power consumption: Total= cell (reference 4.3.1)+BL (reference 4.3.3)

## 2. MECHANICAL SPECIFICATIONS

Item		Min.	Typ.	Max.	Unit	Note
Module Size	Horizontal (H)	495.1	495.6	496.1	mm	(1)
	Vertical (V)	291.7	292.2	292.7	mm	
	Thickness (T)	-	11.0	11.5	mm	
Bezel Area	Horizontal	479.3	479.8	480.3	mm	
	Vertical	270.8	271.3	271.8	mm	
Active Area	Horizontal		476.64	-	mm	
	Vertical		268.11	-	mm	
Weight		-	1910	2100	g	

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

## 3. ABSOLUTE MAXIMUM RATINGS

### 3.1 ABSOLUTE RATINGS OF ENVIRONMENT

Item	Symbol	Value		Unit	Note
		Min.	Max.		
Storage Temperature	TST	-20	60	°C	(1)
Operating Ambient Temperature	TOP	0	50	°C	(1), (2)

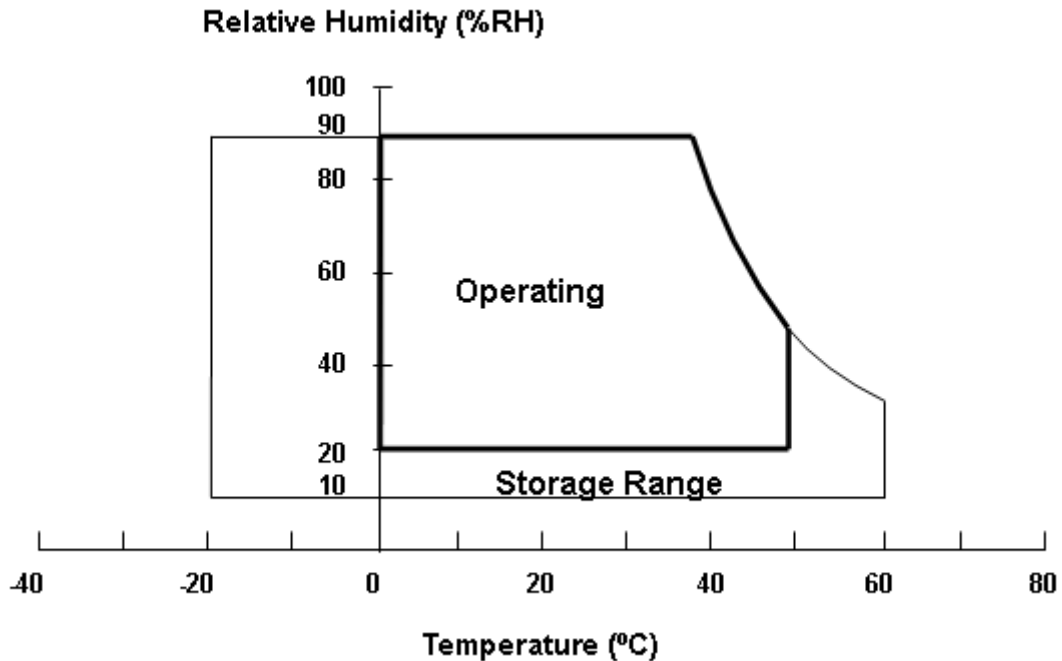
Note (1)

(a) 90 %RH Max. (Ta <= 40 °C).

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

(c) No condensation.

Note (2) Panel surface temperature should be 0°C min. and 65°C max under Vcc=5.0V, fr =60Hz, typical LED string current, 25°C ambient temperature, and no humidity control . Any condition of ambient operating temperature ,the surface of active area should be keeping not higher than 65°C.



### 3.2 ELECTRICAL ABSOLUTE RATINGS

#### 3.2.1 TFT LCD MODULE

Item	Symbol	Value		Unit	Note
		Min.	Max.		
Power Supply Voltage	VCCS	-0.3	6.0	V	(1)
Logic Input Voltage	V <sub>IN</sub>	-0.3	3.6	V	

#### 3.2.2 BACKLIGHT UNIT

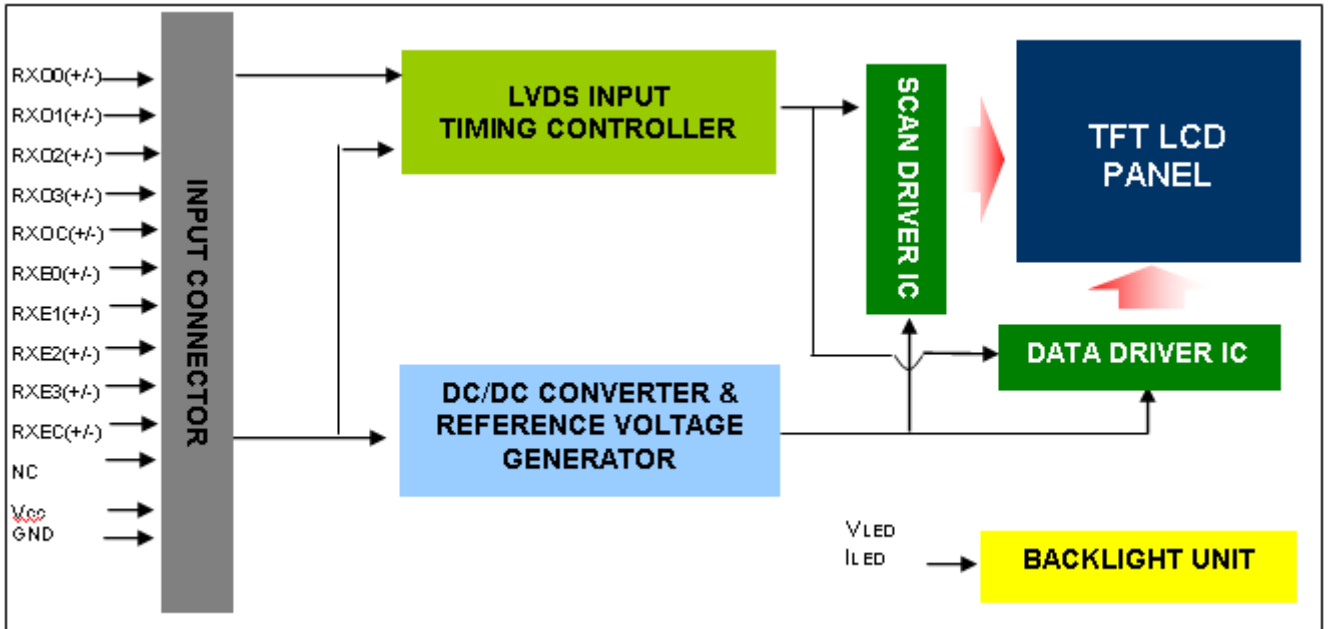
Item	Symbol	Value			Unit	Note
		Min.	Typ	Max.		
LED Forward Current Per Input Pin	IF	--	65	69	mA	(1), (2) Duty=100%
LED Pulse Forward Current Per Input Pin	IP	--	--	150	mA	(1), (2) Pulse Width ≤ 10msec. and Duty ≤ 30%

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 input pin of LED light bar at Ta=25±2 °C (Refer to 4.3.3 and 4.3.4 for further information).

## 4. ELECTRICAL SPECIFICATIONS

### 4.1 FUNCTION BLOCK DIAGRAM



### 4.2. INTERFACE CONNECTIONS

#### PIN ASSIGNMENT

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	For LCD internal use only, Do not connect

26	NC	For LCD internal use only, Do not connect
27	NC	For LCD internal use only, Do not connect
28	Vcc	+5.0V power supply
29	Vcc	+5.0V power supply
30	Vcc	+5.0V power supply

Note (1) Connector Part No.:

WF13-422-3033(Fullconn) or 187098-30091(Ptwo) or GS23302-0311R-7H(Foxconn) equivalent

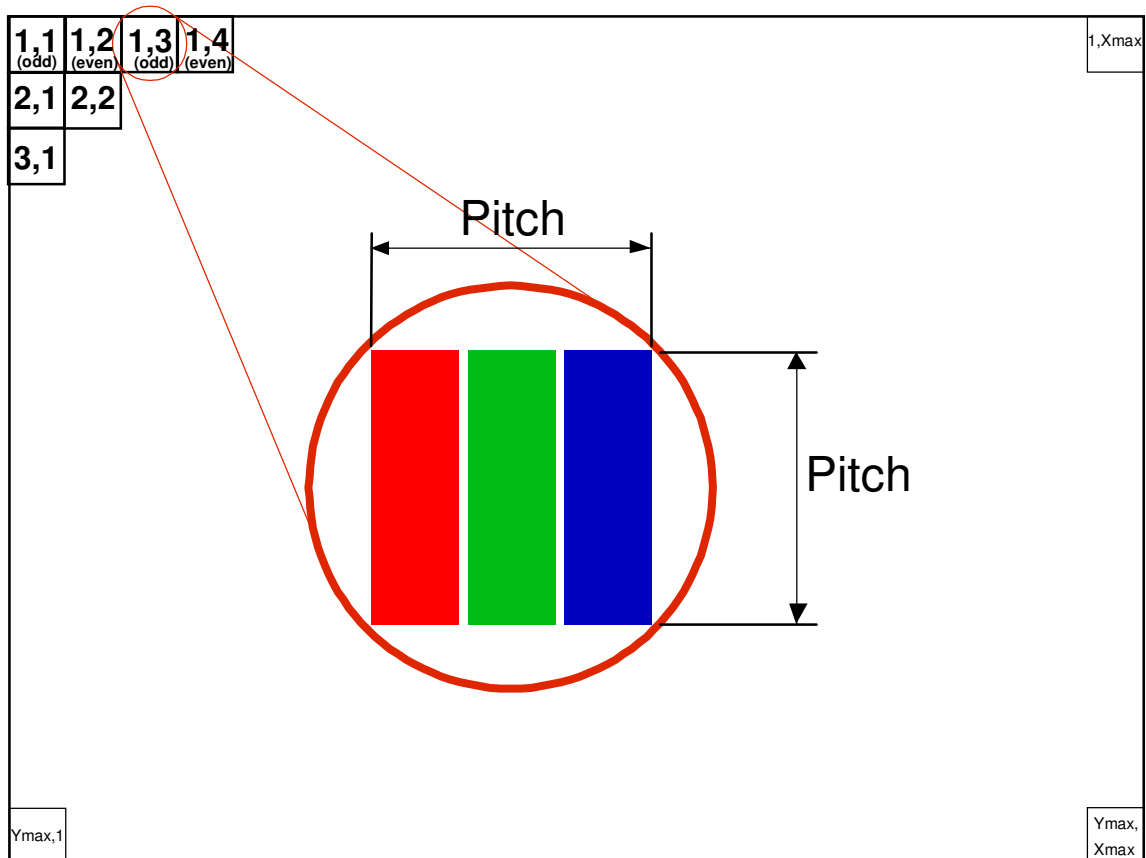
Note (2) User's connector Part No:

Mating Wire Cable Connector Part No.: FI-X30H(JAE) or FI-X30HL(JAE)

Mating FFC Cable Connector Part No.: 217007-013001 (P-TWO) or JF05X030-1 (JAE).

Note (3) The first pixel is odd.

Note (4) Input signal of even and odd clock should be the same timing.





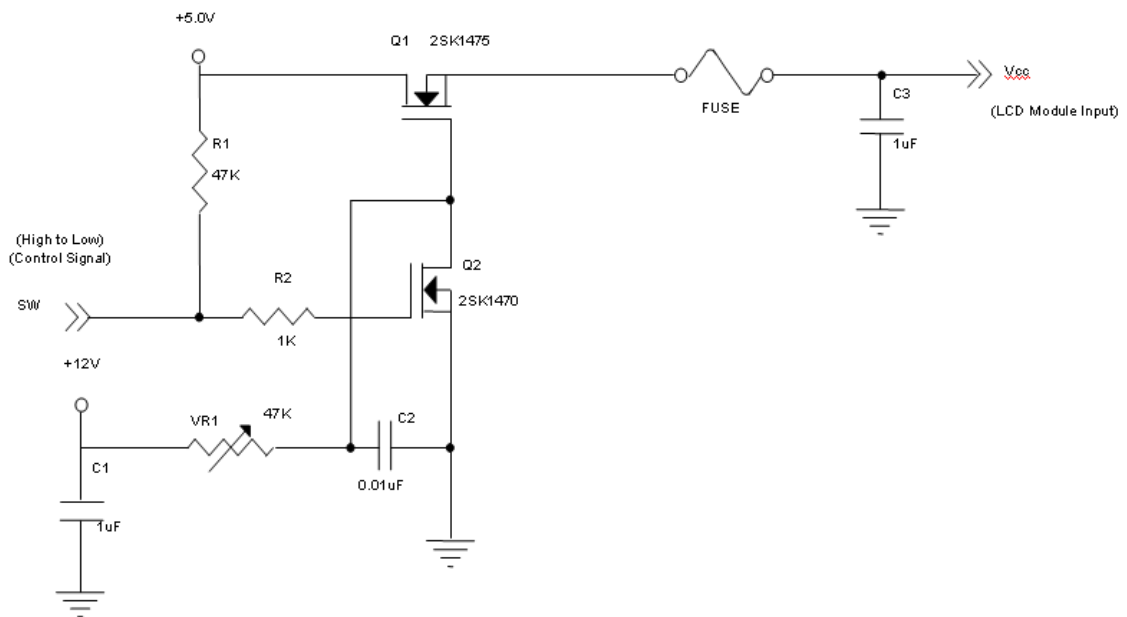
4.3 ELECTRICAL CHARACTERISTICS

4.3.1 LCD ELETRONICS SPECIFICATION

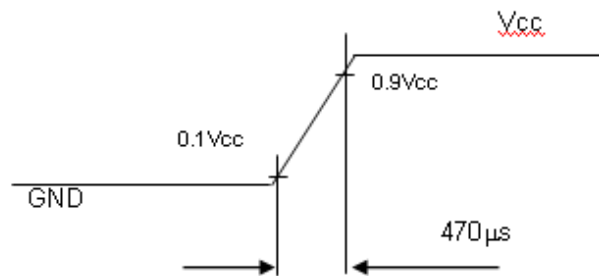
Parameter	Symbol	Value			Unit	Note
		Min.	Typ.	Max.		
Power Supply Voltage	V <sub>CC</sub>	4.5	5.0	5.5	V	-
Ripple Voltage	V <sub>RP</sub>	--	--	300	mV	-
Rush Current	I <sub>RUSH</sub>	--	--	3	A	(2)
AC off Rush Current	I <sub>off_RUSH</sub>	-	--	4	A	(5)
Power Supply Current	White	-	0.39	0.45	A	(3)a
	Black	-	1.17	1.45	A	(3)b
	Vertical Stripe	-	0.75	1.00	A	(3)c
Power Consumption	PLCD	-	5.85	7.97	Watt	(4)
LVDS differential input voltage	V <sub>id</sub>	100	-	600	mV	
LVDS common input voltage	V <sub>ic</sub>	0.05	--	2.35	V	

Note (1) The ambient temperature is Ta = 25 ± 2 °C.

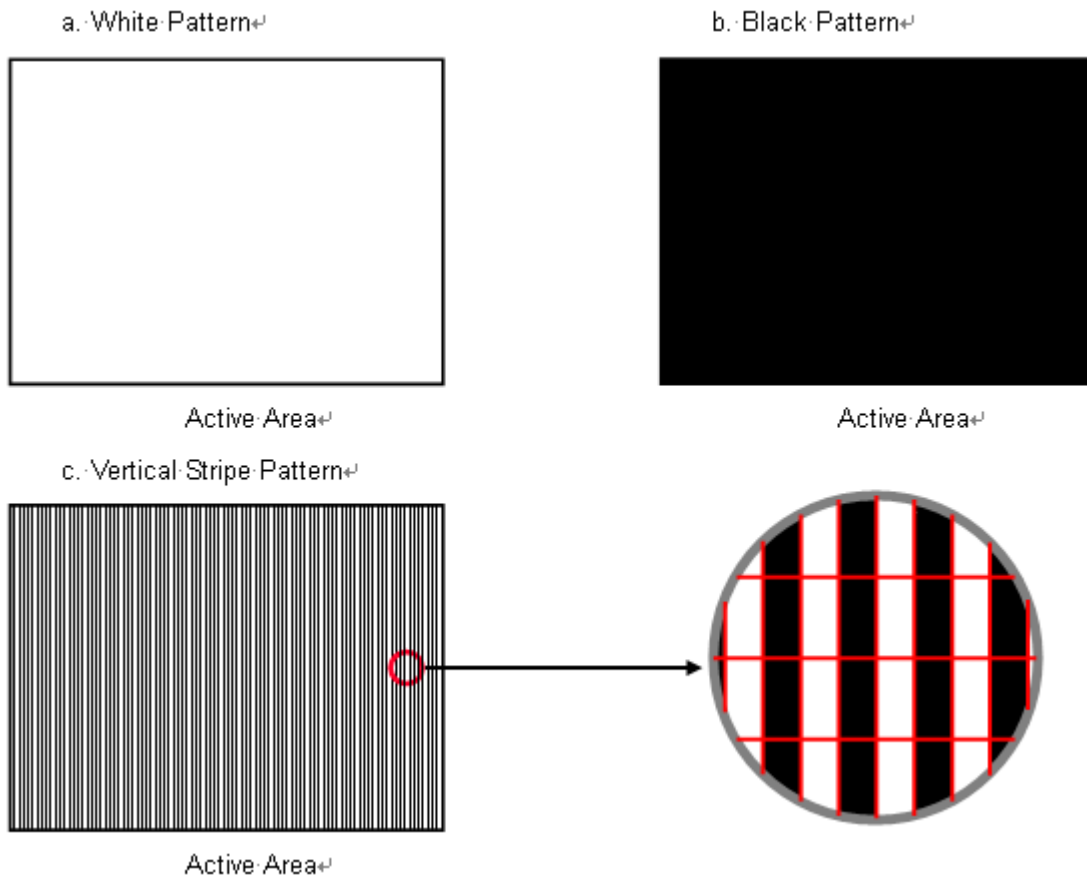
Note (2) Measurement Conditions:



**Vcc rising time is 470µs**



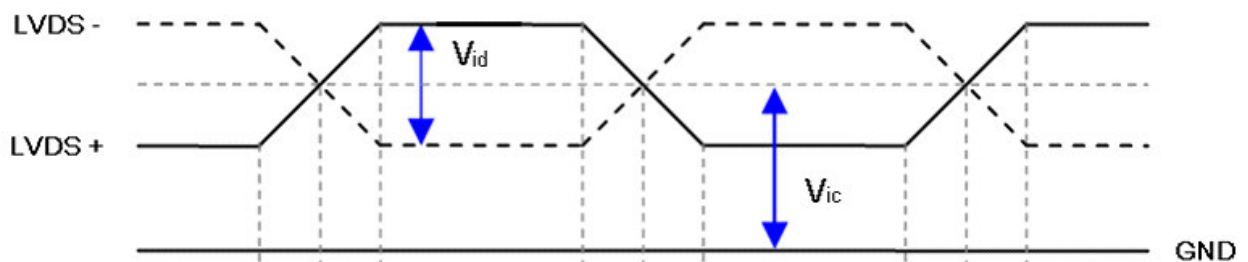
Note (3) The specified power supply current is under the conditions at  $V_{cc} = 5.0\text{ V}$ ,  $T_a = 25 \pm 2\text{ }^\circ\text{C}$ ,  $F_r = 60\text{ Hz}$ , whereas a power dissipation check pattern below is displayed.



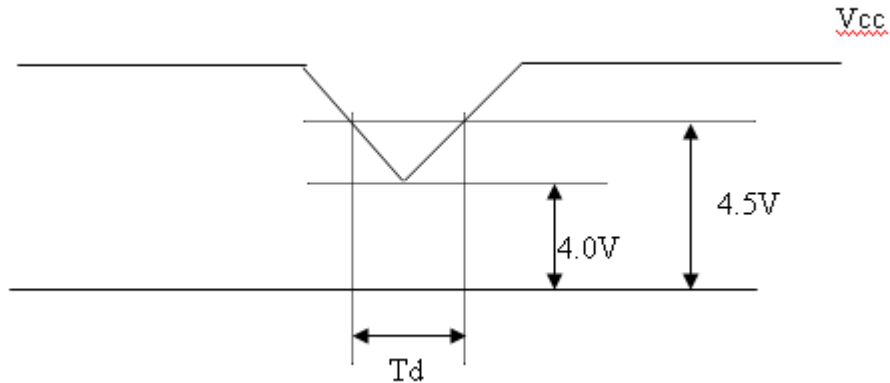
Note (4) The power consumption is specified at the black pattern with the maximum current.

Note (5) The Rush current would be happened when system doesn't follow Power sequence in AC off status

Note (6) VID waveform condition



### 4.3.2 Vcc Power Dip Condition



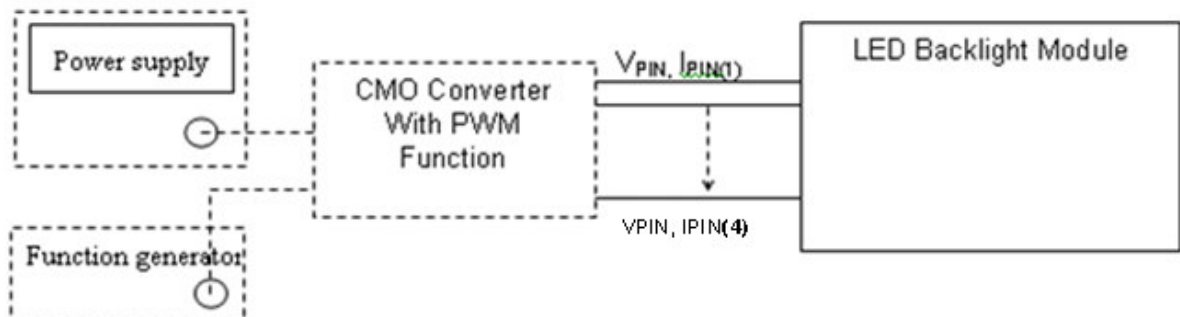
### 4.3.3 BACKLIGHT UNIT

Parameter	Symbol	Value			Unit	Note
		Min.	Typ.	Max.		
LED Light Bar Input Voltage Per Input Pin	VPIN	--	34.1	37.4	V	(1), Duty=100%, IPIN=(65mA)
LED Light Bar Current Per Input Pin	IPIN	--	65	69	mA	(1), (2) Duty=100%
LED Life Time	LLED	40000	--	--	Hrs	(3)
Power Consumption	PBL	--	8.87	10.32	W	(1) Duty=100%, IPIN=(65mA)

Note (1) LED light bar input voltage and current are measured by utilizing a true RMS multimeter as shown below:

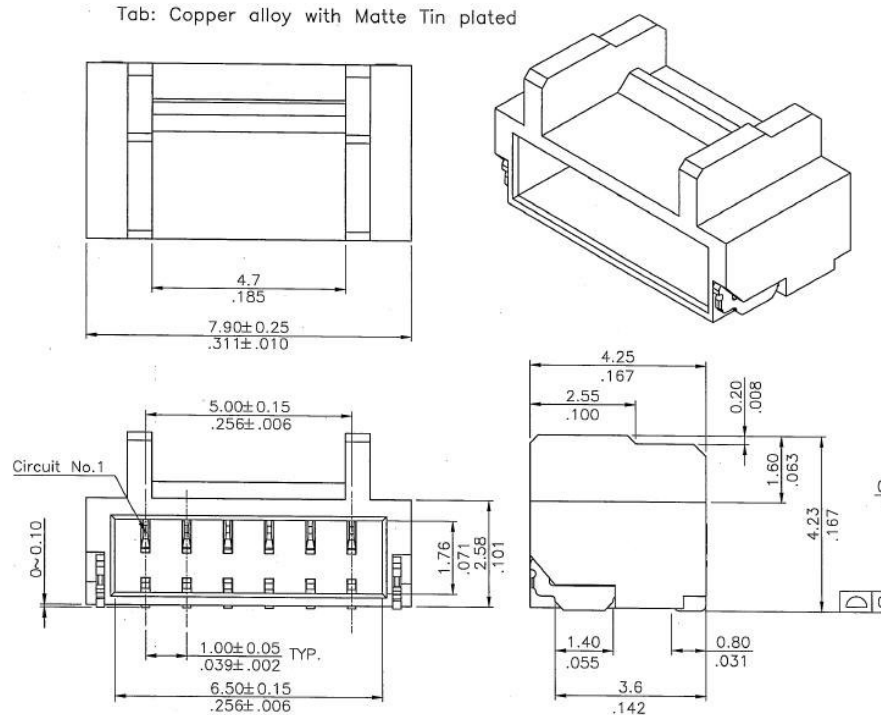
Note (2)  $PBL = IPIN \times VPIN \times (4)$  input pins ,

Note (3) The lifetime of LED is defined as the time when LED packages continue to operate under the conditions at  $T_a = 25 \pm 2 \text{ }^\circ\text{C}$  and  $I = (65)\text{mA}$  (per chip) until the brightness becomes  $\leq 50\%$  of its original value.



### 4.3.4 LIGHTBAR Connector Pin Assignment

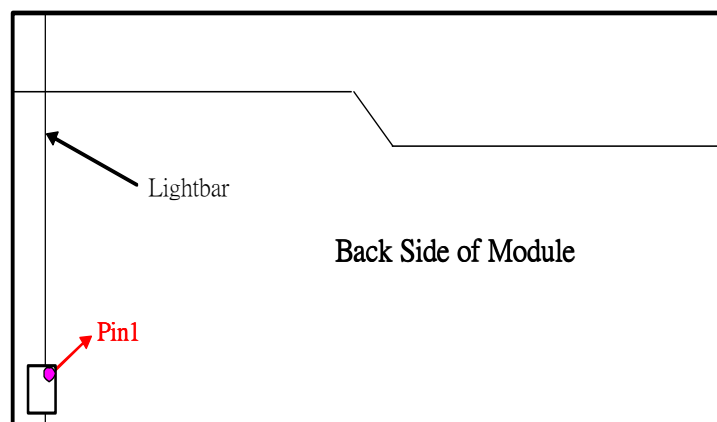
- (1).Connector: C11406M1HRF-NH(CviLux) or compatible.
- (2) LB Connector drawing:



CN1

Pin number	Description
1	Cathode of LED string
2	Cathode of LED string
3	VLED
4	VLED
5	Cathode of LED string
6	Cathode of LED string

Note (1) User's Mating Connector Part No.: C11406SL000-NH (CviLux) or Compatible.



#### 4.4 LVDS INPUT SIGNAL SPECIFICATIONS

##### 4.4.1 LVDS DATA MAPPING TABLE

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
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

**4.4.2 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	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	0	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	0	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	0	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	0	0	0	0	0	0	0	0	0
	White	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
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	
	Red(1)	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	
	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	
	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	
	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	
	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	
	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	
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	
	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	
	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	
	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮		
	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮		
	Green(253)	0	0	0	0	0	0	0	0	1	1	1	1	1	1	0	1	0	0	0	0	0	0	0	
	Green(254)	0	0	0	0	0	0	0	0	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	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	
	Blue(1)	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	1	0	
	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮		
	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮		
	Blue(253)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	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	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	

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

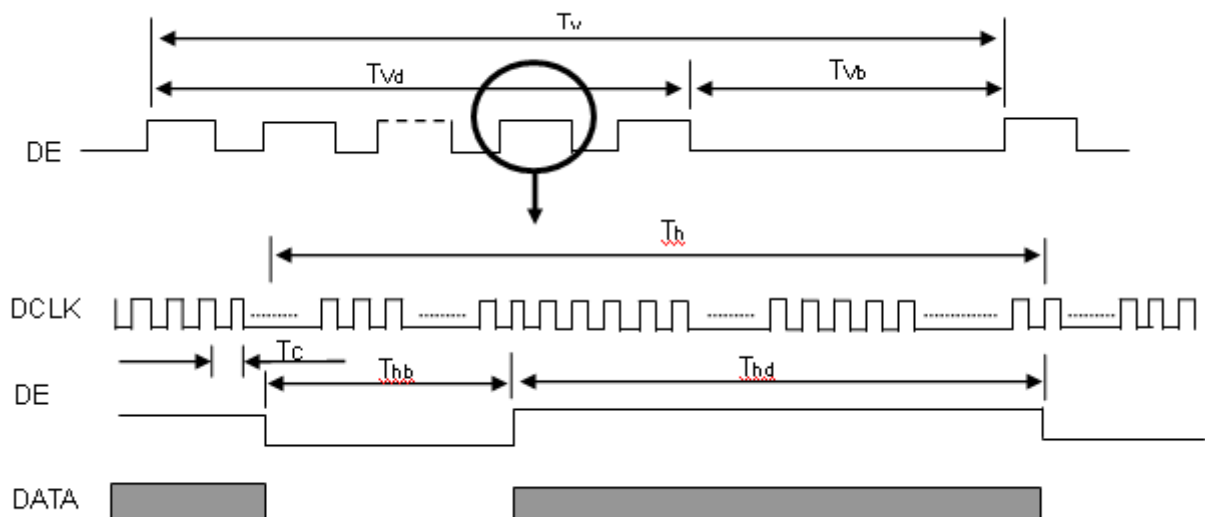
#### 4.5 DISPLAY TIMING SPECIFICATIONS

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

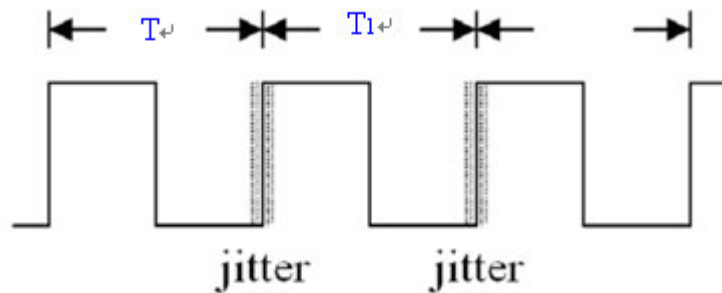
Signal	Item	Symbol	Min.	Typ.	Max.	Unit	Note
LVDS Clock	Frequency	F <sub>c</sub>	58.54	74.25	97.98	MHz	-
	Period	T <sub>c</sub>	-	13.47	-	ns	
	Input cycle to cycle jitter	T <sub>rcl</sub>	-	-	200	ns	(1)
	Input Clock to data skew	TLVCCS			400	ps	(2)
	Spread spectrum modulation range	F <sub>clk_in_mod</sub>	F <sub>c</sub> *98%		F <sub>c</sub> *102%	MHz	(3)
	Spread spectrum modulation frequency	F <sub>SSM</sub>			200	KHz	
Vertical Display Term	Frame Rate	Fr	50	60	75	Hz	-
	Total	T <sub>v</sub>	1115	1125	1136	Th	T <sub>v</sub> =T <sub>vd</sub> +T <sub>vb</sub>
	Active Display	T <sub>vd</sub>	1080	1080	1080	Th	-
	Blank	T <sub>vb</sub>	T <sub>v</sub> -T <sub>vd</sub>	45	T <sub>v</sub> -T <sub>vd</sub>	Th	-
Horizontal Display Term	Total	T <sub>h</sub>	1050	1100	1150	T <sub>c</sub>	T <sub>h</sub> =T <sub>hd</sub> +T <sub>hb</sub>
	Active Display	T <sub>hd</sub>	960	960	960	T <sub>c</sub>	-
	Blank	T <sub>hb</sub>	T <sub>h</sub> -T <sub>hd</sub>	140	T <sub>h</sub> -T <sub>hd</sub>	T <sub>c</sub>	-

Note: Because this module is operated by DE only mode, Hsync and Vsync input signals are ignored.

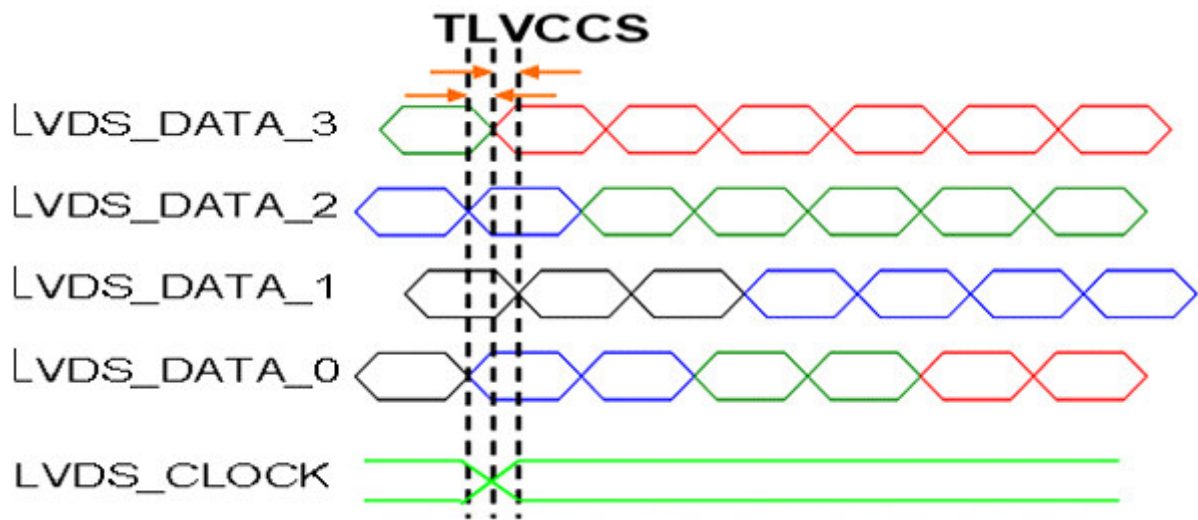
#### INPUT SIGNAL TIMING DIAGRAM



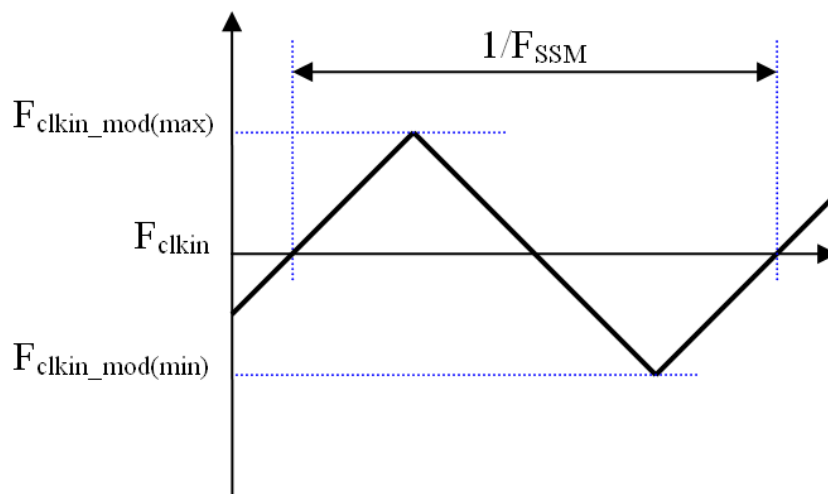
Note (1) The input clock cycle-to-cycle jitter is defined as below figures.  $Trcl = |T_1 - T_1'|$



Note (2) Input Clock to data skew is defined as below figures.



Note (3) The SSCG (Spread spectrum clock generator) is defined as below figures.

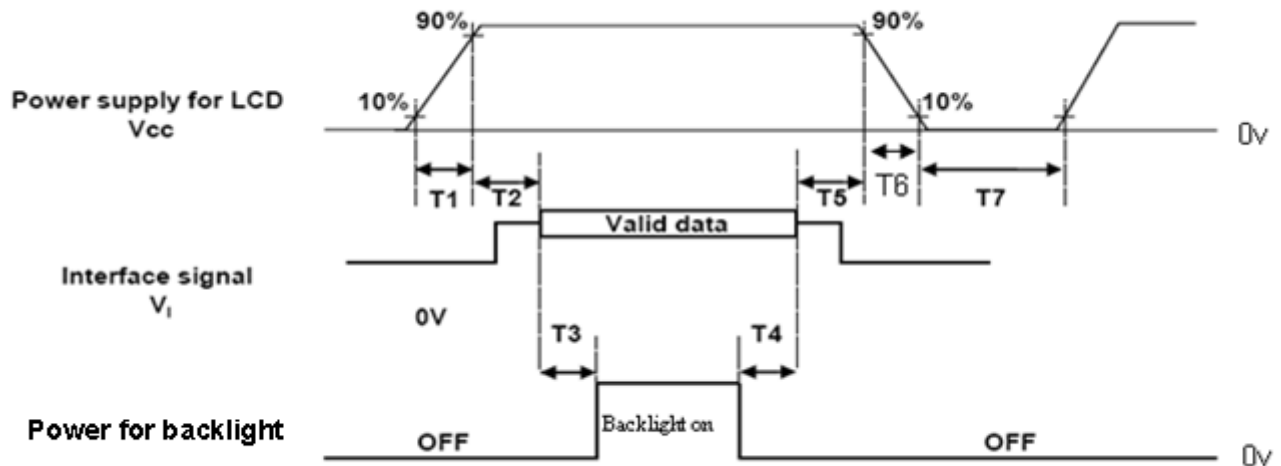


Note (4) The DCLK range at last line of V-blanking should be set in 0 to  $H_{display}/2$



4.6 POWER ON/OFF SEQUENCE

The power sequence specifications are shown as the following table and diagram.



Timing Specifications:

Parameters	Values			Units
	Min	Typ.	Max	
T1	0.5	-	10	ms
T2	0	-	50	ms
T3	450	-	-	ms
T4	90	-	-	ms
T5	0	-	50	ms
T6	5	-	150	ms
T7	500	-	-	ms

Note (1) The supply voltage of the external system for the module input should be the same as the definition of Vcc.

Note (2) When the backlight turns on before the LCD operation of the LCD turns off, the display may momentarily become abnormal screen.

Note (3) In case of VCC = off level, please keep the level of input signals on the low or keep a high impedance.

Note (4) T4 should be measured after the module has been fully discharged between power off and on period.

Note (5) Interface signal shall not be kept at high impedance when the power is on.

Note (6) CMI won't take any responsibility for the products which are damaged by the customers not following the Power Sequence.

Note (7) There might be slight electronic noise when LCD is turned off (even backlight unit is also off). To avoid this symptom, we suggest "Vcc falling timing" to follow "t6 spec".

## 5. OPTICAL CHARACTERISTICS

### 5.1 TEST CONDITIONS

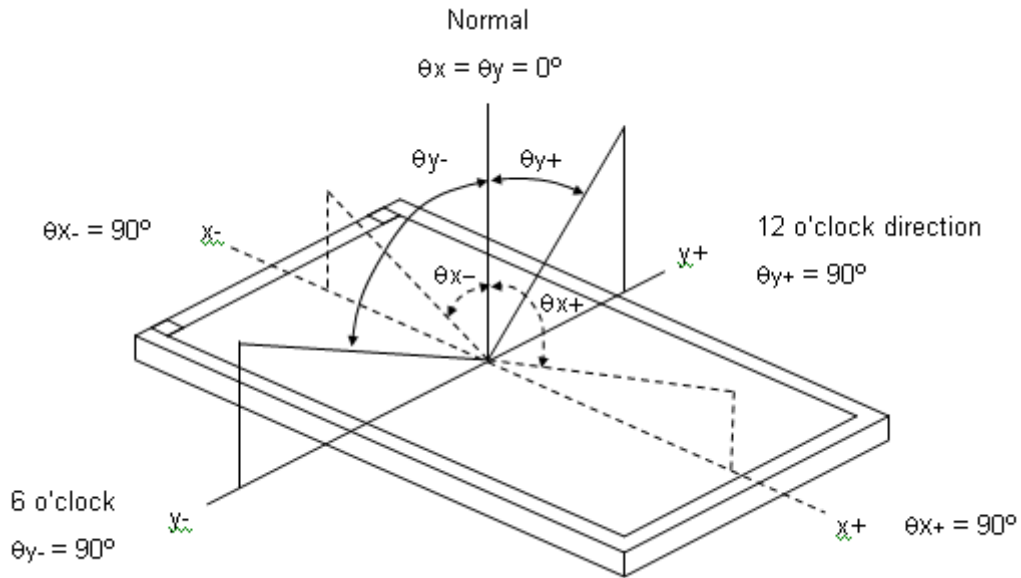
Item	Symbol	Value	Unit
Ambient Temperature	Ta	25±2	°C
Ambient Humidity	Ha	50±10	%RH
Supply Voltage	VCC	5	V
Input Signal	According to typical value in "3. ELECTRICAL CHARACTERISTICS"		
LED Light Bar Input Current Per Input Pin	IPIN	65 ± 1.95	mADC
PWM Duty Ratio	D	100	%
LED Light Bar Test Converter	Test OZ9998-8 Strings T4-8		

### 5.2 OPTICAL SPECIFICATIONS

The relative measurement methods of optical characteristics are shown in 5.2. The following items should be measured under the test conditions described in 5.1 and stable environment shown in Note (5).

Item	Symbol	Condition	Min.	Typ.	Max.	Unit	Note					
Color Chromaticity (CIE 1931)	Red	Rx	Typ - 0.03	0.635	Typ + 0.03	-	(1), (5)					
		Ry		0.352								
	Green	Gx		0.321								
		Gy		0.633								
	Blue	Bx		0.151								
		By		0.052								
	White	Wx		0.313								
		Wy		0.329								
	Center Luminance of White (Center of Screen)	Lc		$\theta_x=0^\circ, \theta_y=0^\circ$ CS-2000 R=G=B=255 Gray scale				200	250	-	cd/m <sup>2</sup>	(4), (5)
	Contrast Ratio	CR						700	1000	-	-	(2), (5)
Response Time	T <sub>R</sub>	$\theta_x=0^\circ, \theta_y=0^\circ$	-		1.5	2.5	ms	(3)				
	T <sub>F</sub>		-	3.5	5.5							
White Variation	δW	$\theta_x=0^\circ, \theta_y=0^\circ$	75	-	-	%	(5), (6)					
Viewing Angle	Horizontal	θ <sub>x-</sub> + θ <sub>x+</sub>	CR ≥ 10	150	170	-	Deg.	(1), (5)				
	Vertical	θ <sub>y-</sub> + θ <sub>y+</sub>		140	160							
Viewing Angle	Horizontal	θ <sub>x-</sub> + θ <sub>x+</sub>	CR ≥ 5	160	178	---	Deg.	(1), (5)				
	Vertical	θ <sub>y-</sub> + θ <sub>y+</sub>		150	170							

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.

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

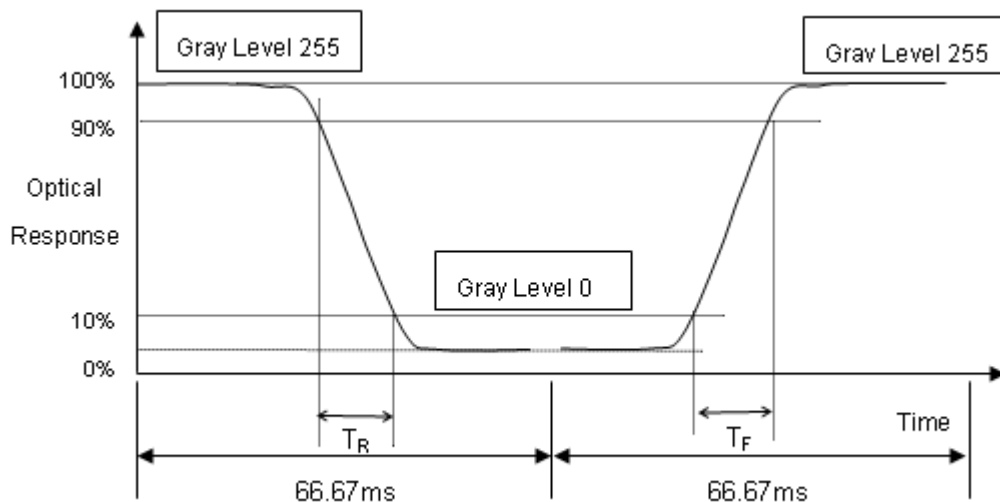
L255: Luminance of gray level 255

L 0: Luminance of gray level 0

$$\text{CR} = \text{CR} (5)$$

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

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



Note (4) Definition of Luminance of White ( $L_c$ ):

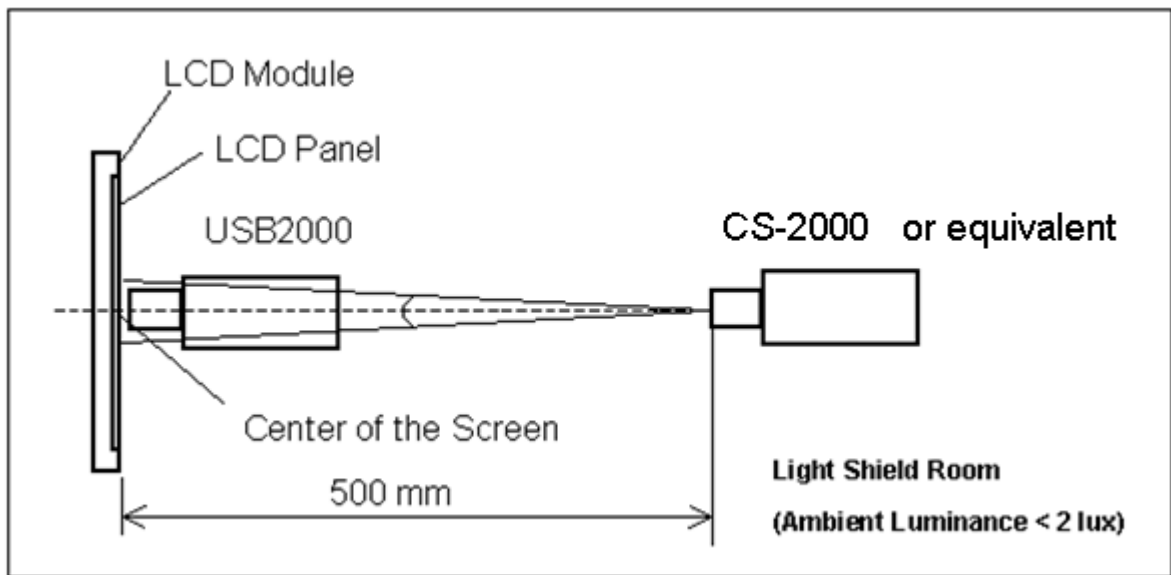
Measure the luminance of gray level 255 at center point

$$L_c = L(5)$$

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

Note (5) Measurement Setup:

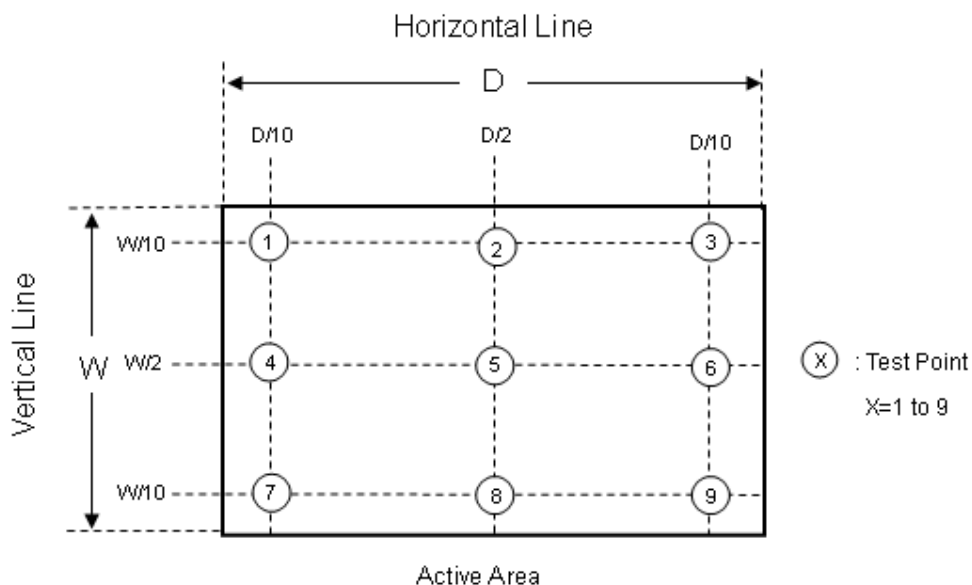
The LCD module should be stabilized at given temperature for 40 minutes to avoid abrupt temperature change during measuring. In order to stabilize the luminance, the measurement should be executed after lighting Backlight for 40 minutes in a windless room.



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

Measure the luminance of gray level 255 at 9 points

$$\delta W = ( \text{Minimum } [L(1) \sim L(9)] / \text{Maximum } [L(1) \sim L(9)] ) * 100\%$$



6. RELIABILITY TEST ITEM

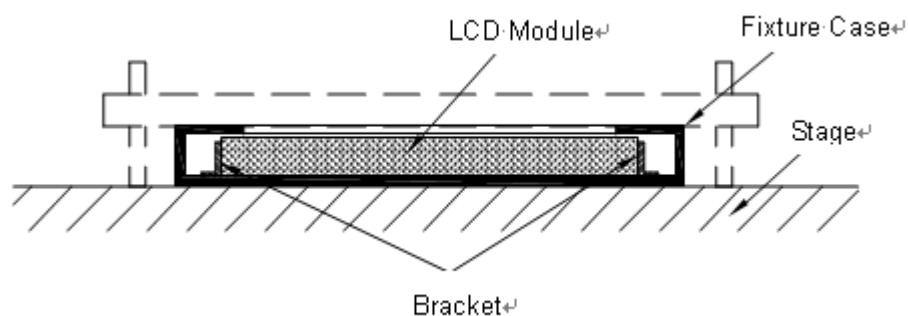
Items	Required Condition	Note
Temperature Humidity Bias (THB)	Ta= 50°C , 80%RH, 240hours	-
High Temperature Operation (HTO)	Ta= 50°C , 50%RH , 240hours	-
Low Temperature Operation (LTO)	Ta= 0°C , 240hours	-
High Temperature Storage (HTS)	Ta= 60°C , 240hours	-
Low Temperature Storage (LTS)	Ta= -20°C , 240hours	-
Vibration Test (Non-operation)	Acceleration: 1.5 Grms Wave: Half-sine Frequency: 10 - 300 Hz Sweep: 30 Minutes each Axis (X, Y, Z)	-
Shock Test (Non-operation)	Acceleration: 50 G Wave: Half-sine Active Time: 11 ms Direction : ± X, ± Y, ± Z.(one time for each Axis)	-
Thermal Shock Test (TST)	-20°C/30min , 60°C / 30min , 100 cycles	-
On/Off Test	25°C ,On/10sec , Off /10sec , 30,000 cycles	-
ESD (Electro Static Discharge)	Contact Discharge: ± 8KV, 150pF(330Ω)	-
	Air Discharge: ± 15KV, 150pF(330Ω)	-
Altitude Test	Operation:10,000 ft / 24hours	-
	Non-Operation:30,000 ft / 24hours	-

Note (1) criteria : Normal display image with no obvious non-uniformity and no line defect.

Note (2) Evaluation should be tested after storage at room temperature for more than two hours.

Note (3) 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:



## 7. PACKING

### 7.1 PACKING SPECIFICATIONS

- (1) 13 LCD modules / 1 Box
- (2) Box dimensions: 567(L) X 301(W) X 376(H) mm
- (3) Weight: approximately: 27.525kg (13 modules per box)

### 7.2 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: 5 – 200 Hz Top & Bottom: 15 minutes (+Z), 15 min (-Z), Right & Left: 10 minutes (X) Back & Forth 10 minutes (Y)	PASS
Dropping Test	1 Corner , 3 Edge, 6 Face, 46cm	PASS

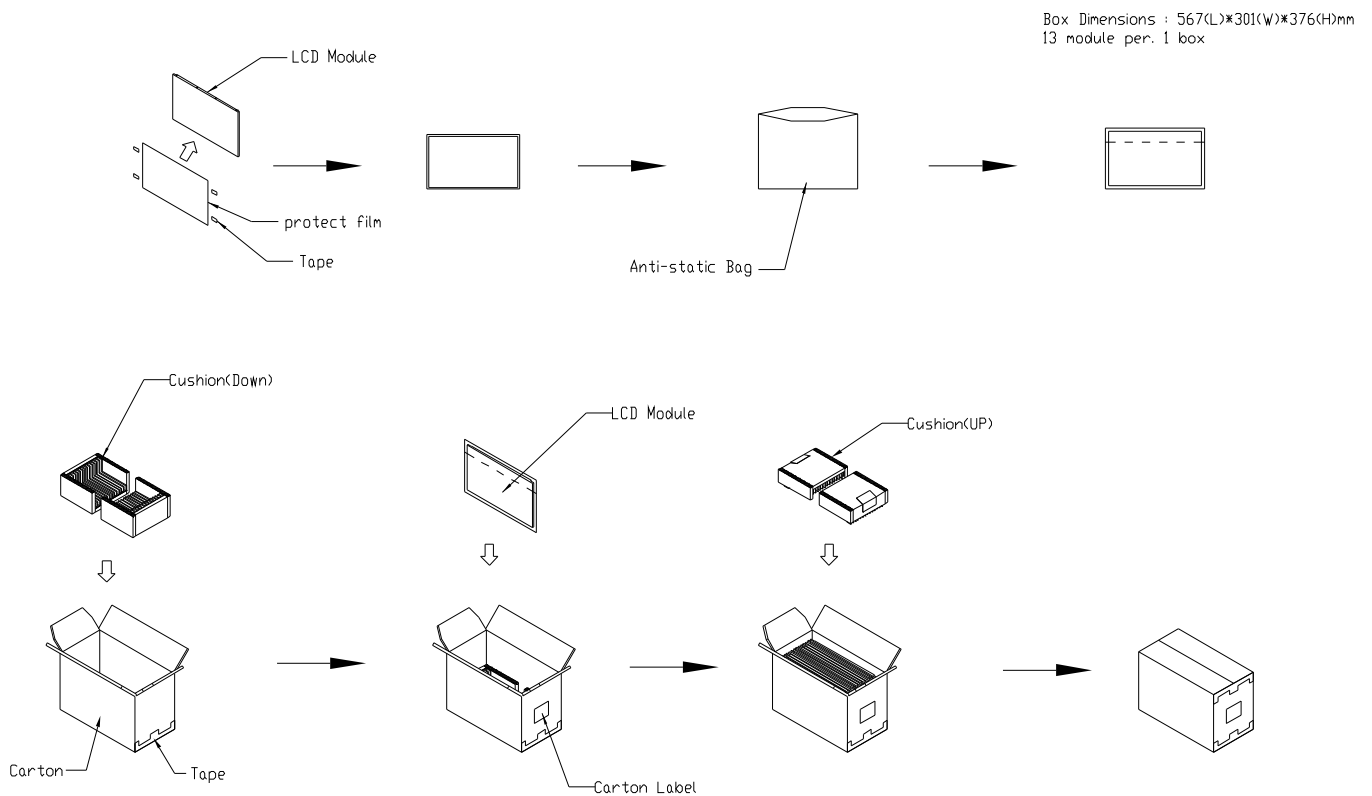


Figure. 7-1 Packing method

7.3 PALLET

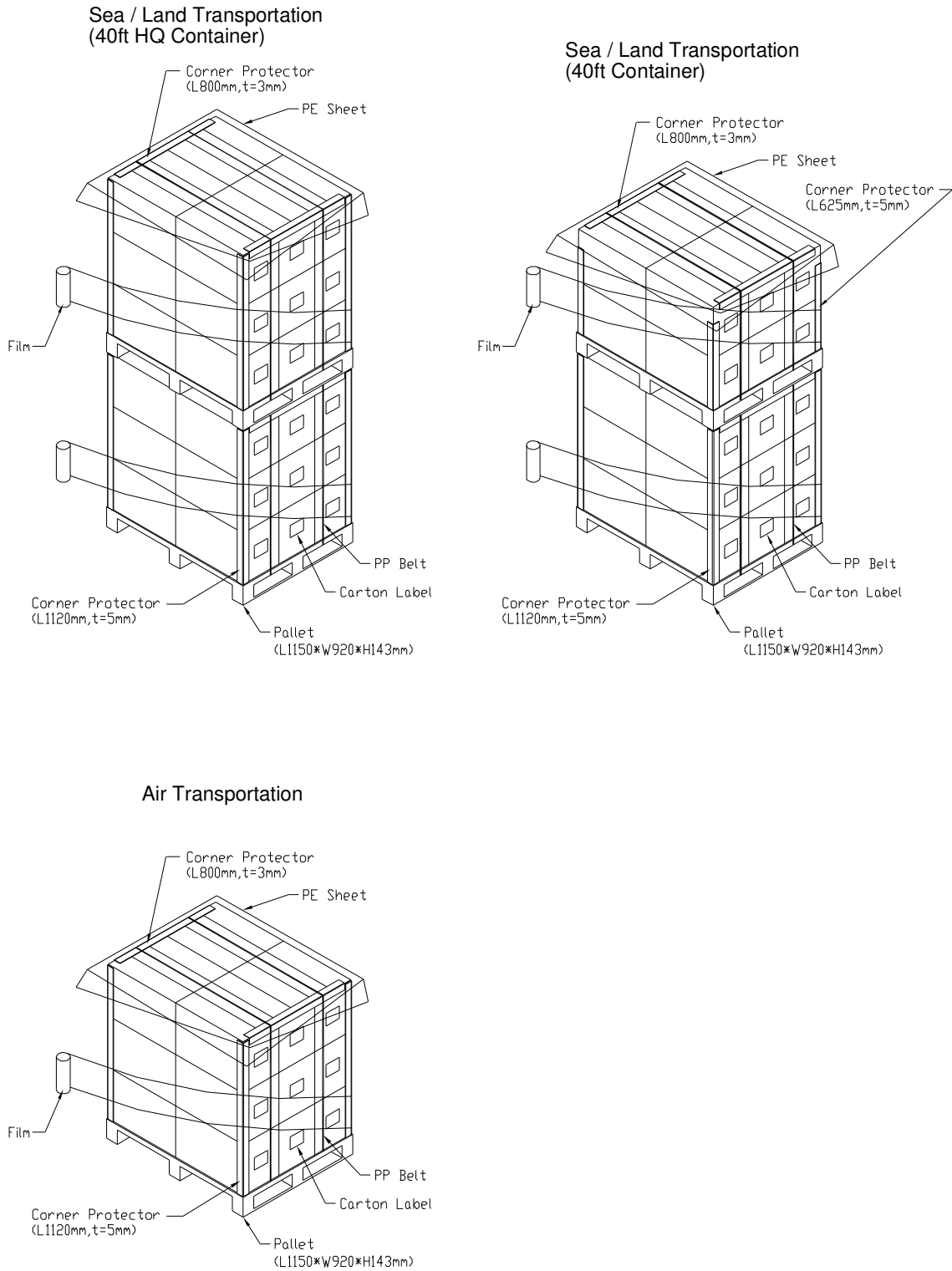


Figure. 7-2 Packing method

## 8. CMI MODULE LABEL

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



(a) Model Name: M215HGE-L21

(b) Revision: Rev. XX, for example: A0, A1... B1, B2... or C1, C2...etc.

(c) CMI barcode definition:

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

Code	Meaning	Description
XX	CMI internal use	-
XX	Revision	Cover all the change
X	CMI internal use	-
XX	CMI internal use	-
YMD	Year, month, day	Year: 0~9, 2001=1, 2002=2, 2003=3...2010=0, 2011=1, 2012=2... 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- L5E21-X-X-X-XX-L-XX-L-YMD-NNNN

Code	Meaning	Description
CM	Supplier code	CMI=CM
L5E21	Model number	M215HGE-L21= L5E21
X	Revision code	Non ZBD: 1,2,~,8,9 / 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, ILITEK=Q, Fiti=Y
X	Gate driver IC code	
XX	Cell location	Tainan Taiwan=TN, Ningbo China=CN, Hsinchu Taiwan=SC
L	Cell line #	1,2,~,9,A,B,~,Y,Z
XX	Module location	Tainan, Taiwan=TN ; Ningbo China=NP, Shenzhen China=SH
L	Module line #	1,2,~,9,A,B,~,Y,Z
YMD	Year, month, day	Year: 0~9, 2001=1, 2002=2, 2003=3...2010=0, 2011=1, 2012=2... 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



(e) FAB ID(UL Factory ID):

Region	Factory ID
TWCMI	GEMN
NBCMI	LEOO
NBCME	CANO
NHCM1	CAPG

## 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) 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.

### 9.2 STORAGE PRECAUTIONS

- (1) Do not leave the module in high temperature, and high humidity for a long time. It is highly recommended to store the module with temperature from 0°C to 35°C and relative humidity of less than 70%
- (2) Do not store the TFT – LCD module in direct sunlight
- (3) The module should be stored in dark place. It is prohibited to apply sunlight or fluorescent light in storing

### 9.3 OPERATION PRECAUTIONS

- (1) The LCD product should be operated under normal condition.  
Normal condition is defined as below :  
Temperature : 20±15°C  
Humidity: 65±20%  
Display pattern : continually changing pattern(Not stationary)

- (2) If the product will be used in extreme conditions such as high temperature, high humidity, high altitude, display pattern or operation time etc... It is strongly recommended to contact CMI for application engineering advice. Otherwise, its reliability and function may not be guaranteed.

#### **9.4 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.

#### **9.5 SAFETY STANDARDS**

The LCD module should be certified with safety regulations as follows:

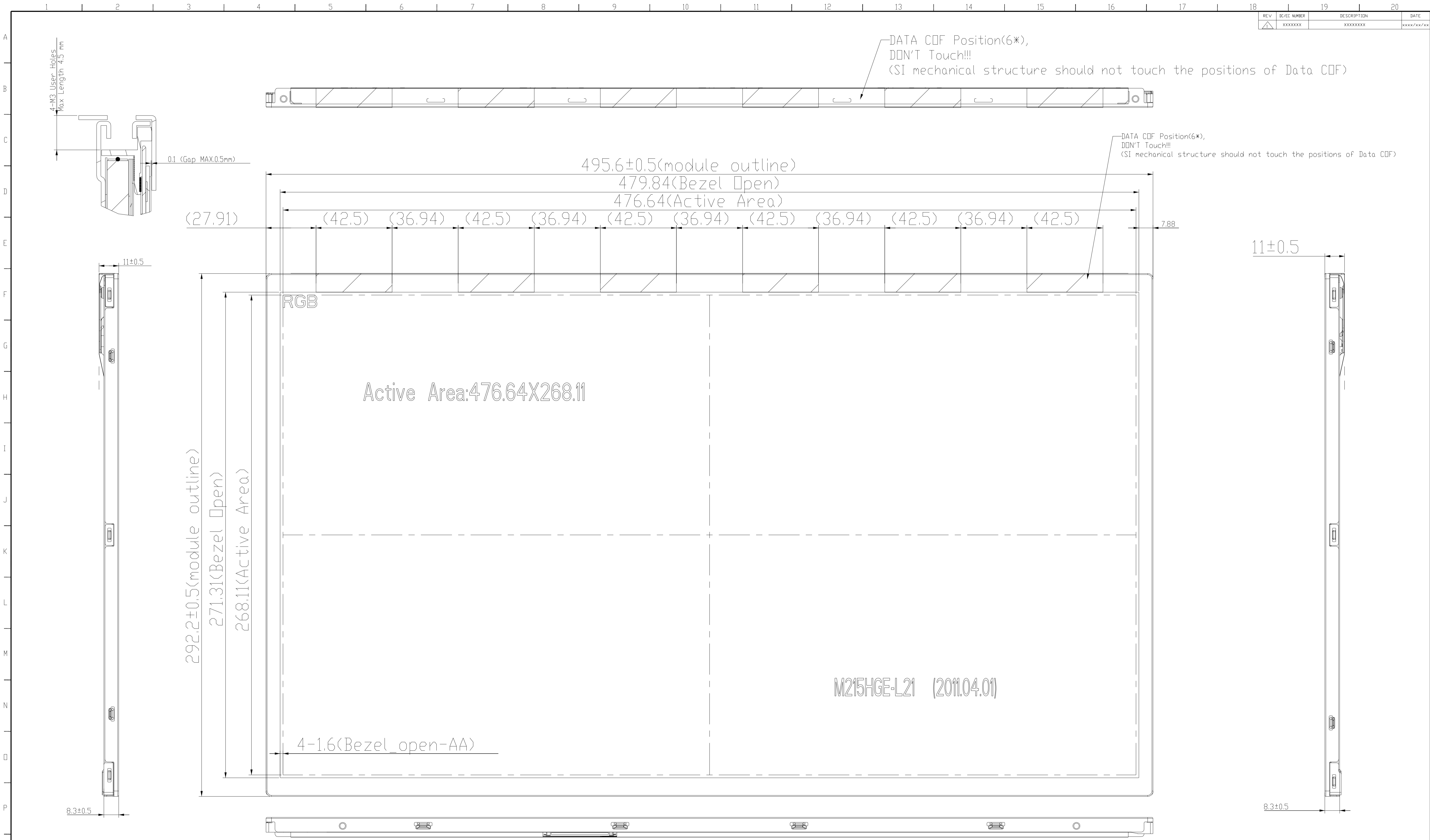
- (1) UL60950-1 or updated standard.
- (2) IEC60950-1 or updated standard.

#### **9.6 OTHER**

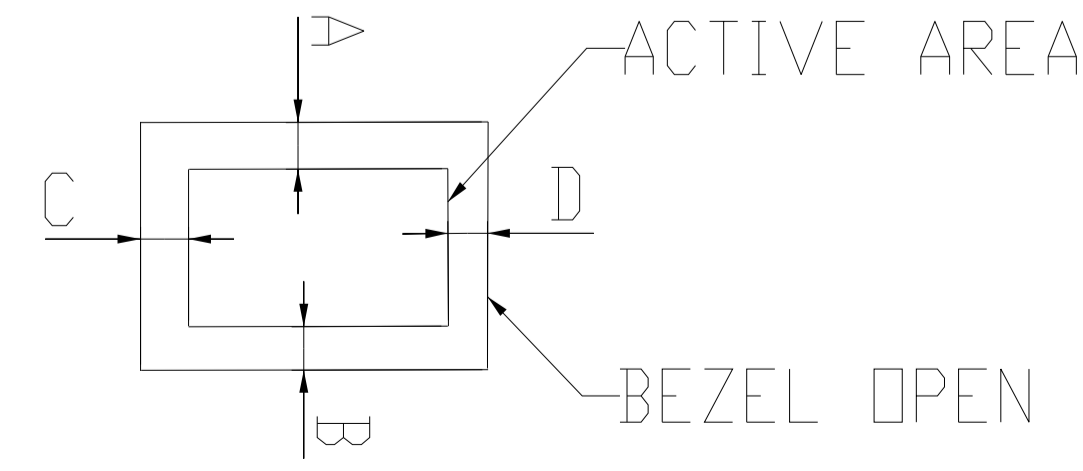
When fixed patterns are displayed for a long time, remnant image is likely to occur.

### **Appendix. OUTLINE DRAWING**

REV	DE/EC NUMBER	DESCRIPTION	DATE
△	xxxxxxx	xxxxxxxx	xxxx/xx/xx

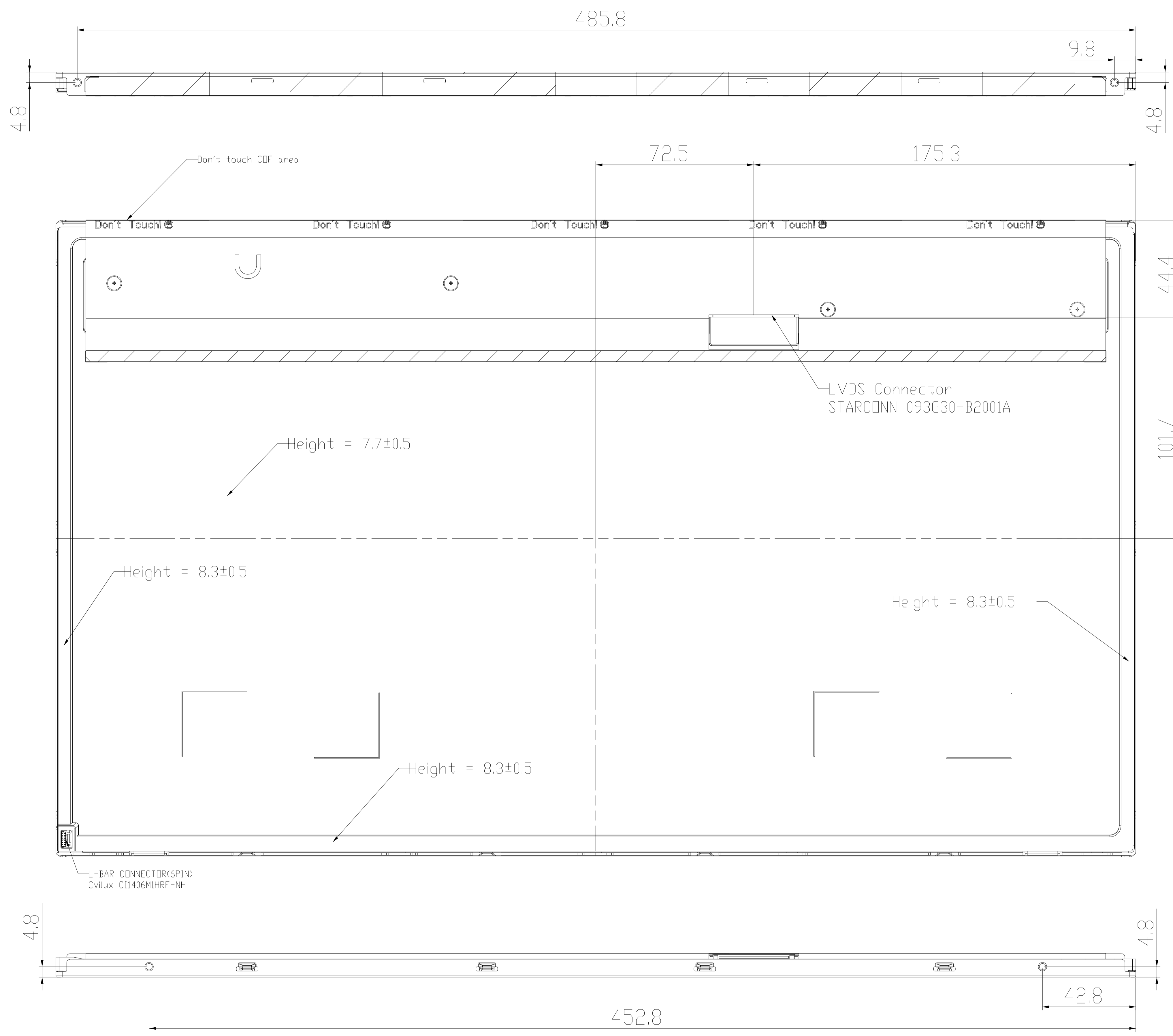


NOTE:  
 1.THE DIMENSION EXCLUDES DEFORMATION  
 2.TOLERANCE WITHOUT NOTICED TO BE ±0.5MM  
 3.TORQUE OF M3 USER HOLE SHOULD BE WITHIN 5 kgf-cm  
 AND JUST RESCREW 10 TIMES  
 4. Display area position tolerance : |A-BK|= 1 & |C-DK|=1



LEVEL	GENERAL LINEAR TOLERANCE	SELECT LEVEL	APPROVED	DATE	SCALE	3rd ANGLE	MODEL NAME
0 - 4	0.05	02	Jack Chen	2011.04.01	1		M215HGE-L21
4 - 14	0.1	02					
14 - 43	0.15	04					
43 - 250	0.2	04					
250 - 630	0.3	04					
630 - 4000	0.5	04					
LEVEL	GENERAL ANGULAR TOLERANCE	SELECT LEVEL	CHECKED	DATE	DESCRIPTION	DRAWING REV	PART NUMBER
0 - 4	0.5	02	Anor Lo	2011.04.01	Lcm_assy_M215HGE-L21	A	
4 - 14	0.5	02					
14 - 43	0.5	04					
43 - 250	0.5	04					
250 - 630	0.5	04					
630 - 4000	0.5	04					
LEVEL	GENERAL ANGULAR TOLERANCE	SELECT LEVEL	DESIGNED	DATE	DESCRIPTION	DRAWING REV	PART NUMBER
0 - 4	0.5	02	Tiffany Chen	2011.04.01		A1	
4 - 14	0.5	02					
14 - 43	0.5	04					
43 - 250	0.5	04					
250 - 630	0.5	04					
630 - 4000	0.5	04					

REV	DE/EC NUMBER	DESCRIPTION	DATE
△	XXXXXX	XXXXXXXX	XXXX/XX/XX



LEVEL	GENERAL LINEAR TOLERANCE	SELECT LEVEL	APPROVED	DATE	SCALE	3rd ANGLE	MODEL NAME
0 - 4	0.10	01	Jack Chen	2011.04.01	1		M215HGGE-L21
4 - 14	0.15	02					
14 - 63	0.2	03					
63 - 250	0.3	04					
250 - 630	0.5	05					
630 - 1600	0.8	06					
1600 - 4000	1.2	07					
4000 - 10000	2.0	08					
10000 - 25000	3.0	09					
25000 - 63000	5.0	10					
63000 - 160000	8.0	11					
160000 - 400000	12.0	12					
400000 - 1000000	20.0	13					
1000000 - 2500000	30.0	14					
2500000 - 6300000	50.0	15					
6300000 - 16000000	80.0	16					
16000000 - 40000000	120.0	17					
40000000 - 100000000	200.0	18					
100000000 - 250000000	300.0	19					
250000000 - 630000000	500.0	20					
630000000 - 1600000000	800.0	21					
1600000000 - 4000000000	1200.0	22					
4000000000 - 10000000000	2000.0	23					
10000000000 - 25000000000	3000.0	24					
25000000000 - 63000000000	5000.0	25					
63000000000 - 160000000000	8000.0	26					
160000000000 - 400000000000	12000.0	27					
400000000000 - 1000000000000	20000.0	28					
1000000000000 - 2500000000000	30000.0	29					
2500000000000 - 6300000000000	50000.0	30					
6300000000000 - 16000000000000	80000.0	31					
16000000000000 - 40000000000000	120000.0	32					
40000000000000 - 100000000000000	200000.0	33					
100000000000000 - 250000000000000	300000.0	34					
250000000000000 - 630000000000000	500000.0	35					
630000000000000 - 1600000000000000	800000.0	36					
1600000000000000 - 4000000000000000	1200000.0	37					
4000000000000000 - 10000000000000000	2000000.0	38					
10000000000000000 - 25000000000000000	3000000.0	39					
25000000000000000 - 63000000000000000	5000000.0	40					
63000000000000000 - 160000000000000000	8000000.0	41					
160000000000000000 - 400000000000000000	12000000.0	42					
400000000000000000 - 1000000000000000000	20000000.0	43					
1000000000000000000 - 2500000000000000000	30000000.0	44					
2500000000000000000 - 6300000000000000000	50000000.0	45					
6300000000000000000 - 16000000000000000000	80000000.0	46					
16000000000000000000 - 40000000000000000000	120000000.0	47					
40000000000000000000 - 100000000000000000000	200000000.0	48					
100000000000000000000 - 250000000000000000000	300000000.0	49					
250000000000000000000 - 630000000000000000000	500000000.0	50					
630000000000000000000 - 1600000000000000000000	800000000.0	51					
1600000000000000000000 - 4000000000000000000000	1200000000.0	52					
4000000000000000000000 - 10000000000000000000000	2000000000.0	53					
10000000000000000000000 - 25000000000000000000000	3000000000.0	54					
25000000000000000000000 - 63000000000000000000000	5000000000.0	55					
63000000000000000000000 - 160000000000000000000000	8000000000.0	56					
160000000000000000000000 - 400000000000000000000000	12000000000.0	57					
400000000000000000000000 - 1000000000000000000000000	20000000000.0	58					
1000000000000000000000000 - 2500000000000000000000000	30000000000.0	59					
2500000000000000000000000 - 6300000000000000000000000	50000000000.0	60					
6300000000000000000000000 - 16000000000000000000000000	80000000000.0	61					
16000000000000000000000000 - 40000000000000000000000000	120000000000.0	62					
40000000000000000000000000 - 100000000000000000000000000	200000000000.0	63					
100000000000000000000000000 - 250000000000000000000000000	300000000000.0	64					
250000000000000000000000000 - 630000000000000000000000000	500000000000.0	65					
630000000000000000000000000 - 1600000000000000000000000000	800000000000.0	66					
1600000000000000000000000000 - 4000000000000000000000000000	1200000000000.0	67					
4000000000000000000000000000 - 10000000000000000000000000000	2000000000000.0	68					
10000000000000000000000000000 - 25000000000000000000000000000	3000000000000.0	69					
25000000000000000000000000000 - 63000000000000000000000000000	5000000000000.0	70					
63000000000000000000000000000 - 160000000000000000000000000000	8000000000000.0	71					
160000000000000000000000000000 - 400000000000000000000000000000	12000000000000.0	72					
400000000000000000000000000000 - 1000000000000000000000000000000	20000000000000.0	73					
1000000000000000000000000000000 - 2500000000000000000000000000000	30000000000000.0	74					
2500000000000000000000000000000 - 6300000000000000000000000000000	50000000000000.0	75					
6300000000000000000000000000000 - 16000000000000000000000000000000	80000000000000.0	76					
16000000000000000000000000000000 - 40000000000000000000000000000000	120000000000000.0	77					
40000000000000000000000000000000 - 100000000000000000000000000000000	200000000000000.0	78					
100000000000000000000000000000000 - 250000000000000000000000000000000	300000000000000.0	79					
250000000000000000000000000000000 - 630000000000000000000000000000000	500000000000000.0	80					
630000000000000000000000000000000 - 1600000000000000000000000000000000	800000000000000.0	81					
1600000000000000000000000000000000 - 4000000000000000000000000000000000	1200000000000000.0	82					
4000000000000000000000000000000000 - 10000000000000000000000000000000000	2000000000000000.0	83					
10000000000000000000000000000000000 - 25000000000000000000000000000000000	3000000000000000.0	84					
25000000000000000000000000000000000 - 63000000000000000000000000000000000	5000000000000000.0	85					
63000000000000000000000000000000000 - 160000000000000000000000000000000000	8000000000000000.0	86					
160000000000000000000000000000000000 - 400000000000000000000000000000000000	12000000000000000.0	87					
400000000000000000000000000000000000 - 1000000000000000000000000000000000000	20000000000000000.0	88					
1000000000000000000000000000000000000 - 2500000000000000000000000000000000000	30000000000000000.0	89					
2500000000000000000000000000000000000 - 6300000000000000000000000000000000000	50000000000000000.0	90					
6300000000000000000000000000000000000 - 16000000000000000000000000000000000000	80000000000000000.0	91					
16000000000000000000000000000000000000 - 40000000000000000000000000000000000000	120000000000000000.0	92					
40000000000000000000000000000000000000 - 100000000000000000000000000000000000000	200000000000000000.0	93					
100000000000000000000000000000000000000 - 250000000000000000000000000000000000000	300000000000000000.0	94					
250000000000000000000000000000000000000 - 630000000000000000000000000000000000000	500000000000000000.0	95					
630000000000000000000000000000000000000 - 1600000000000000000000000000000000000000	800000000000000000.0	96					
1600000000000000000000000000000000000000 - 4000000000000000000000000000000000000000	1200000000000000000.0	97					
4000000000000000000000000000000000000000 - 100	2000000000000000000.0	98					
100 - 25000000000000000000000000000000000000000	3000000000000000000.0	99					
25000000000000000000000000000000000000000 - 63000000000000000000000000000000000000000	5000000000000000000.0	100					
63000000000000000000000000000000000000000 - 1600	8000000000000000000.0	101					
1600 - 4000	12000000000000000000.0	102					
4000 - 100	20000000000000000000.0	103					
100 - 25000	30000000000000000000.0	104					
25000 - 63000	50000000000000000000.0	105					
63000 - 1600	80000000000000000000.0	106					
1600 - 4000	12000000000						