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Doc. Number :

☐ Tentative Specification
☐ Preliminary Specification
■ Approval Specification

MODEL NO.: M238HCA
SUFFIX: LCB

Customer: Common

APPROVED BY **SIGNATURE**

Name / Title

Note
Product Version C1/C2

Please return 1 copy for your confirmation with your signature and comments.

Approved By	Checked By	Prepared By
陳立錚	張耀元	林致成

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REVISION HISTORY

Version	Date	Section	Description
3.0	2022.03.25	All	Approval Specification was first issued .

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1. GENERAL DESCRIPTION

1.1 OVERVIEW

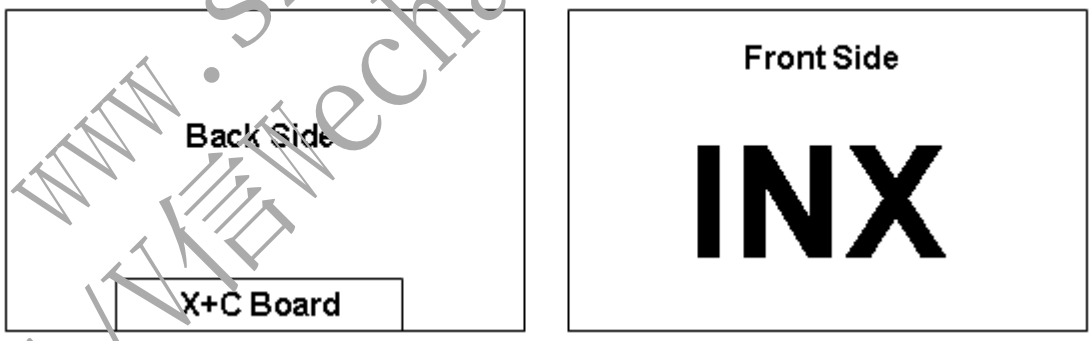
M238HCA-LCB is a 23.8” TFT Liquid Crystal Display MNT module with WLED Backlight unit and 30 pins 2ch-LVDS interface. This module supports 1920 x 1080 Full HD mode and can display up to 16.7M colors. The converter module for Backlight is not built in.

1.2 GENERAL SPECIFICATIONS

Item	Specification	Unit	Note
Screen Size	23.8” real diagonal		
Driver Element	a-si TFT active matrix	-	-
Pixel Number	1920 x R.G.B. x 1080	pixel	-
Pixel Pitch	0.2745 (H) x 0.2745 (V)	mm	-
Pixel Arrangement	RGB vertical stripe	-	-
Display Colors	16.7M(8Bit)	color	-
Transmissive Mode	AAS,Normally black	-	-
Surface Treatment	AG type, 3H hard coating, Haze 25	-	-
Luminance, White	250	Cd/m2	
Color Gamut	sRGB 99%(typ)	-	(4)
Display Orientation	INX		(2)
ROHS,Halogen Free &TCO 8.	ROHS, Halogen Free TCO 8.0 compliance	-	
RoHS	RoHS,Halogen Free		
Low Blue Light Compliance	blue-violet segment of the blue light spectrum ratio 50% (Max)		(3)
Power Consumption	Total:13.932W(Max.)@cell:4.232W(Max.), BL:9.6W(Max.)		(1)

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

Note (2)



Note (3) The ratio of display emission light in the range from 415-455 nm to the display emission of 400-500 nm shall be less than 50%.

Note(4) Based on Coverage of sRGB color space on (CIE-1931) system

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2. MECHANICAL SPECIFICATIONS

Module Size	Horizontal (H)	535 mm(Typ)
	Vertical (V)	313 mm (Typ)
	Thickness (T)	12.2 mm (Typ)
Bezel Area	Horizontal	NA
	Vertical	NA
Active Area	Horizontal	527.04 mm
	Vertical	296.46 mm
Weight		Typ: 2270g ,Max: 2380g

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	ºC	(1)
Operating Ambient Temperature	TOP	0	50	ºC	(1), (2)

Note (1)

(a) 90 %RH Max.

(b) Wet-bulb temperature should be 39 ºC Max.

(c) No condensation.

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

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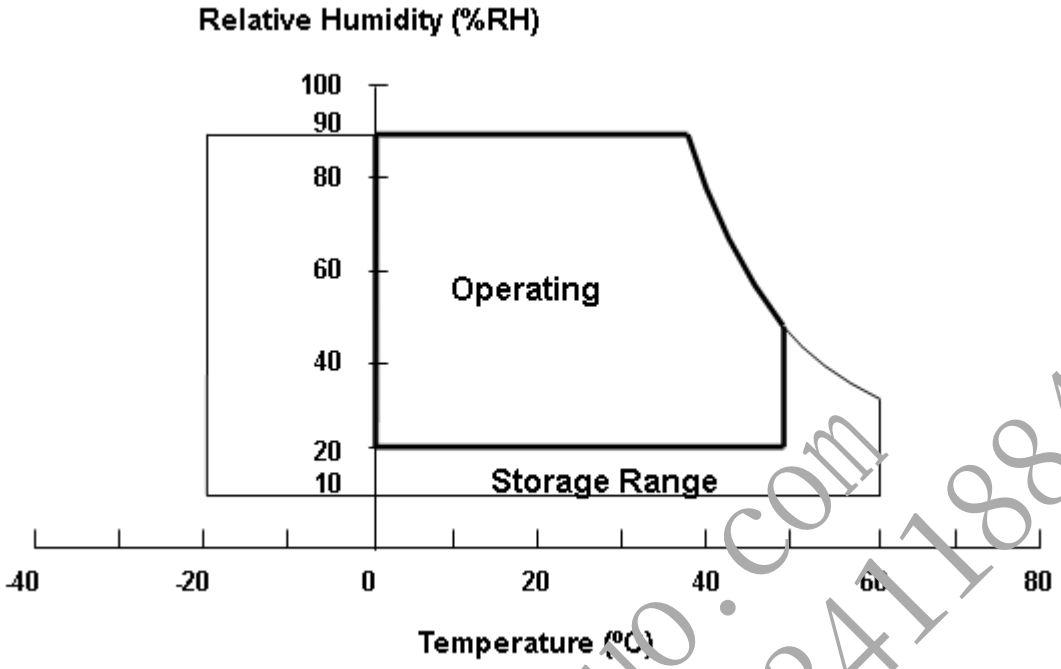

3.2 ELECTRICAL ABSOLUTE RATINGS

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_{IN}	-0.3	3.6	V	

3.2.2 BACKLIGHT UNIT

Item	Symbol	Value			Unit	Note
		Min.	Typ	Max.		
LED Forward Current Per Input Pin	I_F	71	75	79	mA	(1), (2) Duty=100%
LED Reverse Voltage	V_R	---	---	---	V	(1), (2), (3) Duty=100%
LED Pulse Forward Current Per Input Pin	I_P	---	---	300	mA	(1), (2) Pulse Width≦10msec. and Duty≦10%

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 ℃ (Refer to 4.3.3 and 4.3.4 for further information).

Note (3) The devices on the light-bar can NOT be permanently damaged if operating condition is within the absolute maximum ratings.

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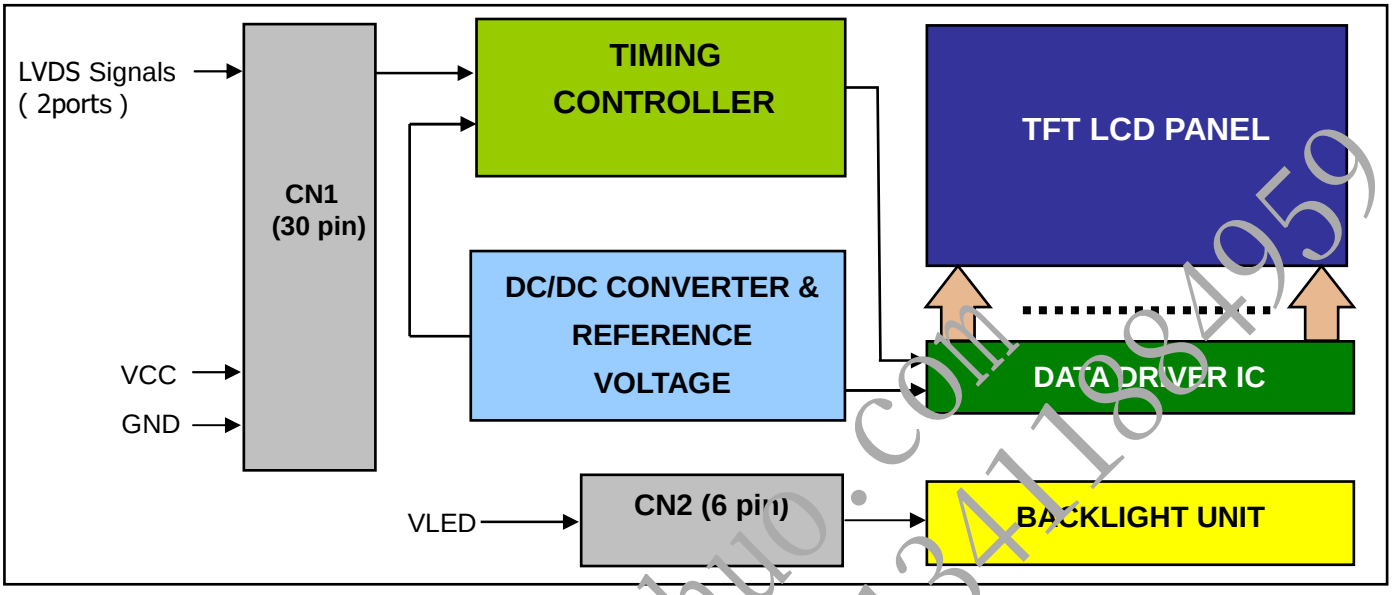
4. ELECTRICAL SPECIFICATIONS

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

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Pin	Name	Description
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.:

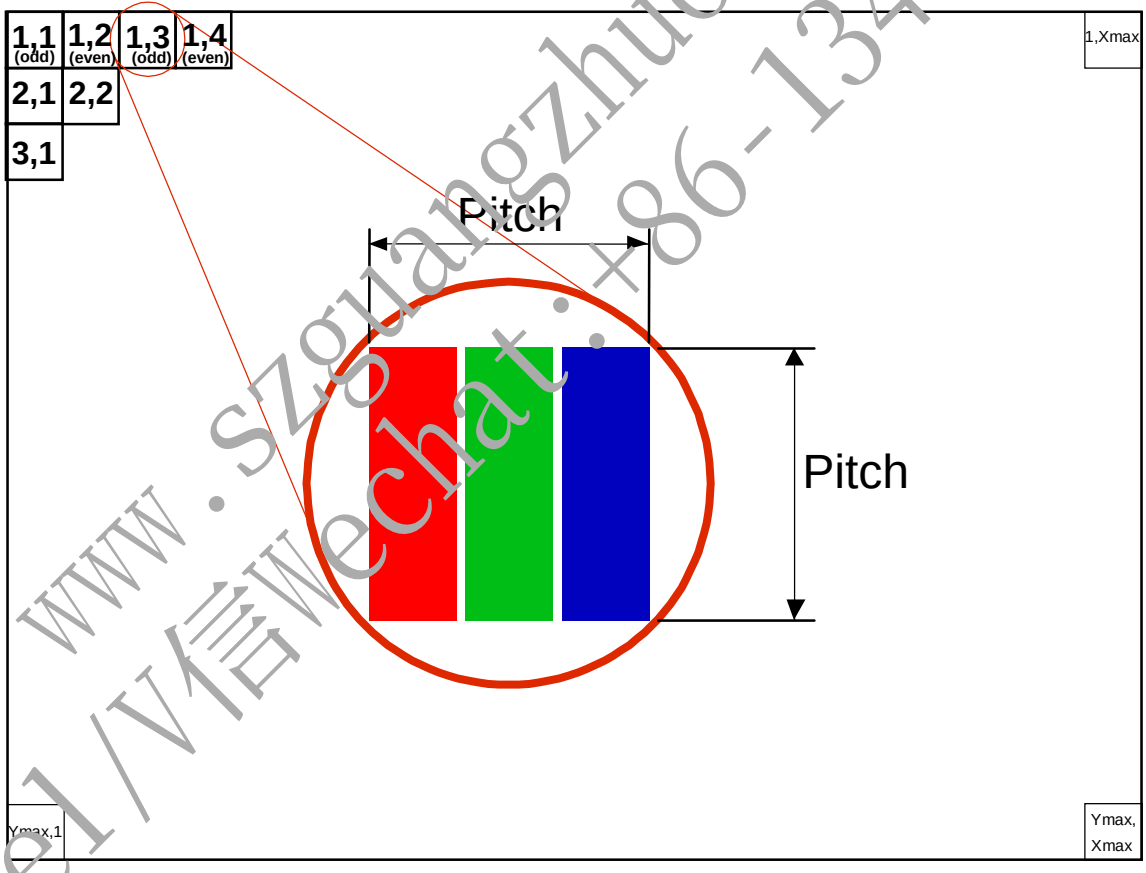
Item	Description
Type Part Number	PTwo 187098-30091
	FCN WF13-422-3033 or equivalent

Note (2) User's connector Part No:

Item	Description
Mating Wire Cable Connector Part No	JAE FI-X30HL
	PTwo LVDS 27 type_287130-403029-1
	Hamburg FCC-W00-300000-000M or compatible

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

Note (4) The first pixel is odd.



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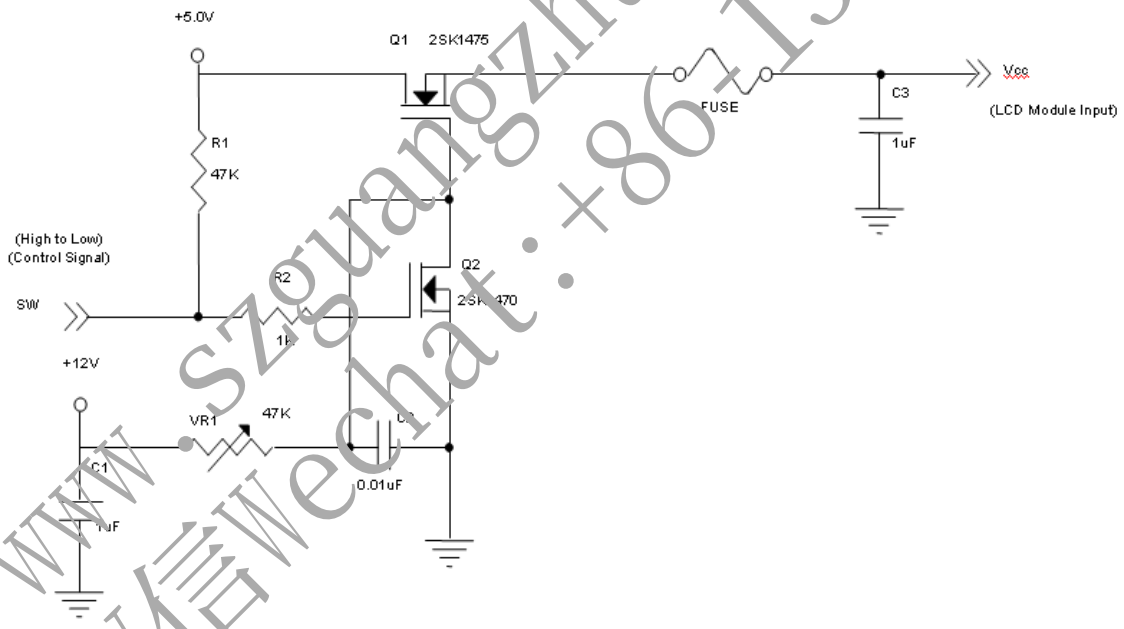
4.3 ELECTRICAL CHARACTERISTICS

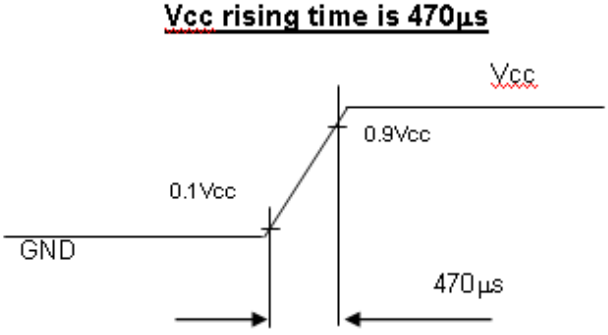
4.3.1 LCD ELETRONICS SPECIFICATION

Parameter		Symbol	Value			Unit	Note
			Min.	Typ.	Max.		
Power Supply Voltage		Vcc	4.5	5.0	5.5	V	-
Ripple Voltage		V_{RP}	-	-	300	mV	-
Rush Current		I_{RUSH}	-	-	3	A	(2)
Power Supply Current	White		-	0.290	0.354	A	(3)a
	Black		-	0.288	0.345	A	(3)b
	H line Stripe		-	0.691	0.846	A	(3)c
Power Consumption		PLCD	-	3.456	4.232	W	(4)
LVDS differential input voltage		Vid	100	-	600	mV	
LVDS common input voltage		Vcm	1.0	1.2	1.4	V	
Differential Input High Threshold Voltage		VIH	-	-	100	mV	
Differential Input Low Threshold Voltage		VIL	-100	-		mV	

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

Note (2) Measurement Conditions:





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Note (3) The specified max power supply current is under the conditions at Vcc = 5.0 V, Ta = 25 ± 2 ºC, Fr = 60Hz, whereas a power dissipation check pattern below is displayed.

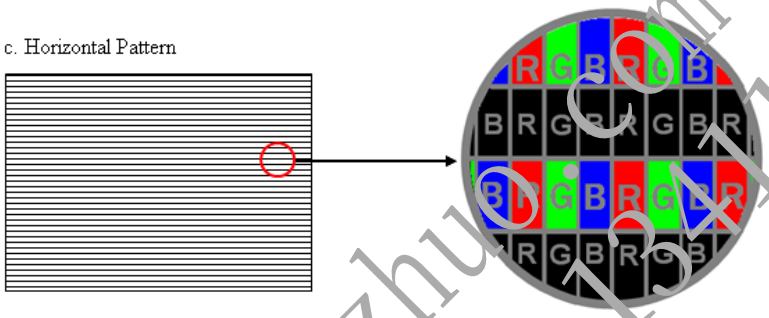
a. White Pattern

Active Area

b. Black Pattern

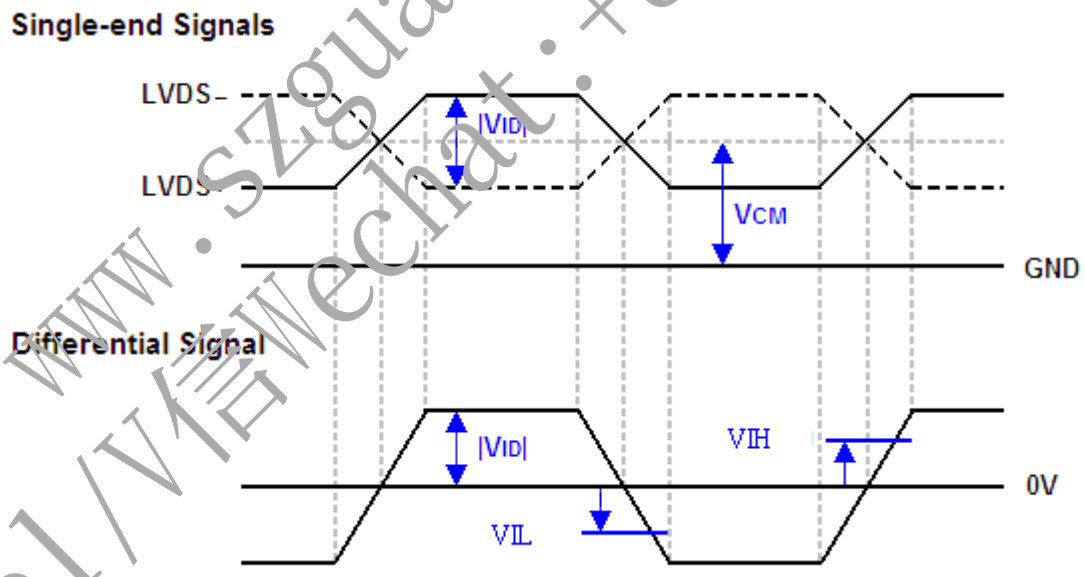
Active Area

c. Horizontal Pattern



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

Note (5) VID waveform condition



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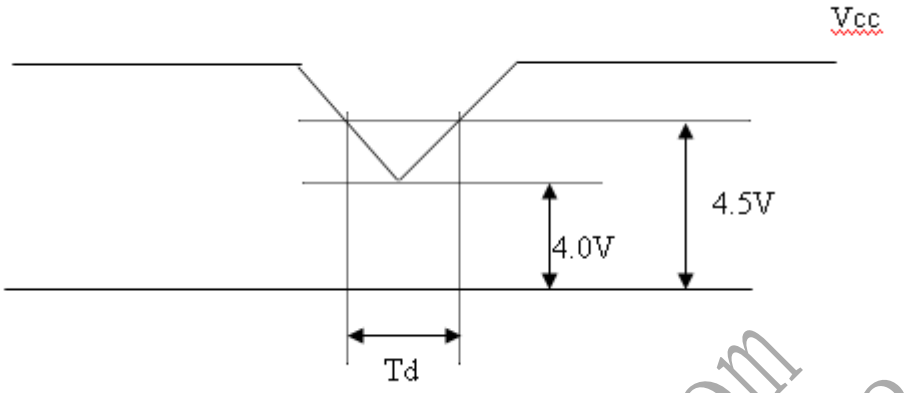
4.3.2 Vcc Power Dip Condition

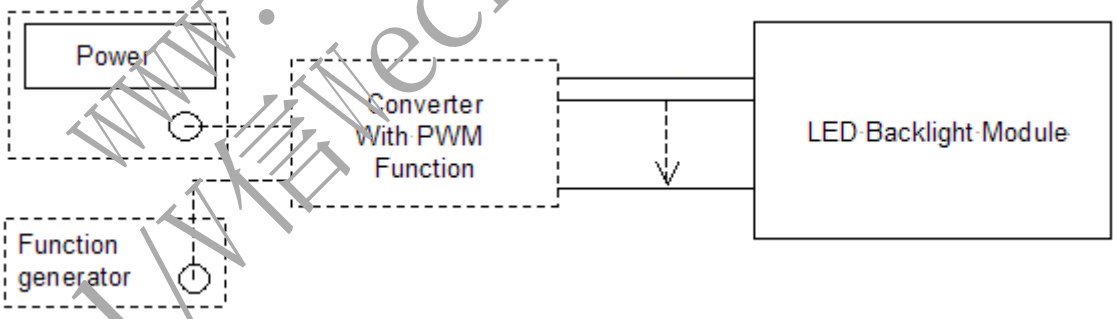


Dip condition:4.0≦Vcc≦4.5, Td≦20ms

4.3.3 BACKLIGHT UNIT

Parameter	Symbol	Value			Unit	Note
		Min.	Typ.	Max.		
LED Light Bar Input Voltage Per Input Pin	VPIN	24.5	28	32	V	(1), Duty=100%, IPIN=75mA
LED Light Bar Current Per Input Pin	IPIN	71	75	79	mA	(1), (2) Duty=100%
LED Life Time	LLED	30000			Hrs	(3)
Power Consumption	PBL	--	8.4	9.6	W	(1) Duty=100%, IPIN=75mA

Note (1) LED light bar input voltage and current are measured by utilizing a true RMS multimeter as shown below: The module must be operated with constant driving current.



Note (2) The lifetime of LED is defined as the time when LED packages continue to operate under the conditions at Ta = 25 ±2 ℃ and I= typical driving current until the brightness becomes ≦ 50% of its original value.

Note (3) Recommended PWM Control Frequence minimum is 240 Hz

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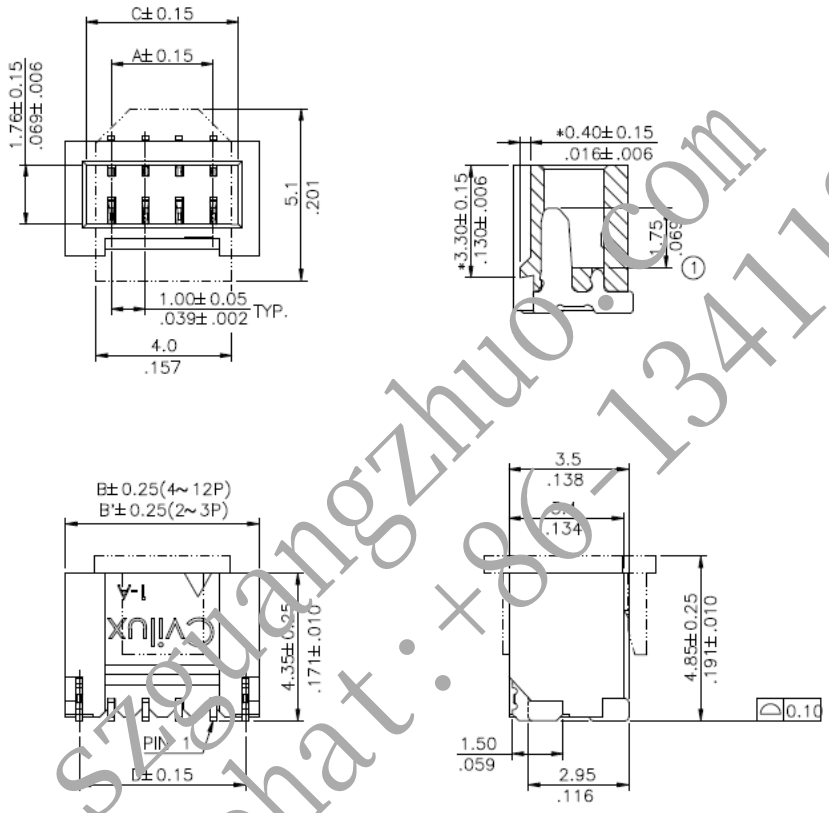
4.3.4 LIGHTBAR Connector Pin Assignment

(1) Connector:

Item	Description
Manufacturer	CviLux
Type part number	CI1406M1VL0-NH or equivalent
Mating housing part number	CviLux CI1406SL000-NH or compatible



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) Connector(wire type): CviLux CI1406M1VL0-NH or equivalent.

Note(2) User's mating connector part No.: CviLux CI1406SL000-NH or compatible.

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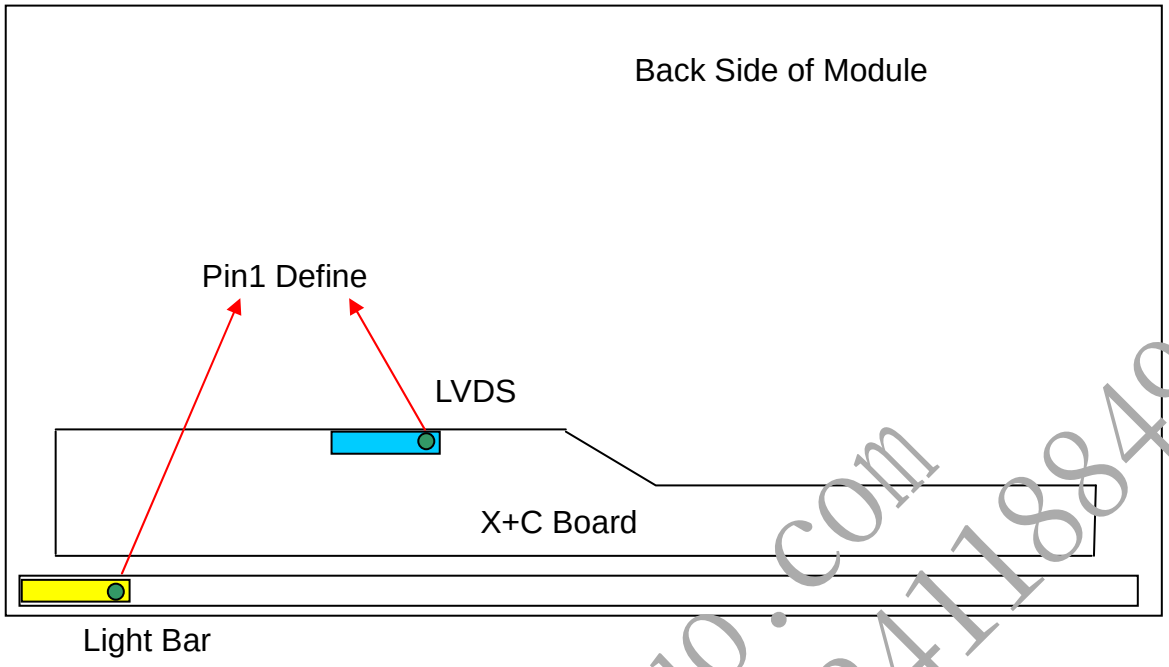

4.4 LVDS INPUT SIGNAL SPECIFICATIONS

4.4.1 LVDS DATA MAPPING TABLE

LVDS Channel O0	LVDS output	D7	D6	D5	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

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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	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
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
	:	:	:	:	:	:		:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
	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	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	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	0
	Green(254)	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0
	Green(255)	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0
Gray Scale Of Blue	Blue(0) / Dark	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Blue(1)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
	Blue(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
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
	Blue(253)	0	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	0	1	1	1	1	1	1	1	0
	Blue(255)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1

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

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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	Fc	56	74.25	97.98	MHz	-
	Period	Tc	-	13.47	-	ns	
	Input cycle to cycle jitter	T_{rcl}	-0.02*Tc	-	0.02*Tc	ns	(1)
	Input Clock to data skew	TLVCCS	-0.02*Tc	-	0.02*Tc	ps	(2)
	Spread spectrum modulation range	F_{clkin_mod}	0.97*Fc	-	1.03*Fc	MHz	(3)
	Spread spectrum modulation frequency	F_{SSM}	-	-	100	KHz	
Vertical Display Term	Frame Rate	Fr	47	60	77	Hz	Tv=Tvd+Tvb
	Total	Tv	1100	1125	1840	Th	-
	Active Display	Tvd	1080	1080	1080	Th	-
	Blank	Tvb	20	45	760	Th	-
Horizontal Display Term	Horizontal Frequency	Fh	53	67.5	94	KHz	
	Total	Th	1050	1100	1150	Tc	Th=Thd+Thb
	Active Display	Thd	960	960	960	Tc	-
	Blank	Thb	90	140	190	Tc	-

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

Fc = Fr X Tv X Th,

Fh(min.)=Fc(min.)/Th(min.),

Fh(typ.)=Fc(typ.)/Th(typ.),

Fh(max.)=Fc(max.)/Th(min.)

Please make sure the range of pixel clock has follow the below equation and Fc, Fr, Tv , Th not allowed to get beyond the min or max spec.

In Free-sync mode, only guaranteed no functional failure, but don't guaranteed its quality of the optical and cosmetic performance.

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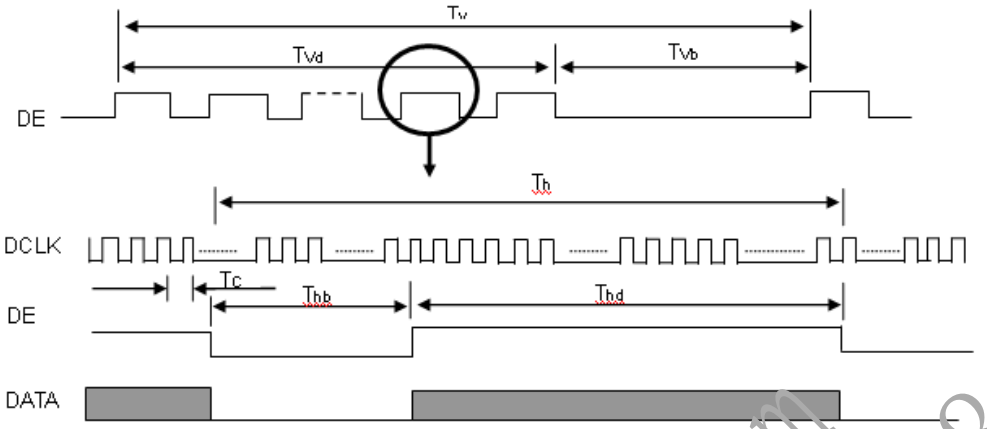

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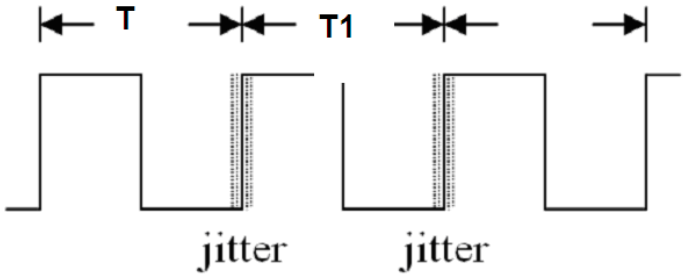
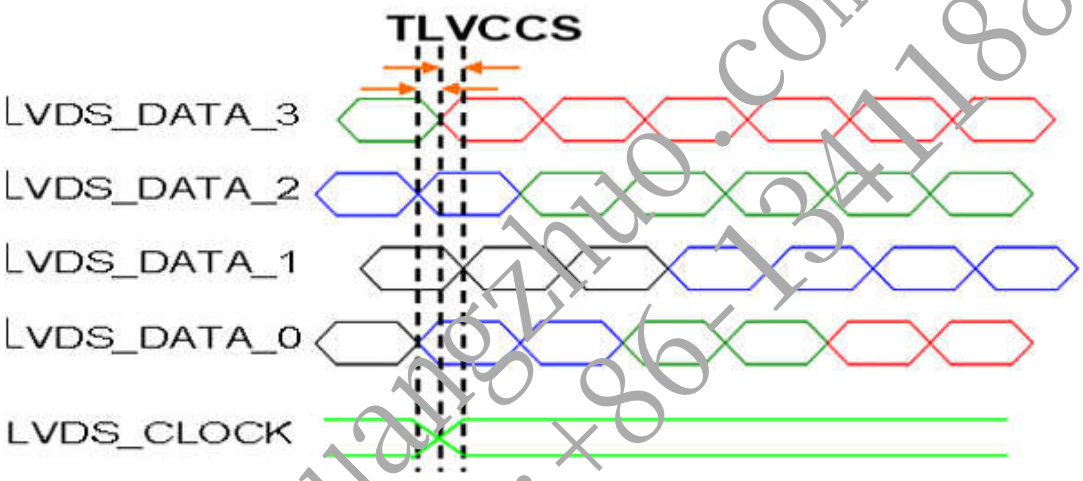
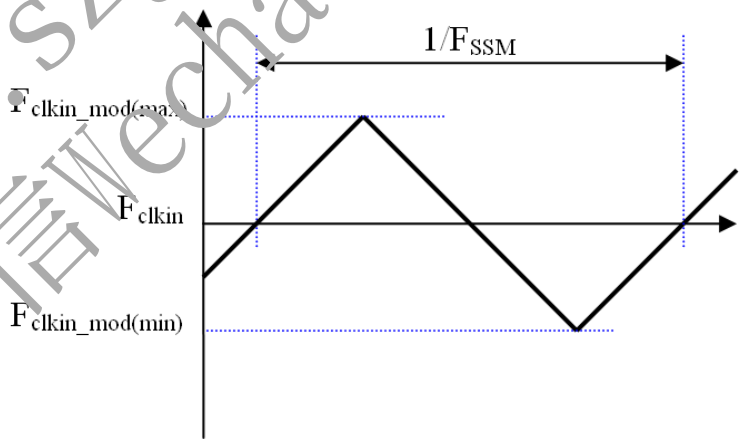
Note (1) The input clock cycle-to-cycle jitter is defined as below figures. Trcl = I T_1 – TI



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-blank should be set in 0 to Hdisplay/2

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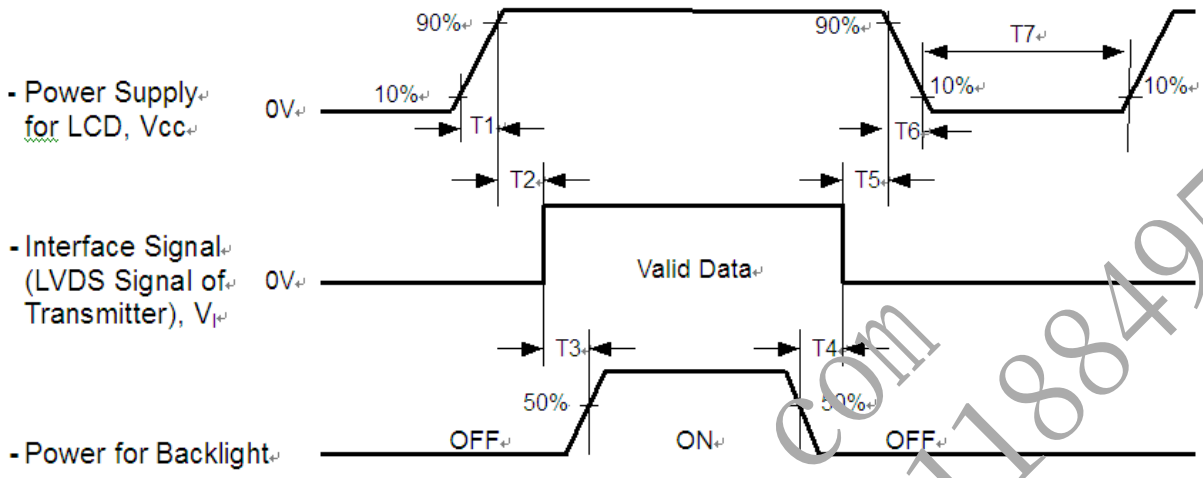
4.6 POWER ON/OFF SEQUENCE

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	30	50	ms
T3	450	-	-	ms
T4	100	250	-	ms
T5	0	20	50	ms
T6	0.1	-	100	ms
T7	1000	-	-	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) Please insert a display black pattern during all T4.When the backlight turns on before the LCD operation of the LCD turns on, the display may momentarily become abnormal screen and it will be no reliability concern(T4<100ms).

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) T7 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) INX 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".

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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	V_{CC}	5	V
Input Signal	According to typical value in "3. ELECTRICAL CHARACTERISTICS"		
LED Light Bar Input Current Per Input Pin	I_{PIN}	75	mA_{DC}
PWM Duty Ratio	D	100	%
LED Light Bar Test Converter	CMI 35-D080484		

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	θ_x=0°, θ_Y =0° CS-2000 R=G=B=255 Gray scale	Typ – 0.03	0.657	Typ + 0.03	-	(1), (5)
		Ry			0.329			
	Green	Gx			0.304			
		Gy			0.615			
	Blue	Bx			0.144			
		By			0.057			
	White	Wx			0.313			
		Wy			0.329			
Center Luminance of White (Center of Screen)		L_C		200	250	-	cd/m^2	(4), (5)
Contrast Ratio		CR		700	1000	-	-	(2), (5)
Response Time		GtG			14	20	ms	(3)
White Variation		W	θ_x=0°, θ_Y =0°	75			%	(5), (6)
Viewing Angle	Horizontal	θx- + θx+	CR ≧ 10	170	178	-	Deg.	(1), (5)
	Vertical	θy- + θy+		170	178	-		
Viewing Angle	Horizontal	θx- + θx+	CR ≧ 5	170	178	-	Deg.	(1), (5)
	Vertical	θy- + θy+		170	178	-		
Crosstalk		CT		--	--	2.0	%	(5), (7)
Flicker		FLK				-15	dB	(5), (8)
Color Gamut		CG	CIE 1931 system	95	99		%	(5), (9)

Note (1) Definition of Viewing Angle (θx, θy):

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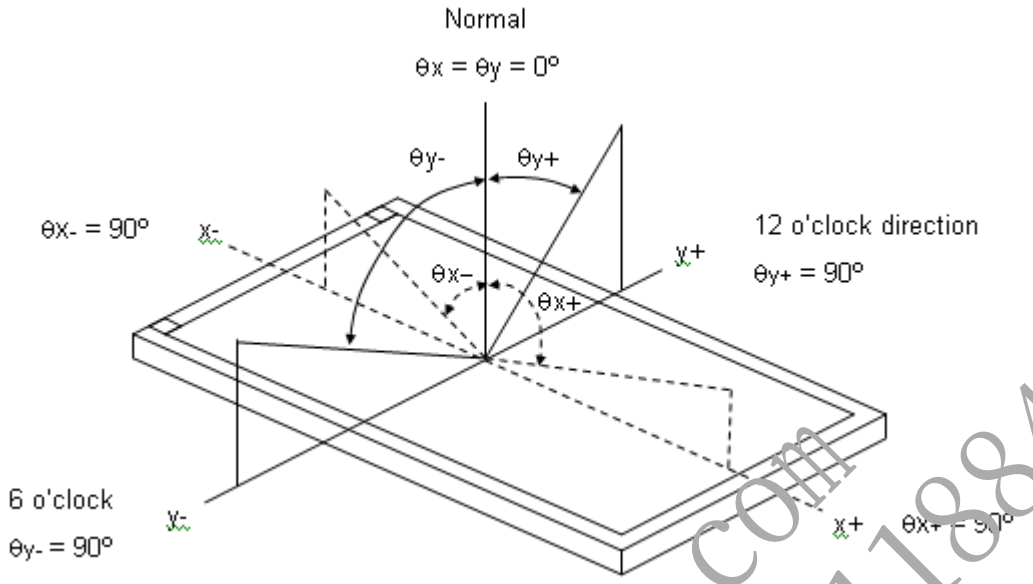

Note (2) Definition of Contrast Ratio (CR):

The contrast ratio can be calculated by the following expression.

Contrast Ratio (CR) = L255 / L0

L255: Luminance of gray level 255

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_{GtG_AVE} is the total average of the T_{GtG} data (Measured by INX GTG instrument)
- T_{GtG} means the transition time from gray N to gray M.(Measured by TEKTRONIX TDS3054B).
- The gray (N,M) stands for the (0,63,127,191,255) as the following table.

Gray to Gray		Rising time				
		0	63	127	191	255
Falling time	0					
	63					
	127					
	191					
	255					

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:

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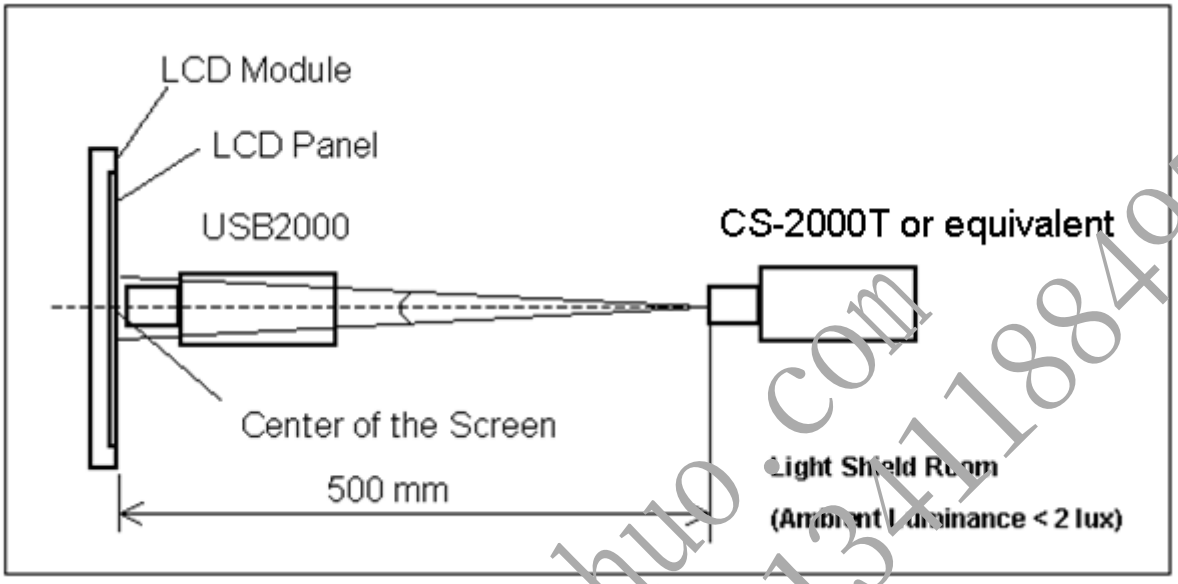
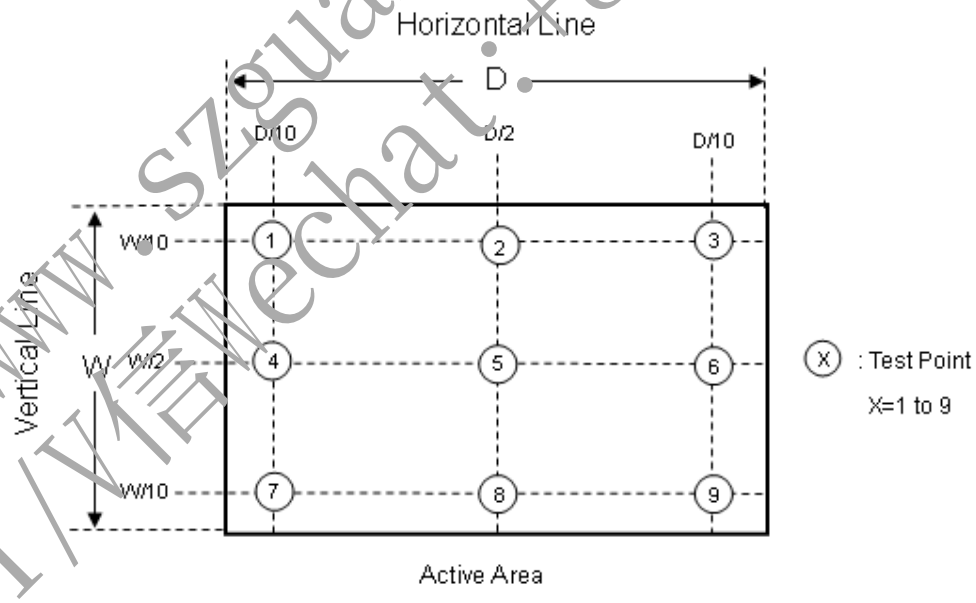
The LCD module should be stabilized at given temperature for 40 minutes to avoid abrupt temperature change during measuring. In order to stabilize the luminance, the measurement should be executed after lighting Backlight for 40 minutes in a windless room.



Note (6) Definition of White Variation (δW):

Measure the luminance of gray level 255 at 9 points

δW = Minimum [L (1) ~ L (9)] / Maximum [L (1) ~ L (9)]



Note (7) Crosstalk measurement

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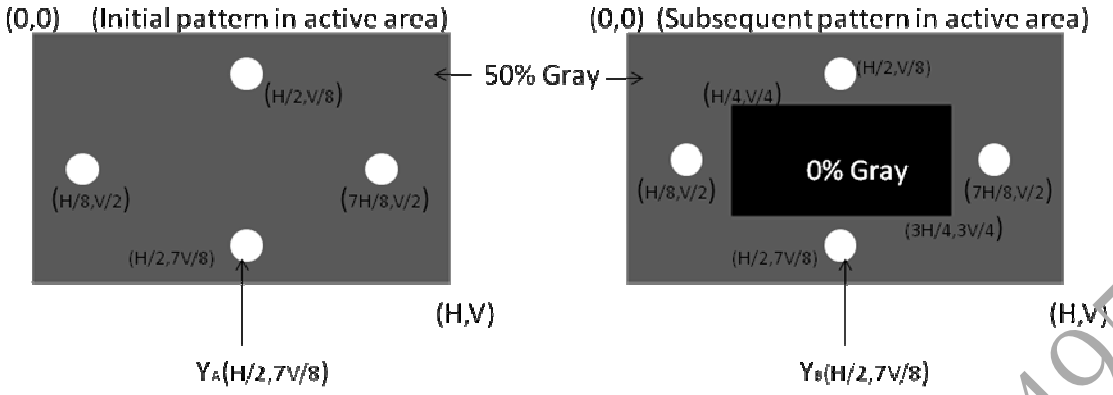


CT% =|(YB- YA)/YA)|x100% CT% =|(YB- YA)/YA)|x100%

Where

YA= Initial pattern's brightness at each specific position.

YB= Subsequent pattern's brightness at each specific position.

Each specific position (H/8,V/2),(H/2,7V/8),(7H/8,V/2) and (H/2,V/8) for measurement should be exactly the same in both patterns.

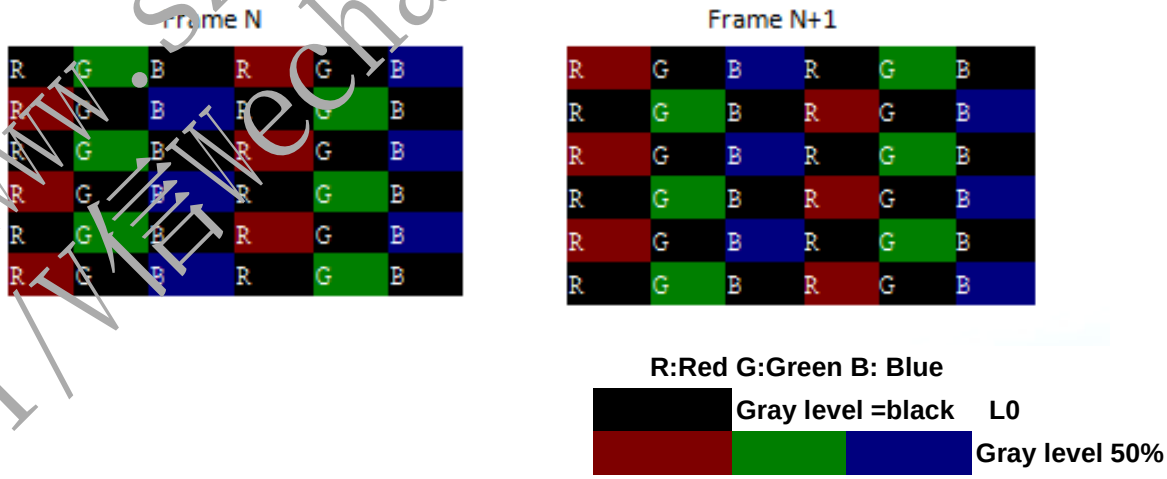
Note (8) Flicker measurement

Flicker test pattern illustrated as below

The measurement position :

At the center of screen point(5), instrument is perpendicular to the screen(θx=0°, θY =0°)

The flicker value, FdB, obtained by the JETA Flicker method.



Note (9) Coverage of sRGB color space on CIE-1931 system

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6. RELIABILITY TEST ITEM

Items	Required Condition	Note
Temperature Humidity Bias (THB)	Ta= 50℃ , 80%RH, 240hours	(1) (2)
High Temperature Operation (HTO)	Ta= 50℃ , 240hours	(1) (2)
Low Temperature Operation (LTO)	Ta= 0℃ , 240hours	(1) (2)
High Temperature Storage (HTS)	Ta= 60℃ , 240hours	(1) (2)
Low Temperature Storage (LTS)	Ta= -20℃ , 240hours	(1)(3)
Vibration Test (Non-operation)	Acceleration: 1.5 G Wave: sine Frequency: 10 - 300 Hz Sweep: 30 Minutes each Axis (X, Y, Z)	(1)(3)
Shock Test (Non-operation)	Acceleration: 50 G Wave: Half-sine Active Time: 11 ms Direction : ± X, ± Y, ± Z.(one time for each Axis)	(1)(3)
Thermal Shock Test (TST)	-20℃/30min , 60℃ / 30min , 100 cycles	(1)
On/Off Test	25℃ ,On/10sec , Off/10sec , 30,000 cycles	(1)
ESD (Electro Static Discharge)	Contact Discharge: ± 8KV, 150pF(330Ω)	(1)
	Air Discharge: ± 15KV, 150pF(330Ω)	(1)(2)
Altitude Test	Operation:10,000 ft / 24hours Non-Operation:30,000 ft / 24hours	(1) (2)

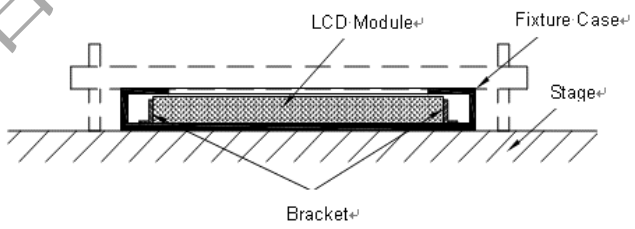
Note (1) criteria : Normal display image with no obvious non-uniformity and no line defect.

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

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:

At Room Temperature



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7. MECHANICAL STRENGTH CHARACTERISTICS

7.1 MECHANICAL STRENGTH SPECIFICATIONS

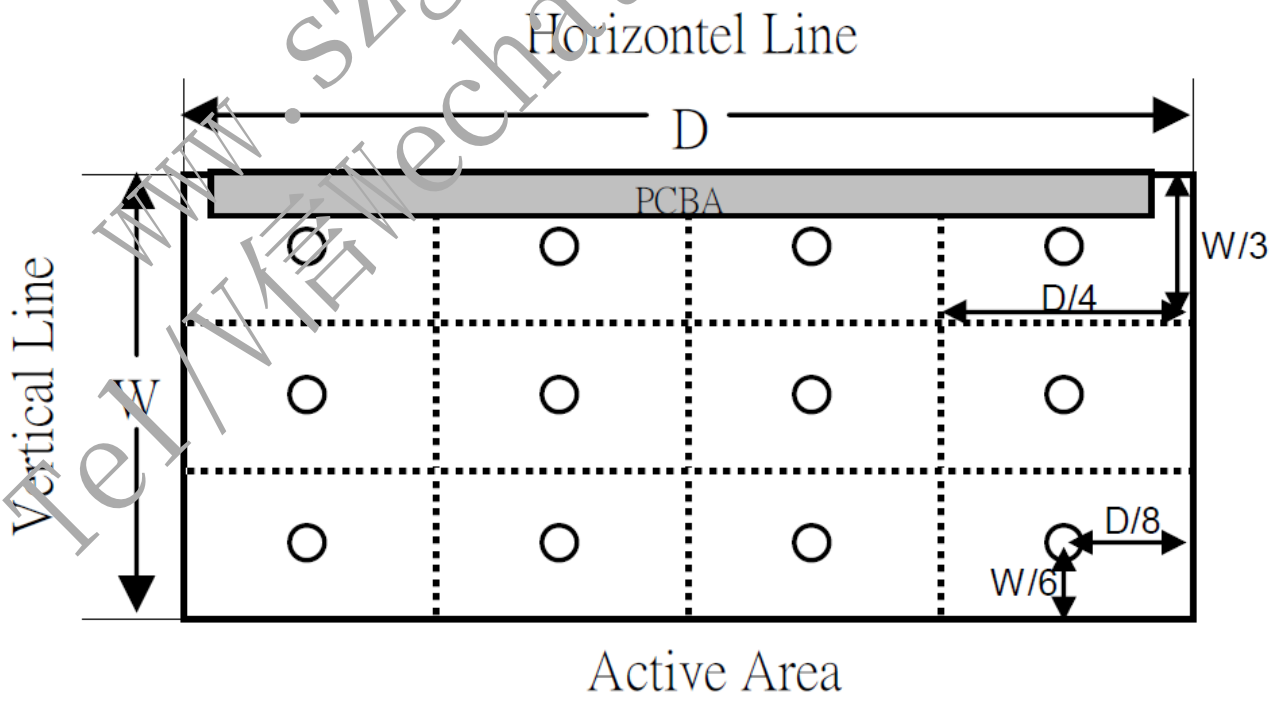
Item	Condition	Min	Unit	Note
Mechanical Strength	128th Gray Pattern	0.6	Kgf	

7.2 TEST CONDITIONS

Items	Description
Test Condition	1. Ambient Illumination : 10~15 lux 2. Test Pattern : 128 Gray 3. Distance of the judgment : 30cm from the surface of module 4. Viewing angle of the judgment : Front
Gage Information	1. Push pull guage a. Model name : HF-50, maker : ALGOL b. Shape of gage tip - Diameter : 2mm - Thickness : 2mm
Definition of Minimum force	To measure minimum force when operator detects any white spot and light leakage that have occurred while operator presses on back side of module with push pull gage.

7.3 DEFINITION OF TEST POINTS

Measure the minimum force of test points at 128th Gray pattern. The test points at back side of module area is showing as below (If the test points on the PCBA or TP board, these points are not included).



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8. PACKING

8.1 PACKING SPECIFICATIONS

(1) 12 LCD modules / 1 Box

(2) Box dimensions: 620(L) X 348(W) X 390(H) mm

(3) Weight: approximately: 30.4kg

8.2 PACKING METHOD

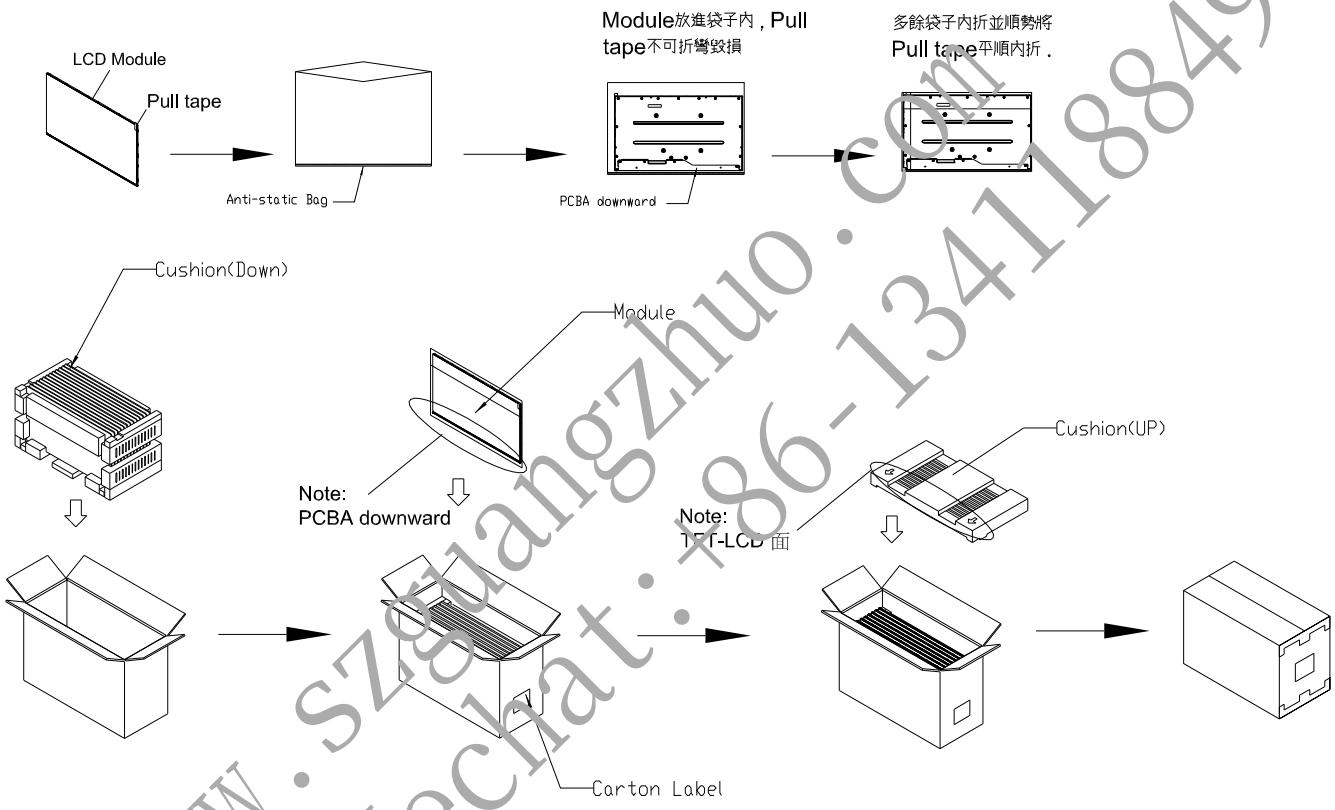

Figure. 7-1 Packing method

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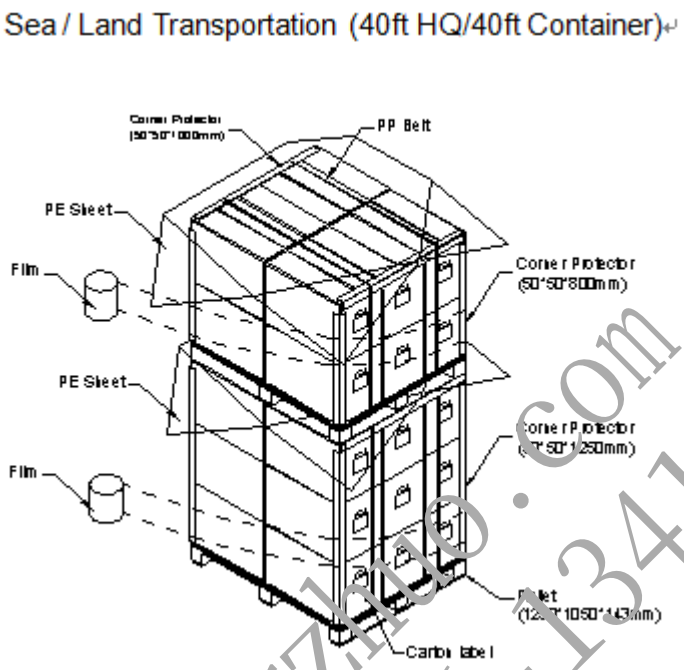
8.3 PALLET

For ocean shipping



For air transport

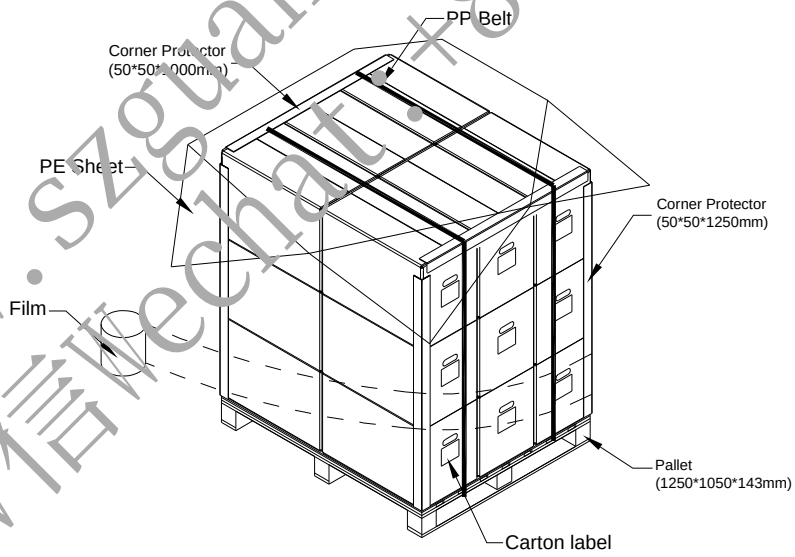


Figure. 7-2 Packing method

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8.4 UN-PACKAGING METHOD

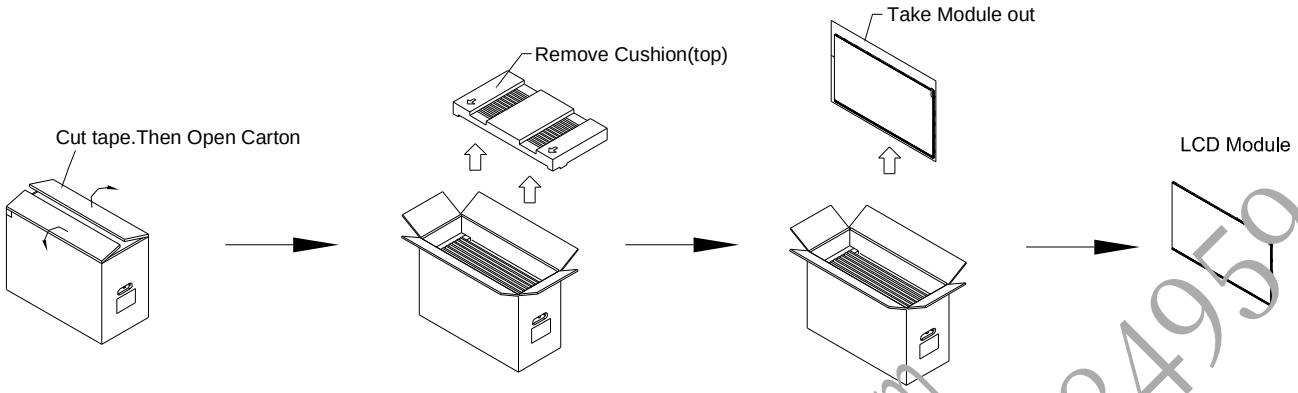

Figure. 8-3 Un-Packing method

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9. Innolux MODULE LABEL

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

(a) Model Name: M238HCA-LCB

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

(c) Innolux barcode definition:

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

Code	Meaning	Description
XX	Innolux internal use	
XX	Revision	Cover all the change
X	Innolux internal use	-
XX	Innolux 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- N8A3B-X-X-X-XX-L-XX-L-YMD-NNNN

Code	Meaning	Description
CM	Supplier code	Innolux =CM
N8ACB	Model number	M238HCA-LCB= N8ACB
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, None IC =Z
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 FoShan China=NH
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

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NNNN	Serial number	By LCD supplier

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(e) FAB ID(UL Factory ID):

Region	Factory ID
TW INX_D廠區	GEMN
TW INX_C廠區	
NB INX_NA廠區	LEOO
NB INX_NB,NC廠區	VIRO
NB INX_ND廠區	COCKN
FS INX_A,B棟	CAPG

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 10ºC may reduce the display quality. For example, the response time will become slowly.

10.2 STORAGE PRECAUTIONS

When storing for a long time, the following precautions are necessary.

(1) Store them in a dark place. Do not expose the module to sunlight or fluorescent light. Keep the temperature between 5℃ and 30℃ at humidity 50+-10 %RH.

(2) The polarizer surface should not come in contact with any other object.

(3) It is recommended that they be stored in the container in which they were shipped.

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10.3 OPERATION PRECAUTIONS

(1) The LCD product should be operated under normal condition.

Normal condition is defined as below :

Temperature : 20±15℃

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 Innolux for application engineering advice . Otherwise , Its reliability and function may not be guaranteed.

10.4 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.

10.5 SAFETY STANDARDS

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

(1) UL60950-1 or updated standard.

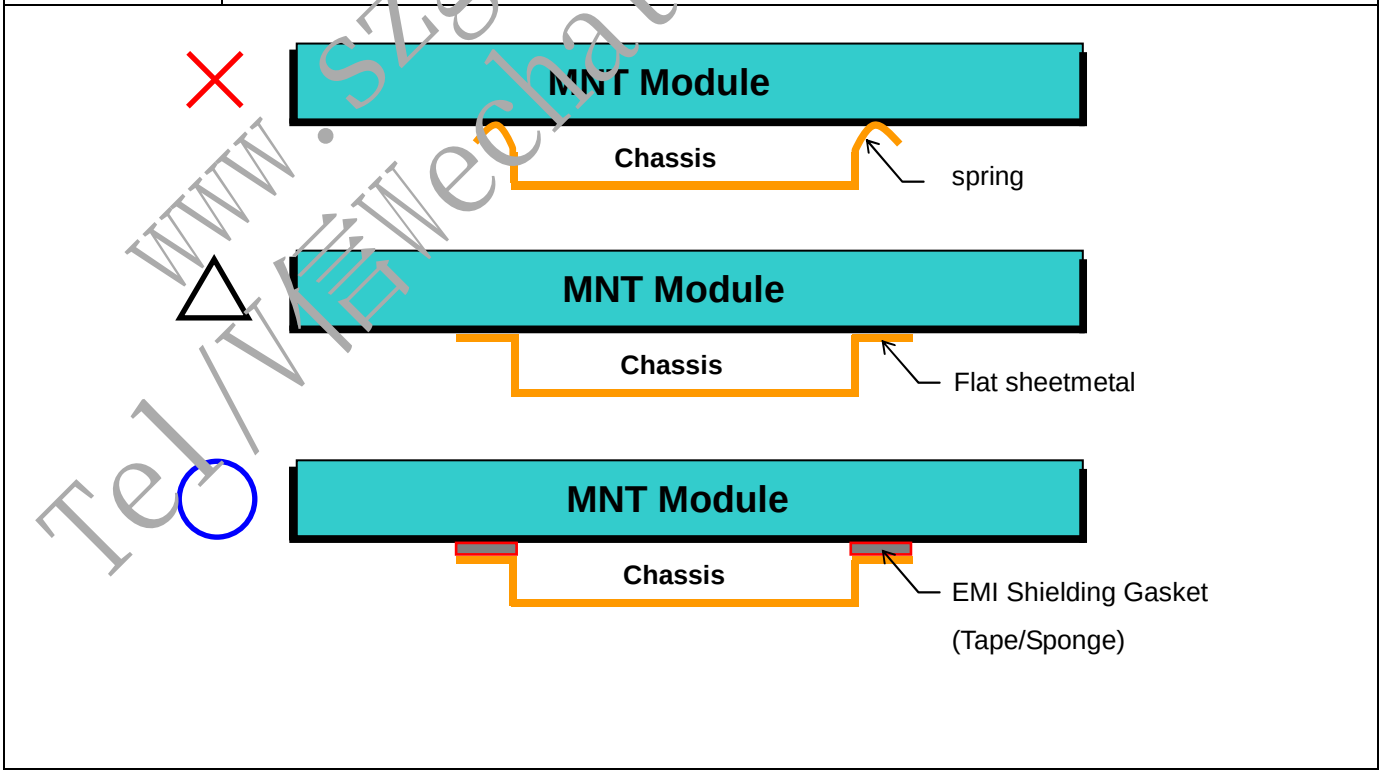
(2) IEC60950-1 or updated standard.

10.6 OTHER

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

Appendix. SYSTEM COVER DESIGN NOTICE

1.	Set Chassis and MNT Module touching Mode



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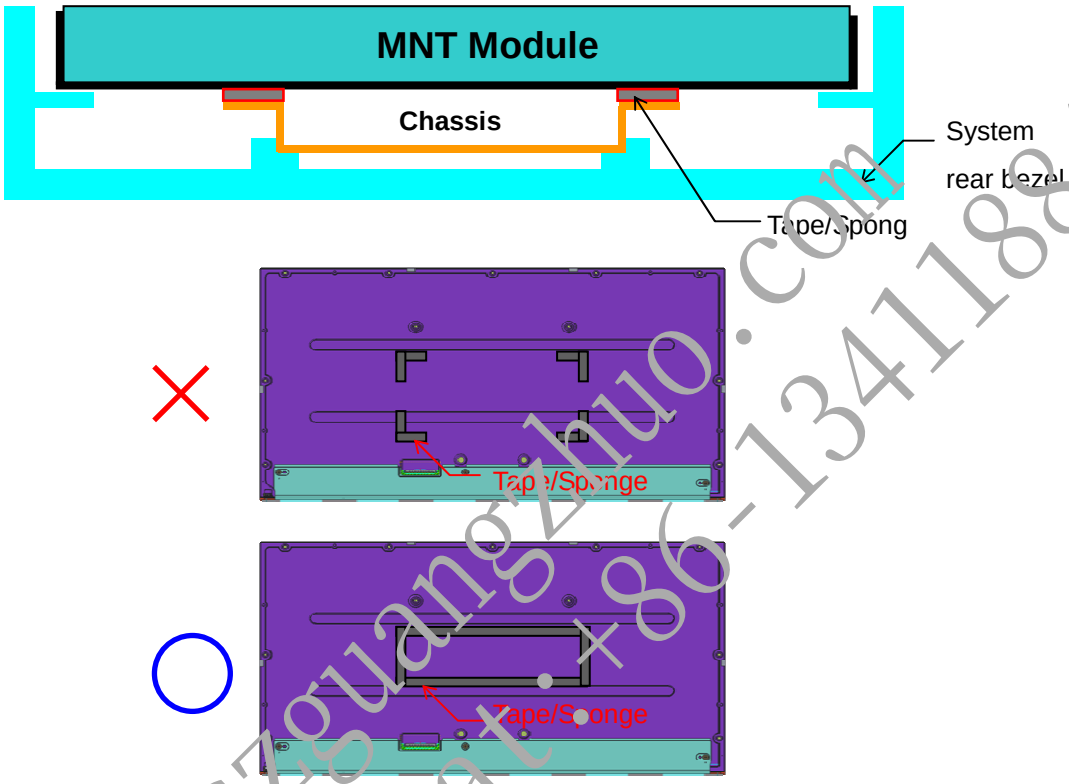
Definition	a) To prevent from abnormal display & white spot after Mechanical test, it is not recommended to used spring type chassis. b) We suggest the contact mode between Chassis and Module rear cover is Tape/Sponge, sencond is Flat sheetmetal type chassis.
2	**Tape/sponge design on system inner surface**
	
Definition	a) To prevent from abnormal display & white spot after Mechanical test, We suggest using Tape/Sponge as medium between chassis and Module rear cover could reduce the occurrence of white spot. b) When using the Tape/Sponge, suggest it be lay over between set chassis and module rear cover. it is not recommended to add tape/sponge in separate location. Since each tape/sponge may act as pressure concentration location.
3	**System inner surface examination**

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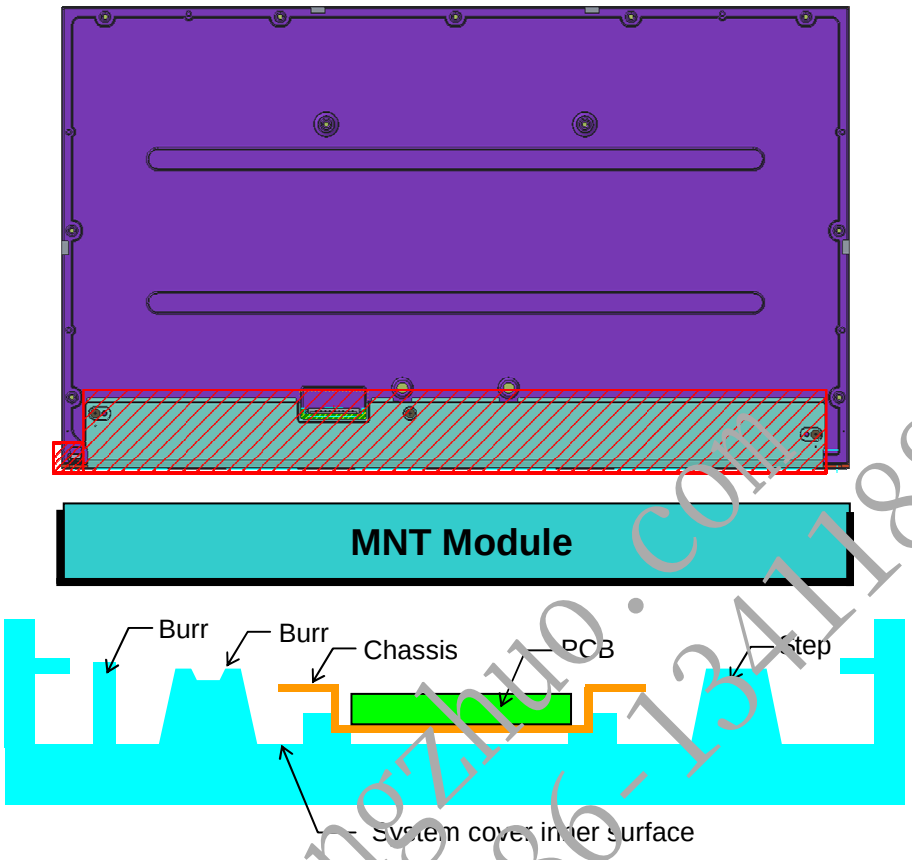
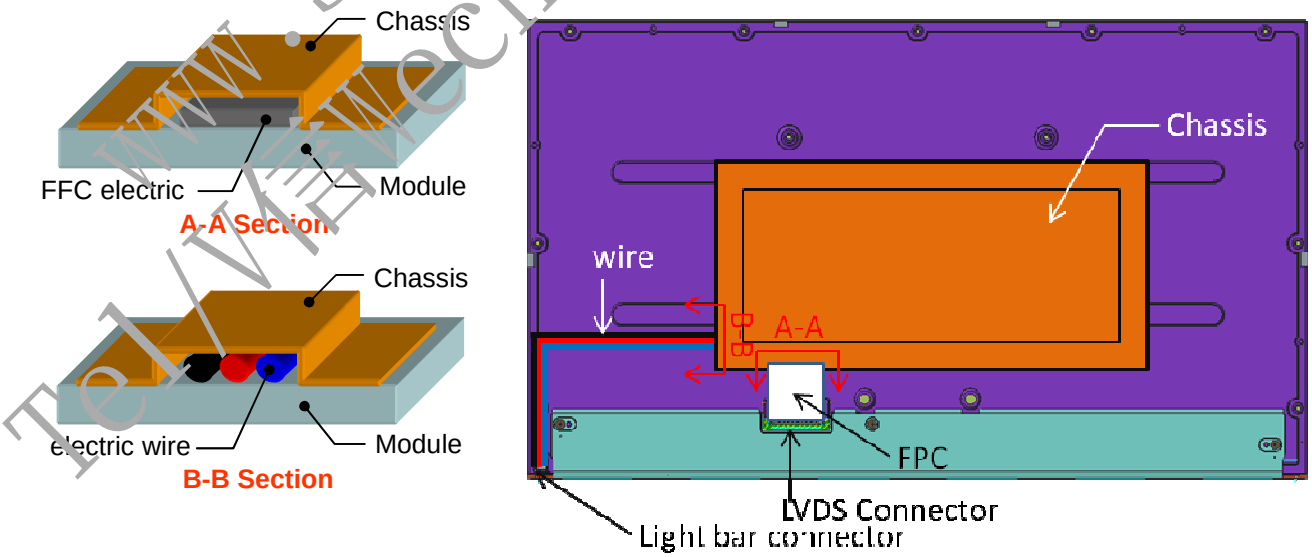


Definition	a). Burr at logo edge, step, protrusion or PCB board will easily cause white spot. b). Keeping flat surface underneath module is recommended. c). The area ( ) on Module PCBA and Light bar connector should keep at least 1mm gap to any structure with System cover inner surface.
4	**The overlapping part on System's Chassis and electric wire needs gap structure.**



Definition	The overlapping part on System's Chassis and electric wire (FPC、FFC and wire) needs gap structure to avoid display of white spot by pressing overlapping part cause interference.

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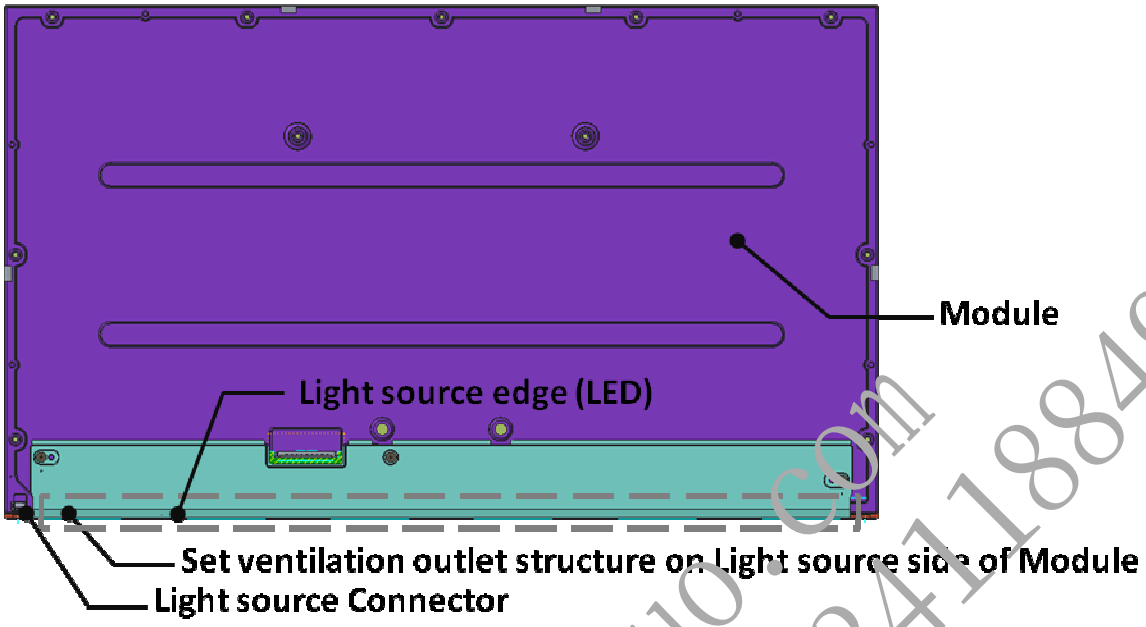
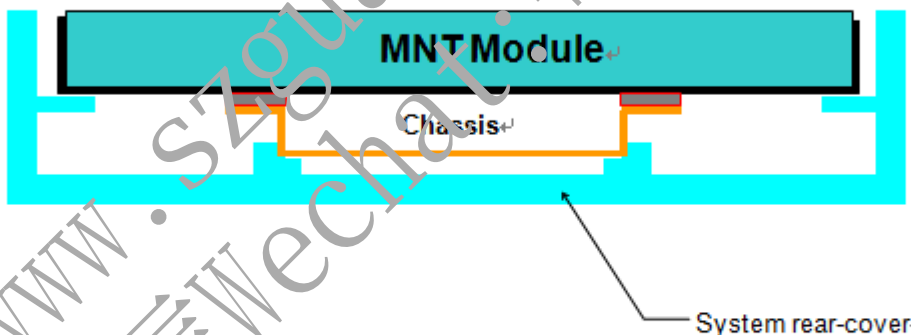
5	System cover's ventilation outlet structure
	
Definition	To prevent from abnormal display of light leakage, We suggest to set ventilation outlet structure on side of Module Light bar in system cover inner surface.

6	Material used for system rear-cover
	
Definition	System rear-cover material with high rigidity is needed to resist deformation during scuffing test, hinge test, pogo test, or backpack test. Abnormal display, white spot, pooling issue may occur if low rigidity material is used. Pooling issue may occur because screw's boss positioning for module's bracket are deformed during open-close test. Solid structure design of system rear-cover may also influence the rigidity of system rear-cover. The deformation of system rear-cover should not caused interference.

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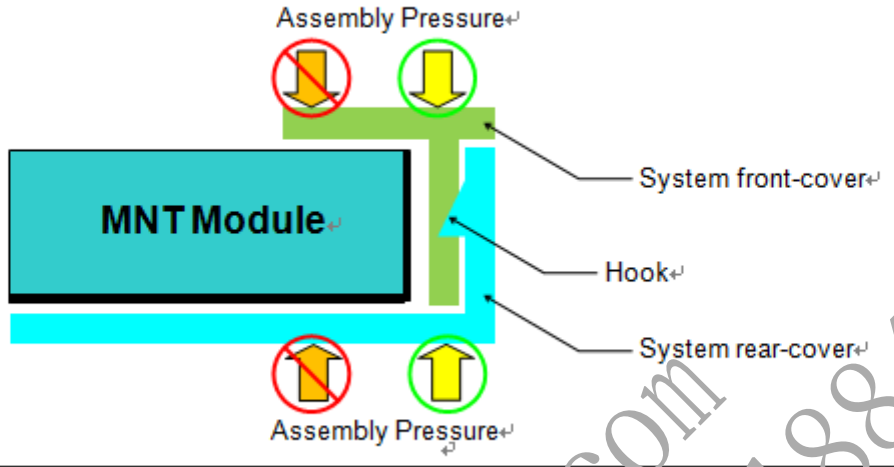
7	Assembly SOP examination for system front-cover with Hook design
	
Definition	To prevent panel crack during system front-cover assembly process with hook design, it is not recommended to press panel or any location that related directly to the panel.

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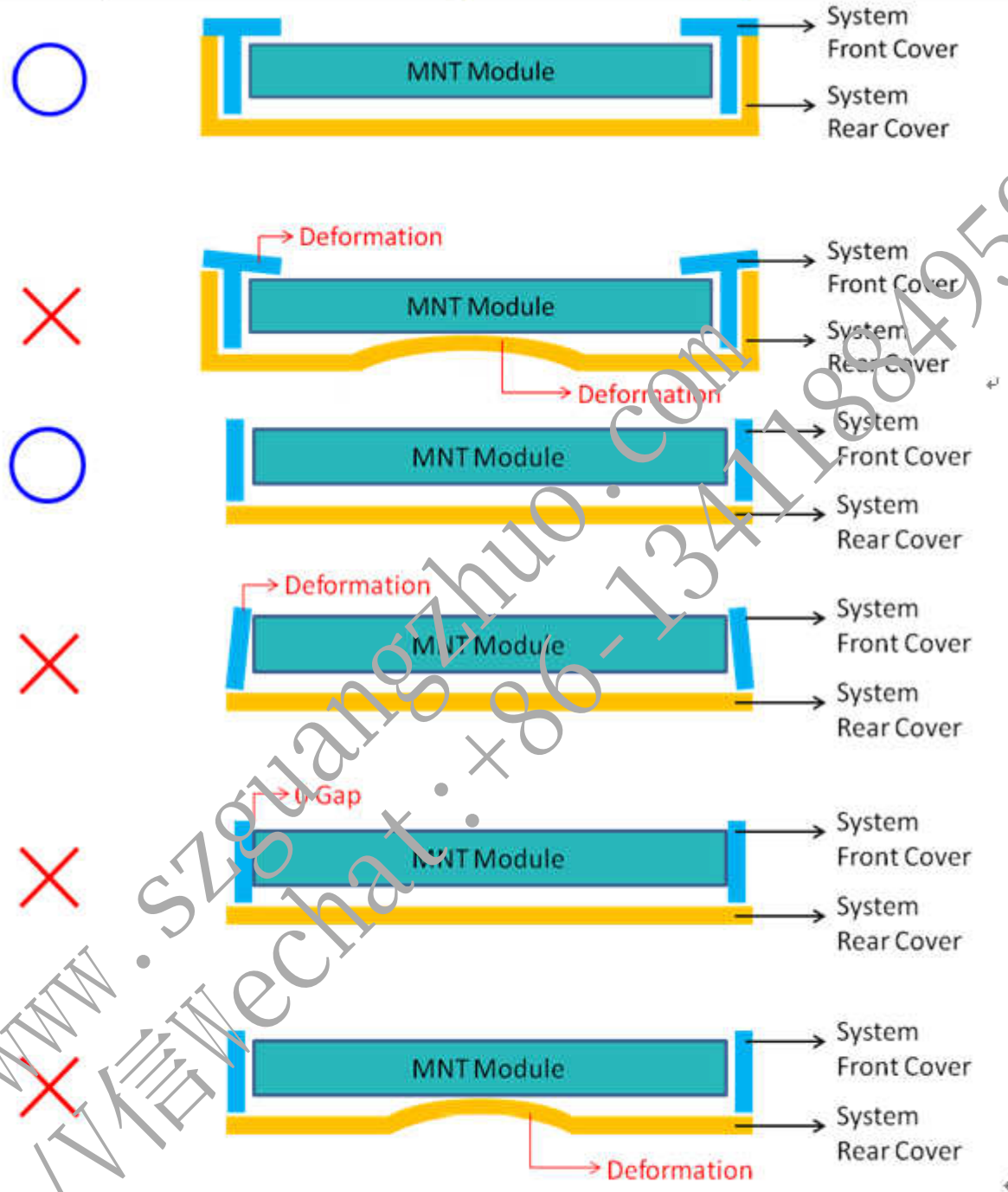
8	Permanent deformation of system cover after reliability test
	
Definition	System cover including front and rear cover may deform during reliability test. Permanent deformation of system front and rear cover after reliability test should not interfere with panel. Because it may cause issues such as pooling, abnormal display, white spot, and also cell crack. Note: If the interference can not be avoided, please feel free to contact INX FAE Engineer for collaboration design. We can help to verify and pass risk assessment for customer reference.

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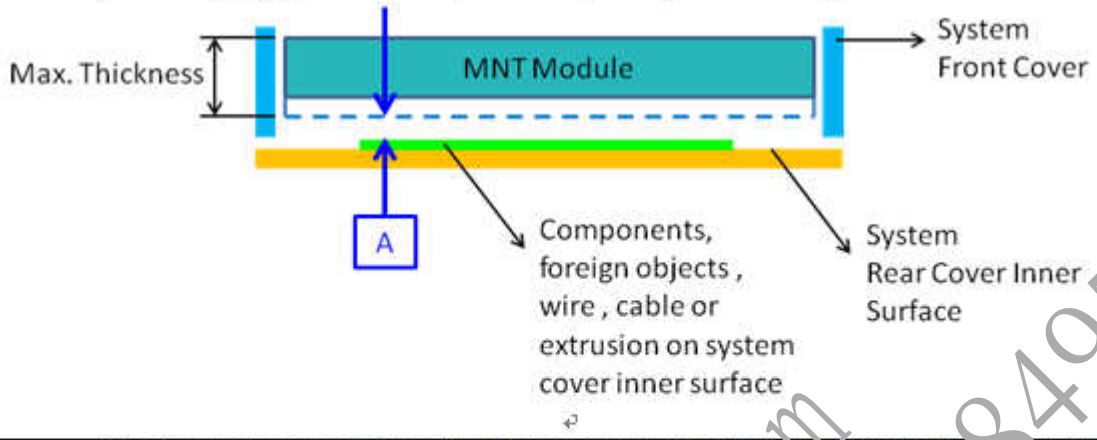
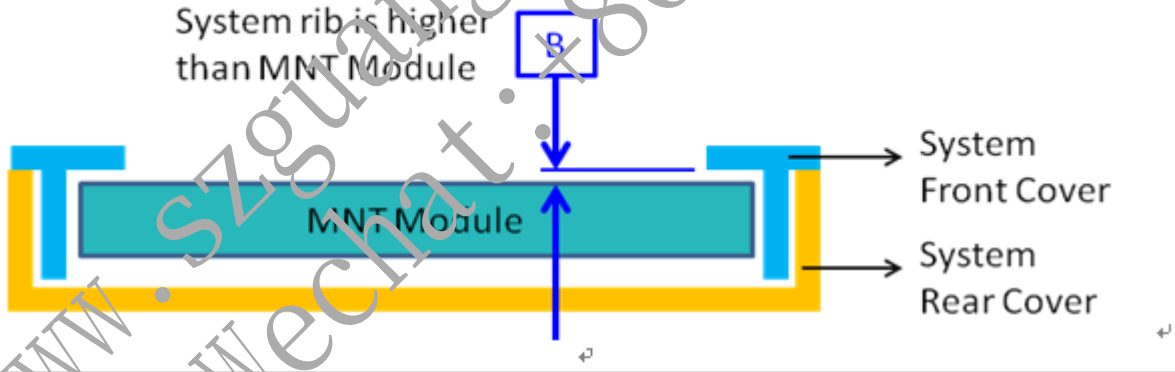
9	Design gap A between panel & any components on system rear-cover
	
Definition	Gap between panel's maximum thickness boundary & system's inner surface components such as wire, cable, extrusion is needed for preventing from backpack or pogo test fail. Because zero gap or interference may cause stress concentration. Issues such as pooling, abnormal display, white spot, and cell crack may occur. Maximum flatness of panel and system rear-cover should be taken into account for gap design. Note: If the interference can not be avoided, please feel free to contact INX FAE Engineer for collaboration design. We can help to verify and pass risk assessment for customer reference.

10	Design gap B between system front cover & panel surface
	
Definition	Gap between system front-cover & panel surface is needed to prevent pooling or glass broken. Zero gap or interference such as burr and warpage from mold frame may cause pooling issue near system font-cover opening edge. This phenomenon is obvious during swing test, hinge test, knock test, or during pooling inspection procedure. To remain sufficient gap, design with system rib higher than maximum panel thickness is recommended. Note: If the interference can not be avoided, please feel free to contact INX FAE Engineer for collaboration design. We can help to verify and pass risk assessment for customer reference.

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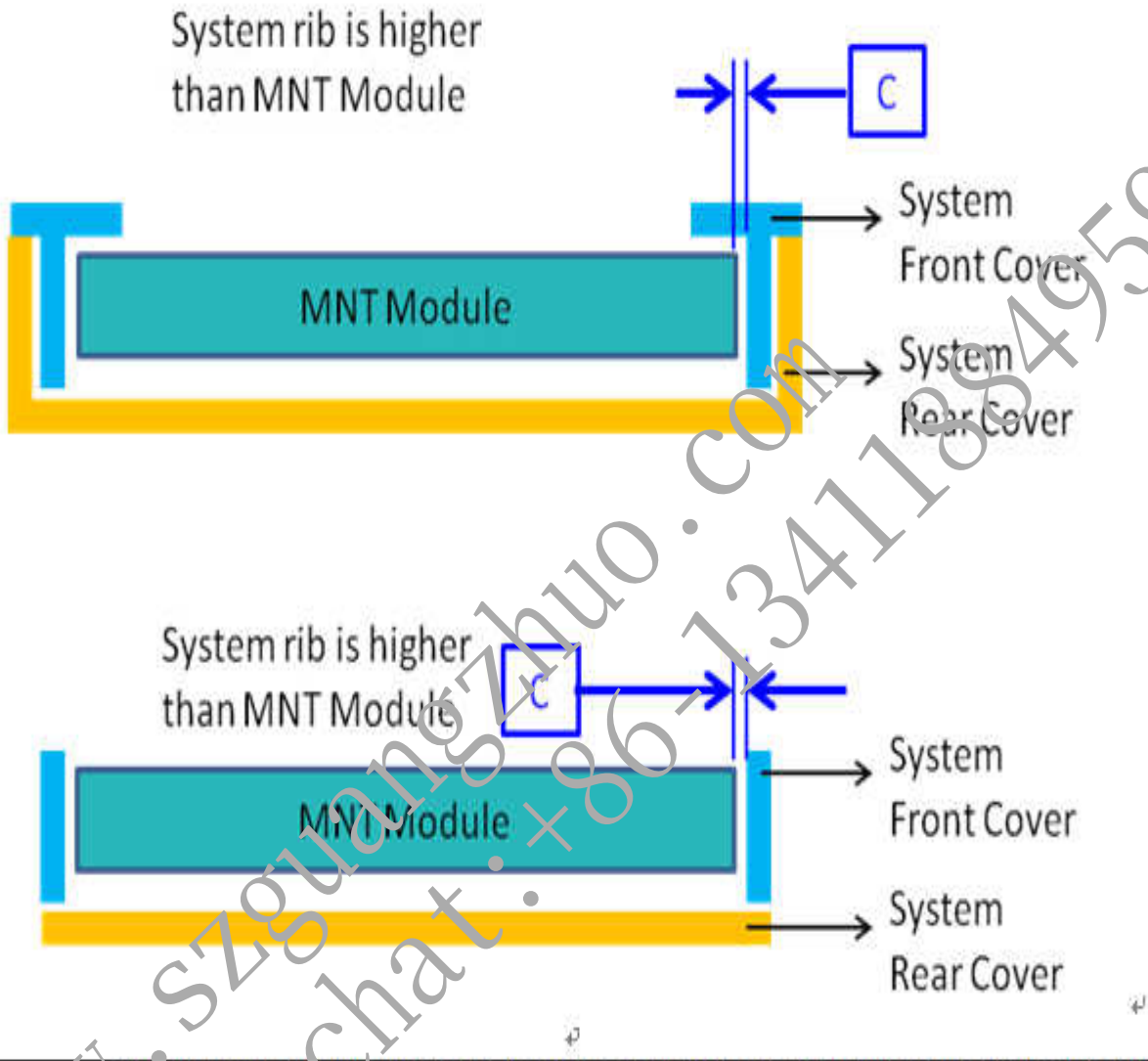
11	Design gap C between panel & system front-cover or protrusions



Definition	Gap between panel & system front-cover or protrusions is needed to prevent shock test failure. Because system front-cover or protrusions with small gap may hit panel during the test. Issue such as cell crack, abnormal display may occur. The gap should be large enough to absorb the maximum displacement during the test. Note: If the interference can not be avoided, please feel free to contact INX FAE Engineer for collaboration design. We can help to verify and pass risk assessment for customer reference.

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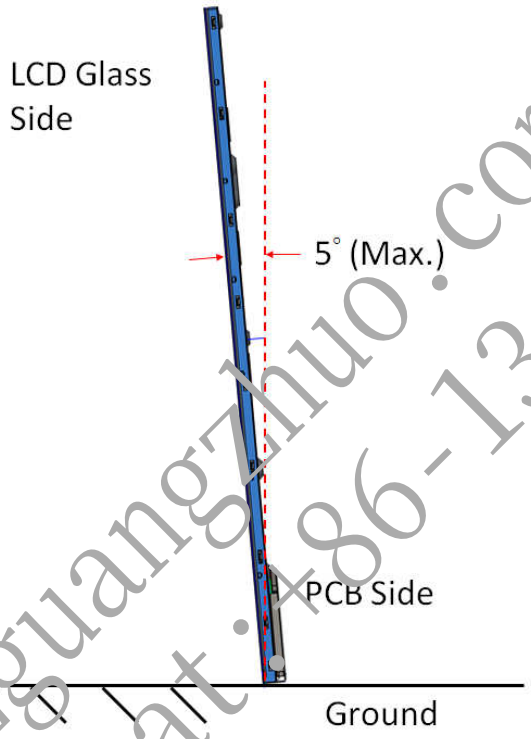
12	For MNT borderless module usage, forward tilt angle limitation.
	
Definition	For MNT borderless module usage, forward tilt angle limitation is 5° maximum. MNT borderless module LCD glass and blacklight unit are bonded by tape, to avoid tape peeling issue, we suggest for MNT borderless module usage, forward tilt angle limitation is 5° maximum. Note: If the interference can not be avoided, please feel free to contact INX FAE Engineer for collaboration design. We can help to verify and pass risk assessment for customer reference.

Appendix. OUTLINE DRAWING

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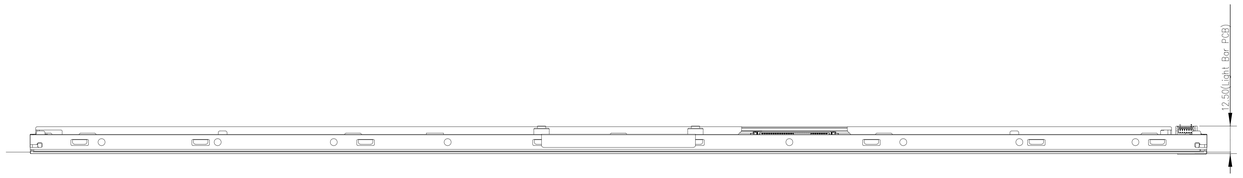
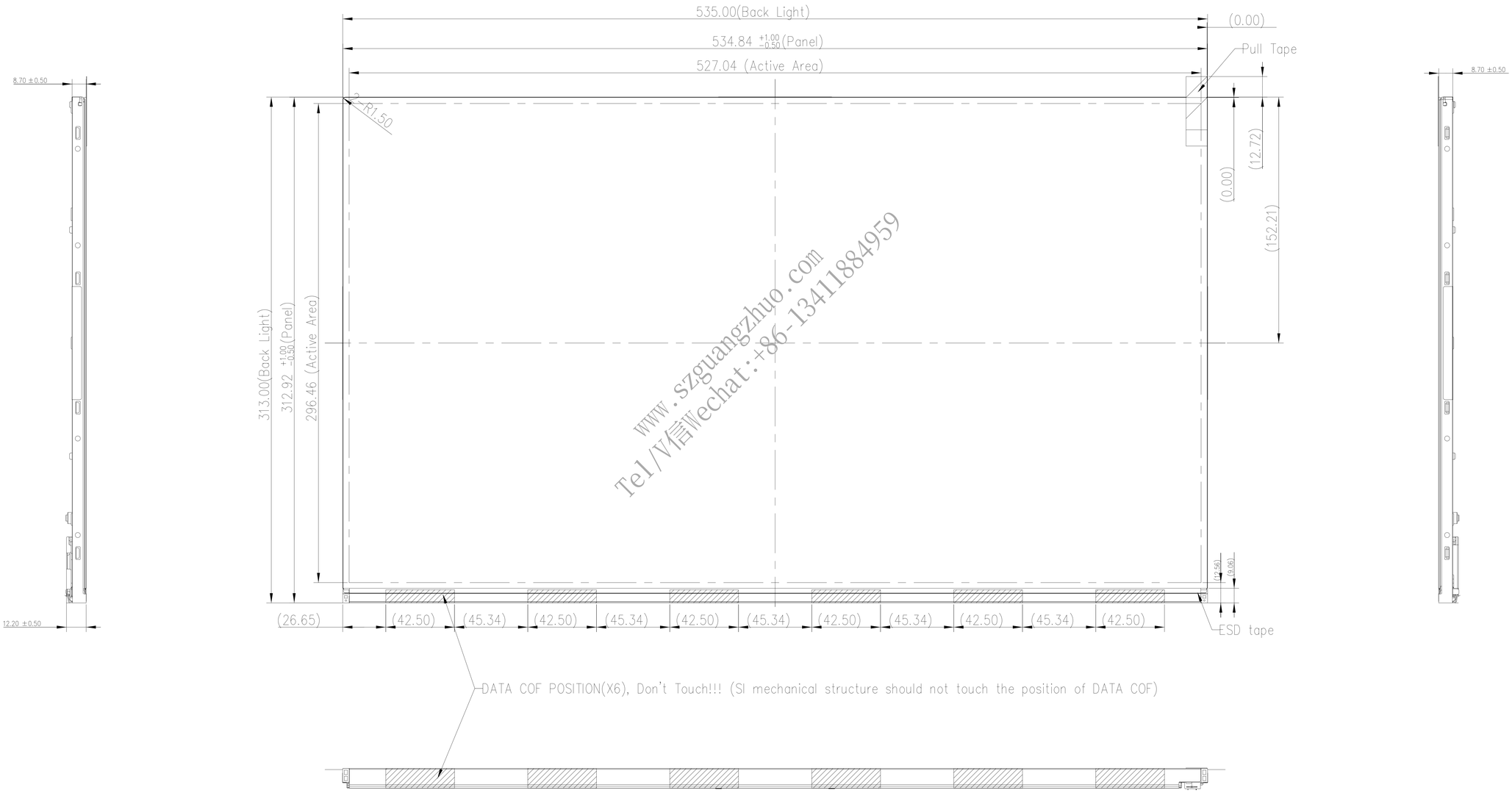
REV	EC NUMBER	DESCRIPTION	DATE
A		FIRST RELEASE	2021/12/10





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NOTES:
1."▨"COF POSITION.
2.CONNECTOR TYPE:
LVDS Con: P-TWO 187098-30091
L-BAR CON: CVILUX CI1406M1VL0-NH
3.THE DIMENSION EXCLUDE DEFORMATION.
4.TOLERANCE WITHOUT NOTICED TO BE ±0.5mm.
5.THE COF AREA IS WEAK, PLEASE DON'T PRESS THE COF AREA.
6.TORQUE OF M3 USER HOLE SHOULD BE WITHIN 6KGF-CM AND JUST RESCREW 10 TIMES.

FIG.1

TYP. DIMENSION	CONTROL DIMENSION	DATE: 2021/12/10	SCALE: 1:1
APPROVED	YS Shiu	PART NUMBER or P/N NUMBER	DRAWING NO. A
CHECKED	Alden Wan	PART DESCRIPTION outline_FU_M238HCA-LCB	SHEET NUMBER 1/2
DESIGNED	Kole Chen	INNOLUX	SIZE A0

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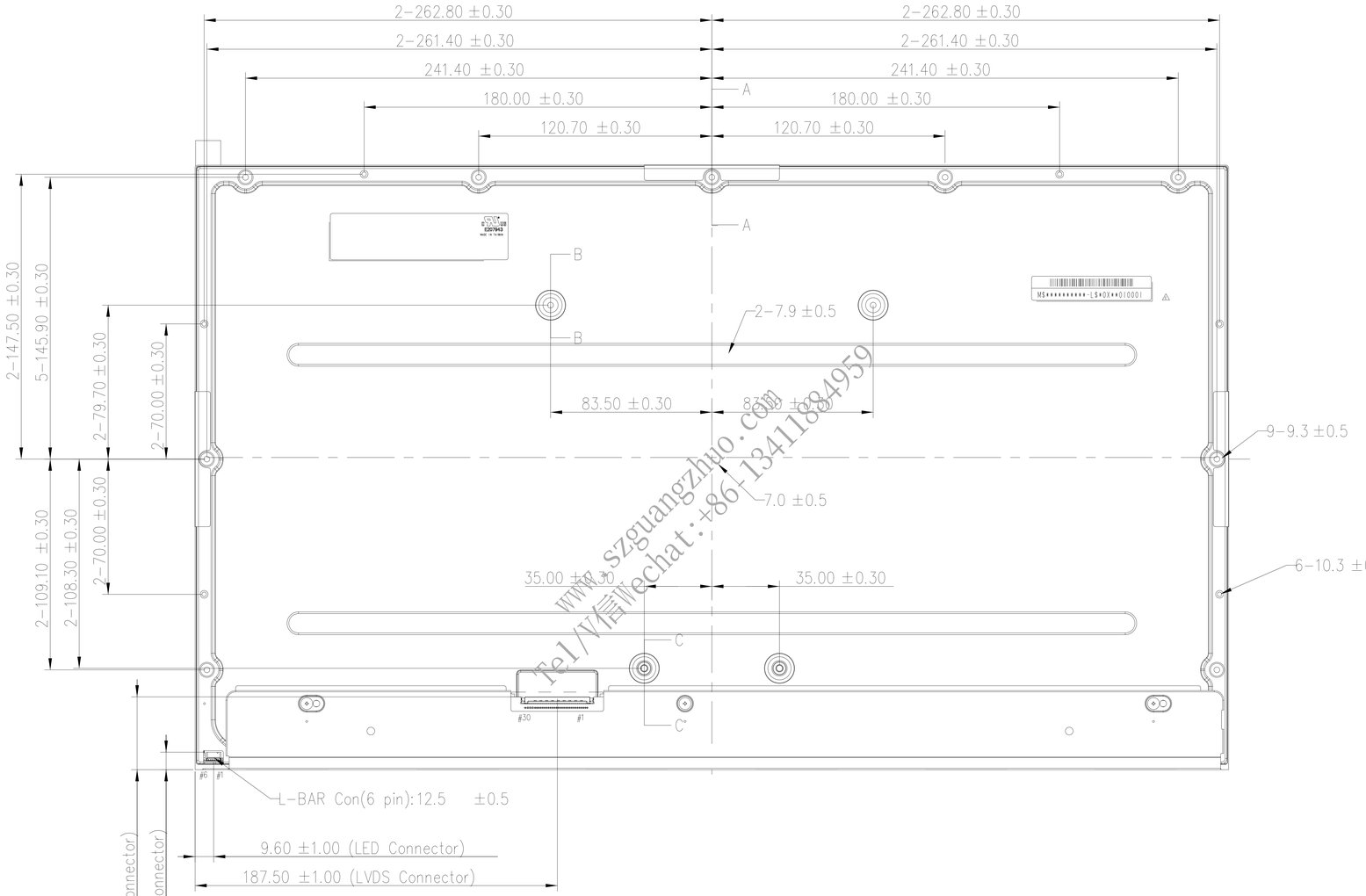
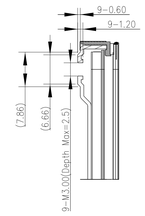
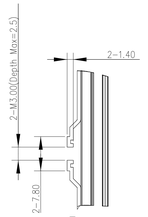
REV	EC NUMBER	DESCRIPTION	DATE
A		FIRST RELEASE	2021/12/10

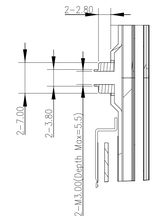




SECTION A-A
SCALE 2:1



SECTION B-B
SCALE 2:1



SECTION C-C
SCALE 2:1

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NOTES:
1." ▨ "COF POSITION.
2.CONNECTOR TYPE:
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L-BAR CON:CVILUX CI1406M1VL0-NH
3.THE DIMENSION EXCLUDE DEFORMATION.
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☒ CRITICAL DIMENSION	☒ CONTROL DIMENSION	DATE 2021/12/10	SCALE 1:1
APPROVED	YS Shiu	PART NUMBER or ITEM NUMBER	DRAWING NO. A1
CHECKED	Alden Wan	PART DESCRIPTION outline_FU_M238HCA-LC0	SHEET NUMBER 2/2
DESIGNED	Kale Chen	INNOLUX	SIZE A0

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