Doc. Number :

□Tentative Specification
□ Preliminary Specification
■ Approval Specification

MODEL NO.: M238DCJ
SUFFIX: E50

Customer:

APPROVED BY **SIGNATURE**

Name / Title
Note
Product Version C1

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

Approved By	Checked By	Prepared By
梁永祥	張耀元	羅仲良

CONTENTS

REVISION HISTORY

Version	Date	Page	Description
2.0	09, Dec., 2015	All	Spec Ver.2.0 was first issued.

1. GENERAL DESCRIPTION

1.1 OVERVIEW

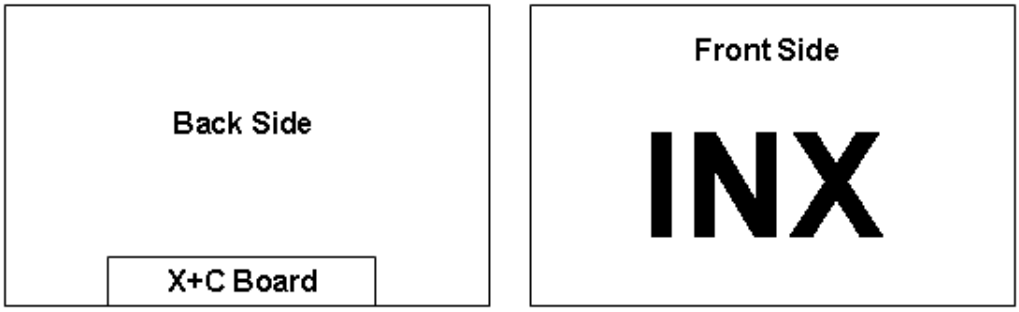
M238DCJ-E50 is a MNT 23.8” TFT Liquid Crystal Display MNT module with WLED Backlight unit and 30 pins 4-lane eDP interface. This module supports 3840 x 2160 UHD mode and can display up to 1.07G (8-bit+FRC /color) . The converter module for Backlight is not built in.

1.2 GENERAL SPECIFICATIONS

Item	Specification	Unit	Note
Screen Size	23.8” real diagonal		
Driver Element	a-si TFT active matrix	-	-
Pixel Number	3840 x R.G.B. x 2160	pixel	-
Pixel Pitch	0.13725 (H) x 0.13725 (V)	mm	-
Pixel Arrangement	RGB vertical stripe	-	-
Display Colors	1.07G colors (8-bit+FRC)	color	-
Transmissive Mode	Normally Black	-	-
Surface Treatment	AG type, 3H hard coating, Haze 25	-	-
Luminance, White	300	Cd/m2	
Color Gamut	95% of NTSC(Typ.)	-	-
Display Orientation	Signal input with “ INX”		(2)
RoHS,Halogen Free &TCO 6.0	RoHS, Halogen Free TCO 6.0 compliance		
Power Consumption	Total 35.919W (Max.) @ cell 17.199 W (Max.), BL 18.72 W (Max.)		(1)

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

Note (2)



2. MECHANICAL SPECIFICATIONS

Item		Min.	Typ.	Max.	Unit	Note
Module Size	Horizontal (H)	544.5	545	545.5	mm	(1)
	Vertical (V)	322.9	323.4	323.9	mm	
	Thickness (T)	12.2	12.7	13.2	mm	
Bezel Area	Horizontal	529.7	530.2	530.7	mm	
	Vertical	299.1	299.6	300.1	mm	
Active Area	Horizontal	-	527.04	-	mm	
	Vertical	-	296.46	-	mm	
Weight		1760	1855	1950	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	ºC	(1)
Operating Ambient Temperature	TOP	0	50	ºC	(1), (2)

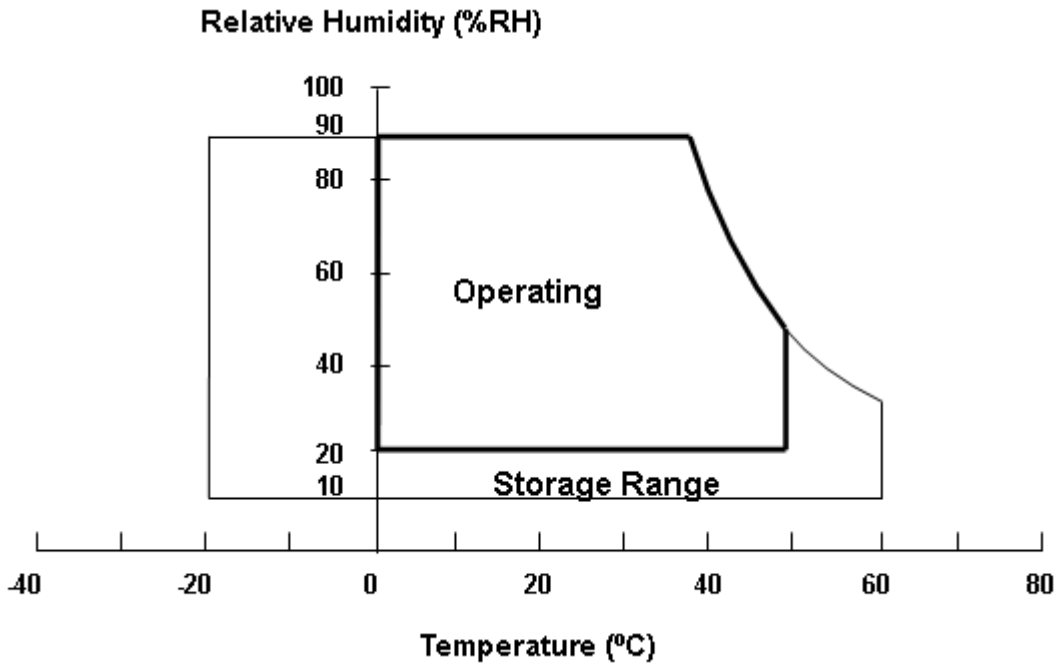
Note (1)

(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, 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℃.



3.2 ELECTRICAL ABSOLUTE RATINGS

3.2.1 TFT LCD MODULE

Item	Symbol	Value		Unit	Note
		Min.	Max.		
Power Supply Voltage	VCCS	-0.3	13.5	V	(1)
Logic Input Voltage	V_{IN}	-0.3	3.6	V	

3.2.2 BACKLIGHT UNIT

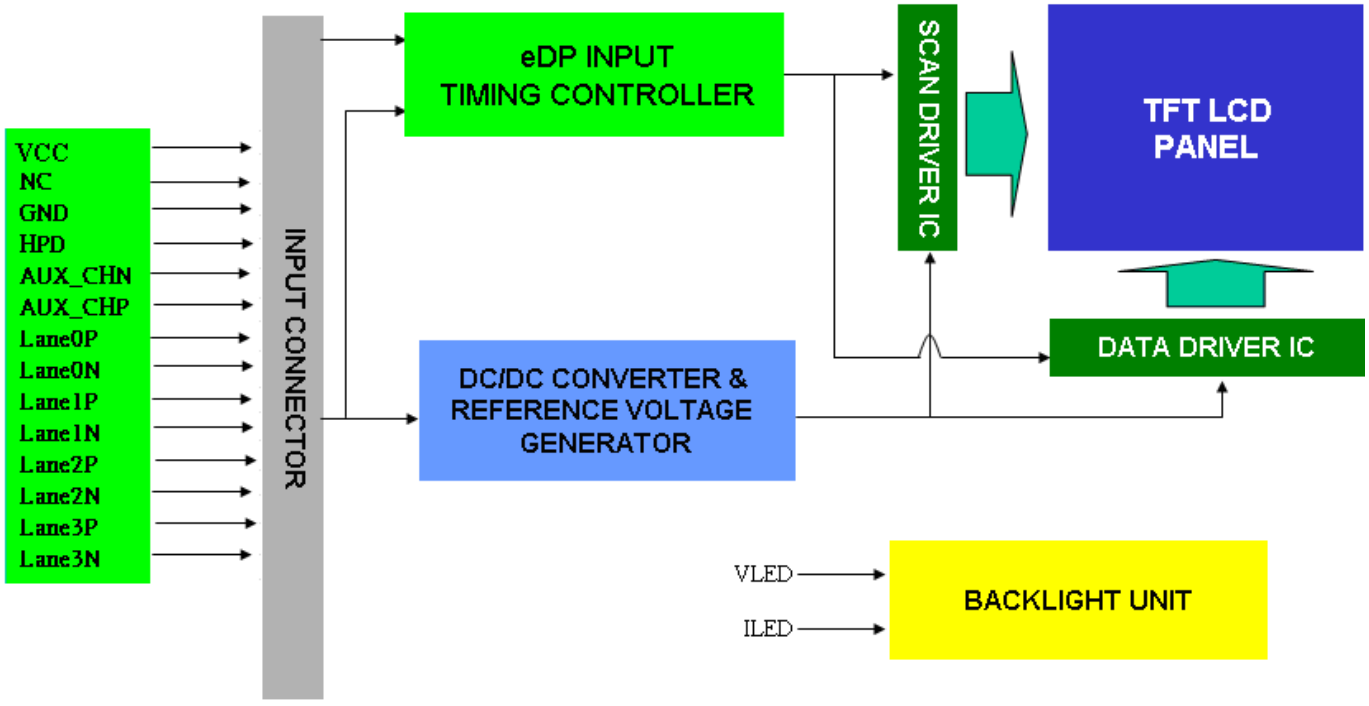
Item	Symbol	Value			Unit	Note
		Min.	Typ	Max.		
LED Forward Current Per Input Pin	I_F		90	95.4	mA	(1), (2) Duty=100%

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).

4. ELECTRICAL SPECIFICATIONS

4.1 FUNCTION BLOCK DIAGRAM



4.2. INTERFACE CONNECTIONS

CNV1 Connector Pin Assignment:[20455-030E-76(I-PEX)]

Pin	Name	Description	Note
1	VCC	Power Supply +10.0V	
2	VCC	Power Supply +10.0V	
3	VCC	Power Supply +10.0V	
4	VCC	Power Supply +10.0V	
5	VCC	Power Supply +10.0V	
6	NC	No Connection	
7	GND	Ground	
8	NC	No Connection	(2)
9	NC	No Connection	(2)
10	GND	Ground	
11	HPD	Hot Plug Detect Signal	
12	GND	Ground	
13	AUX_CHN	Component Signal for Auxiliary Channel	
14	AUX_CHP	True Signal for Auxiliary Channel	
15	GND	Ground	
16	Lane0P	True Signal for Main Link 0	(1)
17	Lane0N	Component Signal for Main Link 0	(1)
18	GND	Ground	
19	Lane1P	True Signal for Main Link 1	(1)
20	Lane1N	Component Signal for Main Link 1	(1)
21	GND	Ground	
22	Lane2P	True Signal for Main Link 2	(1)
23	Lane2N	Component Signal for Main Link 2	(1)
24	GND	Ground	
25	Lane3P	True Signal for Main Link 3	(1)
26	Lane3N	Component Signal for Main Link 3	(1)
27	GND	Ground	
28	GND	Ground	
29	NC	No Connection	(2)
30	GND	Ground	

Connector Information

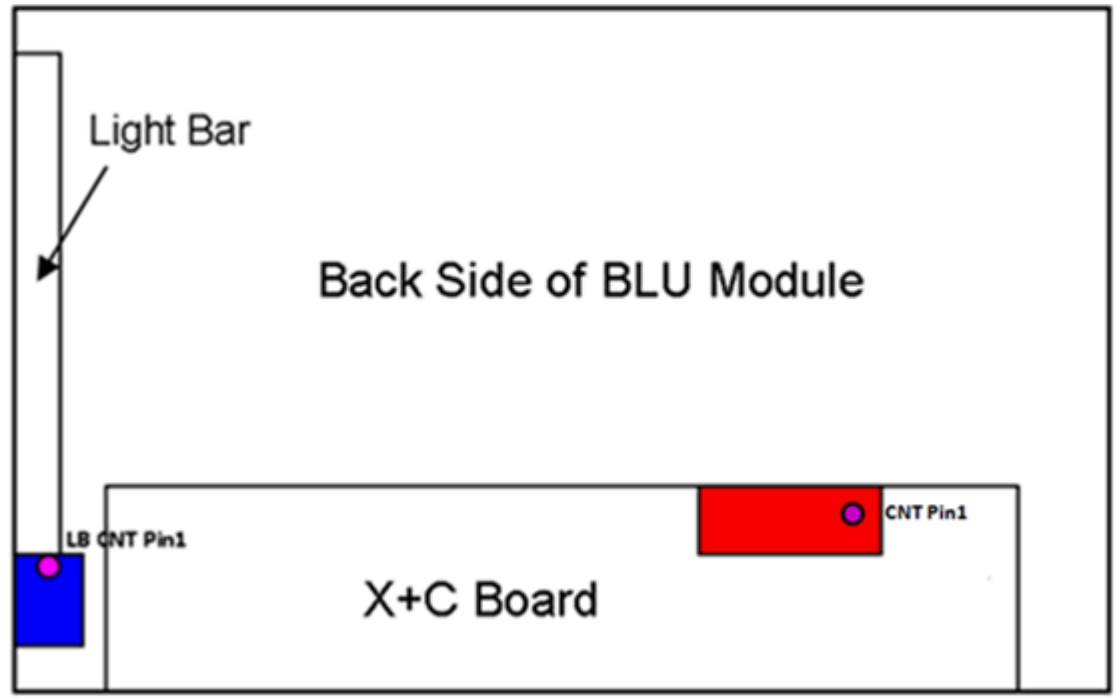
Item	Description
Manufacturer	I-PEX
Type part number	20455-030E-76

*Notice: There would be compatible issues if not using the indicated connectors in the matching list.

Note (1) eDP Four Lane Main Link

Note (2) Reserved for internal use. Please leave it open.

Note (3) eDP connector pin order defined as following:



4.3 ELECTRICAL CHARACTERISTICS

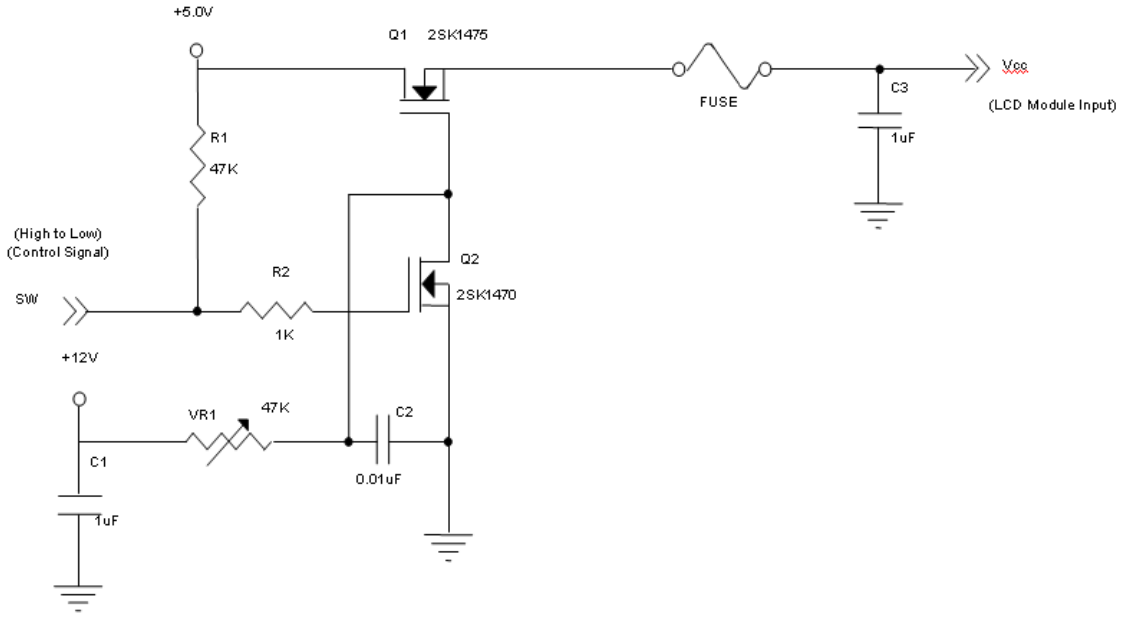
4.3.1 LCD ELETRONICS SPECIFICATION

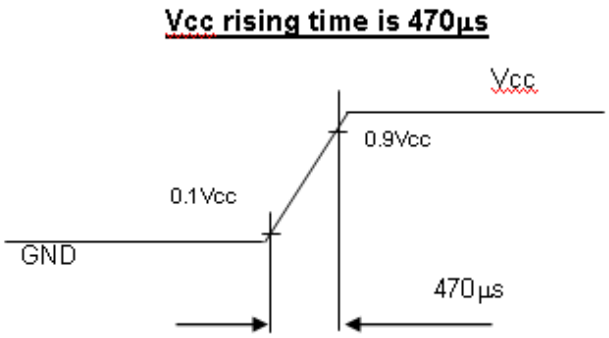
Parameter		Symbol	Value			Unit	Note
			Min.	Typ.	Max.		
Power Supply Voltage		V_{CC}	9.5	10	10.5	V	(2)
Rush Current		I_{RUSH}	–	–	3	A	(3)
Power Consumption	White Pattern	P_T	–	8.09	8.76	–	
	Black Pattern	P_T	–	7.68	8.32	–	
	Horizontal Stripe	P_T	–	14.52	15.73	–	
Power Supply Current	White Pattern	–	–	0.81	0.97	–	(4)
	Black Pattern	–	–	0.77	0.93	–	
	Horizontal Stripe	–	–	1.45	1.73	–	
eDP interface	Differential Input High Threshold Voltage	VRTH	–	–	+50	mV	
	Differential Input Low Threshold Voltage	VRTL	-50	–	–	mV	
	Differential Input Resistor	RRIN	80	100	120	ohm	
CMOS interface	Input High Threshold Voltage	VIH	2.7	–	3.3	V	
	Input Low Threshold Voltage	VIL	0	–	0.7	V	

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

Note (2) The module should be always operated within the above ranges. The ripple voltage should be controlled under 10 % of Vcc (Typ.)

Note (3) Measurement Conditions:





Note (4) The specified power supply current is under the conditions at Vcc = 10V, Ta = 25 ± 2 ºC, fv = 60 Hz, whereas a power dissipation check pattern below is displayed.

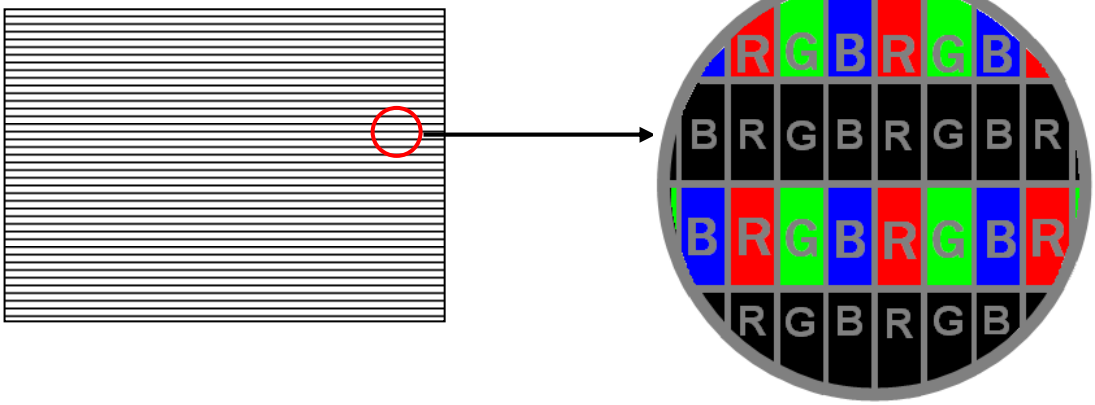
a. White Pattern

Active Area

b. Black Pattern

Active Area

c. Horizontal Stripe



4.3.2 BACKLIGHT UNIT

Parameter	Symbol	Value			Unit	Note
		Min.	Typ.	Max.		
LED Light Bar Input Voltage Per Input Pin	VPIN		48	52	V	(1), Duty=100%, IPIN=90mA
LED Light Bar Current Per Input Pin	IPIN	84.6	90	95.4	mA	(1), (2) Duty=100%
LED Life Time	LLED	30000			Hrs	(3)
Power Consumption	PBL	---	17.28	18.72	W	(1) Duty=100%, IPIN=90mA

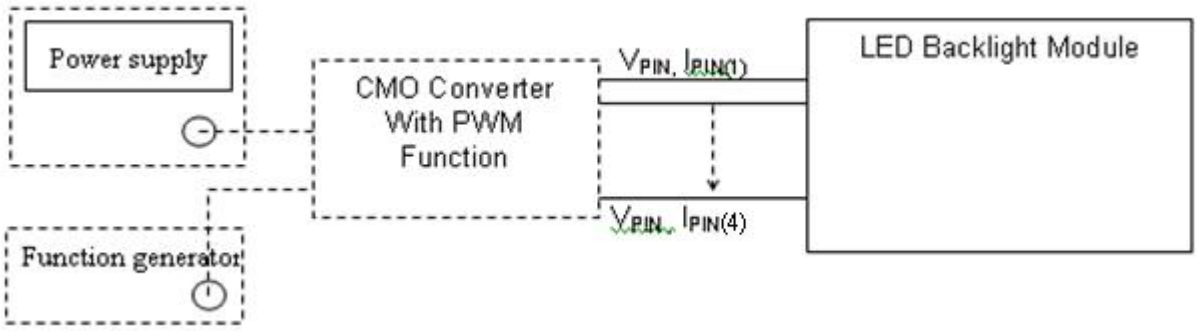
Note (1) LED light bar input voltage and current are measured by utilizing a true RMS multimeter as shown below:

Note (2) PBL = IPIN × VPIN × (4) input pins ,

Note (3) The lifetime of LED is defined as the time when LED packages continue to operate under the conditions at Ta = 25 ±2 ℃ and I= 90 mA (per chip) until the brightness becomes ≦ 50% of its original value.

Note (4) The module must be operated with constant driving current.

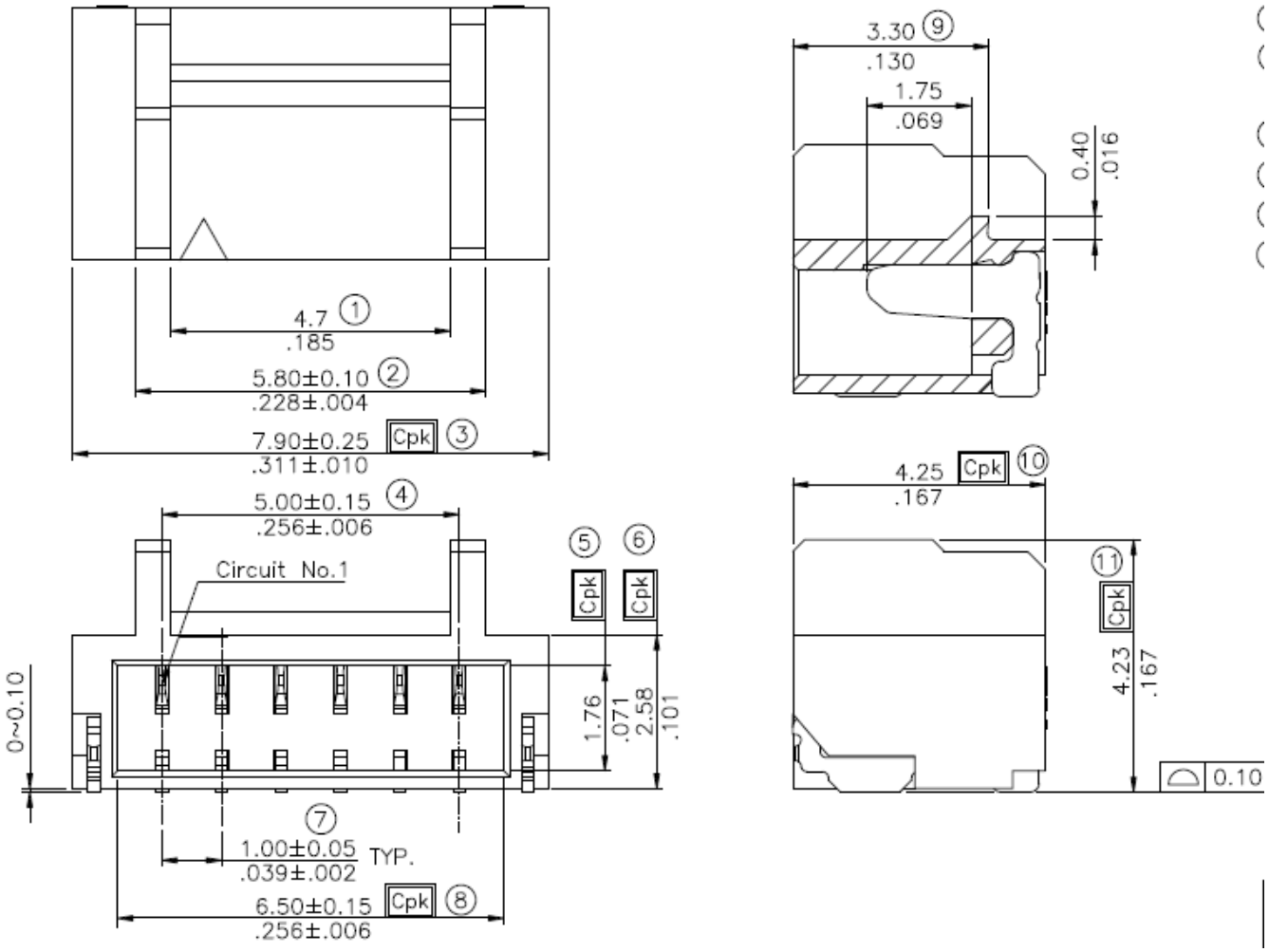
Note (5) If converter has PWM function, the PWM Frequency setting must be over 480Hz.

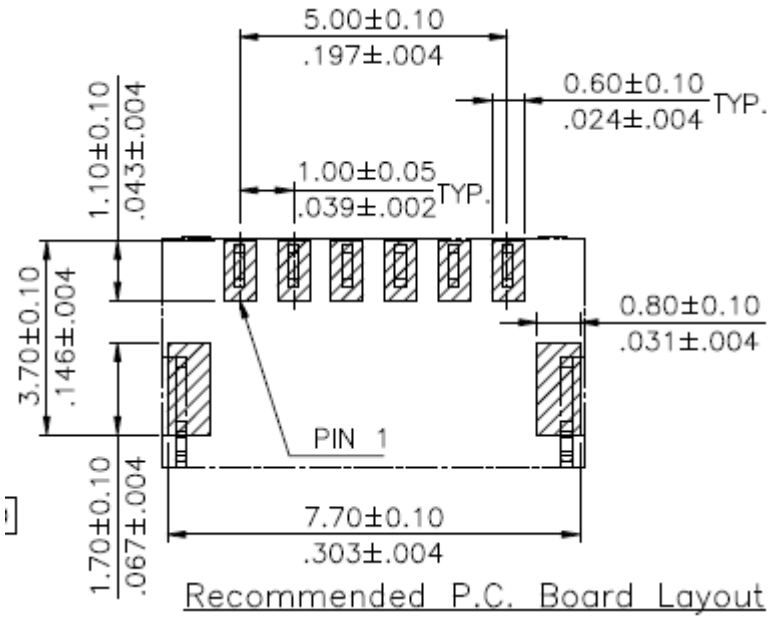


4.3.3 LIGHTBAR CONNECTOR PIN ASSIGNMENT

Connector: WM13-406-063N (FCN)

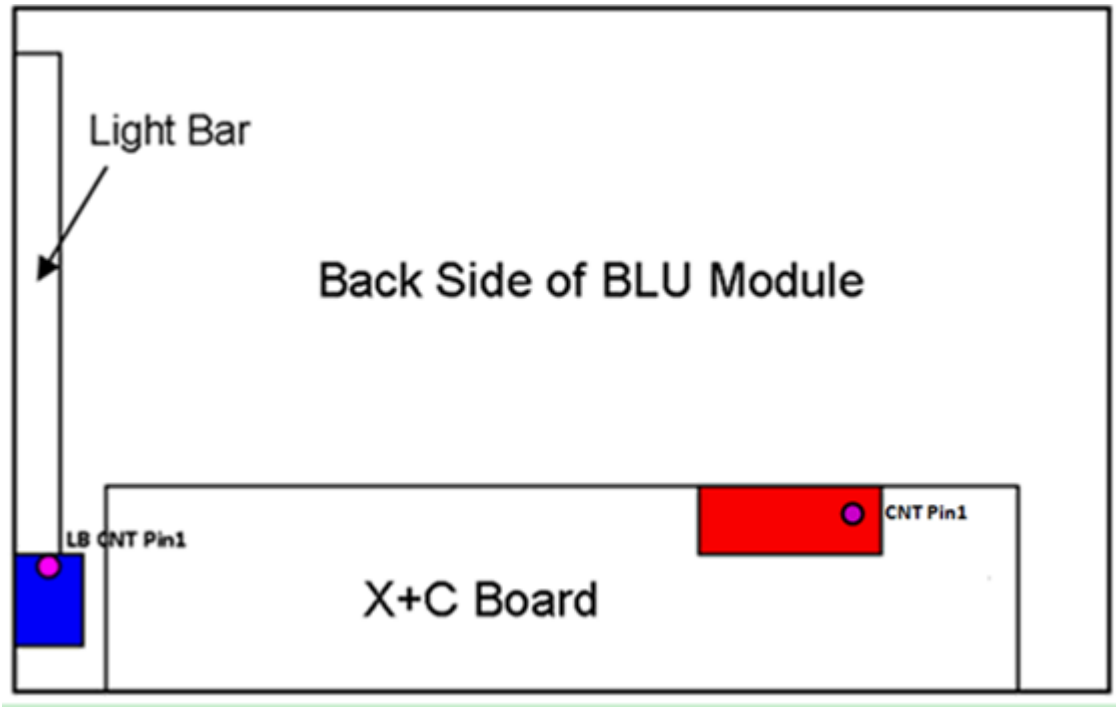
CI1406M1HRK-NH(CviLux) or Compatible, FFC or Wire Harness





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



4.4 eDP INPUT SIGNAL SPECIFICATIONS

4.4.1 eDP DATA MAPPING TABLE

Lane 0	Lane 1	Lane 2	Lane 3
R0-9:2	R1-9:2	R2-9:2	R3-9:2
R0-1:0|G0-9:4	R1-1:0|G1-9:4	R2-1:0|G2-9:4	R3-1:0|G3-9:4
G0-3:0|B0-9:6	G1-3:0|B1-9:6	G2-3:0|B2-9:6	G3-3:0|B3-9:6
B0-5:0|R4-9:8	B1-5:0|R5-9:8	B2-5:0|R6-9:8	B3-5:0|R7-9:8
R4-7:0	R5-7:0	R6-7:0	R7-7:0
G4-9:2	G5-9:2	G6-9:2	G7-9:2
G4-1:0|B49:4	G5-1:0|B5-9:4	G6-1:0|B6-9:4	G7-1:0|B7-9:4
B4-3:0|R8-9:6	B5-3:0|R9-9:6	B6-3:0|R10-9:6	B7-3:0|R11-9:6
R8-5:0|G8-9:8	R9-5:0|G9-9:8	R10-5:0|G10-9:8	R11-5:0|G11-9:8
G8-7:0	G9-7:0	G10-7:0	G11-7:0
B8-9:2	B9-9:2	B10-9:2	B11-9:2
B8-1:0|R12-9:4	B9-1:0|R13-9:4	B10-1:0|R14-9:4	B11-1:0|R15-9:4
R12-3:0|G12-9:6	R13-3:0|G13-9:6	R14-3:0|G14-9:6	R15-3:0|G15-9:6
G12-5:0|B12-9:8	G13-5:0|B13-9:8	G14-5:0|B14-9:8	G15-5:0|B15-9:8
B12-7:0	B13-7:0	B14-7:0	B15-7:0

4.4.2 COLOR DATA INPUT ASSIGNMENT

The brightness of each primary color (red, green and blue) is based on the 10-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 in

Color		Data Signal																													
		Red										Green										Blue									
		R9	R8	R7	R6	R5	R4	R3	R2	R1	R0	G9	G8	G7	G6	G5	G4	G3	G2	G1	G0	B9	B8	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	0	0	0	0	0	0
	Red	1	1	1	1	1	1	1	1	1	1	0	0	0	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	0	0	1	1	1	1	1	1	1	1	1	1	0	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	0	0	0	0	1	1	1	1	1	1	1	1	1	1
	Cyan	0	0	0	0	0	0	0	0	0	0	1	1	1	1	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	1	1	0	0	0	0	0	0	0	0	0	0	1	1	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	1	1	1	1	0	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	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	0	0	0	0	0	0
	Red (1)	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Red (2)	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
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	Red (1021)	1	1	1	1	1	1	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Red (1022)	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Red (1023)	1	1	1	1	1	1	1	1	1	1	0	0	0	0	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	0	0	0	0	0	0
	Green (1)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
	Green (2)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
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	Green (1021)	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	0	1	0	0	0	0	0	0	0	0	0	0
	Green (1022)	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0
	Green (1023)	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0
Gray Scale Of Blue	Blue (0) / Dark	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	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	0	0	0	0	0	1	0
	Blue (2)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
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	Blue (1021)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	0	1
	Blue (1022)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	0
	Blue (1023)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1

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

4.4.3 eDP Main Link Signal

Parameter	Symbol	Min	Typ	Max	Unit	Notes
Unit Interval for high bit rate (5.4Gbps / lane)	UI_HBR2	-	185	-	ps	
Link Clock Down Spreading	Amplitude	0	-	0.5	%	
	Frequency	30		33	kHz	
Differential peak-to-peak voltage at Sink side connector	V-DIFFp-p	150	-	1320	mV	Note 6,7
EYE width at Sink side connector	Rx-EYE-CONN	0.51	-	-	UI	Note 6,7
Rx DC common mode voltage	VCM	-	0	2.0	V	
Lane-to-Lane skew	Rx-skew-inter_pair	-	-	20	UI	Note 8
Lane intra-pair skew	Rx-skew-intra_pair	-	-	50	ps	Note 9
AC Coupling Capacitor	Csource_ML	75		200	nF	Source side

Note (1) Termination resistor is typically integrated into the transmitter and receiver implementations.

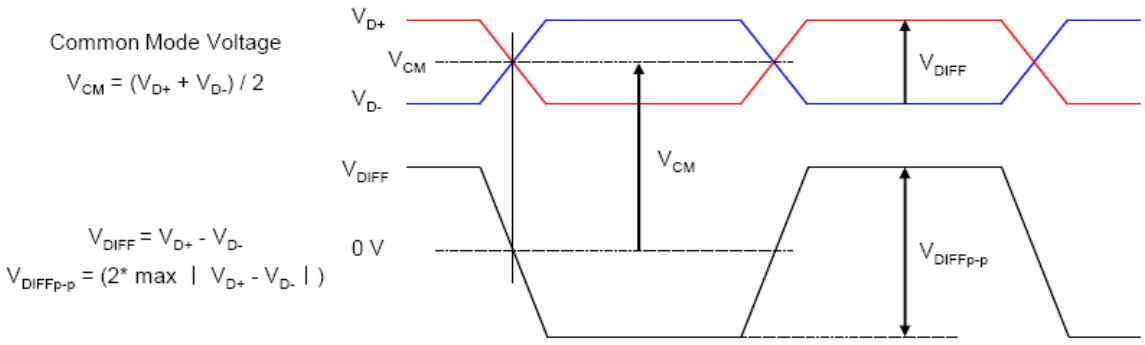
Note (2) In cabled embedded system, it is recommended the system designer ensure that EYE width and voltage are met at the sink side connector pins.

Note (3) Mismatched common mode voltage will occur abnormal display.

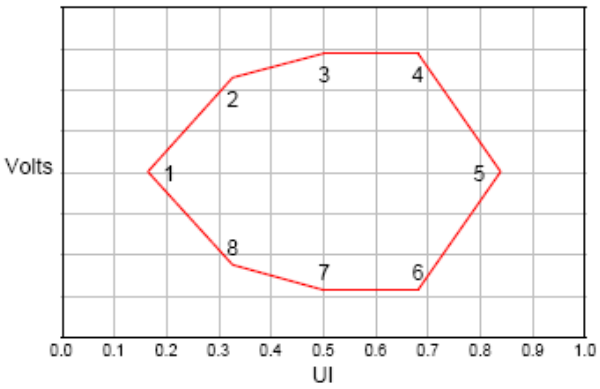
Note (4) All eDP electrical spec is measured at sink connector side.

Note (5) eDP cable Impedance should be 85ohm ± 10%.

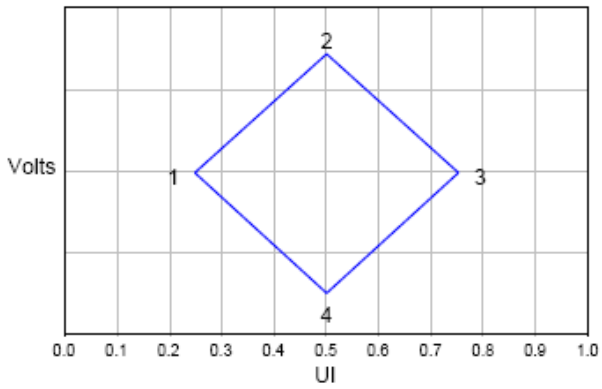
Note (6) Definition of Differential Voltage



Note (7) Main Link EYE Diagram



[EYE Mask at Source Connector Pins]



[EYE Mask at Sink Connector Pins]

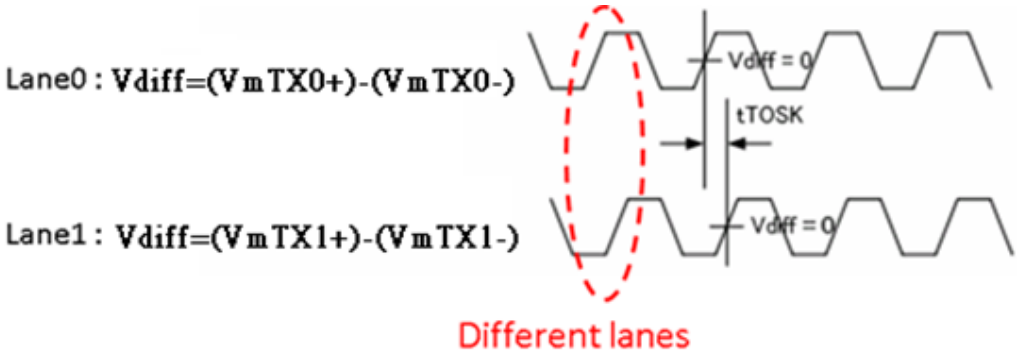
Point	HBR2	
	Time(UI)	Voltage(V)
1	0.21	0
2	0.355	0.14
3	0.5	0.175
4	0.645	0.175
5	0.79	0
6	0.645	-0.175
7	0.5	-0.175
8	0.355	-0.14

[EYE Mask Vertices at Source Connector Pins]

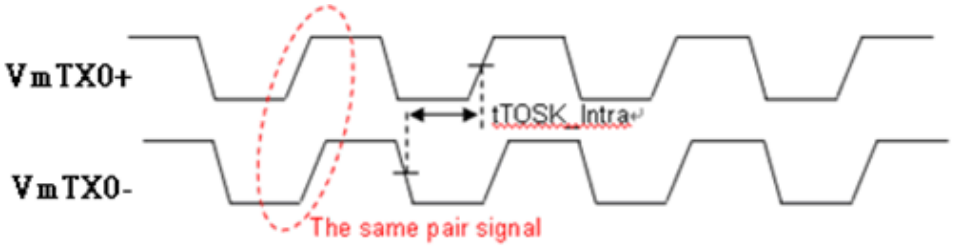
Point	HBR	
	Time(UI)	Voltage(V)
1	0.246	0.000
2	0.500	0.075
3	0.755	0.000
4	0.500	-0.075

[EYE Mask Vertices at embedded DP Sink Connector Pins]

Note (8) eDP Inter-pair skew



Note (9) eDP Intra-pair skew



4.4.4 eDP AUX Channel Signal

Parameter	Symbol	Min	Typ	Max	Unit	Notes
AUX Unit Interval	UI	0.4	-	0.6	us	
AUX Jitter at Tx IC Package Pins	T jitter	-	-	0.04	UI	Equal to 24ns
AUX Jitter at Rx IC Package Pins		-	-	0.05	UI	Equal to 30ns
AUX Peak-to-peak voltage at Connector Pins of Receiving	V_AUX-DIFFp-p	0.27	-	1.36	V	
AUX Peak-to-peak voltage at Connector Pins of Transmitting		0.29	-	1.38	V	
AUX DC common mode voltage	V_AUX-CM_Rx	0		2.0	V	
AC Coupling Capacitor	Csource_ML	75		200	nF	Source side

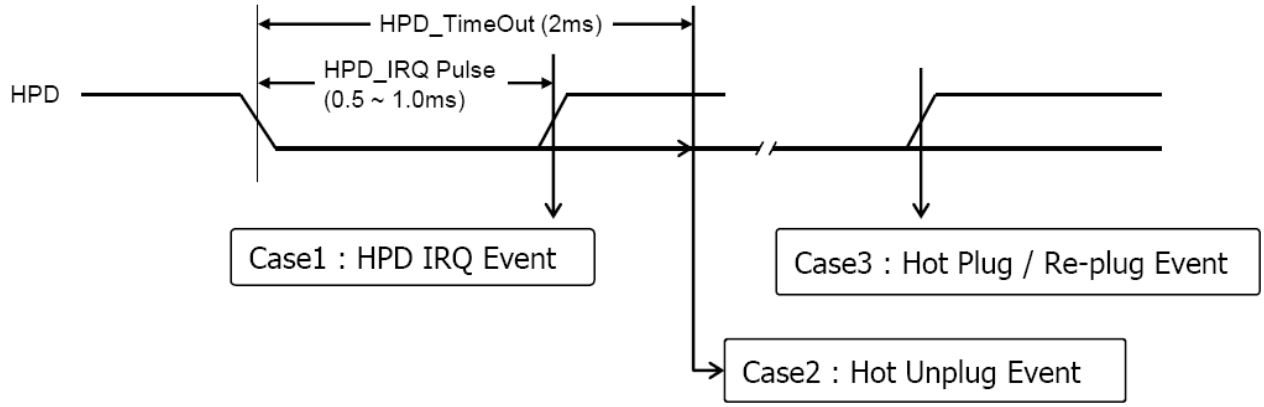
Note (1) Termination resistor is typically integrated into the transmitter and receiver implementations.

Note (2) $V_{AUX-DIFFp-p} = 2*|V_{AUXP}-V_{AUXN}|$

Note (3) Termination resistor should be ±50ohm at source side to AUX level.

Note (4) Mismatched common mode voltage will occur abnormal display.

4.4.5 eDP HPD Signal



Parameter	Symbol	Min	Typ	Max	Unit	Notes
HPD Voltage	HPD	2.25	-	3.6	V	Sink side Driving
Hot Plug Detection Threshold		2	-	-	V	Source side Detecting
Hot Unplug Detection Threshold		-	-	0.8	V	
HPD_IRQ Pulse Width	HPD_IRQ	0.5	-	1	ms	
HPD_TimeOut		2	-	-	ms	HPD Unplug Event

Note (1) HPD IRQ : Sink device wants to notify the Source device that Sink's status has changed so it toggles HPD line, forcing the Source device to read its Link / Sink Receiver DPCD field via the AUX-CH

Note (2) HPD Unplug : The Sink device is no longer attached to the Source device and the Source device may then disable its Main Link as a power-saving measure

Note (3) Plug / Re-plug : The Sink device is now attached to the Source device, forcing the Source device to read its Receiver capabilities and Link/Sink status Receiver DPCD fields via the AUX-CH

4.5 DISPLAY TIMING SPECIFICATIONS

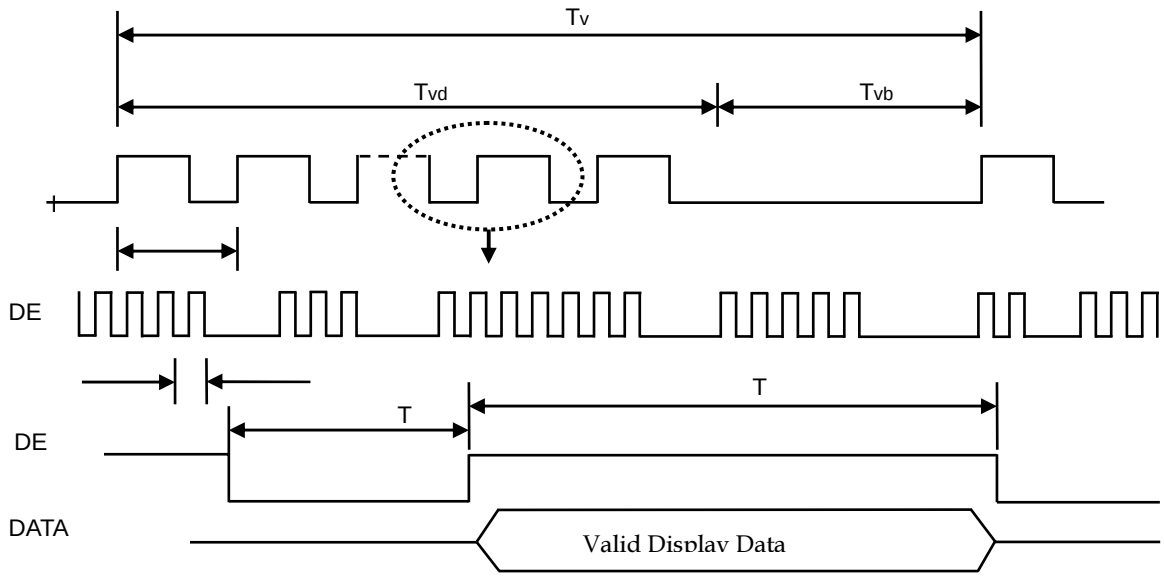
The input signal timing specifications are shown as the following table and timing diagram. (Ta = 25 ± 2 ºC)

Signal	Item	Symbol	Min.	Typ.	Max.	Unit	Note
eDP	Frequency	Fc		533.25		MHz	(1)
Vertical Display Term	Frame Rate	Fr	59.7	60	60.3	Hz	
	Total	Tv	2222	2222	2222	Th	Tv=Tvd+Tvb
	Active Display	Tvd	2160	2160	2160	Th	-
	Blank	Tvb	62	62	62	Th	-
Horizontal Display Term	Total	Th	3980	4000	4020	Tc	Th=Thd+Thb
	Active Display	Thd	3840	3840	3840	Tc	-
	Blank	Thb	140	160	180	Tc	-

Note (1) Please make sure the range of pixel clock has follow the below equation：

Fclkin(max) ≧ Fr × Tv × Th

Fr × Tv × Th ≧ Fclkin (min)



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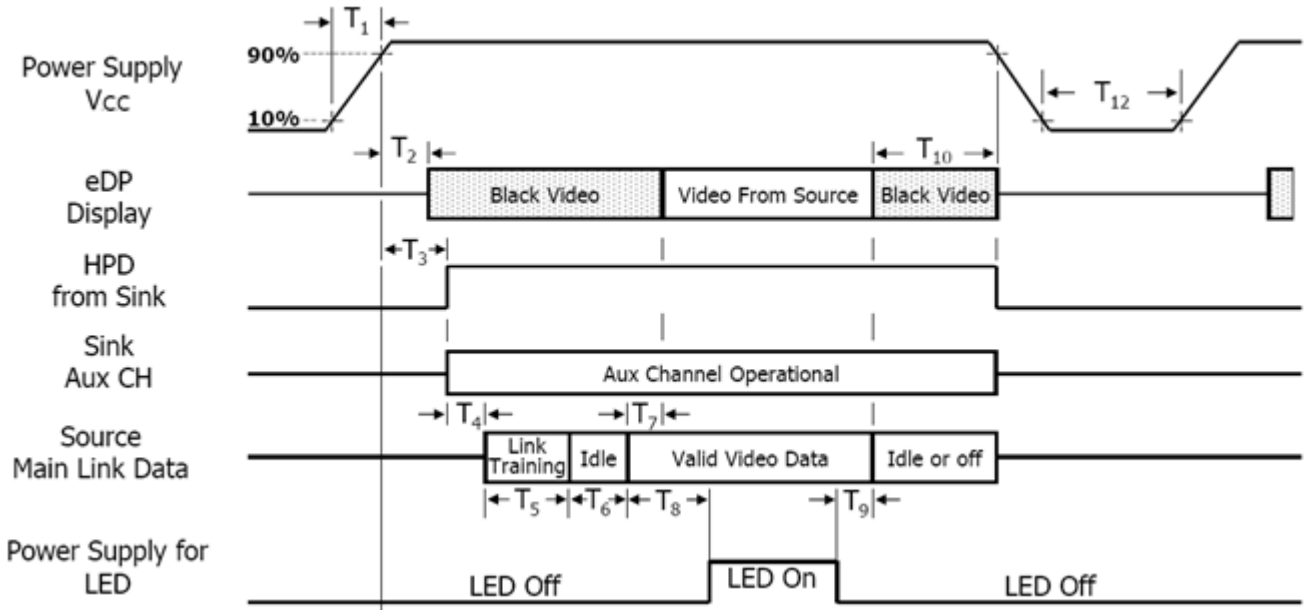
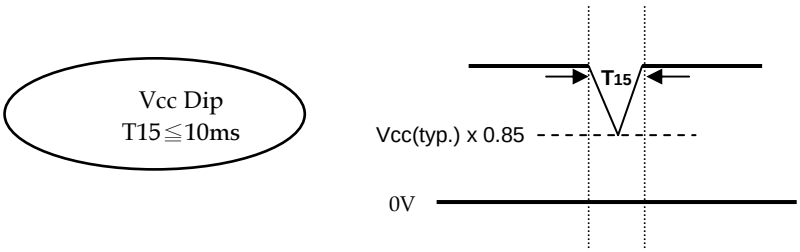
4.6 POWER ON/OFF SEQUENCE

(Ta = 25 ± 2 ºC)

To prevent a latch-up or DC operation of LCD module, the power on/off sequence should be as the diagram below.





Timing Parametr	Required By	Limits		Units	Notes
		Min	Max		
T1	Source	0.5	10	ms	
T2	Sink	10	200	ms	
T3	Sink	15	200	ms	
T4	Source	-	-	ms	
T5	Source	-	-	ms	
T6	Source	-	50	ms	
T7	Sink	0	50	ms	
T8	Source	200	-	ms	
T9	Source	-	-	ms	
T10	Source	0	500	ms	
T12	Source	500	-	ms	

Note (1) The supply voltage of the external system for the module input should follow the definition of **Vcc**

Note (2) Apply the LED voltage within the LCD operation range. When the backlight turns on before the LCD operation or the LCD turns off before the backlight turns off, the display may momentarily become abnormal screen.

Note (3) In case of **Vcc** is in off level, please keep the level of input signals on the low or high impedance. If T2<0,that maybe cause electrical overstress failure.

Note (4) **T12** 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) **Vcc** must decay smoothly when power-off.

5. OPTICAL CHARACTERISTICS

5.1 TEST CONDITIONS

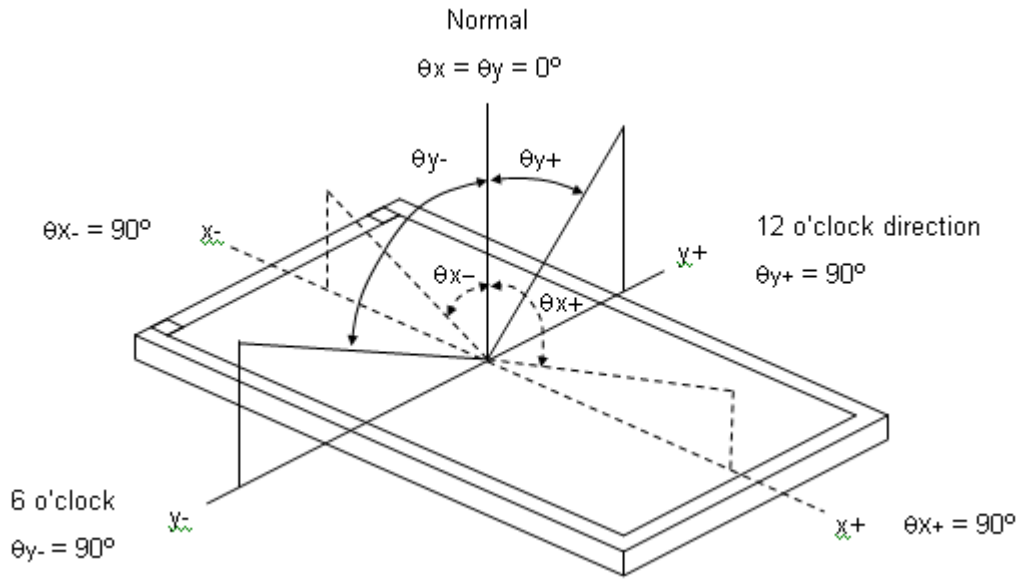
Item	Symbol	Value	Unit
Ambient Temperature	Ta	25±2	°C
Ambient Humidity	Ha	50±10	%RH
Supply Voltage	V_{CC}	5	V
Input Signal	According to typical value in "3. ELECTRICAL CHARACTERISTICS"		
LED Light Bar Input Current Per Input Pin	I_{PIN}	90	mA_{DC}
PWM Duty Ratio	D	100	%
LED Light Bar Test Converter	INX 27-D041745		

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	0.685	Typ + 0.03	-	(1), (5)
		Ry			0.310			
	Green	Gx			0.260			
		Gy			0.685			
	Blue	Bx			0.152			
		By			0.055			
	White	Wx			0.313			
		Wy			0.329			
Center Luminance of White (Center of Screen)		L_C		240	300	-	cd/m^2	(4), (5)
Contrast Ratio (Center of Screen)		CR		700	1000	-	-	(2), (5)
Response Time			θ_x=0°, θ_Y =0°		9.5	20	ms	(3)
White Variation		W	θ_x=0°, θ_Y =0°	-	-	1.42	-	(5), (6)
Viewing Angle	Horizontal	x- + x+	CR ≧ 10	160	178	-	Deg.	(1), (5)
	Vertical	y- + y+		160	178	-		

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



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

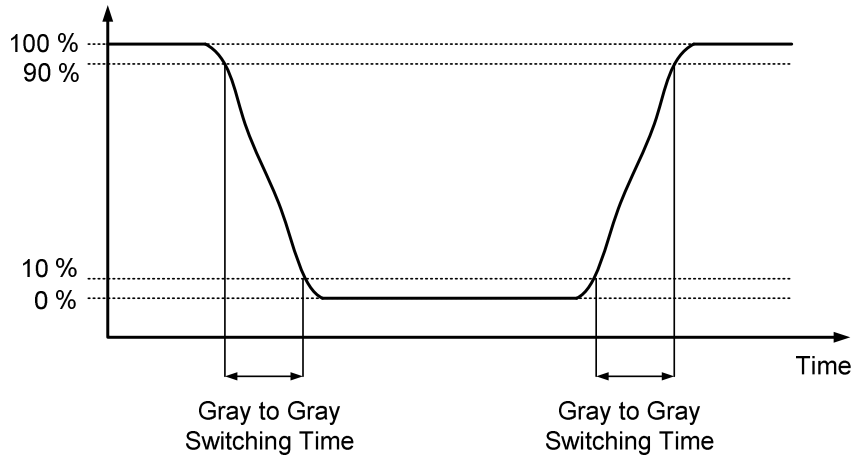
L 0: Luminance of gray level 0

CR_C = CR (5)

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

Note (3) Definition of Gray-to-Gray Switching Time:

Optical Response



The driving signal means the signal of gray level 0, 31, 63, 95, 127, 159, 191, 223 and 255.

Gray to gray average time means the average switching time of gray level 0, 31, 63, 95, 127, 159, 191, 223 and 255 to each other

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

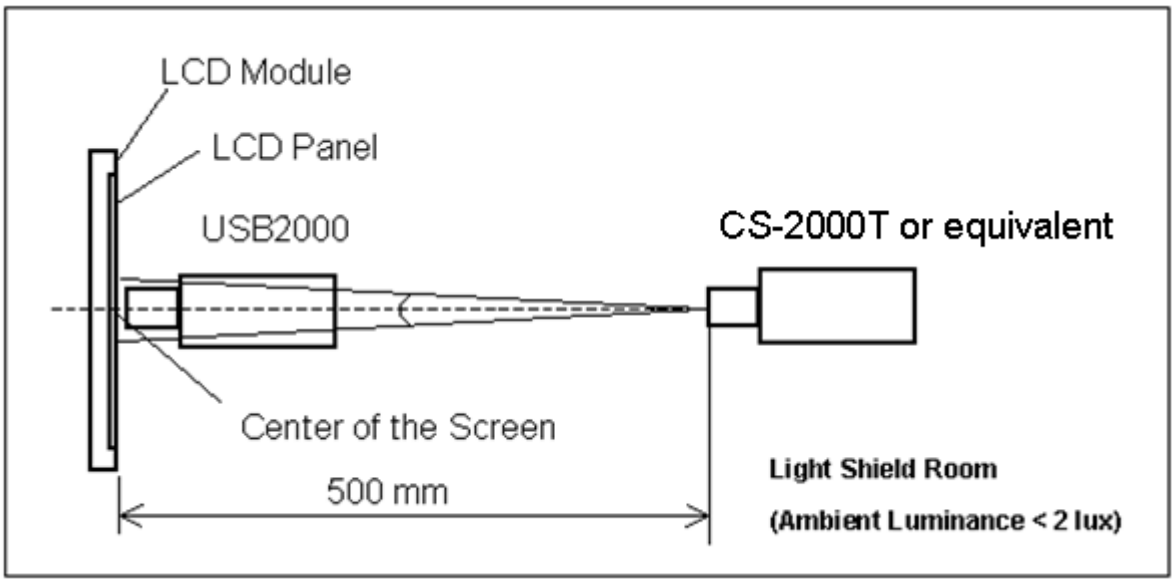
Measure the luminance of gray level 255 at center point

L_C = L (5)

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

Note (5) Measurement Setup:

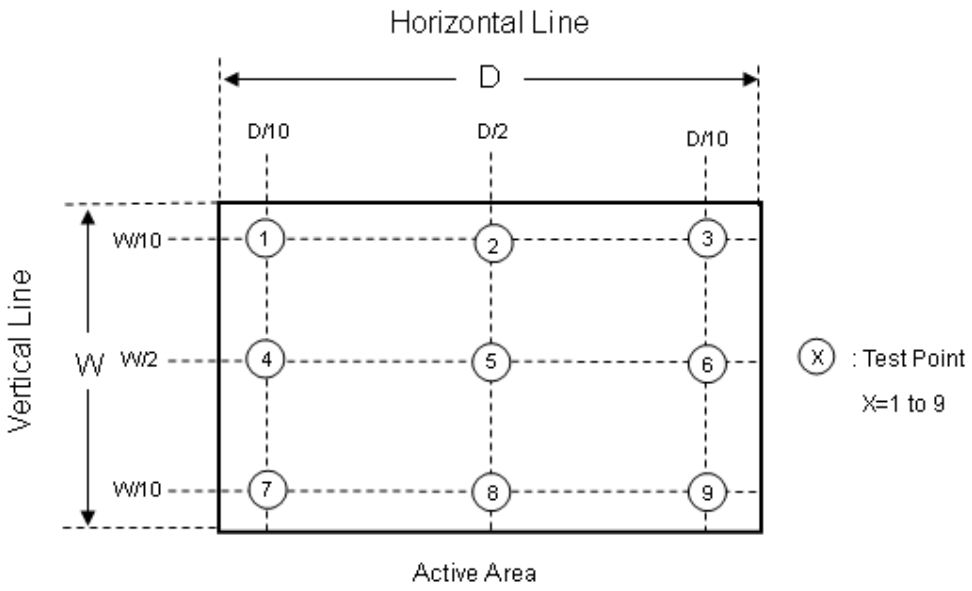
The LCD module should be stabilized at given temperature for 40 minutes to avoid abrupt temperature change during measuring. In order to stabilize the luminance, the measurement should be executed after lighting Backlight for 40 minutes in a windless room.



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

Measure the luminance of gray level 255 at 9 points

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



6. RELIABILITY TEST ITEM

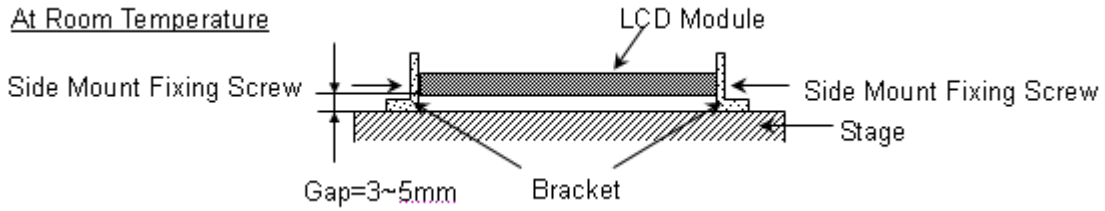
Items	Required Condition	Note
Temperature Humidity Bias (THB)	Ta= 50℃ , 80%RH, 240hours	
High Temperature Operation (HTO)	Ta= 50℃ , 240hours	
Low Temperature Operation (LTO)	Ta= 0℃ , 240hours	
High Temperature Storage (HTS)	Ta= 60℃ , 240hours	
Low Temperature Storage (LTS)	Ta= -20℃ , 240hours	
Vibration Test (Non-operation)	Acceleration: 1.5 G Wave: 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℃/30min , 60℃ / 30min , 100 cycles	
On/Off Test	25℃ ,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 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:



7. MECHANICAL STRENGTH CHARACTERISTICS

7.1 MECHANICAL STRENGTH SPECIFICATIONS

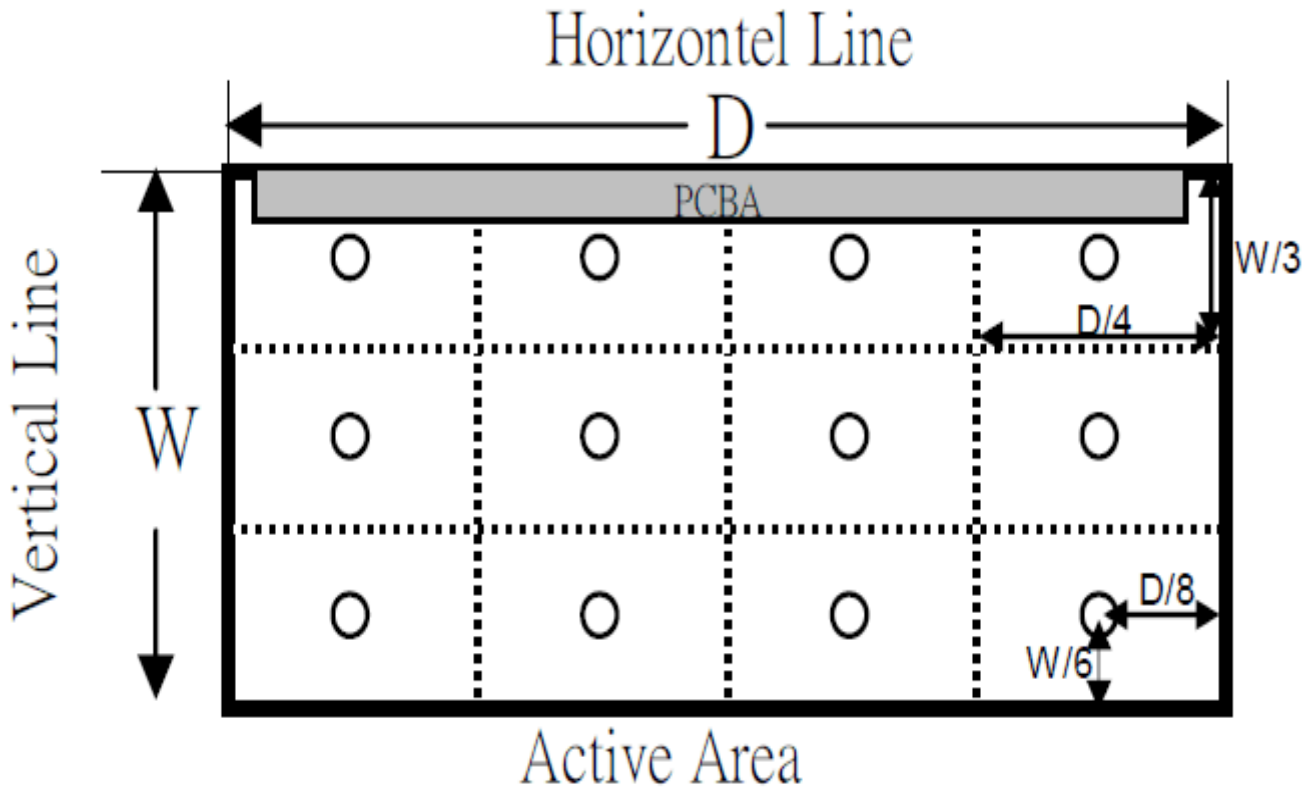
Item	Condition	Min	Unit	Note
Mechanical Strength	128th Gray Pattern	0.6	Kgf	

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, these points are not included).



8. PACKAGING

8.1 PACKING SPECIFICATIONS

(1) 11 LCD modules / 1 Box

(2) Box dimensions: 620(L) X 348(W) X 430(H) mm

(3) Weight: approximately: 28.3kg (11 modules per box)

8.2 PACKAGING METHOD

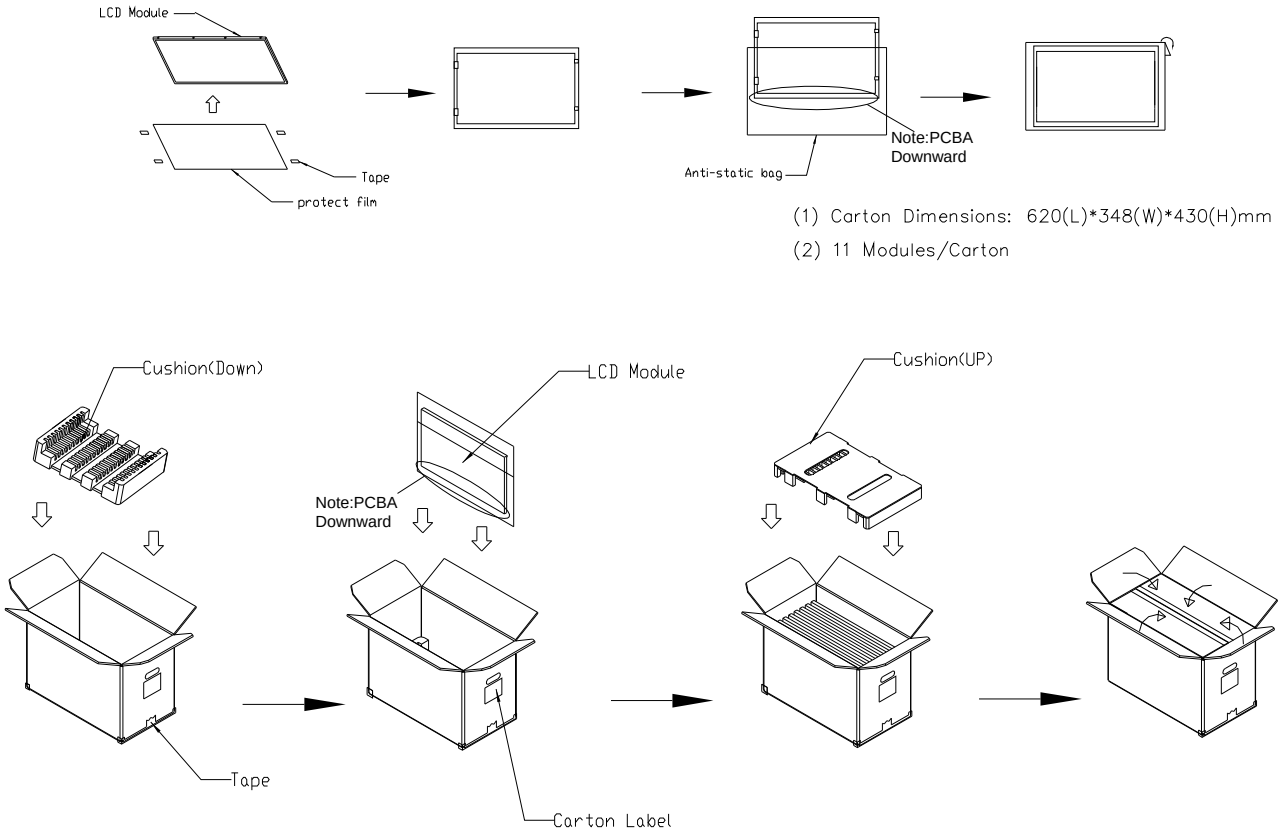
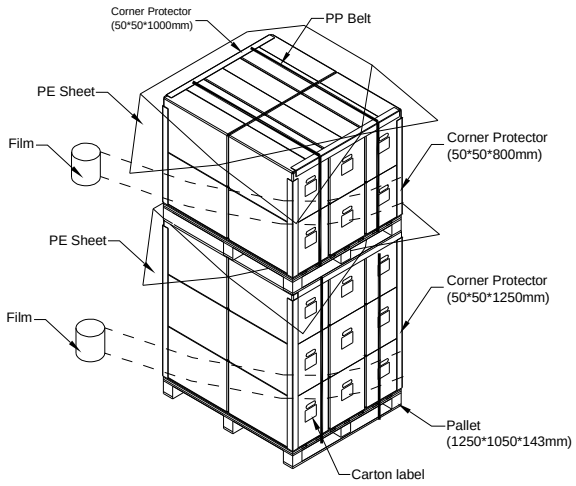


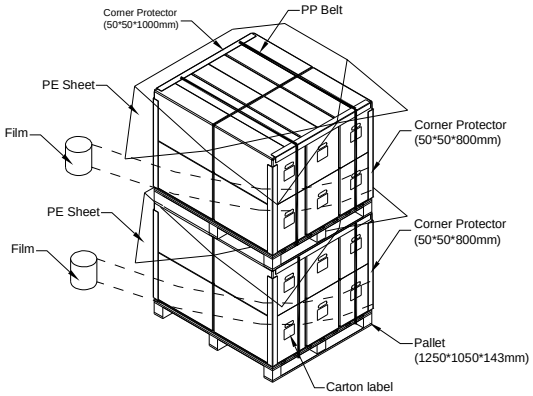
Figure 8-1 packing method

For ocean

Sea / Land Transportation (40ft HQ Container)



Sea / Land Transportation (40ft/20ft Container)



For air

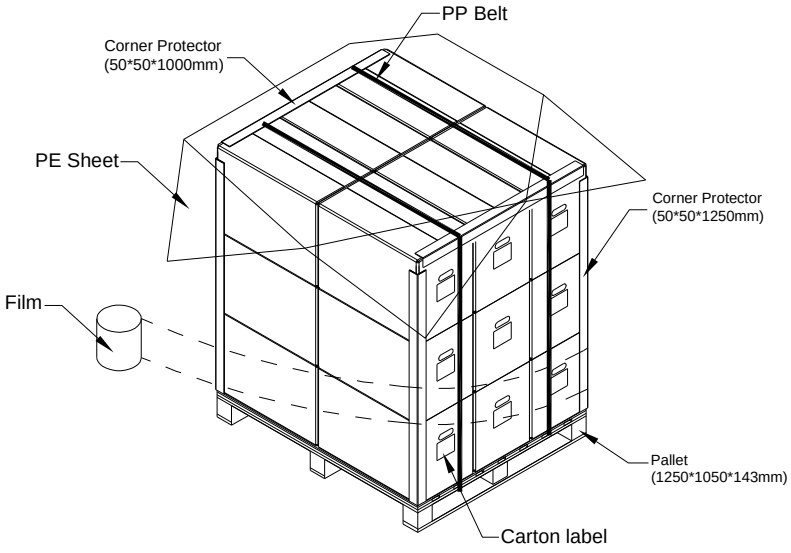


Figure 8-2 packing method

8.3 UN-PACKAGING METHOD

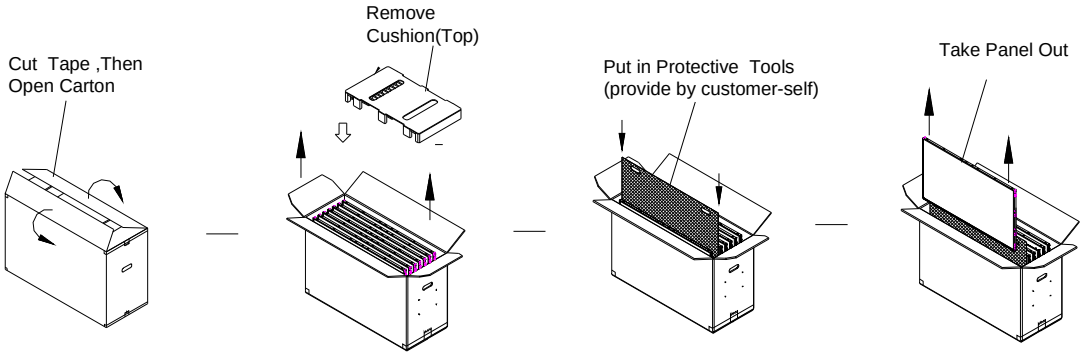
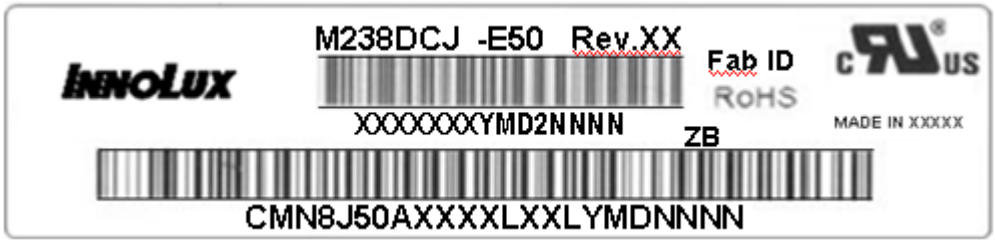


Figure 8-3 UN-packing method

9. INX MODULE LABEL

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



(a) Model Name: M238DCJ-E50

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

(c) INX barcode definition:

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

Code	Meaning	Description
XX	INX internal use	-
XX	Revision	Cover all the change
X	INX internal use	-
XX	INX 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-N8J50-X-X-X-XX-L-XX-L-YMD-NNNN

Code	Meaning	Description
CM	Supplier code	INX=CM
N8J50	Model number	M238DCJ-E50= N8J50
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, Novatek=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 ; Nanhai 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
NNNN	Serial number	By LCD supplier

(e) FAB ID(UL Factory ID):

Region	Factory ID
TWINX	GEMN
NBCMI	LEOO
NBCMI	VIRO
NBCME	CANO
NHCMI	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.

(11) While touching the panel surface under the patterns with higher grey levels, a shadow or mura phenomenon would be seen.This phenomenon is totally recoverable by switching the patterns to lower grey levels. It is a product feature.

10.2 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℃ to 35℃ and relative humidity of less than 90%

(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

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 INX 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:

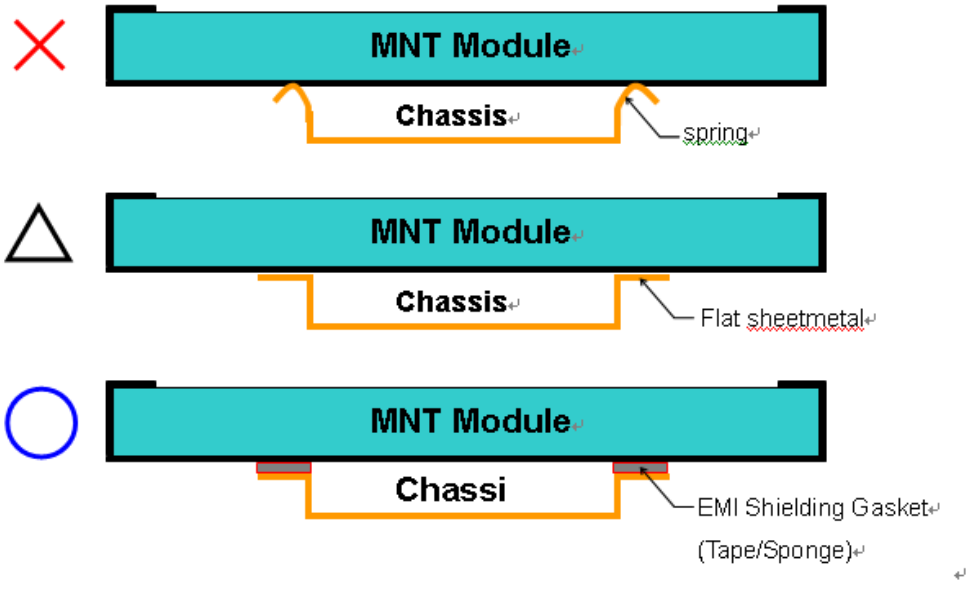
(1) UL60950-1 or updated standard.

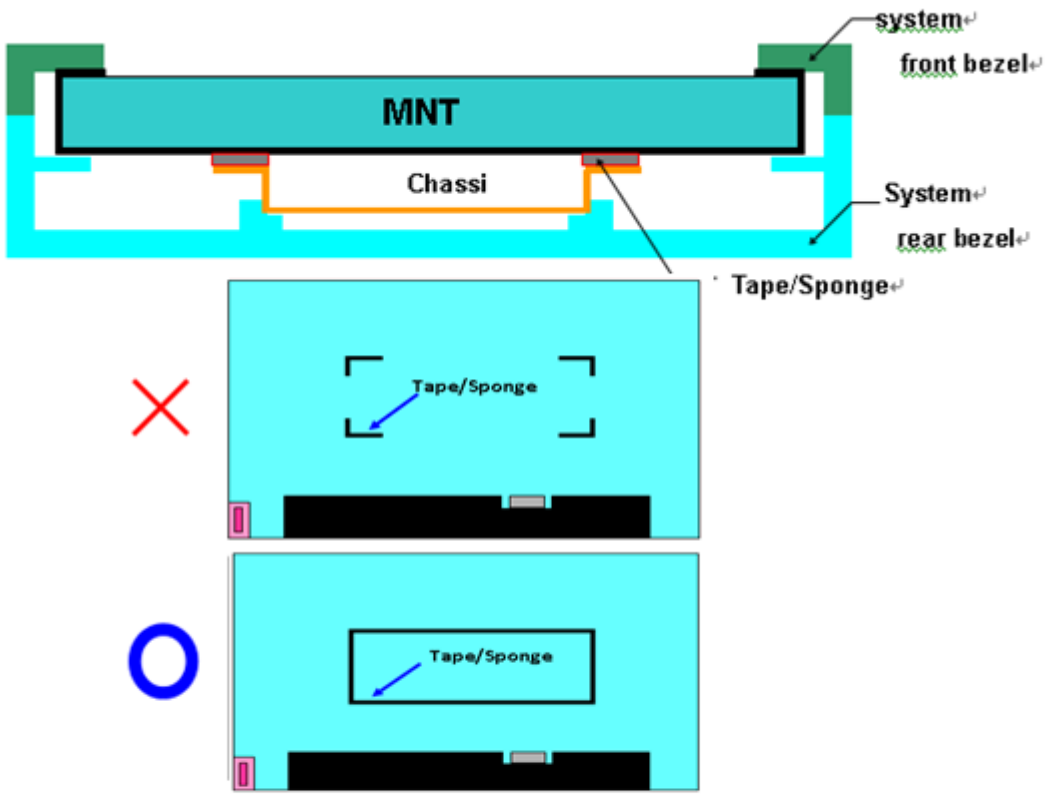
(2) IEC60950-1 or updated standard.

10.6 OTHER

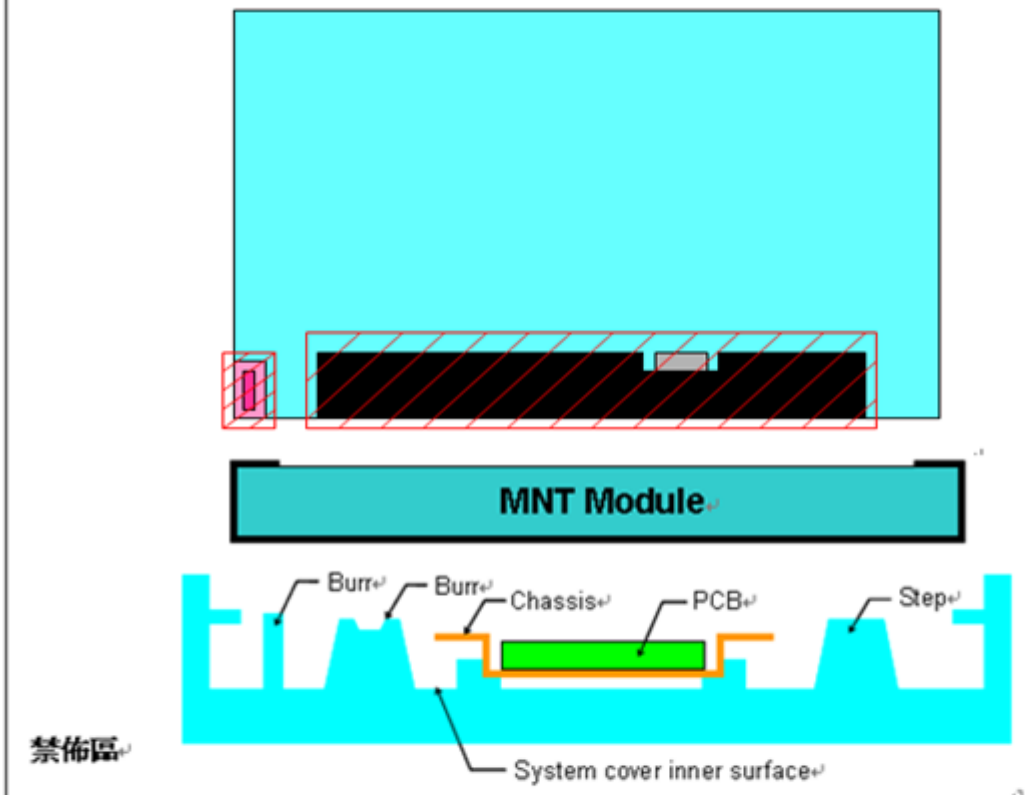
When fixed patterns are displayed for a long time, remnant image is likely to occur.

Appendix 1. SYSTEM COVER DESIGN NOTICE

1.	Set Chassis and MNT Module touching Mode
	
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 (Don't interference from flat sheetmeter of chassis to rear cover of Module).

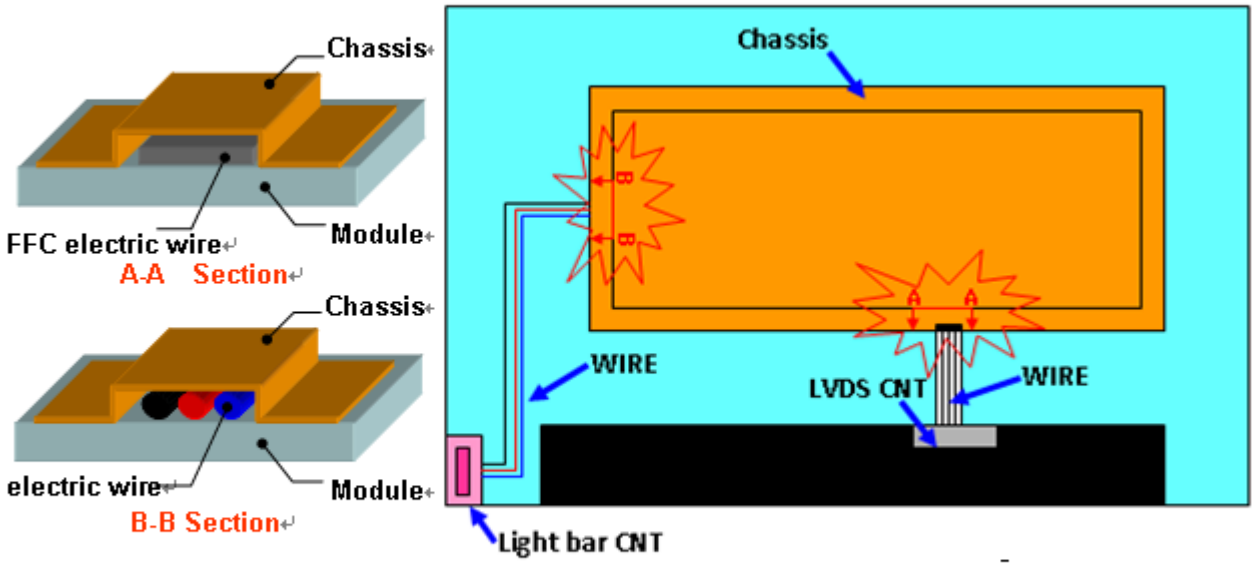
2	Tape/sponge design on system inner surface
	
Definition	a) To prevent from abnormal display & white spot after Mechanical test, We suggest using Tape/Sponge as medium between chassis and Module rear cover could reduce the occurrence of white spot. b) When using the Tape/Sponge, suggest it be lay over 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



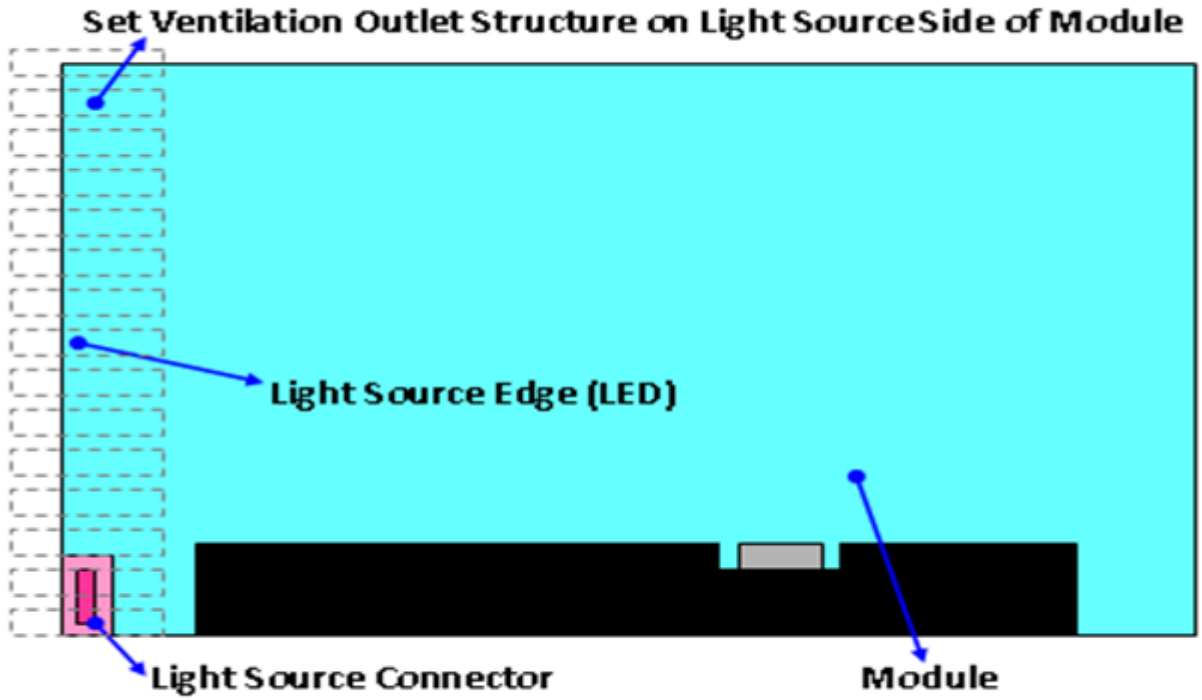
Definition	a). Burr at logo edge, step, protrusion or PCB board will easily cause white spot. b). Keeping flat surface underneath module is recommended. c). The area ( ) on Module PCBA and Light bar connector should keep at least 1mm gap to any structure with System cover inner surface.

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.

5	System cover's ventilation outlet structure



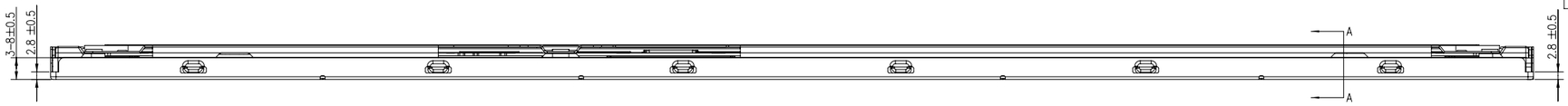
Definition	To prevent from abnormal display of light leakage, We suggest to set ventilation outlet structure on side of Module Light bar in system cover inner surface.

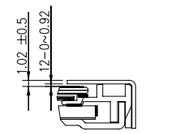
Note: The above drawing is only for design hint,

the actual module outline drawing please refer to Appendix 2

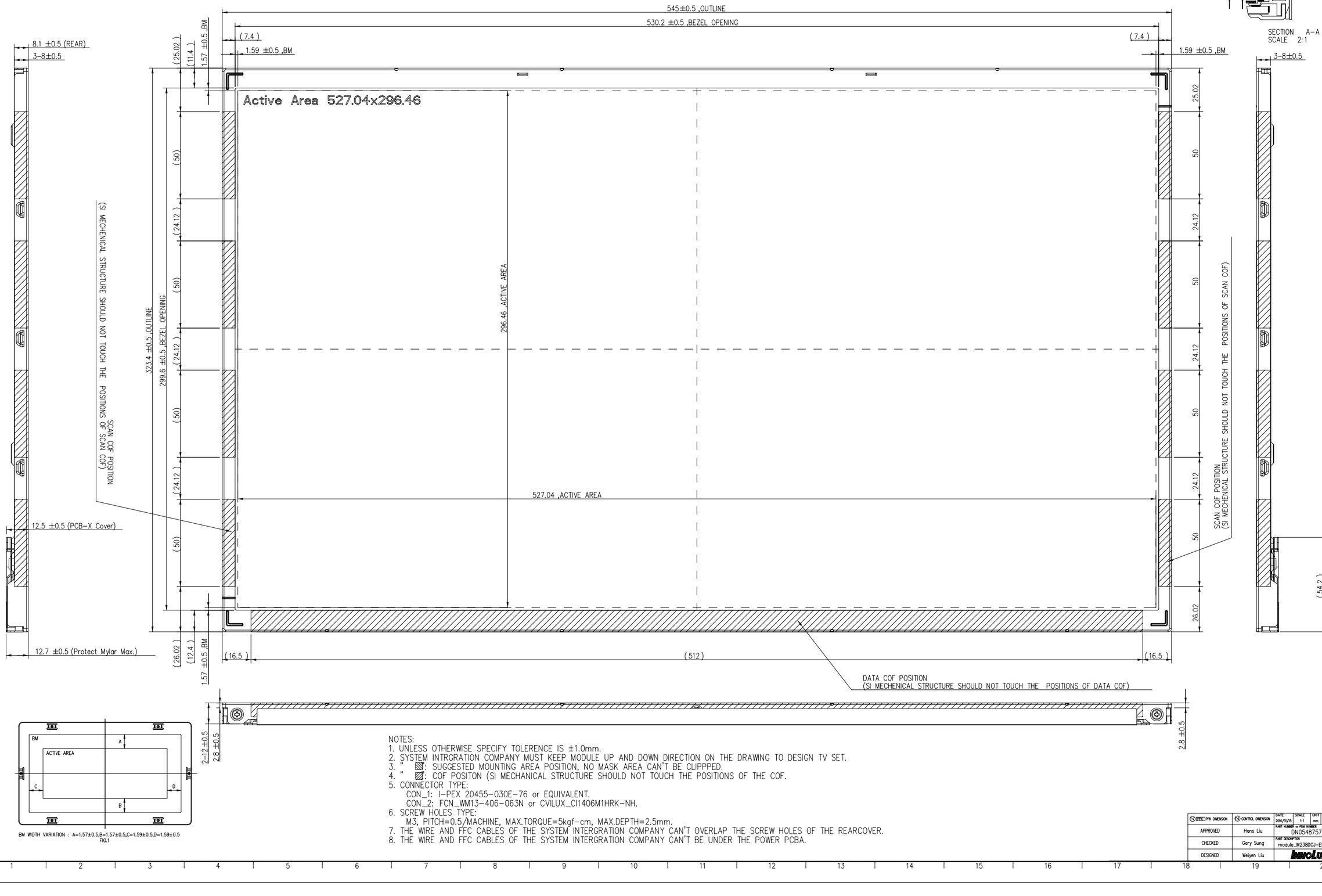
Appendix 2. OUTLINE DRAWING

REV	EC NUMBER	DESCRIPTION	DATE
A		First Release	2016/01/15





SECTION A-A
SCALE 2:1

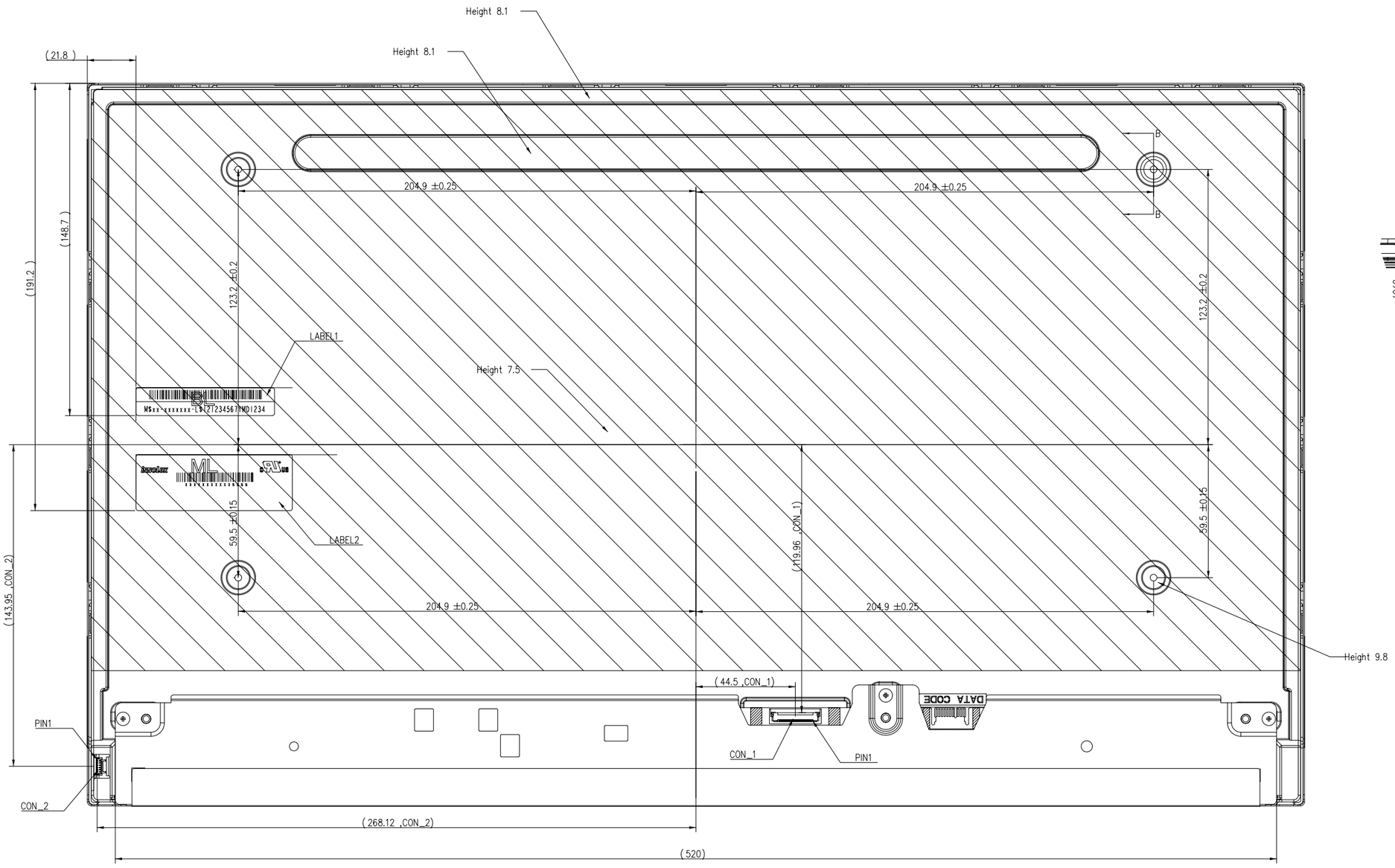


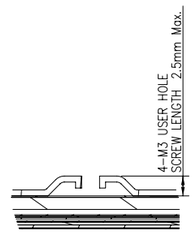
BM WIDTH VARIATION : A=1.57±0.5,B=1.57±0.5,C=1.59±0.5,D=1.59±0.5
FIG.1

NOTES:
1. UNLESS OTHERWISE SPECIFY TOLERENCE IS ±1.0mm.
2. SYSTEM INTRGRATION COMPANY MUST KEEP MODULE UP AND DOWN DIRECTION ON THE DRAWING TO DESIGN TV SET.
3. " ▨: SUGGESTED MOUNTING AREA POSITION, NO MASK AREA CAN'T BE CLIPPPED.
4. " ▨: COF POSITON (SI MECHANICAL STRUCTURE SHOULD NOT TOUCH THE POSITIONS OF THE COF.
5. CONNECTOR TYPE:
   CON_1: I-PEX 20455-030E-76 or EQUIVALENT.
   CON_2: FCN_WM13-406-063N or CVILUX_CI1406M1HRK-NH.
6. SCREW HOLES TYPE:
   M3, PITCH=0.5/MACHINE, MAX.TORQUE=5kgf-cm, MAX.DEPTH=2.5mm.
7. THE WIRE AND FFC CABLES OF THE SYSTEM INTERGRATION COMPANY CAN'T OVERLAP THE SCREW HOLES OF THE REARCOVER.
8. THE WIRE AND FFC CABLES OF THE SYSTEM INTERGRATION COMPANY CAN'T BE UNDER THE POWER PCBA.

PPK DIMENSION	CONTROL DIMENSION	DATE: 2016/01/15	SCALE: 1:1
		UNIT: mm	
APPROVED	Hans Liu	PART NUMBER or PDM NUMBER: DN0548757	DRAWING REV.: A
CHECKED	Gary Sung	PART DESCRIPTION: module_M238DCJ-E50_FU	SHEET NUMBER: 1/2
DESIGNED	Weiyen Liu	InnoLux	SIZE: A1

REV	EC NUMBER	DESCRIPTION	DATE
A		First Release	2016/01/15





SECTION B-B
SCALE 2:1

NOTES:
1. UNLESS OTHERWISE SPECIFY TOLERENCE IS ±1.0mm.
2. SYSTEM INTRGRATION COMPANY MUST KEEP MODULE UP AND DOWN DIRECTION ON THE DRAWING TO DESIGN TV SET.
3. " ▨: SUGGESTED MOUNTING AREA POSITION, NO MASK AREA CAN'T BE CLIPPPED.
4. " ▨: COF POSITION (SI MECHANICAL STRUCTURE SHOULD NOT TOUCH THE POSITIONS OF THE COF.
5. CONNECTOR TYPE:
   CON_1: I-PEX 20455-030E-76 or EQUIVALENT.
   CON_2: FCN_WM13-406-063N or CVILUX_CI1406M1HRK-NH.
6. SCREW HOLES TYPE:
   M3, PITCH=0.5/MACHINE, MAX.TORQUE=5kgf-cm, MAX.DEPTH=2.5mm.
7. THE WIRE AND FFC CABLES OF THE SYSTEM INTERGRATION COMPANY CAN'T OVERLAP THE SCREW HOLES OF THE REARCOVER.
8. THE WIRE AND FFC CABLES OF THE SYSTEM INTERGRATION COMPANY CAN'T BE UNDER THE POWER PCBA.

FPK DIMENSION	CONTROL DIMENSION	DATE	SCALE	UNIT	
		2016/01/15	1:1	mm	
APPROVED	Hans Liu	PART NUMBER or FPN NUMBER: DN0548757			DRAWING REV.: A
CHECKED	Gary Sung	PART DESCRIPTION: module_M238DCJ-E50_FU			SHEET NUMBER: 2/2
DESIGNED	Weiyen Liu	INNOLUX			SIZE: A1