

- Tentative Specification
- Preliminary Specification
- Approval Specification

MODEL NO.: G121ICE

SUFFIX: L01

Customer:**APPROVED BY****SIGNATURE**Name / Title

Note

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

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REVISION HISTORY

Version	Date	Page	Description
Ver 2.0	Aug.17.2020	All	Approval Spec was first issued.
Ver 2.1	Jun.21.2021	20	Update the Optional spec description of Note(1)~(6)
		24	Update the Packaging spec and Packing method.
		31	Add Appendix. System cover design notice.
Ver 2.2	Aug.16.2021	5	Add the item of FEATURE and APPLICATION.
		7	Modify Power Consumption
		8	Add the picture of Relative Humidity& Temperature.
		9	Update BACKLIGHT UNIT
		13	Modify the Typ.and Max of Power Supply Current (White/Black).
		17	Add note (4)
		24	Modify the Min and Max of LVDS Clock Frequency & Spread spectrum modulation.
		28	Modify the Min and Max of Vertical Display Term (Total & Blank)
		29	Modify the Max value of Horizontal Display Term(Total & Blank)
		29	Update note(6)
		29	Update the description of module label.
		29	Update STORAGE PRECAUTIONS &OTHER
Ver 2.3	Mar.14.2022	22	Modify the Typ. of Viewing Angle.
Ver 2.4	Mar.14.2023	7	Modify note(2) Vcc=3.3V
Ver 2.5	Aug.30.2023	All	Driver IC Type changed from EK77221 to EK77526. (Optical & EE characteristics unchanged)

1. GENERAL DESCRIPTION

1.1 OVERVIEW

G121ICE-L01 is a 12.1" TFT Liquid Crystal Display module with LED Backlight unit LVDS interface. This module supports 1280 x 800 Wide-XGA AAS mode and can display 262k/16.7M colors. The LED converter for Backlight is built in control board..

1.2 FEATURE

- WXGA (1280 x 800 pixels) resolution
- PSWG (Panel Standardization Working Group)
- Wide operating temperature.
- RoHS compliance

1.3 APPLICATION

- TFT LCD Monitor
- Factory Application
- Amusement

1.4 GENERAL SPECIFICATIONS

Item	Specification	Unit	Note
Active Area	261.12 (H) x 163.2 (V) (12.1" diagonal)	mm	(1)
Driver Element	a-Si TFT active matrix	-	-
Pixel Number	1280x R.G.B x 800	pixel	-
Pixel Pitch	0.204(H) x 0.204(W)	mm	-
Pixel Arrangement	RGB vertical Stripe	-	-
Display Colors	262k/16.7M	color	-
Display Mode	Normally Black	-	-
Surface Treatment	AG type, 3H hard coating	-	-
Module Power Consumption	11.45W (white pattern)	W	Typ.(2)

1.5 MECHANICAL SPECIFICATIONS

Item	Min.	Typ.	Max.	Unit	Note
Module Size	Horizontal(H)	277.5	278	mm	(1)
	Vertical(V)	183.5	184	mm	
	Depth(D)	9.5	10	mm	
Bezel Area	Horizontal	263.82	264.12	mm	-
	Vertical	165.9	166.2	mm	
Active Area	Horizontal	-	261.12	mm	
	Vertical	-	163.2	mm	
Weight	-	470	490	g	

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

Note (2)The Module Power Consumption is specified at 3.3V, white pattern and 100% duty for LED backlight

2. ABSOLUTE MAXIMUM RATINGS

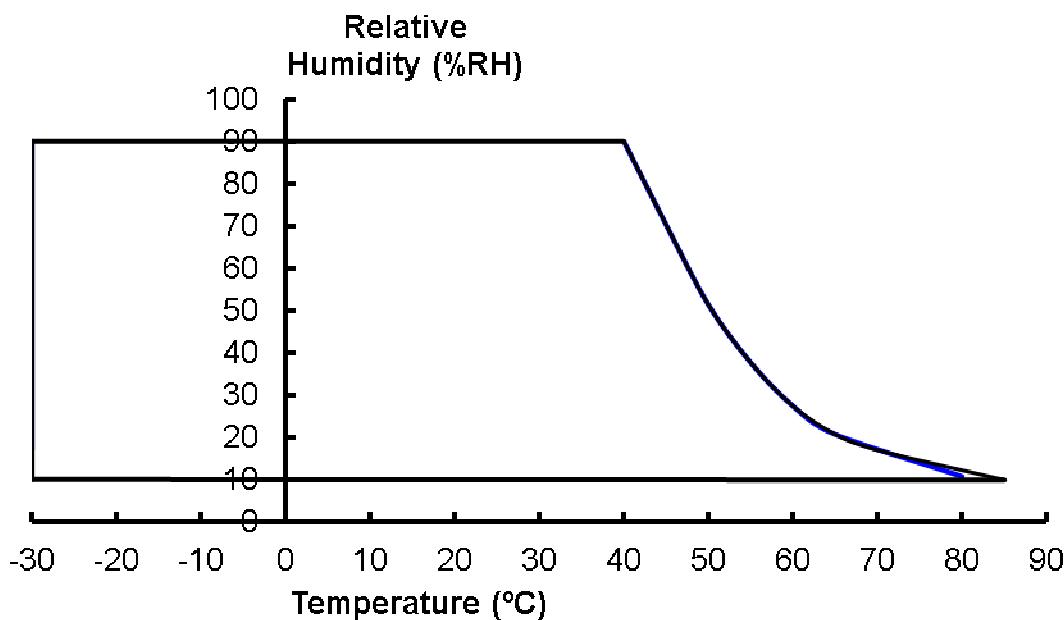
2.1 ABSOLUTE RATINGS OF ENVIRONMENT

Item	Symbol	Value		Unit	Note
		Min.	Max.		
Operating Ambient Temperature	T_{OP}	-30	+80	°C	(1)(2)
Storage Temperature	T_{ST}	-30	+85	°C	

Note (1)

- (a) 90 %RH Max. ($T_a \leq 39^{\circ}\text{C}$)
- (b) Wet-bulb temperature should be 39°C Max.
- (c) No condensation.

Note (2) Panel surface temperature should be 0°C min. and 80°C max under $V_{cc}=3.3\text{V}$, $f_r=60\text{Hz}$, 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 80°C .



2.2 ELECTRICAL ABSOLUTE RATINGS

2.2.1 TFT LCD MODULE

Item	Symbol	Value		Unit	Note
		Min.	Max.		
Power Supply Voltage	V _C C	-0.3	3.6	V	(1)
Logic Input Voltage	V _{IN}	-0.3	3.6	V	

2.2.2 BACKLIGHT UNIT

Item	Symbol	Value		Unit	Note
		Min.	Max.		
Converter Voltage	V _i	-0.3	18	V	(1) , (2)
Enable Voltage	EN	---	5.5	V	
Backlight Adjust	Dimming	---	5.5	V	

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 LED (Refer to 3.2 for further information)

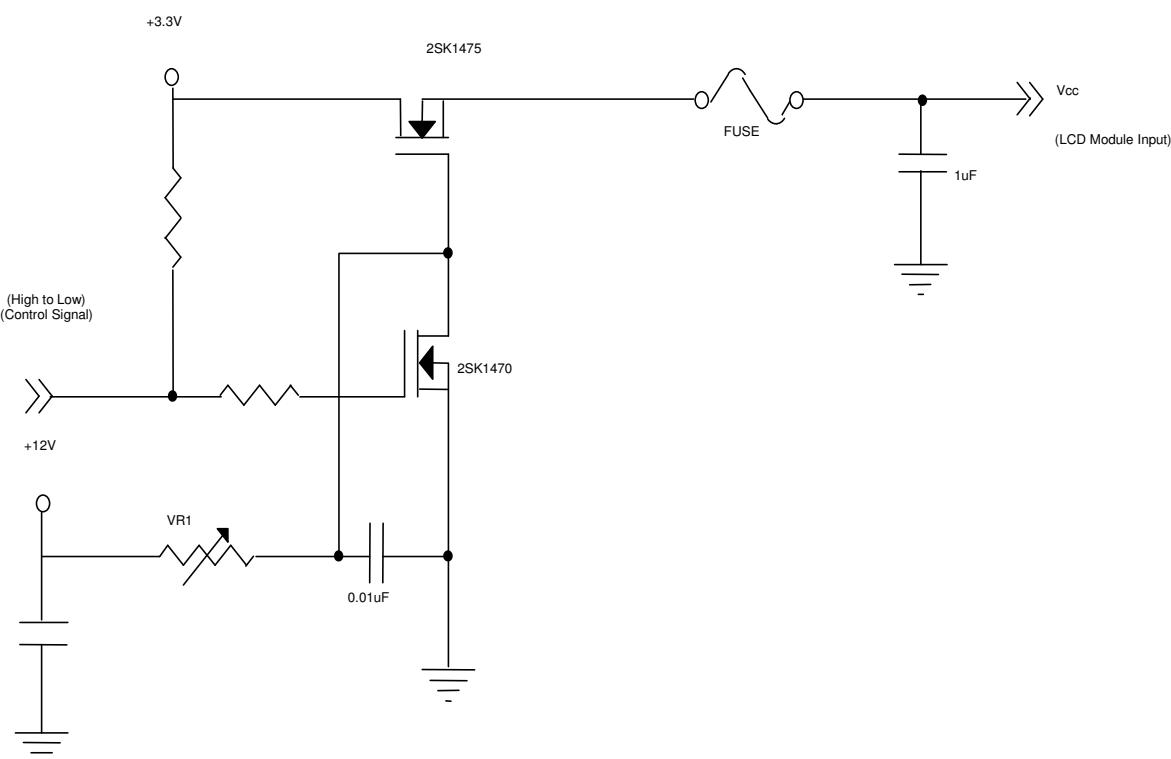
3. ELECTRICAL CHARACTERISTICS

3.1 TFT LCD MODULE

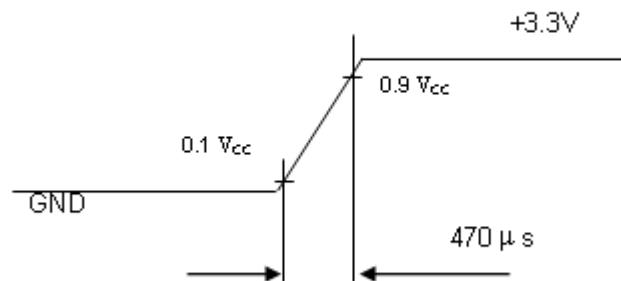
Parameter	Symbol	Value			Unit	Note
		Min.	Typ.	Max.		
Power Supply Voltage	V_{CC}	3.0	3.3	3.6	V	-
Ripple Voltage	V_{RP}	-	50	-	mVp-p	
Inrush Current	I_{INRUSH}	1.5			A	(2)
Power Supply Current	White	I_{CC}	-	560	mA	(3)a
	Black		-	360	mA	(3)b
LVDS differential input voltage	V_{id}	100	-	600	mV	
LVDS common input voltage	V_{ic}	1.125	1.2	1.375	V	
Differential Input Voltage for LVDS Receiver Threshold	“H” Level	V_{IH}	100	-	mV	-
	“L” Level	V_{IL}	-	-	-100	mV
Terminating Resistor	R_T	-	100	-	Ohm	-

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

Note (2)Measurement Conditions:



VCC rising time is 470us



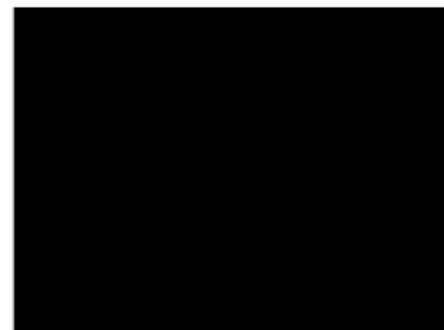
Note (3) The specified power supply current is under the conditions at $V_{DD} = 3.3V$, $T_a = 25 \pm 2 {}^\circ C$, DC Current and $f_v = 60$ Hz, whereas a power dissipation check pattern below is displayed.

a. White Pattern



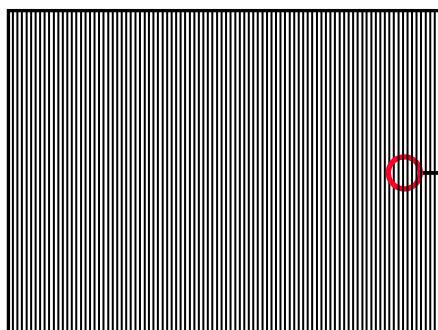
Active Area

b. Black Pattern

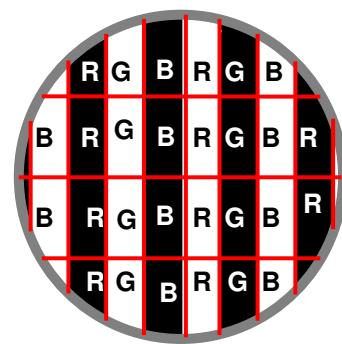


Active Area

c. Vertical Stripe Pattern



Active Area



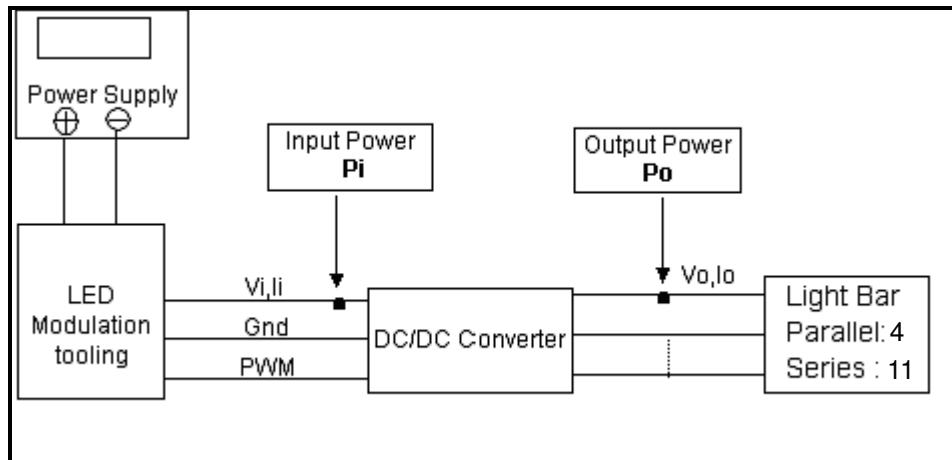
3.2 BACKLIGHT UNIT

PRODUCT SPECIFICATION

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

Parameter	Symbol	Value			Unit	Note
		Min.	Typ.	Max.		
Converter Input Voltage	V_i	10.8	12.0	13.2	V_{DC}	(Duty 100%)
Converter Input Ripple Voltage	V_{iRP}	-	-	350	mV	
Converter Input Current	I_i	-	0.8	1.0	A_{DC}	@ $V_i = 12V$ (Duty 100%)
Converter Inrush Current	I_{iRUSH}	-	-	3.0	A	@ V_i rising time=20ms ($V_i=12V$)
Input Power Consumption	P_i	-	9.6	12	W	(1)
EN Control Level	Backlight on	ENLED (BLON)	2.5	3.3	V	
	Backlight off		0	-	0.3	V
PWM Control Level	PWM High Level	Dimming (E_PWM)	2.5	-	5.0	V
	PWM Low Level		0	-	0.15	V
PWN Noise Range	V_{Noise}	-	-	0.1	V	
PWM Control Frequency	f_{PWM}	190	200	20k	Hz	(2)
PWM Dimming Control Duty Ratio	-	5	-	100	%	(2), Suggestion @ $190Hz < f_{PWM} < 1kHz$
		20	-	100	%	(2), @ $1kHz \leq f_{PWM} < 20kHz$
LED Life Time	L_{LED}	50,000		-	Hrs	(3)

Note (1) LED current is measured by utilizing a high frequency current meter as shown below:



Note (2) At 190 ~1kHz PWM control frequency, duty ratio range is restricted from 5% to 100%.

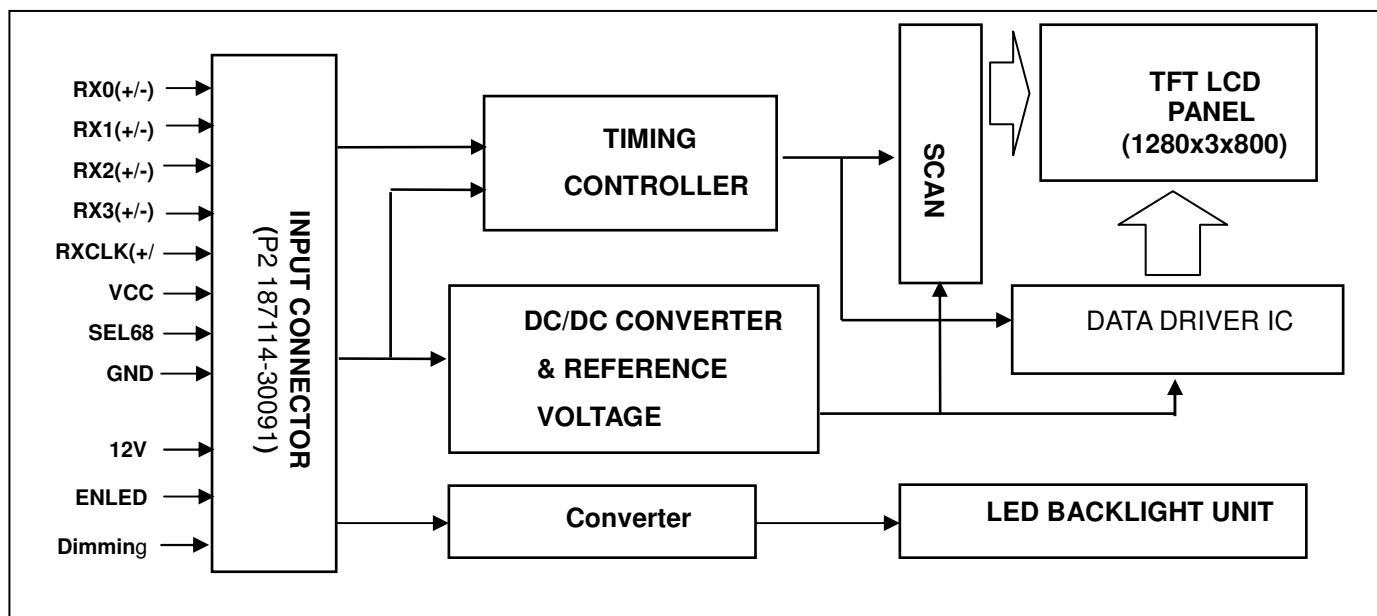
1K ~20kHz PWM control frequency, duty ratio range is restricted from 20% to 100%.

If PWM control frequency is applied in the range from 1KHz to 20KHZ, The “non-linear” phenomenon on the Backlight Unit may be found. So It's a suggestion that PWM control frequency should be less than 1Khz.

Note (3) The lifetime of LED is estimated data and defined as the time when it continues to operate under the conditions at $T_a = 25 \pm 2 {}^\circ C$ and Duty 100% until the brightness becomes $\leq 50\%$ of its original value. Operating LED at high temperature condition will reduce life time and lead to color shift.

4. BLOCK DIAGRAM

4.1 TFT LCD MODULE



5. INPUT TERMINAL PIN ASSIGNMENT

5.1 TFT LCD MODULE

Pin No.	Symbol	Function	Note
1	12V	LED power	
2	12V	LED power	
3	12V	LED power	
4	12V	LED power	
5	ENLED	Enable pin	Note (3)
6	Dimming	Backlight Adjust	Note (3)
7	NC	No Connection or Ground	Note (4)
8	NC	No Connection or Ground	Note (4)
9	VCC	Power supply: +3.3V	
10	VCC	Power supply: +3.3V	
11	GND	Ground	
12	GND	Ground	
13	RX0-	Negative transmission data of pixel 0	
14	RX0+	Positive transmission data of pixel 0	
15	GND	Ground	
16	RX1-	Negative transmission data of pixel 1	
17	RX1+	Positive transmission data of pixel 1	
18	GND	Ground	
19	RX2-	Negative transmission data of pixel 2	
20	RX2+	Positive transmission data of pixel 2	
21	GND	Ground	
22	RXCLK-	Negative of clock	
23	RXCLK+	Positive of clock	
24	GND	Ground	
25	RX3-	Negative transmission data of pixel 3	
26	RX3+	Positive transmission data of pixel 3	
27	GND	Ground	
28	SEL6/8	LVDS 6/8 bit select function control	Note (2).(3)
		Low → 6 bit Input Mode	
		High → 8bit Input Mode	
29	GND	Ground	
30	NC	No Connection	Note (4)

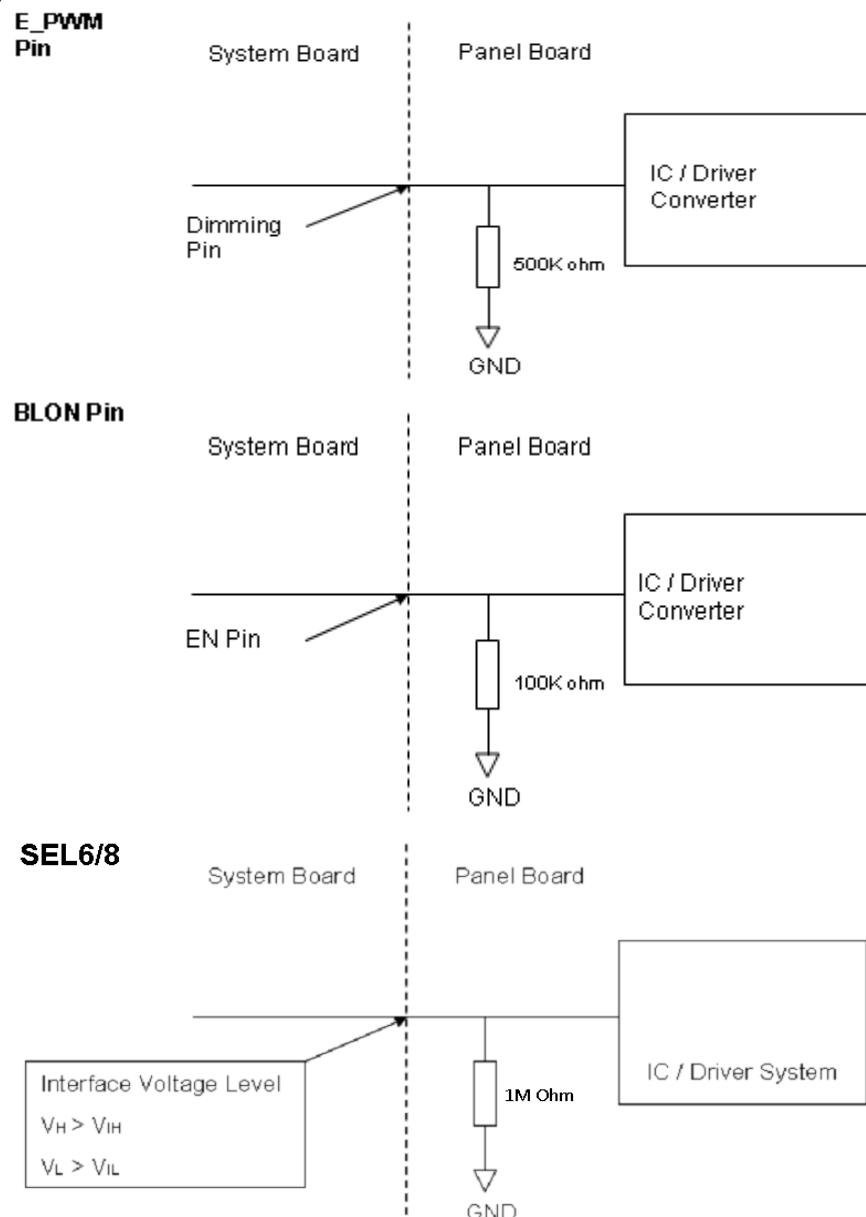
Note (1) Connector Part No.: P2 187114-30091 or equivalent.

User's connector Part No.; JAE FI-X30HL or FI-X30HL-B or equivalent.

Note (2) "Low" stands for 0V. "High" stands for 3.3V

Note (3) ENLED(BLON), Dimming(E_PWM), SEL6/8 as shown below :

Note (4) Pin7, Pin8, Pin30 input signals should be set to no connection or ground, this module would operate normally.



5.2 COLOR DATA INPUT ASSIGNMENT

The brightness of each primary color (red, green and blue) is based on the 6-bit gray scale data input for the color. The higher the binary input, the brighter the color. The table below provides the assignment of color.

Color		Data Signal																	
		Red						Green						Blue					
		R5	R4	R3	R2	R1	R0	G5	G4	G3	G2	G1	G0	B5	B4	B3	B2	B1	B0
Basic Colors	Black	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Red	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
	Green	0	0	0	0	0	0	1	1	1	1	1	1	0	0	0	0	0	0
	Blue	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1
	Cyan	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1
	Magenta	1	1	1	1	1	1	0	0	0	0	0	0	1	1	1	1	1	1
	Yellow	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0
	White	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Gray Scale Of Red	Red(0)/Dark	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Red(1)	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
	Red(2)	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
	Red(61)	1	1	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0
	Red(62)	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0
	Red(63)	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
	Green(0)/Dark	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gray Scale Of Green	Green(1)	0	0	0	0	0	0	0	0	0	0	0	0	1	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
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
	Green(61)	0	0	0	0	0	0	0	1	1	1	1	0	1	0	0	0	0	0
	Green(62)	0	0	0	0	0	0	0	1	1	1	1	1	0	0	0	0	0	0
	Green(63)	0	0	0	0	0	0	0	1	1	1	1	1	0	0	0	0	0	0
	Blue(0)/Dark	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Blue(1)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Gray Scale Of Blue	Blue(2)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
	Blue(61)	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	0
	Blue(62)	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	0
	Blue(63)	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1

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

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	0	1	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
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	
	Red(253)	1	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	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	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	0	1	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	1	0	0	0	0	0	0	0
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	
	Green(253)	0	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	0	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0
	Green(255)	0	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	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	0	1
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	
	Blue(253)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	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

6. INTERFACE TIMING

6.1 INPUT SIGNAL TIMING SPECIFICATIONS

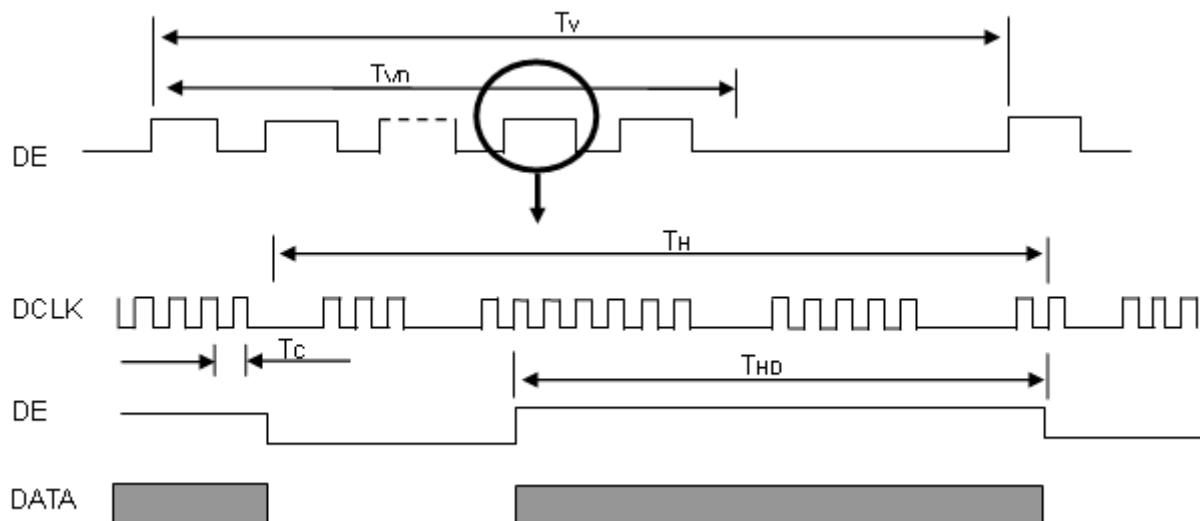
The input signal timing specifications are shown as the following table and timing diagram.

Signal	Item	Symbol	Min.	Typ.	Max.	Unit	Note
LVDS Clock	Frequency	F_r	65.9	71	85	MHz	-
	Period	T_c	13.4	14.1	15.2	ns	
	Input cycle to cycle jitter	T_{rcl}	---	---	200	ns	(a)
	Input Clock to data skew	TLVCCS	-0.02*Tc	---	0.02*Tc	ps	(b)
	Spread spectrum modulation range	F_{clkin_mod}	0.987*Fc	---	1.013*Fc	MHz	(c)
	Spread spectrum modulation frequency	F_{SSM}	---	---	200	KHz	
Vertical Display Term	Frame Rate	F_r	---	60	---	Hz	$T_v = T_{vd} + T_{vb}$
	Total	T_v	808	823	885	T_h	-
	Active Display	T_{vd}	800	800	800	T_h	-
	Blank	T_{vb}	8	23	85	T_h	-
Horizontal Display Term	Total	T_h	1360	1440	1600	T_c	$T_h = T_{hd} + T_{hb}$
	Active Display	T_{hd}	1280	1280	1280	T_c	-
	Blank	T_{hb}	80	160	320	T_c	-

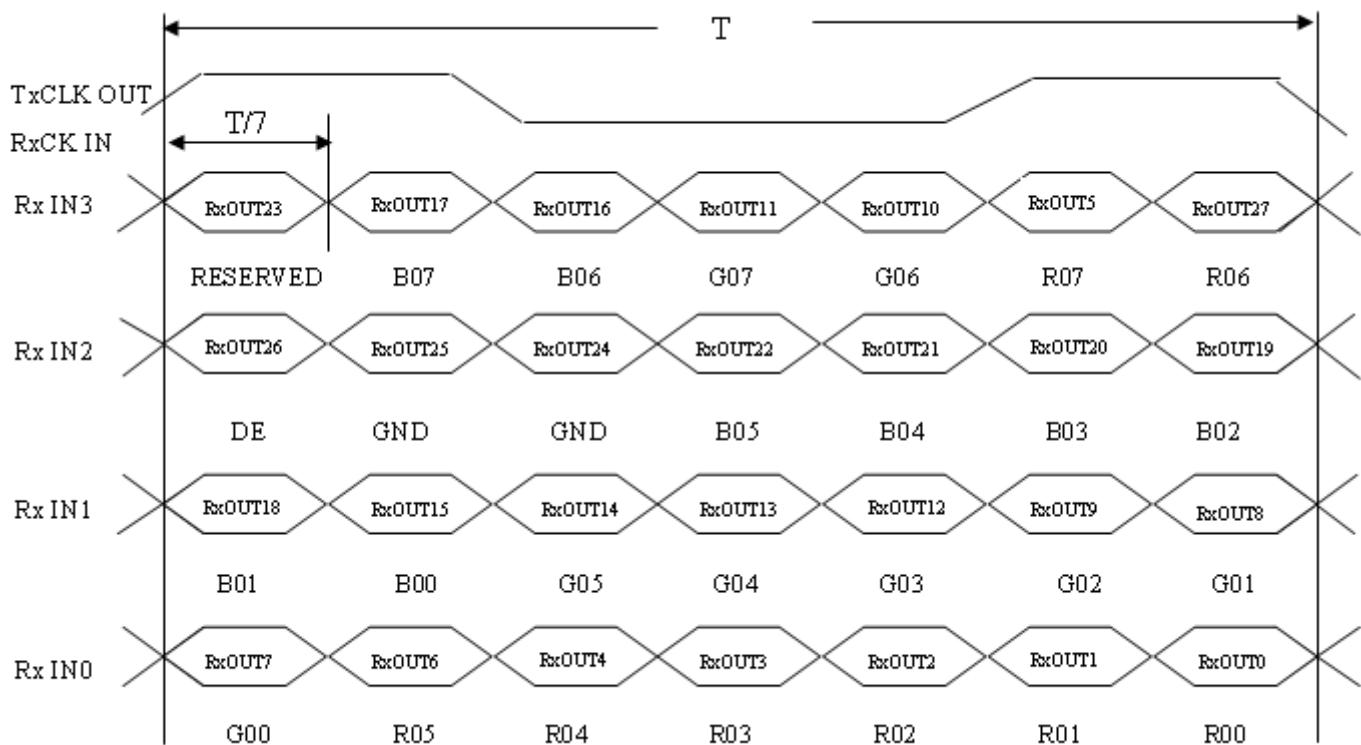
Note (1) Because this module is operated by DE only mode, Hsync and Vsync input signals should be set to low logic level or ground. Otherwise, this module would operate abnormally.

Note (2) The $T_v(T_{vd}+T_{vb})$ must be integer, otherwise, the module would operate abnormally.

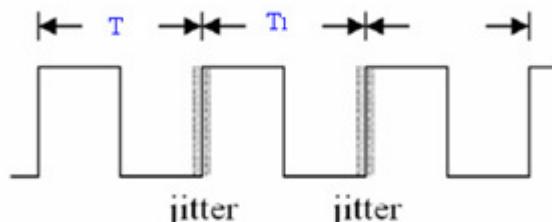
INPUT SIGNAL TIMING DIAGRAM



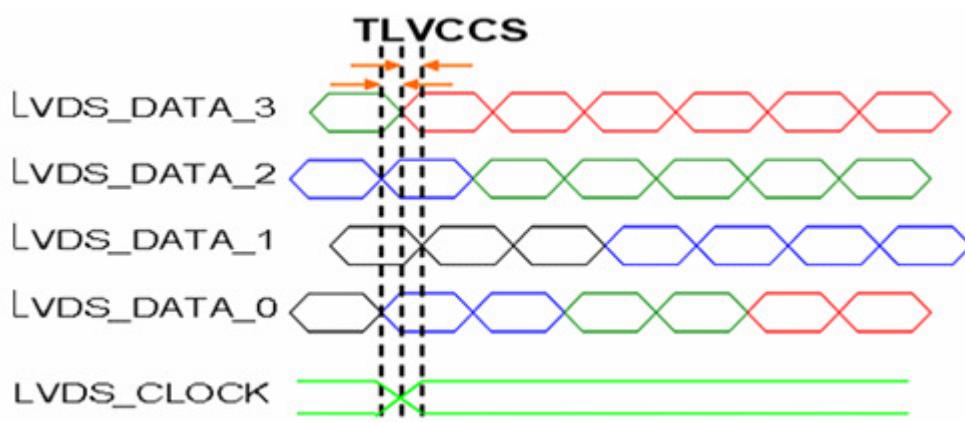
TIMING DIAGRAM of LVDS



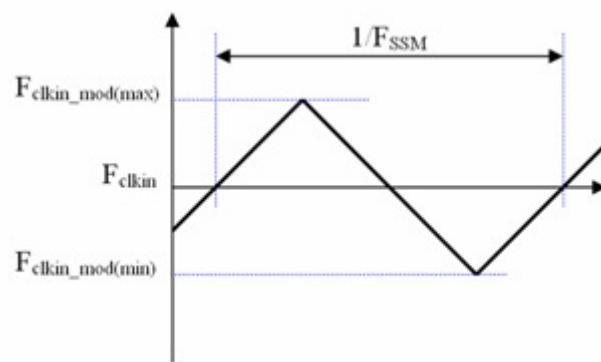
Note (a) The input clock cycle-to-cycle jitter is defined as below figures. $T_{rcl} = |T_1 - T_2|$



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

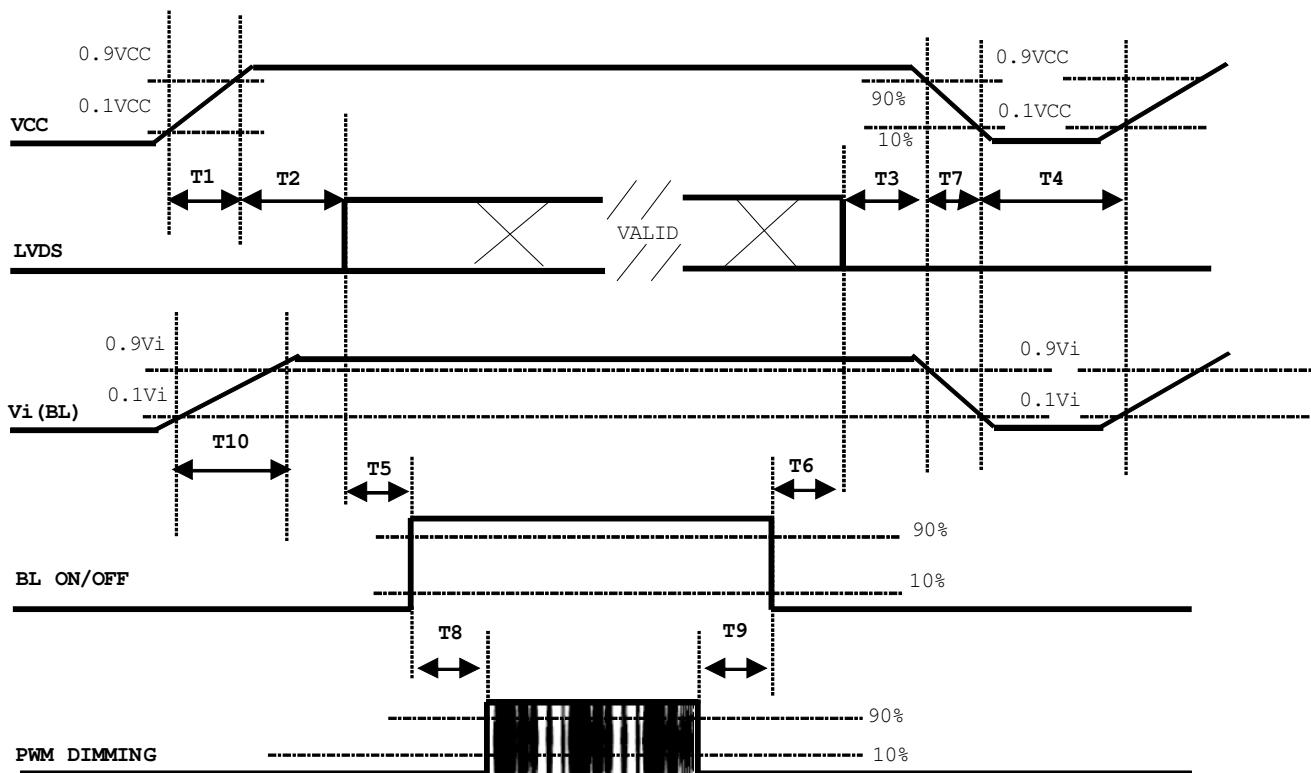


Note (c) The SSCG (Spread spectrum clock generator) is defined as below figures.



6.2 POWER ON/OFF SEQUENCE

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



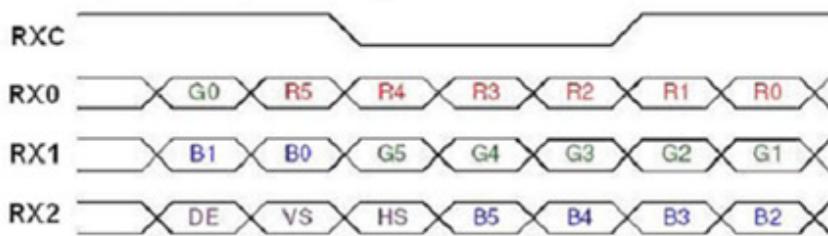
Parameter	Value			Units
	Min	Typ	Max	
T1	0.5	-	10	ms
T2	0	-	50	ms
T3	0	-	50	ms
T4	500	-	-	ms
T5	450	-	-	ms
T6	200	-	-	ms
T7	10	-	100	ms
T8	10	-	-	ms
T9	10	-	-	ms
T10	20	-	50	ms

Note:

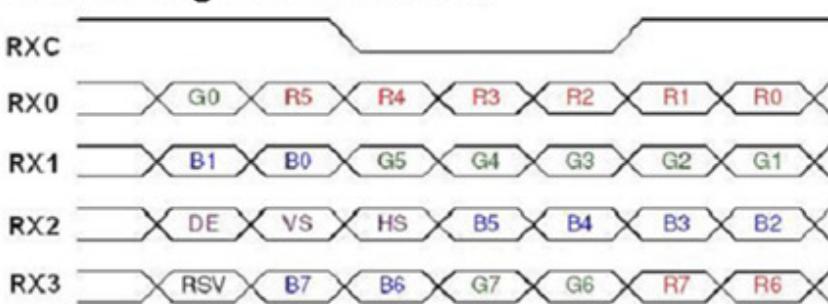
- (1) The supply voltage of the external system for the module input should be the same as the definition of Vcc.
- (2) When the backlight turns on before the LCD operation of the LCD turns off, the display may momentarily become abnormal screen.
- (3) In case of VCC = off level, please keep the level of input signals on the low or keep a high impedance.
- (4) T4 should be measured after the module has been fully discharged between power off and on period.
- (5) Interface signal shall not be kept at high impedance when the power is on.
- (6) INX won't take any responsibility for the products which are damaged by the customers not following the Power Sequence.
- (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 "T7 spec".

6.3 The INPUT DATA FORMAT

SEL 6/8="Low" for 6 Bits LVDS



SEL 6/8="High" for 8 Bits LVDS



Note (1) R/G/B data 7: MSB, R/G/B data 0: LSB

Note (2) Please follow PSWG

Signal Name	Description	Remark
R7	Red Data 7 (MSB)	Red-pixel Data
R6	Red Data 6	Each red pixel's brightness data consists of these 8 bits pixel data.
R5	Red Data 5	
R4	Red Data 4	
R3	Red Data 3	
R2	Red Data 2	
R1	Red Data 1	
R0	Red Data 0 (LSB)	
G7	Green Data 7 (MSB)	Green-pixel Data
G6	GreenData 6	Each green pixel's brightness data consists of these 8 bits pixel data.
G5	GreenData 5	
G4	GreenData 4	
G3	GreenData 3	
G2	GreenData 2	
G1	GreenData 1	
G0	GreenData 0 (LSB)	
B7	Blue Data 7 (MSB)	Blue-pixel Data
B6	Blue Data 6	Each blue pixel's brightness data consists of these 8 bits pixel data.
B5	Blue Data 5	
B4	Blue Data 4	
B3	Blue Data 3	
B2	Blue Data 2	
B1	Blue Data 1	
B0	Blue Data 0 (LSB)	
RXCLKIN+	LVDS Clock Input	
RXCLKIN-		
DE	Display Enable	
VS	Vertical Sync	
HS	Horizontal Sync	

7. OPTICAL CHARACTERISTICS
7.1 TEST CONDITIONS

Item	Symbol	Value	Unit
Ambient Temperature	T _a	25±2	oC
Ambient Humidity	H _a	50±10	%RH
Supply Voltage		According to typical value and tolerance in	
Input Signal		"ELECTRICAL CHARACTERISTICS"	
PWM Duty Ratio	D	100	%

7.2 OPTICAL SPECIFICATIONS

The relative measurement methods of optical characteristics are shown here and all items are measured at the center point of screen unless otherwise noted. The following items should be measured under the test conditions described above and stable conditions shown in Note (5).

Item	Symbol	Condition	Min.	Typ.	Max.	Unit	Note	
Color Chromaticity	Red	θX=0°, θY =0° Grayscale Maximum	0.602	0.652	0.702	-	(1), (5)	
			0.288	0.338	0.388			
	Green		0.276	0.326	0.376			
			0.558	0.608	0.658			
	Blue		0.100	0.150	0.200			
			0.003	0.053	0.103			
	White		0.263	0.313	0.363			
			0.279	0.329	0.379			
Center Luminance of White	L _c		480	600			(4), (5)	
Contrast Ratio	CR		800	1000			(2), (5)	
Response Time	T _R	θ _x =0°, θ _y =0°	-	12	17	-	(3)	
	T _F		-	8	13			
White Variation	δW	θ _x =0°, θ _y =0°	70	80	-	%	(5), (6)	
Viewing Angle	Horizontal	CR ≥ 10	80	89	-	Deg.	(1), (5)	
			80	89	-			
	Vertical		80	89	-			
			80	89	-			

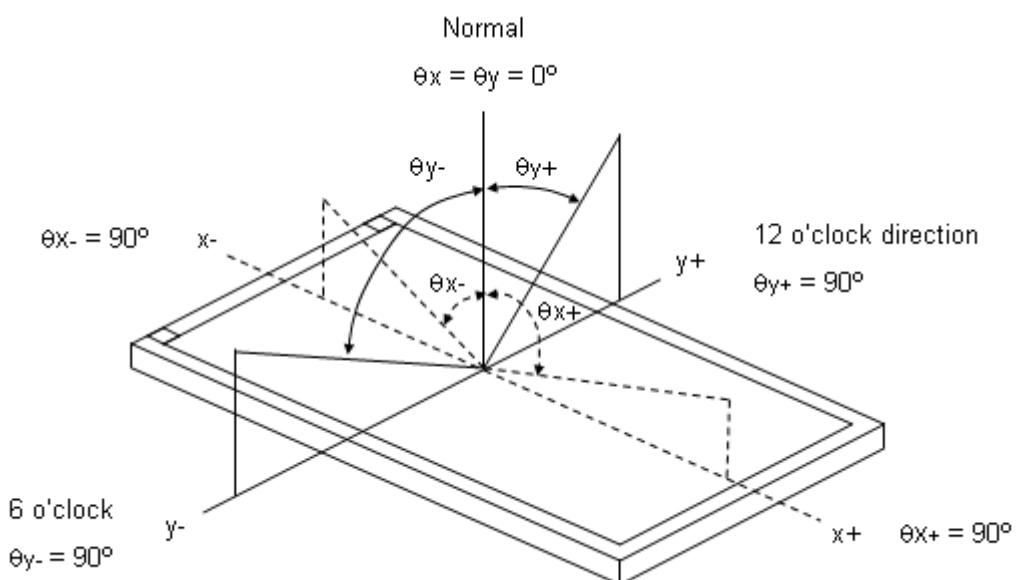
Definition :

Grayscale Maximum : Grayscale 255 (10 bits: grayscale 1023 ; 8 bits : grayscale 255 ; 6 bits: grayscale 63)

White : Luminance of Grayscale Maximum (All R,G,B)

Black : Luminance of grayscale 0 (All R,G,B)

Note (1) Definition of Viewing Angle (θ_x , θ_y):

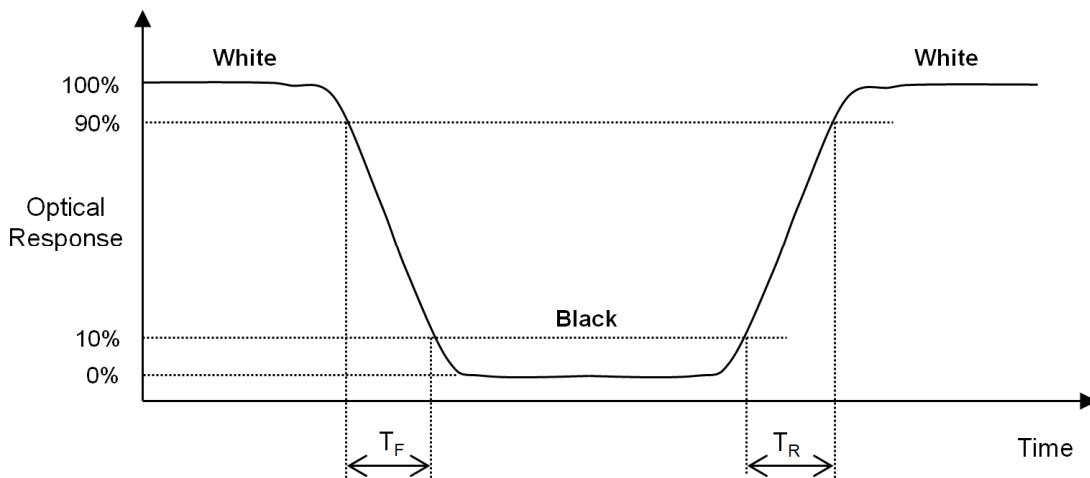


Note (2) Definition of Contrast Ratio (CR):

The contrast ratio can be calculated by the following expression at center point.

$$\text{Contrast Ratio (CR)} = \text{White} / \text{Black}$$

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

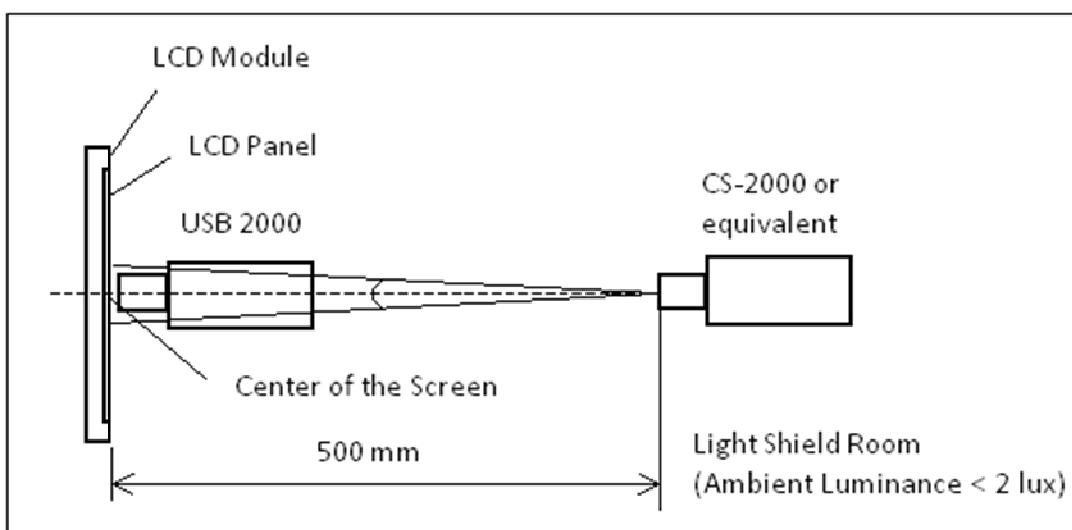


Note (4) Definition of Luminance of White (L_C):

Measure the luminance of White at center point.

Note (5) Measurement Setup:

The LCD module should be stabilized at given temperature 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. The measurement placement of module should be in accordance with module drawing.

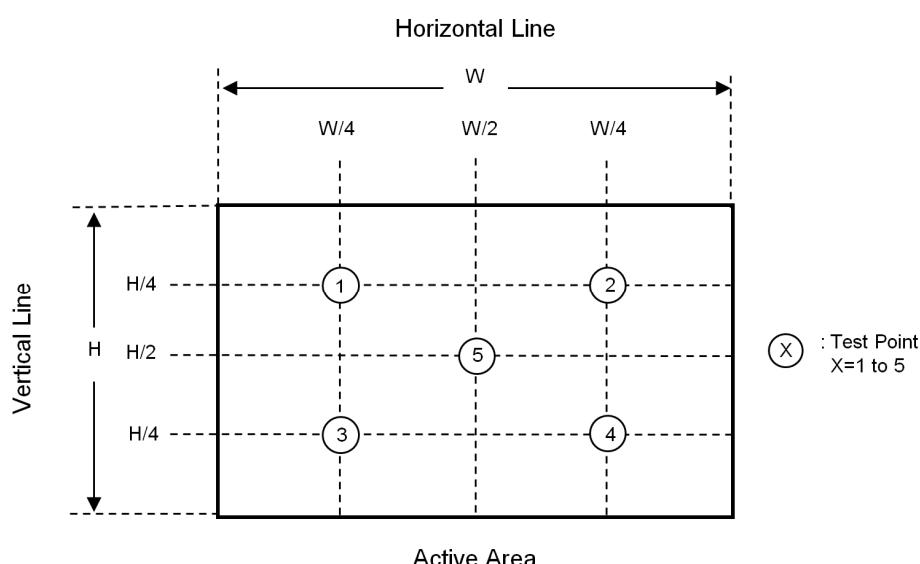


Note (6) Definition of White Variation (δW):

Measure the luminance of White at 5 points.

Luminance of White : $L(X)$, where X is from 1 to 5.

$$\delta W = \frac{\text{Minimum [} L(1) \text{ to } L(5) \text{]}}{\text{Maximum [} L(1) \text{ to } L(5) \text{]}} \times 100\%$$



8. RELIABILITY TEST CRITERIA

Test Item	Test Condition	Note
High Temperature Storage Test	85°C, 240 hours	(1),(2) (4),(5)
Low Temperature Storage Test	-30°C, 240 hours	
Thermal Shock Storage Test	-30°C, 0.5 hour \leftrightarrow 85°C, 0.5 hour; 100cycles, 1 hour/cycle)	
High Temperature Operation Test	80°C, 240 hours	
Low Temperature Operation Test	-30°C, 240 hours	
High Temperature & High Humidity Operation Test	60°C, RH 90%, 240 hours	
ESD Test (Operation)	150pF, 330Ω, 1 sec/cycle Condition 1 : panel contact, ± 8 KV Condition 2 : panel non-contact ± 15 KV	(1), (4)
Shock (Non-Operating)	200G, 2ms, half sine wave, 1 time for $\pm X$, $\pm Y$, $\pm Z$ direction	(2), (3)
Vibration (Non-Operating)	1.5G, 10 ~ 300 Hz sine wave, 10 min/cycle, 3 cycles each X, Y, Z direction	

Note (1)There should be no condensation on the surface of panel during test ,

Note (2) Temperature of panel display surface area should be 80°C Max.

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.

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

Note (5) Before cosmetic and function test, the product must have enough recovery time, at least 24 hours at room temperature.

9. PACKAGING

9.1 PACKING SPECIFICATIONS

- (1) 18pcs LCD modules / 1 Box
- (2) Box dimensions: 465 (L) X 362 (W) X 314 (H) mm
- (3) Weight: approximately 10.15 Kg (18 modules per box)

9.2 PACKING METHOD

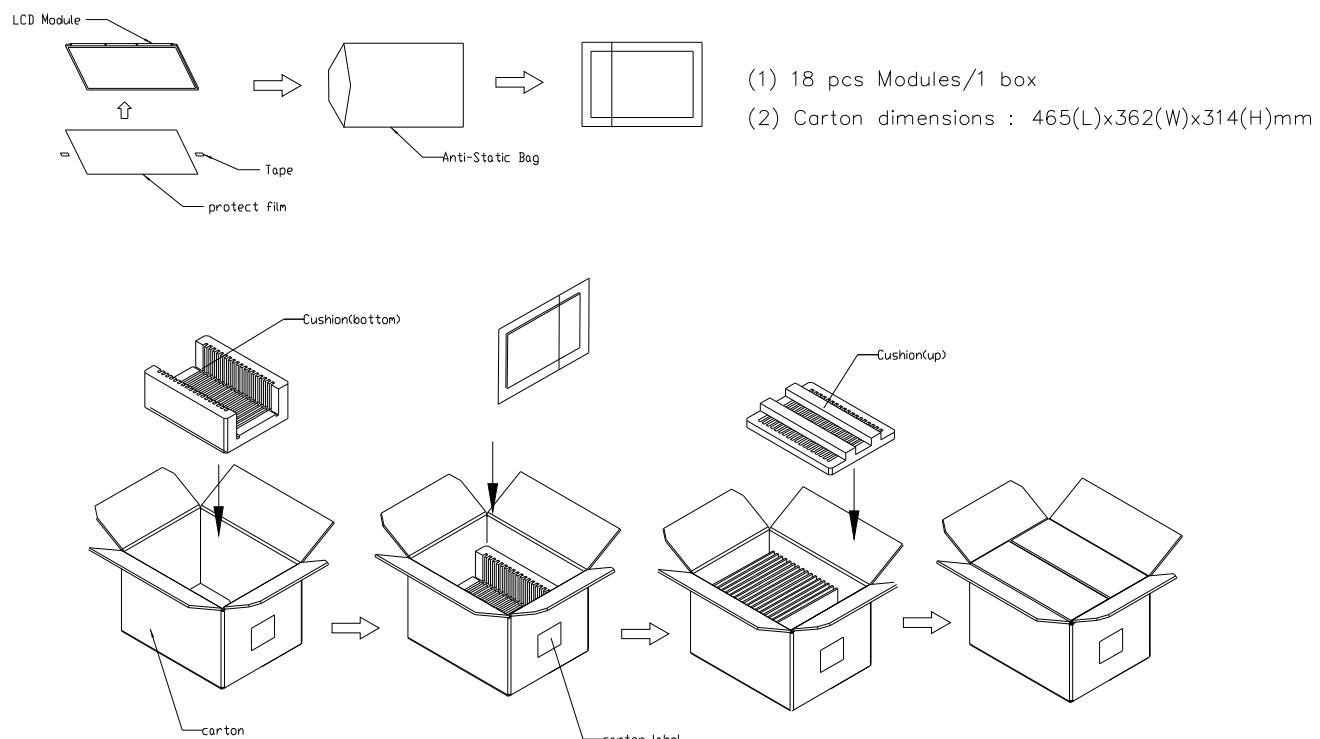
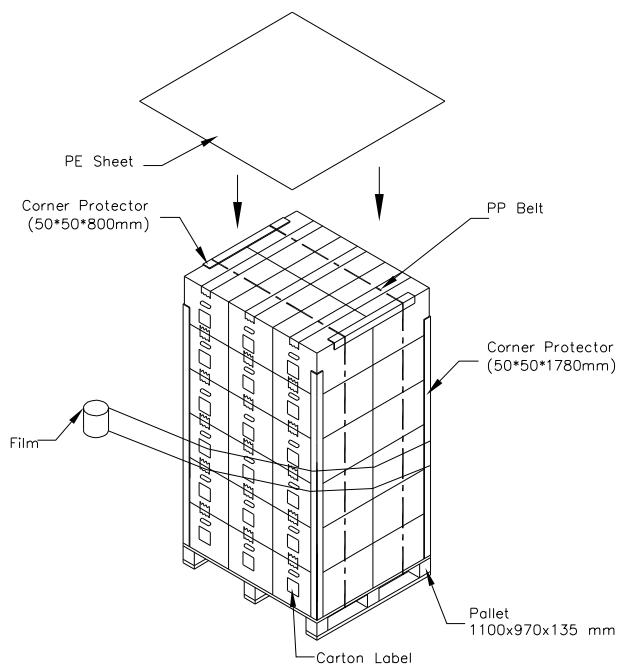


Figure. 9-1 Packing method

Sea / Land Transportation (40ft Container)



Air Transportation

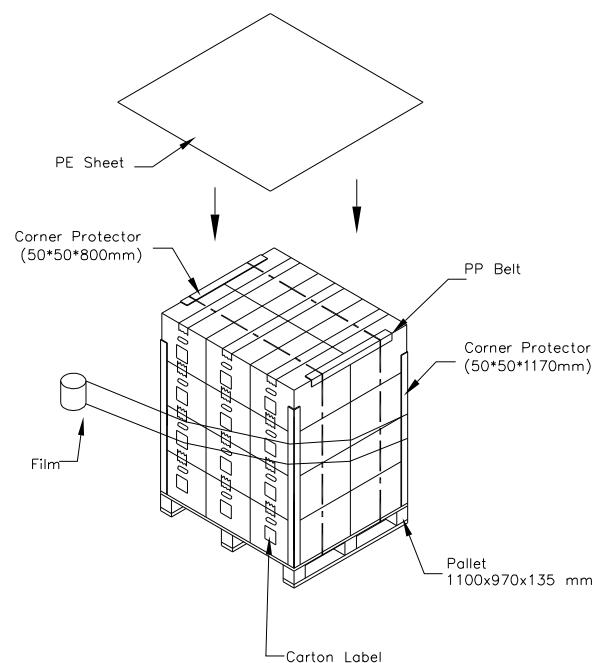


Figure. 9-2 Packing method

9.3 UN-PACKING METHOD

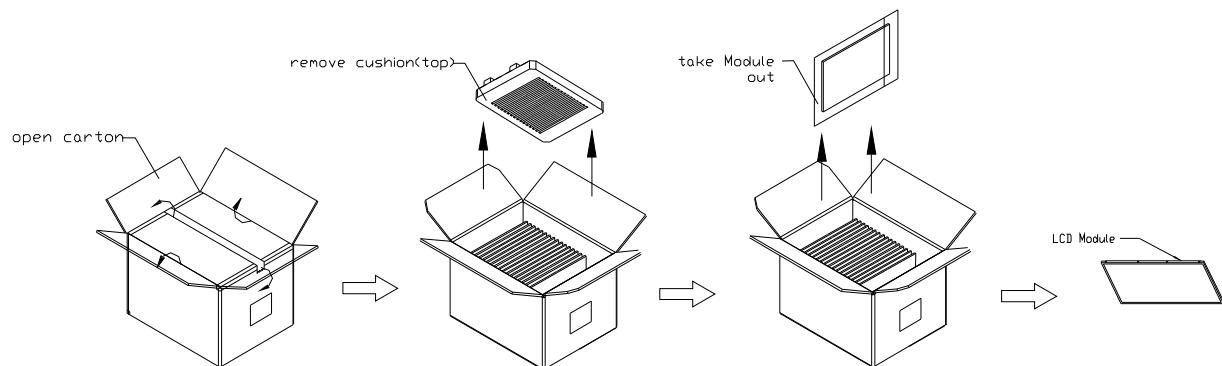
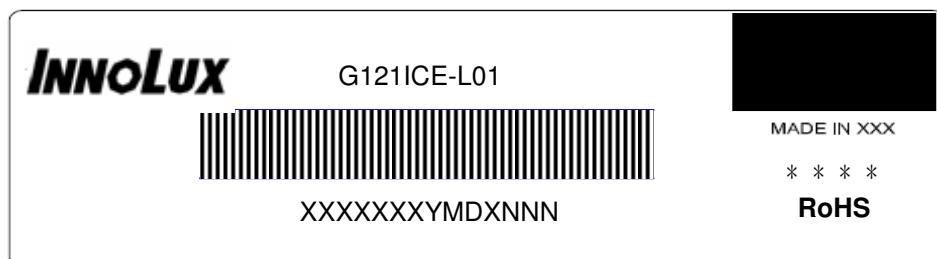
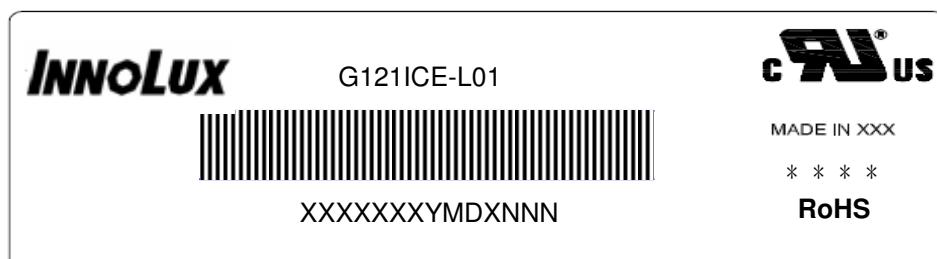


Figure. 9-3 UN-Packing method

10. DEFINITION OF LABELS

10.1 INX MODULE LABEL

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

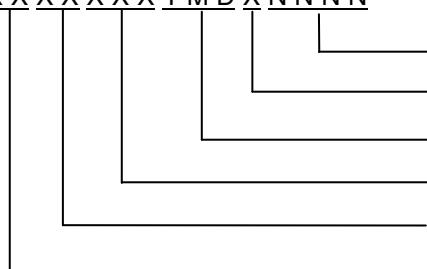


Note (1) Safety Compliance(UL logo) will open after C1 version.

(a) Model Name: G121ICE-L01

(b) * * * * : Factory ID

(c) Serial ID: X X X X X X X Y M D X N N N N



Serial
INX Internal Use
Year, Month, Date
INX Internal Use
Revision
INX Internal Use

Serial ID includes the information as below:

(a) Manufactured Date: Year: 1~9, for 2021~2029

Month: 1~9, A~C, for Jan. ~ Dec.

Day: 1~9, A~Y, for 1st to 31st, exclude I, O and U

(b) Revision Code: cover all the change

(c) Serial No.: Manufacturing sequence of product

11. PRECAUTIONS

11.1 ASSEMBLY AND HANDLING PRECAUTIONS

- (1) The module should be assembled into the system firmly by using every mounting hole. Be careful not to twist or bend the module.
- (2) While assembling or installing modules, it can only be in the clean area. The dust and oil may cause electrical short or damage the polarizer.
- (3) Use fingerstalls or soft gloves in order to keep display clean during the incoming inspection and assembly process.
- (4) Do not press or scratch the surface harder than a HB pencil lead on the panel because the polarizer is very soft and easily scratched.
- (5) If the surface of the polarizer is dirty, please clean it by some absorbent cotton or soft cloth. Do not use Ketone type materials (ex. Acetone), Ethyl alcohol, Toluene, Ethyl acid or Methyl chloride. It might permanently damage the polarizer due to chemical reaction.
- (6) Wipe off water droplets or oil immediately. Staining and discoloration may occur if they left on panel for a long time.
- (7) If the liquid crystal material leaks from the panel, it should be kept away from the eyes or mouth. In case of contacting with hands, legs or clothes, it must be washed away thoroughly with soap.
- (8) Protect the module from static electricity, it may cause damage to the C-MOS Gate Array IC.
- (9) Do not disassemble the module.
- (10) Do not pull or fold the lamp wire.
- (11) Pins of I/F connector should not be touched directly with bare hands.

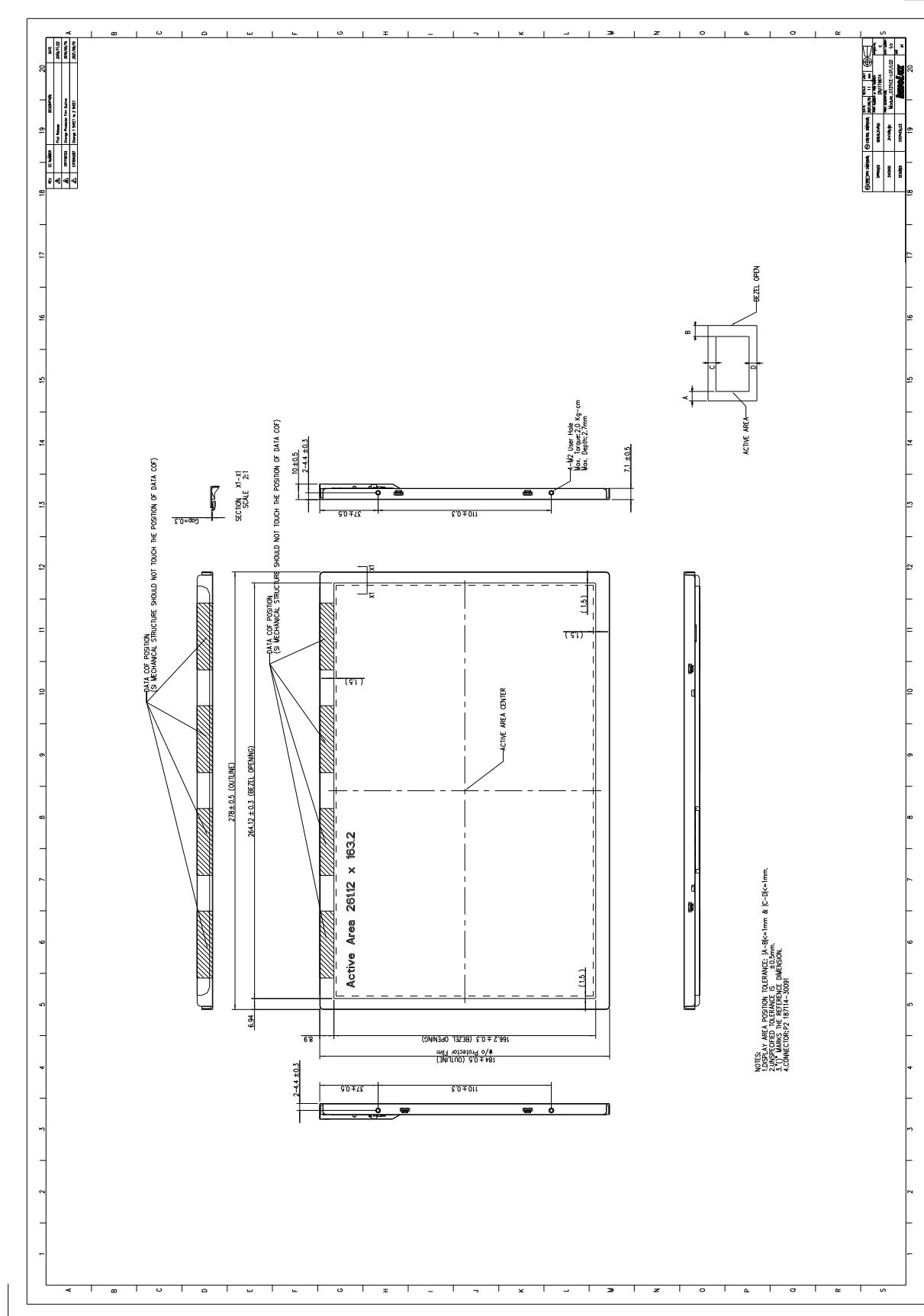
11.2 STORAGE PRECAUTIONS

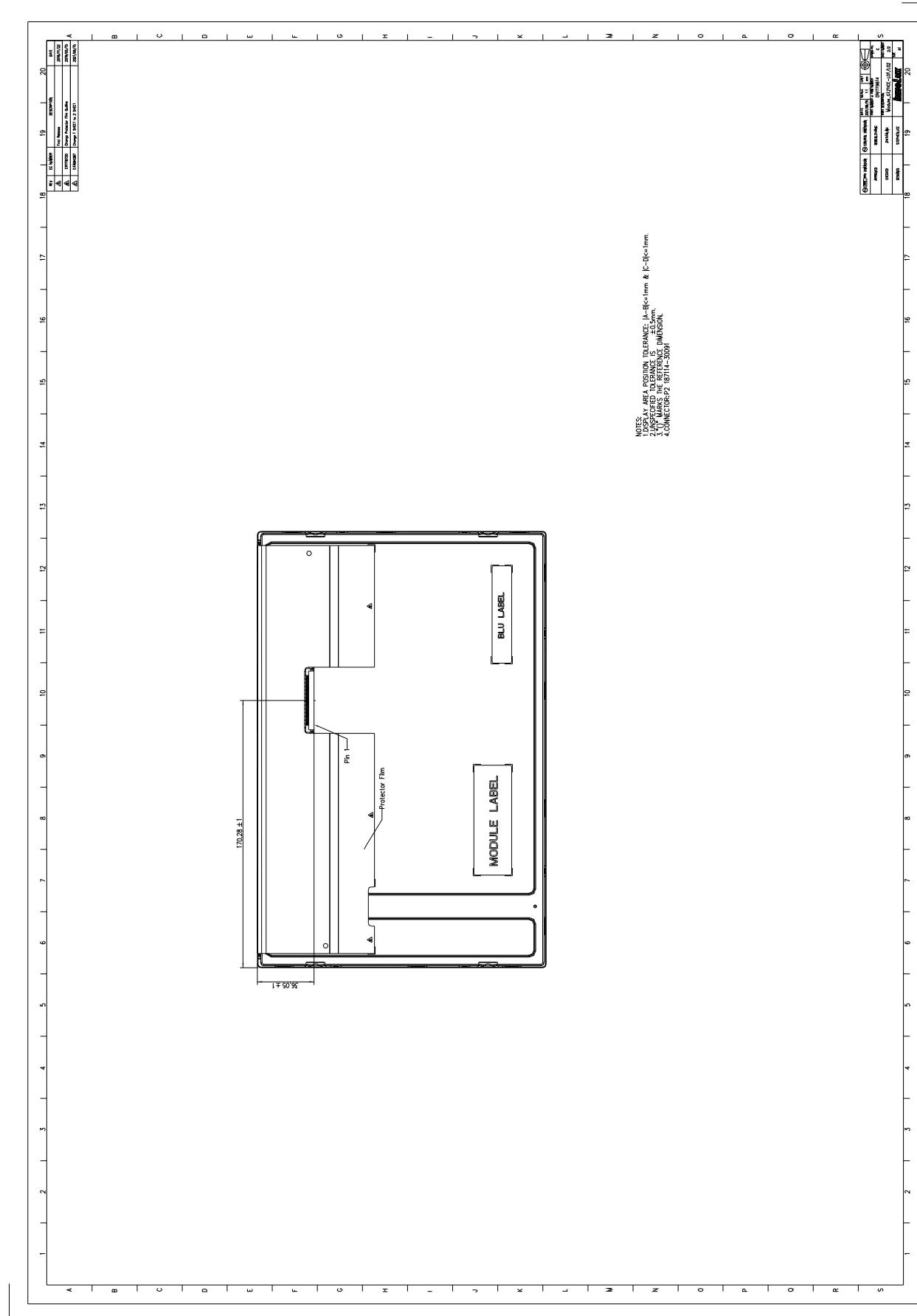
- (1) When storing for a long time, the following precautions are necessary.
 - (a) Store them in a dark place. Do not expose the module to sunlight or fluorescent light. Keep the temperature between 5°C and 30°C at humidity 50+-10%RH.
 - (b) The polarizer surface should not come in contact with any other object.
 - (c) It is recommended that they be stored in the container in which they were shipped.
 - (d) Storage condition is guaranteed under packing conditions.
 - (e) The phase transition of Liquid Crystal in the condition of the low or high storage temperature will be recovered when the LCD module returns to the normal condition
- (2) High temperature or humidity may reduce the performance of module. Please store LCD module within the specified storage conditions.
- (3) It is dangerous that moisture come into or contacted the LCD module, because the moisture may damage LCD module when it is operating.
- (4) It may reduce the display quality if the ambient temperature is lower than 10 °C. For example, the response time will become slowly, and the starting voltage of lamp will be higher than the room temperature.

11.3 OTHER PRECAUTIONS

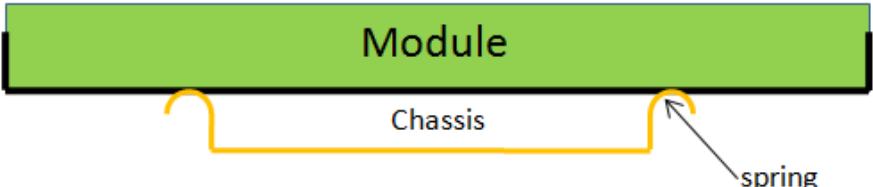
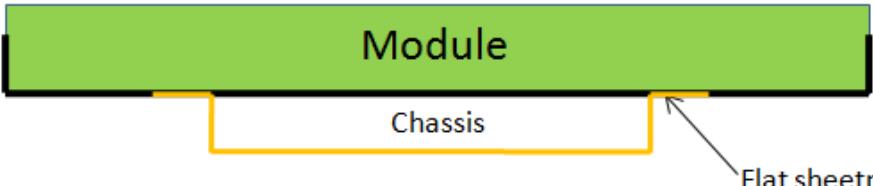
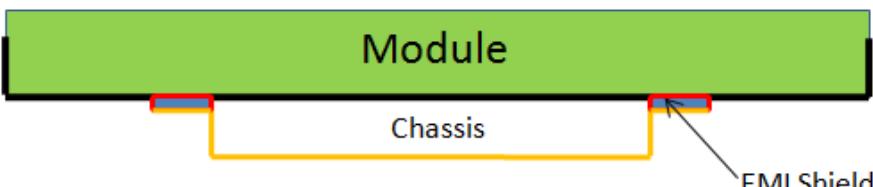
- (1) Normal operating condition
 - (a) Display pattern: dynamic pattern (Real display)
(Note) Long-term static display can cause image sticking.
- (2) Abnormal condition just means conditions except normal condition.

12. MECHANICAL CHARACTERISTICS



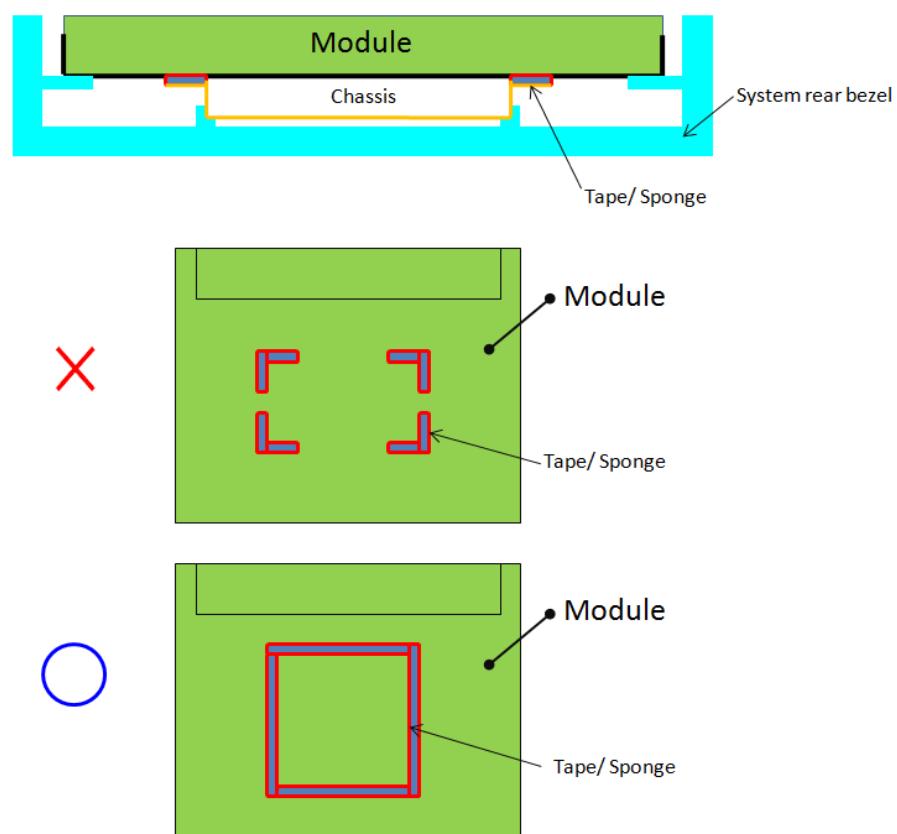


Appendix. SYSTEM COVER DESIGN NOTICE

1	Set Chassis and IAVM Module touching Mode
	 <p>Module</p> <p>Chassis</p> <p>spring</p>
	 <p>Module</p> <p>Chassis</p> <p>Flat sheetmetal</p>
	 <p>Module</p> <p>Chassis</p> <p>EMI Shielding Gasket (Tape/ Sponge)</p>
Definition	<p>a. To prevent from abnormal display & white spot after mechanical test, it is not recommended to use spring type chassis.</p> <p>b. We suggest the contact mode between Chassis and Module rear cover is Tape/Sponge, second is Flat sheet metal type chassis.</p>

2

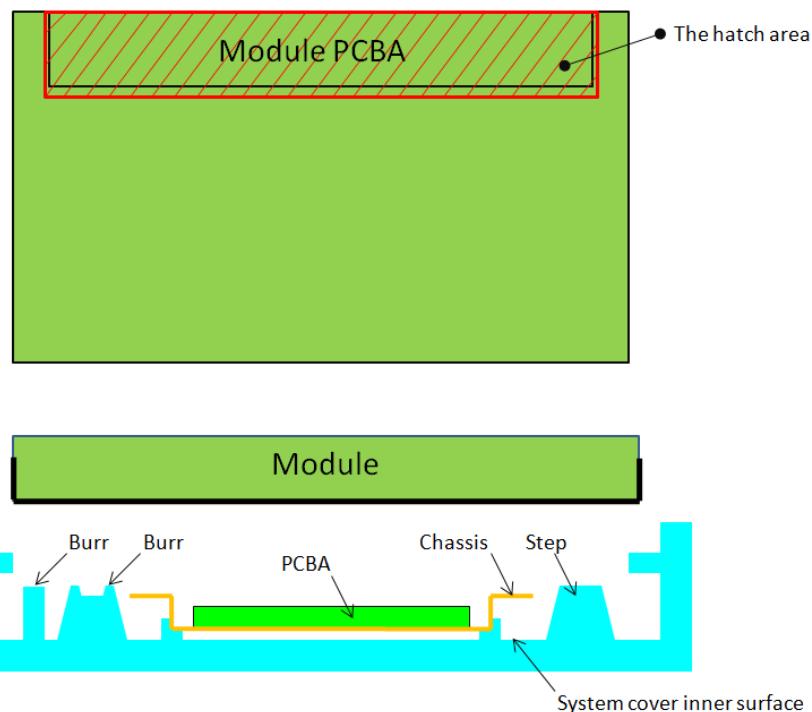
Tape/Sponge design on system inner surface



Definition	<p>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.</p> <p>b. When using the Tape/Sponge, we 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.</p>
------------	---

3

System inner surface examination

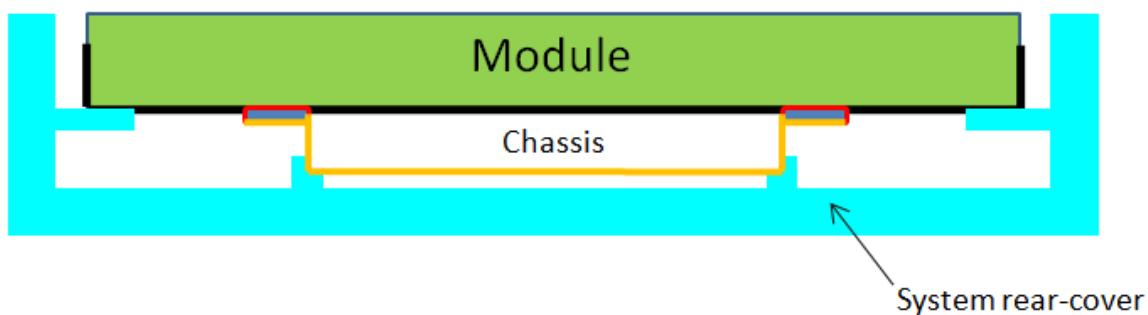


Definition

- a. The hatch area on Module PCBA should keep at least 1mm gap(X,Y,Z direction) to any structure with system cover inner surface.
- b. Burr, Step, PCB protrusion may cause stress concentration. White spot may occur during reliability test.

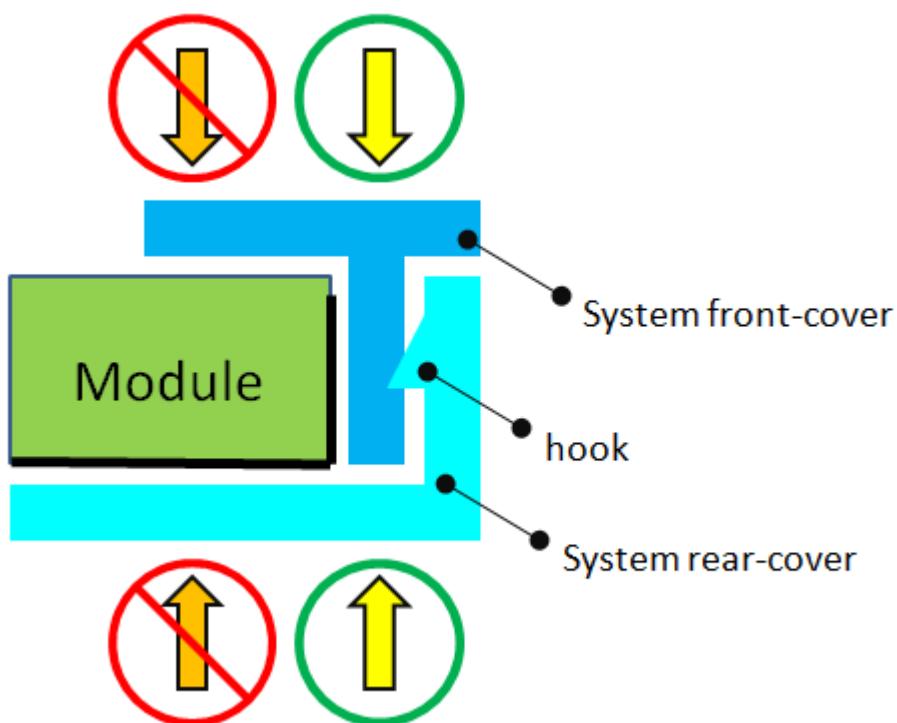
4

Material used for system rear-cover



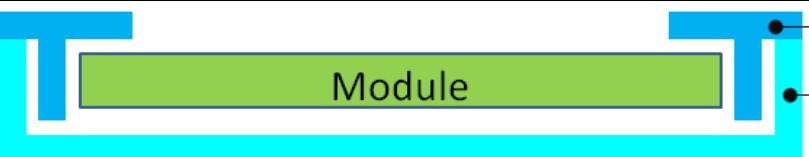
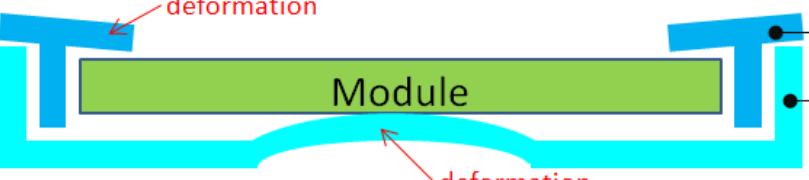
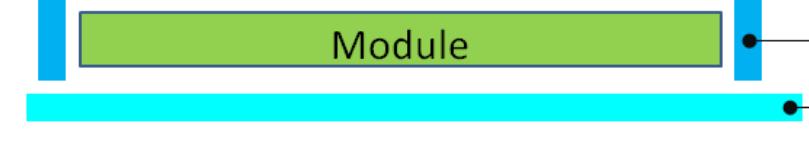
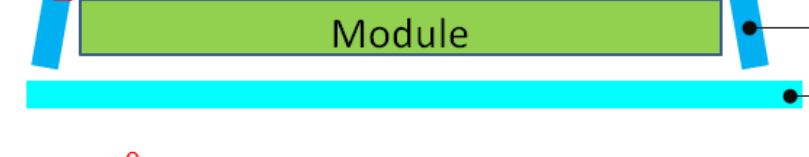
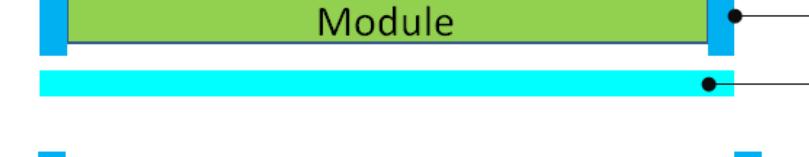
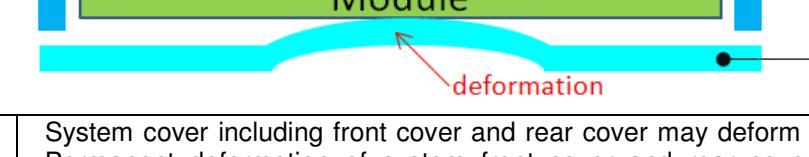
Definition

- 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 position for module's bracket are deformed 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.



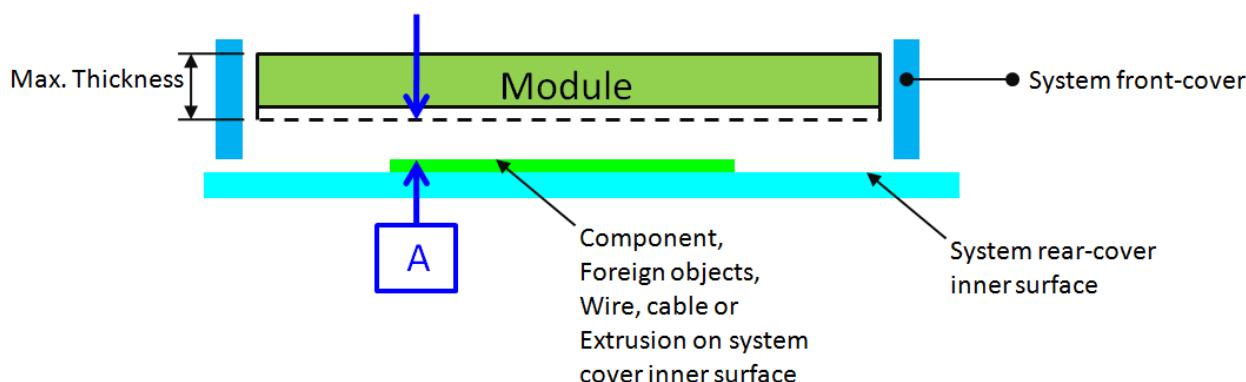
Definition

To prevent panel crack during system front-cover assembly process with hook structure, it is not recommended to press panel or any location that relate directly to the panel.

6	Permanent deformation of system cover after reliability test
	 <ul style="list-style-type: none"> System front-cover System rear-cover
	 <ul style="list-style-type: none"> System front-cover System rear-cover
	 <ul style="list-style-type: none"> System front-cover System rear-cover
	 <ul style="list-style-type: none"> System front-cover System rear-cover
	 <ul style="list-style-type: none"> System front-cover System rear-cover
	 <ul style="list-style-type: none"> System front-cover System rear-cover
Definition	<p>System cover including front cover and rear cover may deform during reliability test. Permanent deformation of system front cover and rear cover after reliability test should not interfere with panel. Because it may cause issue such as pooling, abnormal display, white spot and also cell creak.</p> <p>Note: If the interference cannot be avoided, please feel free to contract INX FAE Engineer for collaboration design. We can help to verify and pass risk assessment for customer reference.</p>

7

Design gap A between panel & any components on system rear-cover

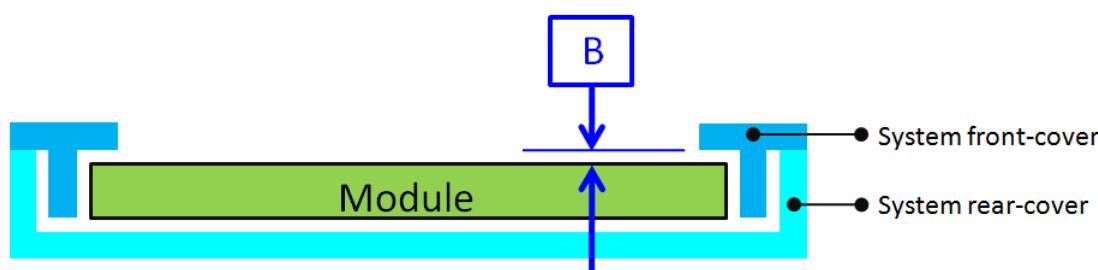


Definition

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

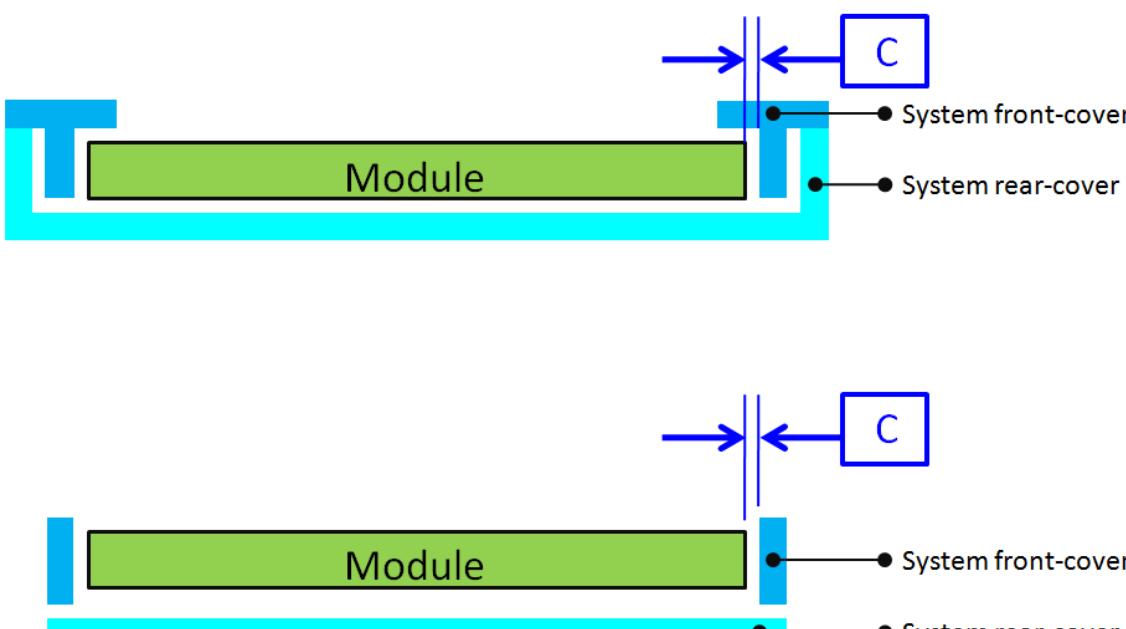
8

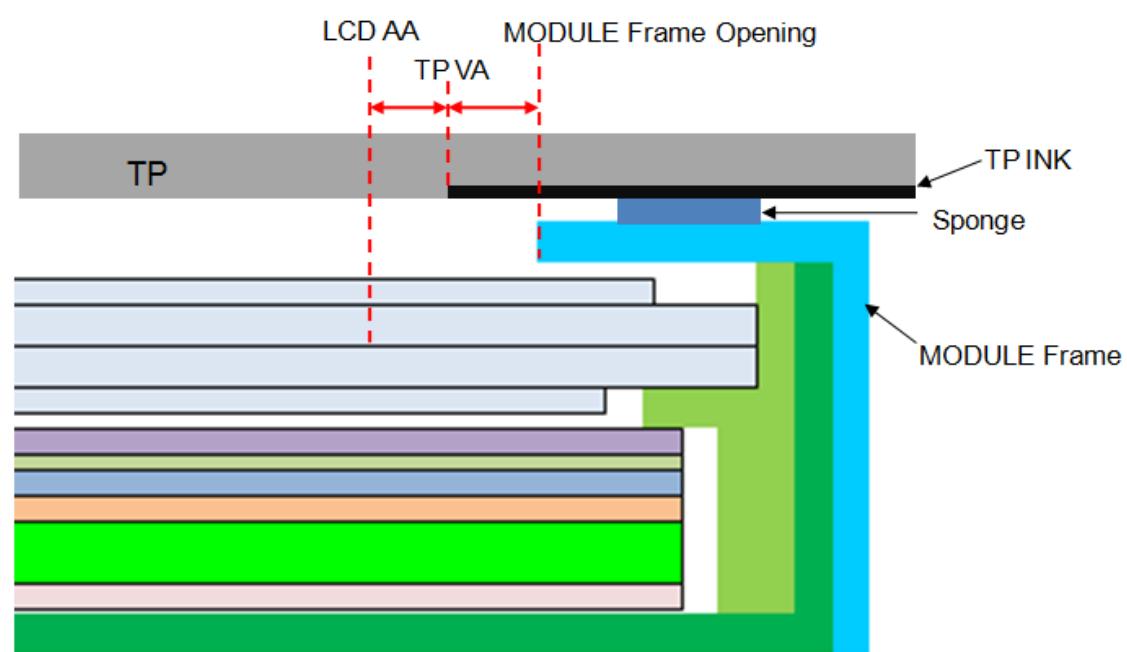
Design gap B between system front-cover & panel surface

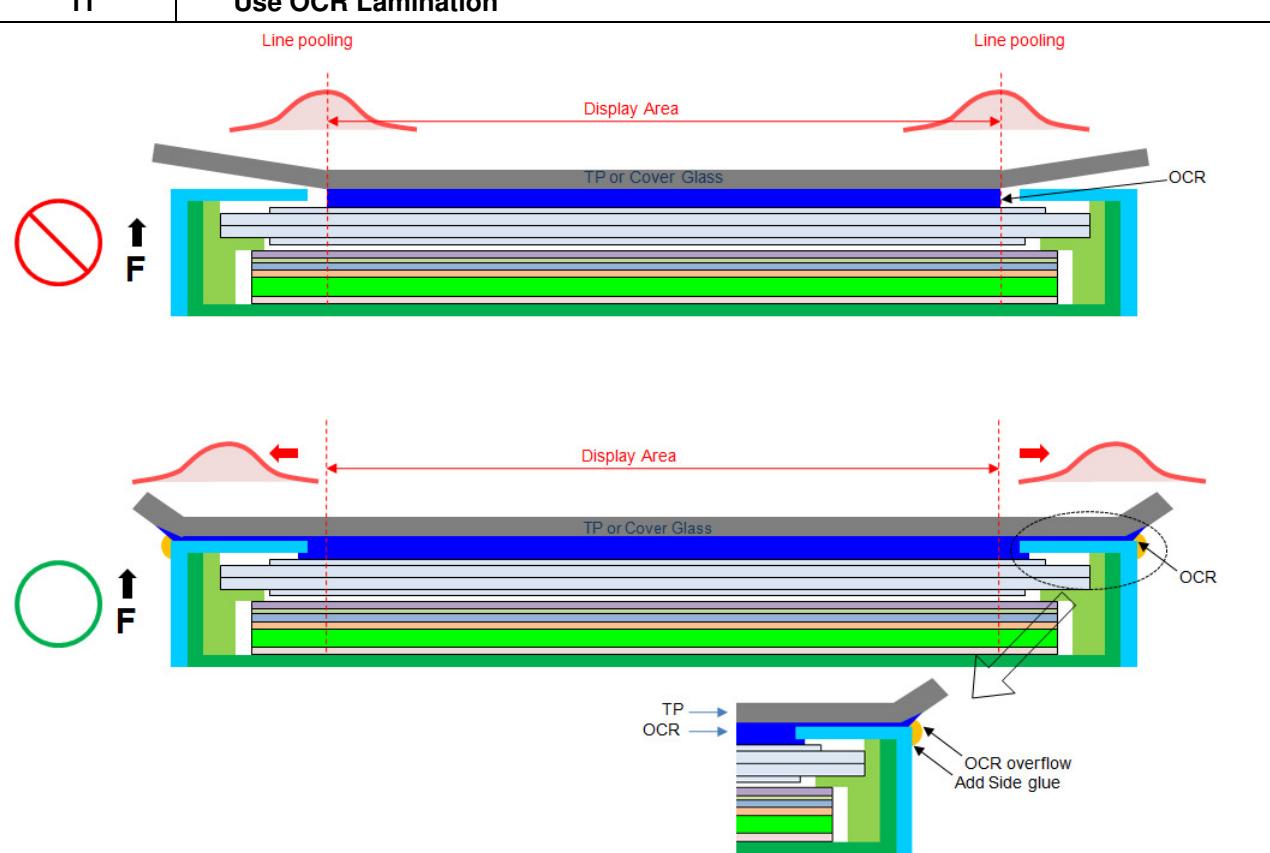


Definition

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 front-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 cannot be avoided, please feel free to contract INX FAE Engineer for collaboration design. We can help to verify and pass risk assessment for customer reference.

9	Design gap C between panel & system front-cover or protrusions
	
Definition	<p>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.</p> <p>The gap should be large enough to absorb the maximum displacement during the test.</p> <p>Note: If the interference cannot be avoided, please feel free to contract INX FAE Engineer for collaboration design. We can help to verify and pass risk assessment for customer reference.</p>

10	Design distance between TP AA to LCD AA
	
Definition	TP VA should avoid TP ink area covering LCD AA or causing the module frame to be exposed.

11	Use OCR Lamination
	 <p>Line pooling</p> <p>Display Area</p> <p>TP or Cover Glass</p> <p>OCR</p> <p>TP</p> <p>OCR</p> <p>OCR overflow</p> <p>Add Side glue</p>

Definition

- 1.OCR glue as possible beyond module, in order to avoid Line Pooling
- 2.Add side glue to avoid Line Pooling