Doc. Number :

☐ Tentative Specification
☐ Preliminary Specification
■ Approval Specification

MODEL NO.: M238HCA
SUFFIX: PGZ

Customer: Common Model

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
陳立錚	張耀元	邱詩容

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CS-2000
R=G=B=255
Gray scale
C light</td><td rowspan="8">Typ −0.03</td><td>(0.632)</td></tr>
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<tr><td rowspan="2">Green</td><td>Gx</td><td>(0.313)</td></tr>
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CS-2000
R=G=B=255
Gray scale
C light</td><td rowspan="8">Typ −0.03</td><td>(0.629)</td></tr>
<tr><td>Ry</td><td>(0.347)</td></tr>
<tr><td rowspan="2">Green</td><td>Gx</td><td>(0.314)</td></tr>
<tr><td>Gy</td><td>(0.566)</td></tr>
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<tr><td>By</td><td>(0.079)</td></tr>
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<tr><td>3</td><td>NC</td><td>For LCD internal use only, Do not connect</td></tr>
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<tr><td>2</td><td>SCL</td><td>I²C SCL signal (For Auto VCOM)</td></tr>
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Gray scale
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<tr><td rowspan="2">Green</td><td>Gx</td><td>0.313</td></tr>
<tr><td>Gy</td><td>0.567</td></tr>
<tr><td rowspan="2">Blue</td><td>Bx</td><td>0.139</td></tr>
<tr><td>By</td><td>0.078</td></tr>
<tr><td rowspan="2">White</td><td>Wx</td><td>0.335</td></tr>
<tr><td>Wy</td><td>0.350</td></tr>
</table></td></tr>
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<tr><td></td><td></td><td></td><td></td></tr>
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</table>

1. GENERAL DESCRIPTION

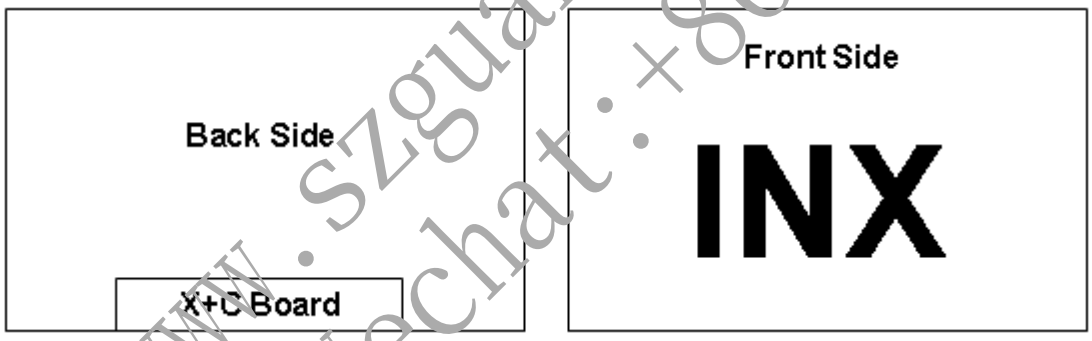
1.1 OVERVIEW

The M238HCA-PGZ is a 23.8” TFT Liquid Crystal Display MNT open cell with driver ICs and a 51-pins+ 41-pins-4ch-LVDS circuit board. The product supports 1920 x 1080 Full HD mode and can display up to 16.7M colors. The backlight unit is not built in.

1.2 GENERAL SPECIFICATIONS

Item	Specification	Unit	Note
Screen Size	23.8 inch Diagonal	mm	
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(8 bits)	color	-
Transmissive Mode	AAS, Normally Black	-	-
Color Gamut	sRGB 99%(Typ.)		(2)
Display Orientation	Signal input with “ INX”	-	(1)
Surface Treatment	AG type, 3H hard coating, Haze 25	-	-
Power Consumption	Total cell 8.5W(Max.)		

Note(1)



Note(2) The Color Gamut is measured with specify BLU

Based on Coverage of sRGB color space on CIE-1931 system

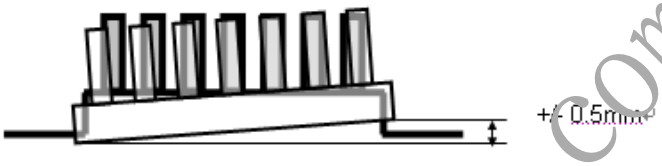
2. MECHANICAL SPECIFICATIONS

Item	Min.	Typ.	Max.	Unit	Note
Weight	450	500	525	g	
I/F connector mounting position	The mounting inclination of the connector makes the screen center within ±0.5mm as the horizontal.				(2)

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

(2) Connector mounting position

(3) Please refer to sec.3.1 for more information of power consumption.



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)

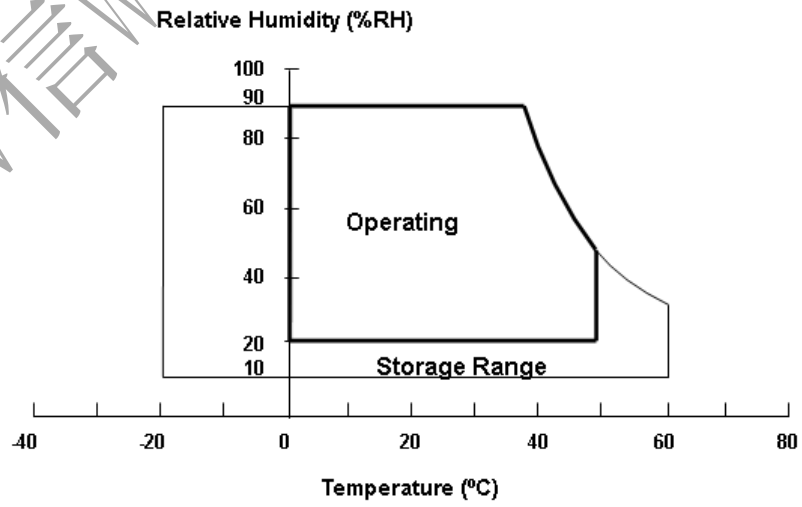
(a) 90 %RH Max.

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

(c) No condensation.

Note (2) The temperature of panel surface should be 0 ºC min. and 65 ºC max.

Panel surface temperature should be 0℃ min. and 65℃ max under Vcc=12.0V, Input fr =120Hz, 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 OPEN CELL

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	

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.

3.3 ABSOLUTE RATINGS OF ENVIRONMENT (OPEN CELL)

High temperature or humidity may reduce the performance of panel. Please store LCD panel within the specified storage conditions.

Storage Condition: With packing.

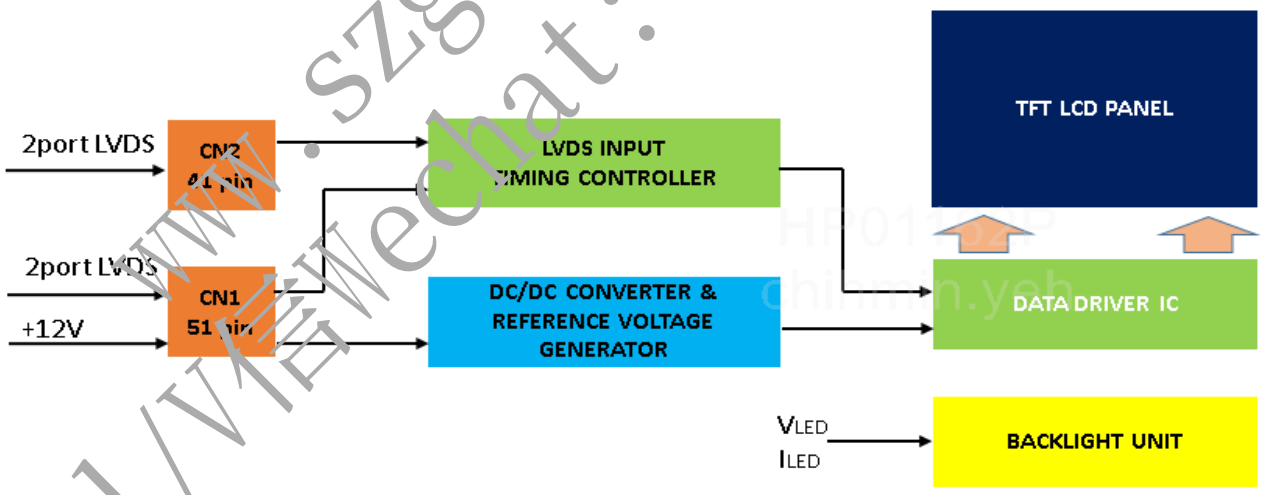
Storage temperature range: 25±5 ºC.

Storage humidity range: 50±10%RH.

Shelf life: 30days

4. ELECTRICAL SPECIFICATIONS

4.1 FUNCTION BLOCK DIAGRAM



4.2 INTERFACE CONNECTIONS

PIN ASSIGNMENT (CN1：51pins)

Pin	Name	Description
1	NC	For LCD internal use only, Do not connect
2	SCL	I^2C SCL signal (For Auto VCOM)
3	SDA	I^2C SDA signal (For Auto VCOM)
4	NC	For LCD internal use only, Do not connect
5	NC	For LCD internal use only, Do not connect
6	NC	For LCD internal use only, Do not connect
7	NC	For LCD internal use only, Do not connect
8	NC	For LCD internal use only, Do not connect
9	NC	For LCD internal use only, Do not connect
10	NC	For LCD internal use only, Do not connect
11	GND	Ground
12	ALV0N	1st LVDS Receiver Signal(0-)
13	ALV0P	1st LVDS Receiver Signal(0+)
14	ALV1N	1st LVDS Receiver Signal(1-)
15	ALV1P	1st LVDS Receiver Signal(1+)
16	ALV2N	1st LVDS Receiver Signal(2-)
17	ALV2P	1st LVDS Receiver Signal(2+)
18	GND	Ground
19	ALVCKN	1st LVDS Receiver Signal(CLK-)
20	ALVCKP	1st LVDS Receiver Signal(CLK+)
21	GND	Ground
22	ALV3N	1st LVDS Receiver Signal(3-)
23	ALV3P	1st LVDS Receiver Signal(3+)
24	NC	For LCD internal use only, Do not connect
25	NC	For LCD internal use only, Do not connect
26	NC	For LCD internal use only, Do not connect
27	NC	For LCD internal use only, Do not connect
28	BLV0N	2nd LVDS Receiver Signal(0-)
29	BLV0P	2nd LVDS Receiver Signal(0+)
30	BLV1N	2nd LVDS Receiver Signal(1-)
31	BLV1P	2nd LVDS Receiver Signal(1+)
32	BLV2N	2nd LVDS Receiver Signal(2-)
33	BLV2P	2nd LVDS Receiver Signal(2+)
34	GND	Ground
35	BLVCKN	2nd LVDS Receiver Signal(CLK-)
36	BLVCKP	2nd LVDS Receiver Signal(CLK+)
37	GND	Ground
38	BLV3N	2nd LVDS Receiver Signal(3-)
39	BLV3P	2nd LVDS Receiver Signal(3+)
40	NC	For LCD internal use only, Do not connect
41	NC	For LCD internal use only, Do not connect
42	NC	For LCD internal use only, Do not connect
43	NC	For LCD internal use only, Do not connect
44	GND	Ground
45	GND	Ground
46	GND	Ground
47	NC	For LCD internal use only, Do not connect
48	VIN(12V)	+12.0V power supply
49	VIN(12V)	+12.0V power supply

50	VIN(12V)	+12.0V power supply
51	VIN(12V)	+12.0V power supply

Connector Information

Note (1) Reserved for internal use. Please leave it open.

Note (2) Connector Part No.:

Item	Description
Type Part Number	P-TWO: 187059-51221
	FCN: WF23-402-5133

Note (3) User's connector Part No:

Item	Description
Mating Wire Cable Connector Part No	JAE FI-RE51HL
	PWOT LVDS 28 Type_187120-51001-3
	Hamburg FCC-W50-510001-000C or compatible

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

PIN ASSIGNMENT (CN2：41pins)

Pin	Name	Description
1	NC	For LCD internal use only, Do not connect
2	NC	For LCD internal use only, Do not connect
3	NC	For LCD internal use only, Do not connect
4	NC	For LCD internal use only, Do not connect
5	NC	For LCD internal use only, Do not connect
6	NC	For LCD internal use only, Do not connect
7	NC	For LCD internal use only, Do not connect
8	NC	For LCD internal use only, Do not connect
9	GND	Ground
10	CLV0N	3rd LVDS Receiver Signal(0-)
11	CLV0P	3rd LVDS Receiver Signal(0+)
12	CLV1N	3rd LVDS Receiver Signal(1-)
13	CLV1P	3rd LVDS Receiver Signal(1+)
14	CLV2N	3rd LVDS Receiver Signal(2-)
15	CLV2P	3rd LVDS Receiver Signal(2+)
16	GND	Ground
17	CLVCKN	3rd LVDS Receiver Signal(CLK-)
18	CLVCKP	3rd LVDS Receiver Signal(CLK+)
19	GND	Ground
20	CLV3N	3rd LVDS Receiver Signal(3-)
21	CLV3P	3rd LVDS Receiver Signal(3+)
22	NC	For LCD internal use only, Do not connect
23	NC	For LCD internal use only, Do not connect
24	GND	Ground
25	GND	Ground
26	DLV0N	4th LVDS Receiver Signal(0-)
27	DLV0P	4th LVDS Receiver Signal(0+)
28	DLV1N	4th LVDS Receiver Signal(1-)
29	DLV1P	4th LVDS Receiver Signal(1+)
30	DLV2N	4th LVDS Receiver Signal(2-)
31	DLV2P	4th LVDS Receiver Signal(2+)
32	GND	Ground
33	DLVCKN	4th LVDS Receiver Signal(CLK-)

34	DLVCKP	4th LVDS Receiver Signal(CLK+)
35	GND	Ground
36	DLV3N	4th LVDS Receiver Signal(3-)
37	DLV3P	4th LVDS Receiver Signal(3+)
38	NC	For LCD internal use only, Do not connect
39	NC	For LCD internal use only, Do not connect
40	GND	Ground
41	GND	Ground

Connector Information

Note (1) Reserved for internal use. Please leave it open.

Note (2) Connector Part No.:

Item	Description
Type Part Number	P-TWO: 187060-41221
	FCN: WF23-400-413C

Note (3) User's connector Part No:

Item	Description
Mating Wire Cable Connector Part No	JAE FI-RE41HL
	PTWO LVDS 28 Type 187120-41001-3
	Hamburg FCC-W50-410001-000C or compatible

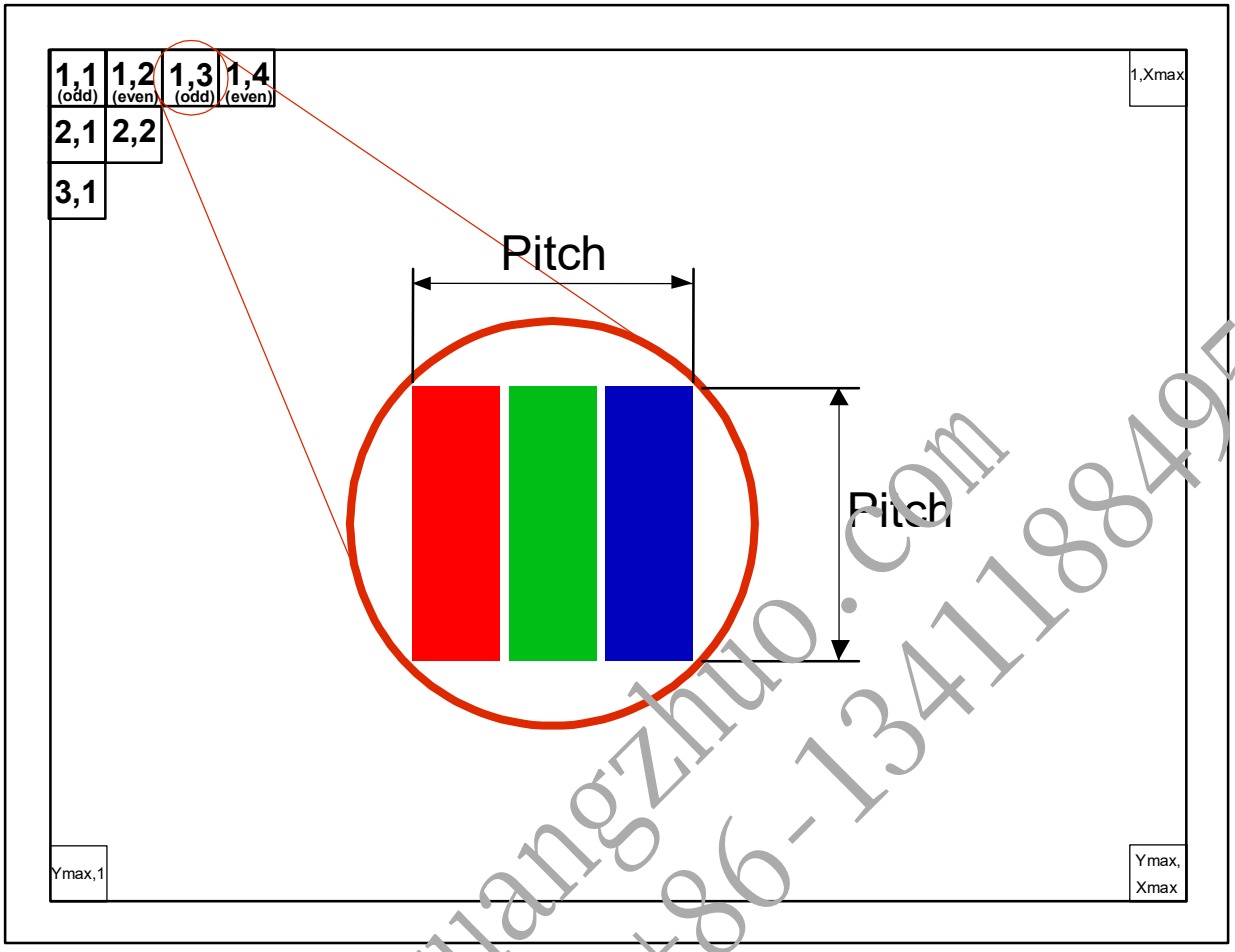
*Notice: There would be compatible issues if not using the indicated connectors in the matching list.

Note (4) LVDS 4-port Data Mapping.

Port	Channel of LVDS	Data Stream
1st Port	First Pixel	1,5,9,……2553,2557
2nd Port	Second Pixel	2,6,10,……2554,2558
3rd Port	Third Pixel	3,7,11,……2555,2559
4th Port	Fourth Pixel	4,8,12,……2556,2560

Note (5) Input signal of 4port LVDS clock should be the same timing.

Note (6) Input signal of even and odd clock should be the same timing.



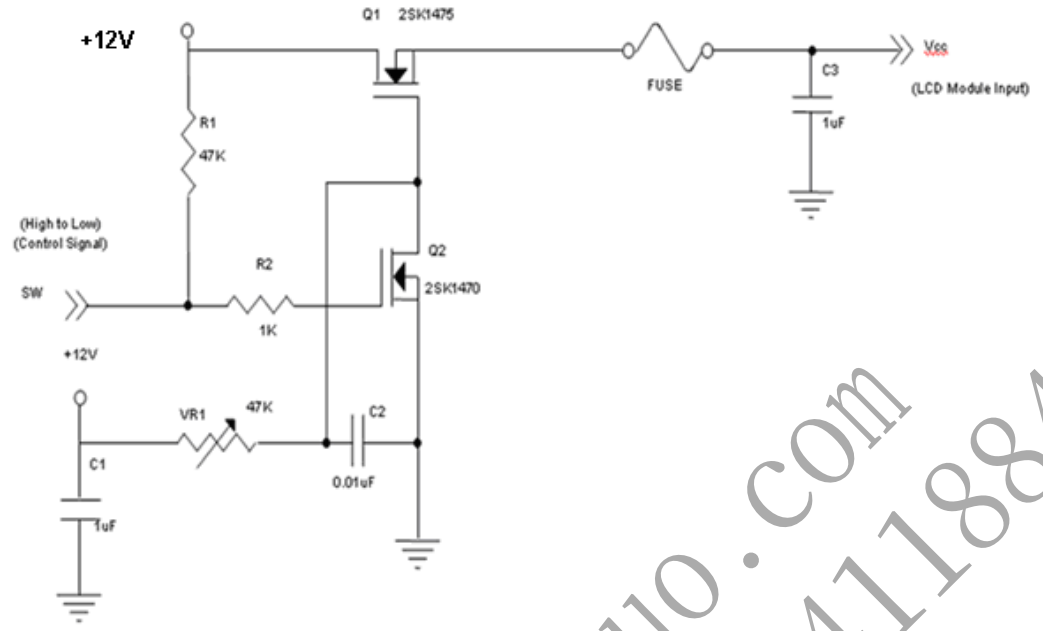
4.3 ELECTRICAL CHARACTERISTICS

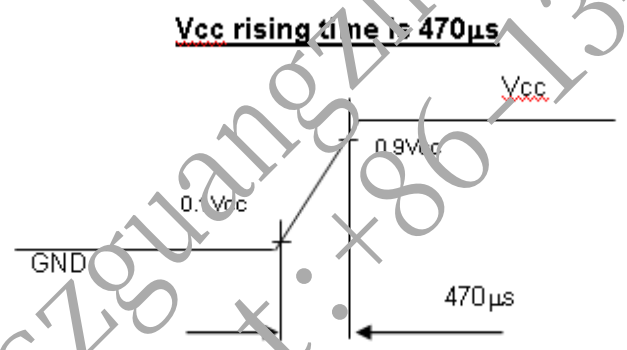
4.3.1 LCD ELETRONICS SPECIFICATION

Parameter		Symbol	Value			Unit	Note
			Min.	Typ.	Max.		
Power Supply Voltage		Vcc	10.8	12	13.2	V	-
Ripple Voltage		V_{RP}			300	mV	-
Rush Current		I_{RUSH}			3	A	(2)
Power Supply Current	White			0.33	0.41	A	(3)a
	Black			0.32	0.40	A	(3)b
	Vertical Stripe			0.54	0.71	A	(3)c
Power Consumption		PLCD		6.47	8.5	Watt	(4)
LVDS differential input voltage		Vid	100		600	mV	
LVDS common input voltage		Vic	1.0	1.2	1.4	V	
Logic High Input Voltage		VIH			+100	mV	
Logic Low Input Voltage		VIL	-100			mV	

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

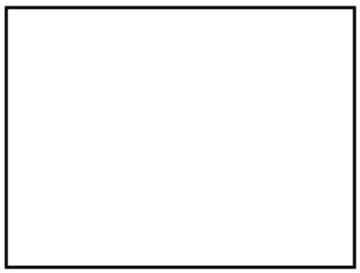
Note (2) Measurement Conditions:





Note (3) The specified power supply current is under the conditions at Vcc=12.0V, Ta=25 ± 2 ºC, Fr =120Hz, whereas a power dissipation check pattern below is displayed.

a. White Pattern

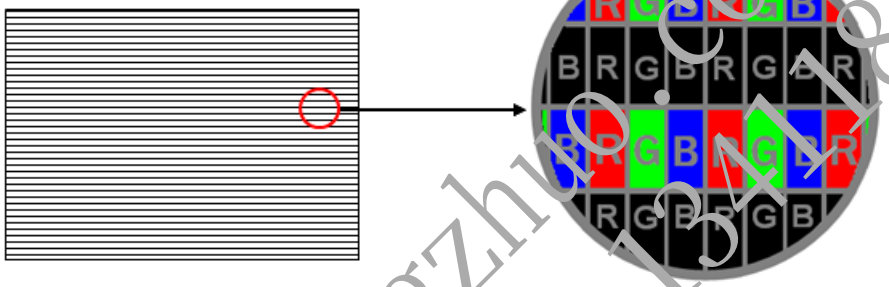


Active Area

b. Black Pattern

Active Area

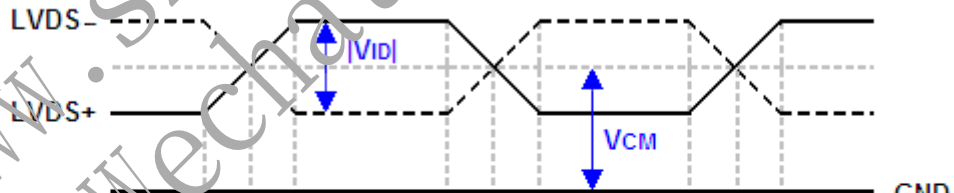
c. Horizontal Pattern



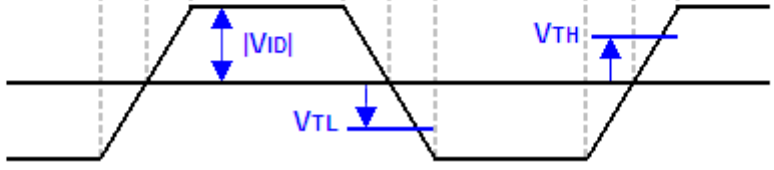
Note (4) The power consumption is specified at the pattern with the maximum current.

Note (5) VID waveform condition

Single-end Signals



Differential Signal



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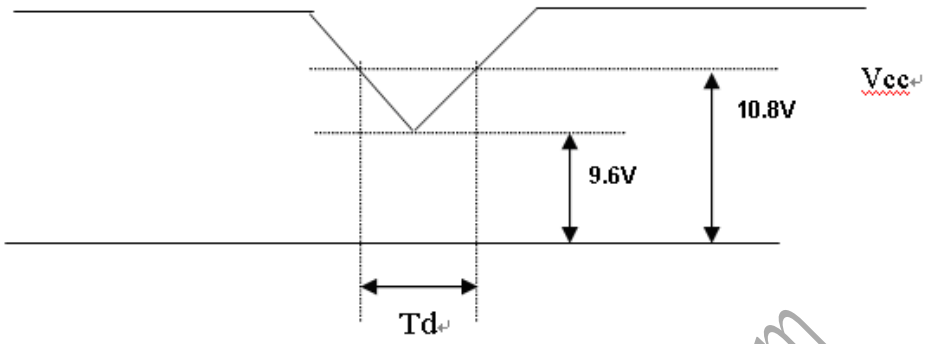
4.3.2 VCC POWER DIP CONDITION



Dip condition : 9.6V≦Vcc≦10.8V, Td≦20ms

4.4 LVDS INPUT SIGNAL SPECIFICATIONS

4.4.1 LVDS DATA MAPPING TABLE

LVDS Channel ALV0	LVDS output	D7	D6	D4	D3	D2	D1	D0
	Data order	1G0	1R5	1R4	1R3	1R2	1R1	1R0
LVDS Channel ALV1	LVDS output	D18	D15	D14	D13	D12	D9	D8
	Data order	1B1	1B0	1G5	1G4	1G3	1G2	1G1
LVDS Channel ALV2	LVDS output	D26	D25	D24	D22	D21	D20	D19
	Data order	DE	NA	NA	1B5	1B4	1B3	1B2
LVDS Channel ALV3	LVDS output	D23	D17	D16	D11	D10	D5	D27
	Data order	NA	1B7	1B6	1G7	1G6	1R7	1R6
LVDS Channel BLV0	LVDS output	D7	D6	D4	D3	D2	D1	D0
	Data order	2G0	2R5	2R4	2R3	2R2	2R1	2R0
LVDS Channel BLV1	LVDS output	D18	D15	D14	D13	D12	D9	D8
	Data order	2B1	2B0	2G5	2G4	2G3	2G2	2G1
LVDS Channel BLV2	LVDS output	D26	D25	D24	D22	D21	D20	D19
	Data order	DE	NA	NA	2B5	2B4	2B3	2B2
LVDS Channel BLV3	LVDS output	D23	D17	D16	D11	D10	D5	D27
	Data order	NA	2B7	2B6	2G7	2G6	2R7	2R6
LVDS Channel CLV0	LVDS output	D7	D6	D4	D3	D2	D1	D0
	Data order	3G0	3R5	3R4	3R3	3R2	3R1	3R0
LVDS Channel CLV1	LVDS output	D18	D15	D14	D13	D12	D9	D8
	Data order	3B1	3B0	3G5	3G4	3G3	3G2	3G1
LVDS Channel CLV2	LVDS output	D26	D25	D24	D22	D21	D20	D19
	Data order	DE	NA	NA	3B5	3B4	3B3	3B2
LVDS Channel CLV3	LVDS output	D23	D17	D16	D11	D10	D5	D27
	Data order	NA	3B7	3B6	3G7	3G6	3R7	3R6
LVDS Channel DLV0	LVDS output	D7	D6	D4	D3	D2	D1	D0
	Data order	4G0	4R5	4R4	4R3	4R2	4R1	4R0
LVDS Channel DLV1	LVDS output	D18	D15	D14	D13	D12	D9	D8
	Data order	4B1	4B0	4G5	4G4	4G3	4G2	4G1
LVDS Channel DLV2	LVDS output	D26	D25	D24	D22	D21	D20	D19
	Data order	DE	NA	NA	4B5	4B4	4B3	4B2
LVDS Channel DLV3	LVDS output	D23	D17	D16	D11	D10	D5	D27
	Data order	NA	4B7	4B6	4G7	4G6	4R7	4R6

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

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	29.7	74.25	97.75	MHz	(1)
	Period	Tc	-	13.468	-	ns	
	Input cycle to cycle jitter	T_{rcl}	-0.02*Tc	-	0.02*Tc	ns	(2)
	Input Clock to data skew	TLVCCS	-0.02*Tc	-	0.02*Tc		(3)
	Spread spectrum modulation range	Fclkin_mod	0.97*Fc	-	1.03*Fc	MHz	(4)
	Spread spectrum modulation frequency	F_{SSM}	-	-	100	KHz	
Vertical Display Term	Frame Rate	Fr	47	120	165	Hz	Tv=Tvd+Tvb
	Total	Tv	1100	1125	3892	Th	-
	Active Display	Tvd	1080	1080	1080	Th	-
	Blank	Tvb	20	45	2818	Th	-
Horizontal Display Term	Frequency	Fh	54	66	88	KHz	
	Total	Th	525	550	575	Tc	Th=Thd+Thb
	Active Display	Thd	480	480	480	Tc	-
	Blank	Thb	45	70	95	Tc	-

Note: In Free-sync mode, only guaranteed no functional failure, but don't guaranteed its quality of the optical and cosmetic performance. The optimal Vertical Frame Rate is 119~165Hz for best picture quality.

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

Fc = Fr X Tv X Th

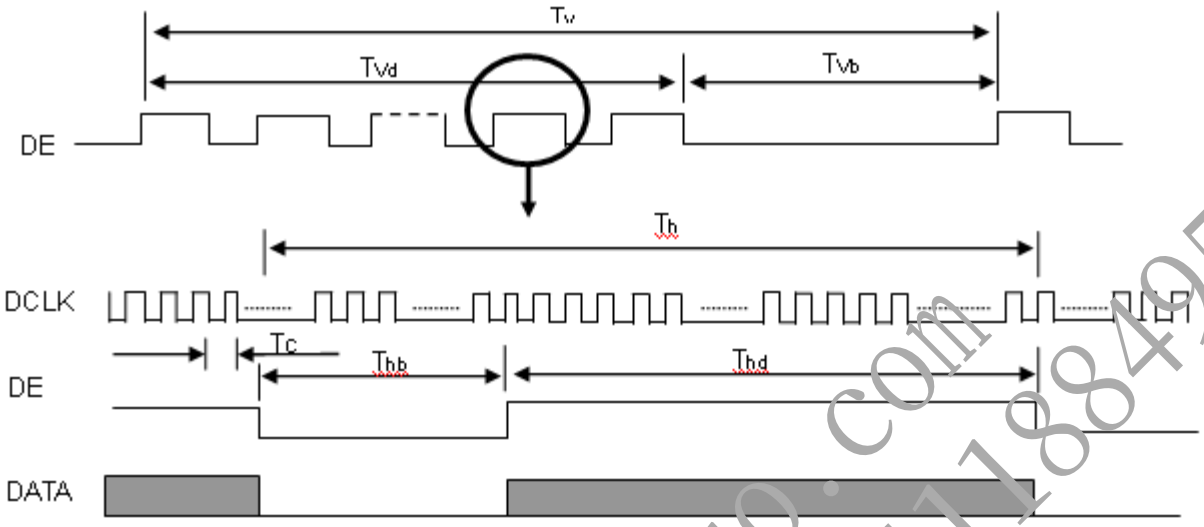
Fh(min.)=Fc(min.)/Th(min.)

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

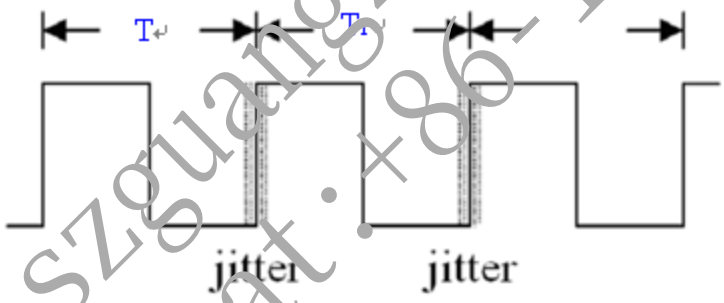
Fh(max.)=Fc(max.)/Th(min.)

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.

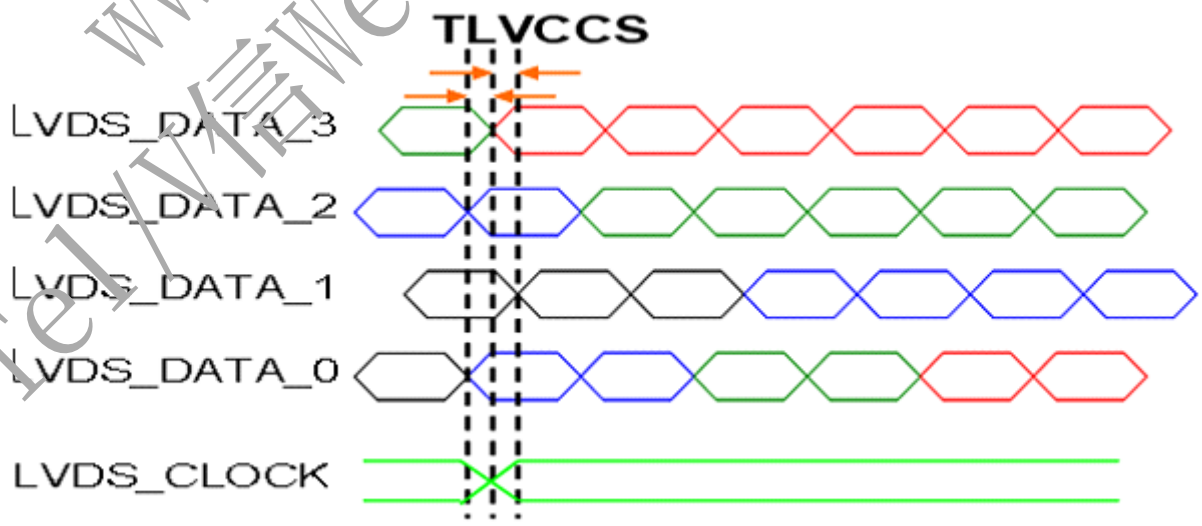
INPUT SIGNAL TIMING DIAGRAM



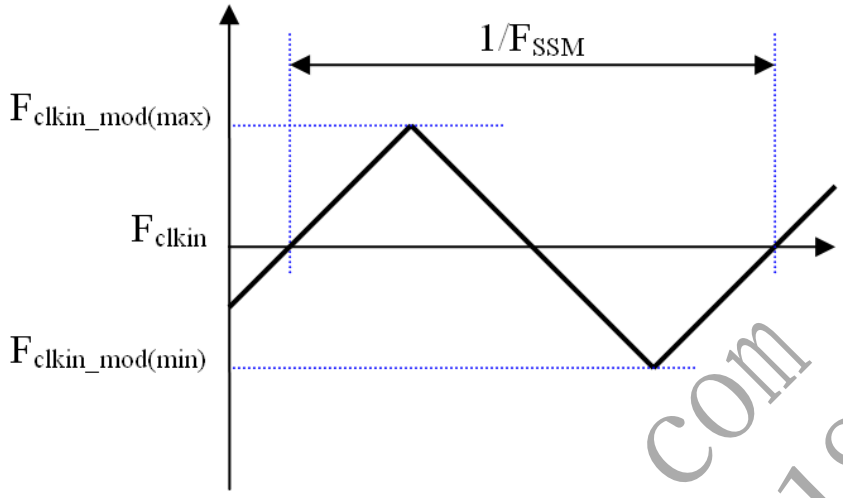
Note(2) The input clock cycle-to-cycle jitter is defined as below figures. Tcl = |T1 – Tl



Note(3) Input Clock to data skew is defined as below figures.



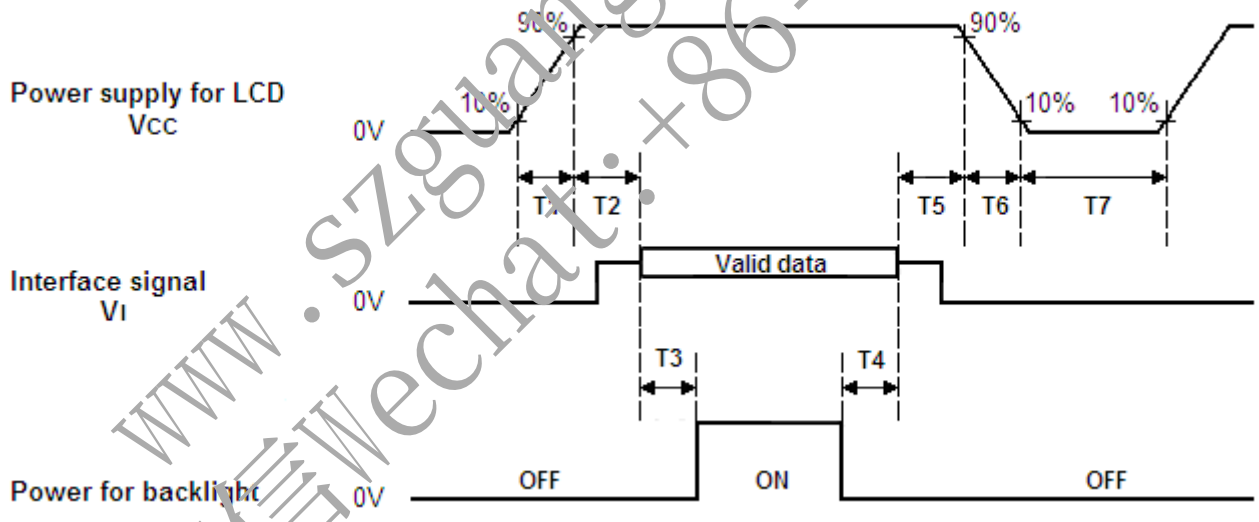
Note(4) The SSCG (Spread spectrum clock generator) is defined as below figures.



Note(5) The DCLK range at last line of V-blank should be set in 0 to Ndisplay/2

4.6 POWER ON/OFF SEQUENCE

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



Timing Specifications:

Parameters	Values			Units
	Min	Typ.	Max	
T1	0.5	-	10	ms
T2	0	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 off, 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) T7should 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".

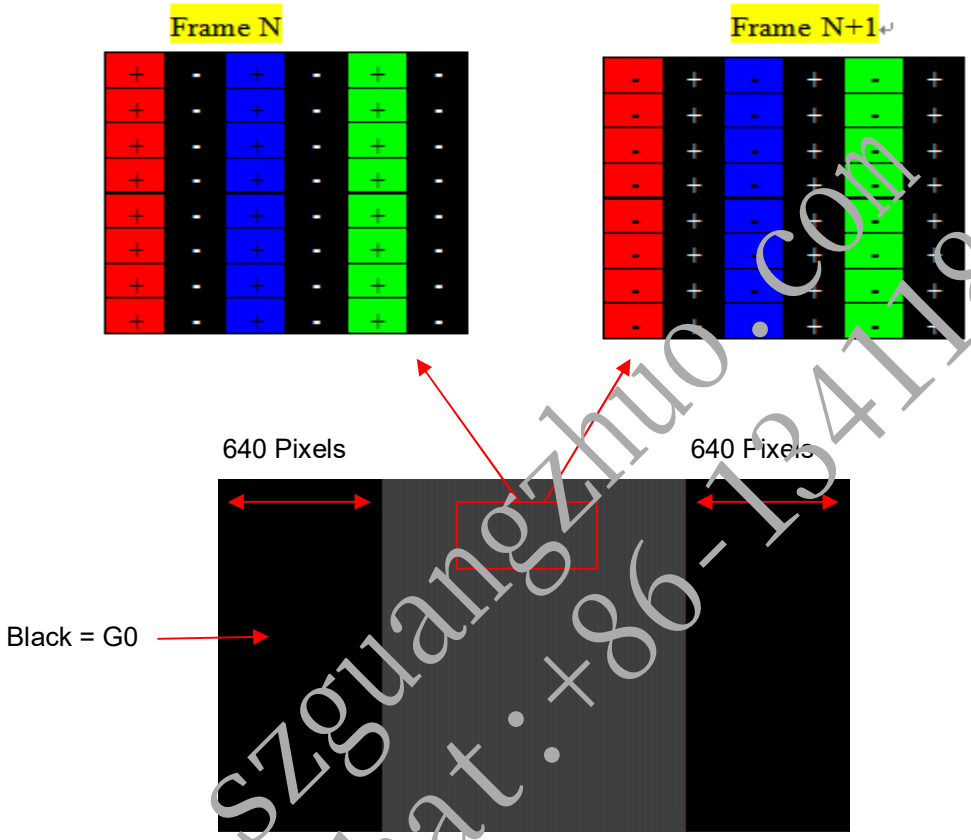
4.7 FLICKER ADJUSTMENT

Flicker must be finely adjusted after module assembly and aging. Please follow the instructions below.

(1) Vcom adjustment type : Auto Vcom

(2) Flicker Pattern :

(Bright Sub-Pixel=G128 ; Dark Sub-Pixel=G0)



5. OPTICAL CHARACTERISTICS

5.1 TEST CONDITIONS

Item	Symbol	Value	Unit
Ambient Temperature	Ta	25±2	oC
Ambient Humidity	Ha	50±10	%RH
Supply Voltage	VCC	12	V
Input Signal	According to typical value in "3. ELECTRICAL CHARACTERISTICS"		
LED Light Bar Input Current Per Input Pin	IPIN	125±1.5	mA
PWM Duty Ratio	D	100	%
LED Light Bar Test Converter	INX R373B0000U000		

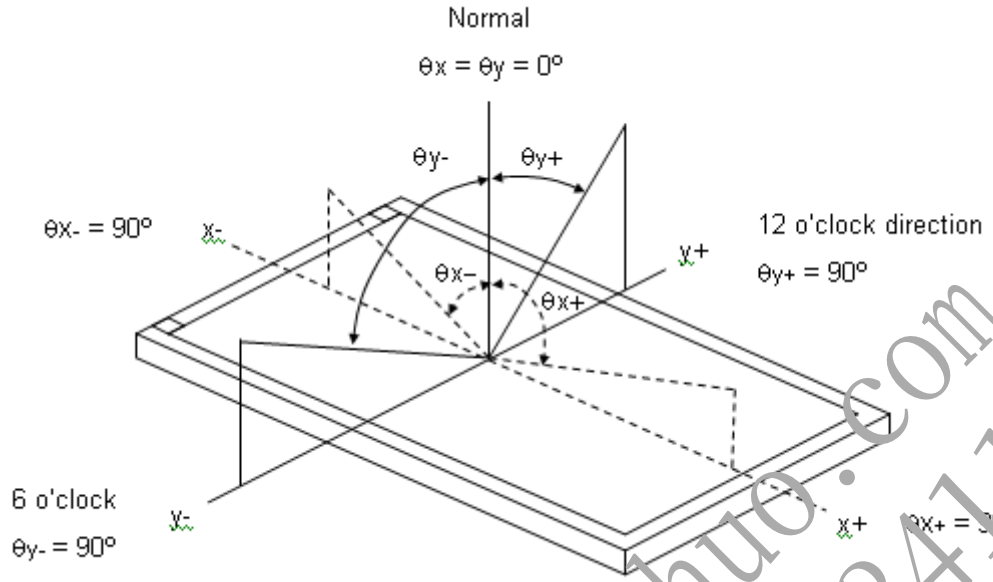
5.2 OPTICAL SPECIFICATIONS

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 (7).

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 C light	Typ – 0.03	0.634	Typ + 0.03	-	(1), (5), (7)
		Ry			0.348			
	Green	Gx			0.313			
		Gy			0.567			
	Blue	Bx			0.139			
		By			0.078			
	White	Wx			0.335			
		Wy			0.350			
Center Transmittance (Center of Screen)		T%			4.08		%	(1), (6)
Contrast Ratio		CR		700	1000	-	-	(1), (2)
Transmittance Variation		δT				1.33		(4)
Response Time		$T_{rise+fall}$	θ_x=0°, θ_Y=0°	-	5	11	ms	(3)
Viewing Angle	Horizontal	x +	CR ≧ 10	85	89	-	Deg.	(1), (5)
		x -		85	89	-		
	Vertical	y +		85	89	---		
		y -		85	89	---		

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

Viewing angles are measured by Autronic Conoscope Cono-80



Note (2) Light source is the BLU which supplied by INX and the cell driving voltage are based on suitable gamma voltages.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 Gray-to-Gray Switching :

- 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 (LC):

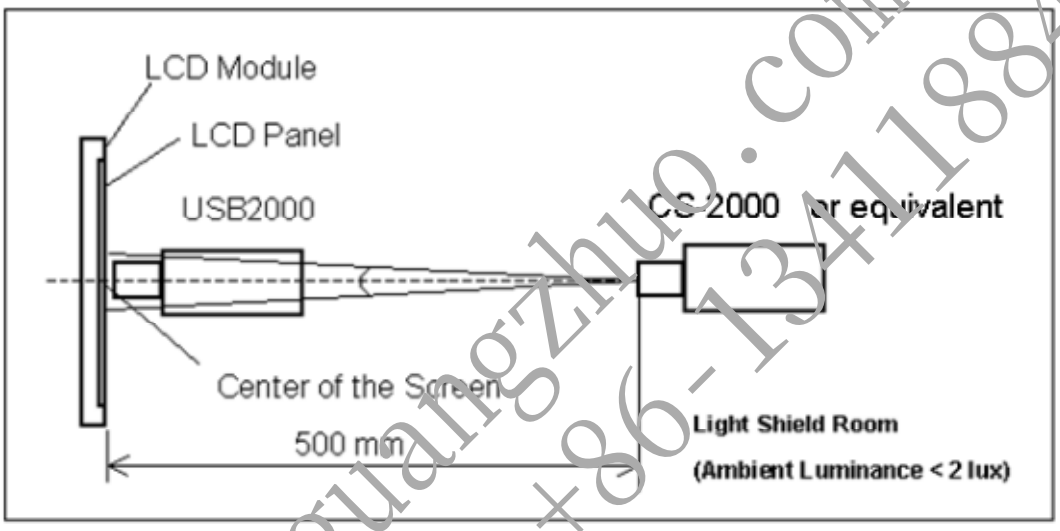
Measure the luminance of gray level 255 at center point.

LC = 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

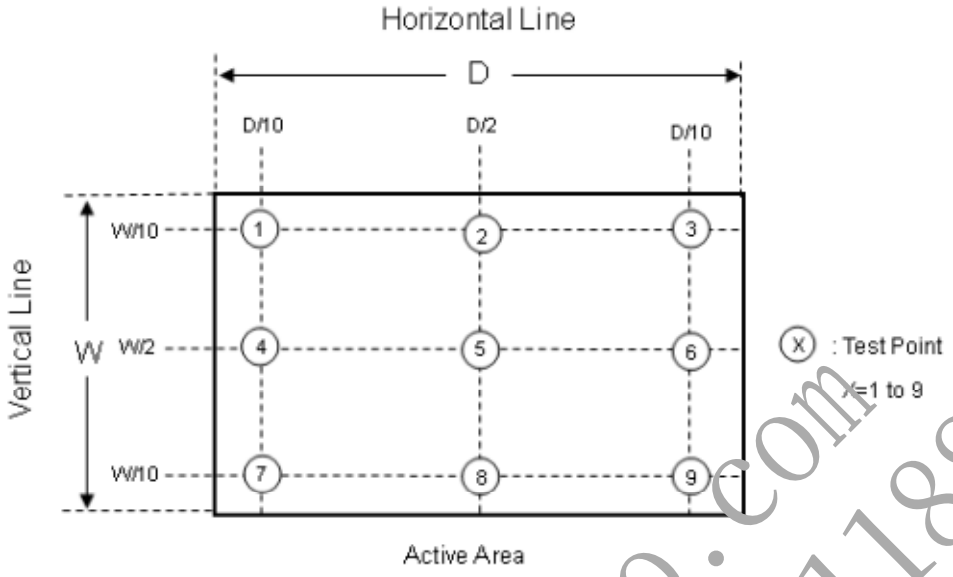


Note (6) Definition of Transmittance (T %):

Measure the transmittance at 9 points.

Light source is the BLU(INX) and the cell driving voltage are based on suitable gamma voltages.

$$T(X) = \frac{\text{L255 (5) of LCD module}}{\text{Luminance (5) of BLU}} \times 100\%$$



Note (7) Light source is the standard light source ”C” which is defined by CIE and driving voltage are based on suitable gamma voltages. The calculating method is as following :

1. Measure Module’s and BLU’s spectrum at center point. W, R,G, B are with signal input. BLU is supplied by INX.
2. Calculate cell’s spectrum.
3. Calculate cell’s chromaticity by using the spectrum of standard light source “C”.

6. RELIABILITY TEST ITEM

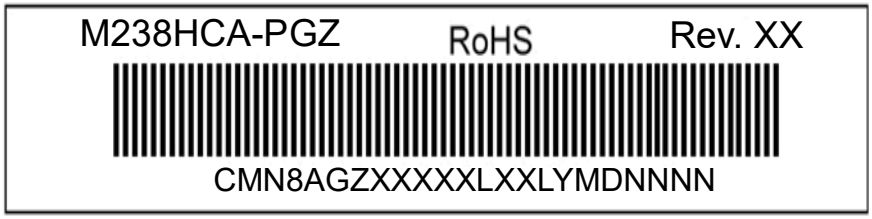
Items	Required Condition	Note
Temperature Humidity Bias (THB)	Ta= 50℃, 80%RH, 240hours	(1), (2)
High Temperature Operation (HTO)	Ta= 50℃, 240hours	
Low Temperature Operation (LTO)	Ta= 0℃, 240hours	
High Temperature Storage (HTS)	Ta= 60℃, 240hours	
Low Temperature Storage (LTS)	Ta= -20℃, 240hours	
Thermal Shock Test (TST)	-20℃/30min, 60℃ / 30min, 100 cycles	

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 h

7. LABEL

7.1 INX OPEN CELL LABEL



Barcode definition:

Serial ID: CM-N8AGZ-X-X-X-XX-L-XX-L-YMD-NNNN

Code	Meaning	Description
CM	Supplier code	INX=CM
N8AGZ	Model number	M238HCA-PGZ=N8AGZ
X	Revision code	C1:1, C2:2, …
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, Toppo=K, Toshiba=L, Winbond=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
L	Module line #	1,2,~,9,A,B,~,Y,Z
YMD	Year, month, day	Year: 2001=1, 2002=2, 2003=3, 2004=4… 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	Manufacturing sequence of product

8. PACKING

8.1 PACKING SPECIFICATIONS

(1)12 PCS LCD PANELS / 1 BOX

(2)BOX DIMENSIONS: 630 (L) X 473 (W) X128 (H)MM

(3)WEIGHT: APPROXIMATELY 11.5 KG

(4)432 PCS LCD PANELS / 1 GROUP

8.2 PACKING METHOD

Packing method (EPP Box) is shown in following figures.

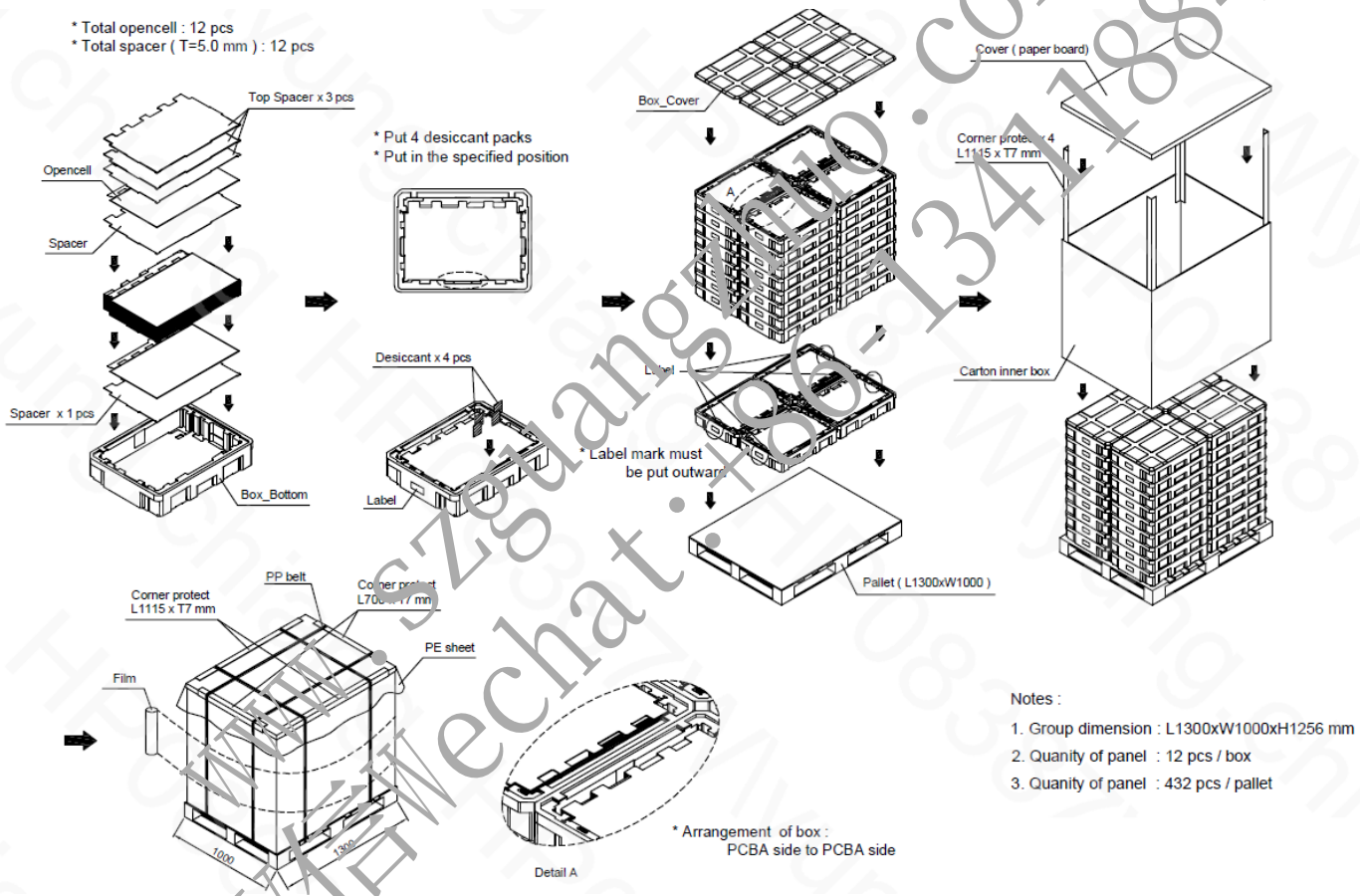


Figure.8-1 packing method

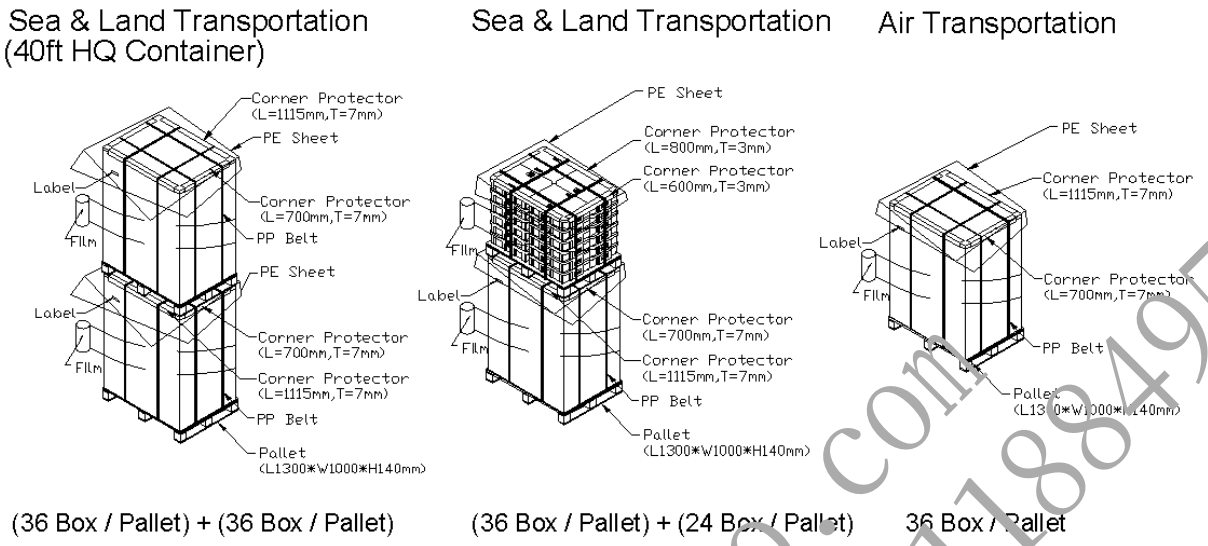


Figure.8-2 packing method

8.3 UN-PACKAGING METHOD

Un-packaging method (EPP Box) is shown in following figures.

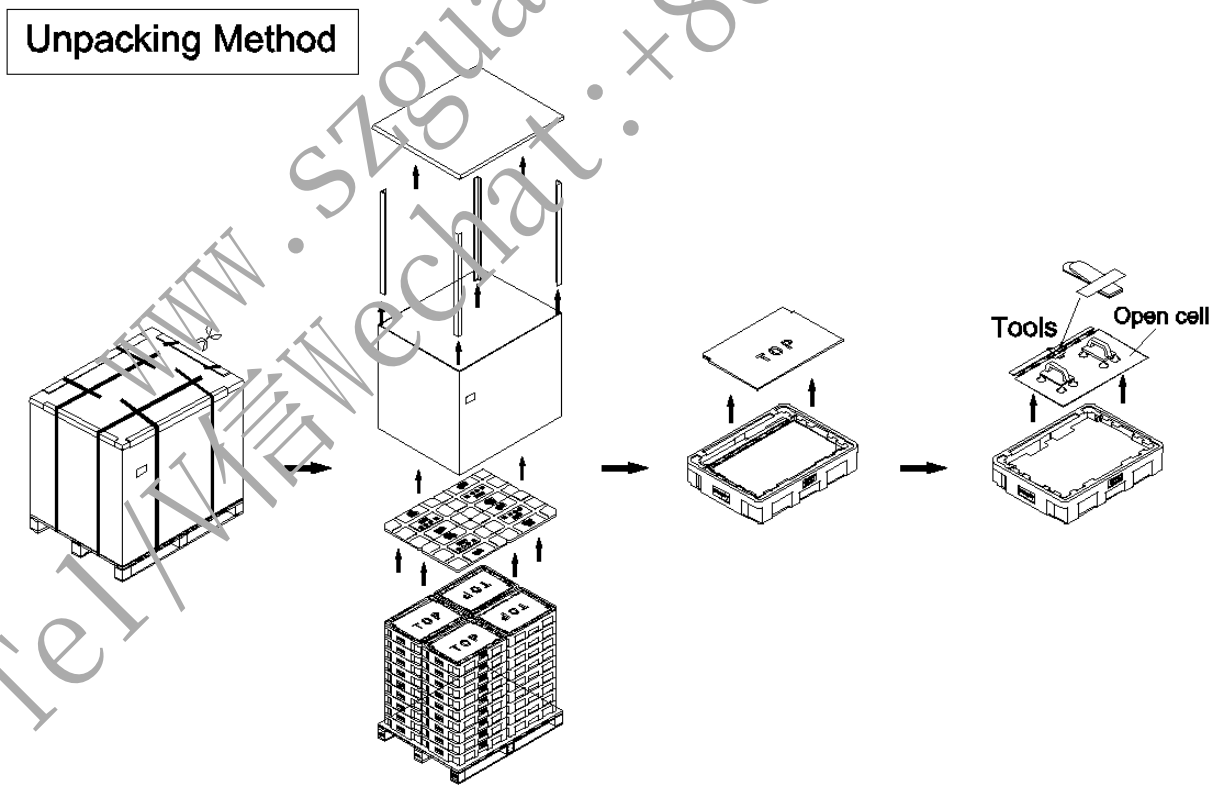


Figure.8-3 unpacking method

9. PRECAUTION

9.1 ASSEMBLY AND HANDLING PRECAUTIONS

(1) Do not apply improper or unbalanced force such as bending or twisting to open cells during assembly.

(2) It is recommended to assemble or to install an open cell into a customer's product in clean working areas. The dust and oil may cause electrical short to an open cell or worsen polarizers on an open cell.

(3) Do not apply pressure or impulse to an open cell to prevent the damage.

(4) Always follow the correct power-on sequence when an open cell is assembled and turned on. This can prevent the damage and latch-up of the CMOS chips.

(5) Do not design sharp-pointed structure / parting line / tooling gate on the plastic part of a COF (Chip on film), because the burr will scrape the COF.

(6) If COF would be bended in assemble process, do not place IC on the bending corner.

(7) The gap between COF IC and any structure of BLU must be bigger than 2 mm. This can prevent the damage of COF IC.

(8) The bezel opening must have no burr and be smooth to prevent the surface of an open cell scraped.

(9) The bezel of a module or a TV set can not contact with force on the surface of an open cell. It might cause light leakage or scrape.

(10) In the case of no FFC or FPC attached with open cells, customers can refer the FFC / FPC drawing and buy them by self.

(11) It is important to keep enough clearance between customers' front bezel/backlight and an open cell. Without enough clearance, the unexpected force during module assembly procedure may damage an open cell.

(12) Do not plug in or unplug an I/F (interface) connector while an assembled open cell is in operation.

(13) Use a soft dry cloth without chemicals for cleaning, because the surface of the polarizer is very soft and easily scratched.

(14) Moisture can easily penetrate into an open cell and may cause the damage during operation.

(15) When storing open cells as spares for a long time, the following precaution is necessary.

(15.1) Do not leave open cells in high temperature and high humidity for a long time. It is highly recommended to store open cells in the temperature range from 0 to 35℃ at normal humidity without condensation.

(15.2) Open cells shall be stored in dark place. Do not store open cells in direct sunlight or fluorescent light environment.

(16) When ambient temperature is lower than 10ºC, the display quality might be reduced.

(17) Unpacking (Cartons/Tray plates) in order to prevent open cells broken:

(17.1) Moving tray plates by one operator may cause tray plates bent which may induce open cells broken. Two operators carry one carton with their two hands. Do not throw cartons/tray plates, avoid any impact on cartons/tray plates, and put down & pile cartons/tray plates gently.

(17.2) A tray plate handled with unbalanced force may cause an open cell damaged. Trays should be completely put on a flat platform.

(17.3) To prevent open cells broken, tray plates should be moved one by one from a plastic bag.

(17.4) Please follow the packing design instruction, such as the maximum number of tray stacking to prevent the deformation of tray plates which may cause open cells broken.

(17.5) To prevent an open cell broken or a COF damaged on a tray, please follow the instructions below:

(17.5.1) Do not peel a polarizer protection film of an open cell off on a tray

(17.5.2) Do not install FFC or LVDS cables of an open cell on a tray

(17.5.3) Do not press the surface of an open cell on a tray.

(17.5.4) Do not pull X-board when an open cell placed on a tray.

(18) Unpacking (Hard Box) in order to prevent open cells broken:

(18.1) Moving hard boxes by one operator may cause hard boxes fell down and open cells broken by abnormal methods. Two operators carry one hard box with their two hands. Do handle hard boxes carefully, such as avoiding impact, putting down, and piling up gently.

(18.2) To prevent hard boxes sliding from carts and falling down, hard boxes should be placed on a surface with resistance.

(18.3) To prevent an open cell broken or a COF damaged in a hard box, please follow the instructions below:

(18.3.1) Do not peel a polarizer protection film of an open cell off in a hard box.

(18.3.2) Do not install FFC or LVDS cables of an open cell in a hard box.

(18.3.3) Do not press the surface of an open cell in a hard box.

(18.3.4) Do not pull X-board when an open cell placed in a hard box.

(19) Handling – In order to prevent open cells, COFs , and components damaged:

(19.1) The forced displacement between open cells and X-board may cause a COF damaged. Use a fixture tool for handling an open cell to avoid X-board vibrating and interfering with other components on a PCBA & a COF.

(19.2) To prevent open cells and COFs damaged by taking out from hard boxes, using vacuum jigs to take out open cells horizontally is recommended.

(19.3) Improper installation procedure may cause COFs of an open cell over bent which causes damages. As installing an open cell on a backlight or a test jig, place the bottom side of the open cell first on the backlight or the test jig and make sure no interference before fitting the open cell into the backlight/the test jig.

(19.4) Handle open cells one by one.

(20) Avoid any metal or conductive material to contact PCB components, because it could cause electrical damage or defect.

(21) Do not apply improper or unbalanced force such as bending or twisting to open cells during assembly.

(22) It is recommended to assemble or to install an open cell into a customer's product in clean working areas. The dust and oil may cause electrical short to an open cell or worsen polarizers on an open cell.

(23) Do not apply pressure or impulse to an open cell to prevent the damage.

(24) Always follow the correct power-on sequence when an open cell is assembled and turned on. This can prevent the damage and latch-up of the CMOS chips.

(25) Do not design sharp-pointed structure / parting line / tooling gate on the plastic part of a COF (Chip on film), because the burr will scrape the COF.

(26) If COF would be bended in assemble process, do not place IC on the bending corner.

(27) The gap between COF IC and any structure of BLU must be bigger than 2 mm. This can prevent the damage of COF IC.

(28) The bezel opening must have no burr and be smooth to prevent the surface of an open cell scraped.

(29) The bezel of a module or a TV set can not contact with force on the surface of an open cell. It might cause light leakage or scrape.

(30) In the case of no FFC or FPC attached with open cells, customers can refer the FFC / FPC drawing and buy them by self.

(31) It is important to keep enough clearance between customers' front bezel/backlight and an open cell. Without enough clearance, the unexpected force during module assembly procedure may damage an open cell.

(32) Do not plug in or unplug an I/F (interface) connector while an assembled open cell is in operation.

(33) Use a soft dry cloth without chemicals for cleaning, because the surface of the polarizer is very soft and easily scratched.

(34) Moisture can easily penetrate into an open cell and may cause the damage during operation.

(35) When storing open cells as spares for a long time, the following precaution is necessary.

(35.1) Do not leave open cells in high temperature and high humidity for a long time. It is highly recommended to store open cells in the temperature range from 0 to 35℃ at normal humidity without condensation.

(35.2) Open cells shall be stored in dark place. Do not store open cells in direct sunlight or fluorescent light environment.

(36) When ambient temperature is lower than 10ºC, the display quality might be reduced.

(37) Unpacking (Cartons/Tray plates) in order to prevent open cells broken:

(37.1) Moving tray plates by one operator may cause tray plates bent which may induce open cells broken. Two operators carry one carton with their two hands. Do not throw cartons/tray plates, avoid any impact on cartons/tray plates, and put down & pile cartons/tray plates gently.

(37.2) A tray plate handled with unbalanced force may cause an open cell damaged. Trays should be completely put on a flat platform.

(37.3) To prevent open cells broken, tray plates should be moved one by one from a plastic bag.

(37.4) Please follow the packing design instruction, such as the maximum number of tray stacking to prevent the deformation of tray plates which may cause open cells broken.

(37.5) To prevent an open cell broken or a COF damaged on a tray, please follow the instructions below:

(37.5.1) Do not peel a polarizer protection film of an open cell off on a tray

(37.5.2) Do not install FFC or LVDS cables of an open cell on a tray

(37.5.3) Do not press the surface of an open cell on a tray.

(37.5.4) Do not pull X-board when an open cell placed on a tray.

(38) Unpacking (Hard Box) in order to prevent open cells broken:

(38.1) Moving hard boxes by one operator may cause hard boxes fell down and open cells broken by abnormal methods. Two operators carry one hard box with their two hands. Do handle hard boxes carefully, such as avoiding impact, putting down, and piling up gently.

(38.2) To prevent hard boxes sliding from carts and falling down, hard boxes should be placed on a surface with resistance.

(38.3) To prevent an open cell broken or a COF damaged in a hard box, please follow the instructions below.

(38.3.1) Do not peel a polarizer protection film of an open cell off in a hard box.

(38.3.2) Do not install FFC or LVDS cables of an open cell in a hard box.

(38.3.3) Do not press the surface of an open cell in a hard box.

(38.3.4) Do not pull X-board when an open cell placed in a hard box.

(39) Handling – In order to prevent open cells, COFs , and components damaged:

(39.1) The forced displacement between open cells and X-board may cause a COF damaged. Use a fixture tool for handling an open cell to avoid X-board vibrating and interfering with other components on a PCBA & a COF.

(39.2) To prevent open cells and COFs damaged by taking out from hard boxes, using vacuum jigs to take out open cells horizontally is recommended.

(39.3) Improper installation procedure may cause COFs of an open cell over bent which causes damages. As installing an open cell on a backlight or a test jig, place the bottom side of the open cell first on the backlight or the test jig and make sure no interference before fitting the open cell into the backlight/the test jig.

(39.4) Handle open cells one by one.

(40) Avoid any metal or conductive material to contact PCB components, because it could cause electrical damage or defect.

9.2 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°C and 30°C 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.

(4) Storage condition is guaranteed under packing conditions.

9.3 ASSEMBLY AND HANDLING PRECAUTIONS

(1) One operator move hard boxes may falling down by abnormal method makes panel broken. Two operators to carry hard boxes with their two hands. Do not throw hard box carelessly, avoid any impact, and put down & pile hard box gently.

(2) To prevent hard boxes falling down via sliding on carts. Hard box should be put on a surface which won't make hard box slide easily.

(3) Backlight brightness need ≦ 7300nits to protect LCD cell.

9.4 HANDLING–IN ORDER TO PREVENT PANEL BROKEN, COF AND COMPONENT DAMAGED

(1) The displacement between panel and X-board may cause COF damaged. As handling panel, suggest using tools to avoid X-Board vibrating, and do not interfere with any component on PCBA & COF.

(2) To prevent panel and COF damaged by taking out from hard boxes. Using vacuum jigs to handle panels, and take out panels horizontally.

(3) Abnormal operating procedure will make COF over bending induce product defect. As setting panels to the test jig / backlight, put the panel with the bottom side first, and avoid meddling on nearside.

9.5 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.

9.6 SAFETY PRECAUTIONS

(1) If the liquid crystal material leaks from the panel, it should be kept away from the eyes or mouth. In case of contact with hands, skin or clothes, it has to be washed away thoroughly with soap.

(2) After the module's end of life, it is not harmful in case of normal operation and storage.

9.7 OTHER

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

Appendix. OUTLINE DRAWING