



PRODUCT SPECIFICATION

Doc. Number: V5

☐ Tentative Specification☐ Preliminary Specification☒ Approval Specification**MODEL NO.: JJ090IA****SUFFIX: 01G****Customer: Garmin****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
1	Nov.9, 2018	All	Tentative Spec Ver.1.0 was first issued
2	Apr.29, 2019	All	Preliminary Spec Ver.1.0 was first issued
3	May.27, 2019	All	Update Chapter 2.Pin Assignment & Chapter 3.3.1.LVDS wake up time & Chapter 7.Mechanical Drawing. Add Chapter 3.4.Interlace Mode Enable/Disable Flow.
4	Jul.15, 2019	P14	Update test conditoins.
	Jul.15, 2019	P16	Update Note 6.
	Jul.15, 2019	P6	Update current for LED backlight
5	Mar 25, 2020	P19	6.2 Add Protect film removal direction
	Mar 25, 2020	P24	8.2 Add SN label and carton label information
	Mar 25, 2020	P25	9.1 Polarizer absorption axis
	Mar 25, 2020	P25	9.2 Pixel RGB information



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1. General Specifications

No.	Item	Specification	Remark
1	LCD size	9.0 inch (Diagonal)	
2	Driver element	a-Si TFT active matrix	
3	Resolution	1280 × 3(RGB) × 720	
4	Display mode	Normally Black, Transmissive, AAS	
5	Dot pitch	0.0518(W) × 0.1554(H) mm	
6	Active area	198.912(W) × 111.888(H) mm	
7	Module size	211.2(W) × 125.3(H) × 5.9(D) mm	Note 1
8	Surface treatment	Hard Coat	
9	Color arrangement	RGB-stripe	
10	Interface	1-port LVDS (DE mode only)	
11	Backlight power consumption	5.29W (Typ.) / 5.64W (Max.)	
12	Panel power consumption	1.2W (Max.)	
13	Weight	230g (Max.)	

Note 1: Refer to Mechanical Drawing.



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2. Pin Assignment

PCBa connector is used for the module electronics interface. The recommended model is 20647-040E-01 manufactured by I-PEX.

Pin No.	Symbol	I/O/P/N	Function	Remark
1	MODE	I	Input timing mode selection. Normally display please pull low.	
2	VDD	P	External main and I/O power supply ; Power3V3.	Note 1
3	VDD	P	External main and I/O power supply : Power3V3.	Note 1
4	BISTEN	I	Enable BIST function. Normally display please pull low.	
5	RESET	I	Global reset pin. Please follow "3.2 power sequence".	Note 1
6	STBYB	I	Standby mode setting pin. Please follow "3.2 power sequence".	Note 1
7	GND	P	Ground.	
8	RXIN0-	I	LVDS data 0-.	
9	RXIN0+	I	LVDS data 0+.	
10	GND	P	Ground.	
11	RXIN01-	I	LVDS data 1-.	
12	RXIN01+	I	LVDS data 1+.	
13	GND	P	Ground.	
14	RXCLKIN-	I	LVDS clk -.	
15	RXCLKIN+	I	LVDS clk +.	
16	GND	P	Ground.	
17	RXIN02-	I	LVDS data 2-.	
18	RXIN02+	I	LVDS data 2+.	
19	GND	P	Ground.	
20	RXIN03-	I	LVDS data 3-.	
21	RXIN03+	I	LVDS data 3+.	
22	GND	P	Ground.	
23	SCL	I	Serial Interface clock input. If no use please connect to ground.	



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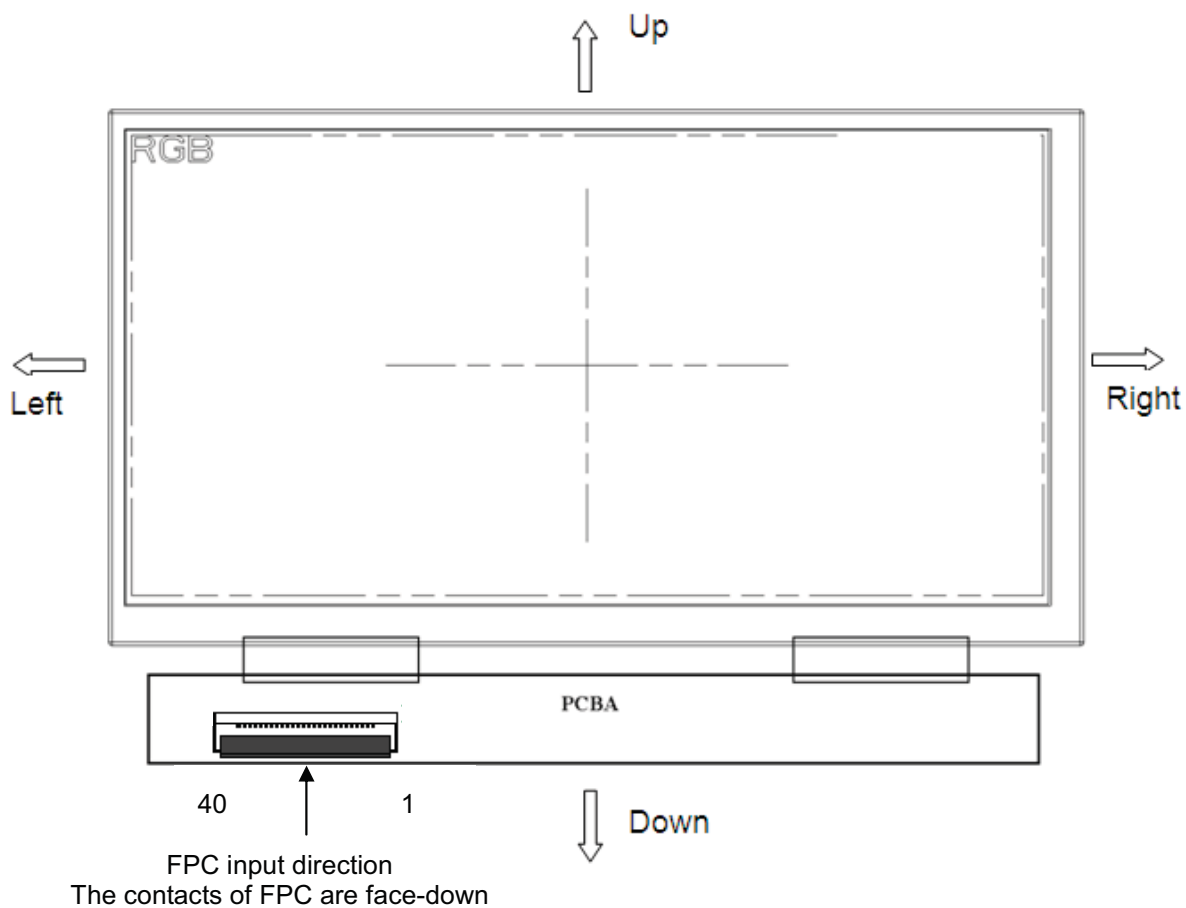
24	SDA	I/O	Serial Interface address and data input/output. If no use please connect to ground.	
25	GND	P	Ground.	
26	CSB	I	Serial Interface chip enable signal. If no use please pull high to disable.	
27	NTC GND	I/O	LED Driver for NTC Function, If not use please keep floating or connect to ground.	
28	SELB(DINT)	I	Input data format selection. DINT = 1 : 8-bit. DINT = 0 : 6-bit.	Note 2&3
29	FCS	I	Function control selection. Please pull low. FCS = 1 : Hardware control priority. FCS = 0 : Software control priority.	Note 2&3
30	GND	P	Ground.	
31	LED-	P	Negative backlight voltage.	
32	LED-	P	Negative backlight voltage.	
33	L/R	I	Horizontal shift direction (source output) selection. Please pull high. L/R = 1: Left -> Right. L/R = 0: Right -> Left.	Note 2&3&4
34	U/D	I	Vertical shift direction (gate output) selection. Please pull high. U/D = 1: Top -> Bottom. U/D = 0: Bottom -> Top.	Note 2&3&4
35	NTC	I/O	LED Driver for NTC Function, If not use please keep floating or connect to ground	
36	ATREN	I	Auto reload OTP in operation mode every 60 frames. Please keep floating.	Note 3
37	OTP_VDD	P	Keep floating	Note 5
38	NC	N	Keep floating	
39	LED+	P	Positive backlight voltage	
40	LED+	P	Positive backlight voltage	

Note 1: Please follow "3.2 power sequence"

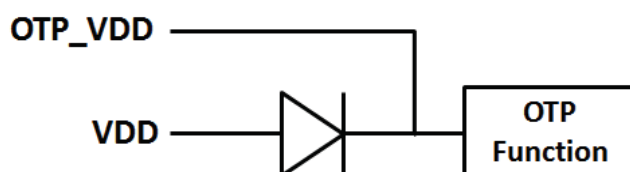
Note 2: Pull high or low potential with 1K ohm.

Note 3: When FCS = 1, the SELB(DINT)(Pin 28), L/R(Pin 33), U/D(Pin 34) control by hardware setting.
When FCS = 0, the SELB(DINT)(Pin 28), L/R(Pin 33), U/D(Pin 34) control by software setting.
Interlaced application please reference "3.4 Interlace Mode Enable/Disable Flow".

Note 4: Definition of scanning direction.
Refer to the figure as below:



Note 5: ESD protection diode is design between VDD and OTP_VDD. Please keep floating otherwise it would induce large current.





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3. Operation Specifications

3.1. Absolute Maximum Ratings

(GND=0V, Note 1)

Item	Symbol	Values		Unit	Remark
		Min.	Max.		
Power voltage	V_{DD}	-0.3	4.0	V	
Operation Temperature	T_a	-30	85	°C	Note 1-1,2,3
Storage Temperature	T_a	-40	90	°C	Note 1-1,2
LED Forward Current	IF	-	150	mA	Each LED

Note 1: The absolute maximum rating values of this product are not allowed to be exceeded at any times. Should a module be used with any of the absolute maximum ratings exceeded, the characteristics of the module may not be recovered, or in an extreme case, the module may be permanently destroyed.

Note 1-1: T_a = Ambient Temperature.

Note 1-2: This rating applies to all parts of the module and should not be exceeded.

Note 1-3: The operating temperature only guarantees operation of the LCM and doesn't guarantee all the contents of Electro-optical specification.

3.1.1. Typical Operation Conditions

(GND =0V)

Item	Symbol	Values			Unit	Remark
		Min.	Typ.	Max.		
Power voltage	V_{DD}	3.1	3.3	3.6	V	Note 2
Input logic high voltage	V_{IH}	0.7 V_{DD}	-	V_{DD}	V	Note 3
Input logic low voltage	V_{IL}	GND	-	0.3 V_{DD}	V	
Internal Pull low / high resistor	RI	150	350	550	kΩ	Note 3

Note 2: V_{DD} setting should match the signals output voltage of customer's system board .

Note 3: RESET, STBYB, SELB(DINT), L/R, U/D

3.1.2. Current Consumption

(GND =0V)

Item	Symbol	Values			Unit	Remark
		Min.	Typ.	Max.		
Current for Driver	I_{DD}	-	180	-	mA	$V_{DD} = 3.3V$ @ full-white image

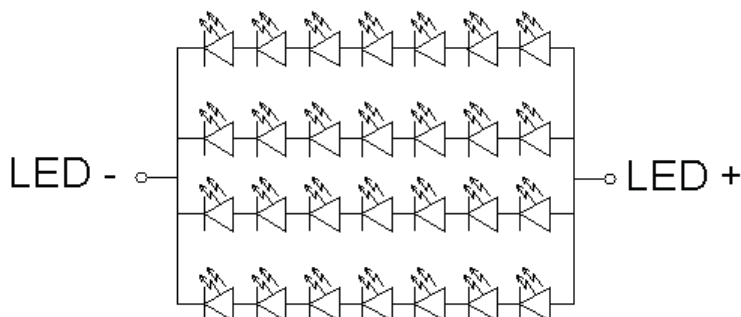
3.1.3. Backlight Driving Conditions

Item	Symbol	Values			Unit	Remark
		Min.	Typ.	Max.		
Voltage for LED backlight	V_L	19.6	21.7	23.1	V	Note 4
		20.3	22.5	24.1		Note 5
Current for LED backlight	I_L		220		mA	
LED life time	-	20,000			Hr	Note 6

Note 4: The LED Supply Voltage is defined by the number of LED at $T_a=25^{\circ}C$ and $I_L = 150mA$

Note 5: The LED Supply Voltage is defined by the number of LED at $T_a= -40^{\circ}C$ and $I_L =150mA$

Note 6: The “LED life time” is defined as the LED brightness decrease to 50% original brightness at $T_a=25^{\circ}C$ and $I_L = 220mA$. The LED lifetime could be decreased if operating I_L is larger than 220mA.

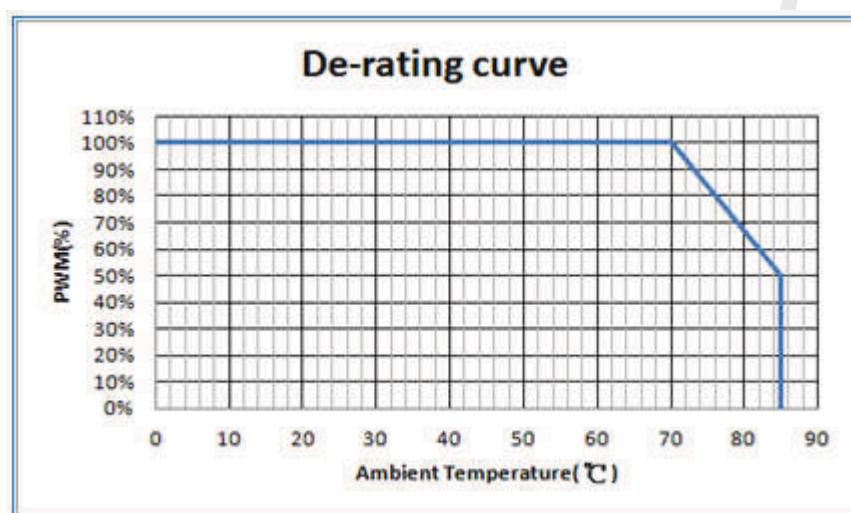


3.1.4 Backlight NTC Resistor

To limit the heat dissipation under high ambient temperature (T_a). The LED string has a NTC (Negative Temperature Coefficient) to detect the ambient temperature of LED string. This NTC was located in the middle of FPC mounted with LED that acts as an indicator to show if the module is operated under safe operation region without overheating and damage. The detail application for this NTC, please refer to data sheet of Murata P/N : NCU15XH103F6SRC About Murata NCU15XH103F6SRC application. Please follow component data sheet.

3.1.5 De-rating diagram

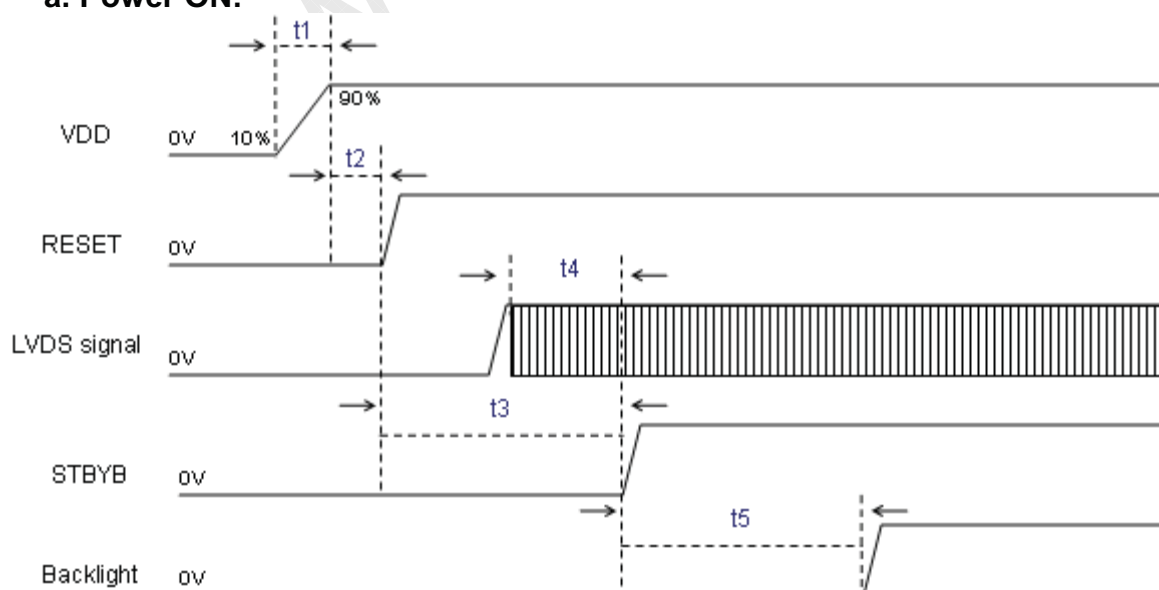
LED power de-rating has to start at 70°C linear down to PWM 50% at 85°C before switching off, see graph as below.



3.2. Power Sequence

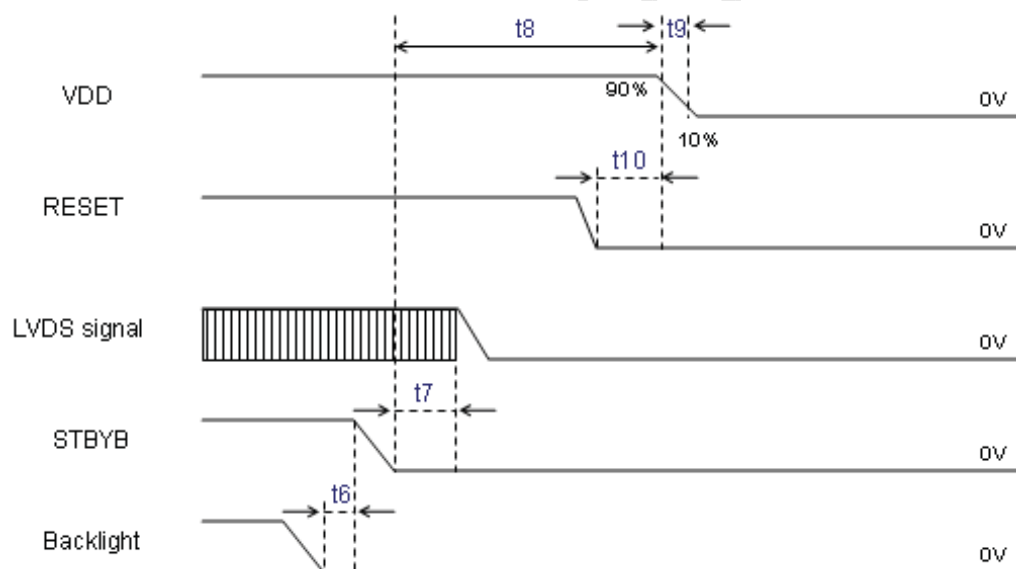
VDD = 3.1~3.6V

a. Power ON:



b. Power OFF:

Symbol	SPEC.			Unit
	Min.	Typ.	Max.	
t1	0.5	5	--	ms
t2	30	40	--	us
t3	10	15	--	ms
t4	1	5	t3	ms
t5	100	117	--	ms
t6	0	25	--	ms
t7	118	119	t8	ms
t8	120	128	--	ms
t9	0.5	5	--	ms
t10	2	10	t8	ms





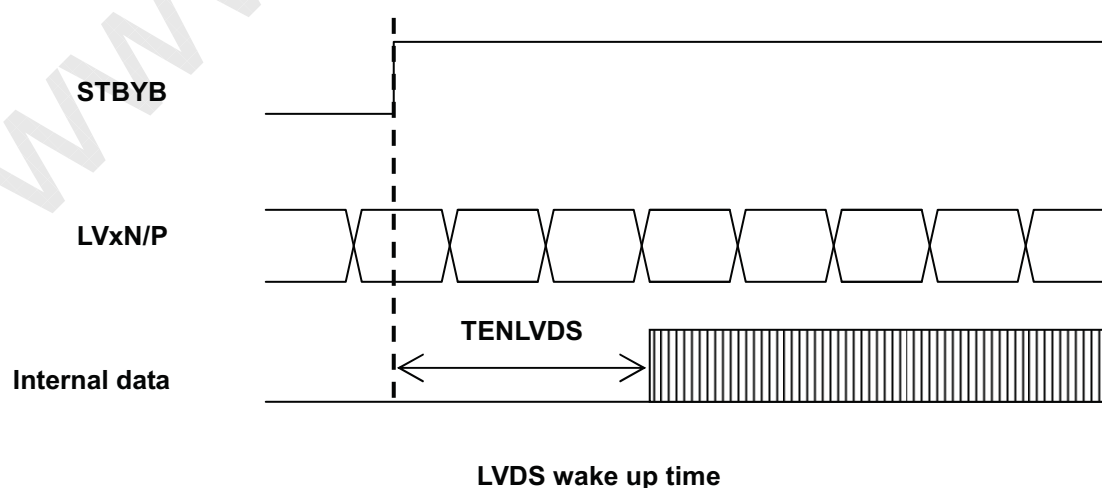
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3.3. Timing Characteristics

3.3.1. AC Electrical Characteristics

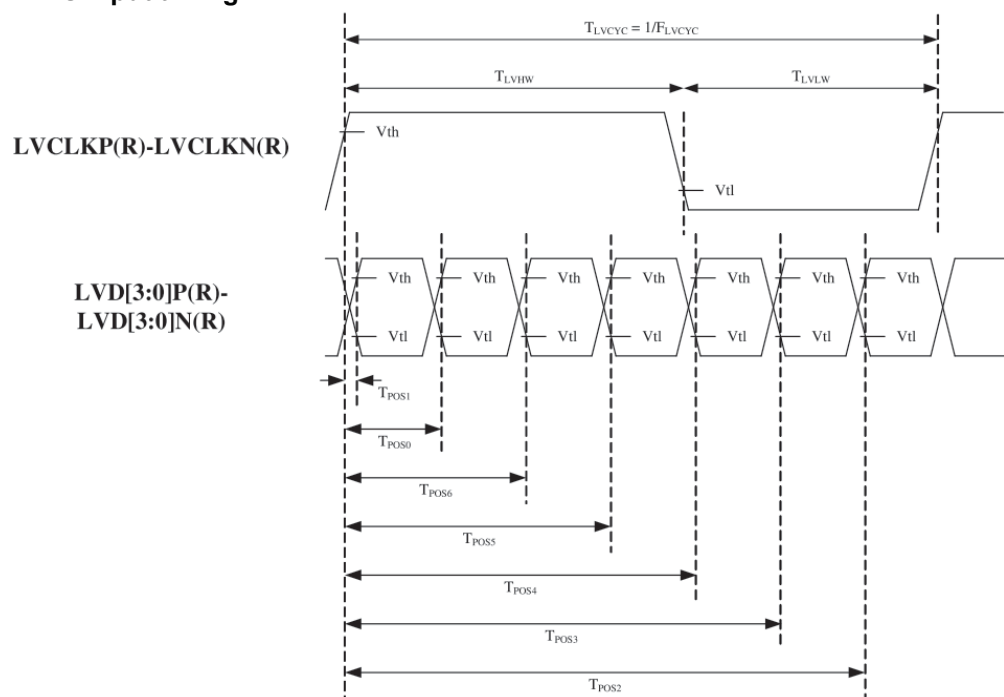
Parameter	Symbol	Spec.			Unit	Remark
		Min.	Typ.	Max.		
Clock frequency	FLVCYC	10	-	85	MHz	Frame rate=60Hz
Clock Period	TLVCYC	11.76	-	100	nsec	Frame rate=60Hz
1 data bit time	UI	-	1/7	-	TLVCYC	
Clock high time	LVHW	2.9	4	4.1	UI	Note 7
Clock low time	LVLW	2.9	3	4.1	UI	
Position 1	TPOS1	-0.2	0	0.2	UI	
Position 0	TPOS0	0.8	1	1.2	UI	
Position 6	TPOS6	1.8	2	2.2	UI	
Position 5	TPOS5	2.8	3	3.2	UI	
Position 4	TPOS4	3.8	4	4.2	UI	
Position 3	TPOS3	4.8	5	5.2	UI	
Position 2	TPOS2	5.8	6	6.2	UI	
Input eye width	TEYEW	0.6	-	-	UI	
Input eye border	TEX	-	-	0.2	UI	
LVDS wake up time	TENLVDS	-	-	150	ns	

Note 7: Please refer to “3.3.2 Input Clock and Data Timing Diagram”



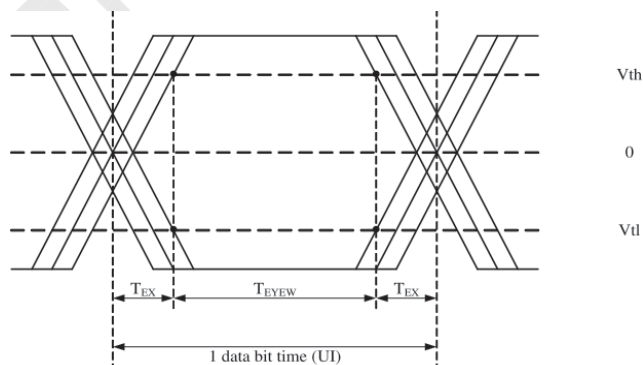
3.3.2. Input Clock and Data Timing Diagram

LVDS input timing:



Differential:

LVD[3:0]P-LVD[3:0]N

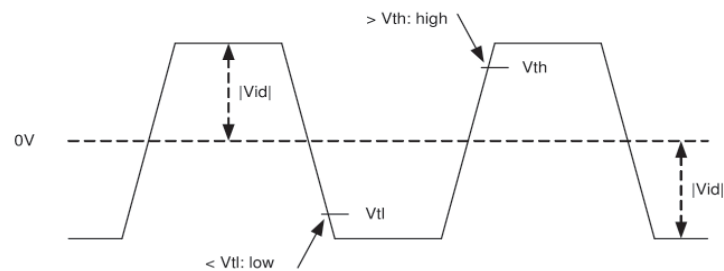


LVDS input eye diagram

3.3.3. DC Electrical Characteristics

Parameter	Symbol	Spec.			Unit	Remark
		Min.	Typ.	Max.		
Differential input high Threshold voltage	Vth	-	-	+0.1	V	Vcm=1.2V
Differential input low Threshold voltage	Vtl	-0.1	-	-	V	
Differential input common Mode voltage	Vcm	1	1.2	$1.8 - V_{id} /2$	V	-
LVDS input voltage	V _{INLV}	0.7		1.8	V	
Differential input voltage	V _{id}	0.2	-	0.6	V	-
Differential input leakage Current	Vleak	-10	-	+10	μA	-
Termination Resistor	Zid	95	100	105	Ω	-

Differential:
LVCLKP(R)-LVCLKN(R),
LVD[3:0]P(R)-
LVD[3:0]N(R)



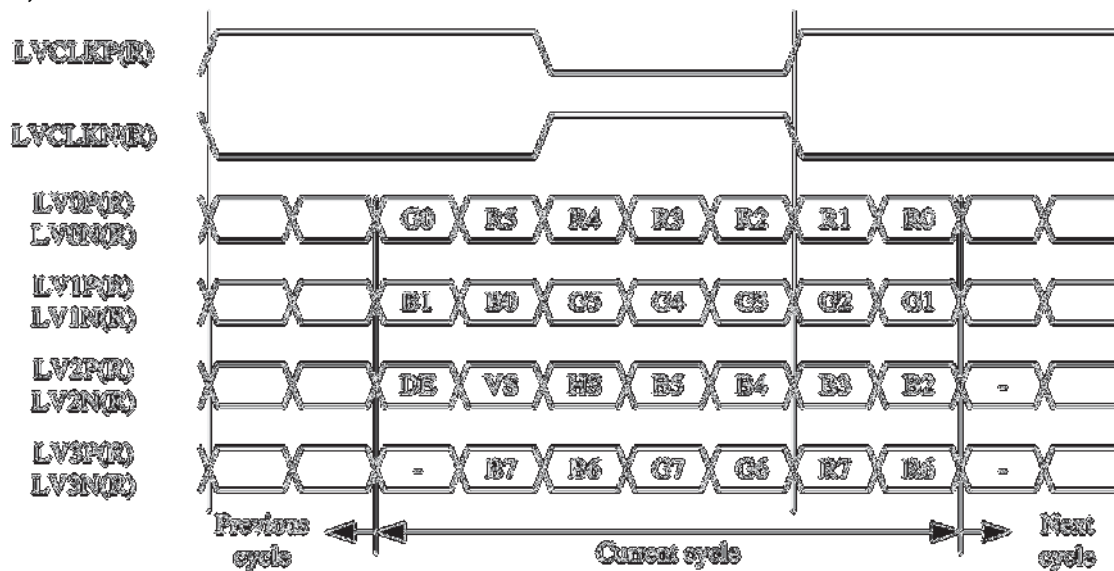
3.3.4. Timing

Parameter	Symbol	Values			Unit	Remark
		Min.	Typ.	Max.		
DCLK Frequency	F DCLK	58.5	63.7	76.3	MHz	Frame rate=60Hz
Horizontal valid data	t _{hd}	1280			DCLK	
H-blanking	t _{hb}	56	60	192	DCLK	
1 Horizontal Line	t _h	1336	1340	1472	DCLK	
Vertical valid data	t _{vd}	720			H	
V-blanking	t _{vb}	10	72	144	H	
1 Vertical field	t _v	730	792	864	H	

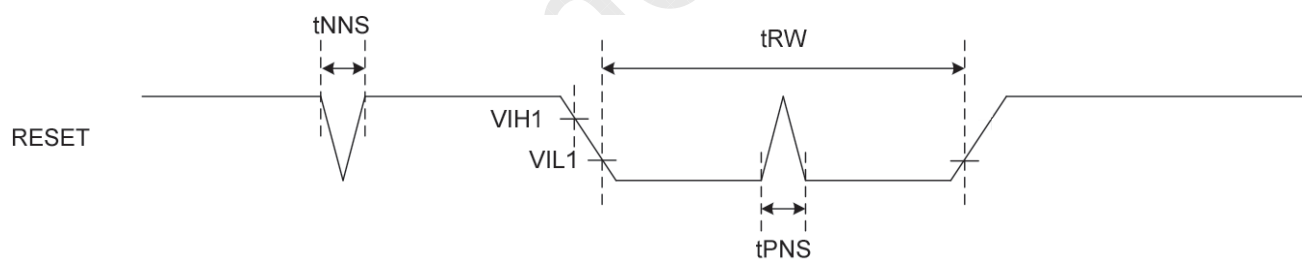
Note 8: DE mode only.

3.3.5. Data Input Format

LVDS, 8-bit, VESA format:



3.3.6. Reset timing

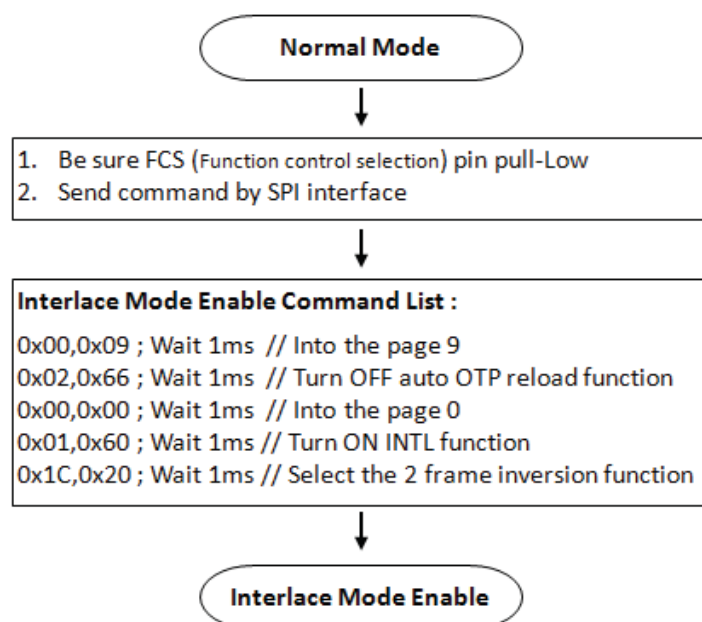


(VDD=3.3V~3.6V)

Signal	Parameter	Symbol	Spec.			Unit	Remark
			Min.	Typ.	Max.		
RESET	Reset pulse width	tRW	10	-	-	μs	-
	Positive spike noise width	tPNS	-	-	100	ns	-
	Negative spike noise width	tNNS	-	-	100	ns	-

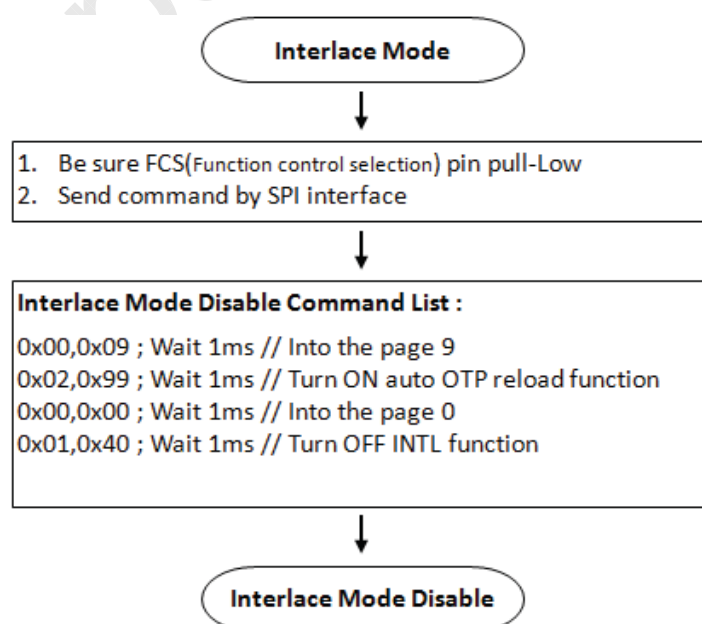
3.4. Interlace Mode Enable/Disable Flow

3.4.1. Interlace mode enable flow



Note9 : Suggest instruction interval is 1ms.

3.4.2. Interlace mode disable flow



Note10 : Suggest instruction interval is 1ms.



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4. Optical Specifications

Item	Symbol	Condition	Values			Unit	Remark
			Min.	Typ.	Max.		
Viewing angle (CR≥ 10)	θ_L	$\Phi=180^\circ$ (9 o'clock)	80	85	-	degree	Note 1
	θ_R	$\Phi=0^\circ$ (3 o'clock)	80	85	-		
	θ_T	$\Phi=90^\circ$ (12 o'clock)	80	85	-		
	θ_B	$\Phi=270^\circ$ (6 o'clock)	80	85	-		
Response time	T_{ON}	Normal $\theta=\Phi=0^\circ$	-	15	20	msec	Note 3
	T_{OFF}		-	10	15	msec	Note 3
Contrast ratio	CR		600	1000	-	-	Note 2 Note 4
Color chromaticity (CIE 1931)	W_X		0.26	0.31	0.36	-	Note 2 Note 5
	W_Y		0.28	0.33	0.38	-	
NTSC (CIE 1931)			65	70	-	%	Note 2 Note 5
Luminance	L		600	750	-	cd/m ²	Note 5
Luminance uniformity	Y_U		75	80	-	%	Note 6 Note 7
Flicker value	Flicker				-25	dB	Note 8

Test Conditions:

1. $DV_{DD}=3.3V$, $I_L=220mA$ (Backlight current), the ambient temperature is $25^\circ C$.
2. The test systems refer to Note 2.

Note 1: Definition of viewing angle range. The view angel for $\Theta=80^\circ$ is measured by DMS.

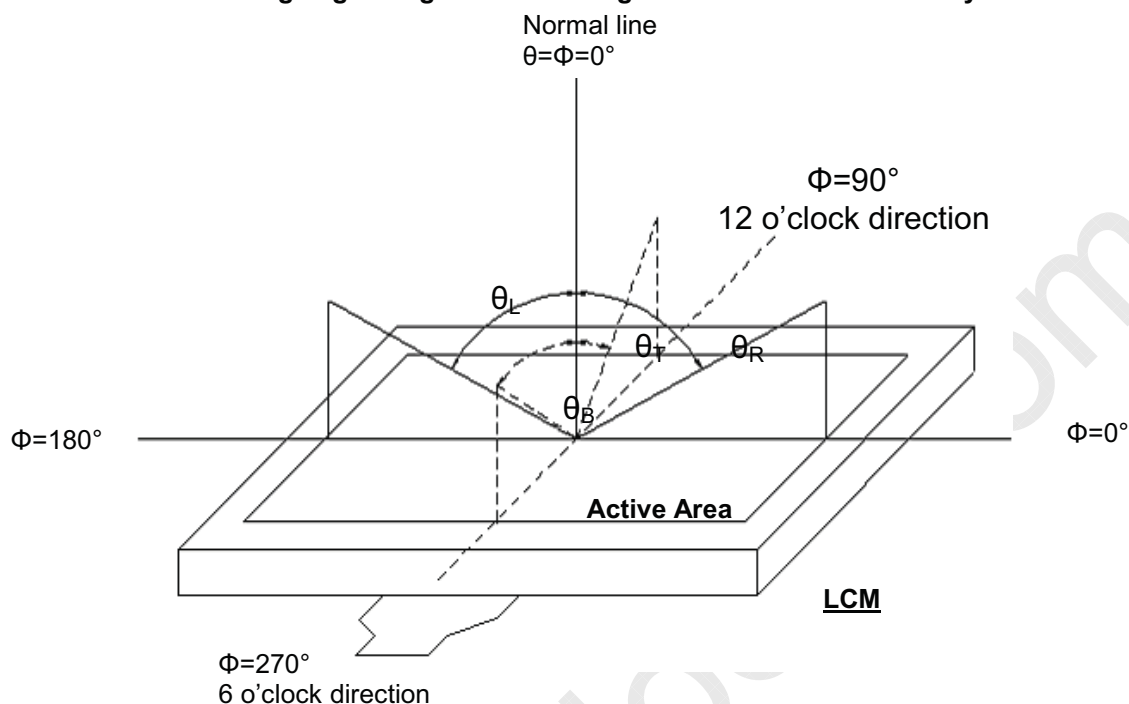


Fig. 4-1 Definition of viewing angle

Note 2: Definition of optical measurement system. The backlight has been light on for 30 minutes then measured the optical properties at the center point of the LCD screen in dark room. The color chromaticity, contrast ratio are measured by DMS.

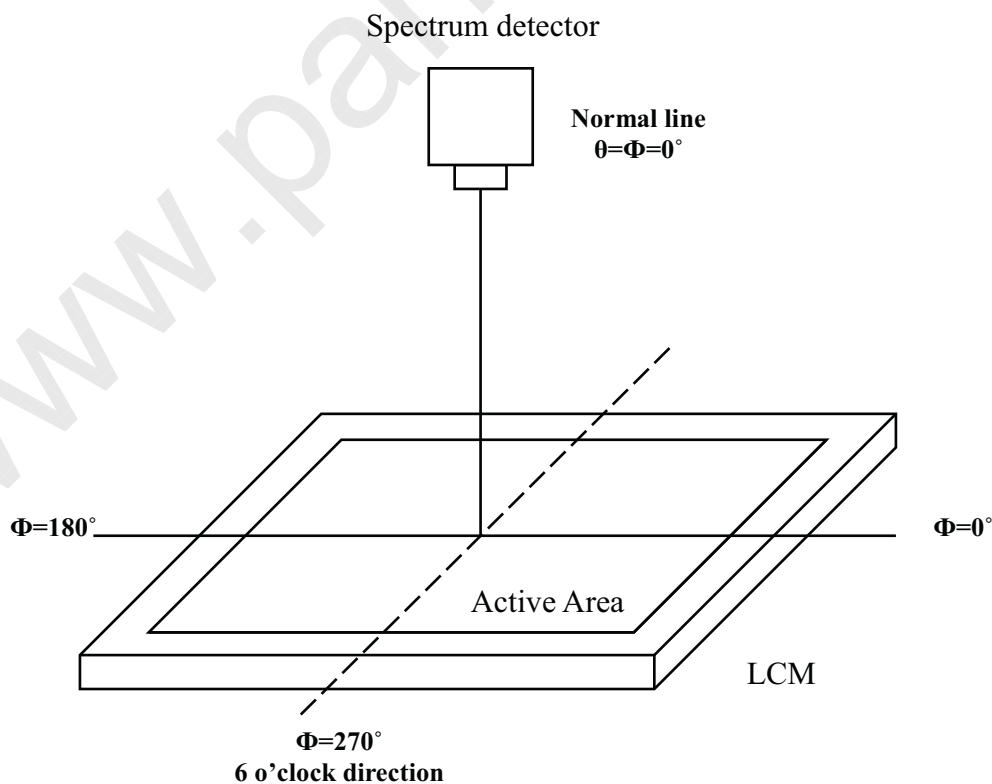


Fig. 4-2 Optical measurement system setup

Note 3: Definition of response time. The response time is measured by photo detector of oscilloscope.

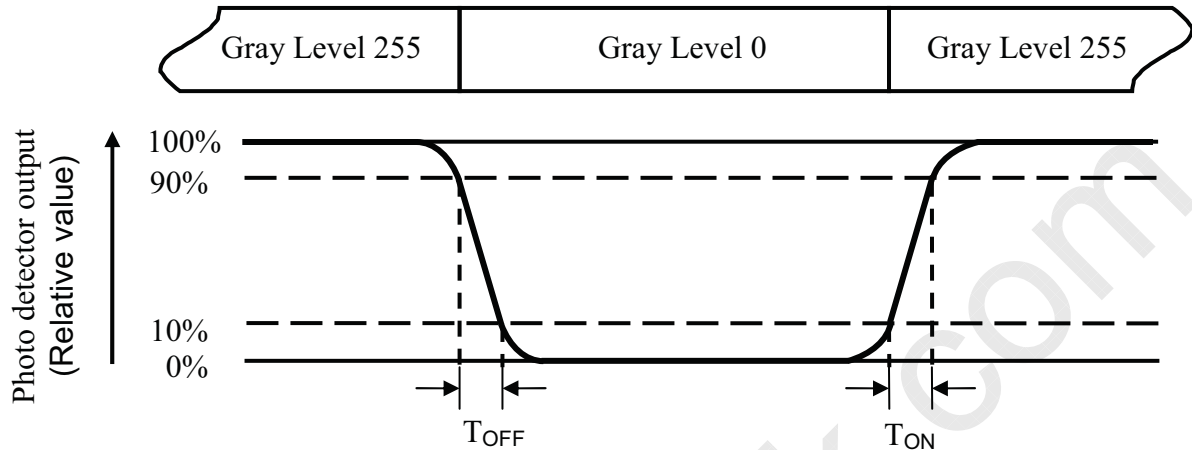


Fig. 4-3 Definition of response time

Note 4: Definition of contrast ratio

$$\text{Contrast ratio (CR)} = \frac{\text{Luminance measured when LCD on the "White" state}}{\text{Luminance measured when LCD on the "Black" state}}$$

Note 5: Color chromaticity is defined by CIE1931.

Color coordinates measured at center point of LCD.

Note 6: All input terminals LCD panel must be ground while measuring the center area of the panel.
The LED driving condition is $IL=(220mA)$.

Note 7: Definition of luminance uniformity

Active area is divided into 9 measuring areas (Refer to Fig. 4-4).

L----- Active area length W----- Active area width

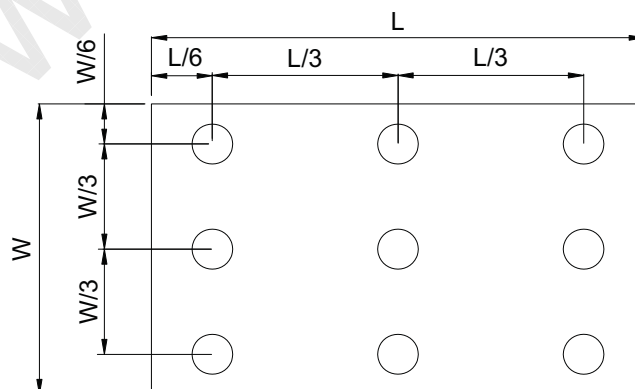


Fig. 4-4 Definition of measuring points

Note 8 : Measure flicker value on flicker pattern must need wait 75 sec after normal display.



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5. Reliability Test Items

Item	Test Conditions	Remark
High Temperature Storage Test	Ta=90°C, 500 hours	Note 1 Note 2 Note 3 Note 5
Low Temperature Storage Test	Ta=-40°C, 500 hours	
High Temperature Operation Test	Tp=85°C, 500 hours	
Low Temperature Operation Test	Ta=-30°C, 500 hours	
High Temperature & High Humidity Operation Test	Ta=60°C, RH 90%, 500hours	
Thermal Shock	[(Ta=-30°C 30min)→(Tp=85°C 30min)]/cycle , 100cycles	
ESD Test (Operation)	Condition 1 : C = 150pF, R = 330Ω Contact Discharge, ± 8KV Condition 2 : C = 150pF, R = 330Ω, Air Discharge, ± 15KV	Note 6
Mechanical Shock	100G, 6ms, half sine wave, 3 times for each direction of ±X, ±Y, ±Z	Note 2 Note 4
Mechanical Vibration	Duration: 8 hrs (X-Axis), 8 hrs (Y-Axis), 8 hrs (Z-Axis) Effective Acceleration = 19.6 m/s ² = 2.0 GRMS	Note 2 Note 4
Packaging Vibration Test	1.14Grms X, Y, Z three axes (30min /axis) [Frequency :1Hz(0.0001G ² /Hz),4Hz(0.01G ² /Hz),100Hz(0.01G ² /Hz), 200Hz(0.001G ² /Hz)]	
Packaging Drop Test	1corner, 3edges, 6faces (1 time/direction) <follow ISTA(1A) Height> 0kg≤W <10kg : 76cm, 10kg≤W <19kg : 61cm, 19kg≤W <28kg : 46cm, 28kg≤W <45kg : 31cm, 45kg≤W ≤68kg : 20cm	

Note 1: Ta = Ambient Temperature, Tp = Panel Surface Temperature.



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Note 2: Criteria: Normal display image with no Function NG, or line defects.

Note 3: Evaluation should be tested after storage at room temperature for more than two hour

Note 4: 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 5: A certain level of Mura (non-uniformity) of dark / black image will happen several days after high temperature testing (H.T.T.). There is a slowly part recovery over a long time (several months). Such a long exposure time like in H.T.T. will normally not happen in a real application. Therefore the test H.T.T. was introduced to simulate cycles with normal conditions in-between but with the same total exposure time what show a significant reduced Mura.

The root cause is related to tension generated due to different amount of shrinking in the stack of layers in the polarizer sheet. The effect is more significant on larger displays like this size. An investigation into alternative polarizer material showed that there is no better alternative currently available.

Note 6: Criteria Class B: Some performance degradation allowed. No data loss. Self - recoverable No hardware failures

6. General Precautions

6.1. Safety

Liquid crystal is poisonous. Do not put it in your mouth. If liquid crystal touches your skin or cloths, wash it off immediately by using soap and water.

6.2. Handling

1. The LCD panel is plate glass. Do not subject the panel to mechanical shock or to excessive force on its surface.
2. The polarizer attached to the display is easily damaged. Please handle it carefully to avoid scratch or other damages.
3. To avoid contamination on the display surface, do not touch the module surface with bare hands.
4. Keep a space so that the LCD panels do not touch other components.
5. Put cover board such as acrylic board on the surface of LCD panel to protect panel from damages.
6. Transparent electrodes may be disconnected if you use the LCD panel under environmental conditions where the condensation of dew occurs.
7. Do not leave module in direct sunlight to avoid malfunction of the ICs.
8. LCD protective film removal direction as Fig 6-1 shown.

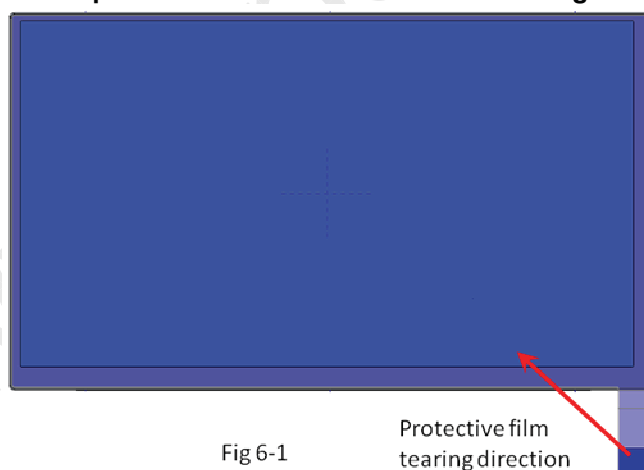


Fig 6-1

Protective film
tearing direction

6.3. Static Electricity

1. Be sure to ground module before turning on power or operating module.
2. Do not apply voltage which exceeds the absolute maximum rating value.



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6.4. Storage

1. Store the module in a dark room where must keep at $25\pm 10^{\circ}\text{C}$ and 65%RH or less.
2. Do not store the module in surroundings containing organic solvent or corrosive gas.
3. Store the module in an anti-electrostatic container or bag.

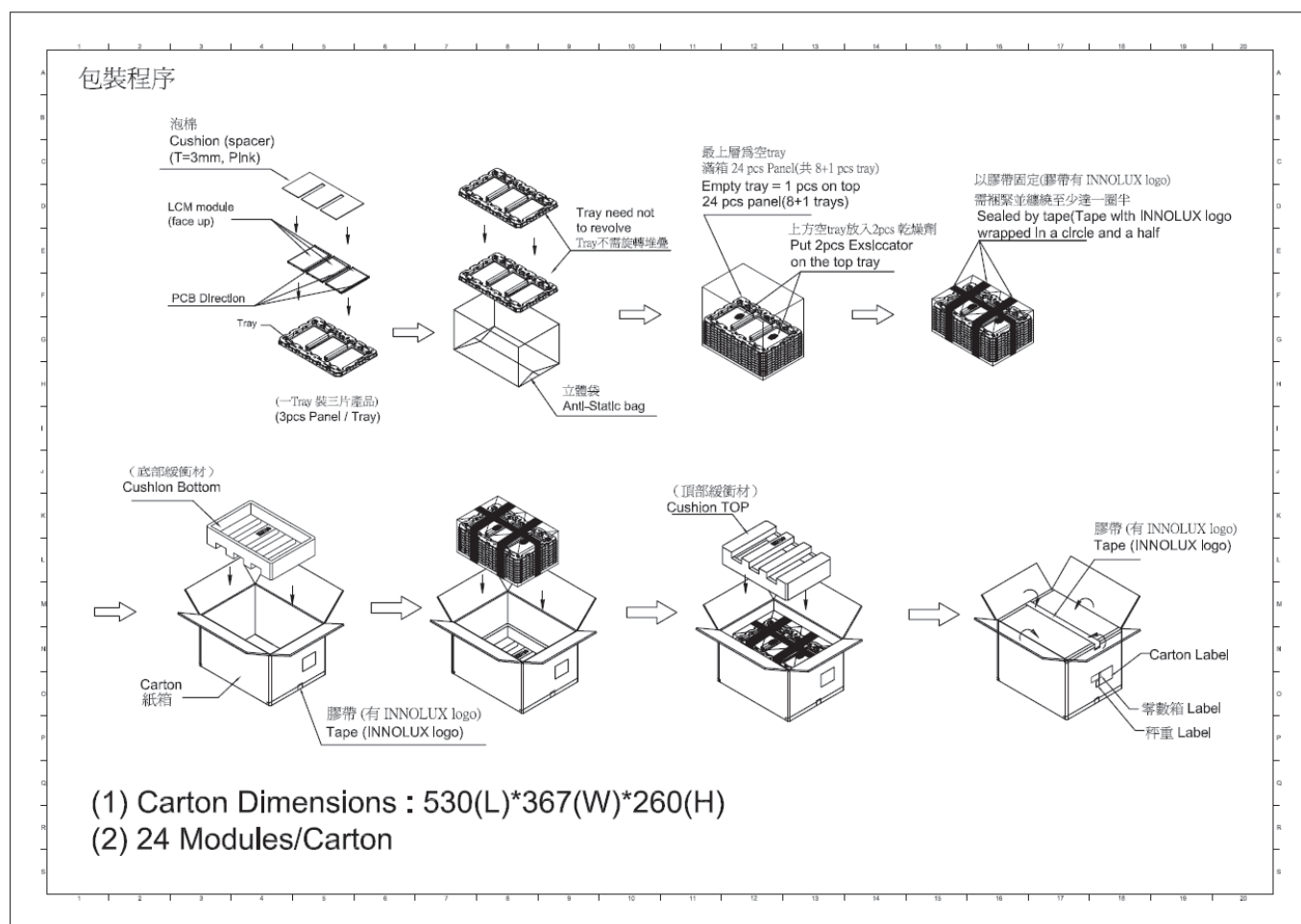
6.5. Cleaning

1. Do not wipe the polarizer with dry cloth. It might cause scratch.
2. Only use a soft sloth with IPA to wipe the polarizer, other chemicals might permanent damage to the polarizer.

7. Mechanical Drawing

8. Package Drawing

8.1. Package drawing





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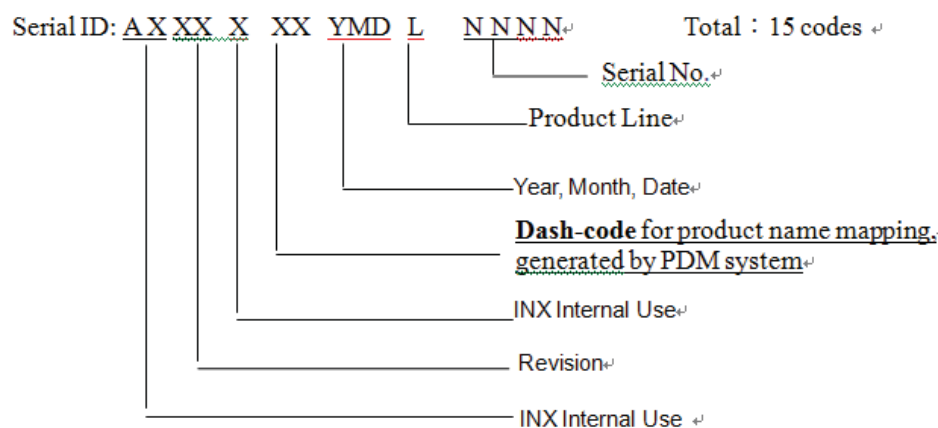
8.2. Label information

a. S/ N Label :

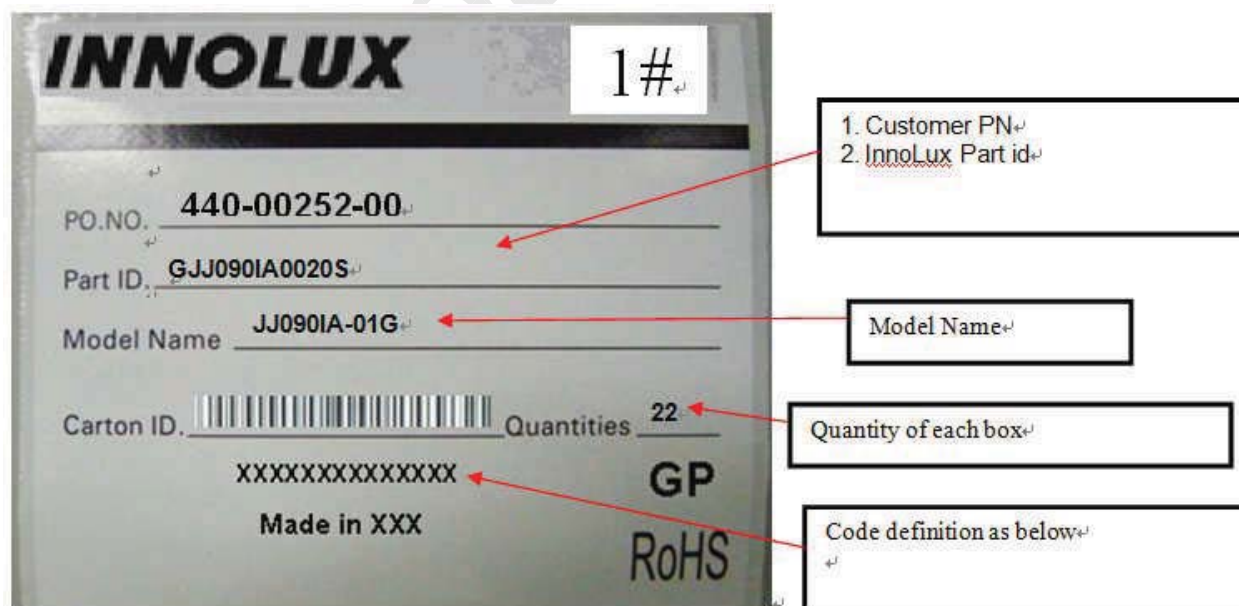


Code definition of SN:

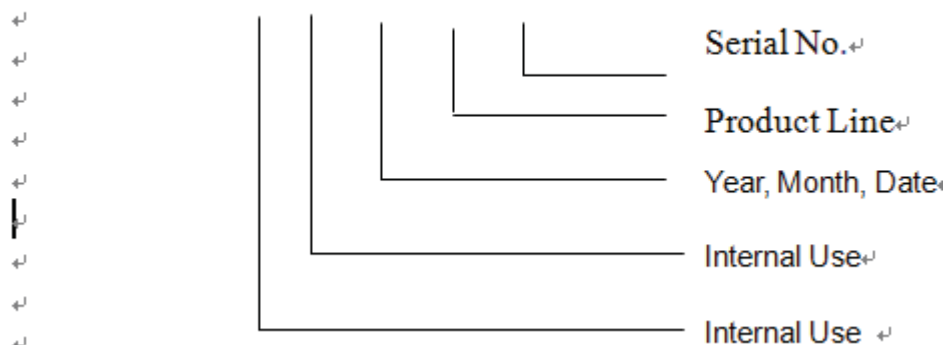
1. Model Name: JJ090IA-01G
2. PN : GJJ090IA0020S



b. Carton Label



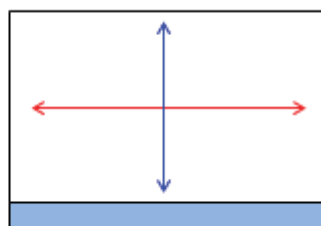
(a) Carton ID: 06 X Y M D L N N N



9. Appendix

9.1. Polarizer absorption axis

 CF Polarizer absorption axis
 TFT Polarizer absorption axis



CF: 0 degree
 TFT: 90 degree

9.2. Pixel RGB information

