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1. Record of Revision

Rev	Issued Date	Description	Editor
1.0	2017/05/03	First Release	Rich Liang



2. General Specifications

	Feature	Spec
Characteristics	Size	2.4inch
	Resolution	240(horizontal)*320(Vertical)
	Interface	SPI 4 Line
	Connect type	Soldering
	Display Colors	65K
	Technology type	a-Si
	Pixel pitch (mm)	0.153x 0.153
	Pixel Configuration	R.G.B.Stripe
	Display Mode	Normally White
	Driver IC	ST7789V
	Viewing Direction	6 O'clock
	Gray Scale Inversion Direction	12 O'clock
Mechanical	LCM (W x H x D) (mm)	42.72*60.26*2.3
	Active Area(mm)	36.72*48.96
	With /Without TSP	Without
	Weight (g)	10 g
	LED Numbers	4LEDs

Note 1: Viewing direction for best image quality is different from TFT definition; there is a 180 degree shift.

Note 2: Requirements on Environmental Protection: RoHS

Note 3: LCM weight tolerance: +/- 5%



3. Input/output Terminals

PIN NO	PIN NAME	DESCRIPTION
1	LEDK	LED backlight cathode
2	LEDA	Backlight LED Anode.
3	NC	-
4	NC	-
5	NC	-
6	NC	-
7	NC	-
8	GND	System Ground
9	VCC	power supply 2.8V
10	SDA	Serial Clock.
11	SCK	Serial Data
12	AO	-Display data/command selection pin in parallel interface.
13	RESET	Reset signal input terminal, active at 'L'
14	CS	Chip select



4. Absolute Maximum Ratings

Item	Symbol	MIN	MAX	Unit	Remark
Supply Voltage	V_{CC}	2.5	4.8	V	
Input Voltage	IOVCC	1.65	3.3	V	
Operating Temperature	T_{OPR}	-20	70	°C	
Storage Temperature	T_{STG}	-30	80	°C	

5. Electrical Characteristics

5.1 Driving TFT LCD Panel

$T_a = 25\text{ }^{\circ}\text{C}$

Item	Symbol	MIN	TYP	MAX	Unit	Remark
Analog Supply Voltage	V_{CC}	2.5	-	3.3	V	
Logic Signal Input /Output Voltage	IOVCC	1.65		3.3	V	
Input Signal Voltage	Low Level	V_{IL}	VSS	-	0.3x IOVCC	V
	High Level	V_{IH}	0.7x IOVCC	-	IOVCC	V
TFT Common Electrode	V_{COMH}	2.5	-	5	V	
TFT Gate ON Voltage	V_{GH}	10	-	16	V	
TFT Gate ON Voltage	V_{GL}	-10	-	-5	V	



5.2 Driving Backlight

Item	Symbol	MIN	TYP	MAX	Unit	Remark
Forward Current	I_F	-	80	100	mA	
Forward Voltage	V_F	-	3.2	3.3	V	
Backlight Power consumption	W_{BL}	-	0.256	0.33	W	
LED Lifetime		25000	-	-	Hrs	

Note 1: Each LED: $I_F = 20 \text{ mA}$, $V_F = 3.2\text{V}$.

Note 2: Optical performance should be evaluated at $T_a = 25^\circ\text{C}$ only.

Note 3: If LED is driven by high current, high ambient temperature & humidity condition. The life time of LED will be reduced. Operating life means brightness goes down to 50% initial brightness.

Typical operating life time is estimated data.

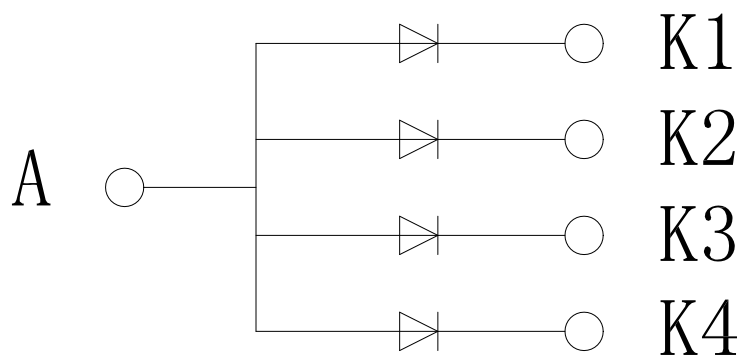


Figure: LED connection of backlight



6. Interface Timing

6.1 Serial Interface Characteristics (4-line serial):

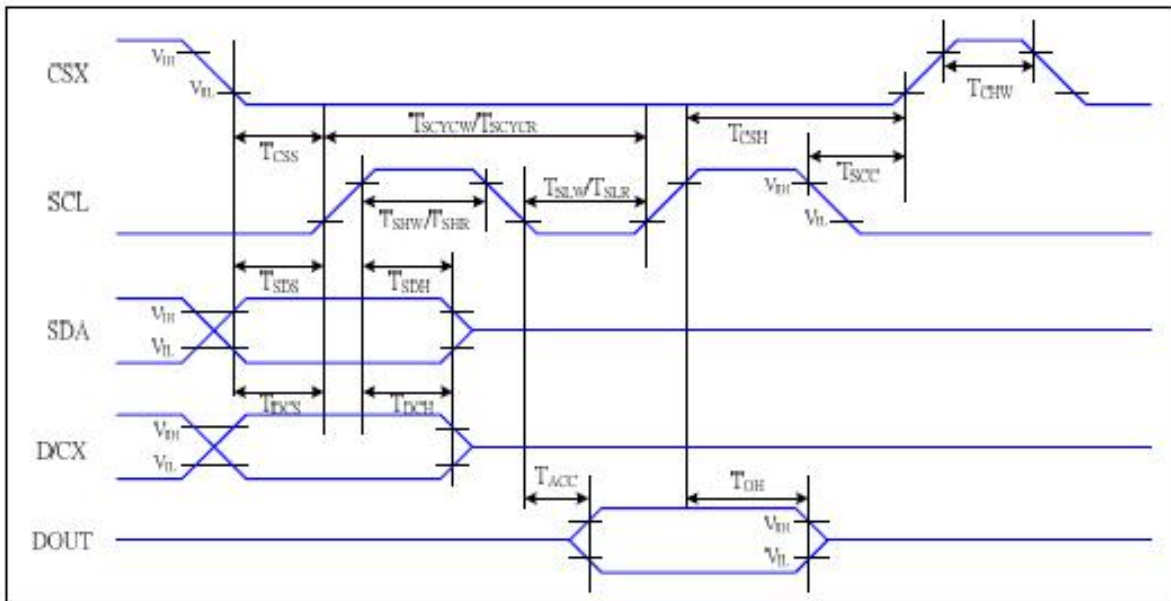


Figure 5 4-line serial Interface Timing Characteristics



VDDI=1.65 to 3.3V, VDD=2.4 to 3.3V, AGND=DGND=0V, Ta=-30 to 70 °C

Signal	Symbol	Parameter	MIN	MAX	Unit	Description
CSX	T _{CSS}	Chip select setup time (write)	15		ns	
	T _{CSH}	Chip select hold time (write)	15		ns	
	T _{CSS}	Chip select setup time (read)	60		ns	
	T _{SCC}	Chip select hold time (read)	65		ns	
	T _{CHW}	Chip select "H" pulse width	40		ns	
SCL	T _{SCYCW}	Serial clock cycle (Write)	66		ns	-write command & data ram
	T _{SHW}	SCL "H" pulse width (Write)	15		ns	
	T _{SLW}	SCL "L" pulse width (Write)	15		ns	
	T _{SCYCR}	Serial clock cycle (Read)	150		ns	-read command & data ram
	T _{SHR}	SCL "H" pulse width (Read)	60		ns	
	T _{SLR}	SCL "L" pulse width (Read)	60		ns	
D/CX	T _{DCS}	D/CX setup time	10		ns	
	T _{DCH}	D/CX hold time	10		ns	
SDA (DIN)	T _{SDS}	Data setup time	10		ns	
	T _{SDH}	Data hold time	10		ns	
DOUT	T _{ACC}	Access time	10	50	ns	For maximum CL=30pF
	T _{OH}	Output disable time	15	50	ns	For minimum CL=8pF

Table 6 4-line serial Interface Characteristics

6.2 Reset Timing:

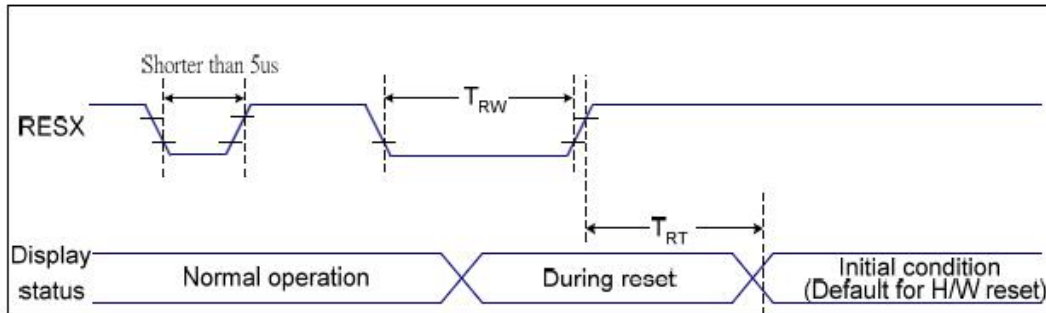


Figure 7 Reset Timing

$V_{DD1}=1.65$ to $3.3V$, $V_{DD}=2.4$ to $3.3V$, $AGND=DGND=0V$, $T_a=-30 \sim 70 \text{ } ^\circ\text{C}$

Related Pins	Symbol	Parameter	MIN	MAX	Unit
RESX	TRW	Reset pulse duration	10	-	us
	TRT	Reset cancel	-	5 (Note 1, 5)	ms
			-	120 (Note 1, 6, 7)	ms

Table 8 Reset Timing



7. Optical Characteristics

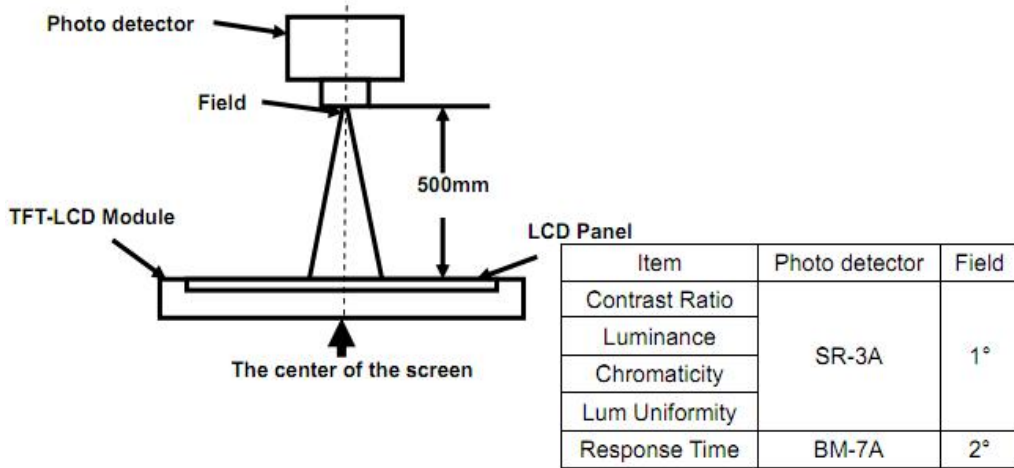
Items		Symbol	Condition	Min	Typ	Max	Unit	Remark
Viewing angles		θ_T	Center CR \geq 10	-	65	-	Degree	Note2
		θ_B		-	55	-		
		θ_L		-	65	-		
		θ_R		-	65	-		
Contrast Ratio		CR	$\Theta = 0$	300	350	-	-	Note1, Note3
Response Time		T_{ON}	25°C	-	20	30	ms	Note1, Note4
		T_{OFF}		-	25	35		
Chromaticity	White	X_W	Backlight is on	0.26	0.31	0.36	-	Note1, Note5
		Y_W		0.28	0.33	0.38	-	
Uniformity		U		80	-	-	%	Note1, Note6
NTSC				-	50	-	%	Note5
Luminance		L		200	300	-	nits	Note1, Note7

Test Conditions:

1. IF= 20mA (one channel), the ambient temperature is 25.
2. The test systems refer to Note 1 and Note 2.

Note 1: Definition of optical measurement system.

The optical characteristics should be measured in dark room. After 5 minutes operation, the optical properties are measured at the center point of the LCD screen. All input terminals LCD panel must be ground when measuring the center area of the panel.



Note 2: Definition of viewing angle range and measurement system.
Viewing angle is measured at the center point of the LCD by CONOSCOPE (ergo-80).

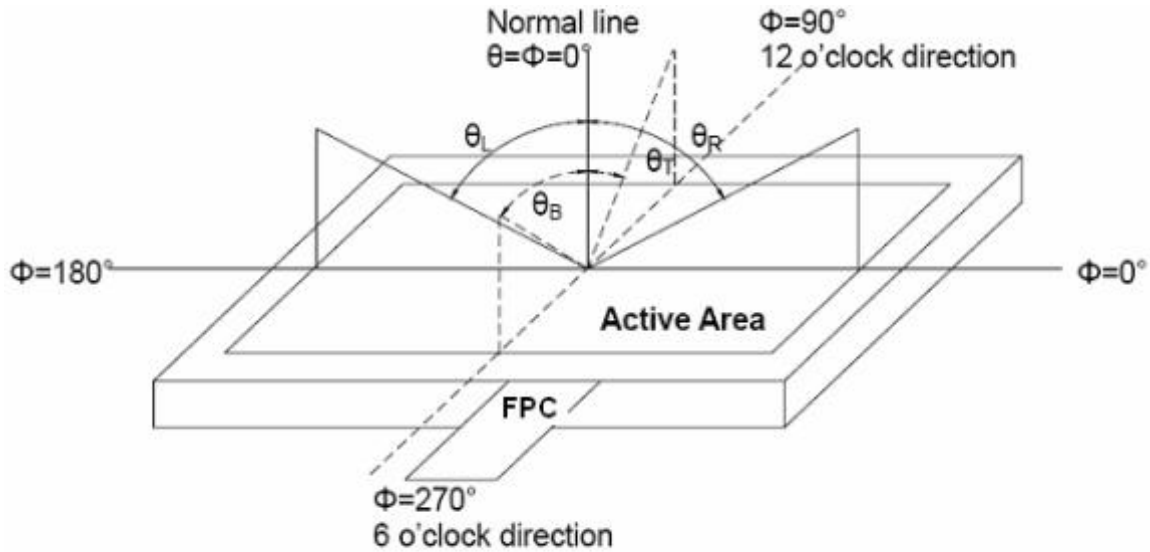


Fig. 1 Definition of viewing angle

Note 3: Definition of contrast ratio

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

“White state “: The state is that the LCD should drive by V_{white} .

“Black state”: The state is that the LCD should drive by V_{black} .

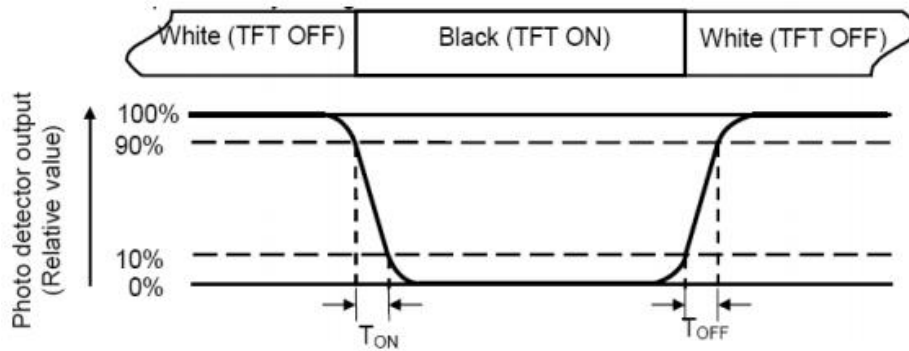
V_{white} : To be determined V_{black} : To be determined.

Note 4: Definition of Response time

The response time is defined as the LCD optical switching time interval between “White” state



and “Black” state. Rise time (T_{ON}) is the time between photo detector output intensity changed from 90% to 10%. And fall time (T_{OFF}) is the time between photo detector output intensity changed from 10% to 90%.



Note 5: Definition of color chromaticity (CIE1931).

Color coordinates measured at center point of LCD.

Note 6: Definition of Luminance Uniformity

Active area is divided into 9 measuring areas (Refer Fig. 2). Every measuring point is placed at the center of each measuring area.

Luminance Uniformity (U) = L_{min} / L_{max}

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

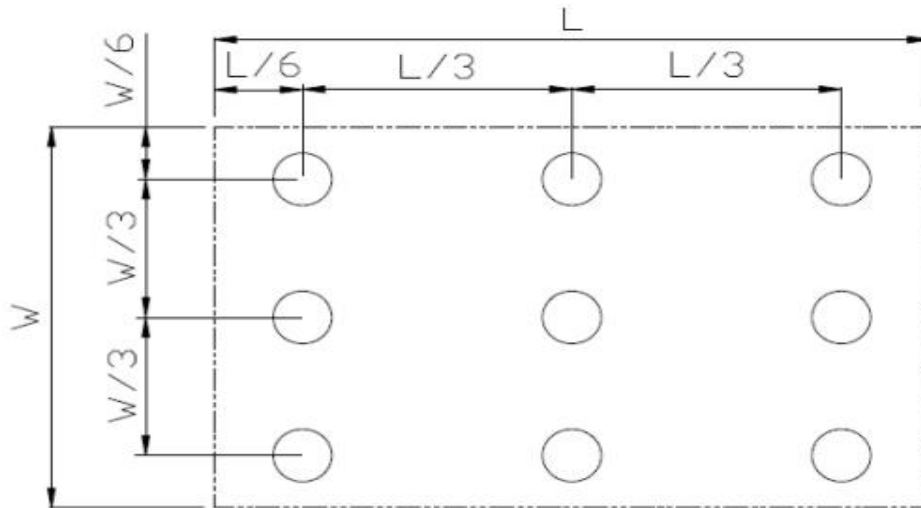


Fig. 2 Definition of uniformity

L_{max} : The measured maximum luminance of all measurement position.

L_{min} : The measured minimum luminance of all measurement position.

Note 7: Definition of Luminance:

Measure the luminance of white state at center point.



8. Environmental / Reliability Tests

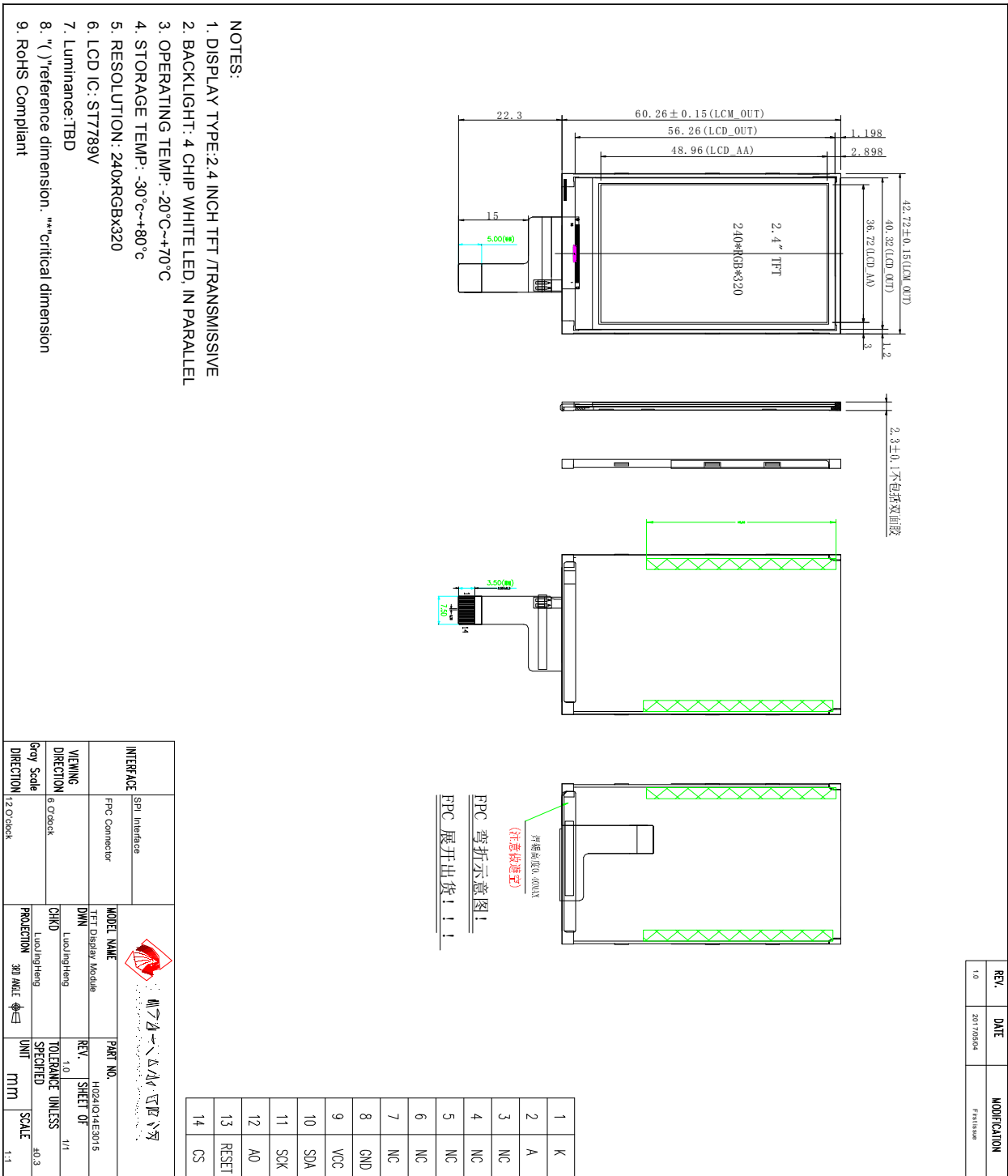
No	Test Item	Condition	Remarks
1	High Temperature Operation	Ts= +70℃, 240hrs	Note 1 IEC60068-2-2, GB2423. 2-89
2	Low Temperature Operation	Ta= -20℃, 240hrs	Note 2 IEC60068-2-1 GB2423.1-89
3	High Temperature Storage	Ta= +80℃, 240hrs	IEC60068-2-2 GB2423. 2-89
4	Low Temperature Storage	Ta= -30℃, 240hrs	IEC60068-2-1 GB/T2423.1-89
5	High Temperature & Humidity Storage	Ta= +60℃, 90% RH max, 160 hours	IEC60068-2-3 GB/T2423.3-2006
6	Thermal Shock (Non-operation)	-30℃ 30 min ~ +80℃ 30 min Change time: 5min, 30 Cycle	Start with cold temperature, end with high temperature IEC60068-2-14, GB2423.22-87
7	Electro Static Discharge (Operation)	C=150pF, R=330 Ω, 5 points/panel Air:±8KV, 5 times; Contact: ±4KV, 5times; (Environment: 15℃ ~35℃, 30% ~ 60%, 86Kpa ~ 106Kpa)	IEC61000-4-2 GB/T17626.2-1998
8	Vibration (Non-operation)	Frequency range: 10~55Hz, Stroke: 1.mm Sweep: 10Hz~55Hz~10Hz 2 hours for each direction of X .Y. Z. (package condition)	IEC60068-2-6 GB/T2423.5-1995
9	Shock (Non-operation)	60G 6ms, ± X, ±Y , ± Z,3 times for each direction	IEC60068-2-27 GB/T2423.5-1995
10	Package Drop Test	Height: 80 cm, 1 corner, 3 edges, 6 surfaces	IEC60068-2-32 GB/T2423.8-1995

Note: 1. TS is the temperature of panel's surface.

Note: 2. Ta is the ambient temperature of sample.



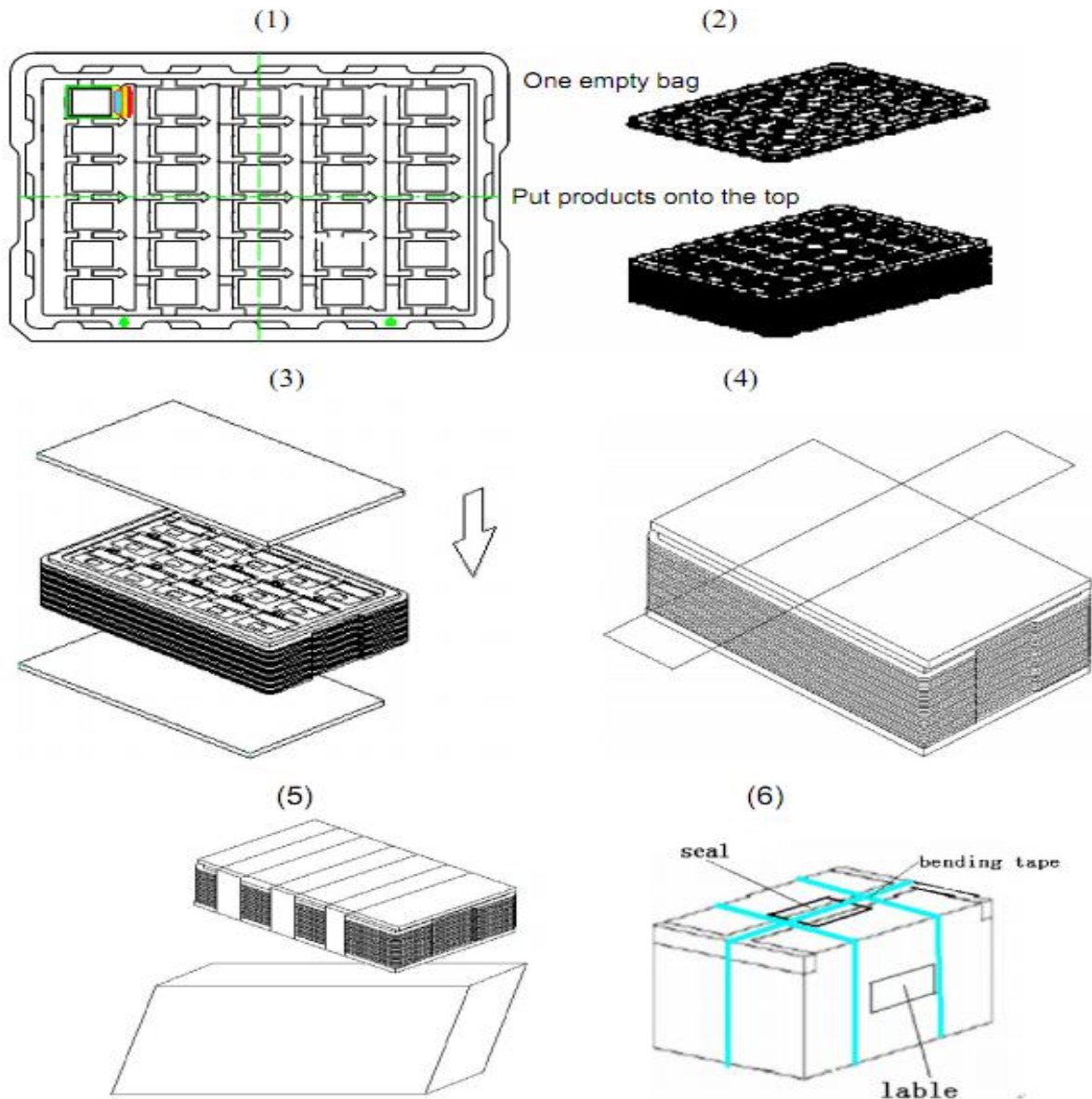
9. Mechanical Drawing





10. Packing

Packing Method



1. Put module into tray cavity:
2. Tray stacking
3. Put 1 cardboard under the tray stack and 1 cardboard above:
4. Fix the cardboard to the tray stack with adhesive tape:
5. Put the tray stack into carton.
6. Carton sealing with adhesive tape.



11. Precautions for Use of LCD modules

11.1 Handling Precautions

11.1.1 The display panel is made of glass. Do not subject it to a mechanical shock by dropping it from a high place, etc.

11.1.2 If the display panel is damaged and the liquid crystal substance inside it leaks out, be sure not to get any in your mouth, if the substance comes into contact with your skin or clothes, promptly wash it off using soap and water.

11.1.3 Do not apply excessive force to the display surface or the adjoining areas since this may cause the color tone to vary.

11.1.4 The polarizer covering the display surface of the LCD module is soft and easily scratched. Handle this polarizer carefully.

11.1.5 If the display surface is contaminated, breathe on the surface and gently wipe it with a soft dry cloth. If still not completely clear, moisten cloth with one of the following solvents:

- Isopropyl alcohol
- Ethyl alcohol

Solvents other than those mentioned above may damage the polarizer. Especially, do not use the following:

- Water
- Ketone
- Aromatic solvents

11.1.6 Do not attempt to disassemble the LCD Module.

11.1.7 If the logic circuit power is off, do not apply the input signals.

11.1.8 To prevent destruction of the elements by static electricity, be careful to maintain an optimum work environment.

11.1.8.1 Be sure to ground the body when handling the LCD Modules.

11.1.8.2 Tools required for assembly, such as soldering irons, must be properly ground.

11.1.8.3 To reduce the amount of static electricity generated, do not conduct assembly and other work under dry conditions.

11.1.8.4 The LCD Module is coated with a film to protect the display surface. Be care when peeling off this protective film since static electricity may be generated.

11.2 Storage Precautions

11.2.1 When storing the LCD modules, avoid exposure to direct sunlight or to the light of fluorescent lamps.

11.2.2 The LCD modules should be stored under the storage temperature range if the LCD modules will be stored for a long time, the recommend condition is:

Temperature : 0℃ ~ 40℃ Relatively humidity: ≤80%

11.2.3 The LCD modules should be stored in the room without acid, alkali and harmful gas.

11.3 Transportation Precautions

The LCD modules should be no falling and violent shocking during transportation, and also should avoid excessive press, water, damp and sunshine.