DATA MODUL

SPECIFICATION

TIANMA

P0650VGF1MA00

6.5" - VGA – LVDS

Version: 2.2
Date: 16.11.2023

Note: This specification is subject to change without prior notice

SPECIFICATION

[ ] Preliminary Specification
[√] Final Specification

Description **6.5” 640xRGBx480 TFT-LCD Module**

Part Number **P0650VGF1MA00**

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* This cover page is for your Comments and Signatures back to TIANMA.

REVISION HISTORY

Rev	Date	Page	Revision Items	Editor
1.0	2021/02/20	-	Preliminary Specification Released.	Gang.Li
2.0	2022/03/24	-	Update more details. Final Specification Released.	Gang.Li
2.1	2022/7/28	-	Update minimum value of CR.	Gang.Li
2.2	2023/11/16	-	Update UL file number.	Gang.Li

CONTENTS

1. Summary

1.1 General Description

This is a 6.5 inch a-Si TFT-LCD module with Normal- White technology. It is composed of a TFT-LCD panel, a driver circuit, PCB, and a LED backlight unit.

1.2 Features

- Ultra-wide viewing angle (Super Fine TFT (SFT))
- High luminance
- 100Khrs Long LED life time
- Wide temperature range
- Interface: 1 port LVDS
- Without LED driver
- Anti- vibration
- AG Surface treatment
- Acquisition product for UL62368-1/CSA C22.2 No.62368-1-03 (File number: E333987)
- Compliant with the European RoHS Directive (2011/65/EU) and Delegated Directive (2015/863/EU, Amending Annex II of 2011/65/EU)

2. General Specifications

Feature		Spec	Unit
Display Spec	Size	6.5 inches	
	Resolution	640(RGB)x480	
	Pixel Pitch	0.207 (H) x 0.207(V)	mm
	TFT Active Area	132.48×99.36	mm
	Technology Type	a-Si	
	Pixel Configuration	R.G.B Vertical Stripe	
	Display Mode	SFT Normally black	
	Surface Treatment	Anti-Glare	
	Viewing Direction	ALL	
Mechanical Characteristics	LCM (W x H x D)	154.00x 121.00 x 7.10	mm
	Weight	179	g
Optical Characteristics	Luminance	1200	cd/m^2
	Contrast Ratio	900:1	
	NTSC	70	%
	Viewing Angle	88/88/88/88	degree
Electrical Characteristics	Interface	1 port LVDS	
	Color Depth	262K/16.7 M	color
	Power Consumption	LCD:396(Typ.) Backlight: 3348(Typ.)	mW

Table 2.1 General TFT Specifications

3. Input / Output Terminals

3.1 CN1 Pin assignment (LCD Interface)

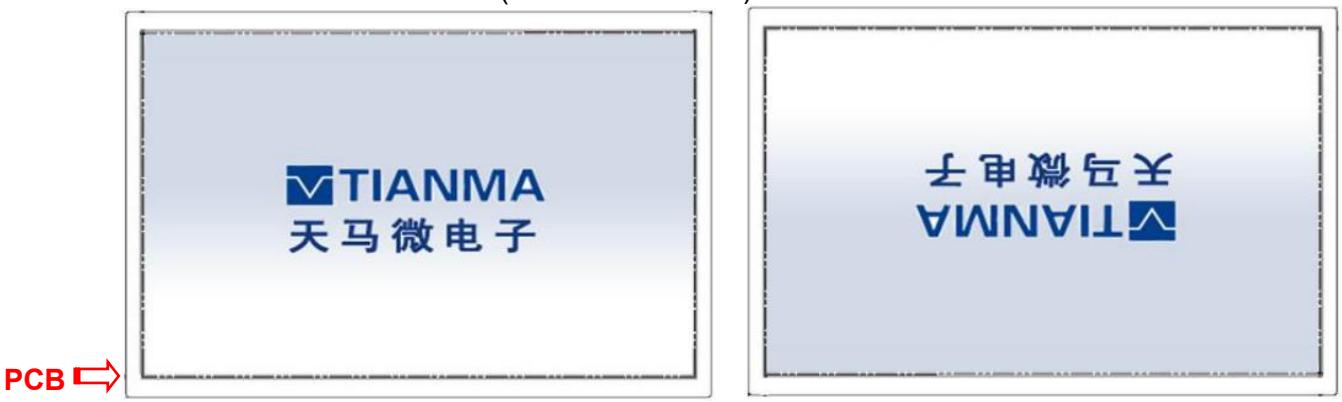
Connector Information	
LCD Module connector	FI-SE20P-HFE (JAE)
Matching connector	FI-S20S or equivalent

Table 3.1.1 Connector information

PIN	Symbol	I/O	8 bit input	6 bit input	Remark
1	VCC	P	Power supply,+3.3V		
2	VCC	P	Power supply,+3.3V		
3	GND	P	GND		
4	GND	P	GND		
5	Link 0-	I	- LVDS Signal(R0~R5,G0)	- LVDS Signal(R0~R5,G0)	
6	Link 0+	I	+LVDS Signal(R0~R5,G0)	+LVDS Signal(R0~R5,G0)	
7	GND	P	GND		
8	Link 1-	I	- LVDS Signal(G1~G5,B0~B1)	- LVDS Signal(G1~G5,B0~B1)	
9	Link 1+	I	+LVDS Signal(G1~G5,B0~B1)	+LVDS Signal(G1~G5,B0~B1)	
10	GND	P	GND		
11	Link 2-	I	- LVDS Signal(B2~B5,DE)	- LVDS Signal(B2~B5,DE)	
12	Link 2+	I	+LVDS Signal(B2~B5,DE)	+LVDS Signal(B2~B5,DE)	
13	GND	P	GND		
14	CLKIN-	I	-LVDS Clock Signal	-LVDS Clock Signal	
15	CLKIN+	I	+LVDS Clock Signal	+LVDS Clock Signal	
16	GND	P	GND		
17	Link 3-	I	-LVDS Signal(R6~R7,G6~G7,B6~B7)	--	
18	Link 3+	I	+LVDS Signal(R6~R7,G6~G7,B6~B7)	--	
19	Mode	I	H: 8bit (Default)	L: 6bit	
20	SC	I	Display direction selection(L: Normal, H: Reverse)		Note3

Table 3.1.2 Pin Assignment for LCD Interface

Note1: I/O definition: I---Input, O---Output, P---Power/Ground, N---No connection
Note2: All of the GND pins should be connected to the system ground.
Note3: Scan direction is shown as below(PCB at down side):



SC=0 SC=1

3.2 CN2 Pin assignment (Back Light)

Connector Information	
LCD Module connector	JST SM06B-SHLS-TF(LF)(SN)
Matching connector	SHLP-06V-S-B or equivalent

Table 3.2.1 Connector information

No	Symbol	I/O	Description	Remark
1	NC	-	No connection	
2	NC	-	No connection	
3	LED C1	P	LED cathode 1	
4	LED A1	P	LED anode 1	
5	LED A2	P	LED anode 2	
6	LED C2	P	LED cathode 2	

Table 3.2.2 Pin Assignment for Back Light Interface

Note1: I/O definition: I---Input, O---Output, P---Power/Ground, N---No connection

4. Absolute Maximum Ratings

GND=0V

Item	Symbol	MIN	MAX	Unit	Remark
Power Supply Voltage	VCC	-0.3	5.0	V	
Digital Input Voltage	$V_{I/O}$	-0.3	VCC+0.3	V	Note1
Operating Temperature	Top	-30	80	℃	
Storage Temperature	Tst	-40	90	℃	
Relative Humidity Note2	RH	--	≤95	%	Ta≤40℃
		--	≤85	%	40℃＜Ta≤50℃
		--	≤55	%	50℃＜Ta≤60℃
		--	≤36	%	60℃＜Ta≤70℃
		--	≤24	%	70℃＜Ta≤80℃
Absolute Humidity	AH	--	≤70	g/m³	Ta＞70℃

Table 4.1 Absolute Maximum Ratings

Note1: Digital input voltage includes MODE,SC.

Note2: Ta means the ambient temperature. It is necessary to limit the relative humidity to the specified temperature range. Condensation on the module is not allowed.

Note3: The absolute maximum rating values of this product are not allowed to be exceeded at any times. A module should be used with any of the absolute maximum ratings exceeded, the characteristics of the module may not be recovered, or in an extreme condition, the module may be permanently destroyed

5. Electrical Characteristics

5.1 DC Characteristics for Panel Driving

Item		Symbol	MIN	TYP	MAX	Unit	Remark
Power supply Voltage		VCC	3.0	3.3	3.6	V	Include ripple
Power supply current		IVCC	-	120	150	mA	Note1
Power supply ripple		Vp-p	-	-	100	mV	
Input Signal Voltage	Low Level	VIL	GND	--	0.3×VCC	V	
	High Level	VIH	0.7×VCC	--	VCC	V	
Output Signal Voltage	Low Level	VOL	GND	--	GND+0.4	V	
	High Level	VOH	VCC-0.4	--	VCC	V	
Inrush current		Irush	-	-	1.5	A	Note2

Table 5.1.1 DC characteristics

Note1: To test the current dissipation, using the “white “testing pattern.
Note2: Inrush current test condition.

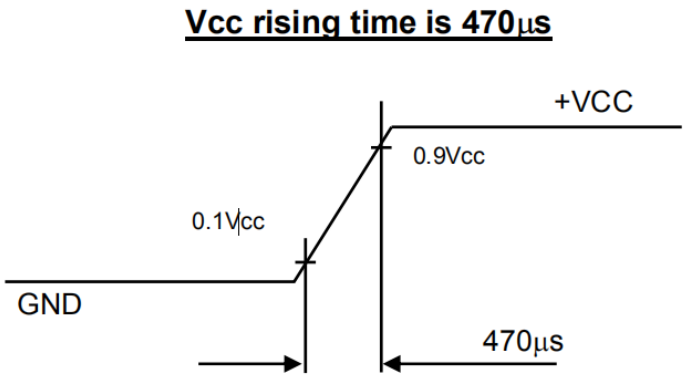


Figure5.1 Inrush current test condition

5.2 DC Characteristics for Backlight Driving

Item	Symbol	MIN	TYP	MAX	Unit	Remark
Forward Current	I_F	-	180	200	mA	12 LEDs (6 LED Serial, 2 LED Parallel)
Forward Current Voltage	V_F	-	18.6	20.4	V	
Backlight Power Consumption	W_{BL}	-	3348	-	mW	
Operating Life Time	--	-	100000	-	hrs	Note

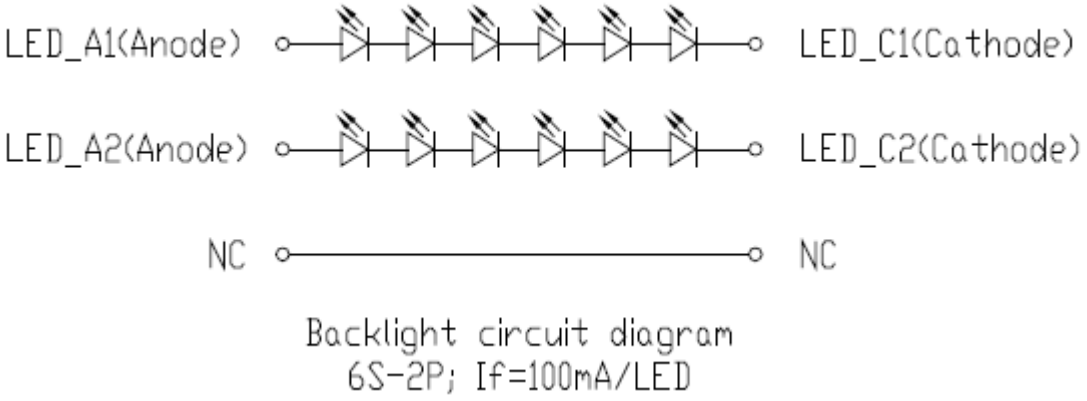
Table 5.2.1 LED Backlight Characteristics

Note1: I_F is defined for total LED.

Note2: Optical performance should be evaluated at Ta=25℃ only.

Note3: If LED is driven by high current, high ambient temperature & humidity condition. The life time of LED will be reduced.

Note4: Operating life means brightness goes down to 50% of initial brightness. Typical operating life time is estimated data.



Backlight circuit diagram
6S-2P; If=100mA/LED

5.3 Recommended Power ON/OFF Sequence

Item	Symbol	Min	Typ	Max	Unit	Remark
VCC on to VCC stable	TP1	0.5	-	3	ms	
VCC stable to LVDS signal on	TP2	4.6	-	100	ms	
Signal on to LED on	TP3	200	-	-	ms	
VCC off time	TP4	1	-	5	ms	
VCC off to next VCC on	TP5	2000	-	-	ms	
LVDS Signal off before VCC off	TP6	123	-	500	ms	
LED off before signal off	TP7	200	-	-	ms	

Table5.3 Power on/off sequence

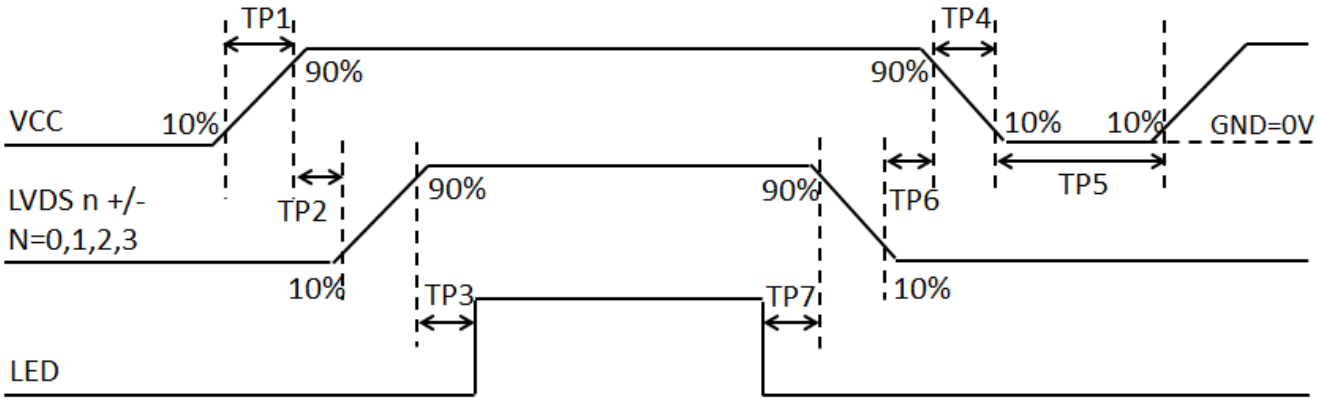


Figure 5.3 Power on/off sequence

Note1: The low level of these signals and analog powers are GND level.
Note2: All of the power and signals should be kept at GND level before power on. If there are residual voltages on them, the LCD might not work properly.
Note3: Keep backlight turned off until the display has stabilized.

5.4 LCD Module Block Diagram

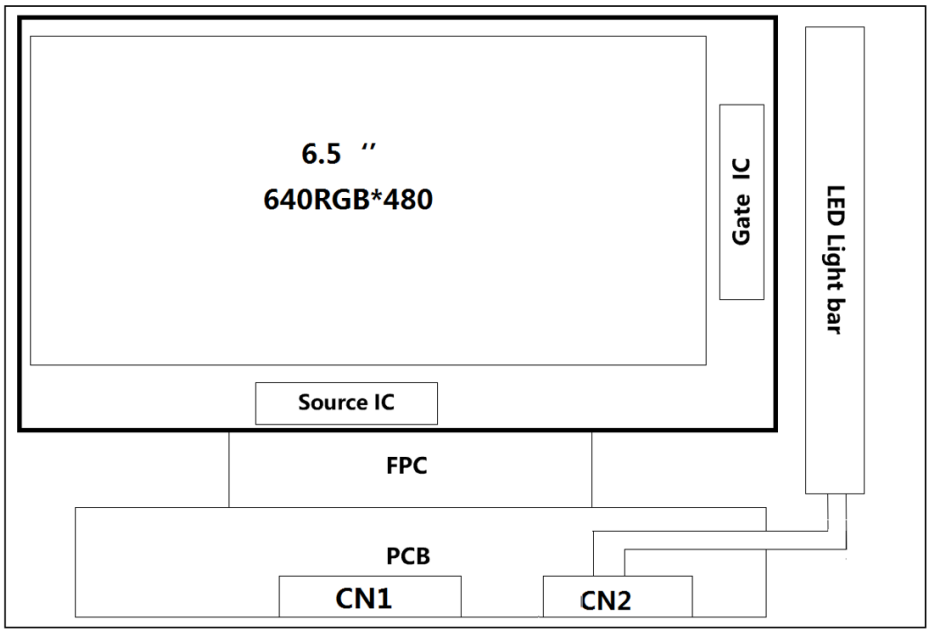


Figure 5.4 LCD Module Block Diagram

6. Timing Characteristics

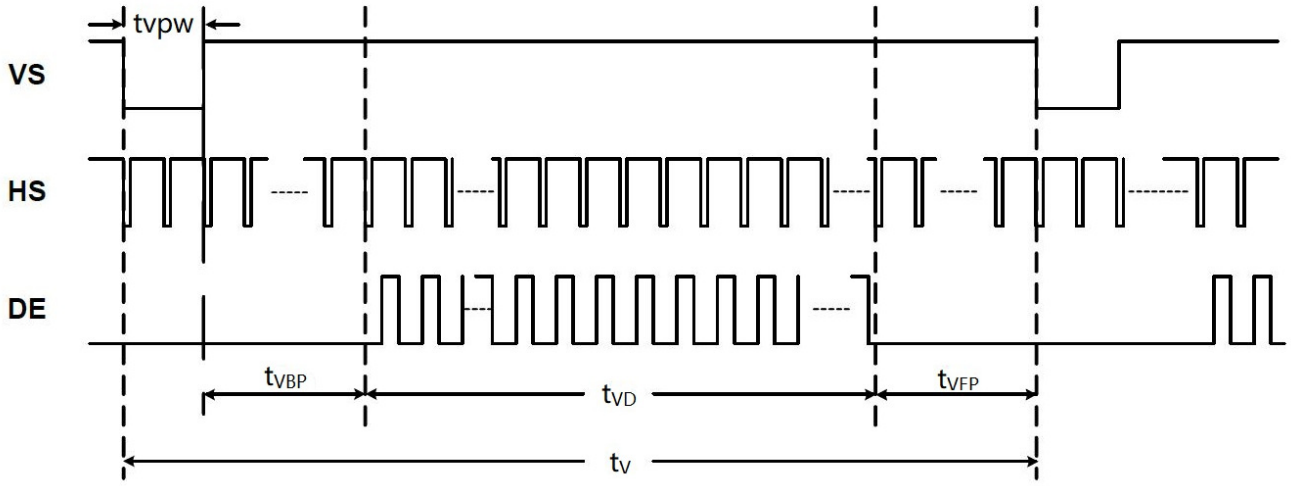
6.1 Data Input Timing Parameter Setting

VCC=3.3V, GND=0V, Ta=25℃

Parameter	Symbol	Min	Typ	Max	Unit	Remark
CLKIN+/- frequency	tCLK	-	20.71	51.1	MHz	
Horizontal blanking time	tHBT	26	34	506	tclk	
Horizontal display area	tHD	-	640	-	tclk	
Horizontal period	tH	666	674	1146	tclk	
Vertical blanking time	tVBT	13	32	206	tH	
Vertical display area	tVD	-	480	-	tH	
Vertical period	tV	493	512	686	tH	
Frame Rate	F	-	60	-	HZ	

Table 6.1.1 Data Input Timing Parameters

Vertical input timing



Horizontal input timing

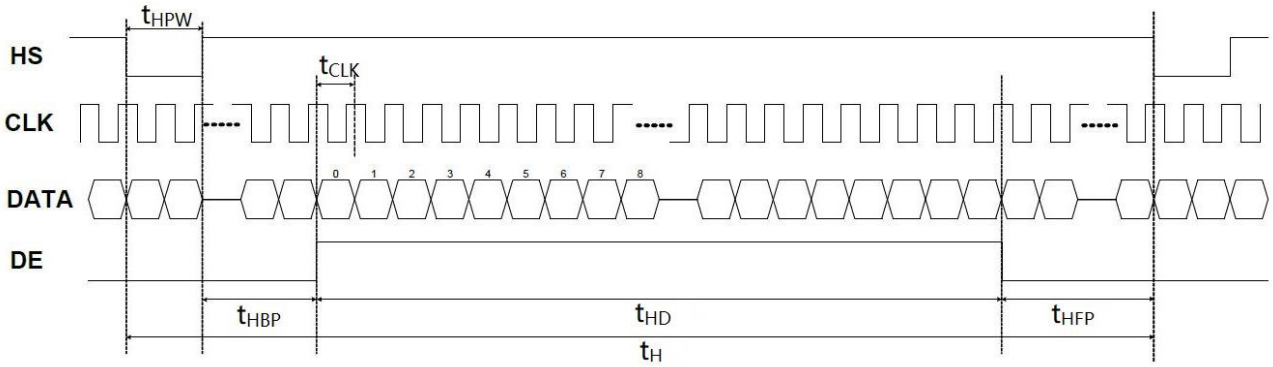


Figure 6.1.1 Data Input Timing

6.2 LVDS DC Electrical Characteristics

Parameter	Symbol	Min.	Typ.	Max.	Unit	Remark
Differential input high Threshold voltage	R_{XVTH}	-	-	0.1	V	R_{XVCM}=1.2V
Differential input Low Threshold voltage	R_{XVTL}	-0.1	-	-	V	
Input voltage range(single-end)	R_{XVIN}	0	-	VCC-1.0	V	
Differential input common Mode voltage	R_{XVCM}	0.6	1.2	2.4-$\|V_{ID}\|$/2	V	
Differential input voltage	$\|V_{ID}\|$	0.2	0.4	0.6	V	
Differential input leakage current	RVxliz	-10	-	10	uA	
LVDS Digital Operating Current	IVDD_LVDS	-	30	45	mA	FCLK=65 MHz , VCC=3.3V Data pattern=55/H → AA/H(loop)

Table 6.2.1 LVDS DC Electrical Characteristics

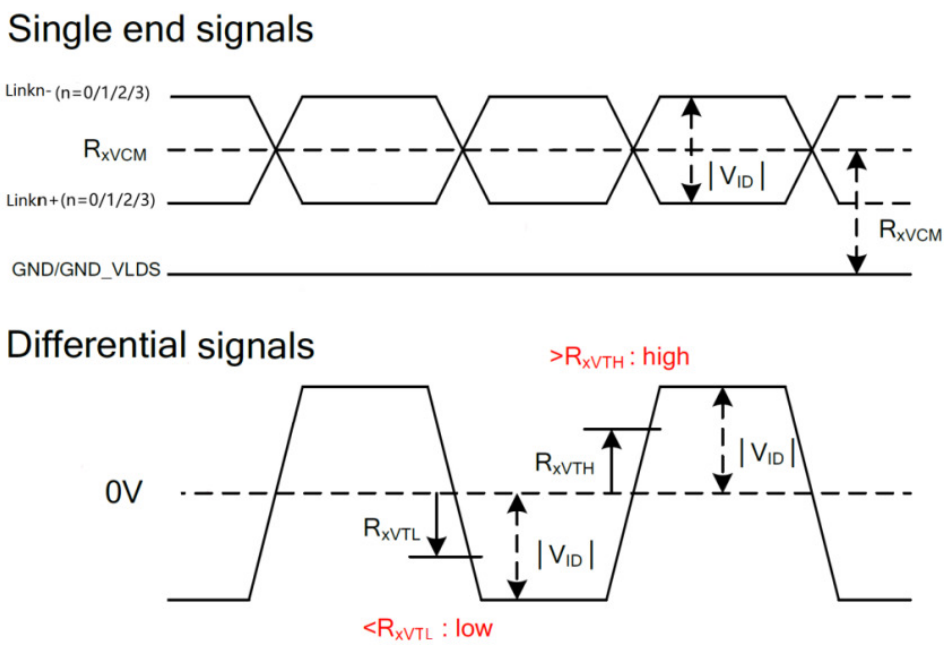


Figure 6.2.1 LVDS DC Electrical Characteristics

6.3 LVDS AC characteristics

VCC=3.3V, GND=0V, Ta=25℃

Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions
Clock Frequency	R_{xFCLK}	20	-	80	MHz	
Clock Period	R_{xTCLK}	12.5	-	50	ns	
1 data bit time	UI	-	1/7	-	R_{xTCLK}	
Clock high time	T_{LVCH}	-	4	-	UI	
Clock low time	T_{LVCL}	-	3	-	UI	
Position 1	T_{POS1}	-0.25	0	0.25	UI	
Position 2	T_{POS2}	0.75	-	1.25	UI	
Position 3	T_{POS3}	0.75	1	1.25	UI	
Position 4	T_{POS4}	1.75	-	2.25	UI	
Position 5	T_{POS5}	1.75	2	2.25	UI	
Position 6	T_{POS6}	2.75	-	3.25	UI	
Position 7	T_{POS7}	2.75	3	3.25	UI	
Position 8	T_{POS8}	3.75	-	4.25	UI	
Position 9	T_{POS9}	3.75	4	4.25	UI	
Position 10	T_{POS10}	4.75	-	5.25	UI	
Position 11	T_{POS11}	4.75	5	5.25	UI	
Position 12	T_{POS12}	5.75	-	6.25	UI	
Position 13	T_{POS13}	5.75	6	6.25	UI	
Position 14	T_{POS14}	6.75	-	7.25	UI	
Input eye width	T_{EYEW}	0.5	-	-	UI	
Input eye border	T_{EX}	-	-	0.25	UI	

Table 6.3.1 LVDS AC characteristics

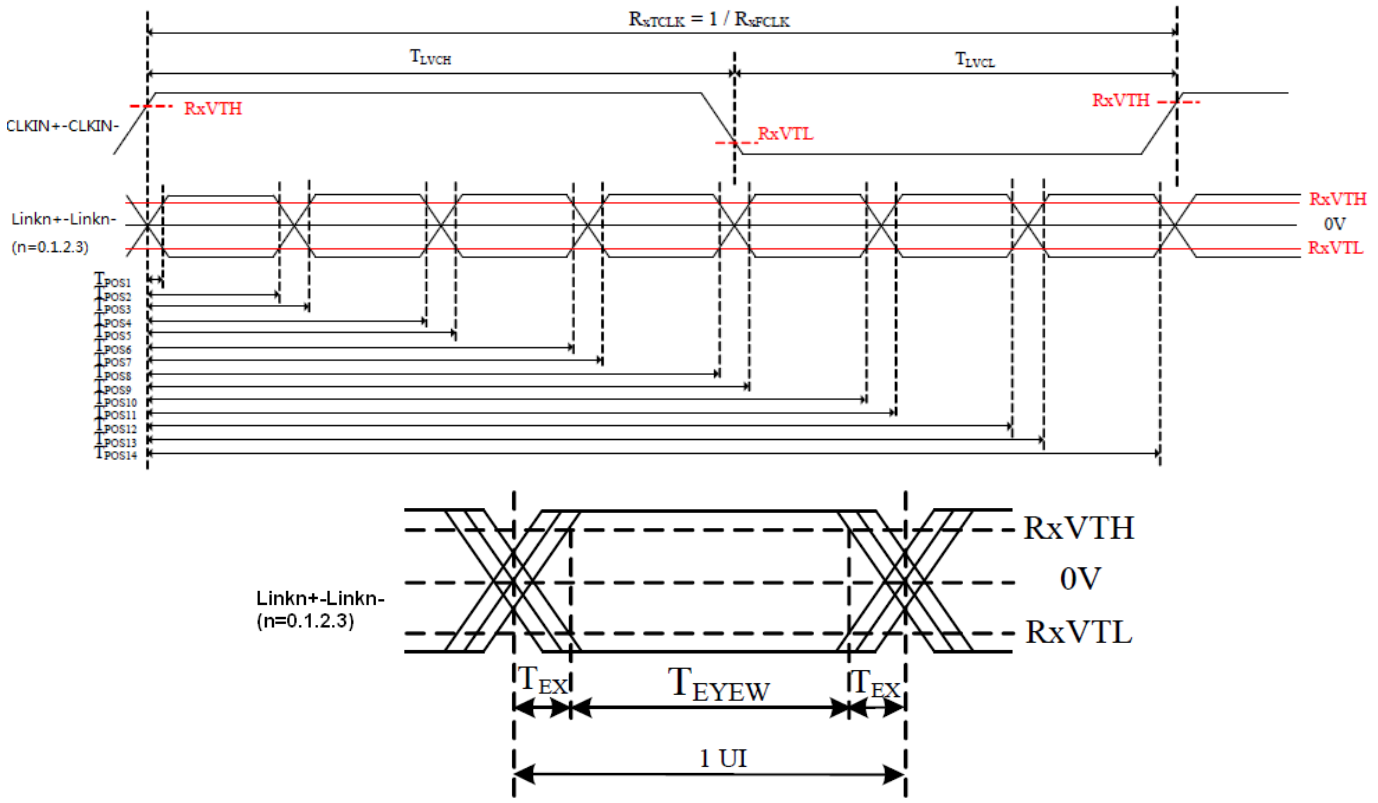


Figure 6.3.1 LVDS AC Electrical Characteristics

6.4 LVDS data mapping

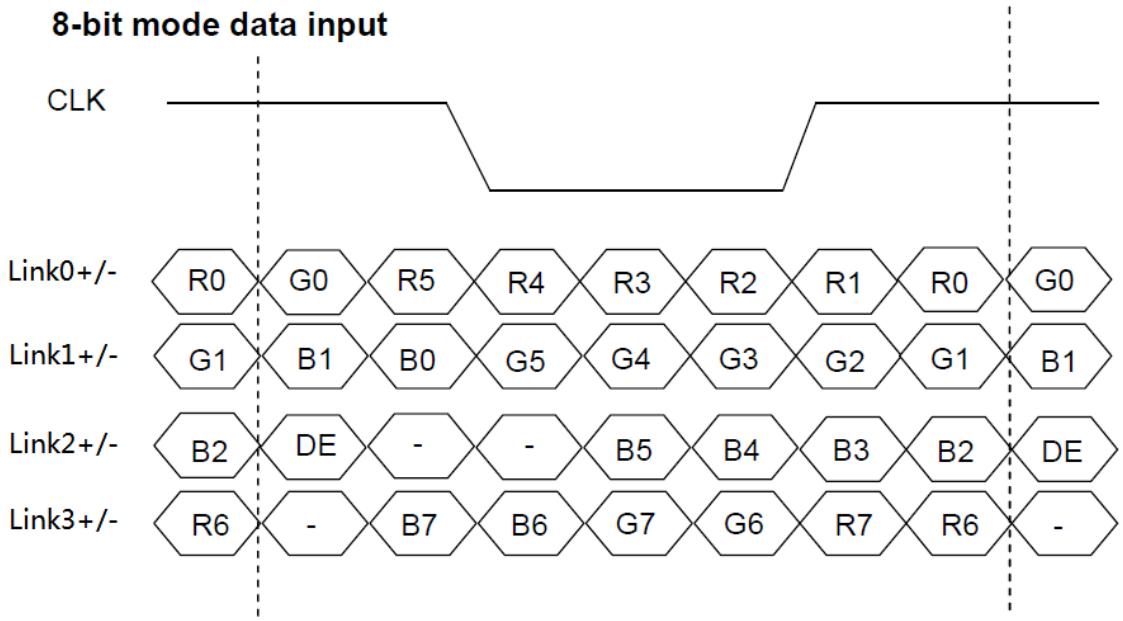


Figure 6.4.1 LVDS 8bit (Mode=H)

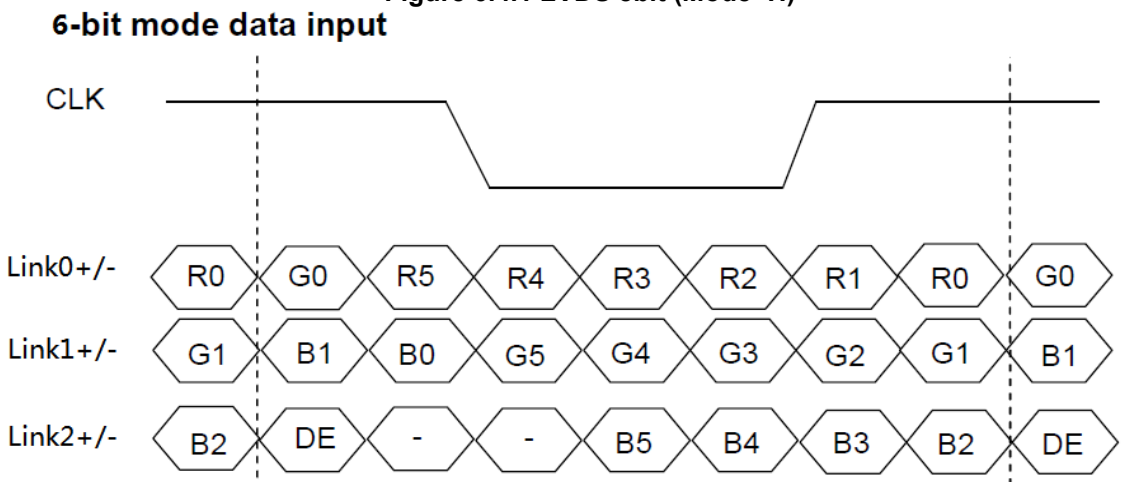


Figure 6.4.2 LVDS 6bit(Mode=L)

7. Optical Characteristics

Item		Symbol	Condition	Min	Typ	Max	Unit	Remark
View Angles		θT	CR≧10	78	88	-	Degree	Note 2
		θB		78	88	-		
		θL		78	88	-		
		θR		78	88	-		
Contrast Ratio		CR	θ=0°	600	900	-		Note1 Note3
Response Time		T_{ON}	25℃	-	30	35	ms	Note1 Note4
		T_{OFF}						
Chromaticity	White	x	Backlight is on	0.252	0.302	0.352		Note1 Note5
		y		0.270	0.320	0.370		
	Red	x		0.577	0.627	0.677		
		y		0.272	0.322	0.372		
	Green	x		0.261	0.311	0.361		
		y		0.580	0.630	0.680		
	Blue	x		0.105	0.155	0.205		
		y		0.005	0.055	0.105		
Uniformity		U		75	80	-	%	Note1 Note6
NTSC				65	70	-	%	Note 5
Luminance (Without TP）		L		900	1200	-	cd/m^2	Note1 Note7

Table 7.1 Optical Parameters

Test Conditions:

1. I_F= **180**mA, and the ambient temperature is 25℃±2℃,humidity is 65±7%.
2. The test systems refer to Note1 and Note2.

Note1: Definition of optical measurement system.

The optical characteristics should be measured in dark room. After 5 Minutes operation, the optical characteristics are measured at the center point of the LCD screen.

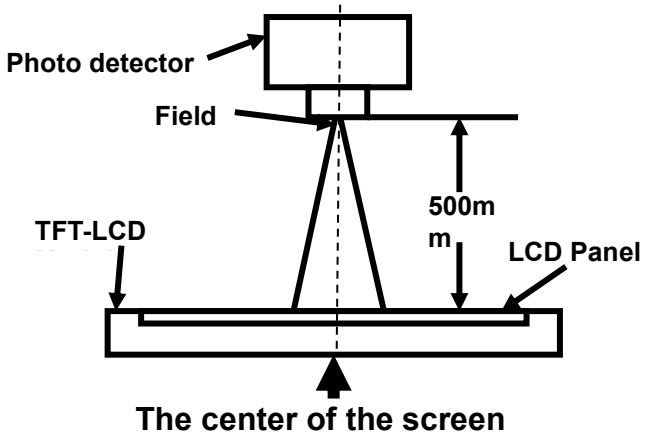


Fig1. Measurement Set Up

Note2: Definition of viewing angle range and measurement system. Viewing angle is measured at the center point of the LCD 。

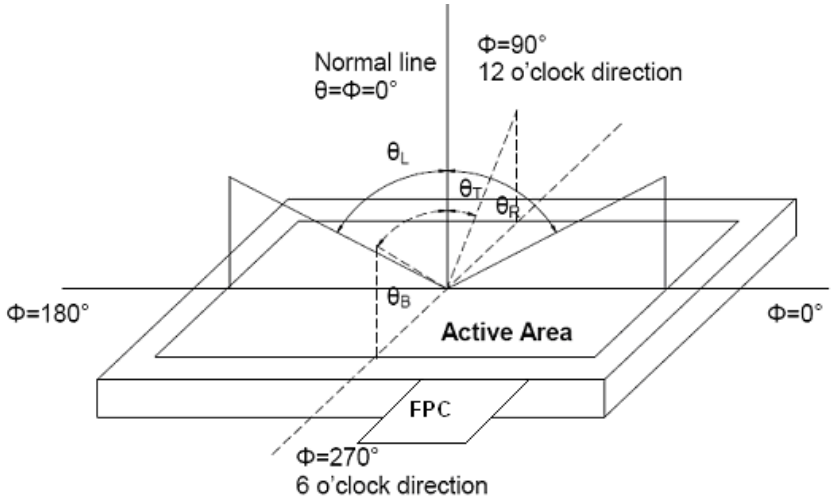


Fig2. Measurement viewing angle

Note3: Definition of contrast ratio

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

Note4: Definition of Response time

For TN LCM,the response time is defined as the LCD optical switching time interval between "White" state and "Black" state. Rise time (T_r) is the time between photo detector output intensity changed from 90% to 10%. And fall time (T_f) is the time between photo detector output intensity changed from 10% to 90%.

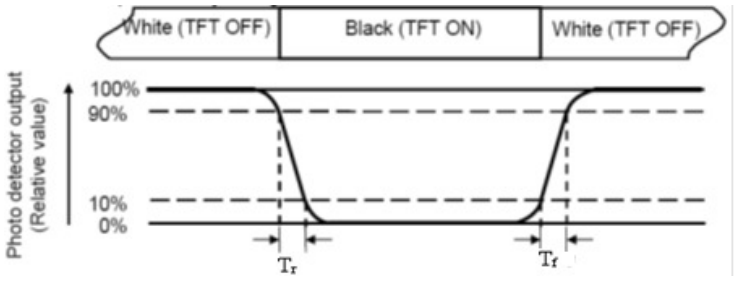


Fig3. Response Time Testing(TN)

For SFT LCM, the response time is defined as the LCD optical switching time interval between "White" state and "Black" state. Rise time (T_r) is the time between photo detector output intensity changed from 10% to 90%. And fall time (T_f) is the time between photo detector output intensity changed from 90% to 10%.

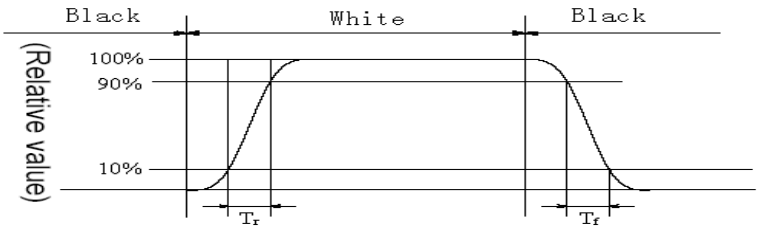


Fig4. Response Time Testing(SFT)

Note5: Definition of color chromaticity (CIE1931)

Color coordinates measured at center point of LCD.

Note6: Definition of Luminance Uniformity

Active area is divided into 9 measuring areas (Refer Fig.5). Every measuring point is placed at the center of each measuring area.

Luminance Uniformity (U) = Lmin/ Lmax

Lmax: The measured Maximum luminance of all measurement position.

Lmin: The measured Minimum luminance of all measurement position.

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

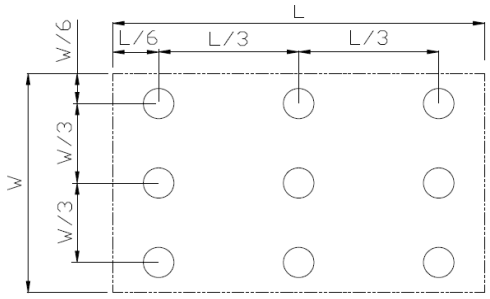


Fig5. Luminance Uniformity Measurement Locations(9 points)

Note7: Definition of Luminance:

Measure the luminance of white state at center point.

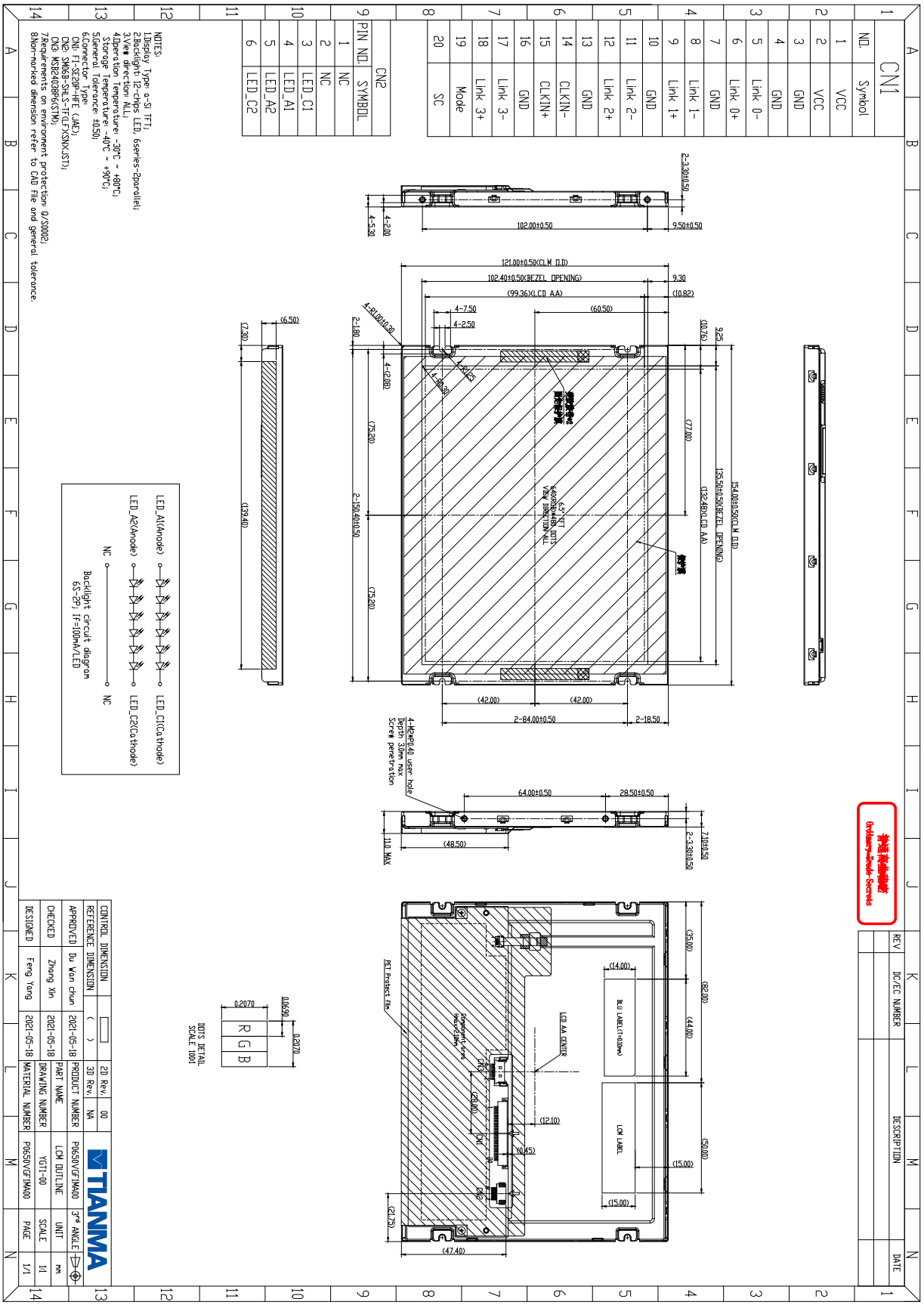
8. Reliability Test

No	Test Item	Condition	Remarks
1	High Temperature Operation	Ta = +80℃, 500 hours	IEC60068-2-1 GB2423.2
2	Low Temperature Operation	Ta = -30℃, 500 hours	IEC60068-2-1 GB2423.1
3	High Temperature Storage	Ta = +90℃, 500 hours	IEC60068-2-1 GB2423.2
4	Low Temperature Storage	Ta = -40℃, 500 hours	IEC60068-2-1 GB2423.1
5	High Temperature and Humidity Operation	Ta = +60℃, 90% RH max,500hours	IEC60068-2-78 GB/T2423.3
6	Thermal Shock (non-operation)	-30℃ 30 min~+80℃ 30 min, Change time:5min, 100 Cycle	Start with cold temperature, End with high temperature, IEC60068-2-14,GB2423.22
7	ESD	C=150pF,R=330Ω,5point/panel Air:±15Kv,5times; Contact:±8Kv,5times (Environment:15℃~35℃, 30%~60%.86Kpa~106Kpa)	IEC61000-4-2 GB/T17626.2
8	Vibration Test (non-operation)	vibration level :9.8m/s2(1G) waveform: sinusoidal Frequency range: 5 to 500Hz Frequency sweep rate:0.5 octave/min Duration : one sweep from 5 to 500Hz in each of three mutually perpendicular axis(each x,y,z axis: 1hour, total 3 hours)	GB/T 2423.10-2008 ; GB/T 2423.56-2006
9	Shock Test	Shock level:1470m/s²(150G) Waveform: half sinusoidal wave,2ms Number of shocks: one shock input in each direction of three mutually perpendicular axis for a total of six shock inputs	GB/T 2423.5-1995
10	Package Drop Test	Height:60cm, 1corner,3edges,6surfaces	GB/T 4857.5-1992
11	Package Vibration	Frequency : 5-20-200HZ , PSD : 0.01-0.01-0.001 Total:0.781g2/HZ, x/y/z axis per 30min)	GB/T 4857.23-2012

Table 8.1 RA test condition

Note1: Temperature is the ambient temperature of sample
Note2: Before cosmetic and function test, the product must have enough recovery time, at least 2 hours at room temperature.
Note3: In the standard condition, there shall be no practical problem that may affect the display function. After the reliability test, the product's function only be guaranteed, but not for all of the cosmetic specification.

9. Mechanical Drawing



10. Packing Instruction

No	Item	Model (Material)	Dimensions(mm)	Unit Weight(Kg)	Quantity	Remark
1	LCM	P0650VGF1MA00	154.00x 121.00 x 7.10	0.179	40	
2	Tray	PET	485×330×21.5	0.260	12	
3	Dust-proof Bag	PE	700×545×0.05	0.021	1	
4	Carton	Corrugated Paper	544×365×250	1.01	1	
5	BOX	Corrugated Paper	520×345×74	0.38	2	
6	EPE	EPE	485×330×5	0.016	2	
7	Label	Paper	100×52	0.001	1	
8	Total weight	12.1±5% Kg				

Table 10.1 Packing Instruction

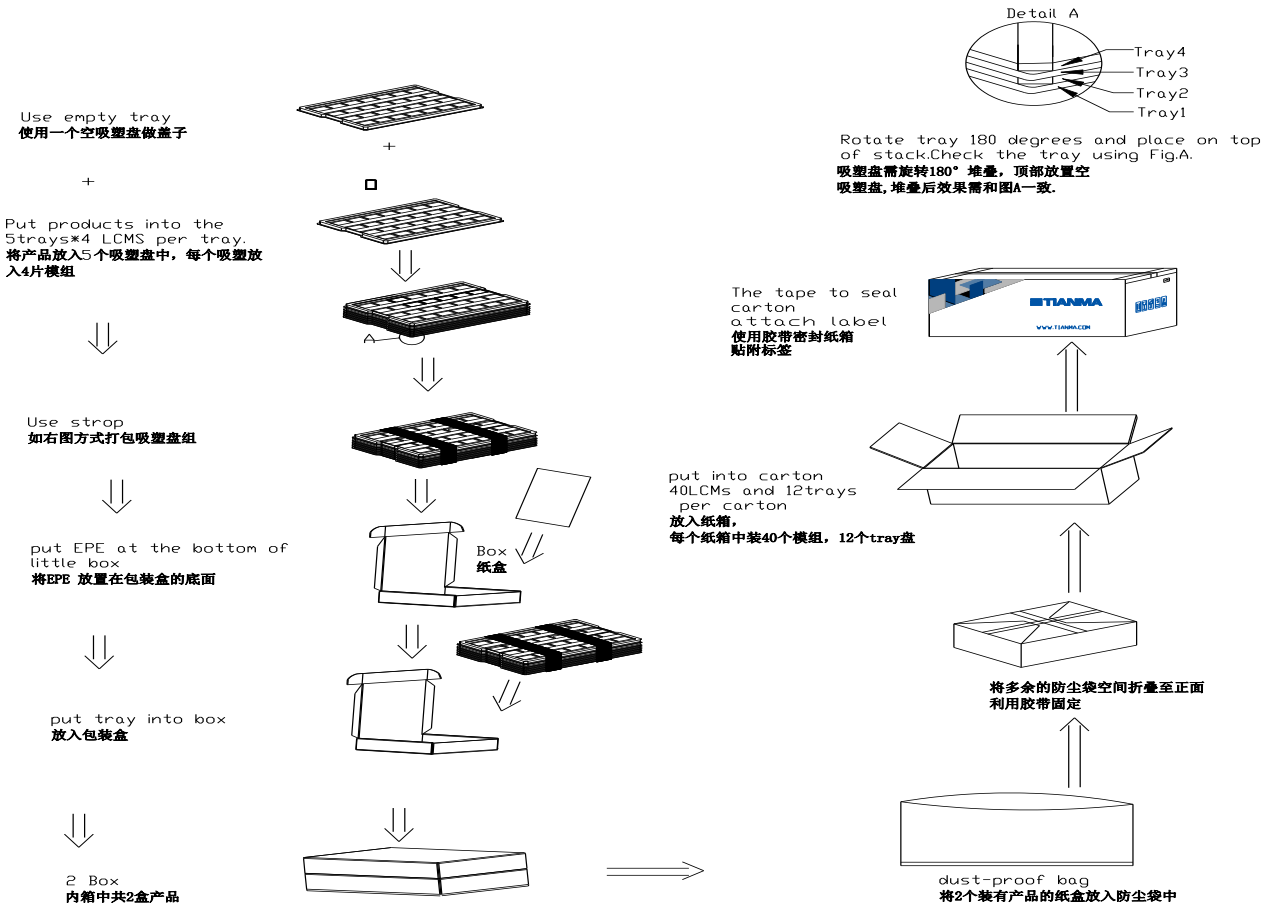


Figure 10.1 Packing Instruction

11. Precautions for Use of LCD Modules

11.1 Handling Precautions

(1) The display panel is made of glass. Do not subject it to mechanical shock by dropping it, etc.
(2) If the display panel is damaged and the liquid crystal fluid inside it leaks out be sure not to get any in your mouth. If the fluid comes into contact with your skin or clothes promptly wash it off using soap and water.
(3) Do not apply excessive force to the display surface or the bezel since this may cause the color tone to vary.
(4) The polarizer covering the display surface of the LCD module is soft and easily scratched. Handle the polarizer carefully.
(5) If the display surface is contaminated, breathe on the surface and gently wipe it with a soft dry cloth. If it is still not completely clear use a moist cloth with one of the following solvents:
   — Isopropyl alcohol
   — Ethyl alcohol

   Solvents other than those mentioned above may damage the polarizer. Specifically, do not use the following:
   — Water
   — Ketone
   — Aromatic solvents
(6) Do not disassemble the LCD Module.
(7) If powered off, do not apply the input signals.
(8) To prevent destruction of the module by static electricity, be careful to maintain an optimum work environment.
(9) Be sure to ground your body when handling the LCD Modules.
(10) Tools used for assembly, must be properly grounded.
(11) To reduce the amount of static electricity generated, do not conduct assembly or other work under very low humidity conditions.
(12) The LCD Module is covered with a film to protect the display surface, remove film slowly under the ionizer.

11.2 Storage precautions

(1) When storing the LCD modules avoid exposure to direct sunlight or to the light of fluorescent lamps.
(2) The LCD modules should be stored within the rated storage temperature range. The recommend condition is: Temperature: 0 ~ 35 ℃ at normal humidity.
(3) The LCD modules should be stored in a room without acid, alkali or other harmful gas.

11.3 Transportation Precautions

The LCD modules should not be dropped or subject to violent mechanical shock during transportation. Also they should avoid excessive pressure, water, high humidity and direct sunlight.

11.4 Screen saver Precautions

Not display the fixed pattern for a long time. Use a screen saver, if the fixed pattern is displayed on the screen

11.5 Safety Precautions

(1) When you waste damaged or unnecessary LCDs, it is recommended to crush LCDs into pieces and wash t hem off with solvents such as acetone and ethanol, which should later be burned
(2) Be sure to turn off the power supply when inserting or disconnecting the LED backlight cable.
(3) LED driver should be designed to limit or stop its function when over current is detected on the LED.

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