DATA MODUL

SPECIFICATION

TIANMA

P0650VGF1MA10

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 **P0650VGF1MA10**

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REVISION HISTORY

Rev	Date	Page	Revision Items	Editor
1.0	2021/03/25	-	Preliminary specification released.	Chunhui Yang
2.0	2021/12/29	-	Update more details. Final specification released.	Chunhui Yang
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- Black technology. It is composed of a TFT-LCD panel, a driver circuit, PCB, and a LED backlight unit.

1.2 Features

- LVDS(1port，6/8bit selectable)
- Ultra-wide viewing angle.
- Built in LED driver
- Long life LED
- 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 (W) x 99.36 (H)	mm
	Technology Type	a-Si	
	Pixel Configuration	R.G.B Vertical Stripe	
	Display Mode	SFT, Normally black	
	Surface Treatment	Anti-Glare	
	Viewing Direction	ALL	
	Gray Scale Inversion Direction	NA	
Mechanical Characteristics	LCM (W x H x D)	153.00x 118.00 x 10.9	mm
	Weight	160.5	g
Optical Characteristics	Luminance	800	cd/m^2
	Contrast Ratio	900:1	
	NTSC	70	%
	Viewing Angle	88/88/88/88	degree
Electrical Characteristics	Interface	LVDS	
	Color Depth	16.7M/262K	color
	Power Consumption	LCD:538(Typ.); Backlinght:2364(Typ.)	mW

Table 2.1 General TFT Specifications

3. Input / Output Terminals

3.1 CN1 Pin assignment (LCD Interface)

Connector Information	
Connector type	MSB24013P20
Matching connector	P24013P20 or DF19-20S-1C

Table 3.1.1 Connector information

No	Symbol	I/O	Description	Comment
1	VCC	P	Power supply,+3.3V(typical)	
2	VCC	P	Power supply,+3.3V(typical)	
3	GND	P	Ground	
4	Mode	I	L: 6bit H: 8bit	
5	Link 0-	I	LVDS Receiver Signal(-)	
6	Link 0+	I	LVDS Receiver Signal(+)	
7	GND	P	Ground	
8	Link 1-	I	LVDS Receiver Signal(-)	
9	Link 1+	I	LVDS Receiver Signal(+)	
10	GND	P	Ground	
11	Link 2-	I	LVDS Receiver Signal(-)	
12	Link 2+	I	LVDS Receiver Signal(+)	
13	GND	P	Ground	
14	CLKIN-	I	LVDS Receiver Clock Signal(-)	
15	CLKIN+	I	LVDS Receiver Clock Signal(+)	
16	NC	-	Not connected	
17	U/D	I	Vertical reverse (H: up to down scan L: down to up scan)	
18	R/L	I	Horizontal reverse (H: left to right scan L ：right to left scan)	
19	Link 3-	I	LVDS Receiver Signal(-)	Note4
20	Link 3+	I	LVDS Receiver Signal(+)	Note4

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: This LCD module supports DE mode, the pin setting is different from each other. Please refer to the descriptions.
Note4： When LVDS 6bit, input pin not in used connect to GND.

3.2 U/D R/L Function Description

Scan control input		Scanning direction
UD	LR	
VCC	VCC	Up to down, left to right (reverse)
GND	GND	Down to up, right to left (normal)
VCC	GND	Up to down, right to left
GND	VCC	Down to up, left to right

Table 3.2 Pin Assignment for BL Interface

3.3 CN2 Pin assignment (BL Interface)

Connector Information	
Connector type	MS24016RHD
Matching connector	STM P24016

Table 3.3.1 Connector information

No	Symbol	I/O	Description	Comment
1	VLED	P	12V Input	
2	VLED	P	12V Input	
3	GND	P	Ground	
4	GND	P	Ground	
5	LED ON/OFF	I	3.3V On; GND Off	
6	PWM DIM	I	Dimming signal	

Table 3.3.2 Pin Assignment for BL Interface

4. Absolute Maximum Ratings

Item	Symbol	MIN	MAX	Unit	Remark
Power Voltage	VCC	-0.3	5.0	V	
Input voltage	V_{IN}	-0.5	5.0	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: Input voltage include all in put data.
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

VCC=3.3V，GND=0V，Ta = 25℃

Item		Symbol	MIN	TYP	MAX	Unit	Remark
Power supply Voltage		VCC	3.2	3.3	3.4	V	Without ripple
Power supply current		IVCC	-	163	-	mA	
Power consumption		P	-	538	-	mW	Note1
Input voltage threshold	Low level	VIL	0	-	0.3VCC	V	
	High level	VIH	0.7VCC	-	VCC	V	
Inrush current		Irush	-	-	1.5	A	Note2

Table 5.1.1 LCD module electrical characteristics

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

Vcc rising time is 470μs

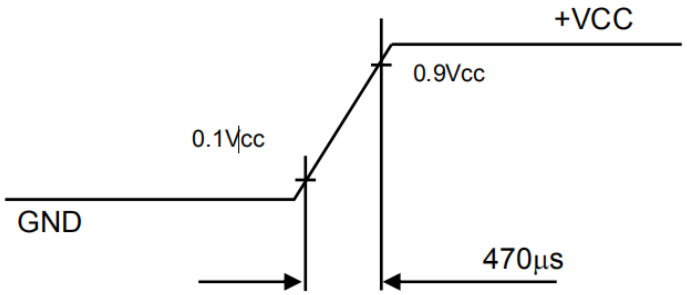


Figure5.1.1 Inrush current test condition

5.2 DC Characteristics for Backlight Driving

(GND=0V, Ta=25℃)

Item	Symbol	MIN	TYP	MAX	Unit	Remark
LED driver input voltage	VLED	9	12	13	V	100% Duty
LED driver forward current	I_F	-	120	-	mA	100% Duty
Backlight Power Consumption	W_{BL}	-	2364	-	mW	100% Duty
LED ON/OFF	VIH	2	3.3	5	V	
	VIL	-	0	0.8	V	
PWM DIM	VIH	2	3.3	5	V	
	VIL	-	0	0.8	V	
Dimming Frequency	$F_{PWM\ DIM}$	0.1	-	100	KHZ	
Dimming Duty	$D_{PWM\ DIM}$	1	-	100	%	Note5
Life Time	Lf	50000	70000	-	hrs	Note3

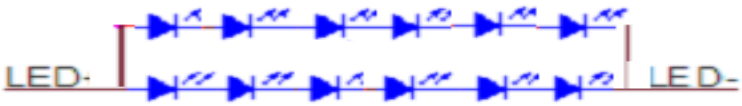
Table 5.2.1 LED Backlight Characteristics

Note1: The LED driving condition is defined for total LED module.

Note2: Under LCM operating, the stable forward current should be inputted. And forward voltage is for reference only.

Note3: Optical performance should be evaluated at Ta=25℃ only 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.

Note4: The LED driving condition is defined for each LED module.



Note5: It should be noted that the accuracy of 1% duty is not guaranteed.

5.3 LCD Module Block Diagram

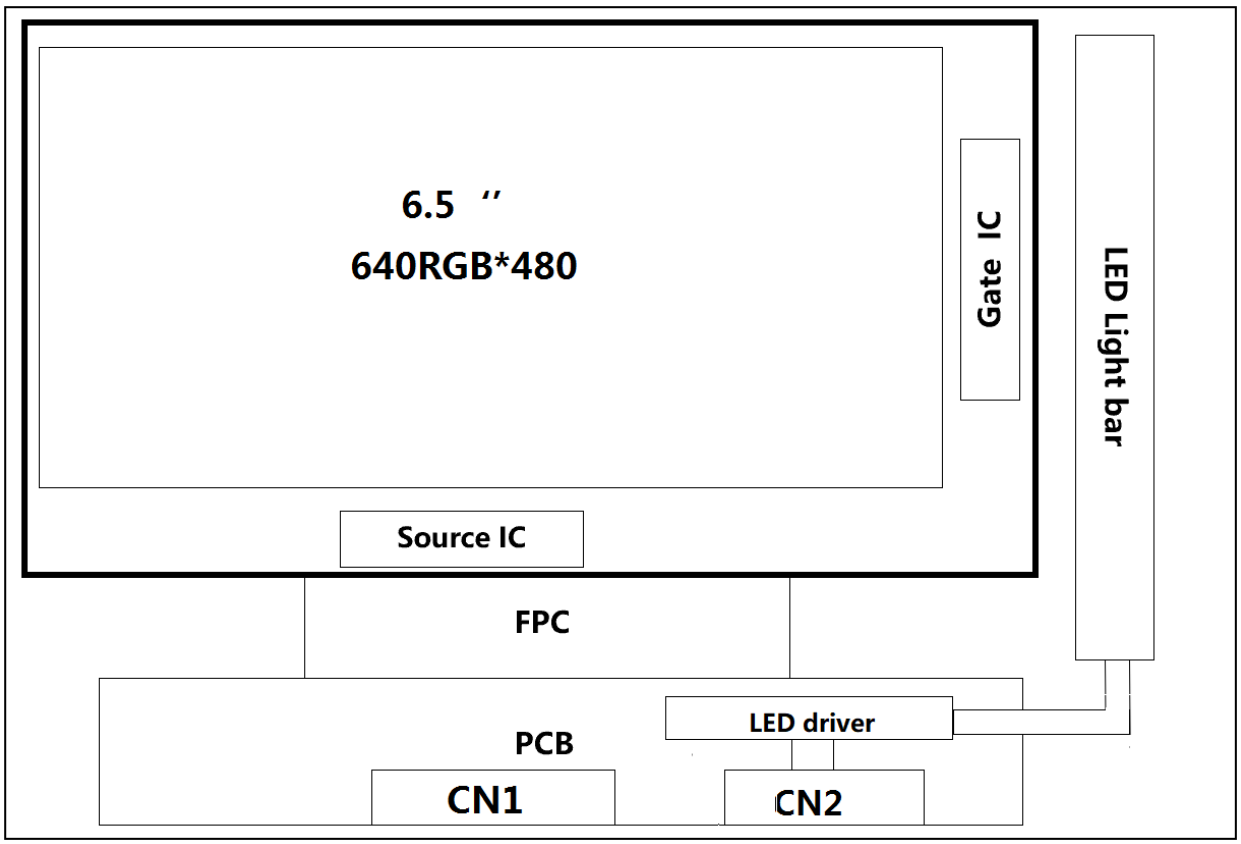


Figure 5.3.1 LCD Module Block Diagram

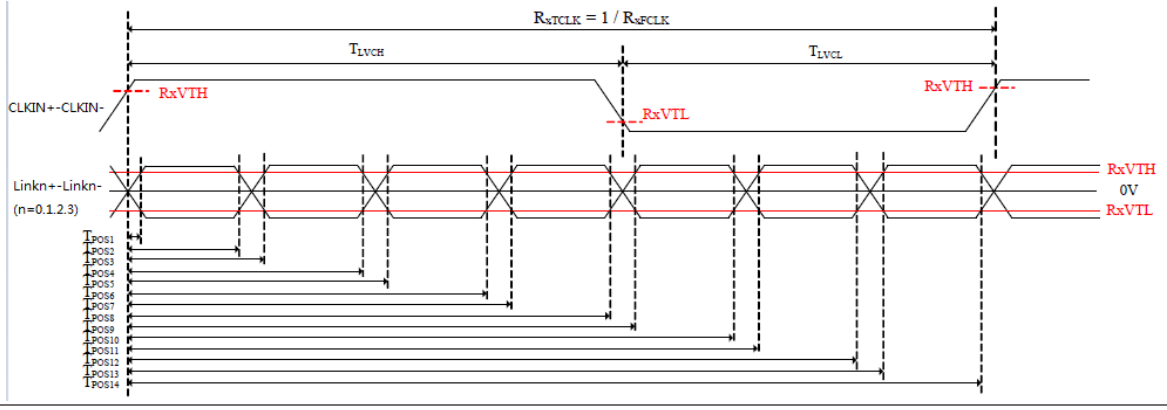
6. Interface Timing Characteristics

6.1 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 6.1.1 LVDS AC Electrical Characteristics



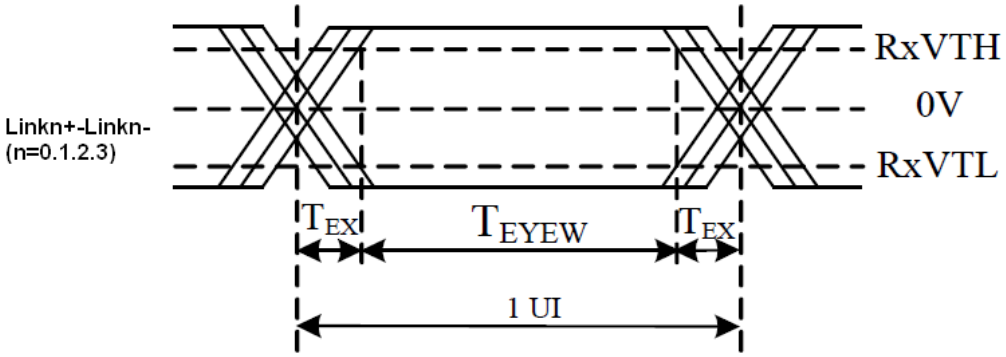


Figure 6.1.1 Clock and Data Input Timing Diagram

6.2 LVDS DC Electrical Characteristics

Parameter	Symbol	Min.	Typ.	Max.	Unit	Remark
Differential input high Threshold voltage	R_{XVTH}	-	-	0.1	V	
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-|VID|/2	V	
Differential input voltage	$\|V_{ID}\|$	0.2	0.4	0.6	V	
Differential input leakage current	RVxliz	-10	-	10	uA	

Table 6.2.1 LVDS DC Electrical Characteristics

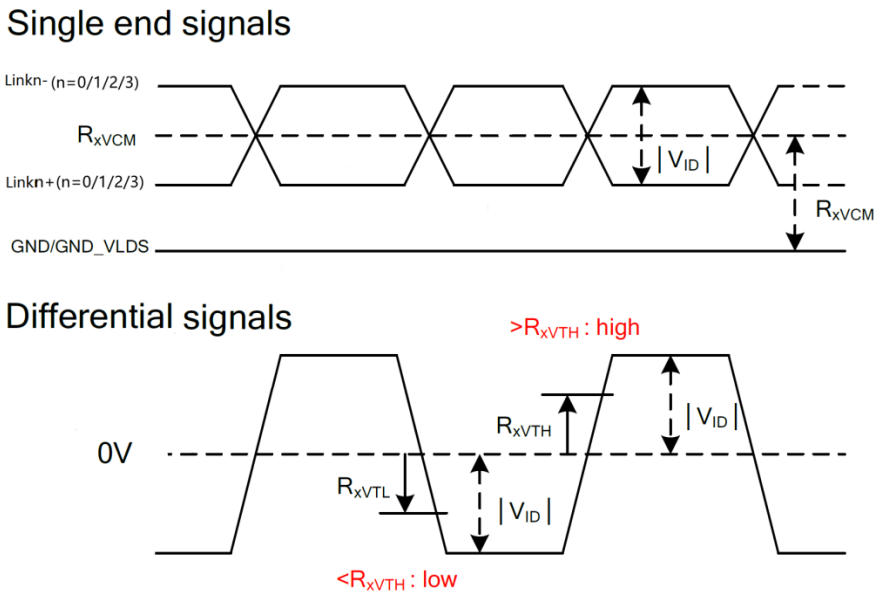


Figure 6.2.1 LVDS DC Electrical Characteristics

6.3 Data Input Timing Parameter Setting

TCON (Embedded In Source IC) Input Timing (DCLK, HSYNC, VSYNC, DE)

VCC=3.3V, GND=0V, Ta=25℃

Parameter	Symbol	Min	Typ	Max	Unit	Remark
CLKIN+/- frequency	F_{dclk}	-	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	

Note 1: DE mode, HSYNC&VSYNC is unnecessary.

Table 6.3.1 Data Input Timing Parameters

6.4 TCON Vertical Input Timing Diagram HV

Horizontal input timing

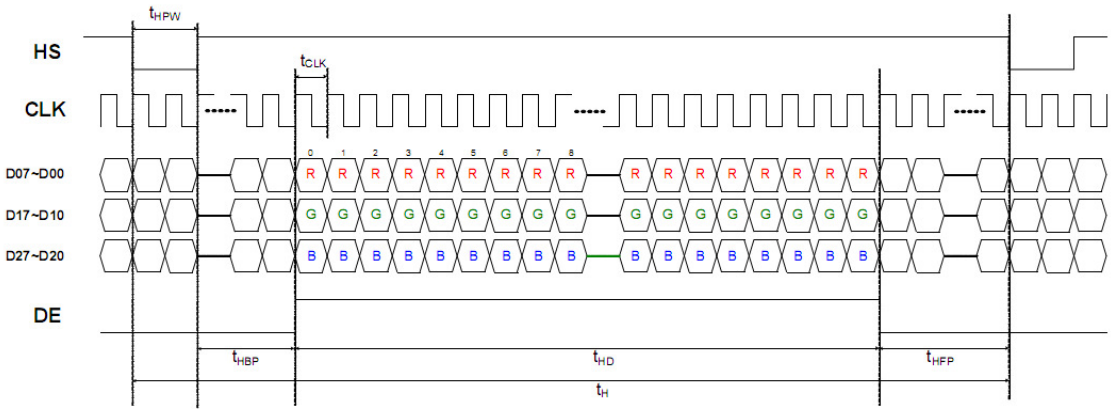


Figure 6.4.1 Horizontal input timing

Vertical input timing

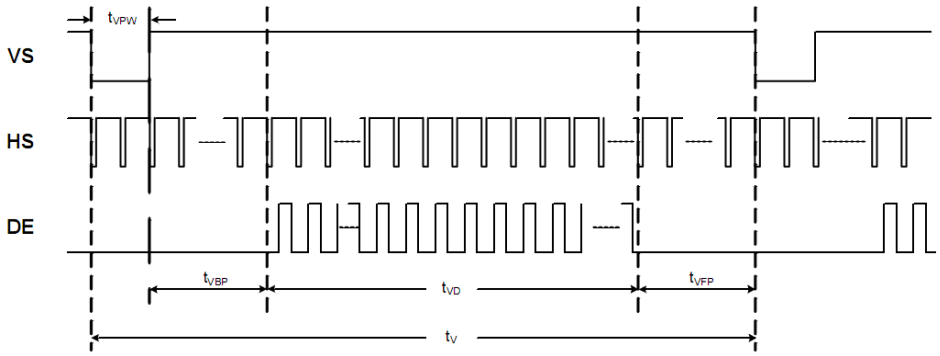


Figure 6.4.2 Vertical input timing

6.5 LVDS Data Mapping

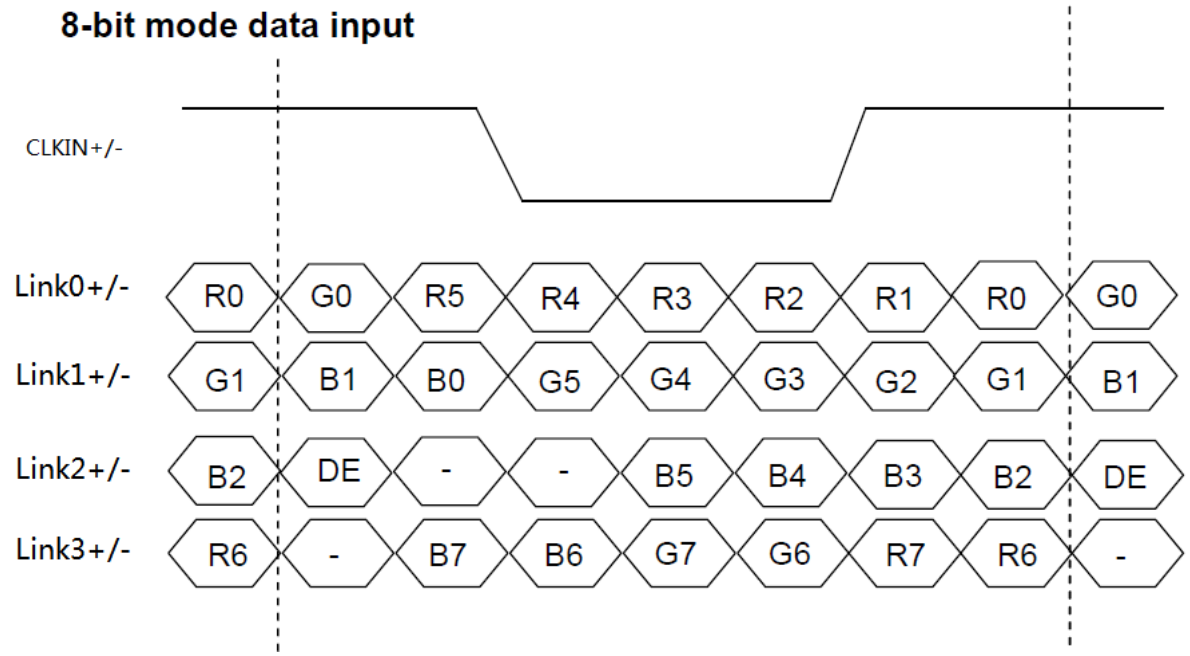


Figure 6.5.1 LVDS 8bit(Mode=H)

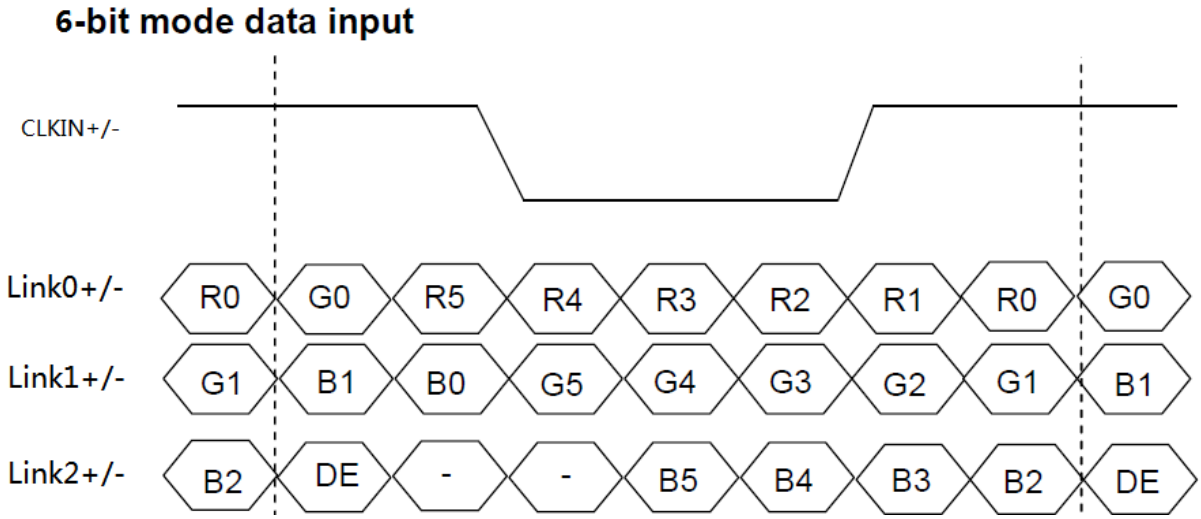


Figure 6.5.2 LVDS 6bit(Mode=L)

6.6 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/OFF pull-H	TP3	200	-	-	ms	
PWM DIM on to LED ON/OFF on	Tp4	0	-	200	ms	
VLED to PWM DIM on	Tp5	10	-	-	ms	
VLED on to VLED stable	Tp6	0.5	-	10	ms	
VCC off time	Tp7	0.5	-	10	ms	
VCC off to next VCC on	Tp8	2000	-	-	ms	
LVDS Signal off before VCC off	Tp9	123	-	500	ms	
LED ON/OFF off before signal off	Tp10	200	-	-	ms	
LED ON/OFF off before PWM DIM off	Tp11	0	-	200	ms	
PWM DIM off before VLED off	Tp12	10	-	-	ms	

Table 6.6 Power on/off sequence

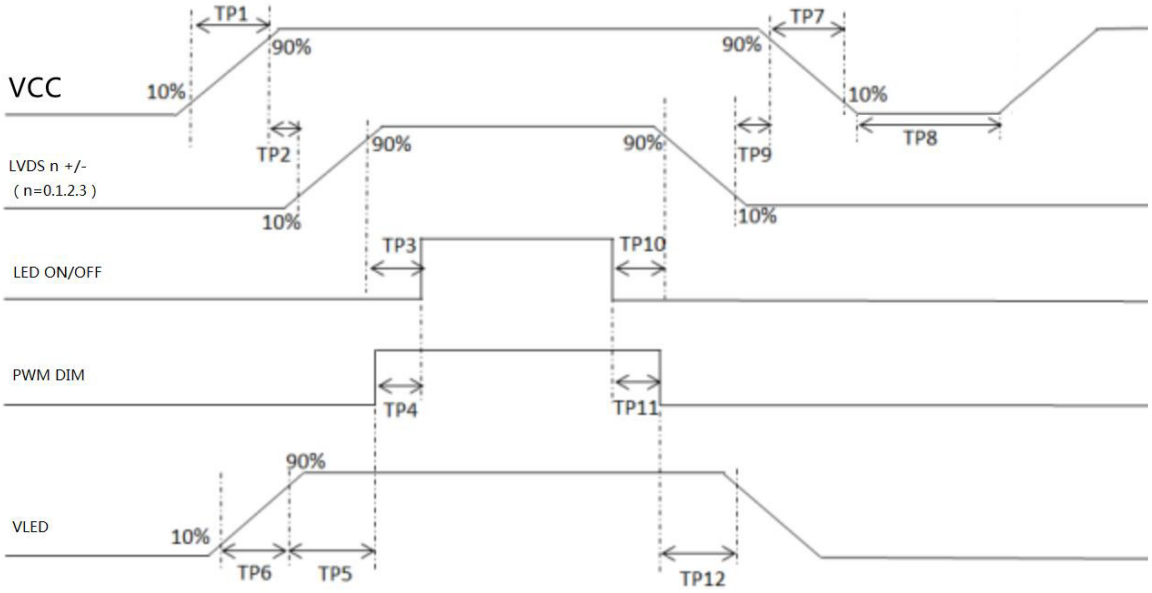


Figure 6.6 Power On/Off Sequence

7. Optical Characteristics

Item		Symbol	Condition	Min	Typ	Max	Unit	Remark
View Angles		θT	CR≧10	75	88	-	degree	Note2,3
		θB		75	88	-		
		θL		75	88	-		
		θR		75	88	-		
Contrast Ratio		CR	θ=0°	600	900	-		Note 3
Response Time		T_{ON}	25℃	-	25	35	ms	Note 4
		T_{OFF}						
Chromaticity	**White**	x	Backlight is on	0.245	0.295	0.345		Note 1,5
		y		0.272	0.322	0.372		
	Red	x		0.580	0.630	0.680		Note 1,5
		y		0.274	0.324	0.374		
	Green	x		0.248	0.298	0.348		Note 1,5
		y		0.572	0.622	0.672		
	Blue	x		0.101	0.151	0.201		Note 1,5
		y		0.014	0.064	0.114		
Uniformity		U		75	80		%	Note 6
NTSC		-		65	70		%	Note 5
Luminance		L		600	800		cd/m^2	Note 7

Table 7.1 Optical Parameters

Test Conditions:

1. I_F= 120 mA and the ambient temperature is 25℃.
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.

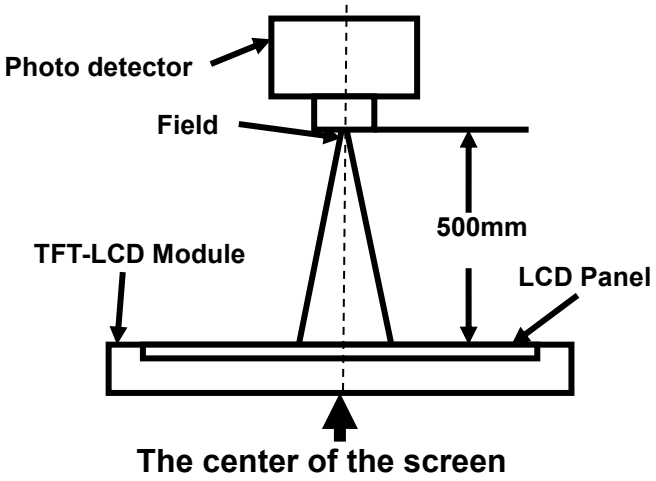


Fig1.Measurement Set Up

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

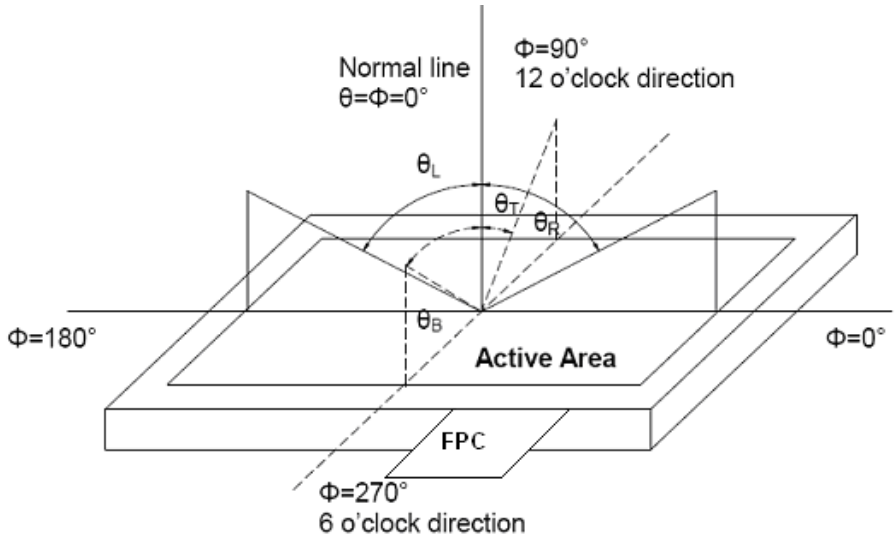


Fig2. Measurement viewing angle

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%.

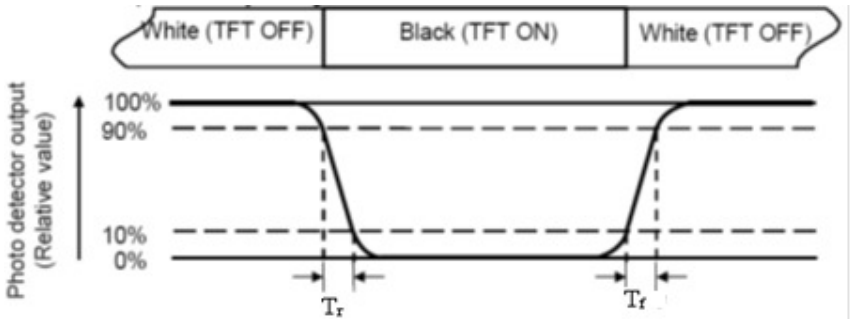


Fig3. Response Time Testing(TN)

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%.

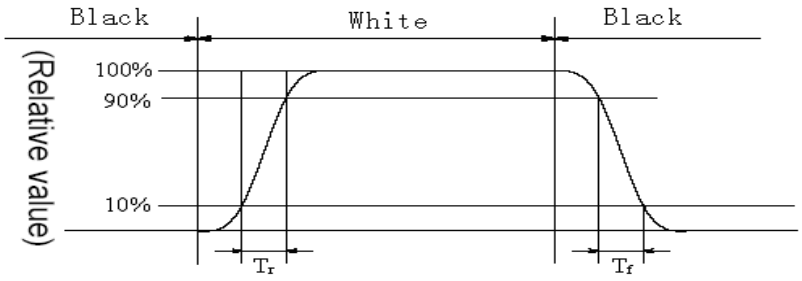


Fig4.Response Time Testing(SFT)

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

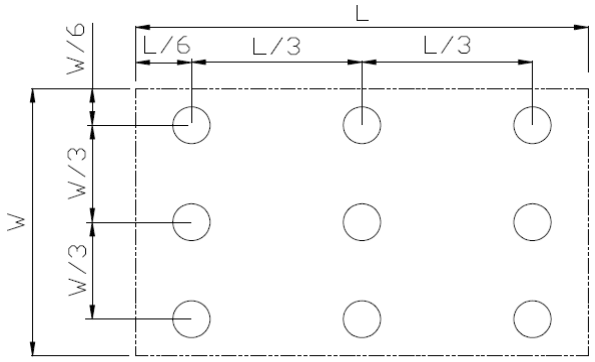


Fig5. Luminance Uniformity Measurement Locations(9 points)

Note7: Definition of Luminance:

Measure the luminance of white state at center point.

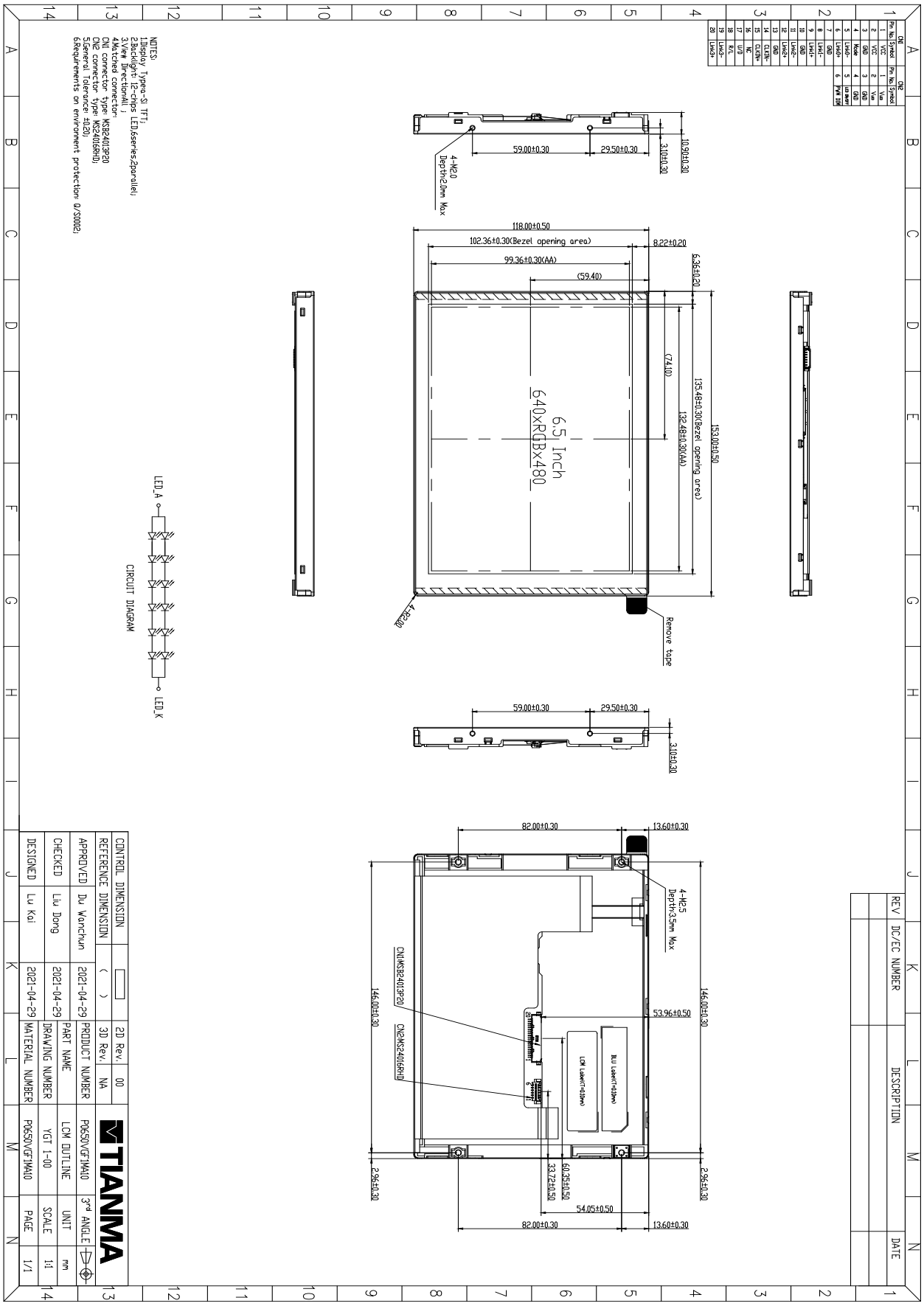
8. Reliability Test

No	Test Item	Condition	Remarks
1	High Temperature Operation	+80℃，300H	IEC60068-2-1:2007 GB2423.2-2008
2	Low Temperature Operation	-30℃，300H	IEC60068-2-1:2007 GB2423.1-2008
3	High Temperature Storage	+90℃，300H	IEC60068-2-1:2007 GB2423.2-2008
4	Low Temperature Storage	-40℃，300H	IEC60068-2-1:2007 GB2423.1-2008
5	Operation at High Temperature and Humidity	+60℃，90%RH，300H	IEC60068-2-78 :2012 GB/T 2423.3-2016
6	Thermal Shock (non-operation)	-30℃，30min~80℃，30min，change time：5min，100cycle	Start with cold temperature, End with high temperature, IEC60068-2-14:1984,GB2423.22-2002
7	ESD	C=150pF，R=330Ω，5point/panel Air：±8kv，5times； Contact：±4kv，5times； （Environment：15℃~35℃，30%~60%，86Kpa~106Kpa）	IEC61000-4-2:2001 GB/T17626.2-2006
8	Vibration Test (Non Op)	5~100HZ，19.60m/s2 1min/cycle 120times Per X\Y\Z	IEC60068-2-6:2007 GB/T 2423.10-2019
9	Mechanical Shock (Non Op)	Half Sine Wave 60G ,6ms,±X,±Y,±Z 3times for each direction	IEC60068-2-27:2008 GB/T2423.5-2019
10	Package Vibration	5-20-200HZ，PSD：0.01-0.01-0.001 Total:0.781g2/HZ, x/y/z 30min）	GB/T 4857.5-1992
11	Package Drop Test	Height: 60 cm,1 corner, 3edges, 6 surfaces	GB/T 4857.10-2005 ISO8318:2000 MOD

Table 8.1 RA test condition

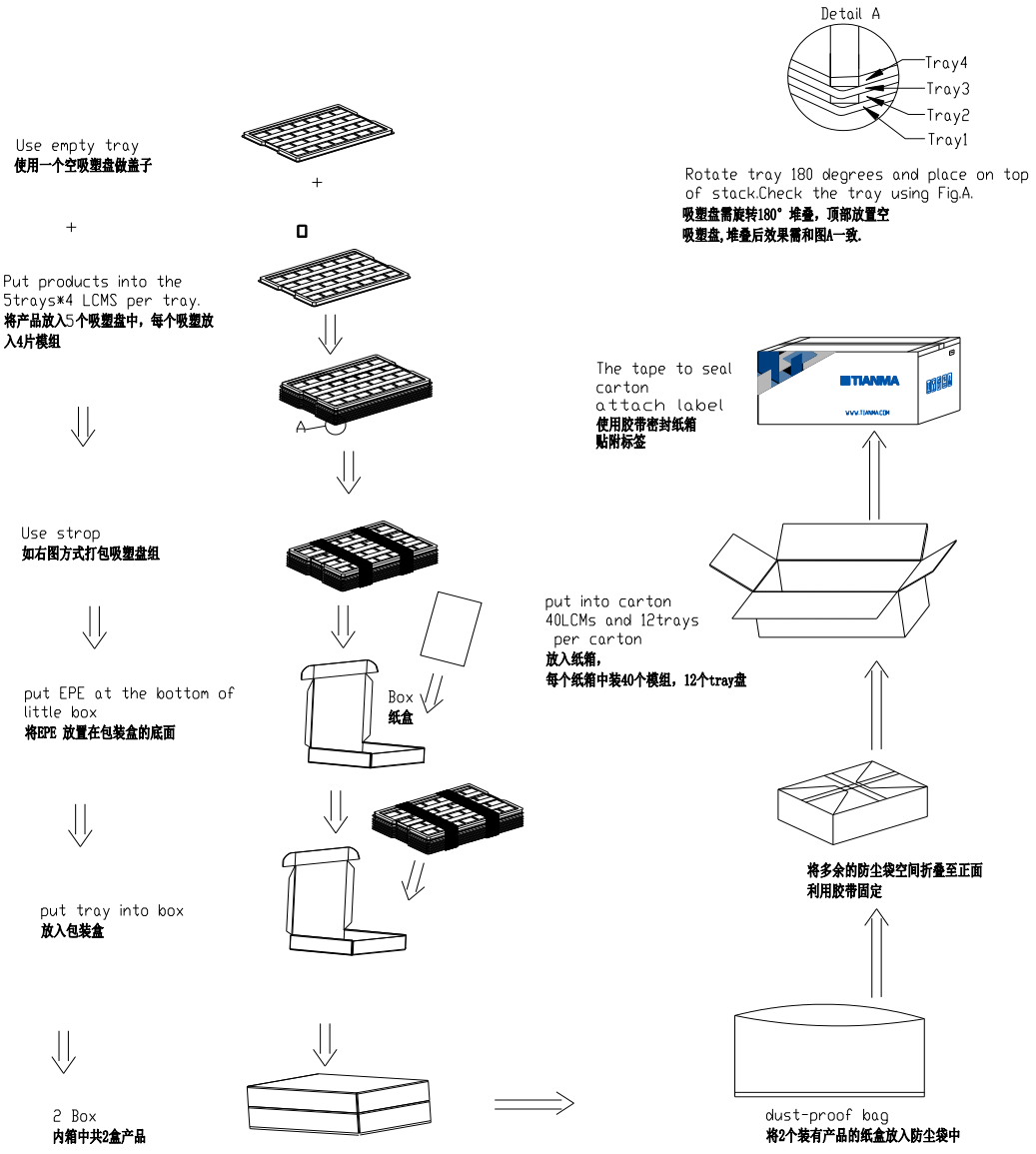
Note1: Temperature is the ambient temperature of sample
Note2: Before cosmetic and function test, the product must have enough recovery time, at least 2 hours at room temperature.
Note3: In the standard condition, there shall be no practical problem that may affect the display function. After the reliability 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 module	P0650VGF1MA10	192×122×7.5	0.1605	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	11.364±5% Kg				



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 them 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 carefully to limit or stop its function when over current is detected on the LED.

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