FORTEC
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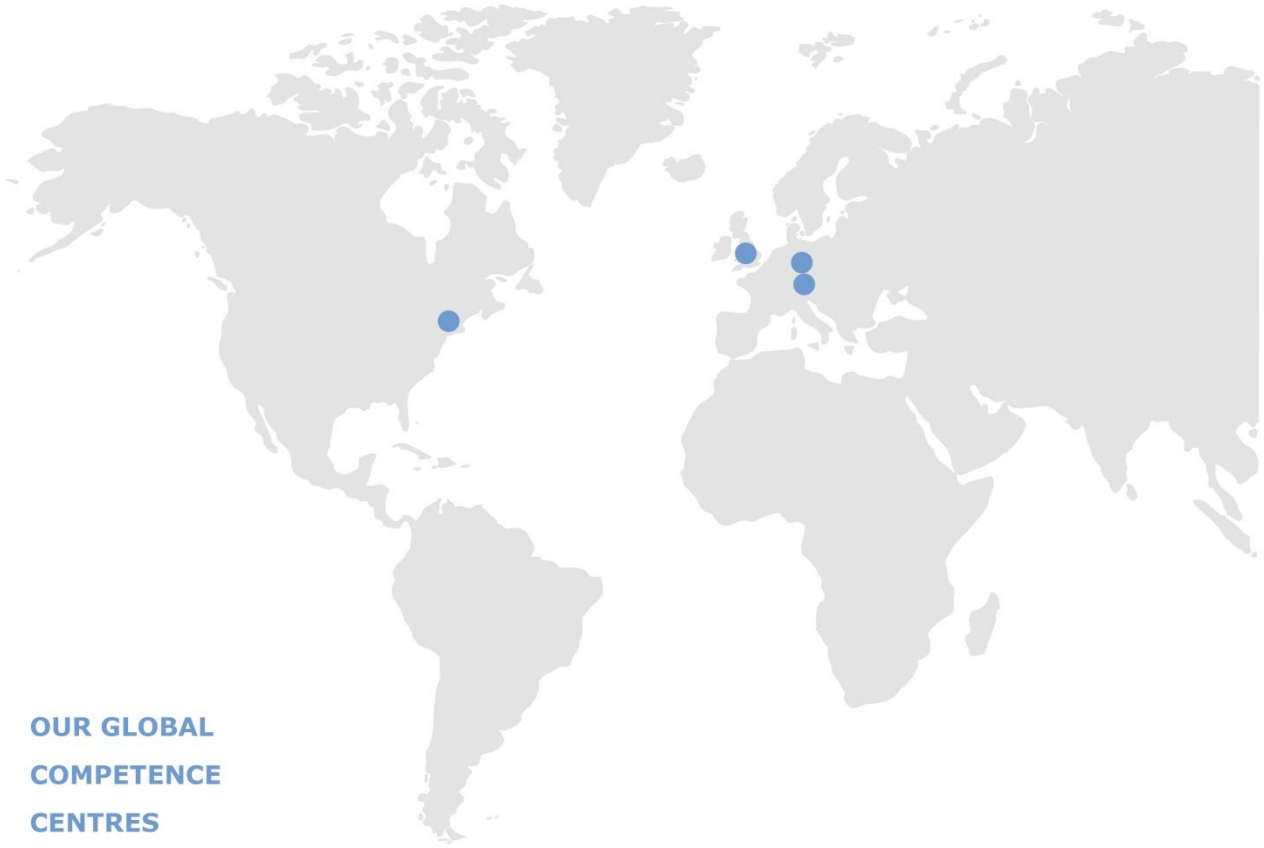

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Datasheet

Tianma

P0650VGF1MA10

TI-01-017

MODEL NO. : P0650VGF1MA10

Module version A

VERSION : Ver 1.1

ISSUED DATE: 2021-09-24

■**Preliminary Specification**

□**Final Product Specification**

Customer :

Approved by	Notes

TIANMA Confirmed :

Prepared by	Checked by	Approved by
Chunhui Yang	LongPing Deng	Jinquan Liu

This technical specification is subjected to change without prior notice.

Table of Contents

Record of Revision

Rev	Issued Date	Description	Editor
1.0	2021-03-25	Preliminary Specification Released.	Chunhui Yang
1.1	2021-09-24	Items update.	Chunhui Yang

1 General Specifications

Feature		Spec
Display Spec.	Size	6.5 inch
	Resolution	640(RGB) x 480
	Technology Type	a-Si TFT
	Pixel Pitch (mm)	0.207 (H) x 0.207(V)
	Pixel Configuration	R.G.B. Vertical Stripe
	Display Mode	SFT, Normally black
	Surface Treatment	AG
	Viewing Direction	ALL
Mechanical Characteristics	LCM (W x H x D) (mm)	153.00x 118.00 x 10.9
	Active Area(mm)	132.48×99.36
	With /Without TSP	Without Touch Screen
	Weight (g)	160.5
	Matching Connection Type	CN1: P24013P20 CN2: STM P24016
Electrical Characteristics	Interface	LVDS
	Color Depth	16.7M/262K

Note 1: Requirements on Environmental Protection: Q/S0002

Note 2: LCM weight tolerance: +/- 5%

2 Input/Output Terminals

2.1 CN1(LCD)

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

PIN	Symbol	I/O	Description	Remark
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)	Note1
18	R/L	I	Horizontal reverse (H: left to right scan L：right to left scan)	Note1
19	Link 3-	I	LVDS Receiver Signal(-)	Note2
20	Link 3+	I	LVDS Receiver Signal(+)	Note2

Table 2.1 terminal pin assignments

Note 1: Scan direction is shown as below(PCB at down side):

U/D=0 R/L=0　　U/D=1 R/L=1

Note2：When LVDS 6bit, input pin not in used connect to GND.

Note3：I---Input, O---Output, P--- Power/Ground

2.2 CN2(Backlight)

Connector type: MS24016RHD
Matching connector: STM P24016

No	Symbol	I/O	Description	Remark
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	

Table2.2 Backlight pin assignment

3 Absolute Maximum Ratings

Ta = 25℃

Item	Symbol	Min	Max	Unit	Remark
Power Voltage for LCD	VCC	-0.5	5.0	V	Note1
LVDS supply voltage	V_{LVDS}	-0.5	5.0	V	
Input voltage for LCD	Vin	-0.5	VCC+0.3	V	
Operating Temperature	TOPR	-30	+80	℃	Note2
Storage Temperature	TSTG	-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 3.1 absolute maximum rating

Note1: V_{IN} including Mode,SC data etc..
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.

4 Electrical Characteristics

4.1 Recommended Operating Condition

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	
Power supply current		IVCC	-	TBD	-	mA	
Power consumption		P	-	TBD	-	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 4.1 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

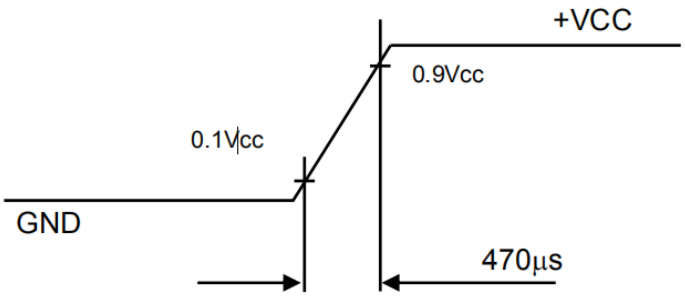


Figure4.1 Inrush current test condition

4.2 Backlight Unit Driving Condition

(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	V_F	—	18	—	V	100% Duty
LED driver forward current	I_F	—	120	—	mA	100% Duty
Backlight Power Consumption	W_{BL}	—	TBD	—	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

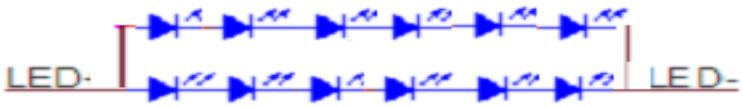
Table 4.2 Backlight Unit Driving Condition

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.

4.3 BLOCK DIAGRAM

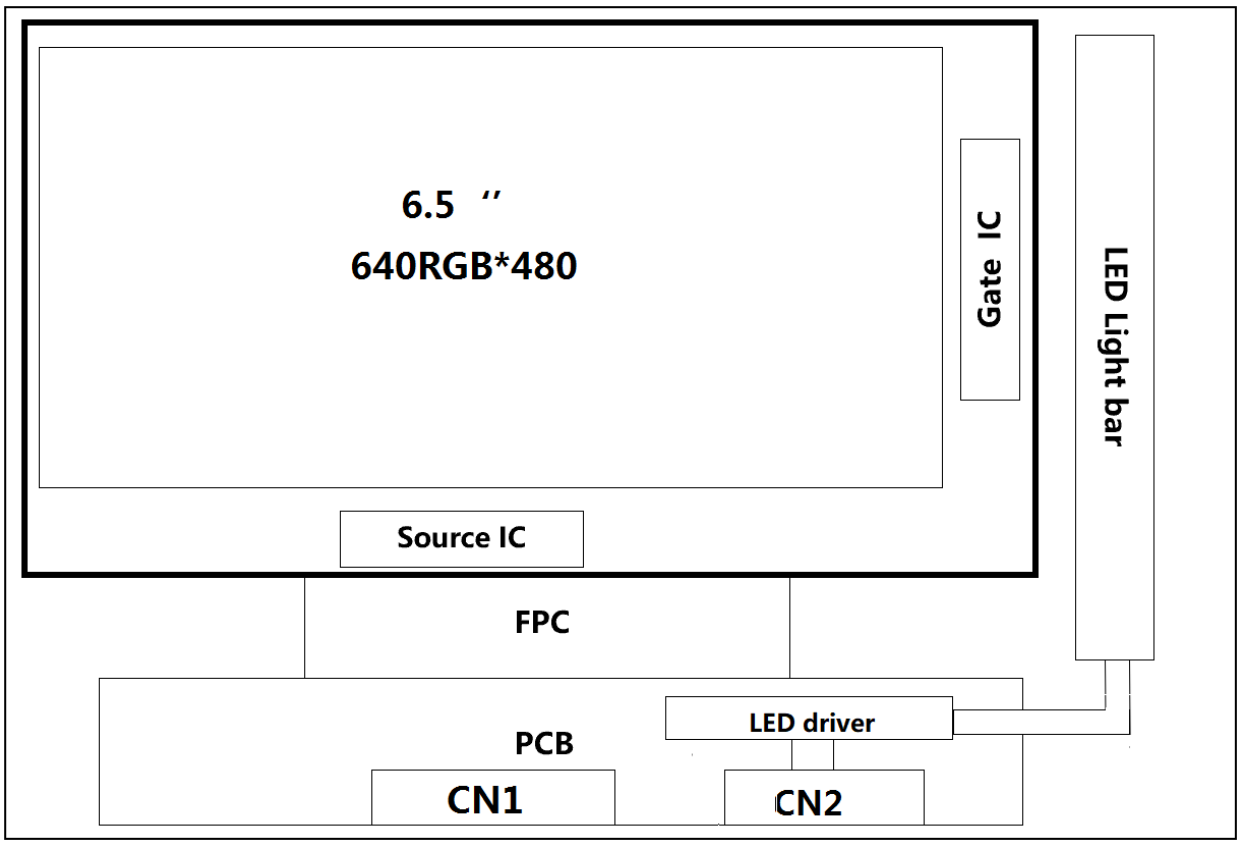


Figure4.3 Block diagram

5 Timing Chart

5.1 Input Timing

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: DE mode, HSYNC&VSYNC is unnecessary.

Table 5.1 Timing table

5.2 Timing Diagram

Horizontal input timing

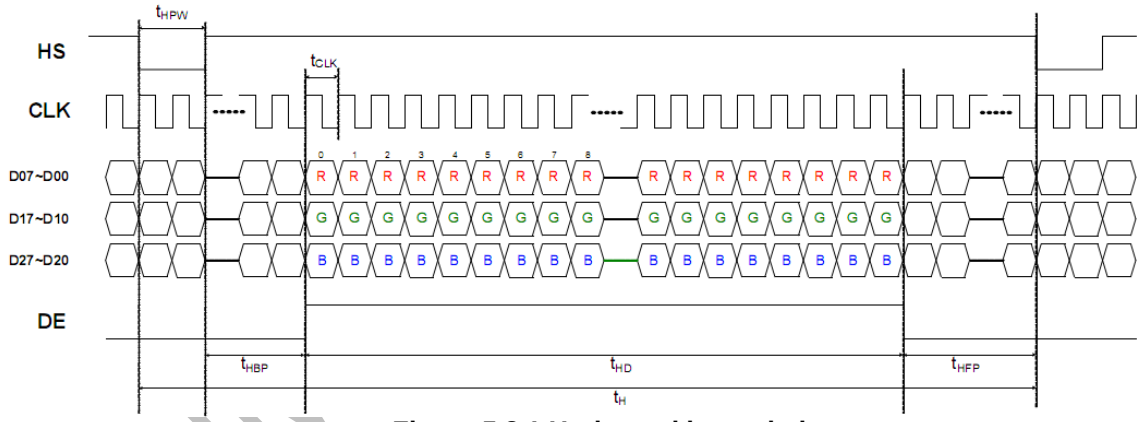


Figure 5.2.1 Horizontal input timing

Vertical input timing

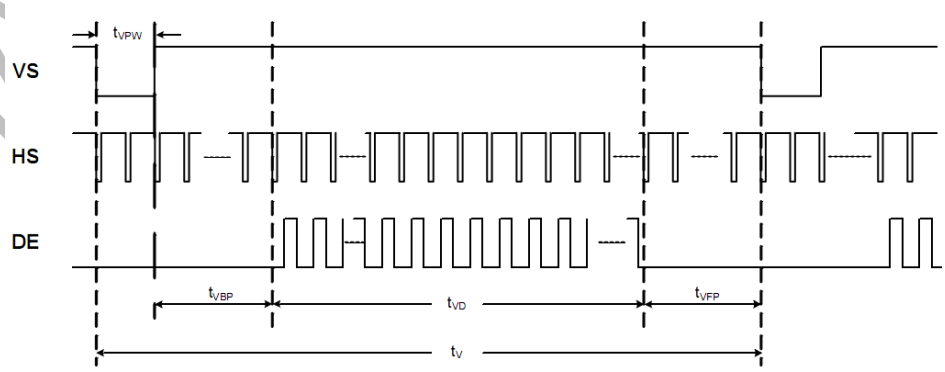


Figure 5.2.2 Vertical input timing

Note: HS/VS waveform is for reference only.

5.3 LVDS data mapping

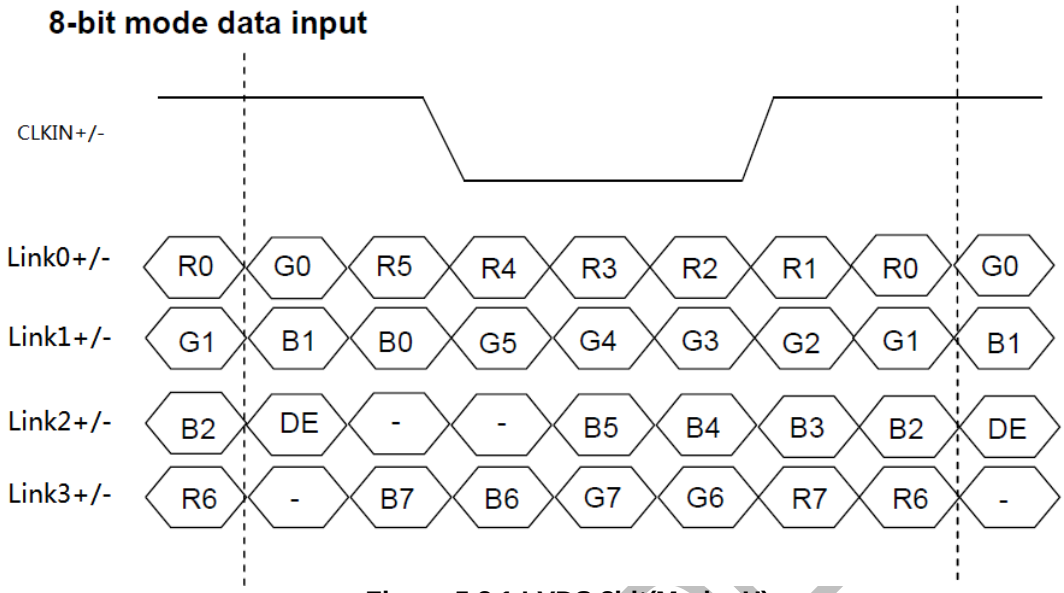


Figure 5.3.1 LVDS 8bit(Mode=H)

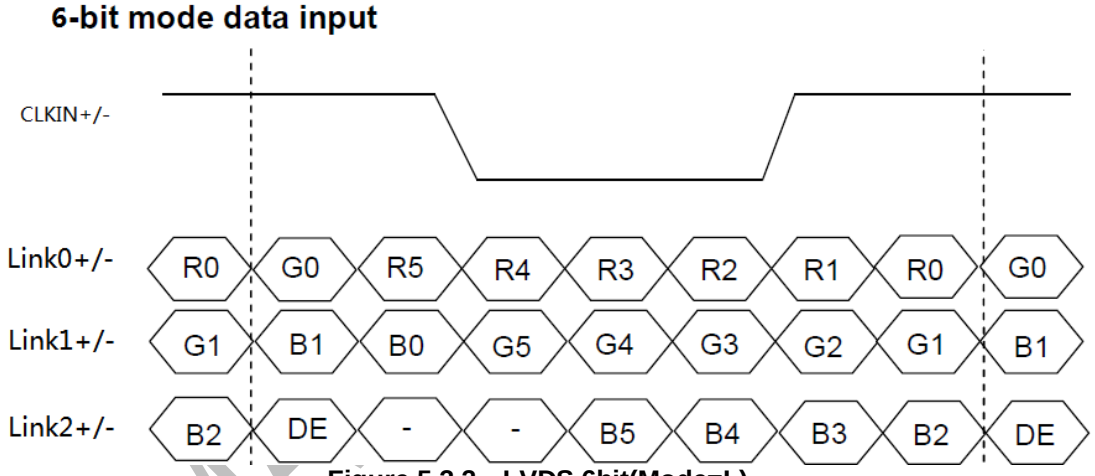


Figure 5.3.2 LVDS 6bit(Mode=L)

5.4 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	TBD（0.5）	-	TBD（10）	ms	
VCC off time	Tp7	0.5	-	10	ms	
VCC off to next VCC on	Tp8	500	-	-	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 5.4 Power on/off sequence

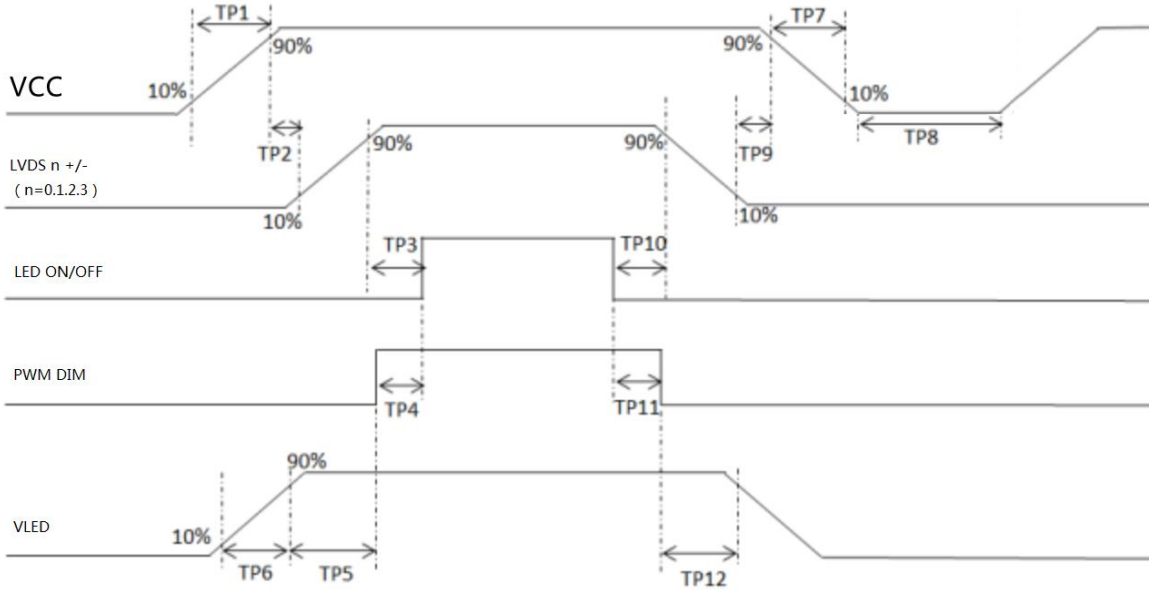


Figure 5.4 Power on/off sequence

5.5 LVDS AC Electrical Characteristics

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 5.5 LVDS AC Electrical Characteristics

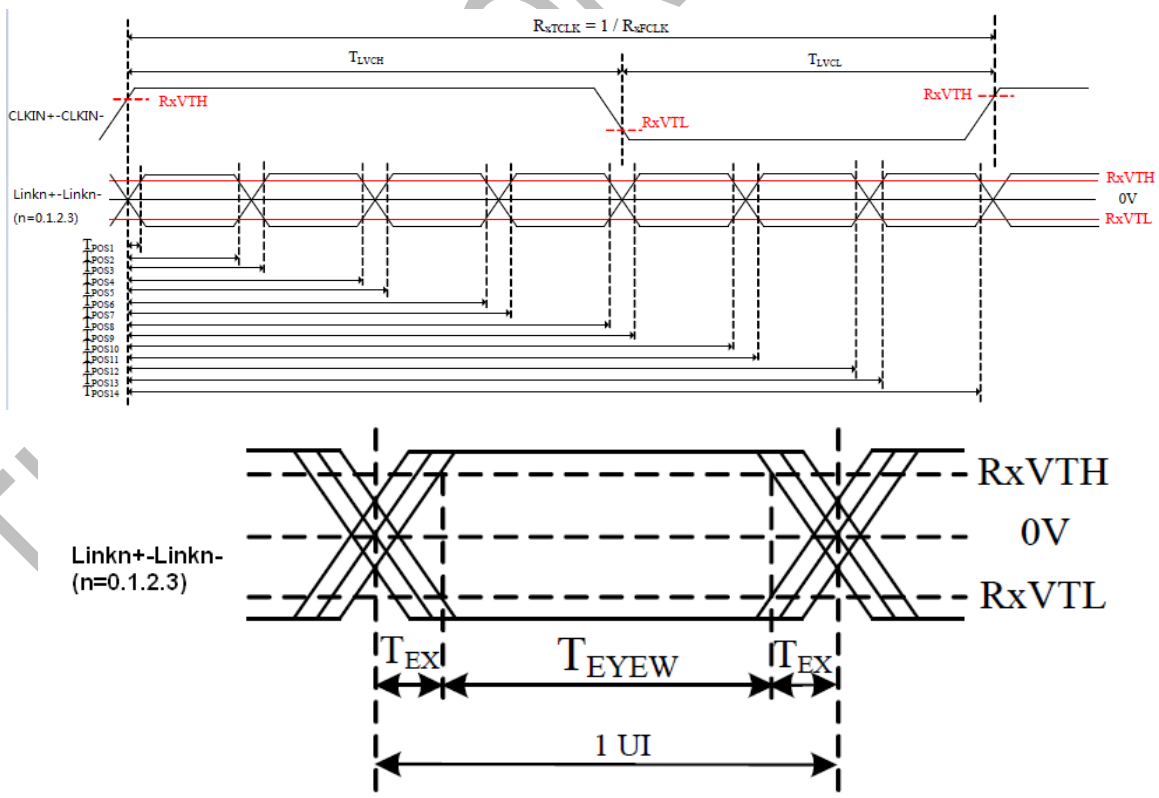


Figure 5.5 LVDS AC Electrical Characteristics

5.6 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	
LVDS Digital Operating Current	IVDD_LVDS	-	30	45	mA	
LVDS Digital Stand-by Current	ISTBD_LVDS	-	10	50	uA	

Table 5.6 LVDS DC Electrical Characteristics

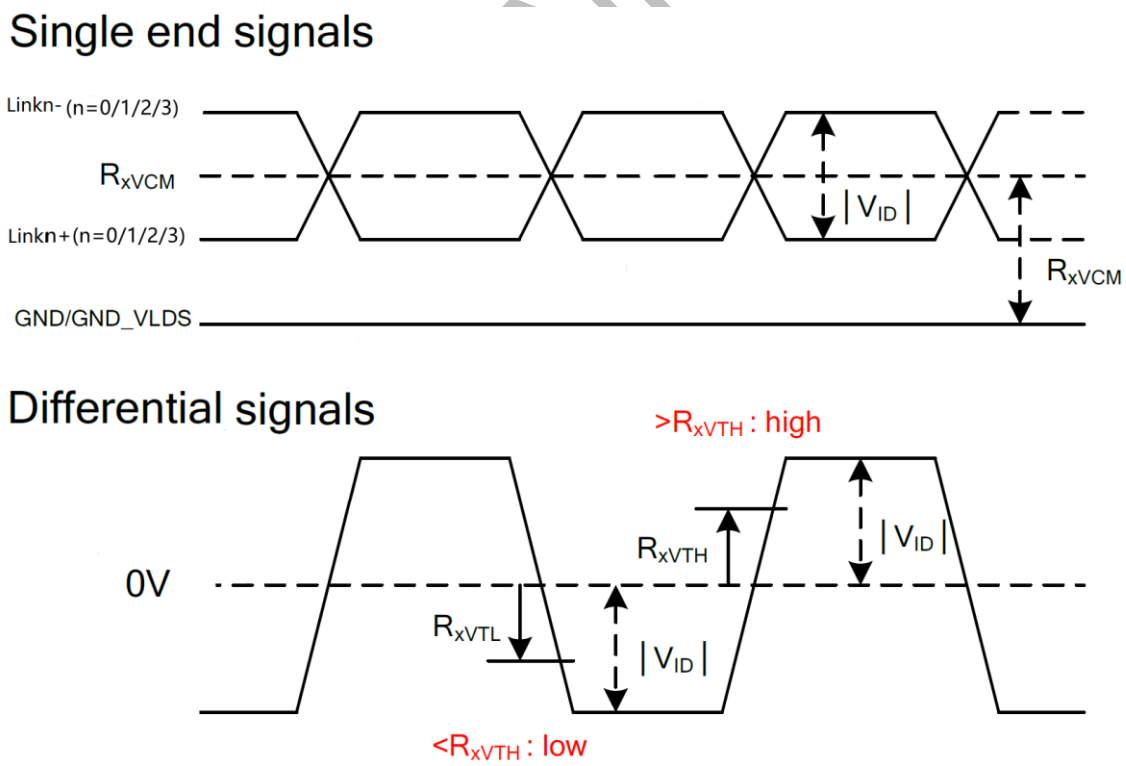


Figure 5.6 LVDS AC Electrical Characteristics

6 Optical Characteristics

Ta=25℃

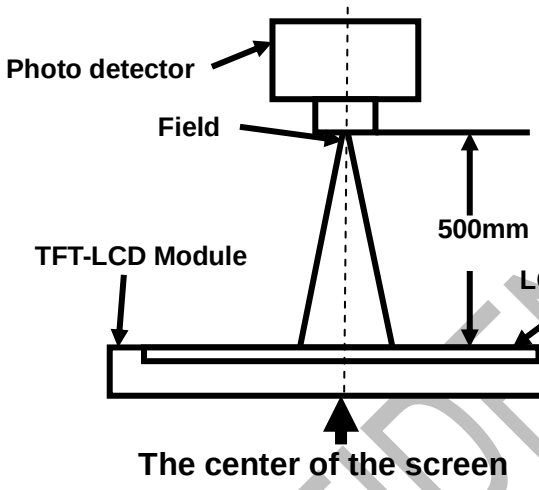
Item		Symbol	Condition	Min	Typ	Max	Unit	Remark
View Angles		θT	CR≧10	75	88	-	Degree	Note 2
		θB		75	88	-		
		θL		75	88	-		
		θR		75	88	-		
Contrast Ratio		CR	θ=0°	700	900	-		Note1 Note3
Response Time		T_{ON}	25℃	-	25	35	ms	Note1 Note4
		T_{OFF}						
Chromaticity	White	x	Backlight is on	0.245	0.295	0.345		Note1 Note5
		y		0.272	0.322	0.372		
	Red	x		0.580	0.630	0.680		
		y		0.274	0.324	0.374		
	Green	x		0.248	0.298	0.348		
		y		0.572	0.622	0.672		
	Blue	x		0.101	0.151	0.201		
		y		0.014	0.064	0.114		
Uniformity		U		75	80	-	%	Note1 Note6
NTSC				65	70	-	%	Note 5
Luminance（Without TP）		L		600	800	-	cd/m^2	Note1 Note7

Test Conditions:

1. I_F= 120 mA, and the ambient temperature is 25±2℃.humidity is 65±7%
2. The test systems refer to Note 1 and Note 2.

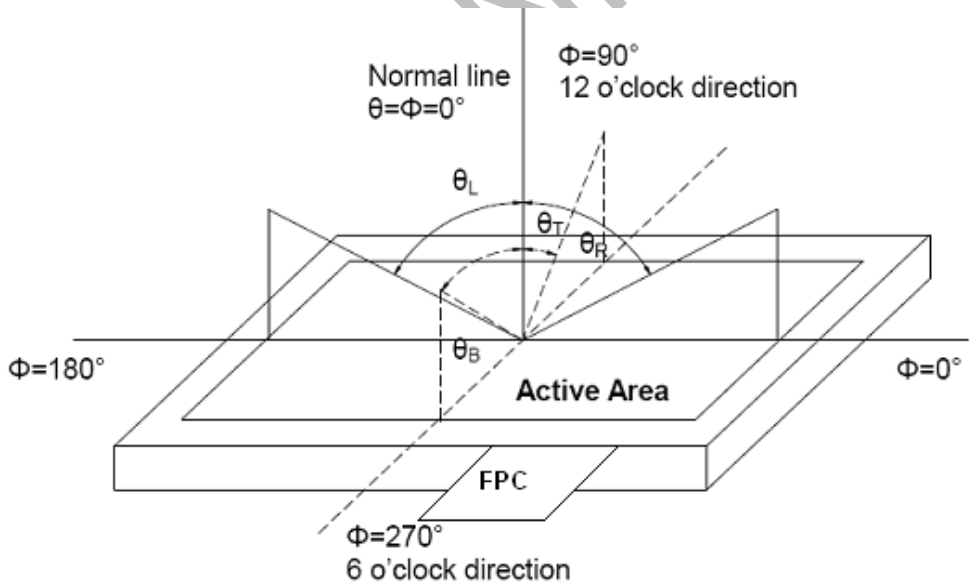
Note 1: Definition of optical measurement system.

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)。



Note 3: Definition of contrast ratio

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

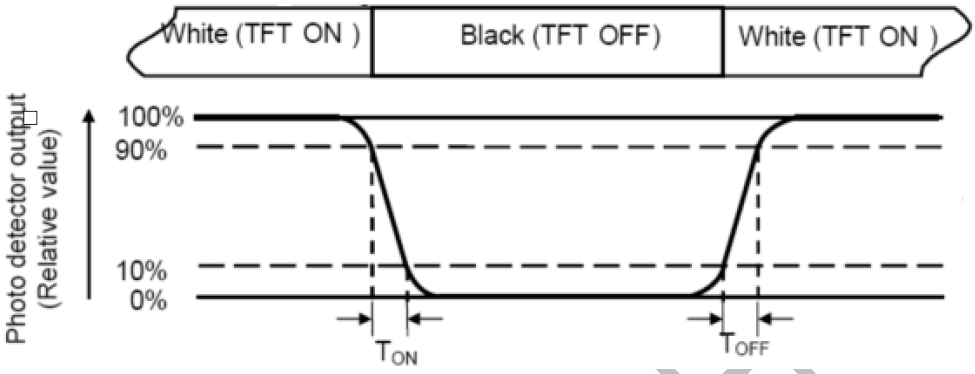
"White state ": The state is that the LCD should drive by Vwhite.

"Black state": The state is that the LCD should drive by Vblack.

Vwhite: To be determined Vblack: 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)

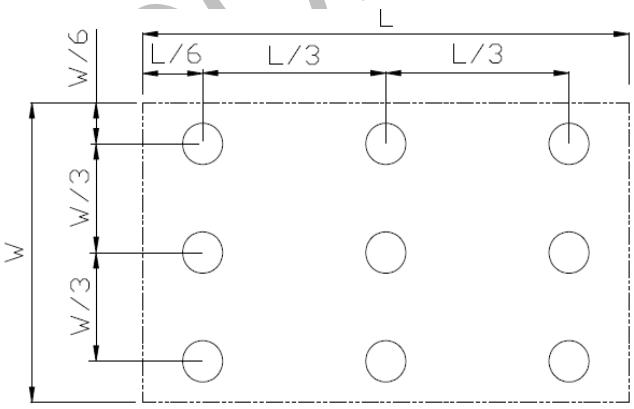
Color coordinates measured at center point of LCD.

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) = Lmin/ Lmax

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



Lmax: The measured Maximum luminance of all measurement position.

Lmin: The measured Minimum luminance of all measurement position.

Note 7: Definition of Luminance:

Measure the luminance of white state at center point.

7 Environmental / Reliability Test

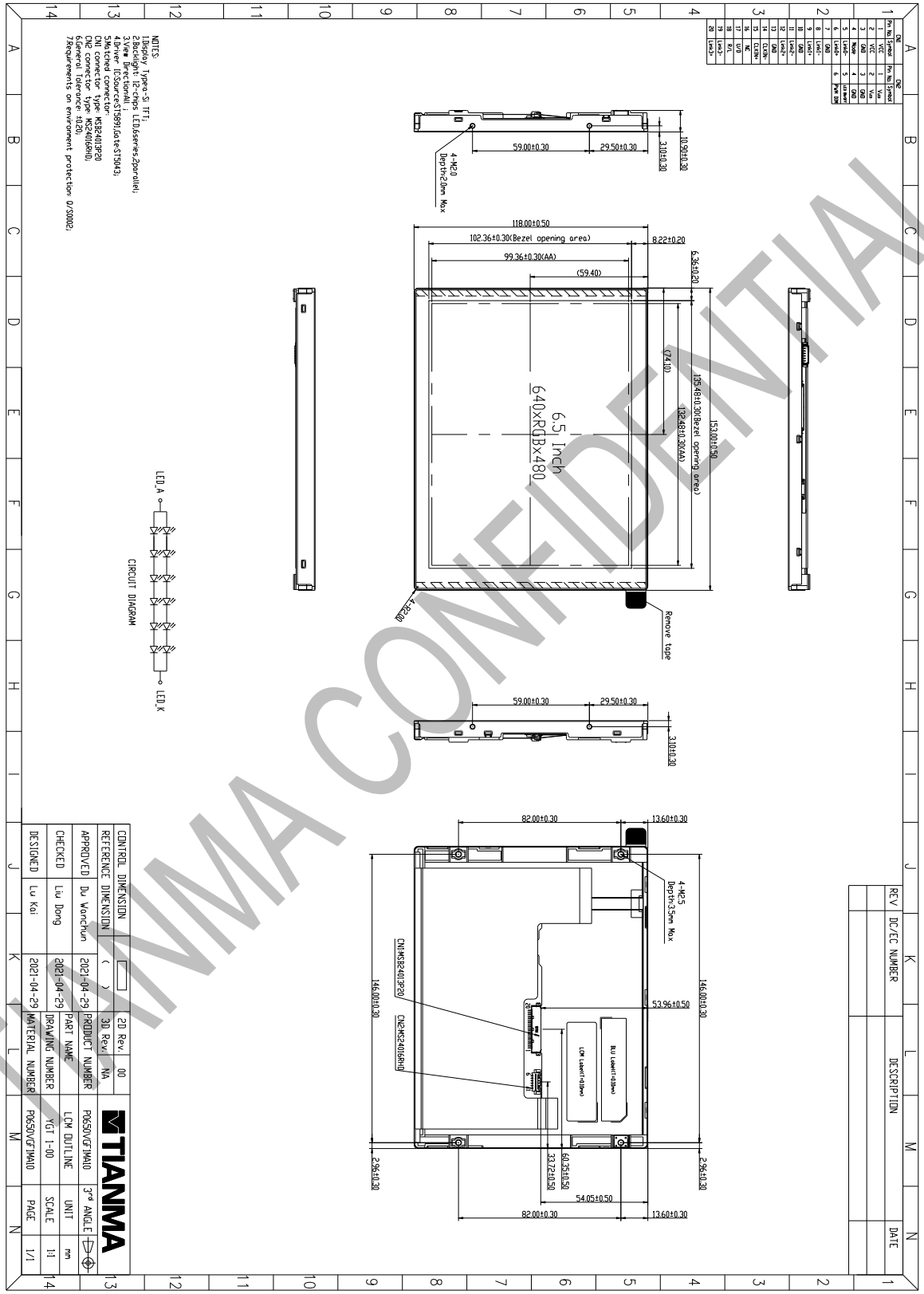
No	Test Item	Condition	Remarks
1	High Temperature Operation	Ta = +80℃, 300 hours	IEC60068-2-2:2007 GB/T 2423.2-2008
2	Low Temperature Operation	Ta = -30℃, 300 hours	IEC60068-2-1:2007 GB/T 2423.1-2008
3	High Temperature Storage	Ta = +90℃, 300 hours	IEC60068-2-2:2007 GB/T 2423.2-2008
4	Low Temperature Storage	Ta = -40℃, 300 hours	IEC60068-2-1:2007 GB/T 2423.1-2008
5	High Temperature and Humidity Operation	Ta = +60℃, 90% RH max,300hours	IEC60068-2-78 :2012 GB/T 2423.3-2016
6	Thermal Shock (non-operation)	-30℃ 30 min~+80℃ 30 min, Change time:5min, 100 Cycle	Start with cold temperature, End with high temperature, IEC60068-2-14:2009, GB/T2423.22-2012
7	ESD	C=150pF,R=330Ω,5point/panel Air:±8Kv,5times; Contact:±4Kv,5times (Environment:15℃~35℃, 30%~60%.86Kpa~106Kpa)	IEC61000-4-2:2008 GB/T17626.2-2018
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 Drop Test	Height:60cm, 1corner,3edges,6surfaces	GB/T 4857.10-2005 ISO8318:2000 MOD
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 4857.5-1992

Note1: Ta is the ambient temperature of samples.

Note2: Before cosmetic and function test, the product must have enough recovery time, at least 24 hours at room temperature.

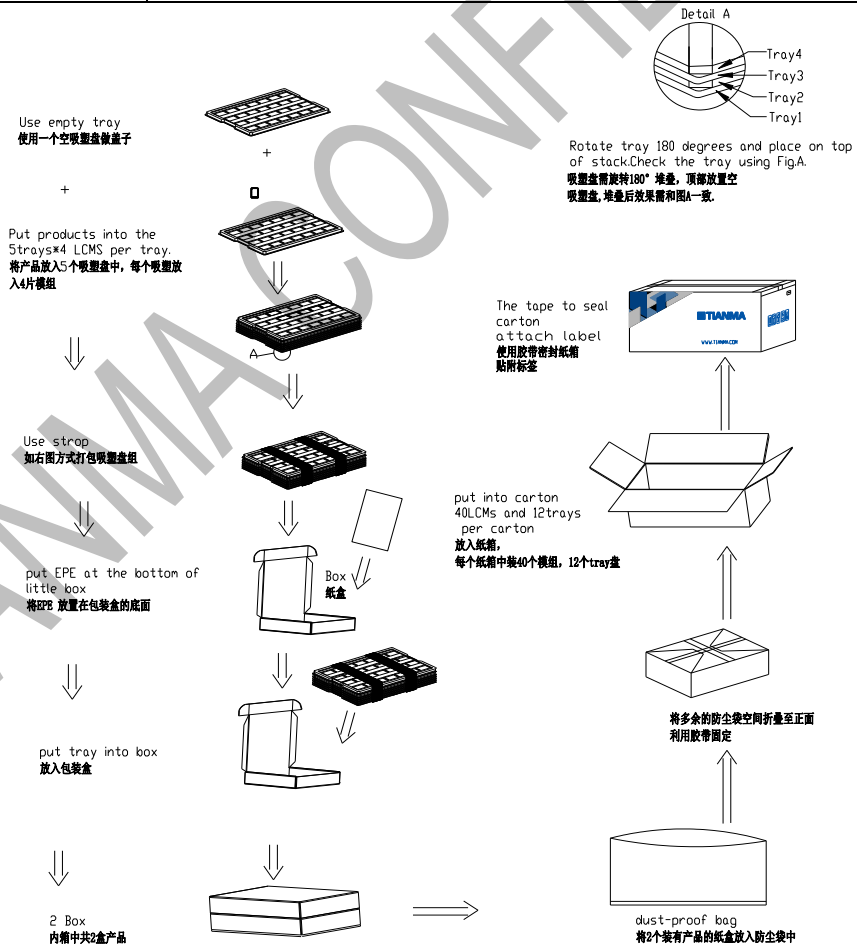
Note3: In the standard condition, there shall be no practical problem that may affect the display function. After the reliability test, the product only guarantees operation, but don't guarantee all of the cosmetic specification.

8 Mechanical Drawing



9 Packing drawing

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		100×52	0.001	1	
8	Total weight	11.364±5% Kg				



10 Precautions for Use of LCD Modules

10.1 Handling Precautions

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

10.1.2 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.

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

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

10.1.5 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

10.1.6 Do not attempt to disassemble the LCD Module.

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

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

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

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

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

10.1.8.4 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.

10.2 Storage precautions

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

10.2.2 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%

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

10.3 Transportation Precautions

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

Our company network supports you worldwide with offices in Germany, Austria, Switzerland, the UK and the USA. For more information please contact:

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