SPECIFICATION

[ ] Preliminary Specification
[◉] Final Specification

Description **8.0” 1280(RGB)x720 TFT-LCD Module**

Part Number **A0800WXF1MB00**

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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	2021/08/20		Preliminary spec	Bin Wang
1.1	2022/04/12		Update Preliminary spec	Bin Wang
2.0	2022/06/20		Final spec	Bin Wang

CONTENTS

1. Features

1.1 General Description

This is an 8.0 inch Amorphous-TFT-LCD (Thin Film Transistor Liquid Crystal Display) Normally Black technology module, which is composed of a TFT-LCD panel, LCD Driver IC ， FPC and a LED backlight unit. It is designed for Automotive and other high reliability electronic products and complies with the *RoHS* environmental protection directive.

1.2 Features

- Ultra-wide viewing angle (Super Fine TFT (SFT)
- High luminance typ：1200nits
- Interface: LVDS
- Compliant with the European RoHS Directive (2011/65/EU) and Delegated Directive (2015/863/EU,Amending Annex II of 2011/65/EU)
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2. General Specifications

Feature		Spec	Unit
Display Spec	Size	8.0 inch	
	Resolution	1280(RGB)x720	
	Pixel Pitch	0.138 x 0.138	mm
	TFT Active Area	176.64 x 99.36	mm
	Technology Type	a-Si	
	Pixel Configuration	R.G.B Vertical Stripe	
	Display Mode	Normally Black SFT technology	
	Surface Treatment	HC	
	Viewing Direction	All	
	Gray Scale Inversion Direction	No gray inversion.	
Mechanical Characteristics	LCM (W x H x D)	192.8x116.9x6.4	mm
	Weight	186±5%	g
Optical Characteristics	Luminance	Min：850 Typ：1200	cd/m^2
	Contrast Ratio	Min: 900:1 Typ:1300:1	
	NTSC	Typ:73	%
	Viewing Angle	88/88/88/88	degree
Electrical Characteristics	Interface	LVDS	
	Color Depth	16.7 Million	color
	Power Consumption	LCD:1.0725 Backlinght:6.588	W

Table 2.1 General TFT Specifications

Note 1: Requirements on Environmental Protection: Q/S0002.
Note 2: The height dimension does not include the length of FPC.
Note 3: LCM weight tolerance: ±5%.

3. Input / Output Terminals

3.1 CN1 Pin assignment (LCD Interface)

Connector Information	
Matching connector	FH28D-30S-0.5SH (Hirose)

Table 3.1.1 Connector information

No	Symbol	I/O	Description	Remark
1	NC	N	Keep this pin open.	
2	VDD	P	Power supply 3.3V(Typ)	
3	VDD	P	Power supply 3.3V(Typ)	
4	GND	P	Power Ground	
5	RESET	I	Reset signal	
6	STBYB	I	Standby mode control signal	
7	GND	P	Power Ground	
8	SDA	N	Only for Tianma OTP use, Keep this pin open	
9	SCL	N	Only for Tianma OTP use, Keep this pin open	
10	CSB	N	Only for Tianma OTP use, Keep this pin open	
11	GND	P	Power Ground	
12	UD	I	Vertical shift direction selection	
13	RL	I	Horizontal shift direction selection	
14	GND	P	Power Ground	
15	LV0N	I	Negative LVDS Differential data input(0)	
16	LV0P	I	Positive LVDS Differential data input(0)	
17	GND	P	Power Ground	
18	LV1N	I	Negative LVDS Differential data input(1)	
19	LV1P	I	Negative LVDS Differential data input(1)	
20	GND	P	Power Ground	
21	LV2N	I	Negative LVDS Differential data input(2)	
22	LV2P	I	Positive LVDS Differential data input(2)	
23	GND	P	Power Ground	
24	CLKN	I	Negative LVDS Differential clock input	
25	CLKP	I	Positive LVDS Differential clock input	
26	GND	P	Power Ground	
27	LV3N	I	Negative LVDS Differential data input(3)	
28	LV3P	I	Positive LVDS Differential data input(3)	
29	GND	P	Power Ground	
30	VDDOTP	N	Power input for OTP programming, Keep this pin open	

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: Description of Scan Direction.

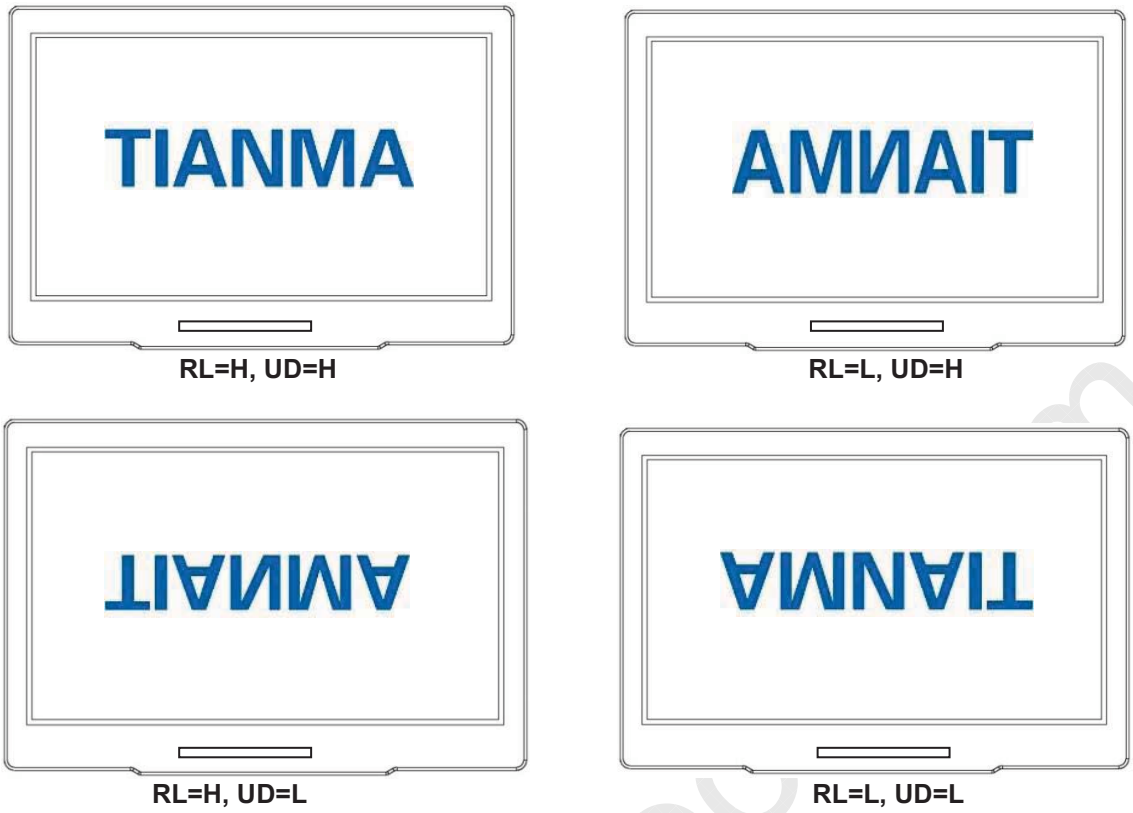


Figure 3.1.1 Description of Scan Direction

3.2 CN2 Pin assignment (Back Light)

Connector Information	
Matching connector	FH28-10S-0.5SH Hirose

Table 3.2.1 Connector information

No	Symbol	I/O	Description	Remark
1	A1	P	LED Anode	
2	A2	P	LED Anode	
3	A3	P	LED Anode	
4	NC	N	Keep this pin open	
5	THER+	I/O	Thermistor +	
6	THER-	I/O	Thermistor -	
7	NC	N	Keep this pin open	
8	C3	P	LED Cathode	
9	C2	P	LED Cathode	
10	C1	P	LED Cathode	

Table 3.2.1 Pin Assignment for Back Light 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.

4. Absolute Maximum Ratings

Item	Symbol	MIN	MAX	Unit	Remark
Power Voltage	VDD	-0.3	5.0	V	Note1
Operating Temperature	Top	-30	85	℃	
Storage Temperature	Tst	-40	85	℃	
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

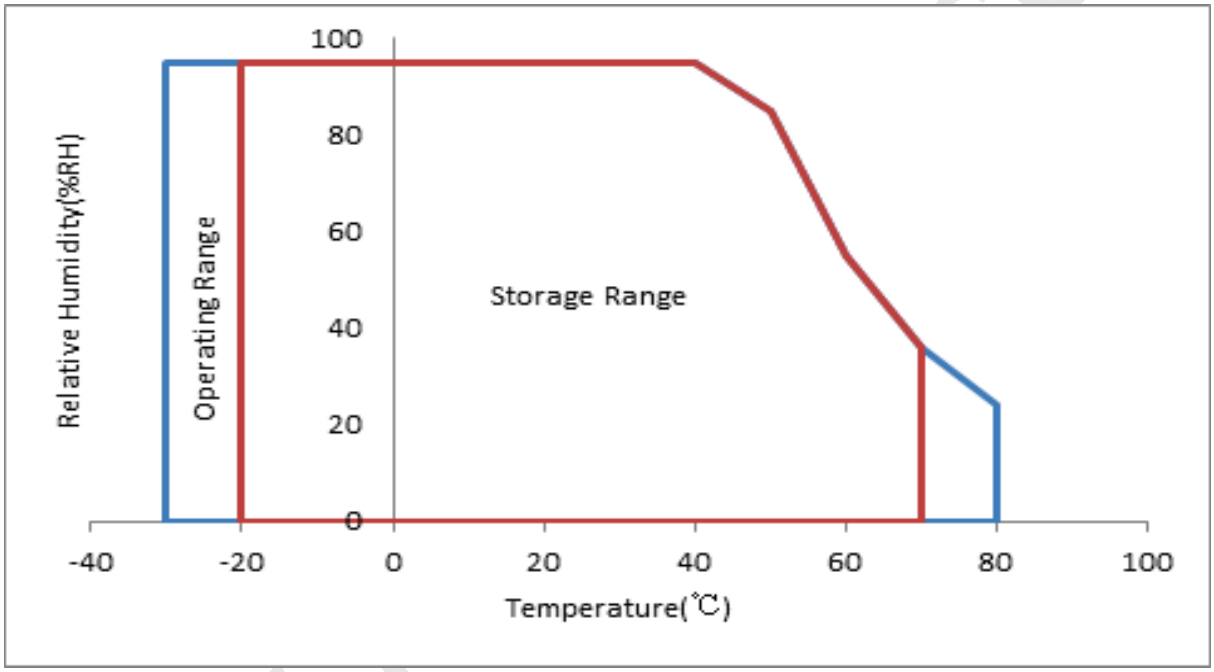


Table 4.2 Absolute Maximum Ratings chart

Note1: 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.

Note2: 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

GND=0V, Ta = 25℃

Item	Symbol	MIN	TYP	MAX	Unit	Remark
Logic supply voltage	VDD	3.0	3.3	3.6	V	
VDD Current	Ivdd	-	325	-	mA	
Permissible Ripple Voltage of VDD	Vr			100	mV	
Input High Voltage	V_{IH}	0.7*VDD		VDD	V	Note 1
Input Low Voltage	V_{IL}	GND		0.3*VDD	V	
Differential Input common Mode voltage	RXVCM	1	1.2	1.4	V	Note 2
Differential Input voltage	|VID|	0.1	-	(1.5-RxVCM)*2	V	
Differential Input leakage Current	RVXliz	-10	-	10	uA	
VDD Inrush current	Irush	-	-	1.5	A	Note3

Table 5.1.1 Operating Voltages

Note1: RESET, STBYB, RL, UD.
Note2: LVDS input signal electrical characteristics
Note3: Test condition of VDD Inrush current: The rise time of 10%VDD to 90%VDD is 470us.

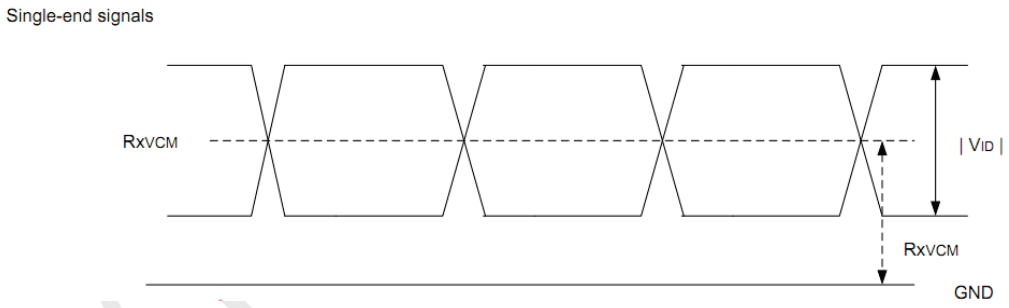


Table 5.1.2 LVDS mode DC electrical characteristics

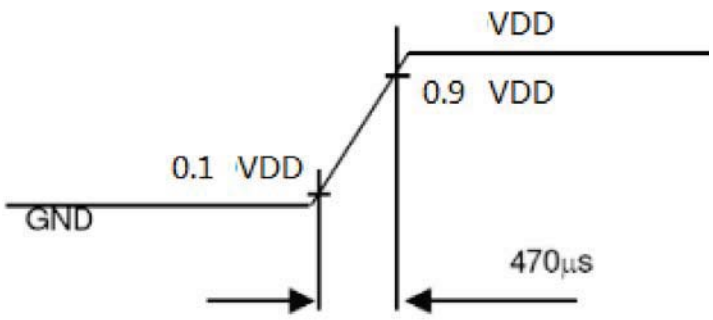


Table 5.1.3 VDD Inrush current

5.2 DC Characteristics for Backlight Driving

Item	Symbol	Min	Typ	Max	Unit	Remark
Forward Current	I_{BL}	-	120	-	mA	Note1
Forward Voltage	V_{BL}	16.8	18.3	20.4	V	Note2
Backlight Power Consumption	V_{BL}	-	6.588	-	W	Note2
Lifetime	-	30000	50000	-	Hrs	Note3

Table 5.2.1 LED Backlight Characteristics

Note1: I_F is defined for each channel.
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.

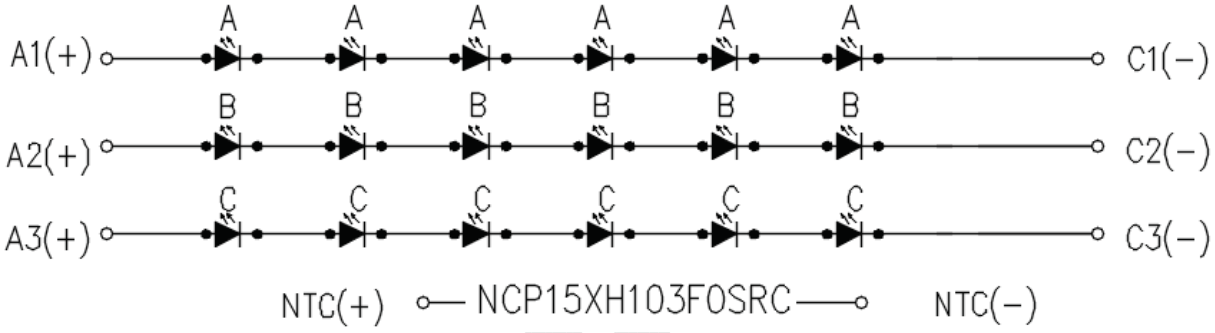


Figure 5.2.1 LED connection of backlight

Item	Value	Remarks
Part Number	NCP15XH103F0SRC	Murata
Resistance / Tolerance	10kΩ±1%	Ta=25℃
Permissive Operating Current	0.31mA	Ta=25°C Note5

Table 5.2.2 Thermistor Description

Note1: I_F is defined for one channel LEDs. There are a total of 3 LED channels in the backlight unit. While the LCM is operating, a stable forward current should be supplied. The PWM value is only for inrush current.
Note2: I_F =120mA.
Note3: Optical performance should be evaluated at Ta=25℃ only. If the LEDs are driven at high current or at high ambient temperature & high humidity environment, the lifetime of the LEDs will be reduced. Operating lifetime means the brightness will decrease to 80% of the original brightness.
Note4: An NTC thermistor is included in the LED circuit. Part number: NCP15XH103F0SRC. It is used for the measuring LED temperature and is located in the LED circuit on the backlight FPC.
Note5: To reduce the influence of NTC self-heating and improve the measurement accuracy. suggest the operating current of NTC be xx mA

Note6: When operating at high temperature, NTC resistance should not be below xx **k Ω**

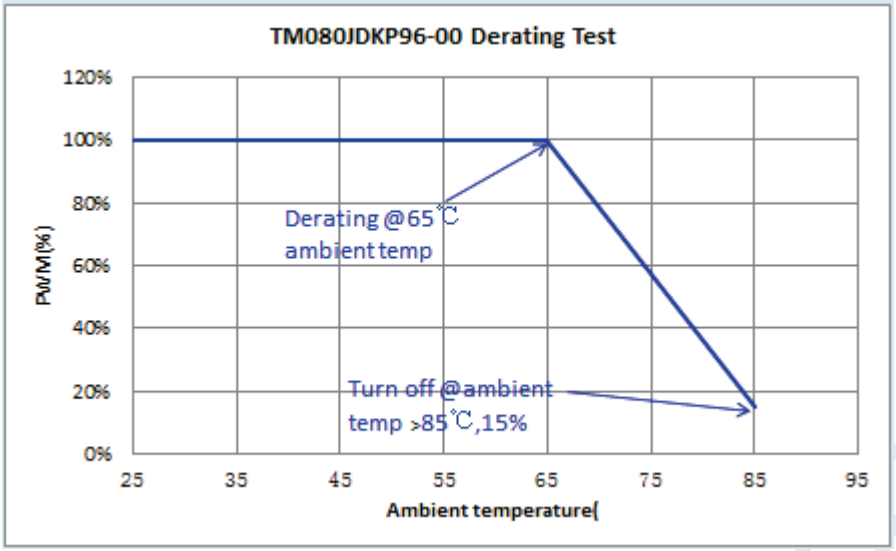
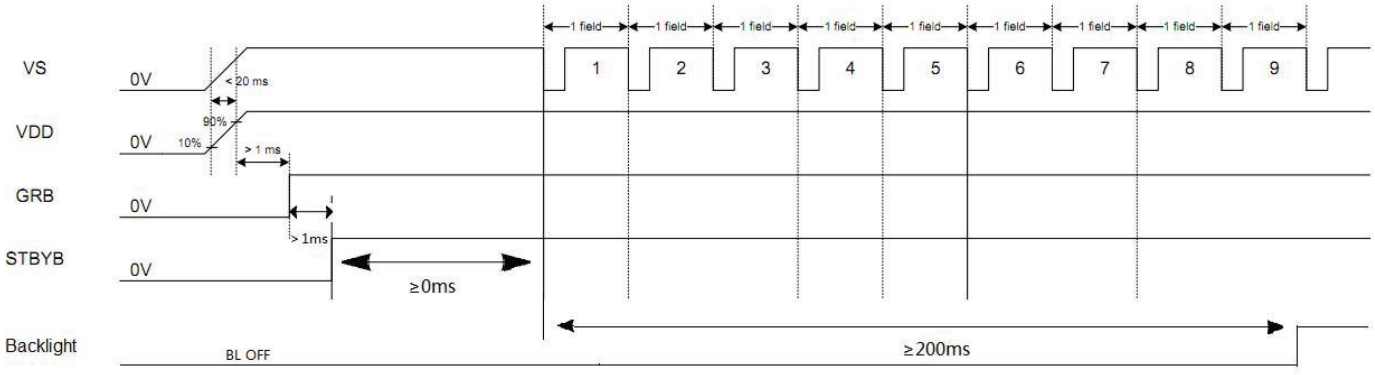
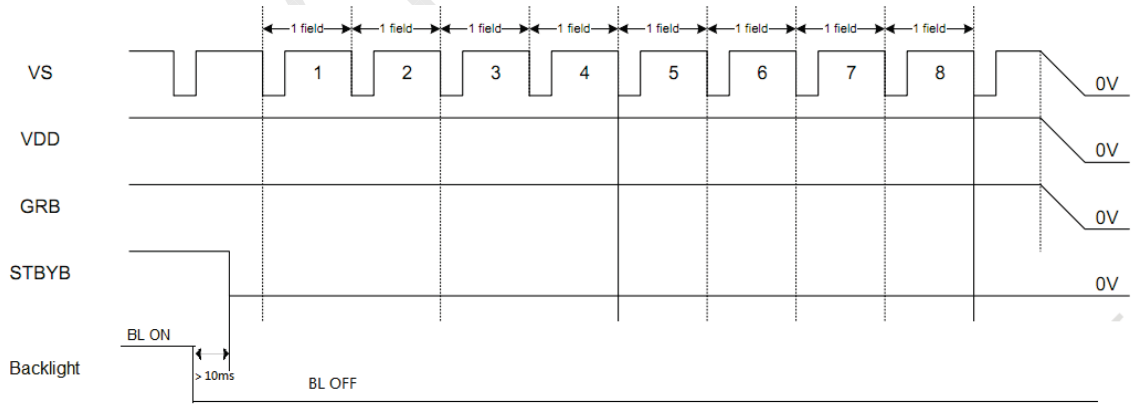


Figure 5.2.3 PWM vs Ambient Temperature

5.3 Recommended Power ON/OFF Sequence



5.3.1 Power on Sequence



5.3.2 Power off Sequence

Note1: GRB=RESET.
Note2: Power on/off of UD(RL) is at the same time as VDD.

5.4 LCD Module Block Diagram

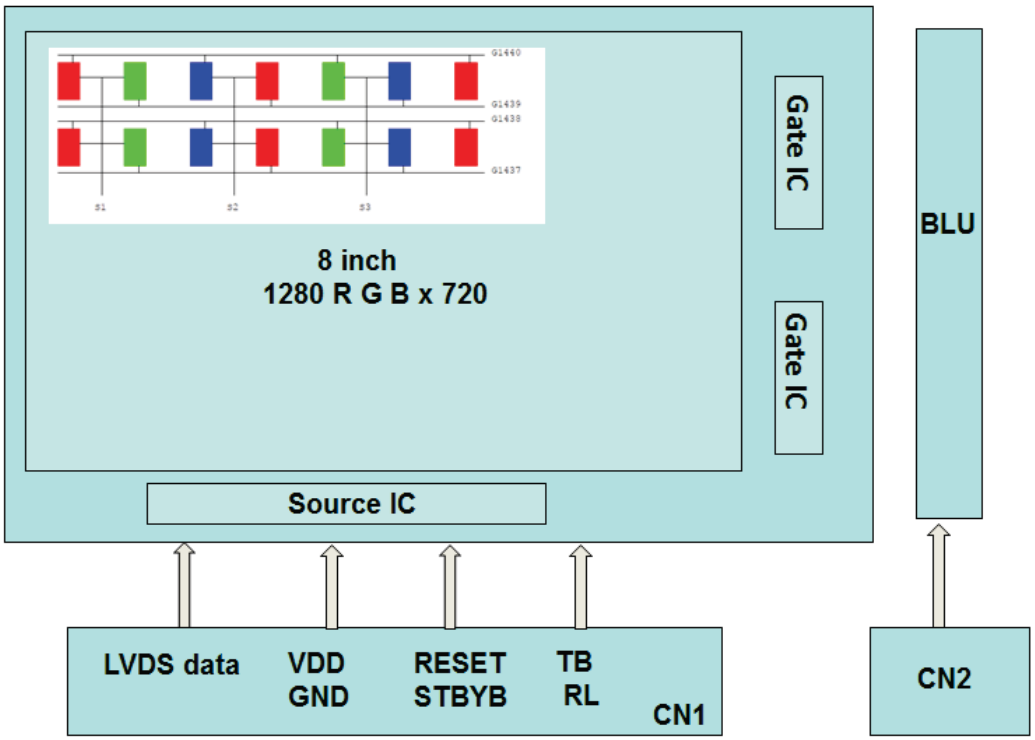


Figure 5.4.1 LCD Module Block Diagram

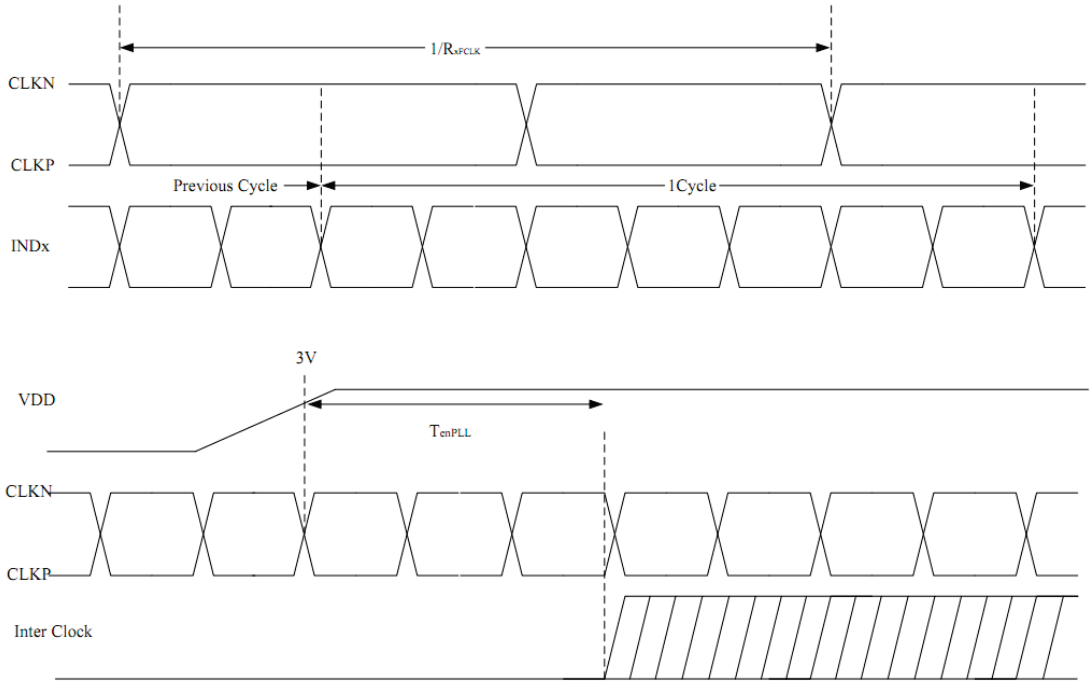
6. Interface Timing Characteristics

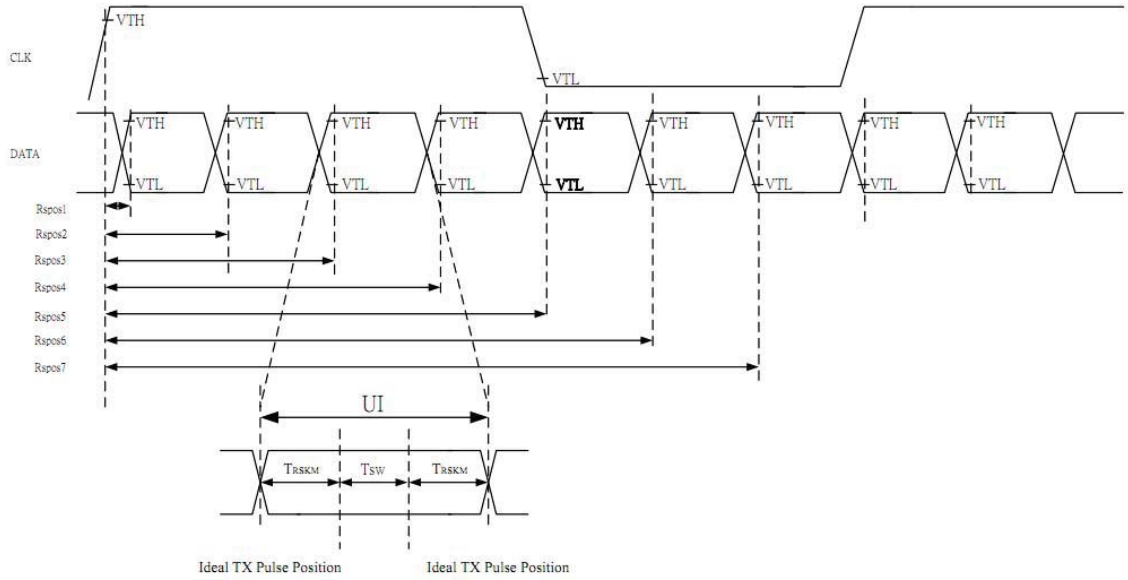
6.1 LVDS AC characteristics

(DVDD=DVDD_IF=1.7 to 1.9V, VDD= 2.7 to 3.6V, AVDD= 10 to 13.5V, VSS_IF=VSS=AGND=0V)

Parameter	Symbol	Min.	Typ.	Max.	Unit	Condition
Clock frequency	RXFCLK	10	-	110	MHz	
1 data bit time	UI		1/7		1/RXFCLK	
Position 1	Rspos1	-0.2	0	0.2	UI	
Position 2	Rspos2	0.8	1	1.2	UI	
Position 3	Rspos3	1.8	2	2.2	UI	
Position 4	Rspos4	2.8	3	3.2	UI	
Position 5	Rspos5	3.8	4	4.2	UI	
Position 6	Rspos6	4.8	5	5.2	UI	
Position 7	Rspos7	5.8	6	6.2	UI	
Input data skew margin	T_{RSKM}	-	-	0.2	UI	|VID|=100mV RXVCM=1.2V RXFCLK=75MHz
Clock high time	T_{LVCH}	-	4/(7*RXFCLK)	-	ns	
Clock low time	T_{LVCL}	-	3/(7*RXFCLK)	-	ns	
PLL wake-up time	T_{enPLL}	-	-	150	us	

Table 6.1.1 LVDS mode AC electrical characteristics





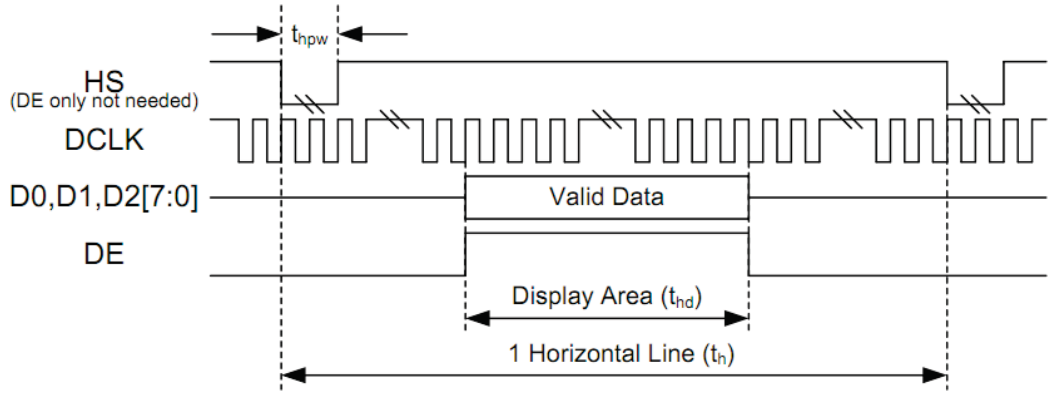
TRSKM: Receiver strobe margin
Tsw : Strobe width (internal data sampling window)
VTH=Rxvcm+|VID|/2, VTL=Rxvcm-|VID|/2

6.2 DE Mode Data Input Timing Parameter Setting

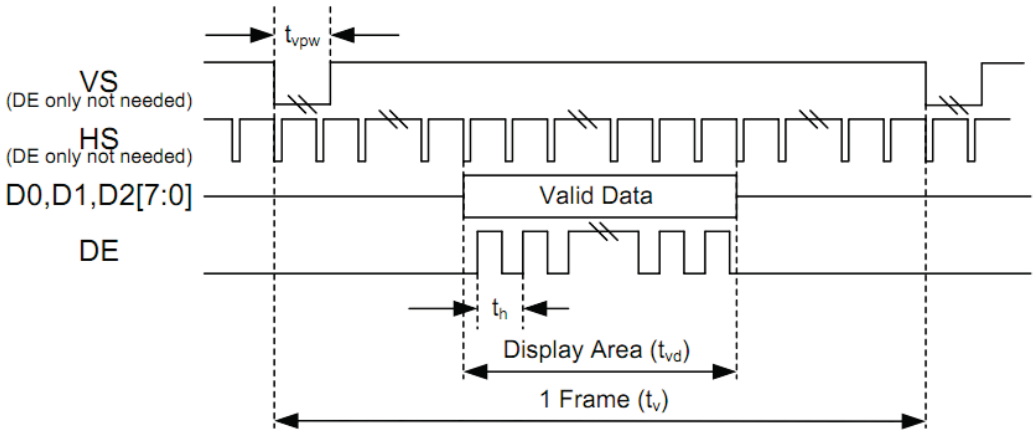
Parameter	Symbol	1280RGBx720 (One Port)		
		Min.	Typ.	Max.
DCLK Frequency	F_{DCLK}	58.37	58.71	74.88
Horizontal valid data	t_{hd}		1280	
1 Horizontal Line	t_h	1340	1344	1470
Vertical valid data	t_{vd}		720	
1 Vertical field	t_v	726	728	849
Frame rate	FR		60	

Table 6.2.1 Data Input Timing Parameters

Horizontal



Vertical



Note：Above of all these information is just for reference，the final information should be based on the test result of module and be set for module in initial code.

6.3 LVDS signal format

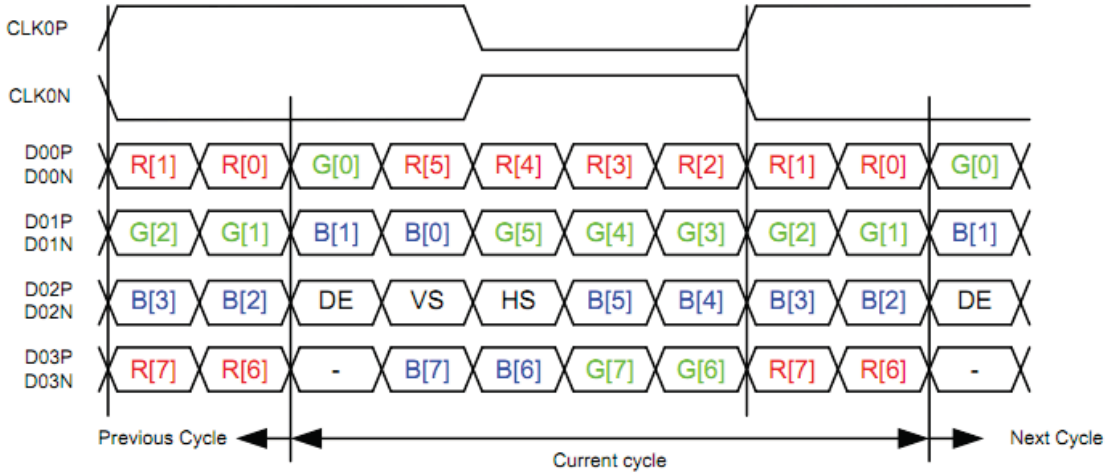


Figure 6.3.1 LVDS signals, VESA format

Note: CLK0P/N=CLKP/N, D00P/N=LV0P/N, D01P/N=LV1P/N, D02P/N=LV2P/N, D03P/N=LV3P/N

7. Optical Characteristics

Item		Symbol	Condition	Min	Typ	Max	Unit	Remark
View Angles		θU	CR≥10	80	88	--	Degree	Note1 Note2
		θD		80	88	--		
		θL		80	88	--		
		θR		80	88	--		
Contrast Ratio		CR	Vertical,25℃	900:1	1300:1	--	--	Note3 Note6
			Vertical,85℃	50% value of 25℃	--	--	--	
Response Time		$T_{ON}+T_{OFF}$	25℃	--	--	25	ms	Note4
			-20℃	--	--	200		
			-30℃	--	--	350		
Chromaticity	White	x	Backlight is on	0.250	0.300	0.350		Note5
		y		0.265	0.315	0.365		
	Red	x		0.586	0.636	0.686		
		y		0.286	0.336	0.386		
	Green	x		0.256	0.306	0.356		
		y		0.579	0.629	0.679		
	Blue	x		0.095	0.148	0.195		
		y		0.013	0.063	0.113		
Uniformity		White	--	75	80	--	%	Note7
NTSC			CIE1931-XYZ	70	73	--	%	Note5
Luminance		L	--	850	1200	--	cd/m^2	Note8

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.

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

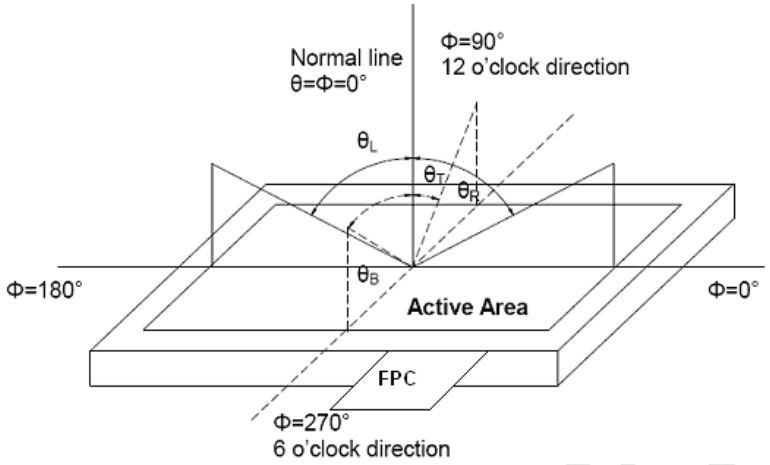


Fig1. Measurement viewing angle

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%.

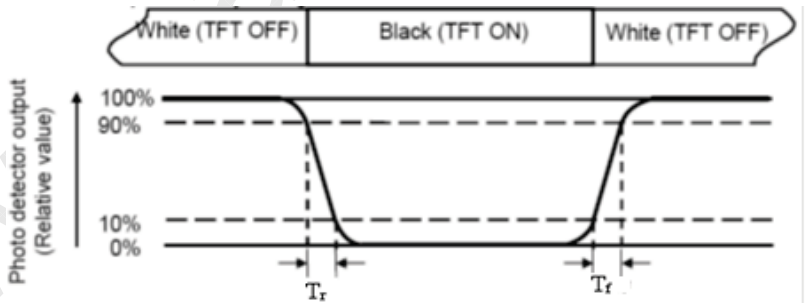


Fig2. Response Time Testing(TN)

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%.

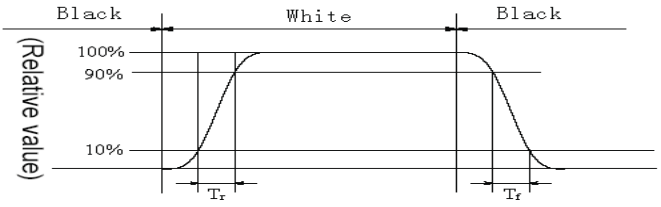


Fig3.Response Time Testing(SFT)

Note5: Definition of color chromaticity (CIE1931)

Color coordinates measured at center point of LCD.

Note 6: Contrast ratio against temperature

CR defines the allowed contrast reduction at the defined temperature based on the CR at room temperature. For example: CR = (CR@25°C – CR@85°C) / CR@25°C x 100%

Note7: Definition of Luminance Uniformity

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

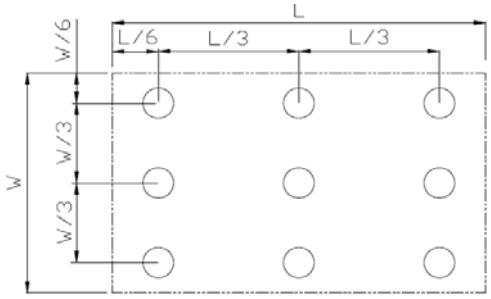


Fig4. Luminance Uniformity Measurement Locations(9 points)

Note8: Definition of Luminance:

Measure the luminance of white state at center point.

8. Reliability Test

No	Test Item	Condition	Remarks
1	High Temperature Operation	85℃±2℃ 240H RH<=45% Restore 2H at 25℃ operation	Note 1 IEC 60 068 - 2 - 2Bb
2	Low Temperature Operation	-30℃±3℃ 240H Restore 2H at 25℃ operation	Note 1 IEC 60 068 - 2 - 1Ab
3	High Temperature Storage	85℃ 240H RH<=45% Restore 2H at 25℃ non-operation	Note 1 IEC 60 068 - 2 - 2Bb Note 7
4	Low Temperature Storage	-40℃±3℃ 240H Restore 2H at 25℃ non-operation	Note 1 IEC 60 068 - 2 - 1Ab
5	Storage at High Temperature and Humidity(operation)	60℃±2℃, 90±2%RH 240H operation	Note 1 IEC 60 068 - 2 - 3Ca
6	Thermal Shock (non-operation)	-40°C→ change→+85°C 30min 30s 30min 100cycle non-operation	Note 1 IEC 60 068 - 2 - 14Nb
7	Vibration Test	Frequency: 8 - 33.3 Hz, Total amplitude: 1.3mm Frequency: 33.3 - 400 Hz, Acceleration: 29.4 m/s² sweep time: 15 minutes 2 hours each for X and Z directions, 4 hours for Y direction (total 8 hours) Non-operation	Note 2 IEC 60 068 - 2 - 6Fc
8	Shock Test	50 x 9.8m/s2, t=11ms, XYZ directions, Half sin curve, [non-operating],each directions 10 times	Note 2 IEC 60 068 - 2 - 27Ea
9	ESD	Air discharge: C=150pF±10%,R=330Ω±10%, 5 point/panel Air: +/-8KV, 5times	Note 4 GB/T17626（IEC61000）/ISO10605
		Contact discharge: C=150pF±10%,R=330Ω±10%, 5 point/panel Contact: +/-4KV,5times	
10	Package Drop Test	Height: X cm,1 corner, 3edges, 6 surfaces Note：X > 10Kg:60cm ; ≤10Kg:80cm	IEC60068-2-32:1990 GB/T2423.8—1995
11	Image Sticking	Viewing distance: 35cm Ambient illumination: 100 lux Ambient temperature: +25℃ Light source condition: Full	Note 8

		Luminance Viewing Angle: 0° Zone: Active area Picture Pattern: 8×6 checker pattern (Black and White) Burn-in time: 8h Judge at 30min @mid gray pattern Criteria: ≤level 2	

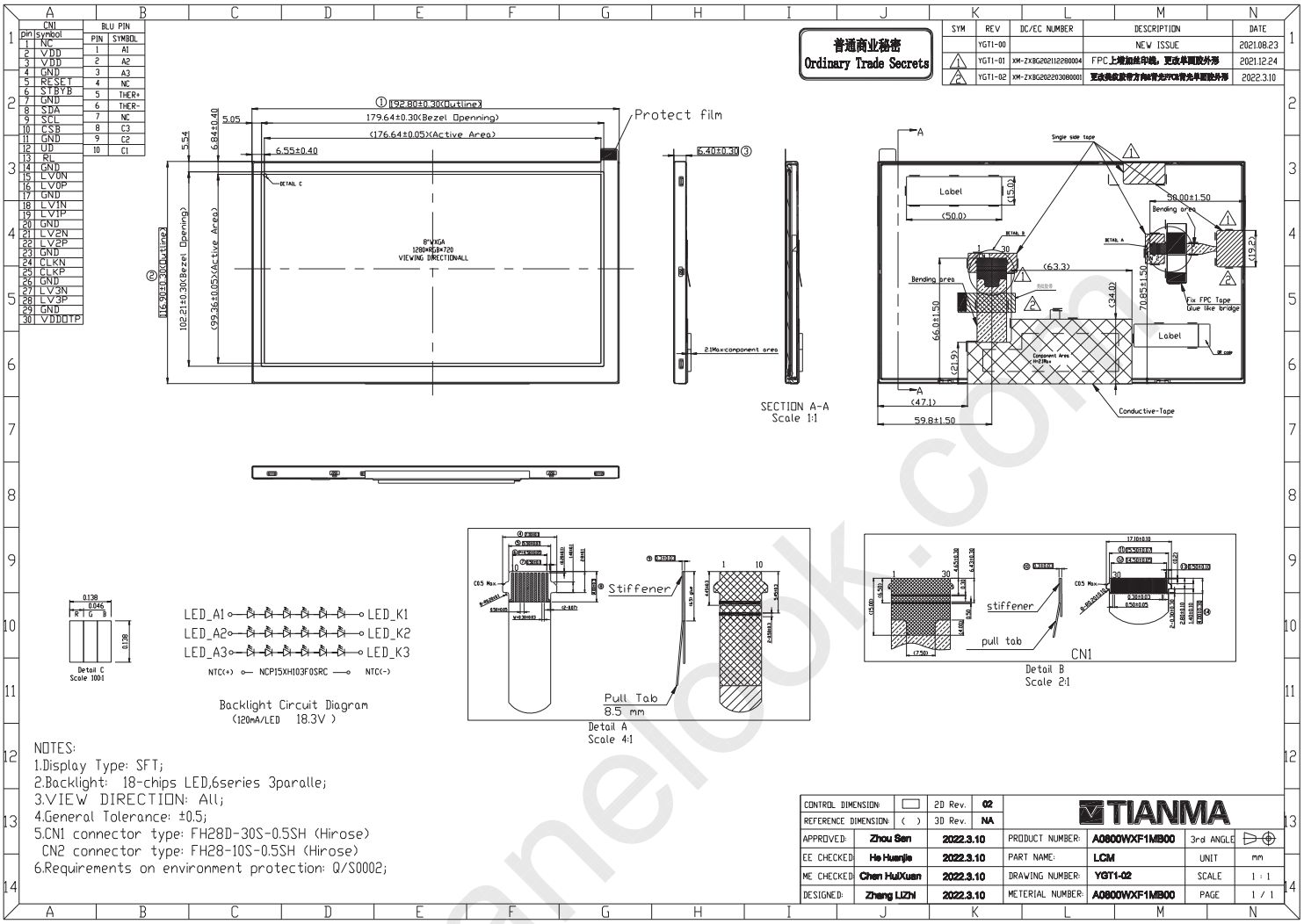
Table 8.1 RA test condition

Notes:

1. The test result shall be evaluated after the sample has been left at room temperature and humidity for 2 hours without load. No condensation shall be accepted. The sample will not be accepted if appear these defects:
   1) Air bubble in the LCD
   2) Seal leak
   3) Non-display
   4) Missing segments
   5) Glass crack
2. Each test item applies for a test sample only once, The test sample can not be used again in any other test item.
3. For Damp Proof Test, Pure water(Resistance＞10MΩ) should be used.
4. In case of malfunction defect caused by ESD damage, if it would be recovered to normal state after resetting, it would bejudgeas a good part. ESD is not only related to the module, but also related to the system. We promise to cooperate with the customer to meet the requirements of the whole machine, and improve ESD if necessary.
5. In the test of High Temperature Operation and High Temperature & Humidity Operation. The operation temperature is the surface temperature of module
6. We will consult with our customers, if appearing problems during the reliability test.
7. LED forward current should follow the De-rating curve.
8. Level Definition:

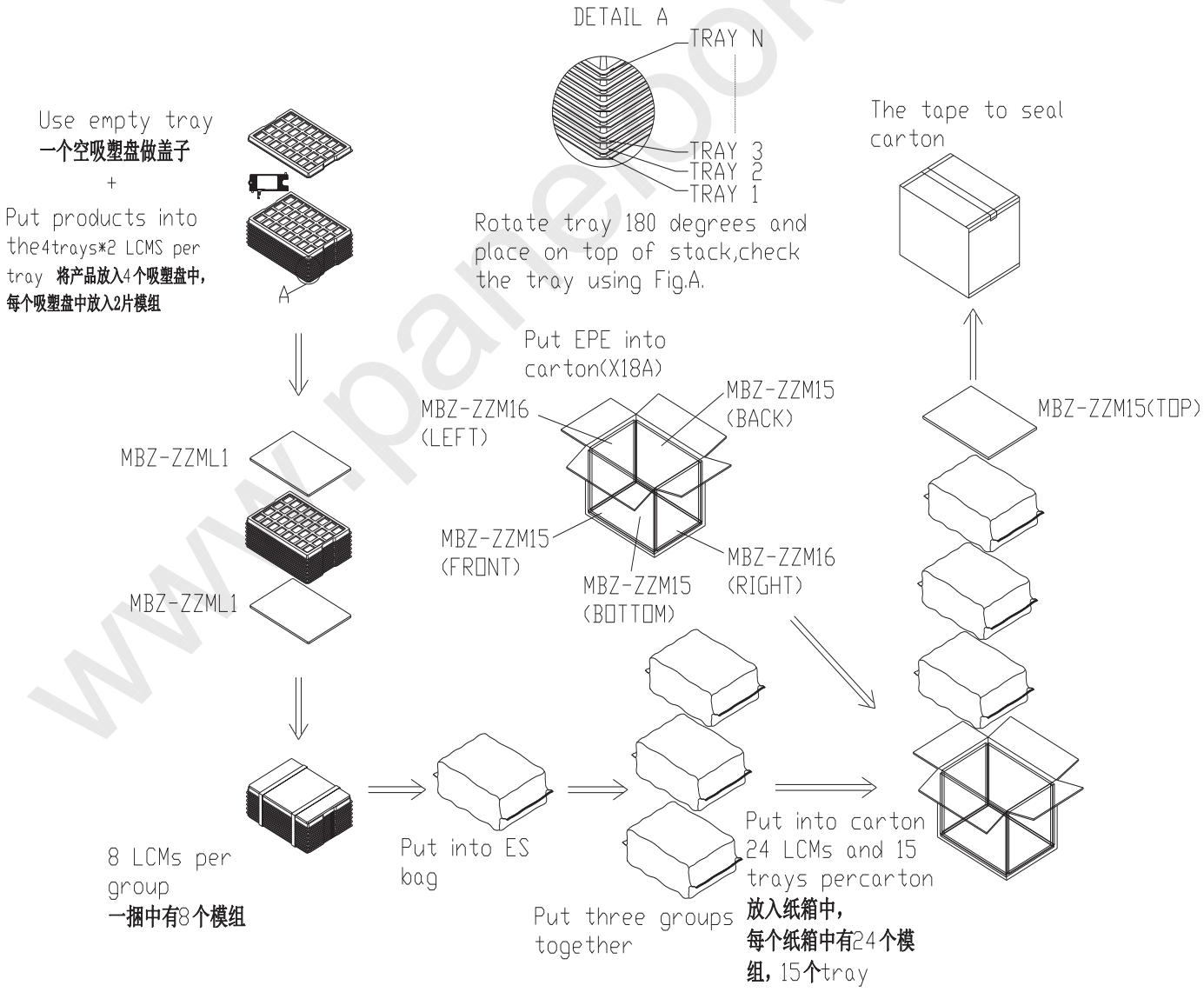
Level	Description	Remark
L0	Completely invisible	For all distance and viewing angle
L1	Invisible from perpendicular viewing direction	For all distance
L2	Visible by a closer look	Invisible by 60cm distance and viewing angle
L3	Slightly Visible	60cm distance and viewing angle

9. Mechanical Drawing



10. Packing Instruction

No	Item	Model (Materiel)	Dimensions(mm)	Unit Weight(Kg)	Quantity	Remark
1	LCM	TM080JDGP06-00	103.86*72.14*2.05	0.186	24	
2	Tray(吸塑盘)	PET	356*256*11.5	0.098	15	
3	EPE（珍珠棉1）	MBZ-ZZML1	336*246*6	0.01	6	
4	EPE（珍珠棉2）	MBZ-ZZM15	375*275*10	0.014	4	
5	EPE（珍珠棉3）	MBZ-ZZM16	250*280*12	0.015	2	
6	Carton(纸箱)	X18A	395*290*315	0.58	1	
7	ESD bag（防静电真空包装袋）	JD13	400*520	0.042	3	
8	Total Weight 总重量	6.786Kg±5%				



11 Product Inspection Criteria

11.1 Incoming Inspection

The customer shall inspect the modules within twenty calendar days of the delivery date (the inspection period) at its own cost. The result of the inspection (acceptance or rejection) shall be recorded in writing, and a copy of this writing will be promptly sent to the seller. If the results of the inspecting from buyer does not send to the seller within twenty calendar days of the delivery date. The modules shall be regarded as accepted.

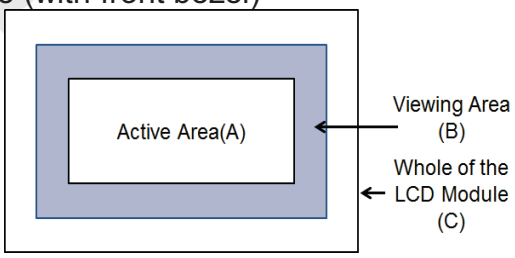
Should the customer fail to notify the seller within the inspection period, the buyer's right to reject the modules shall be lapsed and the modules shall be deemed to have been accepted by the buyer.

11.2 Inspection Sampling Method

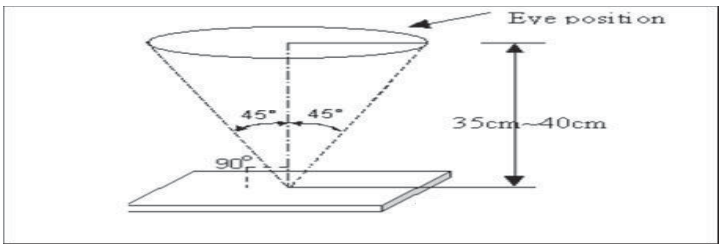
11.2.1 Lot size: Quantity per shipment lot per model
11.2.2 Sampling type: Normal inspection, Single sampling
11.2.3 Inspection level: II
11.2.4 Sampling table: MIL-STD-105D
11.2.5 Acceptable quality level (AQL)
Major defect: AQL=0.65
Minor defect: AQL=1.00

11.3 Inspection Conditions

11.3.1 Ambient conditions:
a. Temperature: Room temperature 25±5℃
b. Humidity: (60±10) %RH
c. Illumination: Single fluorescent lamp non-directive (300 to 700 Lux)
11.3.2 Viewing distance
The distance between the LCD and the inspector's eyes shall be at least 35±5 ㎝.
11.3.3 Viewing Angle
U/D: 45º/45º, L/R: 45º/45º
11.3.4 Definition of LCD zone (with front bezel)



A-zone: The inside of the Active Area (as defined on the product drawing)
B-zone: The inside of the Viewing Area which is between A-zone and the metal frame (defined on the product drawing if no up metal frame)
C-zone:Whole of the LCD Module except the zone A and B. (Including FPC& MetalFrame& backside of the LCD Module)

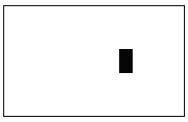
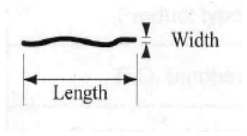


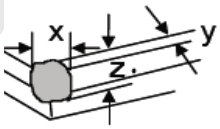
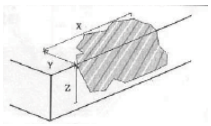
11.4 Cosmetic Inspection Criteria

11.4.1 Major defect

No	Items to be inspected	Inspection standard
1	All functional defects	1) No display 2) Abnormal display 3) Short circuit 4) line defect
2	Crack	Glass Crack

11.4.2 Minor defect

Inspection Item	Inspection Standards	Acceptable Qty.	Applied Zone	Inspection Mode	Note
Bright spots	φ≤0.15	Ignore	A	Backlight-on	φ=(x+y)/2 x y
	0.15<φ≤0.3mm	3			
	0.3<φ	None			
Dark spots	φ≤0.2	Ignore	A	Backlight-on	φ=(x+y)/2 x y
	0.2<φ≤0.4	3			
	0.4<φ	None			
Bright pixel dot	1 sub-pixel, Visible through ND2%	None	A	Backlight-on	
Dark pixel dot	1 sub-pixel	3 (distance≥5mm)	A	Backlight-on	
Lints& Scratches	W≤0.03 and L≤3.0	Ignore	A\B	Backlight-on Backlight – off	
	0.03<W≤0.05 and L≤3.0	2			
	0.05<W or L>3.0	None			
Polarizer Dent/Bubble	φ≤0.2	Ignore	A\B	Backlight-on Backlight – off	φ=(x+y)/2 x y
	0.2 <φ ≤ 0.4	3			
	0.40<φ	None			

		Note: If it can't be seen under the Cover lens or CTP, the defect can be ignored.				
Mura		Visible through ND2% at full black pattern	None	A	Backlight – on	
Dirty\Dust		Those wiped out easily are acceptable		A\B	Backlight – off	\
Cover Shield		The rust on the side and cross section of bezel can be ignored. It does not affect function/operation of LCM.		A\B	Backlight – off	
Glass Defect	Corner Fragment:	X≤3mm, Y≤3mm, Z≤T	Ignore	A	Backlight – off	
	Side Fragment:	X≤5.0mm, Y≤1.0mm, Z≤T	Ignore	A	Backlight – off	
T: Glass thickness X: Length Y: Width Z: Thickness						

Note1: Dot defect is defined as the defective area of the dot area is larger than 50% of the dot area.
Note2: Polarizer bubble is defined as the bubble appears on active display area. The defect of polarizer bubble shall be ignored if the polarizer bubble appears on the outside of active display area.
Note3: If any problems or doubts arise with the LCD, the customer and supplier will cooperate and make efforts to solve it with mutual confidence and respect. Issues which are not defined in these criteria shall be discussed with both parties, customer and supplier, for a better solution.
Note4: The distance between black dot defects should be more than 5mm.

12. Precautions for Use of LCD Modules

12.1 Handling Precautions

12.1.1 The display panel is made of glass. Do not subject it to mechanical shock by dropping it, etc.
12.1.2 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.
12.1.3 Do not apply excessive force to the display surface or the bezel since this may cause the color tone to vary.
12.1.4 The polarizer covering the display surface of the LCD module is soft and easily scratched. Handle the polarizer carefully.
12.1.5 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

12.1.6 Do not attempt to disassemble the LCD Module.
12.1.7 If the logic circuitry is powered off, do not apply the input signals.
12.1.8 To prevent destruction of the module by static electricity, be careful to maintain an optimum work environment.

12.1.8.1 Be sure to ground your body when handling the LCD Modules.
12.1.8.2 Tools used for assembly, such as soldering irons, must be properly grounded.
12.1.8.3 To reduce the amount of static electricity generated, do not conduct assembly or other work under very low humidity conditions.
12.1.8.4 The LCD Module is covered with a film to protect the display surface. Be careful and slowly when peeling off this protective film since static electricity may be generated.

12.2 Storage precautions

12.2.1 When storing the LCD modules avoid exposure to direct sunlight or to the light of fluorescent lamps.
12.2.2 The LCD modules should be stored within the rated storage temperature range. If the LCD modules will be stored for a long time, the recommend condition is:
Temperature: 15 ~ 35 degree C (or at least Temp. 10 ~ 40 degree C / Humidity 25% ~ 75%), for National Std. recommendation
12.2.3 The LCD modules should be stored in a room without acid, alkali or other harmful gases.

12.3 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.