

SPECIFICATION

Customer Part Number: BC20020010

Tianma Part Number: TL162XVKS01-00

Product Description: 16.2" 2880xRGBx1080 TFT-LCD

[] Target Specification
[] Preliminary Specification
[●] Final Specification

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REVISION HISTORY

Revision	Date	Page	Revision Items	Remark
1.0	2021/06/17	-	First release	
1.1	2021/07/15	3 10	Add pin symbol remark Update Figure 6.1.2 Vertical timing format Figure 6.1.3 Horizontal timing format	
1.2	2021/07/30	1 8 9 12	Update touch Response time, Report rate Update power on/off sequence Update LVDS data mapping(VESA) Add touch I2C Timing	
1.3	2021/08/17	1 6 7 12 14	Update finger separation Add 5.1.2 current consumption Update backlight forward current Add touch I2C address Update luminance	
1.4	2021/09/14	15	Change haze value 10 to 5	
1.5	2022/04/15	2 7 8 21 25	Add weight information Update DC Characteristics for Backlight Driving Update LED Connection of Backlight Add PWM vs.NTC Temperature Update Mechanical Drawing Update Module label information	
1.6	2022/05/06	14 17	Add black uniformity Add gamma test method	
2.0	2022/07/05	2 5 6 12 21 24 26	Update CN1 Pin assignment (LCD Interface) Update Table 4.1 Absolute Maximum Rating Update Table 5.1.1 Operating Voltages Update 5.1.2 current consumption Update Table 6.2.1 LVDS AC characteristics Update Mechanical Drawing Update Table 10.2.2 Minor Defect Update Module label information	
2.1	2022/12/7	22 24 26	Update 10.1.1 Ambient conditions Illumination Update 10.2.2 Minor Defect Update 11. Packing Instruction	

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1. Brief Description

This is a 16.2 inch LTPS-TFT-LCD (Thin Film Transistor Liquid Crystal Display) module with normal-black and In-cell technology. It is composed of a Cover, TFT-LCD panel, LCD Driver IC with T-con integrated. This product is designed for automotive and other high reliability electronic products and complies with *RoHS* directive.

2. General Specification

Items	Specification	Remark
Diagonal Size	16.2 inch	--
Resolution	2880 x RGB x 1080	--
Active Area(mm)	385.344mm x 144.504mm	--
Pixel Pitch (mm)	0.1338mm x 0.1338mm	--
Pixel Configuration	R.G.B. Vertical Stripe	--
Technology Type	LTPS	--
Display Mode	Normally Black	--
Landscape or Portrait	Landscape	--
Surface Treatment (Top Polarizer)	Hard Coating	--
Interface	LVDS_VESA	--
Color Depth	8bits	--
Timing Control Mode	DE mode	
Dimension (H x V x D) (mm)	399.34x166.2x9.2 (with Cover Typ.)	Note1
Weight (g)	1010±5%	Note2

Table 2.1 General TFT Specifications

Note1: The dimensions do not include the length of FPC, screw and component height etc.. For detail dimension, please refer to the module outline drawing.

Note2: The weight does not include the weight of protective film.

TP Feature	Specification	Remark
Number of Simultaneous Touches	10 points	
Accuracy central area	±1.0mm	
Accuracy whole area (use 8mm copper column)	±1.5mm	
Linearity central area	±1.0mm	
Linearity whole panel (use 8mm copper column)	±1.5mm	
Response time	Max.=40ms	
Finger size supported	Min.6mm, Max.20mm	
Finger separation	14.2 mm(x-y axis) , 16.7 mm(diagonal)	
Report rate	TYP 110Hz	

3. Input / Output Terminals

3.1 CN1 Pin assignment (LCD Interface)

Mating connector type: FH28H-80S-0.5SH

No.	Symbol	P/I/O	Description	Remark
1	LED2_A1	P	LED2 positive 1	
2	LED2_A2	P	LED2 positive 2	
3	LED2_A3	P	LED2 positive 3	
4	NC	N	No Connect	
5	NTC+	I	Connector Thermistor Resistor	
6	NTC-	I	Connector Thermistor Resistor	
7	NC	N	No Connect	
8	LED2_K3	P	LED2 negative 3	
9	LED2_K2	P	LED2 negative 2	
10	LED2_K1	P	LED2 negative 1	
11	NC	N	No Connect	
12	LED1_A1	P	LED1 positive 1	
13	LED1_A2	P	LED1 positive 2	
14	LED1_A3	P	LED1 positive 3	
15	NC	N	No Connect	
16	NTC+	I	Connector Thermistor Resistor	
17	NTC-	I	Connector Thermistor Resistor	
18	NC	N	No Connect	
19	LED1_K3	P	LED1 negative 3	
20	LED1_K2	P	LED1 negative 2	
21	LED1_K1	P	LED1 negative 1	
22	NC	N	No Connect	
23	GND	P	Ground	
24	NC	N	No Connect	
25	VDD	P	3.3+/-0.3V	
26	VDD	P	3.3+/-0.3V	
27	VDD	P	3.3+/-0.3V	
28	VDD	P	3.3+/-0.3V	
29	NC	N	No Connect	
30	GND	P	Ground	
31	TP_INT	O	Touch screen interrupt line(Interrupt active when it is low) Let it open if not used.	

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32	TP_SDA	I	I2C interface data signal for touch.	
33	TP_SCL	I	I2C interface clock signal for touch.	
34	TP_RESET	I	TP external reset signal(Active low).	TP_EXT_RSTN
35	GND	P	Ground	
36	DISP_CSB	I	SPI interface chip select pin	
37	DISP_SDA	I	SPI interface data input/output pin	
38	DISP_SCL	I	SPI interface clock input pin	
39	DISP_RESET	I	Global reset pin, active low.	RESX
40	DISP_STBYB	I	Standby mode setting pin, active low.	PON
41	DISP_ON/OFF	I	Display on/off hardware control pin DISP=0,Display off mode DISP=1,Display on mode	DISP
42	RL	I	Horizontal shift direction selection for source output.	
43	NC	N	No Connect	
44	FAIL_DET	O	Fail detection signal output pin	
45	NC	N	No Connect	
46	GND	P	Ground	
47	CABC_PWM	O	CABC control	
48	GND	P	Ground	
49	GND	P	Ground	
50	CH1_TX3P	I	EVEN data input 3+	
51	CH1_TX3N	I	EVEN data input 3-	
52	GND	P	Ground	
53	CH1_CLKP	I	Clock input 1+	
54	CH1_CLKN	I	Clock input 1-	
55	GND	P	Ground	
56	CH1_TX2P	I	EVEN data input 2+	
57	CH1_TX2N	I	EVEN data input 2-	
58	GND	P	Ground	
59	CH1_TX1P	I	EVEN data input 1+	
60	CH1_TX1N	I	EVEN data input 1-	
61	GND	P	Ground	
62	CH1_TX0P	I	EVEN data input 0+	
63	CH1_TX0N	I	EVEN data input 0-	
64	GND	P	Ground	

65	GND	P	Ground	
66	CH0_TX3P	I	ODD data input 3+	
67	CH0_TX3N	I	ODD data input 3-	
68	GND	P	Ground	
69	CH0_CLKP	I	Clock input 1+	
70	CH0_CLKN	I	Clock input 1-	
71	GND	P	Ground	
72	CH0_TX2P	I	ODD data input 2+	
73	CH0_TX2N	I	ODD data input 2-	
74	GND	P	Ground	
75	CH0_TX1P	I	ODD data input 1+	
76	CH0_TX1N	I	ODD data input 1-	
77	GND	P	Ground	
78	CH0_TX0P	I	ODD data input 0+	
79	CH0_TX0N	I	ODD data input 0-	
80	GND	P	Ground	

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

Note1: This product supports DE mode only.

Note2: All of the GND pins should be connected to the system ground.

Note3: Description of Scan Direction.

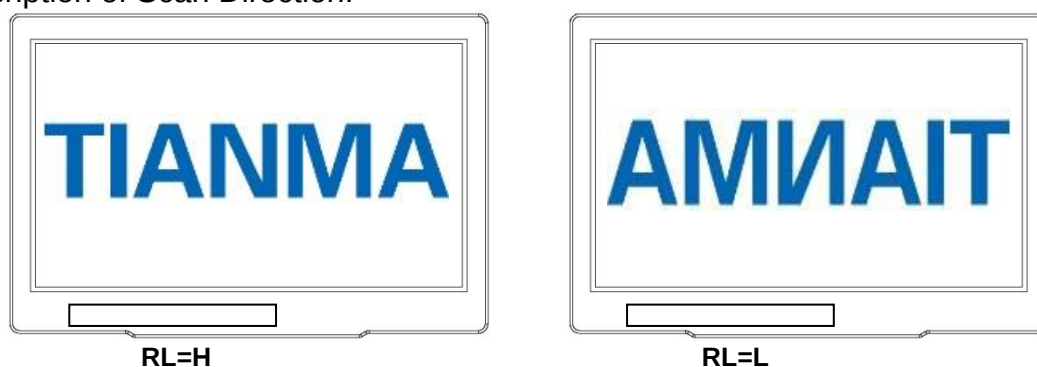


Figure 3.1.1 Description of Scan Direction

4. Absolute Maximum Ratings

GND=0V, Ta = 25°C

Item	Symbol	Min	Max	Unit	Remark
Logic supply voltage	VDD	3.0	3.6	V	
Backlight Forward Current	I _{BL}	-	345*2LB	mA	
Backlight Forward voltage	V _{BL}	25.2*2LB	30.6*2LB	V	Note5
Operating Temperature	Top	-40	85	°C	Note1/2/3/4
Storage Temperature	Tst	-40	90	°C	Note1

Table 4.1 Absolute Maximum Rating

Note1: The temperature is the ambient temperature of module.

Note2: No Electro-optical specification is guaranteed below -30°C. But above -30°C, electro-optical specifications can be recovered.

Note3: LED forward current should follow the De-rating curve.

Note4: NTC resistance should not be below 1.268kΩ .

Note5: At LEDs power off status, please use the design to avoid releasing reverse voltage.

Note6: If the voltage exceeds the absolute maximum ratings, the LCM may be damaged. Also, if the LCM is operated with the absolute maximum ratings for a long time, its reliability may drop.

5. Electrical Characteristics

5.1 DC Characteristics for Panel Driving

GND=0V, Ta = 25°C

Item	Symbol	MIN	TYP	MAX	Unit	Remark
Logic supply voltage	VCC	3.0	3.3	3.6	V	
System Ground	GND	-	0	-	V	
Permissible Ripple Voltage of VCC	Vr	-	-	100	mV	
Input / Output High Voltage	V _{IH} /V _{oh}	0.7VCC/ 0.8VCC	-	VCC	V	
Input / Output Low Voltage	V _{IL} /V _{oh}	0	-	0.3VCC/ 0.2VCC	V	
LVDS differential input high threshold voltage	V _{TH}	-	-	90	mV	Note1
LVDS differential input low threshold voltage	V _{TL}	-90	-	-		
Differential input voltage	V _{ID}	-	350	800	mV	
Differential input common mode voltage	V _{CMLVDS}	0.3+ V _{ID} /2	-	2.3- V _{ID} /2	V	

Table 5.1.1 Operating Voltages

Single-ended:
CLKP
CLKN
LV[3:0]P
LV[3:0]N



Differential:
CLKP-CLKN
LV[3:0]P
LV[3:0]N

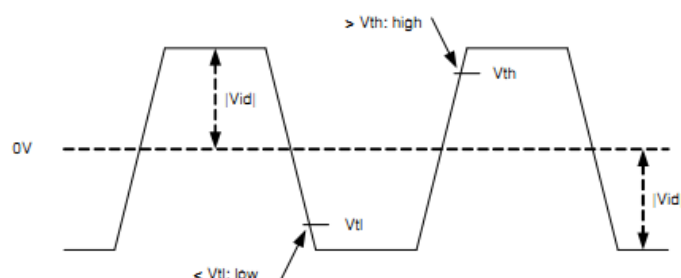


Figure 5.1.1 LVDS waveform

GND=0V, Ta = 25°C

Item	Symbol	Min	Typ	Max	Unit	Remark
Logic Supply Current	IVDD	/	300	450	mA	Note1
VCC inrush current	Inrush	/	1500	/	mA	

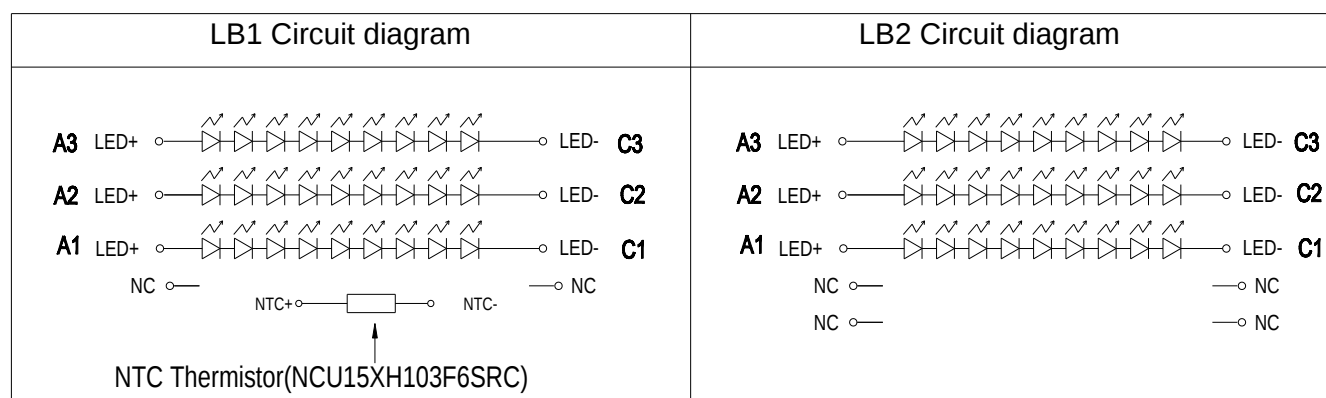
Table 5.1.2 Current consumption

Note1: Test pattern: white pattern.

5.2 DC Characteristics for Backlight Driving

Item	Symbol	Min	Typ	Max	Unit	Remark
Forward Current	I_F	-	95	115	mA	Note1
Forward Voltage	V_{BL}	25.2*2LB	27.9 *2LB	30.6*2LB	V	Note2, two LB
Backlight Power Consumption	W_{BL}	7.18*2LB	7.95*2LB	8.72*2LB	W	Note2, two LB
Lifetime	-	20000	-	-	Hrs	Note3

Table 5.3.1 LED Backlight Characteristics



$$3P9S *2LB = 54LED$$

Figure 5.3.1 LED Connection of Backlight

Item	Value	Remarks
Part Number	NCU15XH103F6SRC	Murata
Resistance / Tolerance	10kΩ±1%	Ta=25°C
Permissive Operating Max. Current	0.1mA	Ta=25°C Note5

Table 5.3.2 Thermistor Description

Note1: I_F is defined for one channel LEDs. There are total of 3 LED channels in the backlight unit and 2 LB-FPC.. While the LCM is operating, a stable forward current should be supplied. The forward current max value is only for inrush current.

Note2: $I_F = 95mA$.

Note3: Optical performance should be evaluated at Ta=25°C only. Operating lifetime means the brightness will decrease to 70% of the original brightness.

Note4: An NTC thermistor is included in the LED circuit. It is used to measure the LED temperature and is located in the LED circuit on the backlight FPC.

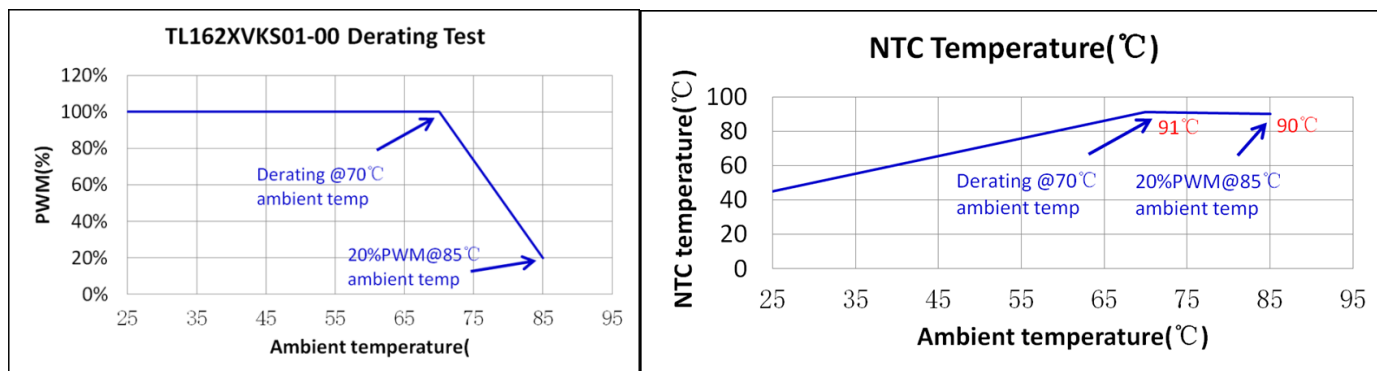


Figure 5.3.2 PWM vs. Ambient/NTC Temperature

Note5: To reduce the influence of NTC self-heating and improve the measurement accuracy, suggest the operating current of NTC is 0.031mA.

Note6: NTC resistance should not be below 1.268k Ω .

5.3 Recommended Power ON/OFF Sequence

Power on Sequence

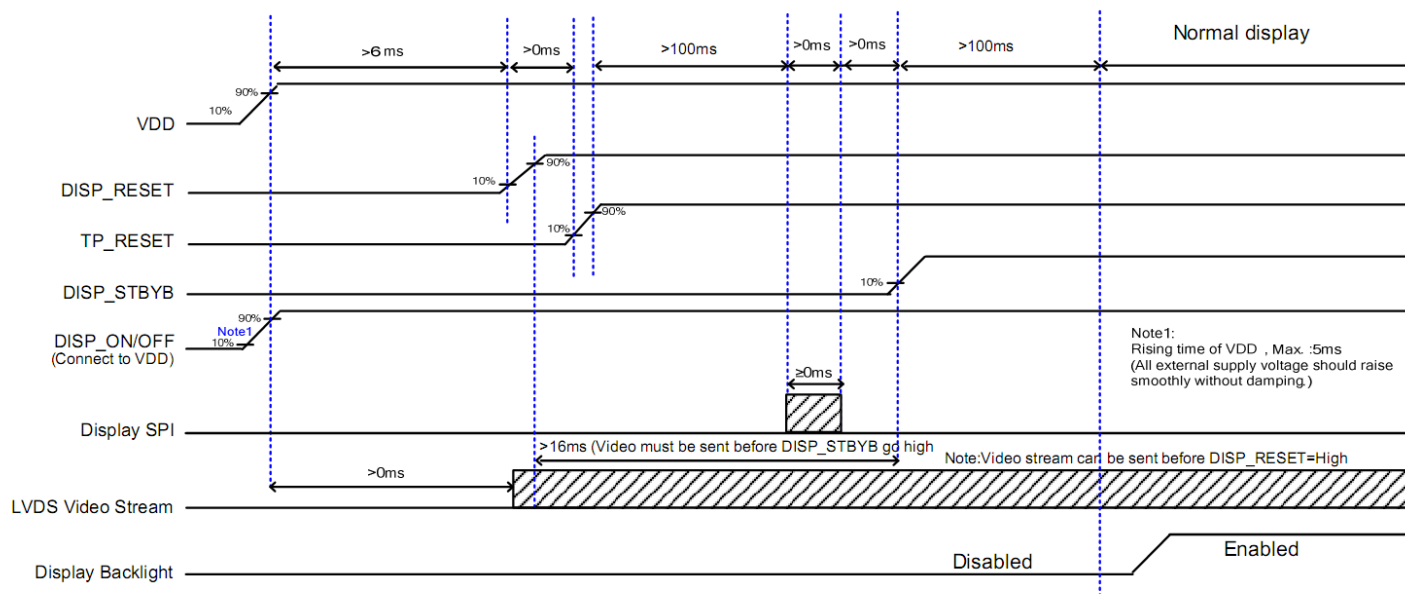


Figure 5.3.1 Power on Sequence

Power off Sequence

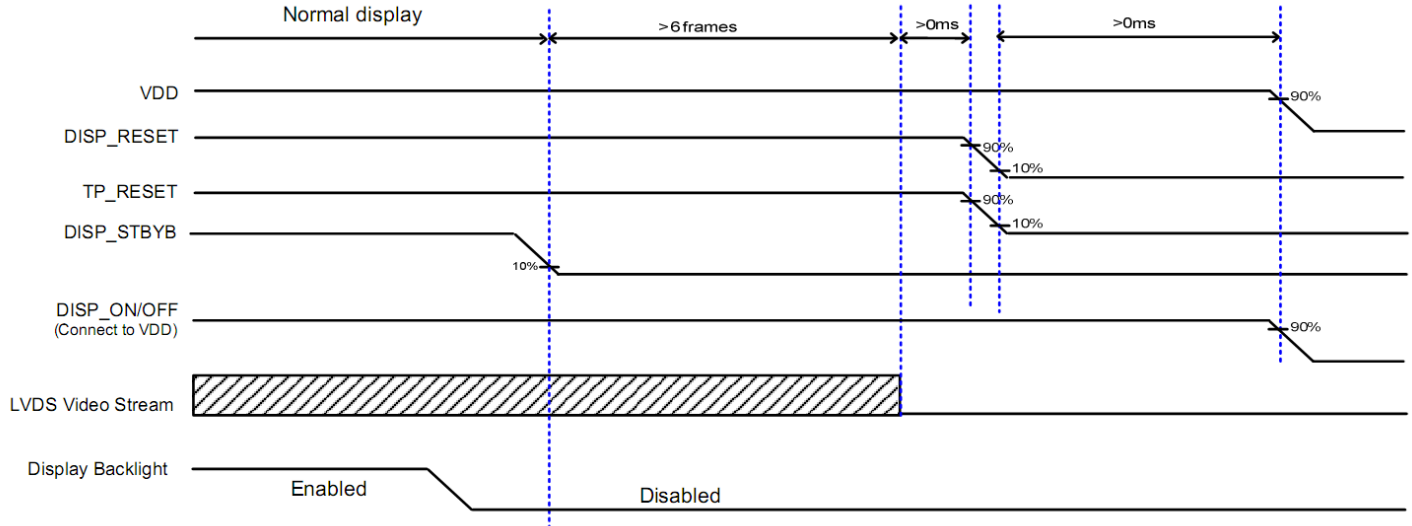


Figure 5.3.2 Power off Sequence

5.4 LCD Module Block Diagram

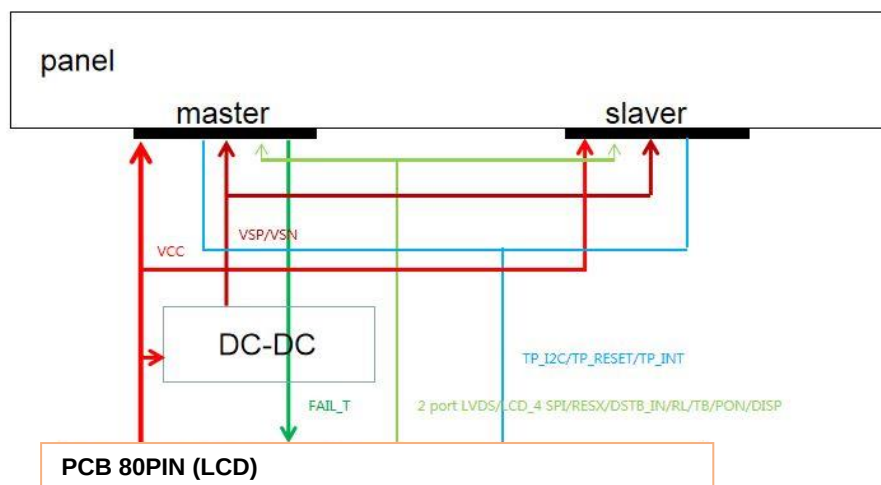


Figure 5.6 LCD Module Block Diagram

6. Interface Timing Characteristics

6.1 LVDS Interface Timing Characteristics

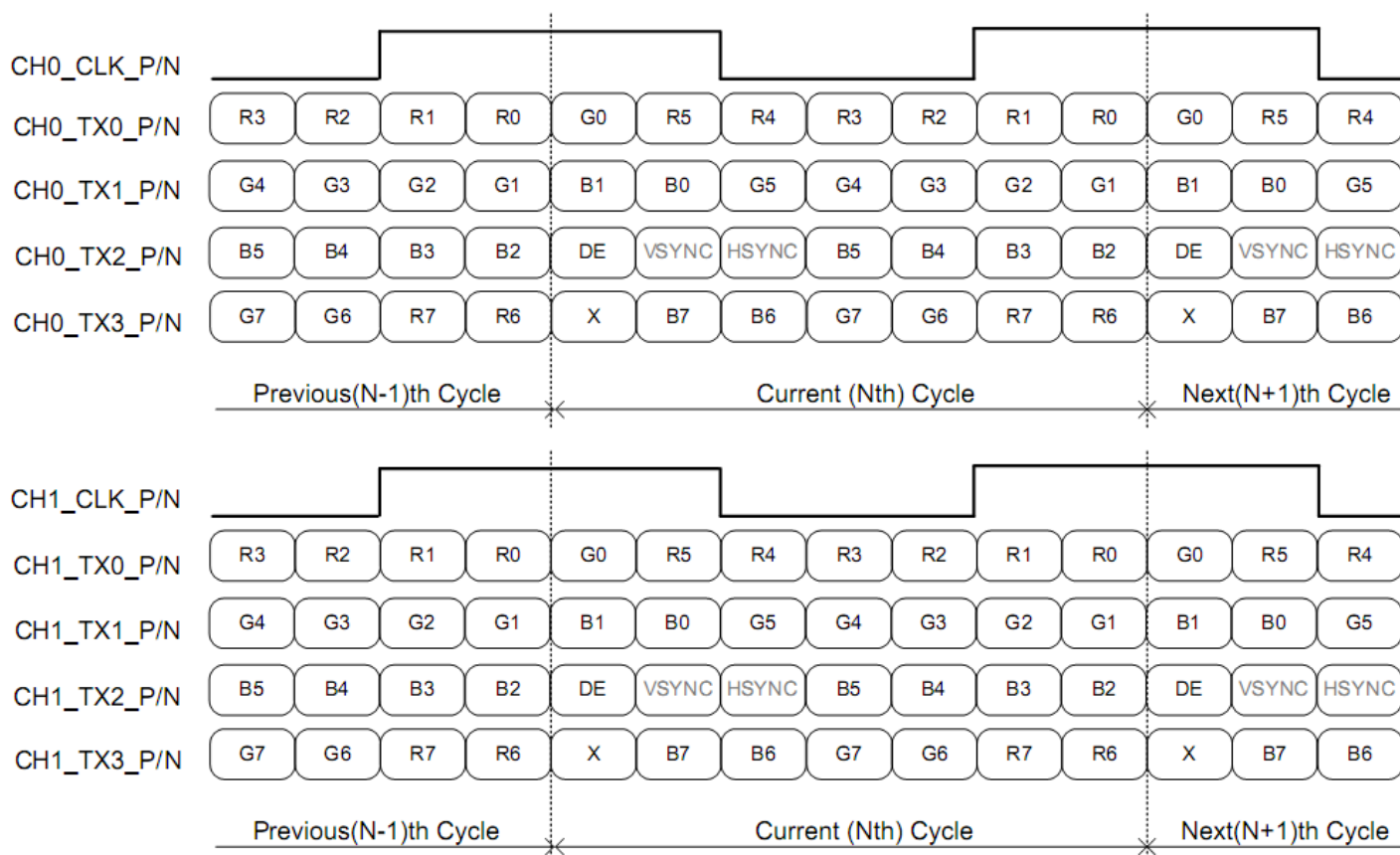


Figure 6.1.1 LVDS data mapping(VESA)

Parameter	Symbol	Min	Typ.	Max	Unit
DCLK frequency	FDCLK		89.33925		MHz
Horizontal valid data	thd	1440			DCLK
Hsync pulse Width	thpw		10		DCLK
Hsync back porch	thbp		10		DCLK
Hsync front porch	thfp		10		DCLK
1 horizontal line	th		1470		H
Vertical valid data	tvd	1080			H
Vsync pulse width	tpw		2		H
Vsync back porch	tvbp		8		H
Vsync front porch	tvfp		15		H
1 vertical field	tv		1105		H
Frame rate	FR		55		HZ

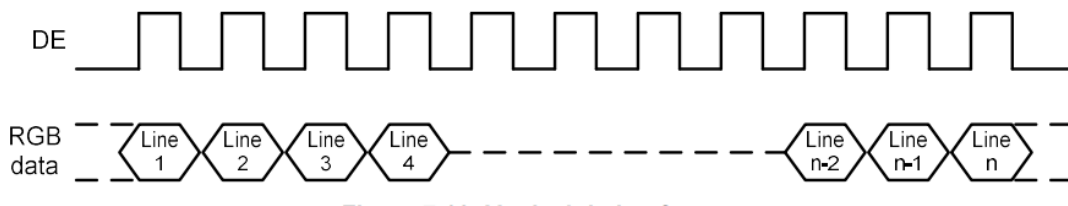


Figure 6.1.2 Vertical timing format

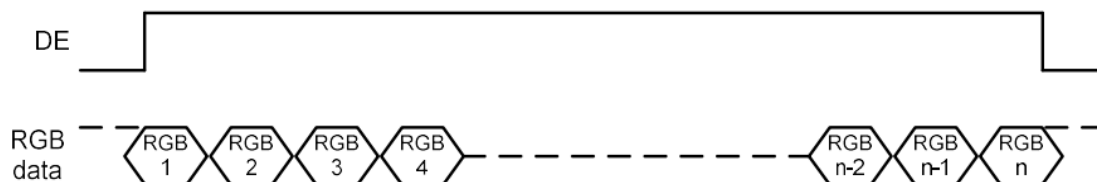


Figure 6.1.3 Horizontal timing format

6.2 LVDS AC Characteristics

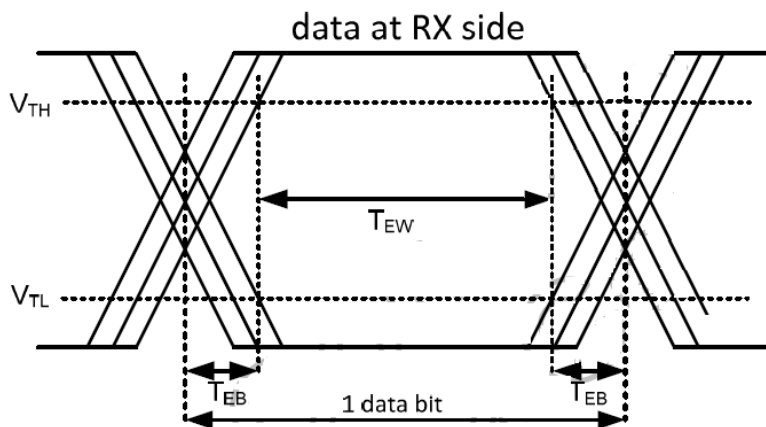
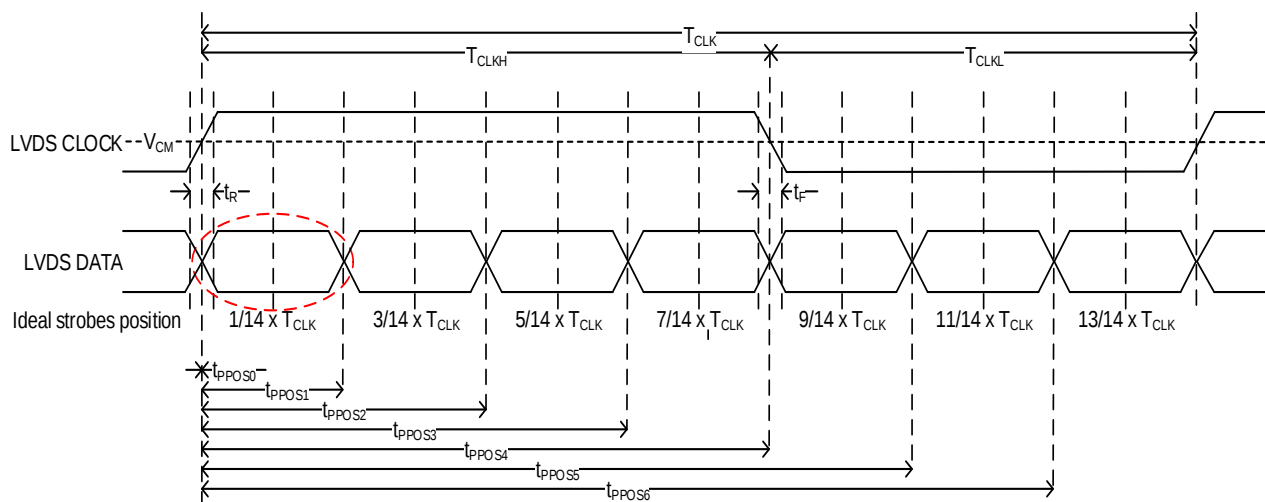


Figure 6.2.1 LVDS input timing

Parameter	Symbol	Min	Typ.	Max	Unit
DCLK frequency	FDCLK	-	91.16	-	MHz
Input clock period	t_{CLK}	-	10.97	-	ns
1 data bit	T_P	-	1/7	-	T_{CLK}
Input clock high period	t_{CLKH}	-	4/7	-	T_{CLK}
Input clock low period	t_{CLKL}	-	3/7	-	T_{CLK}
Input data pulse position	t_{PPOSn}	$n/7 \times T_{CLK} - t_{EB}$	$n/7 \times T_{CLK}$	$n/7 \times T_{CLK} + t_{EB}$	ns
Input eye width	T_{EW}	0.5			T_P
Input eye border	T_{EB}			0.25	T_P

Note: AC Characteristics based on close to IC side.

Table 6.2.1 LVDS AC characteristics

6.3 Touch I2C Timing

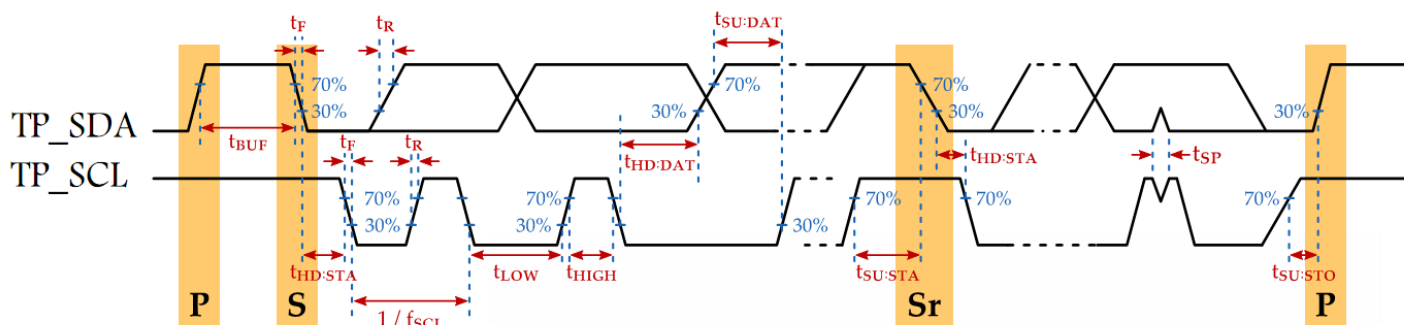


Figure 6.2.1 Touch I2C Timing

Parameter	Symbol	Standard-Mode I-BUS		Fast-Mode I-BUS		Fast-mode Plus I-BUS		Unit
		Min.	Max.	Min.	Max.	Min.	Max.	
SCL clock frequency.	f_{SCL}	0	100	0	400	0	1000	KHz
Hold time (Repeated) START condition. After this period, the first clock pulse is generated.	$t_{HD:STA}$	4.0	-	0.6	-	0.26	-	μs
LOW period of the SCL clock.	t_{LOW}	4.7	-	1.3	-	0.5	-	μs
HIGH period of the SCL clock.	t_{HIGH}	4.0	-	0.6	-	0.26	-	μs
Set-up time for a repeated START condition.	$t_{SU:STA}$	4.7	-	0.6	-	0.26	-	μs
Data hold time.	$t_{HD:DAT}$	0	-	0	-	0	-	μs
Data set-up time.	$t_{SU:DAT}$	250	-	100	-	50	-	ns
Rise time of both SDA and SCL signals.	t_R	-	1000	20	300	-	120	ns
Fall time of both SDA and SCL signals.	t_F	-	300	10.9	300	10.9	120	ns
Set-up time for STOP condition.	$t_{SU:STO}$	4.0	-	0.6	-	0.26	-	μs
Bus free time between STOP and START condition.	t_{BUF}	4.7	-	1.3	-	0.5	-	μs
Pulse width of spikes that must be suppressed by the input filter.	t_{SP}	-	-	0	50	0	50	ns
Capacitive load for each bus line.	C_b	-	400	-	400	-	500	pF

Table 6.3.1 Touch I2C Timing table

Note: Touch I2C address: 0x90

7. Optical Characteristics

Item	Symbol	Condition	Min	Typ	Max	Unit	Remark
Viewing Angle	θU	$CR \geq 10$	70	80	--	°	Note 1&2&3
	θD		70	80	--		
	θL		70	80	--		
	θR		70	80	--		
Contrast Ratio	Vertical	25°C	1200	1500	--	--	Note 1&2&3&10 (before WPC)
	A+ H +/- 10°, V +8/-4°		800	1000	--		
	A H +/- 40°, V +20/-10°		500	700	--		
	B H +/- 50°, V +20/-10°		200	400	--		
Response Time	T_{on+off}	25°C	--	30	35	ms	Note 1&4 @Environment temp.
	T_{on+off}	0°C	--	45	55		
	T_{on+off}	-20°C	--	135	150		
	T_{on+off}	-30°C	--	240	270		
Chromaticity	White	X	0.280	0.310	0.340	--	Note 1&5 Before WPC
		y	0.300	0.330	0.360		
	Red	X	0.639	0.669	0.699		
		y	0.272	0.302	0.332		
	Green	X	0.264	0.294	0.324		
		y	0.626	0.656	0.686		
	Blue	X	0.115	0.145	0.175		
		y	0.046	0.076	0.106		
	NTSC		80	85	--	%	
Luminance	L	25°C	850	1000		cd/m ²	Note 1&6
	H +/- 10°, V +8/-4°		780	900			
	H +/- 40°, V +20/-10°		325				
	H +/- 50°, V +20/-10°		220				
Uniformity (MOD+cover)	white	25°C, @ 15 point	80	--	--	%	Note 1&7
	Black	25°C, @ 15 point	TBD	--	--	%	
Flicker	JEITA	25°C @ L128	--	--	-30	dB	Note8

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Gamma	VESA	25°C	1.9	2.2	2.5		Note 1,Note11 VESA
Reflectivity	SCI	25°C	--	--	3.0	%	With Cover Note 9
Cover-Transmittance	Vertical	25°C	90			%	
Haze	Vertical	25°C		5		%	
Seamless	$\Delta E L a^* b^*$	25°C		2.5			Note10

Test Conditions:

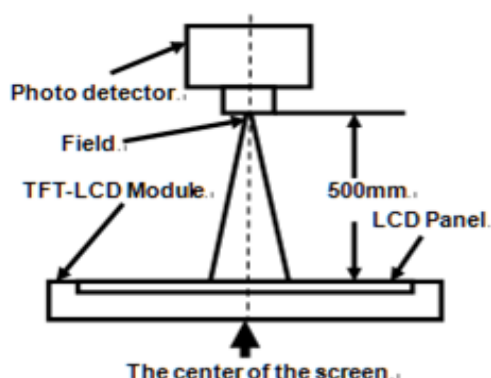
1. $I_F = 95mA$ (one channel), the ambient temperature is 25°C.
2. The test systems refer to Note 1 and Note 2.

Note1: Definition of optical measurement system

Measured at the center of the panel by SR-3

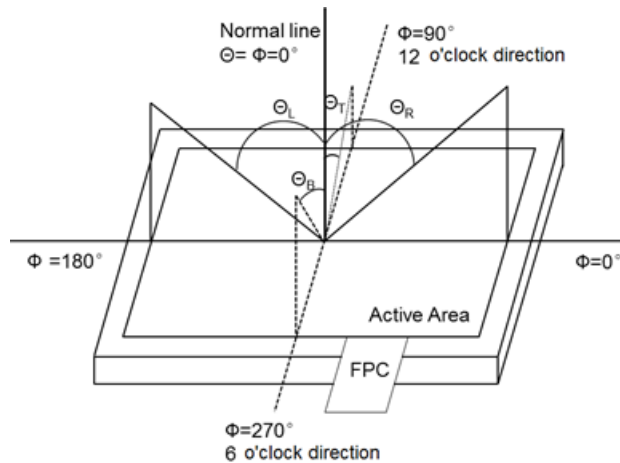
Measuring condition:

- Measuring surroundings: Dark room.
- Measuring temperature: $T_a = +25^\circ C$.
- Adjust operating voltage to get optimum contrast at the center of the display.
- Measured value at the center point of LCD panel after more than 10 minutes while backlight is turned on.



Item	Photo detector	Field	High
Contrast Ratio	SR-3 series	1°	H=500mm
Luminance			
Chromaticity			
Luminance Uniformity	SR-3 series	1°	H=500mm
Contrast Plot	EZ-Contrast/DMS	6mm/3mm	H=1mm/H≈80mm
Response Time	LCD5200	3mm	H=200mm
Reflectivity	CM-3600A	8mm/25.4mm	H=0mm

Note2: Definition of viewing angle range and measurement system



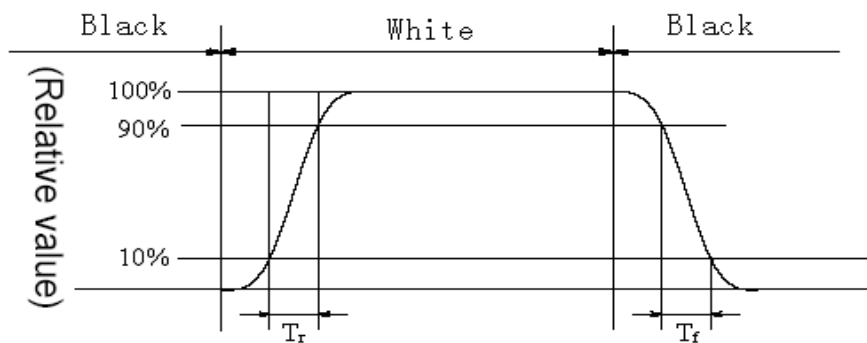
Note3: Definition of contrast ratio:

$$\text{Contrast Ratio(CR)} = \frac{\text{Luminance When LCD is White}}{\text{Luminance When LCD is Black}}$$

Contrast Ratio is measured in the optimum common electrode voltage

Note4: 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 10% to 90%. And fall time (T_{OFF}) is the time between photo detector output intensity changed from 90% to 10%. Please see the illustration below:



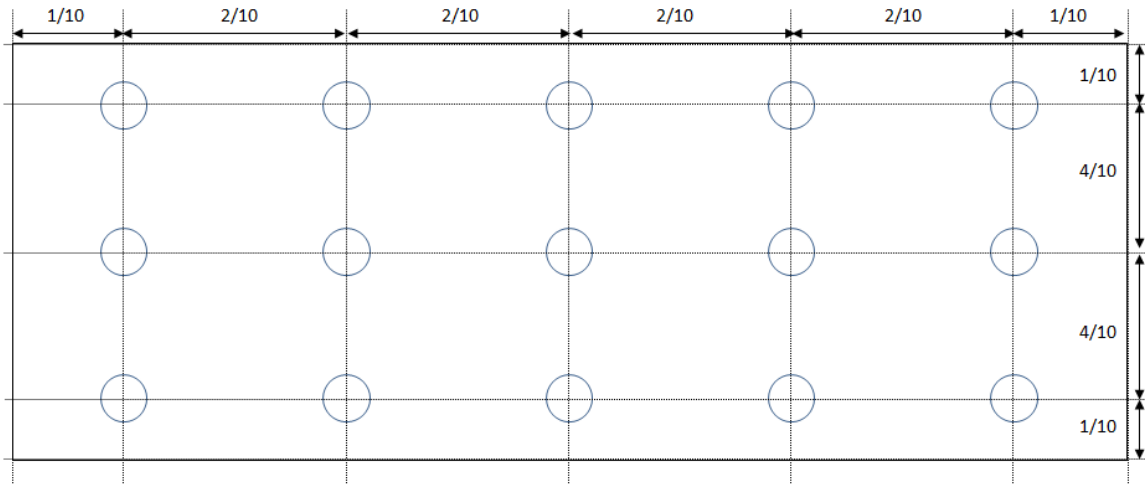
Note5: Definition of color chromaticity (CIE1931)
Color coordinates measured at the center point of the LCD.

Note6: Definition of Luminance
Measure the luminance at white state at the center point.

Note7: Definition of Luminance Uniformity
The luminance uniformity is calculated by using the following formula.

$$\text{Luminance uniformity (Lu)} = \frac{\text{Minimum luminance from (1) to (15)}}{\text{Maximum luminance from (1) to (15)}}$$

Luminance is measured at the 15 points shown below.



Note8: The value % base on CR measurement method, dB base on JEITA method, flicker test at half grey pattern.

Note9: SCI reflective ratio measure method.

Measurement system: CM 3600A fully integral sphere

Light source: D65

d/8°(ASTM E 1164-09)

Observing angle: 10°

State: LCD powered off

Standard d/8° Integration Sphere Spectroscopic – Reflectometer

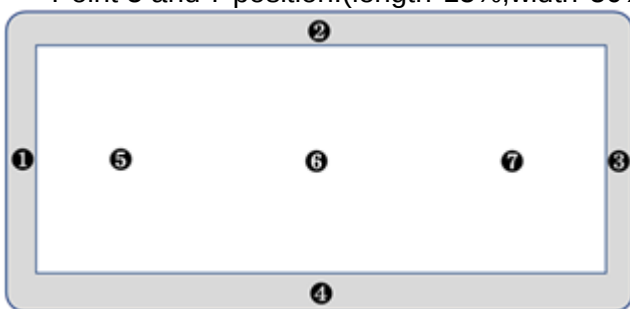
Note10: One black measure and calculation method, based on Note 9

$$\Delta E = \sqrt{(L^* - L_0^*)^2 + (a^* - a_0^*)^2 + (b^* - b_0^*)^2}$$

BM area L^*, a^*, b^* = Average value from ① to ④;

AA area : L_0^*, a_0^*, b_0^* = Average value from ⑤ to ⑦;

Point 5 and 7 position: (length*15%, width*50%)



Note11: Gamma test 0 4 8.....255(every 4 gray scale as 1 level, total 64 level), take the center value.

8. Reliability Test

Contents of Reliability Test

No	Test Item	Test condition	Criterion
1	High Temperature Storage	90°C±2°C 500H RH≤45% for LCM+CTP Restore 2H at 25°C non-operation (功能 OK, 可能会有 mura 问题, 预计 24h 后消失)	Note1, Note2, Note4, IEC60068-2-1,GB2423.2
2	Low Temperature Storage	-40°C±3°C 500H Restore 2H at 25°C non-operation	Note1, Note2, Note4 IEC60068-2-1,GB2423.1
3	High Temperature Operation	85°C±2°C 500H RH≤45% Restore 2H at 25°C operation	Note1, Note2, Note4, Note7 IEC60068-2-1,GB2423.2
4	Low Temperature Operation	-30°C±3°C 500H Restore 2H at 25°C operation -40°C LCD function OK	Note1, Note2, Note4 IEC60068-2-1,GB2423.1
5	High Temperature & Humidity Operation	60°C±2°C, 90±2%RH 500H Restore 2H or more at 25°C	Note1, Note2, Note4 IEC60068-2-78,GB/T2423.3
6	Thermal Shock (non-operational)	-40° C→ change→+85° C 30min 5min 30min 100cycle non-operation	Note1, Note2, Note4 Start with cold temperature End with high temperature, IEC60068-2-14,GB2423.22
7	Vibration Test (non-operational)	Frequency: 8 - 33.3 Hz, Total amplitude: 1.3mm Frequency: 33.3 - 400 Hz, Acceleration: 29.4 m/s ² sweep time: 15 minutes 2 hours each for X and Z directions, 4 hours for Y direction (total 8 hours) non-operation	Note1, Note2 Not apply to FOG project
8	Shock Test (non-operational)	100 x 9.8m/s ² , t=6ms, XYZ directions, Half sin curve, [non-operating],each directions 3 times	Note1, Note2 IEC 60068-2-27 Not apply to FOG project
9	ESD (operational)	non operating : C=150pF±10%,R=330Ω±10%, 5 point/panel Contact: +/-8KV,5times, class B Air: +/-15KV, 5times, class B operating : C=330pF±10%,R=330Ω±10%, 5 point/panel Contact: +/-8KV,5times, class B	Note1, Note2, Note3

AUTOMOTIVE DISPLAY MODULE

		Air: +/-15KV, 5times, class B +/-25KV, 5times, class C 不做承诺, 搭配客户整机验证达成	
10	Image Sticking	Viewing distance: 35cm Ambient illumination: 100 lux Ambient temperature: +65°C Light source condition: Full Luminance Viewing Angle: 0° Zone: Active area Picture Pattern: 8×6 checker pattern (Black and White) Burn-in time: 1hrs Judge at 5min @mid gray pattern Criteria: Less level2	Note6

Note1: After completion of the test, the sample shall be free from the following defects:

- 1) Air bubble in the LCD
- 2) Seal leak
- 3) Non-display
- 4) Missing segments
- 5) Glass crack
- 6) Yellowish appearance will not be taken into consideration after RA tests

Note2: Use sample for only one reliability test.

Note3: In case of an abnormal display caused by discharge, if it can recover to normal state after reset, it is considered "PASS". The use of an ionizer (antistatic blower) is recommended during this test. When removing the protection film from LCM panel, do it at a slow speed (preferably more than one second) and blow with ionizer toward the peeling face to minimize ESD which may damage the electrical circuit.

Note4: For duration test in the chamber

- a. Keep a small distance between each sample and don't place the samples close to the wall or the wick. Don't open the chamber unless absolutely necessary.
- b. During the test, avoid moisture condensation on the polarizer.
- c. After taking the samples out of the chamber and returning to room temperature and humidity, wait at least two hours before inspecting and measuring data.
- d. Perform de-rating during high temp. operation test.

Note5: Polarizer color minor change (Such as yellowish) will consider as pass if the optical test data is within spec.

Note6: Image Sticking Level Definition:

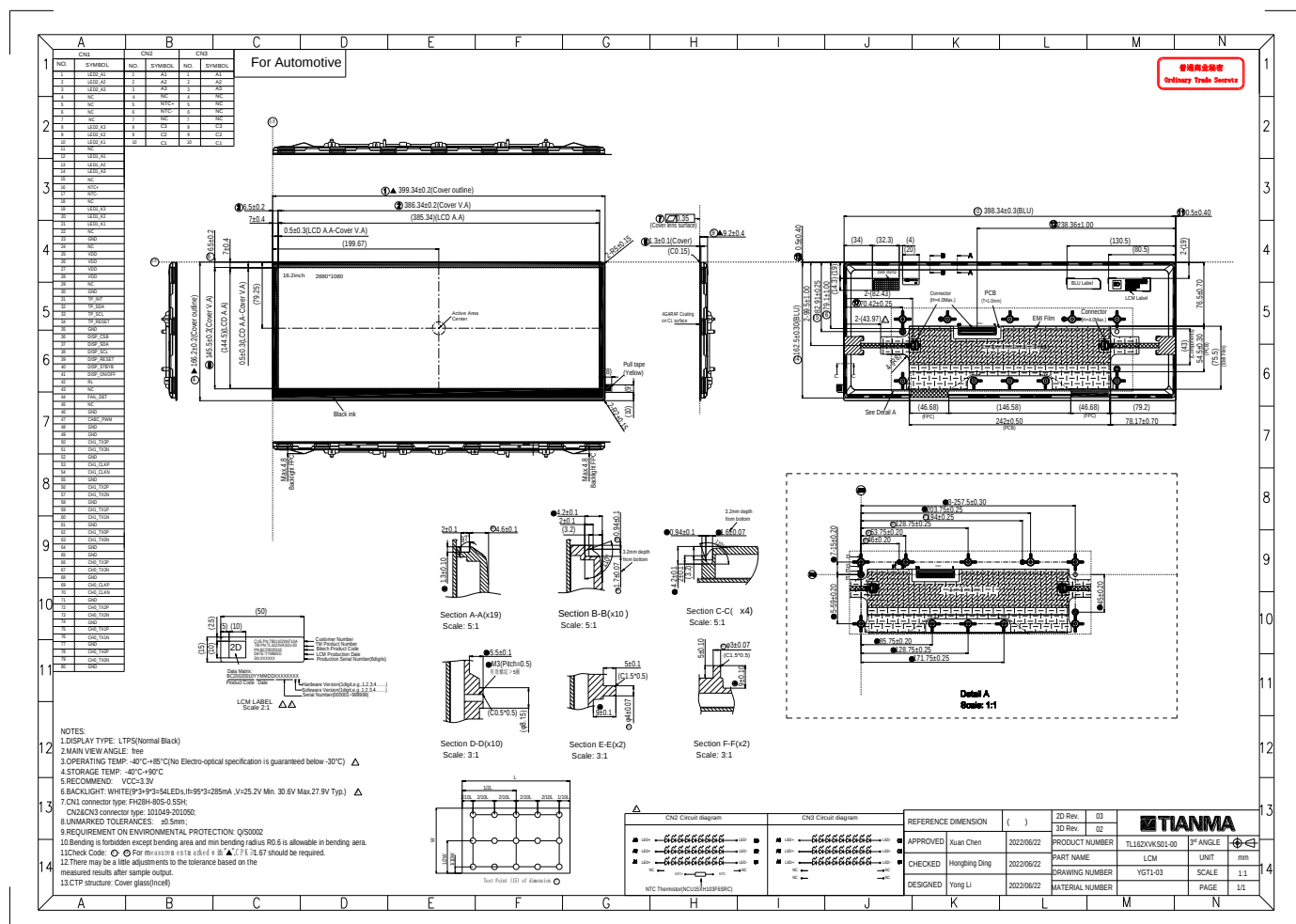
Level	Description	Remark
L0	Completely invisible	For the defined viewing distance and viewing angle
L1	Invisible from perpendicular viewing direction	For the defined viewing distance and viewing angle
L2	Visible by a closer look	Invisible by 30cm distance and viewing angle

L3	Slightly Visible	30cm distance and viewing angle
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Note7: LED forward current should follow the De-rating curve and the NTC resistance should not be below 1.268K Ω .

Note8: Tianma suggests that EMC related test to be carried out on customer's unit and Tianma will assist to improve EMC performance if required.

9. Mechanical Drawing



10. Product Inspection Criteria

10.1 Inspection Conditions

10.1.1 Ambient conditions:

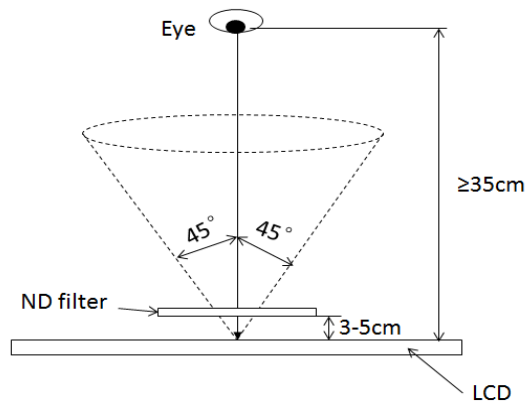
- Temperature: Room temperature $25 \pm 5^{\circ}\text{C}$
- Humidity: $(60 \pm 10) \% \text{RH}$
- Illumination:
Display backlight unit on, illumination on the display: $150 \pm 50 \text{lux}$
Display backlight unit off, illumination on the display light-off: 800-1200lux

10.1.2 Viewing distance

The distance between the LCD and the inspector's eyes shall be 35cm or more.

10.1.3 Viewing Angle

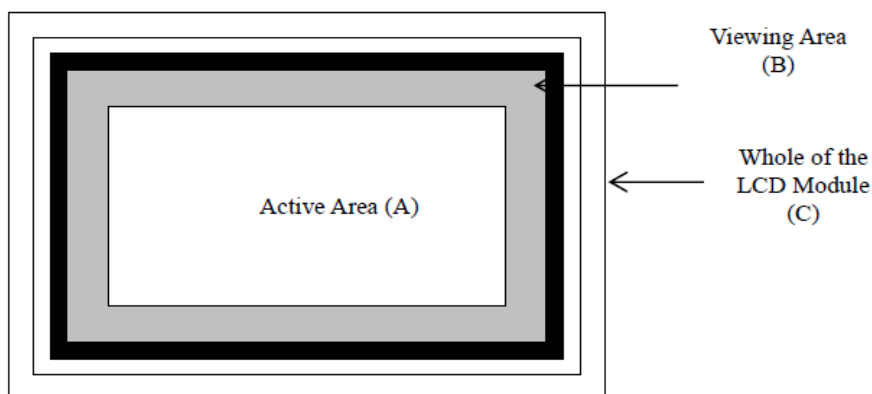
U/D: $30^{\circ}/30^{\circ}$, L/R: $45^{\circ}/45^{\circ}$



10.1.4 Light-on condition

The luminance of the module should refer to the recommended value in this specification.

10.1.5 Definition of LCD zone



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. (Including CTP Black painting area)

C-zone: Whole of the LCD Module except the zone A and B. (Including FPC& Metal Frame & backside of the LCD Module)

10.2 Defect Criteria

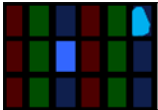
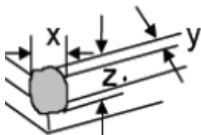
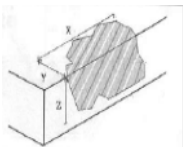
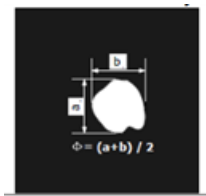
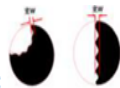
Defects are classified as major defects and minor defects according to the definition hereunder:

10.2.1 Major Defect

No.	Inspection Items	Inspection Standard
1	All functional defects	1) No display 2) Abnormal display 3) Short circuit 4) Line defect
2	Crack	Glass crack

10.2.2 Minor Defect

No.	Inspection Item	Inspection Standards	Acceptable Qty.	Applied Zone	Inspection Mode	Note	Applied Type
1	Bright spots	$\varphi \leq 0.25$	Ignore	A	Light-on		MDL MDL+CTP CFOG
		$0.25 < \varphi \leq 0.5$	4(Minimum distance between defects 5mm.)				
		$0.50 < \varphi$	None				
2	Dark spots	$\varphi \leq 0.25$	Ignore	A/B	Light-on		MDL MDL+CTP CFOG
		$0.25 < \varphi \leq 0.5$	4(Minimum distance between defects 5mm.)				
		$0.50 < \varphi$	None				
3	Lints & Scratches	$W \leq 0.1$ and $L \leq 5$	Ignore	A/B	Light-on Light-off		MDL MDL+CTP CFOG
		$0.1 < W \leq 0.20$ and $L \leq 10$	4(Minimum distance between defects 5mm.)				
		$0.20 < W$ or $L > 10$	None				
4	Dent\Bubble	$\varphi \leq 0.25$	Ignore	A/B	Light-on Light-off		MDL MDL+CTP CFOG
		$0.2 < \varphi \leq 0.5$	4(Minimum distance between defects 5mm.)				
		$0.50 < \varphi$	None				
5	Dirty\Dust	Those wiped out easily are acceptable					MDL MDL+CTP CFOG
6	Electrical Sub pixel Dot Defect	Inspection pattern: Red, green and blue screens		A	Light-on	Black Sub pixel dot 	MDL MDL+CTP CFOG
		Black Sub pixel	4				

		dot defect				Bright Sub pixel dot		
		Bright Sub pixel dot defect	0					
		Total Sub pixel Dot	4					
7	Glass defect	Corner Fragment:						CFOG MDL W/O top bezel
		X≤3mm	Ignore	A/B	Light-off			
		Y≤3mm	T: Glass thickness					
		Z≤T	X: Length Y: Width Z: thickness					
		Side Fragment:						
		X≤6.0mm	Ignore	A/B	Light-off			
		Y ≤1mm	T: Glass thickness					
		Z≤T	X: Length Y: Width Z: thickness					
8	Mura	Visible through ND5% at full black pattern Illumination: 150±50lux	None	A	Light-on		MDL MDL+CTP CFOG	
9	SECC/SGLC Rust	Rust	Ignore	A/B	Light-off	/	MDL MDL+CTP	
10	Pinhole	φ ≤ 0.2	Ignore	B	Light-off		MDL MDL+CTP	
		0.2 < φ ≤ 0.35	4(Minimum distance between defects 5mm.)					
		0.35 < φ	None					
11	Ink jag or bump point	W≤0.2	Ignore	B	Light-off		MDL MDL+CTP	
		W>0.25	None					
12	Total defects	Spots & Lints & scratches & dent		A	Light-on/ Light-off	/	MDL MDL+CTP CFOG	

Note1: When the size of a specific dot defect is bigger than 50% of the total dot, it is considered as a dot defect.

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.

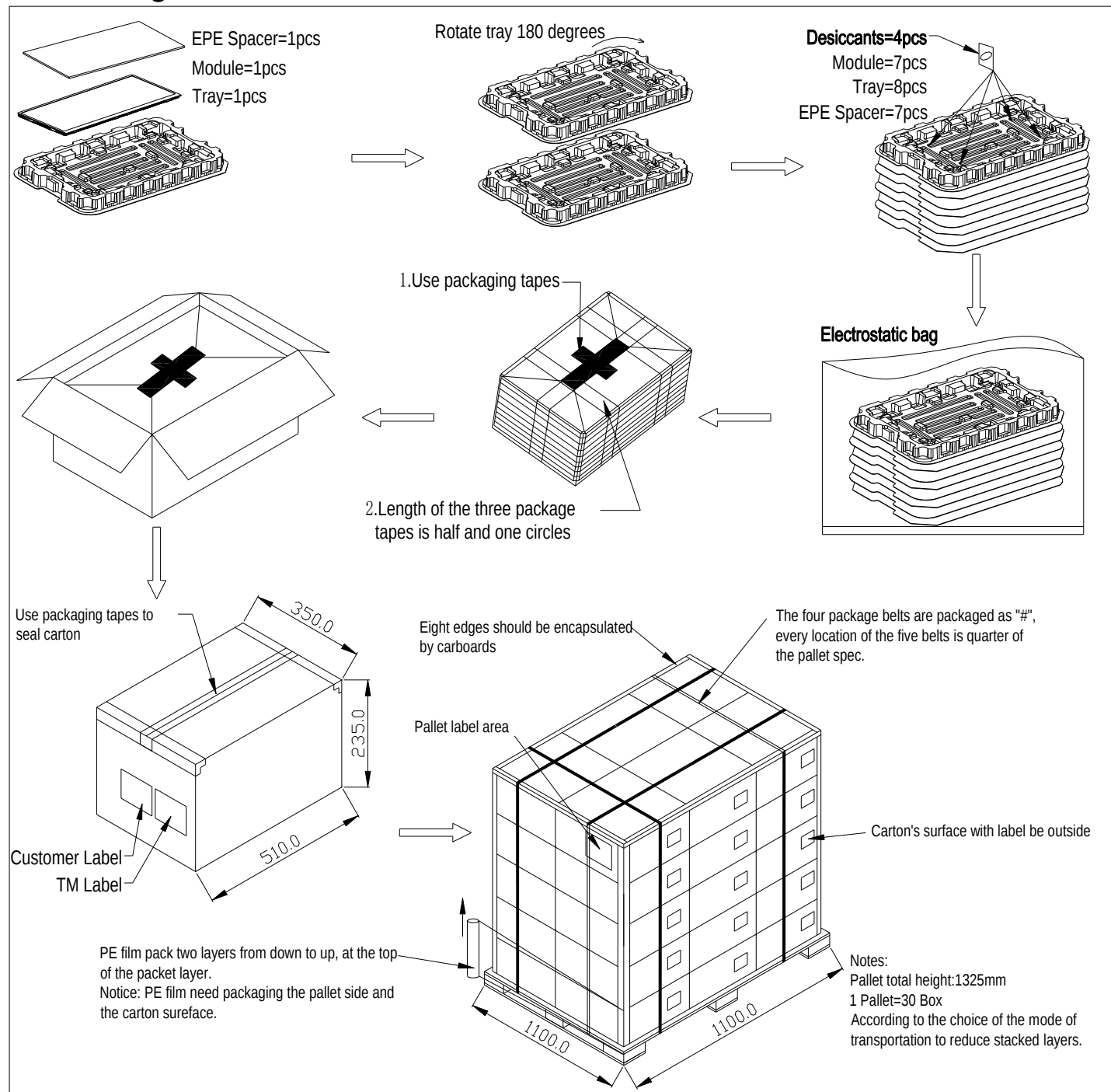
Note3: If any problems or doubts arise with the LCD, the customer and supplier will cooperate and make efforts to solve it with mutual confidence and respect.

Issues which are not defined in these criteria shall be discussed with parties, customer and supplier, for a better solution.

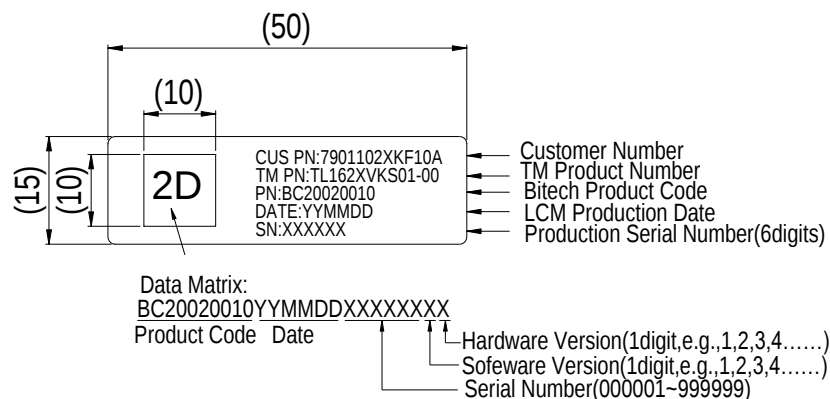
Note4: The distance between black dot defects should be more than 5mm.

Note5: Mura is checked via ND5%. Tianma will update this value based on actual measurement during sample phase.

11. Packing Instruction



Module label information



12. Appendix

The Relationship of Temperature and Resistance for NTC

TEMP (deg.C)	Resistance (kohm)	TEMP (deg.C)	Resistance (kohm)	TEMP (deg.C)	Resistance (kohm)	TEMP (deg.C)	Resistance (kohm)
-40.000	195.652	2.000	24.988	44.000	5.086	86.000	1.413
-39.000	184.917	3.000	23.951	45.000	4.917	87.000	1.375
-38.000	174.845	4.000	22.963	46.000	4.754	88.000	1.338
-37.000	165.391	5.000	22.021	47.000	4.597	89.000	1.303
-36.000	156.513	6.000	21.123	48.000	4.446	90.000	1.268
-35.000	148.171	7.000	20.267	49.000	4.301	91.000	1.234
-34.000	140.330	8.000	19.450	50.000	4.161	92.000	1.202
-33.000	132.958	9.000	18.670	51.000	4.026	93.000	1.170
-32.000	126.022	10.000	17.926	52.000	3.896	94.000	1.139
-31.000	119.494	11.000	17.214	53.000	3.771	95.000	1.110
-30.000	113.347	12.000	16.534	54.000	3.651	96.000	1.081
-29.000	107.565	13.000	15.886	55.000	3.535	97.000	1.053
-28.000	102.116	14.000	15.266	56.000	3.423	98.000	1.026
-27.000	96.978	15.000	14.674	57.000	3.315	99.000	0.999
-26.000	92.132	16.000	14.108	58.000	3.211	100.000	0.974
-25.000	87.559	17.000	13.566	59.000	3.111	101.000	0.949
-24.000	83.242	18.000	13.049	60.000	3.014	102.000	0.925
-23.000	79.166	19.000	12.554	61.000	2.922	103.000	0.902
-22.000	75.316	20.000	12.081	62.000	2.834	104.000	0.880
-21.000	71.677	21.000	11.628	63.000	2.748	105.000	0.858
-20.000	68.237	22.000	11.195	64.000	2.666	106.000	0.837
-19.000	64.991	23.000	10.780	65.000	2.586	107.000	0.816
-18.000	61.919	24.000	10.382	66.000	2.509	108.000	0.796
-17.000	59.011	25.000	10.000	67.000	2.435	109.000	0.777
-16.000	56.258	26.000	9.634	68.000	2.364	110.000	0.758
-15.000	53.650	27.000	9.284	69.000	2.294	111.000	0.740
-14.000	51.178	28.000	8.947	70.000	2.228	112.000	0.722
-13.000	48.835	29.000	8.624	71.000	2.163	113.000	0.705
-12.000	46.613	30.000	8.315	72.000	2.100	114.000	0.688
-11.000	44.506	31.000	8.018	73.000	2.040	115.000	0.672
-10.000	42.506	32.000	7.734	74.000	1.981	116.000	0.656
-9.000	40.600	33.000	7.461	75.000	1.925	117.000	0.640
-8.000	38.791	34.000	7.199	76.000	1.870	118.000	0.625
-7.000	37.073	35.000	6.948	77.000	1.817	119.000	0.611
-6.000	35.442	36.000	6.707	78.000	1.766	120.000	0.596
-5.000	33.892	37.000	6.475	79.000	1.716	121.000	0.583
-4.000	32.420	38.000	6.253	80.000	1.669	122.000	0.569
-3.000	31.020	39.000	6.039	81.000	1.622	123.000	0.556
-2.000	29.689	40.000	5.834	82.000	1.578	124.000	0.544
-1.000	28.423	41.000	5.636	83.000	1.535	125.000	0.531
0.000	27.219	42.000	5.445	84.000	1.493		
1.000	26.076	43.000	5.262	85.000	1.452		

13. Precautions for Use of LCD Module

13.1 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

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

- Water
 - Ketone
 - Aromatic solvents
- (6) POL surface temperature shall not exceed 95°C when the product is used or tested.
 - (7) The storage or use environment must not contain an acid or base environment. for example,NH₃,SO₂...
 - (8) Do not attempt to disassemble the LCD Module.
 - (9) If the logic circuitry is powered off, do not apply the input signals.
 - (10) To prevent destruction of the module by static electricity, be careful to maintain an optimum work environment.
 - (11) Be sure to ground your body when handling the LCD Modules.
 - (12) Tools used for assembly, such as soldering irons, must be properly grounded.
 - (13) To reduce the amount of static electricity generated, do not conduct assembly or other work under very low humidity conditions.
 - (14) The LCD Module is covered with a film to protect the display surface. Be careful when peeling off this protective film since static electricity may be generated.

13.2 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. 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
- (3) The LCD modules should be stored in a room without acid, alkali or other harmful gases.

13.3 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.

14. Contact Us

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