B2 12.8 FHD TLCM Product Specification Rev.P0

SUPPLIER	Chengdu BOE Optoelectronics Technology CO., LTD
FG-Code	AV128FHT-L12

ITEM	BUYER SIGNATURE	DATE

ITEM	SUPPLIER SIGNATURE	DATE
Prepared		
Reviewed		
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REV.	ECN NO.	DESCRIPTION OF CHANGES	DATE	PREPARED
P0	-	Initial Release	2019.08.21	白磊
		Page10:Update The direction setting Page12:Upadte LVDS Signal Timing Page 23&24：Update ESD Spec	2020.07.09	刘媛媛
		Page 22: Update the MS drawing (change the studs aperture size Tolerance ±0.05→ ±0.1)	2020.08.12	王凯文
		Page15：Update Power on/off sequence（T5&T9 TBD（Typ）→—） Page 23:Update Image Sticking Spec	2020.09.16	刘媛媛

Contents

1.0 GENERAL DESCRIPTION

1.1 Introduction

12.8 inch module is a color active matrix TFT LCD TDDI module using amorphous silicon TFT‘s (Thin Film Transistors) as an active switching devices. It is a transmissive type display operating in the normal black. The TFT-LCD has a 12.8 inch diagonally measured active area with resolutions (1920 horizontal by 1080 vertical pixel arrays). Each pixel is divided into RED, GREEN, BLUE dots which are arranged in vertical stripe and this panel can display 16.7M colors.

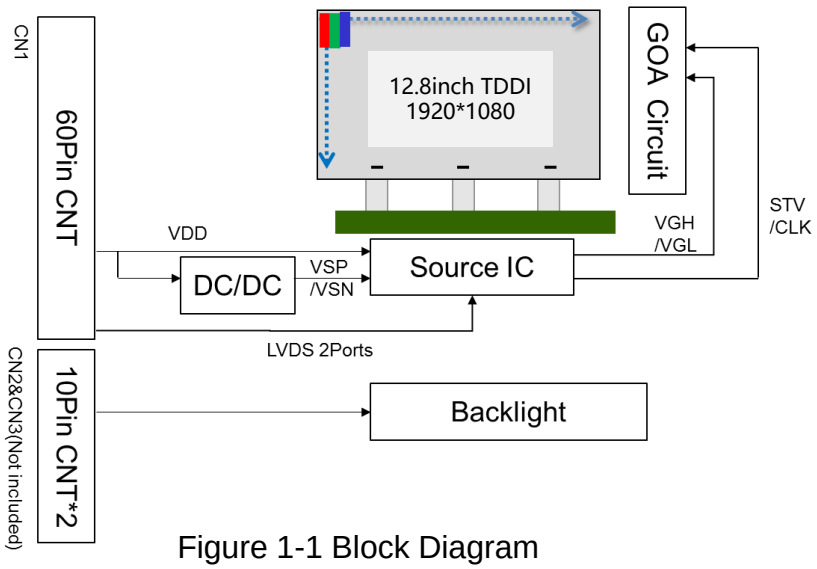


Figure 1-1 Block Diagram

1.2 Features

- Wide viewing angle (U/D/L/R)：85/85/85/85
- Color Gamut：75%
- RoHS/Halogen Free
- LVDS Interface

1.3 Application

- **Vehicle-mounted Production**

1.4 General Specification

Table 1-1 General Specifications

Parameter		Specification	Unit	Remarks
Active area		283.392(H) × 159.408(V)	mm	16:9
Number of pixels		1920(H) × RGB ×1080(V)	pixels	
Pixel pitch		0.1476(H) ×0.1476 (V)	mm	
Pixel arrangement		RGB Vertical stripe		
Display colors		16.7M	colors	
Color gamut		75%	%	Typ.
Display mode		Normally black		
Module outline		321.46*181.0513*13.29	mm	
Viewing Direction (Human Eye)		U/D/L/R Min 80/80/80/80 Typ 85/85/85/85		
TLCM	Surface Treatment	Etching AG + coating AR/AF		Total (In cell TFT+CG)
	Reflection	SCI<2.2	%	
		SCE<0.9		
	Hardness	3H（500g）		
	AF WCA	≥110	°	
	Haze	5	%	Typ.
	Gloss	≥90		@60°

Note:1.At the U/D/L/R direction, the viewing angle is same;

1.5.The TFT and CF Align Direction;

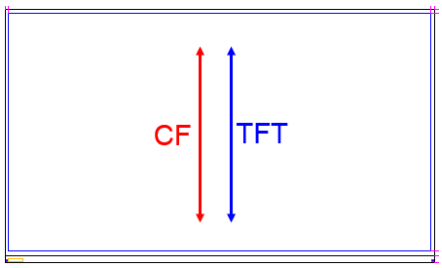


Figure 1-3 The TFT and CF Align Direction

2.0 ABSOLUTE MAXIMUM RATINGS

The followings are maximum values which, if exceed, may cause faulty operation or damage to the unit. The operational and non-operational maximum voltage and current values are listed in Table 2-1

Table 2-1 Environment Absolute Maximum Ratings

Parameter	Symbol	Min.	Max.	Unit	Remarks
LCD Logic Voltage	DVDD	-	3.6	V	Ta=25+/-2°C
Operating Temperature (Humidity)	T_{OP}	-30	+85	℃	
	RH	-	90	%	At 60°C
Storage Temperature (Humidity)	T_{ST}	-40	+95	℃	
	RH	-	90	%	At 60°C

3.0 ELECTRICAL SPECIFICATIONS

3.1 The LCD Module Electrical Interface Connection

Table 3-1 Pin Assignments for the LCD
(Recommended Connector typ: FH28-60S-0.5SH)

PIN	SYMBOL	I/O	Description	Remark
1	**GND**	**P**	Ground	
2	**GND**	**P**	Ground	
3	**GND**	**P**	Ground	
4	**GND**	**P**	Ground	
5	**VDD1**	**P**	Power Supply for LCD	Typ3.3V
6	**VDD1**	**P**	Power Supply for LCD	Typ3.3V
7	**VDD1**	**P**	Power Supply for LCD	Typ3.3V
8	**VDD2**	**P**	Power Supply for Touch IC	Typ3.3V
9	**GND**	**P**	Ground	
10	**XRESB**	**I**	Reset signal for Touch IC	H:Release reset L:Activate reset
11	**GND**	**P**	Ground	
12	**ATTN**	**I**	Attention Output Pin For Touch IC	H:Processing L:New Data Activate
13	**MISO**	**I/O**	SPI Data Output Pin For Touch IC	
14	**MOSI**	**I/O**	SPI Data Input Pin For Touch IC	
15	**SSB**	**I/O**	SPI Chip Select Pin For Touch IC	

PIN	SYMBOL	I/O	Description	Remark
16	**SCLK**	**I/O**	SPI Clock Pin For Touch I C	
17	**GND**	**P**	Ground	
18	**LVD0BN**	**I**	LVDS Receiver Signal(-)	
19	**LVD0BP**	**I**	LVDS Receiver Signal(+)	
20	**GND**	**P**	Ground	
21	**LVD1BN**	**I**	LVDS Receiver Signal(-)	
22	**LVD1BP**	**I**	LVDS Receiver Signal(+)	
23	**GND**	**P**	Ground	
24	**LVD2BN**	**I**	LVDS Receiver Signal(-)	
25	**LVD2BP**	**I**	LVDS Receiver Signal(+)	
26	**GND**	**P**	Ground	
27	**LVDCLKBN**	**I**	LVDS Receiver Signal(-)	
28	**LVDCLKBP**	**I**	LVDS Receiver Signal(+)	
29	**GND**	**P**	Ground	
30	**LVD3BN**	**I**	LVDS Receiver Signal(-)	
31	**LVD3BP**	**I**	LVDS Receiver Signal(+)	
32	**GND**	**P**	Ground	
33	**LVD3AP**	**I**	LVDS Receiver Signal(+)	
34	**LVD3AN**	**I**	LVDS Receiver Signal(-)	
35	**GND**	**P**	Ground	
36	**LVDCLKAP**	**I**	LVDS Receiver Clock(+)	
37	**LVDCLKAN**	**I**	LVDS Receiver Clock(-)	
38	**GND**	**P**	Ground	
39	**LVD2AP**	**I**	LVDS Receiver Signal(+)	
40	**LVD2AN**	**I**	LVDS Receiver Signal(-)	

PIN	SYMBOL	I/O	Description	Remark
41	**GND**	**P**	Ground	
42	**LVD1AP**	**I**	LVDS Receiver Signal(+)	
43	**LVD1AN**	**I**	LVDS Receiver Signal(-)	
44	**GND**	**P**	Ground	
45	**LVD0AP**	**I**	LVDS Receiver Signal(+)	
46	**LVD0AN**	**I**	LVDS Receiver Signal(-)	
47	**GND**	**P**	Ground	
48	**SPI_SCL**	**I/O**	SPI Clock Pin For LCD Driver IC	
49	**SPI_SDA**	**I/O**	SPI Data Signal Pin For LCD Driver IC	
50	**NC**	**NA**	Not Connect	
51	**GND**	**P**	Ground	
52	**XCS**	**I/O**	SPI Chip Select Pin For LCD Driver IC	H:Disable L:Enable
53	**GND**	**P**	Ground	
54	**XRES**	**I**	Device Reset For LCD Driver IC	H:Release reset L:Activate reset
55	**NC/VOTP**	**NA**	Not Connect(OTP for BOE，Voltage:7.25V)	
56	**BRS**	**I**	Feedback Signal From Driver IC	
57	**NC**	**NA**	Not Connect	
58	**NC**	**NA**	Not Connect	
59	**GND**	**P**	Ground	
60	**GND**	**P**	Ground	

Remark:
1. For “I/O”, “I” is input; “O” is output; “P” is power ; “NA” is passive

3.2 Scan direction setting as the picture below;

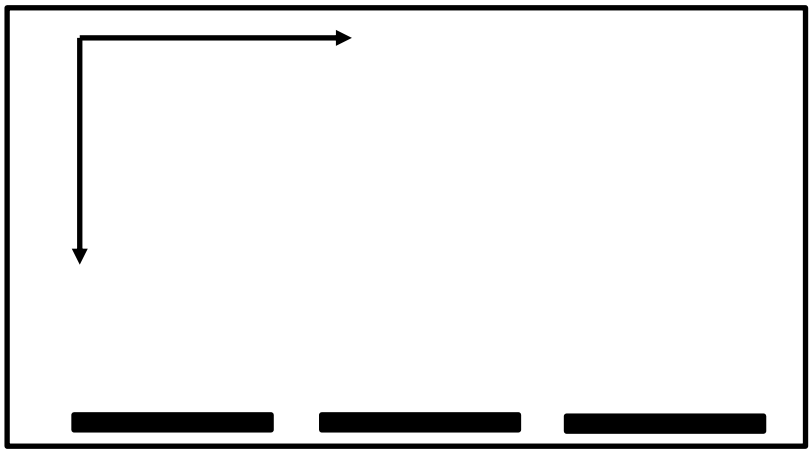


Figure 3-1 The direction setting

3.3 The backlight Pin map

Table 3-2 Pin Assignments for the BackLight
（Recommended Connector typ: FH28-10S-0.5SH（not included））

Connector 1				Connector 2			
PIN	**SYMBOL**	**I/O/P**	**Description**	**PIN**	**SYMBOL**	**I/O**	**Description**
1	**LED_A1**	**P**	LED Anode	1	**LED_A1**	**P**	LED Anode
2	**LED_A2**	**P**	LED Anode	2	**LED_A2**	**P**	LED Anode
3	**LED_A3**	**P**	LED Anode	3	**LED_A3**	**P**	LED Anode
4	**NC**	**-**	Not connect	4	**NC**	**-**	Not connect
5	**LED_K1**	**P**	LED cathode	5	**LED_K1**	**P**	LED cathode
6	**LED_K2**	**P**	LED cathode	6	**LED_K2**	**P**	LED cathode
7	**LED_K3**	**P**	LED cathode	7	**LED_K3**	**P**	LED cathode
8	**NC**	**-**	Not connect	8	**NC**	**-**	Not connect
9	**NTC1**	**O**	NTC Anode	9	**NC**	**-**	Not connect
10	**NTC2**	**O**	NTC cathode	10	**NC**	**-**	Not connect

Remark: For “I/O”, “I” is input; “O” is output; “P” is power

3.4 Electrical Specifications

Table 3-3 Electrical Specifications Ta=25+/-2°C

Parameter		Symbol	Values			Unit	Remark
			Min	Typ.	Max		
TFT Logic Power	Voltage	DVDD	3.0	3.3	3.6	V	
	Current	I_{DVDD}	400	-	800	mA	
Supply current of LED backlight		Per string	-	105	110	mA	6 strings
Total Supply current of LED Backlight		I_{LED}Total	-	630	660	mA	Note 1, 2
Supply voltage of LED backlight		Per string	16.6	18.4	19.6	V	6 strings
LED Life time		L80	10,000	-		Hrs	Note 3

Notes :

1: BLU LED consists of 36 LEDs, 6 strings * 6 LEDs, the typical drive current is 105mA per string, total current is 630mA; the Max drive current is used to remind limit the custom er of the maximum limit set;

2: Each string LED should be drove by constant current separately;

3: The lifetime is determined as the time at which luminance of LED become 80% of the initial brightness at IPIN=105mA on condition of continuous operating at 25±2°C.

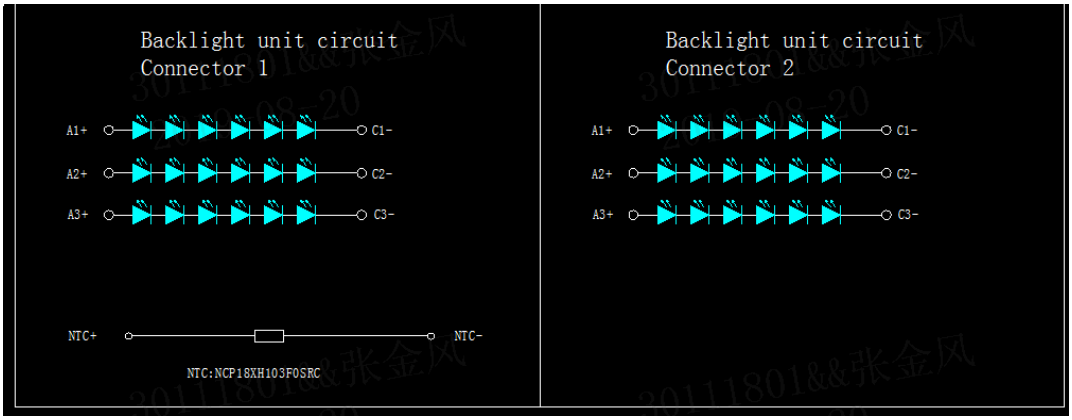


Figure 3-2 LED&NTC Diagram

Note 4:

A NTC thermistor is included in the LED circuit and the part number is NCP18XH103F0SRB, and its permissive operating current is 0.31Ma at Ta=25℃. NTC is used for the measuring LED temperature and is located in the middle of the LED circuit on backlight FPC. The relationship of temperature and resistance for NTC please refer to the table.

Temperature (℃)	NTC阻值 (KΩ)	Temperature (℃)	NTC阻值 (KΩ)	Temperature (℃)	NTC阻值 (KΩ)	Temperature (℃)	NTC阻值 (KΩ)
-40	195.652	5	22.021	50	4.161	95	1.110
-35	148.171	10	17.926	55	3.535	100	0.974
-30	113.347	15	14.674	60	3.014	105	0.858
-25	87.559	20	12.081	65	2.586	110	0.758
-20	68.237	25	10.000	70	2.228	115	0.672
-15	53.650	30	8.315	75	1.925	120	0.596
-10	42.506	35	6.948	80	1.669	125	0.531
-5	33.892	40	5.834	85	1.452		
0	27.219	45	4.917	90	1.268		

3.5 LVDS Signal Timing

Table 3-4 LVDS Signal Timing

Parameter		Symbol	Min.	Typ.	Max.	Unit	Remark
DCLK Frequency		1/tDCLK	-	71.6	-	MHz	
Horizontal	Display Area	thd		960		tDCLK	
	Period	th	-	1024	-	tDCLK	Note1
	Back Porch	thbp	-	16	-	tDCLK	
	Front Porch	thfp	-	32	-	tDCLK	
	Pulse Width	thpw	-	16	-	tDCLK	
Vertical	Display Area	tvd		1080		tHP	
	Period	tv	-	1166	-	tHP	Note1
	Back Porch	tvbp	-	8	-	tHP	
	Front Porch	tvfp	-	70	-	tHP	
	Pulse Width	tvpw	-	8	-	tHP	
	Frequency	fV	-	60	-	Hz	
Clock period		Tcph	16.67	-	-	ns	
Clock high time		TLVCH	-	4/(7*FLVDS)	-	ns	
Clock low time		TLVCL	-	3/(7*FLVDS)	-	ns	
PLL wake-up time		TPLLwkup	-	-	150	us	

3.6 Signal Format

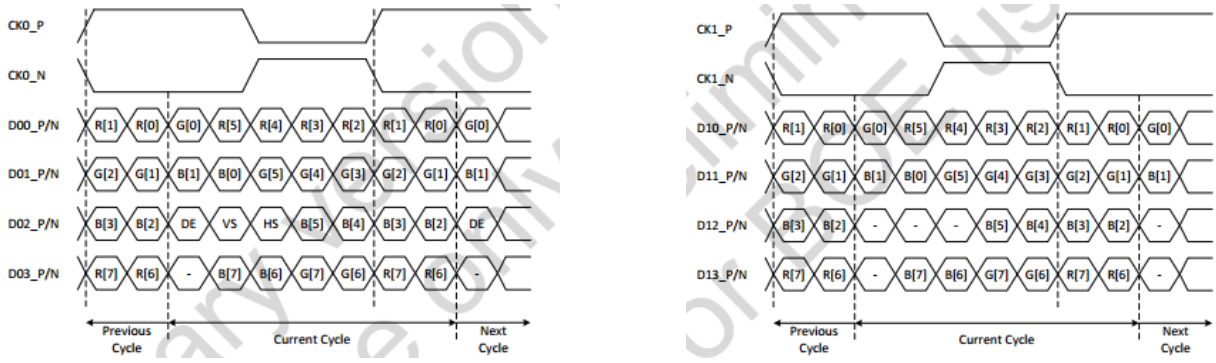


Figure 3-3 Signal Format

3.7 LVDS DC Characteristics

Table 3-5 LVDS DC Characteristics

Table: DC characteristics for LVDS

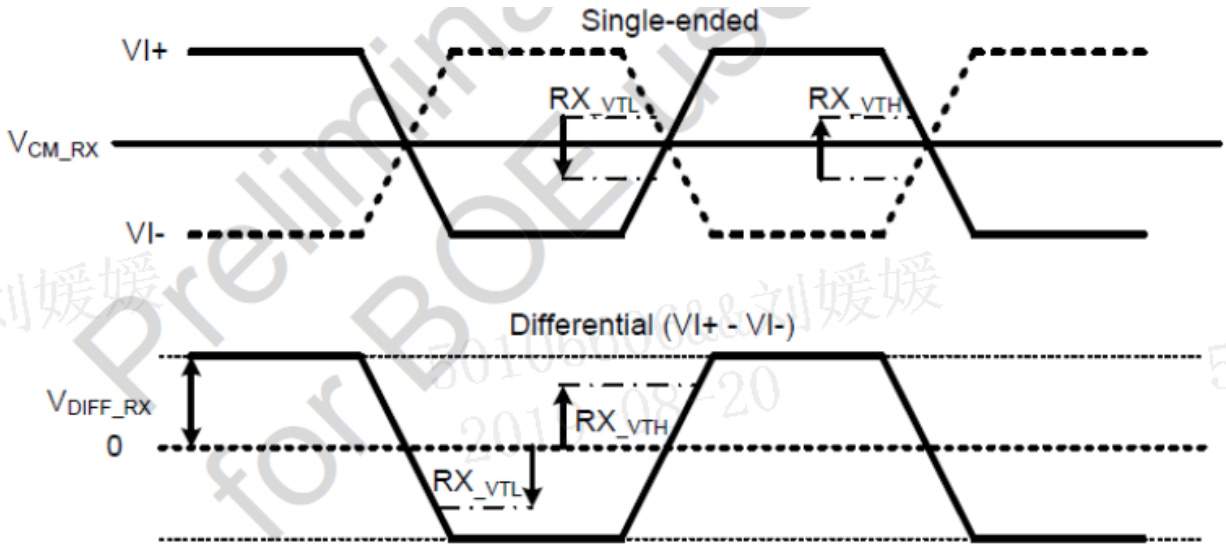
(VCI = 3.0~3.6V, AVDD=5.0~7.5V, AVEE=-5.0~-7.5V, VSS = AVSS = 0V, T_{OP} = 25℃)

Parameter	Symbol	Conditions	Specification			Unit
			Min.	Typ.	Max.	
For The Digital Circuit: LVDS Mode						
Operating frequency LVDS mode	FLVDS	By resolution	15	TBD	120 (TBD)	MHz
Differential input high threshold voltage (NOTE1)	RX_VTH	VCM_RX = 1.2v	-	-	+0.1	V
Differential input low threshold voltage (NOTE1)	RX_VTL	VCM_RX = 1.2v	-0.1	-	-	V
Differential input common mode voltage	VCM_RX		1	1.2	1.7-VID/2	V
Differential input voltage(1)	VID		0.2	-	0.6	V
Differential input leakage current	RXI_Ikg		-10	-	+10	μA

NOTE1: Input Differential Voltage VID = VI+ - VI-

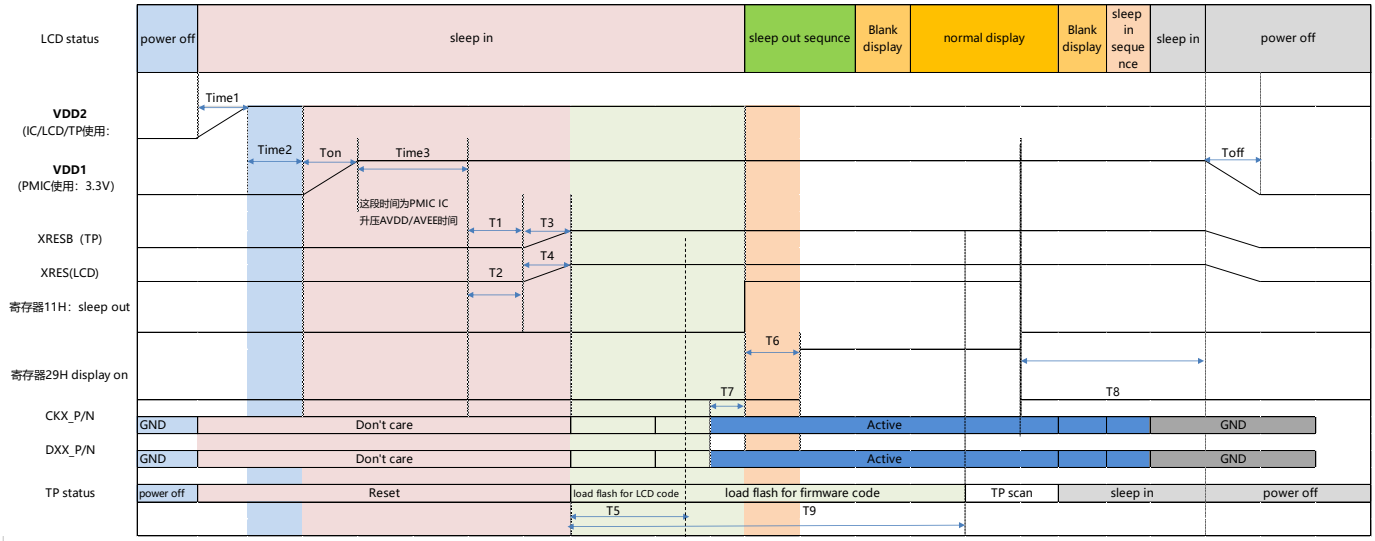
VI+ - VI- = VID < RX_VTL = "LOW"

VI+ - VI- = VID > RX_VTH = "HIGH"



3.8 Power on/off sequence

Figure 3-4 Power on/off sequence



parameter	Value			unit	Remark
	Min	Typ	Max		
Ton/Toff	0.5	—	—	ms	VDD建立上电时间/和VDD掉电时间
T1	5	—	—	ms	IC内部剩下部分完全建立电压时间
T2	5	—	—	ms	IC内部剩下部分完全建立电压时间
T3	0	—	1	ms	TP reset从0V到3.3V过程时间
T4	0	—	1	ms	LCD reset从0V到3.3V过程时间
T5	120	—	—	ms	load flash for LCD code
T6	50	—	—	ms	sleep out到display on的时间
T7	1	—	—	ms	sleep in之前送data的时间
T8	120	—	—	ms	Display off到VDD开始掉电部分
T9	450	—	—	ms	load flash for LCD code和 load flash for firmware code的时间
Time1	0.5	—	—	ms	VDD2从0V到3.3V建立的时间
Time2	1	—	3	ms	VDD2和VDD1时间差
Time3	5	—	—	ms	TFT PMIC IC 升压AVDD/AVEE时间

3.9 TP Specifications

Item	Specification	Remark
Uniformity	U=Xmax*min/Ymax*min; > 85%	@6mm铜柱
Accuracy	中心≤1mm 边缘≤1.5mm	@6mm铜柱
Linearity	中心≤1mm 边缘≤1.5mm	@6mm铜柱
Sensitivity	无断线，且中心≤1mm	@6mm铜柱
Multi-Points Min Distance	Distance between 2 points≤12mm	@6mm铜柱
Response Latency	First touch Response Latency < 20ms	
Jitter	≤1mm	@6mm铜柱
Glove	Single click, double click, single line	@6mm铜柱
Moisture	Single click, double click, single line	@6mm铜柱
NO. of touch	最少5指触控	

4.0 OPTICAL SPECIFICATIONS

4.1 Overview

The test of Optical specifications shall be measured in a dark room (ambient luminance ≤ 1lux and temperature = 25±2℃) with the equipment of Luminance meter system (Goniometer system and TOPCON BM-5) and test unit shall be located at an approximate distance 50cm from the LCD surface at a viewing angle of θ and Φ equal to 0°. The center of the measuring spot on the Display surface shall stay fixed.

The backlight should be operating for 30 minutes prior to measurement.

Table 4-1 Optical Specifications

Parameter		Symbol	Condition	Min.	Typ.	Max.	Unit	Remark
Viewing Angle range	Horizontal	Θ_3	CR > 10	80	85	-	Deg.	Note 1
		Θ_9		80	85	-	Deg.	
	Vertical	Θ_{12}		80	85	-	Deg.	
		Θ_6		80	85	-	Deg.	
Contrast ratio		CR	Θ = 0° (Center)	800	1000	-	-	Note 2
			H=-27° V=3.8°	500	700	-	-	-
White luminance uniformity		ΔY	Θ = 0° (Center) Normal Viewing Angle	80	-		%	Note 4
NTSC		%		70%	75%			-
White Chromaticity		x_w		Typ-0.03	0.303	Typ+0.03	-	Actual value based on samples test Note 5
		y_w			0.329			
Reproduction of color	Red	x_R			0.651			
		y_R			0.332			
	Green	x_G			0.314			
		y_G			0.632			
	Blue	x_B			0.148			
		y_B			0.077			
Response Time (Rising / Falling)		T_{RT}	25℃ -20℃ -30℃	-	-	30 250 500	ms	Note 6

Parameter	Condition	Min.	Typ.	Max.	Remark
Luminance	Θ = 0° (Center)	650 nit	800 nit	-	@TLCM Surface, 25℃
	H= - 27° V=3.8°	500 nit	600nit	-	
Flicker		-	-	-30dB	Interval Gray Pattern between L0 and L127, after 30s light up stably

Note :

1. Viewing angle is the angle at which the contrast ratio is greater than 10. The viewing are determined for the horizontal or 3, 9 o'clock direction and the vertical or 6, 12 o'clock direction with respect to the optical axis which is normal to the LCD surface.
2. Contrast measurements shall be made at viewing angle of θ= 0° and at the center of the LCD surface. Luminance shall be measured with all pixels in the view field set first to white, then to the dark (black) state. (See FIGURE 2 shown in Appendix) Luminance Contrast Ratio (CR) is defined mathematically.

$$CR = \frac{\text{Luminance when displaying a white raster}}{\text{Luminance when displaying a black raster}}$$

3. Center trans of white is defined as the LCD surface. Luminance shall be measured with all pixels in the view field set first to white. This measurement shall be taken at the locations shown in FIGURE 4 for a total of the measurements per display.
4. The White luminance uniformity on LCD surface is then expressed as :
   ΔY = (Minimum Luminance of 9points / Maximum Luminance of 9points) * 100
5. The color chromaticity coordinates specified in Table 4. shall be calculated from the spectral data measured with all pixels first in red, green, blue and white.
6. The electro-optical response time measurements shall be made as FIGURE 5 shown in Appendix by switching the "data" input signal ON and OFF. The times needed for the transmittance to change from 10% to 90% is Tr, and 90% to 10% is Tf.

4.2 OPTICAL TEST APPENDIX

Figure 4-1 The Definition of Vth & Vsat

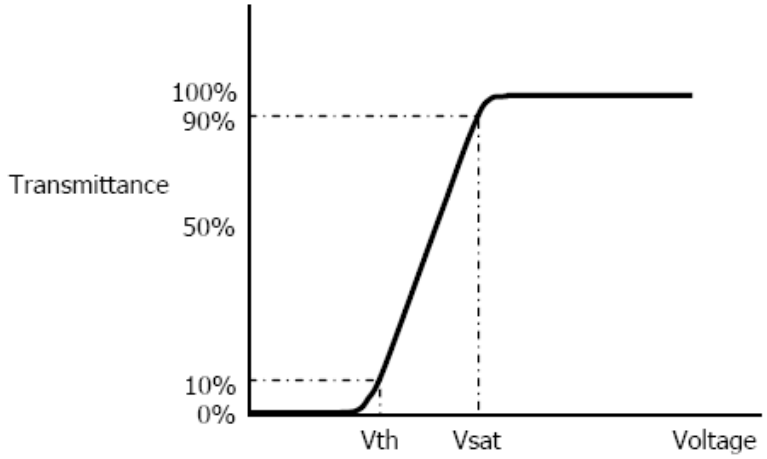


Figure 4-2 Measurement Set Up

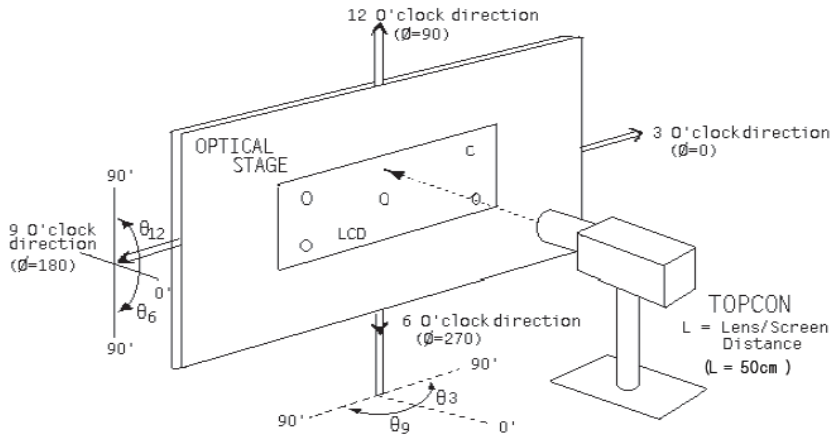


Figure 4-3 Response Time Testing

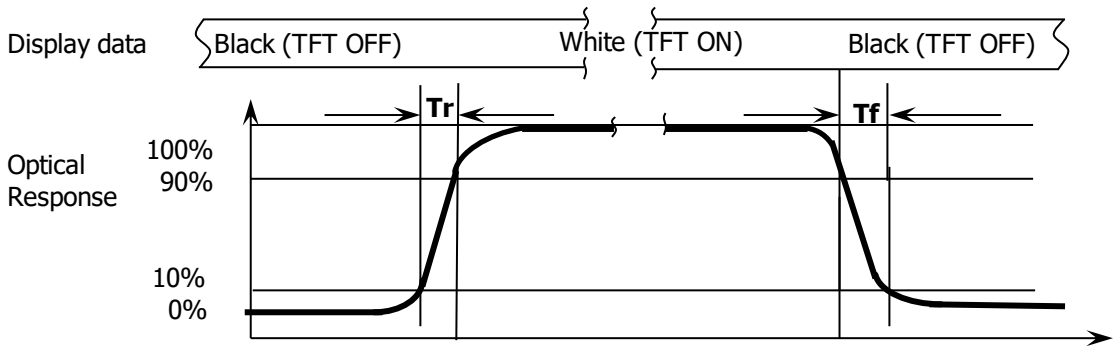
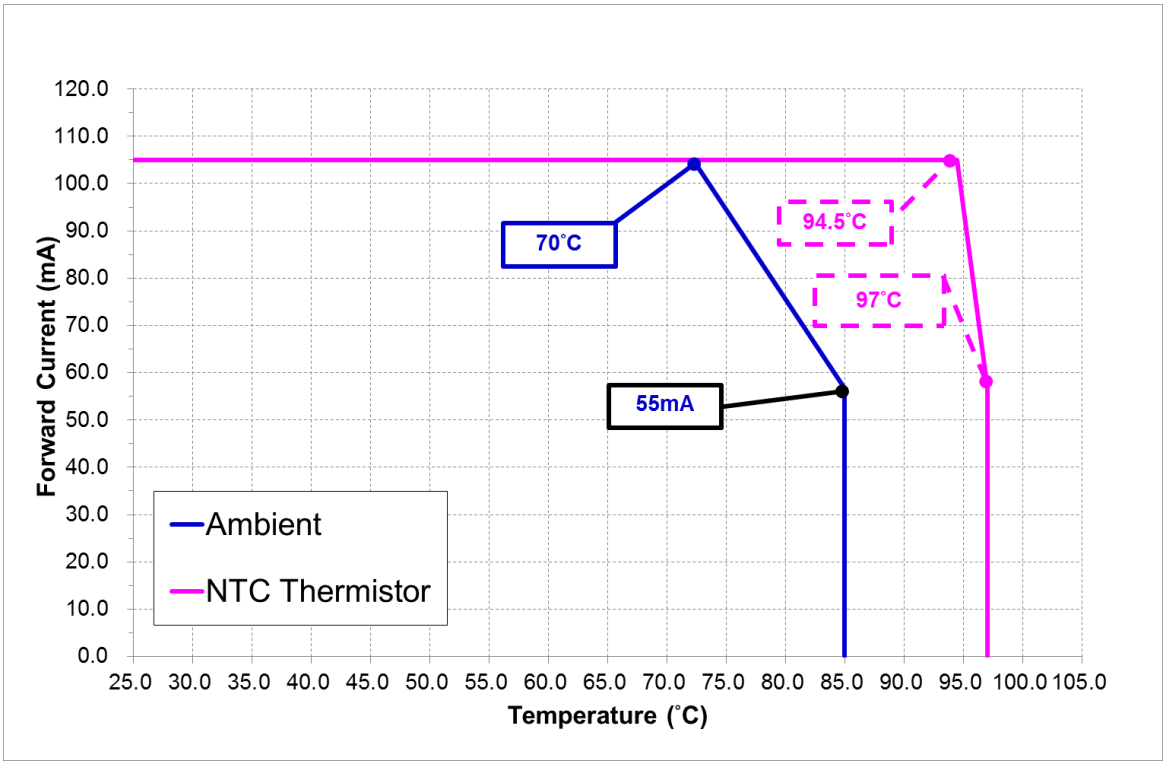


Figure 4-4 De-rating Curve



Note：this is actual result，update based on samples test，Ta=70℃，Start De-rating；Ta=85℃，BLU Current=55mA, Ta>85℃，shut down BLU.

5.0 MECHANICAL CHARACTERISTICS

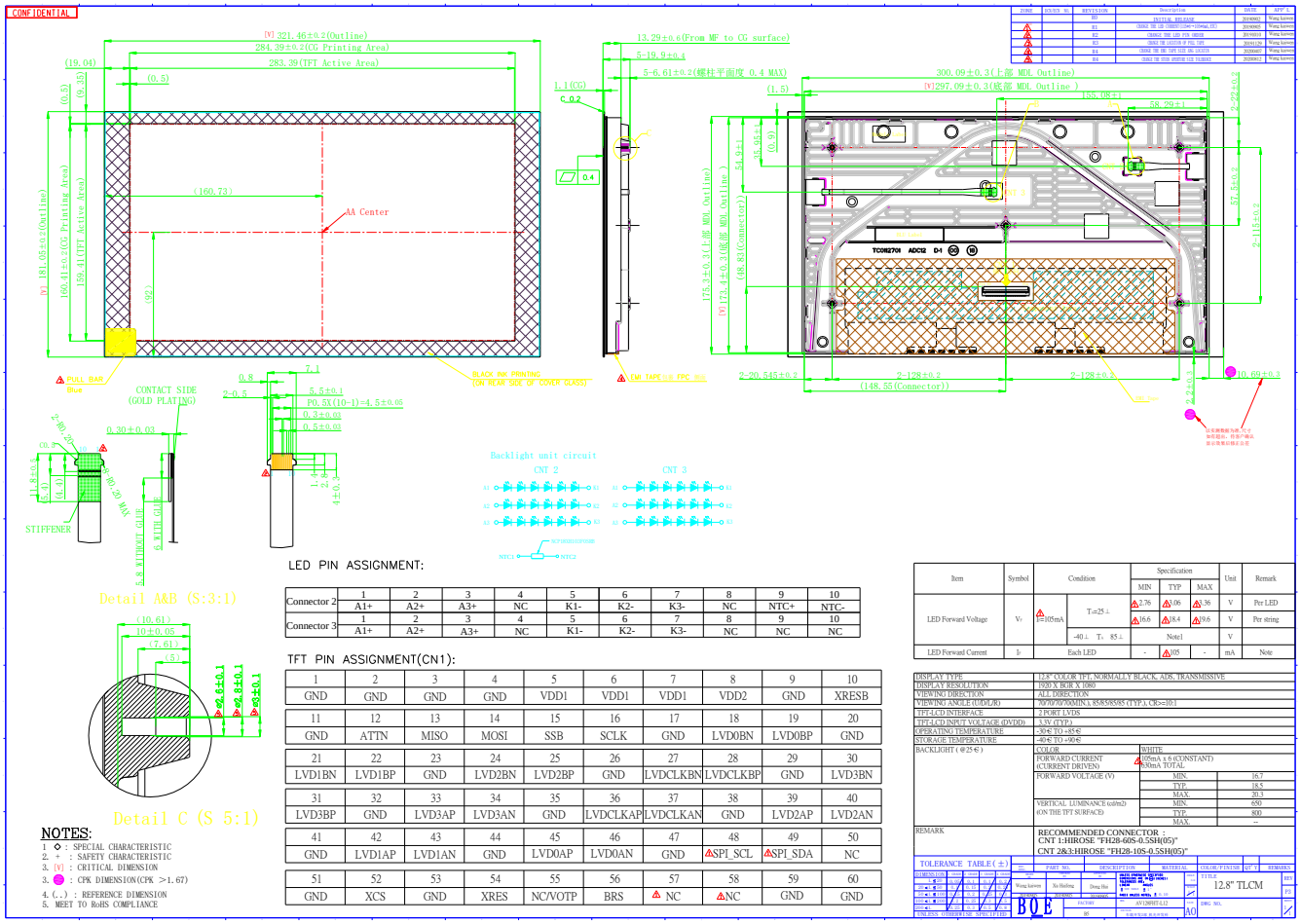
5.1 Dimensional Requirements

Figure in next page shows mechanical outlines for the panel.

Table 5-1 Dimensional Parameters

Parameter	Specification	Unit
Active Area	283.392(H) × 159.408(V)	mm
Number of pixels	1920(H) × RGB x 1080(V)	Pixels
Pixel pitch	0.1476(H) ×0.1476 (V)	mm
Pixel arrangement	RGB Vertical stripe	
Display colors	16.7M	colors
Display mode	Normally black	
Module thickness	13.29	mm
Module outline	321.46X181.0513	mm
AA-MDL outline L/R/U/D	19.035/19.035 /9.346/12.2953	mm

5.2 Outline



LED PIN ASSIGNMENT:

Connector 2	1	2	3	4	5	6	7	8	9	10
	A1+	A2+	A3+	NC	K1-	K2-	K3-	NC	NTC+	NTC-
Connector 3	1	2	3	4	5	6	7	8	9	10
	A1+	A2+	A3+	NC	K1-	K2-	K3-	NC	NC	NC

Item	Symbol	Condition		Specification MIN	TYP	MAX	Unit	Remark
LED Forward Voltage	V_F	I_F=105mA	T=25℃	2.76	3.05	3.36	V	Per LED
				16.6	18.4	19.6	V	Per string
			-40℃ ≤ T ≤ 85℃		Note1		V	
LED Forward Current	I_F	Each LED		-	105	-	mA	Note

TFT PIN ASSIGNMENT(CN1):

1	2	3	4	5	6	7	8	9	10
GND	GND	GND	GND	VDD1	VDD1	VDD1	VDD2	GND	XRESB
11	12	13	14	15	16	17	18	19	20
GND	ATTN	MISO	MOSI	SSB	SCLK	GND	LVD0BN	LVD0BP	GND
21	22	23	24	25	26	27	28	29	30
LVD1BN	LVD1BP	GND	LVD2BN	LVD2BP	GND	LVDCLKBN	LVDCLKBP	GND	LVD3BN
31	32	33	34	35	36	37	38	39	40
LVD3BP	GND	LVD3AP	LVD3AN	GND	LVDCLKAP	LVDCLKAN	GND	LVD2AP	LVD2AN
41	42	43	44	45	46	47	48	49	50
GND	LVD1AP	LVD1AN	GND	LVD0AP	LVD0AN	GND	SPI_SCL	SPI_SDA	NC
51	52	53	54	55	56	57	58	59	60
GND	XCS	GND	XRES	NC/VOTP	BRS	NC	NC	GND	GND

DISPLAY TYPE	12.8" COLOR TFT, NORMALLY BLACK, ADS, TRANSMISSIVE
DISPLAY RESOLUTION	1920 X RGB X 1080
VIEWING DIRECTION	ALL DIRECTION
VIEWING ANGLE (U/D/L/R)	70/70/70/70(MIN.), 85/85/85/85 (TYP.), CR≥10:1
TFT-LCD INTERFACE	2 PORT LVDS
TFT-LCD INPUT VOLTAGE (DVDD)	3.3V (TYP.)
OPERATING TEMPERATURE	-30℃ TO +85℃
STORAGE TEMPERATURE	-40℃ TO +90℃
BACKLIGHT (@25℃)	COLOR: WHITE FORWARD CURRENT (CURRENT DRIVEN): 105mA ± 6 (CONSTANT) 630mA TOTAL FORWARD VOLTAGE (V): MIN. 16.7, TYP. 18.5, MAX. 20.3 VERTICAL LUMINANCE (cd/m2) (ON THE TFT SURFACE): MIN. 650, TYP. 800, MAX. --
REMARK	RECOMMENDED CONNECTOR : CNT 1:HIROSE "FH28-60S-0.5SH(05)" CNT 2&3:HIROSE "FH28-10S-0.5SH(05)"

NOTES:
1. ◇ : SPECIAL CHARACTERISTIC
2. + : SAFETY CHARACTERISTIC
3. [V] : CRITICAL DIMENSION
3. ● : CPK DIMENSION(CPK >1.67)
4. (..) : REFERENCE DIMENSION
5. MEET TO RoHS COMPLIANCE

6.0 RELIABILITY TEST

No	Test Items	Conditions	Remark
1	High temperature storage test	Ta = 90 ℃, 504 hrs	
2	Low temperature storage test	Ta = -40 ℃, 504 hrs	
3	High temperature storage test	Ta =95℃, 6 hrs	
4	High temperature operation test	Ta = 85℃, 500 hrs,1000 hrs for reference	
5	Low temperature operation test	Ta = -30 ℃, 240 hrs; Ta=-40℃, 96H for reference	
6	High temperature & high humidity operation test	Ta = 40±2 ℃, 93±3%RH, 21 days	
7	High Temperature and High Humidity storage Test	Ta = 60 ℃, 90%RH, 240 hrs	
8	Thermal shock	Ta = -40 ℃ ↔ 85 ℃ (0.5 hr), 200 cycle	Non-operation
9	Temperature Step Test	20℃→-30℃, -30℃→75℃, 5℃ a step, each step wait 15min	Non-operation Note 1
10	Image Sticking	8X6 flag pattern, burn in 6H，@25℃ judgement：after 30s，5%ND filter，128grag pattern，No visible	
11	ESD	Air Voltage:±15KV to display surface Contact Voltage:±8KV to side BZ R: 330Ω C: 330pF Class B	Note 3
12	Light-Proof（Sun radiation）	Sa, Xenon 20 cm 1.1 kW/40°C, 168 h. Seven 24h cycles, 8h on and 16h off in each cycle (total time 168h, total exposure time 7*8h = 56h). Irradiance exposure 1120 w/㎡.	
13	Falling-ball on screen	Steel ball diameter: 3mm, height 0.3m fall points 9 (average distribution)	

14	Hardness of the screen surface	Pencil hardness 3H.The DUT on the hardness testing device with horizontal arrangement;Let the cusp of pencil on the screen, pressure 500g, speed 0.5mm/s~1mm/s, track distance 7mm;Repeat 3times on different location with parallel ;After test ,using soft cloth to clean, and look with naked eye	

6.0 RELIABILITY

Note 1：Temperature Step Test

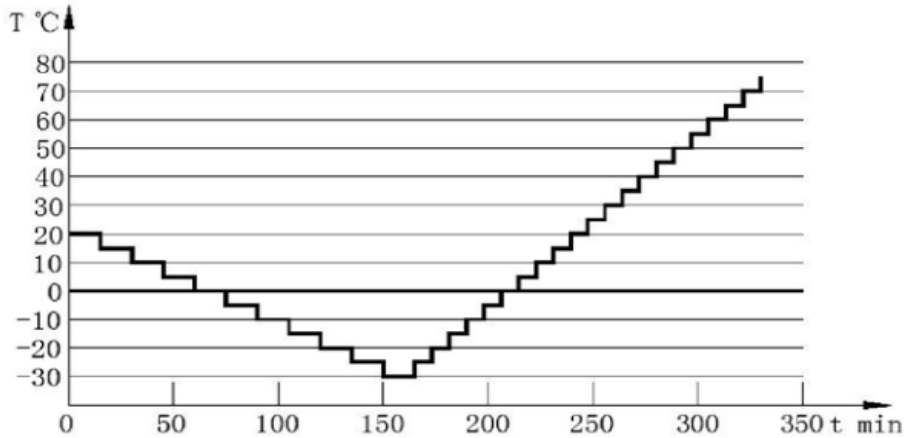


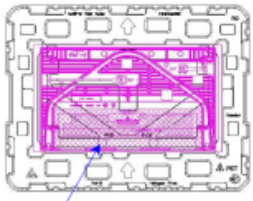
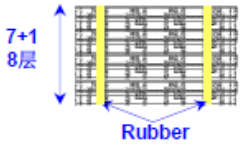
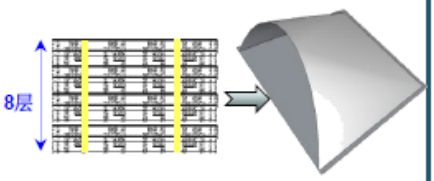
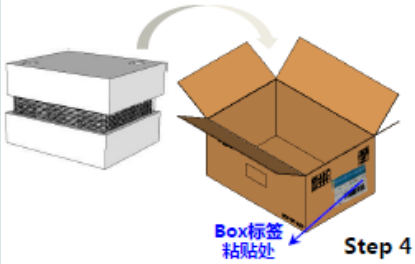
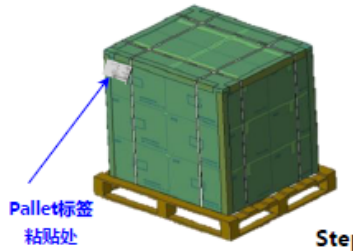
图1　温度变化曲线

Note 2：After the reliability test, the product only guarantee function normally without any fat al defect (non-display, line defect, abormal display etc). All the cosmetic specification is judg ed before the reliablity test.

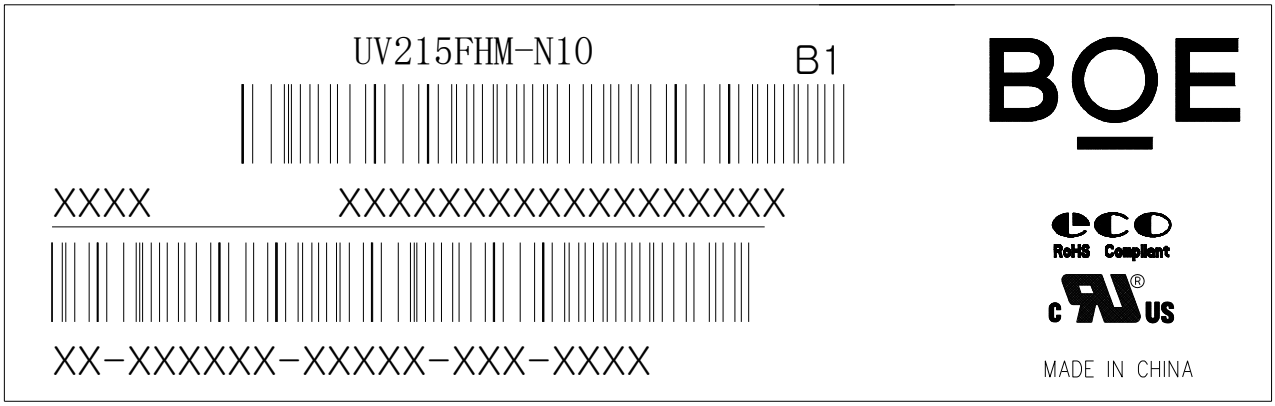
Note 3

Class B，有异常而可恢复，比如闪屏

7.0 Packing

Put 1 TLCM upon Tray , Place CG downward。 1 TLCM/ Tray ;	Put 7 full Tray with TLCM , Put 1 dummy Tray on the top , then rubber band。 **(Tray Rotate 180°)** 7 TLCM//8 Tray	Put 8 Tray into 1 Shielding Bag 。 Vacuum pressure : -8KPa~-6KPa 7 TLCM/ Box ; 1 Bag/ Box
 **Step 1**	 **Step 2**	 **Step 3**
Put 2 Cushion & 8 Tray into 1 Box , sealing box with type “H” 。 2 Cushion/Box ; 7 TLCM/Box	Put 1 Dual Cover on pallet , Put 12 Outer Box on Dual Cover ,2x2x3。 1 Dual Cover/Pallet ; 12 Outer Box/Pallet	Put 8 Paper Corner , 3 layers stretch film wind 5 surface , belt pack with total 4 line , paste Label。 84 TLCM/Pallet
 **Step 4**	 **Step 5**	 **Step 6**

8.0 PRODUCT SERIAL NUMBER (TBD)



1	2	3	4	5	6	7
X X	X	X	X X	X	X X X X	X X X X X X X

1. Control Number
2. Rank / Grade
3. Line Classification
4. Year (2001 : 01, 2002 : 02, …)
5. Month (1,2,3, … , 9, X, Y, Z)
6. Internal Use
7. Serial Number

9.0 PRECAUTIONS

9.1 Handing

(1) Use fingerstalls with soft gloves in order to keep display clean during the incoming inspection and assembly process.
(2) You must mount a module using specified mounting holes (Details refer to the drawings).
(3) Please make sure to avoid external forces applied to the Source PCB or FPC and D-IC during the process of handling or assembling. If not, It causes panel damage or malfunction.
(4) Note that polarizers are very fragile and could be easily damaged. Do not touch, push or rub the exposed polarizers with glass, tweezers or anything harder than HB pencil lead. And please do not rub with dust clothes with chemical treatment.
(5) Do not pull or fold the source D-IC which connect the source PCB or FPC and the panel. Do not pull or fold the LED wire.
(6) After removing the protective film, when the surface becomes dusty, please wipe gently with absorbent cotton or other soft materials like chamois soaks with alcohol or purified water. Do not strong polar solvent because they cause chemical damage to the polarizer
(7) Wipe off saliva or water drops as soon as possible. Their long time contact with . polarizer causes deformations and color fading.
(8) Protection film for polarizer on the module shall be slowly peeled off just before use so that the electrostatic charge can be minimized.
(9) Since the LCD is made of glass, do not apply strong mechanical impact or static load onto it. Handling with care since shock, vibration, and careless handling may seriously affect the product. If it falls from a high place or receives a strong shock, the glass may be broken.
(10) Do not disassemble the module.
(11) To determine the optimum mounting angle, refer to the viewing angle range in the specification for each model.
(12) If the customer's set presses the main parts of the LCD, the LCD may show the abnormal display. But this phenomenon does not mean the malfunction of the LCD and should be pressed by the way of mutual agreement.
(13)Do not drop water or any chemicals onto the LCD’s surface.
(14)The ITO pad area needs special careful caution because it could be easily corroded. Do not contact the ITO pad area with HCFC, Soldering flux, Chlorine, Sulfur, saliva or fingerprint. To prevent the ITO corrosion, customers are recommended that the ITO area would be covered by UV or silicon.

注：① (4)(6)(7)(8) 涉及到Pol相关条目适用于OC/MDL出货产品，针对Q/Single建议改为LCD surface
②第(14)条适用于Q/Single出货产品

9.2 Operating Precautions

(1) Be careful for condensation at sudden temperature change. Condensation makes damage to polarizer or electrical contacted parts. And after fading condensation, smear or spot will occur.
(2) Module has high frequency circuits. Sufficient suppression to the electromagnetic interference shall be done by system manufacturers. Grounding and shielding methods may be important to minimized the interference.
(3) The electrochemical reaction caused by DC voltage will lead to LCD degradation, so DC drive should be avoided.
(4) The LCD modules use C-MOS LSI drivers, so customers are recommended that any unused input terminal would be connected to Vdd or Vss, do not input any signals before power is turn on, and ground you body, work/assembly area, assembly equipments to protect against static electricity.
(5) Do not exceed the absolute maximum rating value. (supply voltage variation, input voltage variation, variation in part contents and environmental temperature, and so on) Otherwise the Module may be damaged.
(6) Design the length of cable to connect between the connector for back-light and the converter as short as possible and the shorter cable shall be connected directly. The longer cable between that of back-light and that of converter may cause the luminance of LED to lower and need a higher startup voltage(Vs).
(7) Connectors are precise devices for connecting PCB and transmitting electrical signals. Operators should insert and unplug MDL in parallel when assembling MDL.
(8) Do not connect or disconnect the cable to/ from the module at the "Power On" condition.
(9) When the module is operating, do not lose CLK, HS,VS signals. If any one these signals is lost, the LCD panel would be damaged.
(10) Obey the supply voltage sequence. If wrong sequence is applied, the module would be damaged.
(11) Do not re-adjust variable resistor or switch etc.

注：①(1)涉及到Pol相关条目适用于OC/MDL出货产品，针对Q/Single建议改为LCD surface
②(6)(7)涉及到connector相关适用于MDL出货产品

9.3 Electrostatic Discharge Control

(1) Since a module is composed of electronic circuits, it is not strong to electrostatic discharge. Make certain that treatment persons are connected to ground through wrist band etc. And don't touch interface pin directly. Keep products as far away from static electricity as possible.
(2) Avoid the use work clothing made of synthetic fibers. We recommend cotton clothing or other conductivity-treated fibers.

9.4 Precautions for Strong Light Exposure

Strong light exposure causes degradation of polarizer and color filter. It is not allowed to store or run directly in strong light or in high temperature and humidity for a long time.

9.5 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 under the storage temperature range. the recommend condition is: Temperature : 0℃~ 40℃, Relatively humidity: ≤80%, and no more than 1 year.
(3) The LCD modules should be stored in the room without acid, alkali and harmful gas.

9.6 Handling Precautions for Protection Film

(1) Remove the protective film slowly, keeping the removing direction approximate 30-degree not vertical from panel surface, If possible, under ESD control device like ion blower, and the humidity of working room should be kept over 50%RH to reduce the risk of static charge.
(2) In handling the LCD, wear non-charged material gloves. And the conducting wrist to the earth and the conducting shoes to the earth are necessary.

9.7 Operation Condition Guide

(1) Lifetime in this spec. is guaranteed only when Commercial Display is used according to operating usages.
(2) Module used in unnormal orientation mode, need to confirm with the manufacturer.
(3) Do not exceed the absolute maximum rating value. (supply voltage variation, input voltage variation, variation in part contents and environmental temperature, and so on) Otherwise the Module may be damaged.

(4) Dew drop atmosphere should be avoided.
(5) The storage room should be equipped with a good ventilation facility, which has a temperature controlling system.
(6) When expose to drastic fluctuation of temperature (hot to cold or cold to hot） ,the LCD may be affected; Specifically, drastic temperature fluctuation from cold to hot ,produces dew on the LCD's surface which may affect the operation of the polarizer and the LCD.
(7) Response time will be extremely delayed at lower temperature than the operating temperature range and on the other hand at higher temperature LCD may turn black at temperature above its operational range. However those phenomena do not mean malfunction or out of order with the LCD. The LCD will revert to normal operation once the temperature returns to the recommended temperature range for normal operation.

9.8 Others

(1)When returning the module for repair or etc., Please pack the module not to be broken. We recommend to use the original shipping packages.
(2) In order to prevent potential problems, flicker should be adjusted by optimizing the Vcom value in customer LCM.（适用于Q panel/single/OC出货）
(3) If the liquid crystal material leaks from the panel, it should be kept away from the eyes or mouth. In case of contact with hands, legs or clothes, it must be washed away thoroughly with soap.
(4) For the crash damaged or unnecessary LCD, it is recommended to wash off liquid crystalby either of solvents such as acetone and ethanol an should be burned up later.
(5) If you should swallow the liquid crystal, first, wash your mouth thoroughly with water, then drink a lot of water and induce vomiting, and then, consult a physician.
(6) If the liquid crystal should get in your eyes, flush your eyes with running water for at least fifteen minutes.
(7) Client needs to add heat dissipation design , such as fan, water cooling , etc.
(8) After assembling into modules, guarantee that the temperature rise of panel surface does not exceed 20 C at room temperature.
(9) Customers need to drive current down according to derating curve.