BOE

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S8-*	TFT- LCD	P0	2018-08-31	1 OF 29

B3 BV062WFM-L02-3900 Product Specification Rev.P0

BUYER	
SUPPLIER	HEFEI BOE Optoelectronics Technology CO., LTD
FG-Code	BV062WFM-L02-3900（6.22二郎神）

ITEM	BUYER SIGNATURE	DATE

ITEM	SUPPLIER SIGNATURE	DATE
Prepared		
Reviewed		
Approved		

HEFEI BOE OPTOELECTRONICS TECHNOLOGY

PRODUCT GROUP	REV	ISSUE DATE	BOE
TFT- LCD PRODUCT	P0	2015-*-*	

SPEC. NUMBER	SPEC . TITLE	PAGE
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REVISION HISTORY

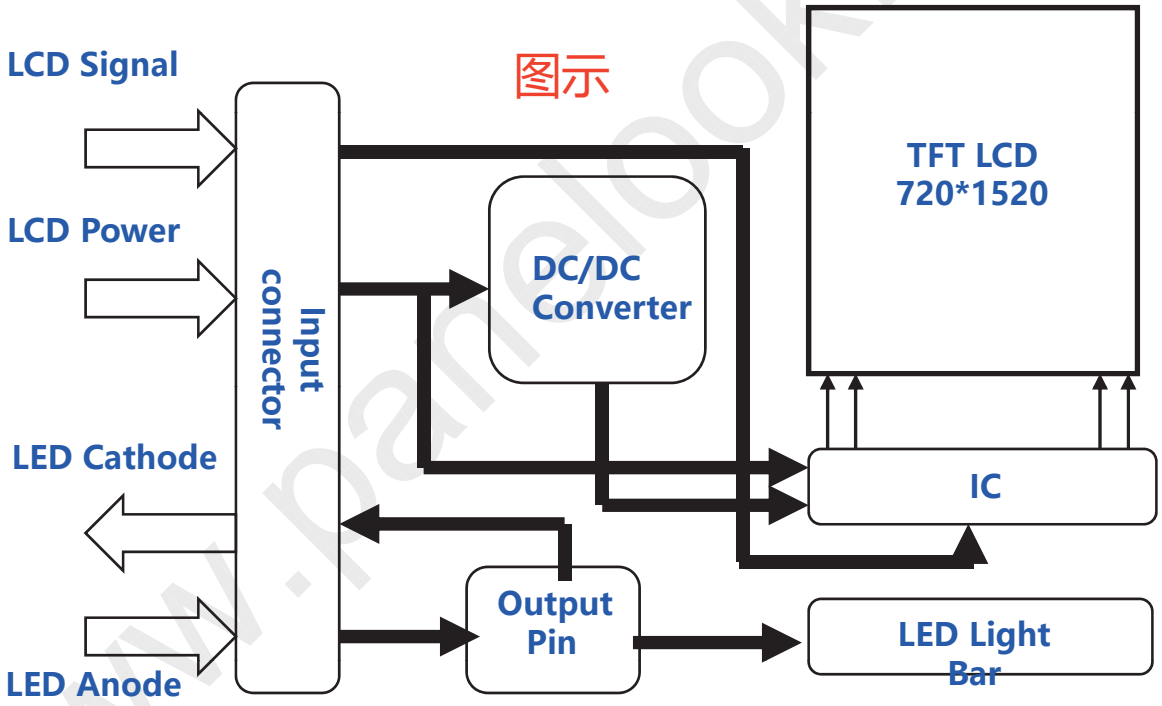
REV.	ECN No.	DESCRIPTION OF CHANGES	DATE	PREPARED
P0		Initial Release	2018-8-31	周昆

Contents

1.0 GENERAL DESCRIPTION

1.1 Introduction

BV062WFM-L02 is a color active matrix TFT LCD module using amorphous silicon TFT 's (Thin Film Transistors) as an active switching devices. This module has a 6.22 inch diagonally measured active area with HD+ resolutions (720 horizontal by 1520 vertical pixel array). Each pixel is divided into RED, GREEN, BLUE dots which are arranged in vertical stripe and this module can display 16.7M colors.



1.2 Features

- 3 Lane MIPI Interface;
- 8-bit color depth, display 16.7M colors
- Thin and light weight
- High luminance and contrast ratio, low reflection and wide viewing angle
- RoHS compliant

1.3 Application

- Tablet PC

1.4 General Specification

The followings are general specifications at the ** ********

<Table 1. LCD Module Specifications>

Parameter	Specification	Unit	Remarks
Active Area	67.608*142.728	mm	
Number Of Pixels	720(H)×1520(V)	pixels	
Pixel Pitch	0.0313(H)×RGB×0.0939(V)	mm	
Pixel Arrangement	Pixels RGB stripe arrangement		
Display Mode	Normally Black		
Display Colors	16.7M(8bits)	colors	
Display Mode	Normally Black		
Surface Treatment	HC		
Contrast Ratio	1500:1(typ.)		
Viewing Angle(CR>10)	80/80/80/80(typ.)	deg.	
Response Time	25(typ.)	ms	
Color Gamut	70%		
Brightness	320(min)/360(typ)(w/ TP)	cd/m2	
Brightness Uniformity	13 point: min 80%		
Power Consumption	Active model : 34mW standby mode + TP off : ≤6.6mW	watt	
Outline Dimension	69.91(W)×149.28 (H) ×1.301T (LCM) 71.61 (W) ×151.66 (H) ×2.231(T)TLCM)	mm	
Weight	49.6	gram	Typ

<Table 2. Touch Panel Specifications>

Parameter		Specification				Remarks
TP Structure		TDDI				
Sensing Method		Mutual Capacitance				
Number Of Touch		10				
Performance	Sensitivity(mm)	Φ4				
	Report Rate	LV 60Hz				
	Finger Separation	≦10mm				
	Response Time	-				
	Accuracy(mm)	Center	≦0.8	Edge	≦1.5	@Φ6mm
	Precision(mm)	Center	≦0.5	Edge	≦0.5	@Φ6mm
	Linearity(mm)	Center	≦0.8	Edge	≦1.5	@Φ6mm
	Jitter(mm)	Center	≦0.2	Edge	≦0.3	@Φ6mm
SNR(dB)		≧40				
Pen Type & Pen Size		-				
Glove Touch		-				
Hover		-				
Palm & Face Rejection(Φ30mm)		Ø40-50mm				
Temperature Shock Self-adaption		-				
Anti Water	Spray	-				
	Water Drop	-				
Gesture Support	Success Rate	-				
	Gesture Type	-				
Power Consumption(Typ.) Active/Idle/Sleep		-				

2.0 ABSOLUTE MAXIMUM RATINGS

The followings are maximum values which, if exceed, may cause faulty operation or damage to the unit.

< Table 3. Absolute Maximum Ratings>

Item	Symbol	Values			Unit	Remarks
		Min	Typ	max		
I/O Supply Voltage	LCD_IOVCC	1.65	1.8	1.95	V	Ta = 25 ℃ Note 1&2
Liquid crystal drive supply voltage	VSP(AVDD)	5.85	6	6.15	V	
Liquid crystal drive supply voltage	VSN(AVEE)	-6.15	-6	-5.85	V	
Gate High Voltage	V_{GH}	13.5	14	14.5	V	
Gate Low Voltage	V_{GL}	-14.5	-14	-13.5	V	
Input High Voltage	V_{IH}	0.7VDDI	-	VDDI	mV	
Input Low Voltage	V_{IL}	VSS	-	0.3VDDI	mV	Note 3
Input High Current	I_{IH}		-	1	uA	
Input Low Current	I_{IL}	-1	-		uA	
Output High Voltage	V_{OH}	0.8VDDI	-	VDDI	mV	
Output Low Voltage	V_{OL}	VSS	-	0.2VDDI	mV	

3.0 ELECTRICAL SPECIFICATIONS

3.1 TFT LCD Module

< Table 4. LCD Module Electrical specifications > [Ta =25±2 ℃]

Parameter		Values			Unit	Notes
		Min.	Typ.	Max.		
Frame Frequency	FRAME		60HZ		Hz	Video mode
Power consumption Sleep out mode Display mode	I_{IOVCC}		20.4	26.5	mA	Frame frequency=60Hz white pattern
	I_{VSP}		6.8	8.9	mA	
	I_{VSN}		5	6.5	mA	
	I_{IOVCC}		20.4	26.5	mA	Frame frequency=60Hz black pattern
	I_{VSP}		6.2	8.1	mA	
	I_{VSN}		5	6.5	mA	
	I_{IOVCC}		20.4	26.5	mA	Frame frequency=60Hz red pattern
	I_{VSP}		6.8	8.9	mA	
	I_{VSN}		5	6.5	mA	
	I_{IOVCC}		20.4	26.5	mA	Frame frequency=60 Hz gerrn pattern
	I_{VSP}		6.8	8.9	mA	
	I_{VSN}		5	6.5	mA	
	I_{IOVCC}		20.4	26.5	mA	Frame frequency=60 Hz blue pattern
	I_{VSP}		6.8	8.9	mA	
	I_{VSN}		5	6.5	mA	
Power consumption standby +TP off mode	I_{IOVCC}		1	1.3	mA	
	I_{VSP}		0.1	0.16	mA	
	I_{VSN}		0.05	0.065	mA	

3.2 Back-Light Unit

Table 5. LED Driver Electrical Specifications > [Ta =25±2 ℃]

Item	Symbol	Min	Typ	Max	Unit	Remark	
Forward Current	I_F	**15**	**20**	**25**	**mA**	**1pcs LED**	
Forward Voltage	V_F	**2.9**	**3.0**	**3.1**	**V**	**1pcs LED**	
Power Consumption Of BL（MAX）	W_{BL}	**696**	**960**	**1240**	**mW**		

3.4 INPUT TERMINAL PIN ASSIGNMENT

This LCD employs three interface connections, a 51 pin ZIF connector is used for the LCD module electronics interface, a 8 pin ZIF connector is used for the touch electronics interface and a 9 pin ZIF connector is used for the internal backlight system.

3.4.1 Pin assignment for LCD module

Connector : 20535-051E (I-PEX) or equivalent

< Table7. Pin Assignment for LCD Module Connector >

Pin No.	Symbol	Description	I/O
1	LEDA	LED anode（+）	
2	NC	NC	
3	GND	Ground	
4	DSI_D2+	MIPI DSI data2+	
5	DSI_D2-	MIPI DSI data2-	
6	GND	Ground	
7	DSI_D1+	MIPI DSI data1+	
8	DSI_D1-	MIPI DSI data1-	
9	GND	Ground	
10	DSI_CLK+	MIPI DSI clock+	
11	DSI_CLK-	MIPI DSI clock-	
12	GND	Ground	
13	DSI_D0+	MIPI DSI data0+	
14	DSI_D0-	MIPI DSI data0-	
15	GND	Ground	
16	DSI_D3+	MIPI DSI data3+	
17	DSI_D3-	MIPI DSI data3-	
18	RESET	Hardware Reset Signal	
19	PWM	CABC PWM Output Signal	
20	TP_RST	Touch Hardware Reset Signal	
21	TP_INT	Touch Interrupt Signal	
22	TP_SDA	Touch IIC SDA Signal	
23	TP_SCL	Touch IIC SCL Signal	
24	LCD_TE	Frame Synchronies Signal	
25	GND	Ground	

Pin No.	Symbol	Description	I/O
26	VDDI(+1.8V)	Power Supply 1.8V	
27	NC	NC	
28	AVEE	Power Supply -6V	
29	NC	NC	
30	AVDD	Power Supply +6V	
31	RT	Thermistor	
32	NC	NC	
33	LEDK2	LED 2 cathode	
34	LEDK1	LED 1 cathode	

3.4.2 Pin assignment for LED Bar

Connector : PF040-B09B-C09 (STM) or equivalent

< Table8. Pin assignment for LED Bar >

Pin No	Symbol	Description	Remarks
1	VLED	LED Anode Power Supply	
2	VLED	LED Anode Power Supply	
3	VLED	LED Anode Power Supply	
4	NC	NC	
5	NC	NC	
6	FB1	LED Cathode Power Supply	
7	FB2	LED Cathode Power Supply	
8	FB3	LED Cathode Power Supply	
9	FB4	LED Cathode Power Supply	

3.4.3 Pin assignment for TP

Connector : FH34SRJ-8S-0.5SH(50) (Hirose) or equivalent

< Table9. Pin assignment for TP >

Pin No	Symbol	Description	Remarks
1	I2C_SCL	I2C CLK,TYP. 1.8V	
2	I2C_SDA	I2C SDA,TYP. 1.8V	
3	TP_SYNC	SYNC signal for touch panel，TYP 3.3V	
4	TOUCH_INT	Interrupt Pin, TYP 1.8V	
5	TOUCH_RESET	Reset Pin，TYP 1.8V	
6	GND	Ground	
7	AVDD	Analog Power supply, TYP. 3.3V	
8	DVDD_IO	I/O Digital Power supply, TYP. 1.8V	

3.4.4 Pin assignment for fingerprint identification

Connector : FH34SRJ-10S-0.5SH(50) (Hirose) or equivalent)

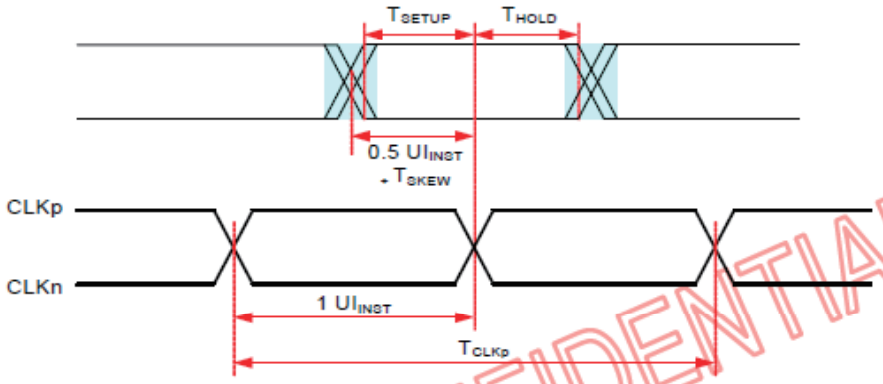
< Table10. Pin assignment for fingerprint >

Pin No	Symbol	Description	Remarks
1	DRDY_N/IRQ	Active (high) when data is available and inactive(low) when data is not available. Referenced to VDDIO	IRQ
2	SLEEP/RESET	Used to bring Module in and out of Sleep mode. When asserted, the device enters sleep mode and sensor operation is suspended. When de-asserted, the device enters it' s operating mode.	RESET
3	ID	For FPC Sensor connect ID pin to VDDIO(3.3V) For Synaptics Sensor connect ID pin to GND	ID PIN
4	MOSI	SPI data input (host interface). This signal is used to transfer data into the sensor. Referenced to VDDIO	MOSI
5	MISO	SPI data output (host interface). This signal is used to transfer data out of sensor. Referenced to VDDIO	MISO
6	SS_N/CS	Slave Select, active low (host interface). The host SPI interface is active when SS_N is low; it is inactive when SS_N is high, with MISO driven to a high impedance state. Referenced to VDDIO	CS
7	VDDIO	Digital Power supply. Connect to 3.3V	VDDIO 3.3V
8	NC		
9	SCLK	SPI data clock (host interface). Referenced to VDDIO	CLK
10	GND_ Fingerprint	Connect to ground	GND

3.5 MIPI Interface Characteristic

3.5.1 Data Format

High Speed Data Transmission: Data-Clock Timing



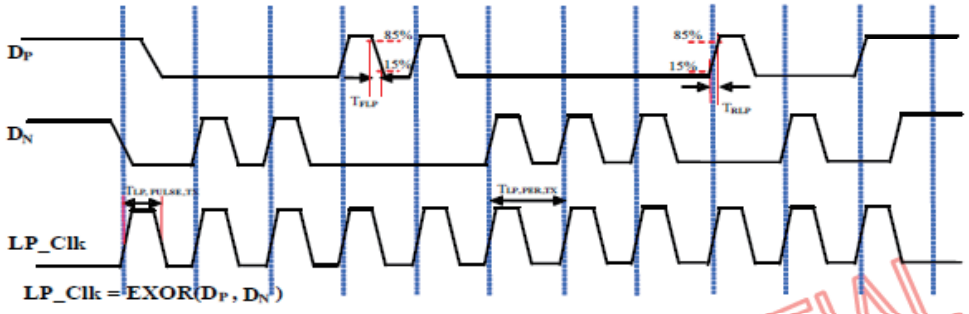
Parameter	Symbol	Min	Typ	Max	Units	Notes
UI instantaneous	UI_{INST}	1		4	ns	1,2,10
Data to Clock Skew [measured at tansmitter]	$T_{SKEW}[TX]$	-0.15		0.15	UI_{INST}	3
		-0.2		0.2	UI_{INST}	4
Data to Clock Setup Time [measured at receiver]	$T_{SETUP}[RX]$	0.15		0.15	UI_{INST}	5
		0.2		0.2	UI_{INST}	6
Data to Clock Hold Time [measured at reciever]	$T_{HOLD}[RX]$	0.15		0.15	UI_{INST}	5
		0.2		0.2	UI_{INST}	6
20% - 80% rise time and fall time	t_R / t_F	100			ps	9
				0.3	UI_{INST}	7
				0.35	UI_{INST}	8

< MIPI Tx Data Configuration >

3.5 MIPI Interface Characteristic

3.5.1 Data Format

LP Transmission AC Specification

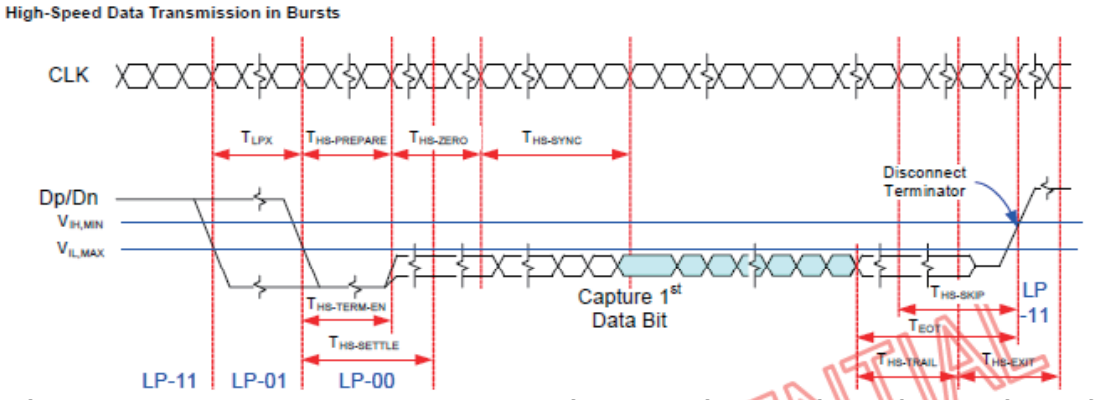


Parameter		Symbol	Min	Typ	Max	Units	Notes
15%-85% rise time and fall time		T_{RLP} / T_{FLP}			25	ns	1
30%-85% rise time and fall time		T_{REOT}			35	ns	1,5,6
Pulse width of the LP exclusive-OR clock	First LP exclusive-OR clock pulse after STOP state or last pulse before stop state	$T_{LP-PULSE-TX}$	40			ns	4
	All other pulses		20			ns	4
Period of the LP exclusive-OR clock		$T_{LP-PER-TX}$	90			ns	
Slew Rate@ C_{LOAD} = 0pF		$\delta V/\delta t_{SR}$	30		500	mV/ns	1,2,3,7
Slew Rate@ C_{LOAD} = 5pF			30		200	mV/ns	1,2,3,7
Slew Rate@ C_{LOAD} = 20pF			30		150	mV/ns	1,2,3,7
Slew Rate@ C_{LOAD} = 70pF			30		100	mV/ns	1,2,3,7
Load Capacitance		C_{LOAD}			70	pF	1

< MIPI Tx Data Configuration >

3.5 MIPI Interface Characteristic

3.5.1 Data Format



Parameter	Symbol	Min	Typ	Max	Units
Time to drive LP-00 to prepare for HS transmission	$T_{HS-PREPARE}$	40+4UI		85+6UI	ns
Time from start of tHS-TRAIL or tCLK-TRAIL period to start of LP-11 state	T_{EOT}			105+12UI	ns
Time to enable Data Lane receiver line termination measured from when Dn cross VIL,MAX	$T_{HS-TERM-EN}$			35+4UI	ns
Time to drive flipped differential state after last payload data bit of a HS transmission burst	$T_{HS-TRAIL}$	60+4UI			ns
Time-out at RX to ignore transition period of EoT	$T_{HS-SKIP}$	40		55+4UI	ns
Time to drive LP-11 after HS burst	$T_{HS-EXIT}$	100			ns
Length of any Low-Power state period	T_{LPX}	50			ns
Sync sequence period	$T_{HS-SYNC}$		8UI		ns
Minimum lead HS-0 drive period before the Sync sequence	$T_{HS-ZERO}$	105+6UI			ns

< MIPI Tx Data Configuration >

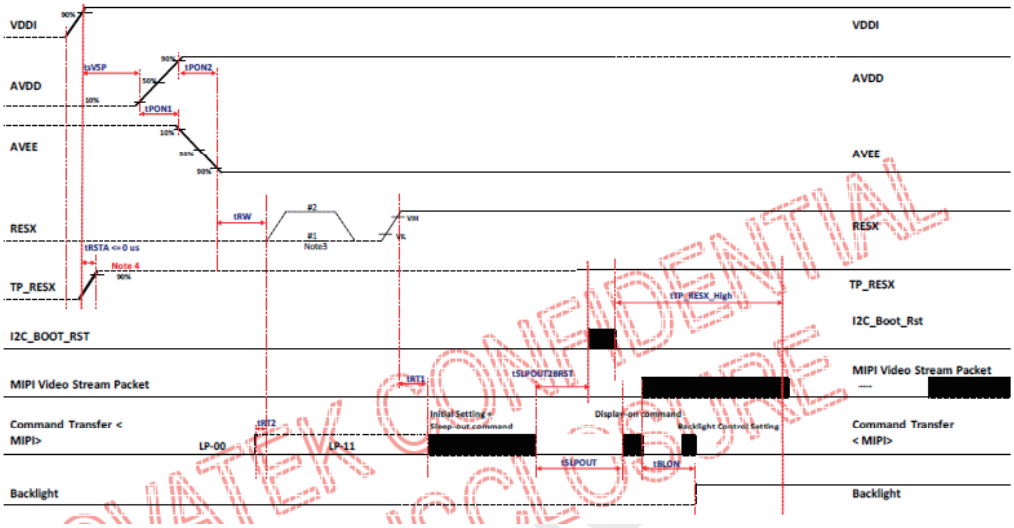
3.6 Interface timing Parameter

< Table13. Timing Parameter >

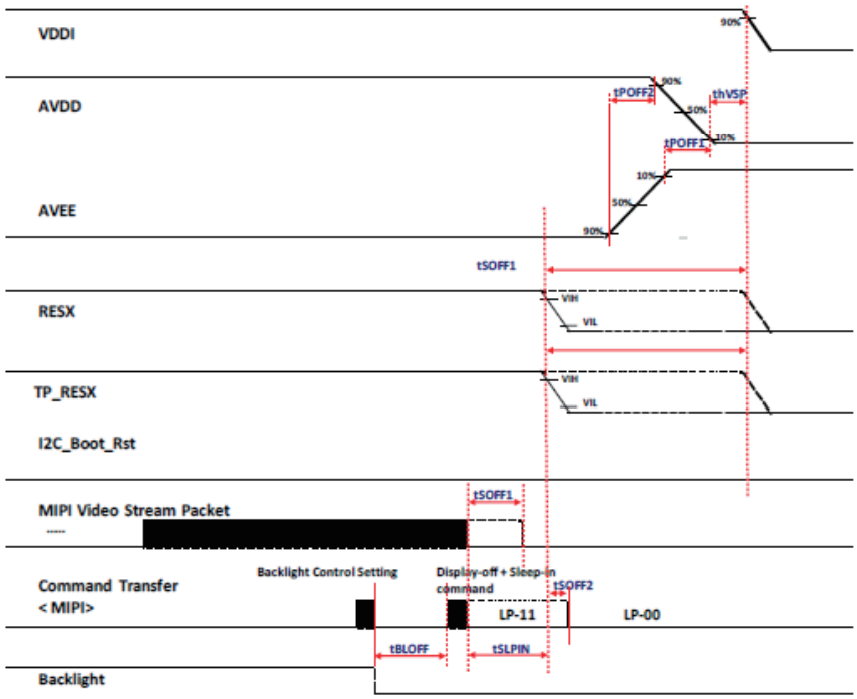
□ Speed Setting		
LABEL	SETTING	VALUE
(MHz)	DotClock	89.64
(Mbps)	MIPI Speed, 10% margin	788
(number)	Lane	3
MIPI mode	Burst mode &Vedio mode	
□ RGB Setting		
LABEL	SETTING	VALUE
1	X-size Total	845
2	Y-size Total	1768
3	X-size	720
4	Y-size	1520
5	HBP (Horizontal Back Porch)	70
6	HFP (Horizontal Front Porch)	35
7	HSW (Horizontal Sync Width)	20
9	VBP (Vertical Back Porch)	236
10	VFP (Vertical Front Porch)	10
11	VSW (Vertical Sync Width)	2

3.7 Power Sequence

Power on



Power off

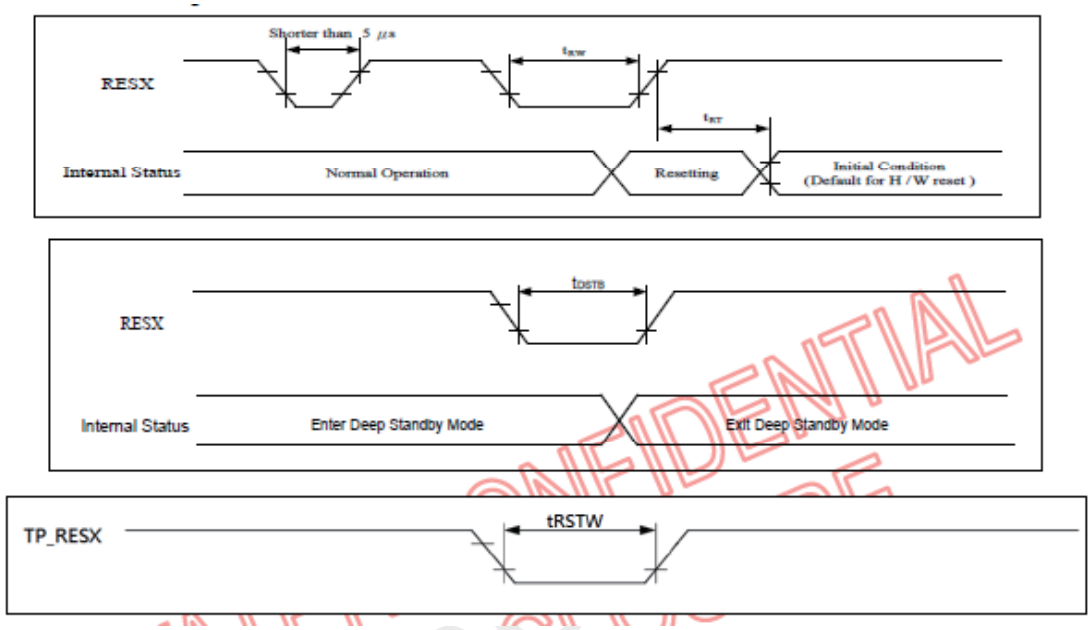


3.7 Power Sequence

Item	Symbol	Condition	Min	Typ	Max	Unit
AVDD - AVEE delay time (10% to 10%)	tPON1	Power On	0	-	-	us
AVDD - AVEE delay time (90% to 90%)	tPON2	Power On	0	-	-	us
VDDI On to AVDD On time (90% to 10%)	tsVSP	Power On	1	-	-	ms
All Power On to RESX Hi-level time (90% to VIL)	tRW	Power On	10	-	-	ms
VDDI On to TP_RESX Hi-level time	tRSTA	Power On	-	-	0	ms
MIPI SLP_OUT command to I2C Boot reset time	tSLPOUT2BRST	Power On	5	-	-	ms
TP_RESX keep high time after I2C_Boot_Rst	tTP_RESX_High	Power On	100	-	-	ms
RST Hi-level (VIH) to 1st Command time	tRT1	Power On	10	-	-	ms
(MIPI goes to LP11 state) to RST goes to High-level (VIL)	tRT2	Power On	0	-	-	us
SLPOUT Sequence Request time	tSLPOUT	Power On	100	-	-	ms
Display On Command to BL On time	tBLON	Power On	40	-	-	ms
AVDD - AVEE delay time (10% to 10%)	tPOFF1	Power Off	0	-	-	us
AVDD - AVEE delay time (90% to 90%)	tPOFF2	Power Off	0	-	-	us
AVDD Off to VDDI Off time (10% to 90%)	thVSP	Power Off	0	-	-	us
RST Low to VDDI Off time (VIH to 90%)	**tROFF**	**Power Off**	**0**	-	-	**us**
BL Off to Display Off Command time	tBLOFF	Power Off	0	-	-	us
SLPIN Sequence Request time	tSLPIN	Power Off	60	-	-	ms
SLPIN Finished to MIPI Video Stream Off (90%) time	tSOFF1	Power Off	0	-	-	us
RST goes to Low-level (VIH) to (MIPI goes to LP00 state)	**tSOFF2**	**Power Off**	**0**	-	-	**us**

< Table15. Sequence Table >

3.7 Power Sequence



Signal	Symbol	Parameter	Min.	Max.	Unit
RESX	t_{RW}	Reset pulse duration	10(Note)	-	us
	t_{RT}	Reset cancel	-	10(Note)	ms
			-	120(Note)	ms
	tDSTB	Reset pulse duration	3	-	ms
TP_RESX	tRSTW	Reset pulse duration	2		ms

LCD reset timing

< Table15. Sequence Table >

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 (Gonio meter 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°. We refer to θØ =0 (=θ3) as the 3 o' clock direction (the "right"), θØ=90 (= θ12) as the 12 O' clock direction ("upward"), θØ=180 (= θ9) as the 9 O' clock direction ("left") and θØ=270(= θ6) as the 6 O' clock direction ("bottom"). While scanning θ and/or Ø, the center of the measuring spot on the Display surface shall stay fixed.

4.2 Optical Specifications

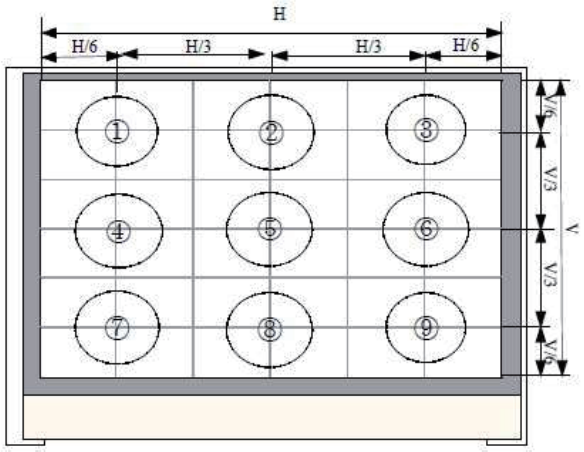
< Table16. Optical Table >

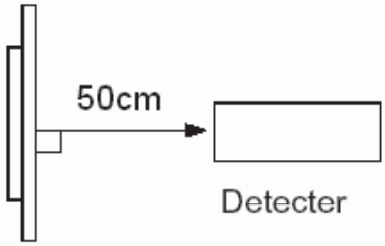
Item	Symbol	Condition	Min	Typ.	Max	Unit	Note
luminance	Bp	θ=0°	320	360	--	cd/m2	Note 1
Maximum Brightness of Black Pattern	Bblk	=0°	---	---	0.45	cd/m2	
Brightness Uniformity	▵Bp		80	--	--	%	Note 2
Color Uniformity	Δu'v' (w.r.t. center)						Note20 Sign the limit sample shall prevail.
	Δu'v'			0.01	0.015		
	Δu'v' (worst neighbor			0.003	0.007		
Viewing Angle	θL	Cr≥10	75	80	--	deg	Note 3
	θ_R		75	80	--		
	ψ_T		75	80	--		
	ψ_B		75	80	--		
Contrast Ratio	Cr	θ=0° FF=0°	1000	1500	--	-	Note 4
Response Time	Tr+Tf		--	25	30	ms	Note 5
	Tgray		--	--	35	ms	
Color Coordinate of CIE1931	**Rx**	θ=0°	0.611	0.641	0.671	-	Note 6
	Ry		0.310	0.340	0.370		
	Gx		0.286	0.316	0.346		
	Gy		0.581	0.611	0.641		
	Bx		0.12	0.150	0.180		
	By		0.027	0.057	0.087		
	Wx		0.277	0.307	0.337		
	Wy		0.293	0.323	0.353		
NTSC Ratio	NTSC	CIE1931	65	70	--	%	Note 7
Color Temperature	CT			6890			
Flicker	amount	-	-	-	-30	dB	Note 8
Gamma	-		1.9	2.2	2.5		Note 9

Note1:Luminance measurement

The test condition is at ILED=20mA and measured on the surface of LCD module at 25℃.

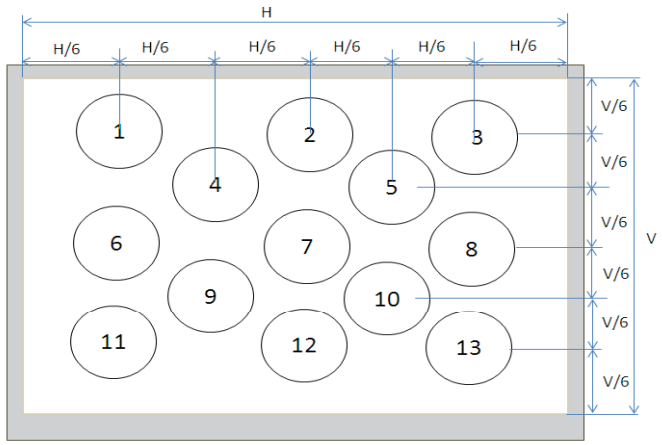
- The data are measured after LEDs are lighted on for more than 5 minutes and LCM displays are fully white. The brightness is the average value of 9 measured spots. Measurement equipment CS2000 or similar equipments(Field of view:1deg,Distance:50cm)
- Measuring surroundings: Dark room.
- Measuring temperature: Ta=25℃.
- Adjust operating voltage to get optimum contrast at the center of the display.
- Measured value at the center point of LCD panel must be after more than 5 minutes while backlight



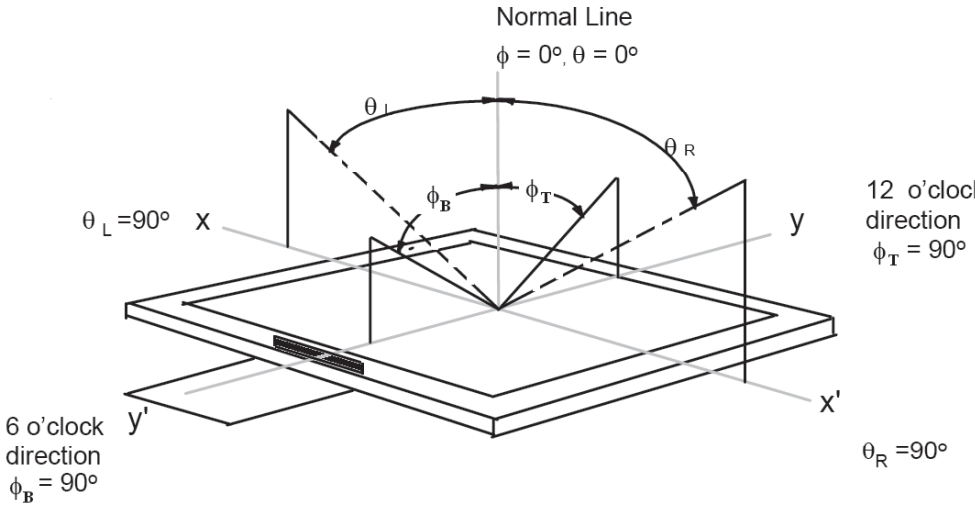


Note2:Uniformity

- The test condition is at ILED=20mA and measured on the surface of LCD module at 25℃.
- Measurement equipment:CS2000 or similar equipments
- The luminance uniformity is calculated by using following formula:
- △Bp = Bp (Min.) / Bp (Max.)×100 (%)
- Bp (Max.) = Maximum brightness in 13 measured spots
- Bp (Min.) = Minimum brightness in 13 measured spots.



Note 3:**The definition of Viewing Angle**
Refer to the graph below marked by θ and Φ.

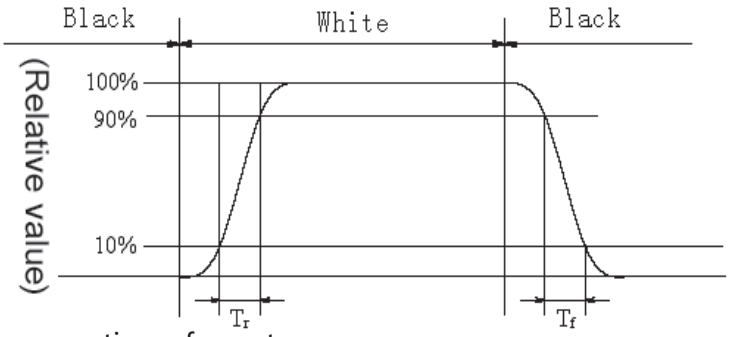


Note4:**ThedefinitionofContrastRatio** (Test LCM using CS2000 or similar equipments):

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

(Contrast Ratio is measured in optimum common electrode voltage)

Note5:**DefinitionofResponse time.**(Test LCD using DMS501 or similar equipments):
The output sign also photo detector are measured when the input sign also are changed from "black" to "white" (Voltage falling time)and from "white" to "black" (Voltage rising time), respectively . The response time is defined as the time interval between the 10% and 90% of amplitudes . Refer to figures below.



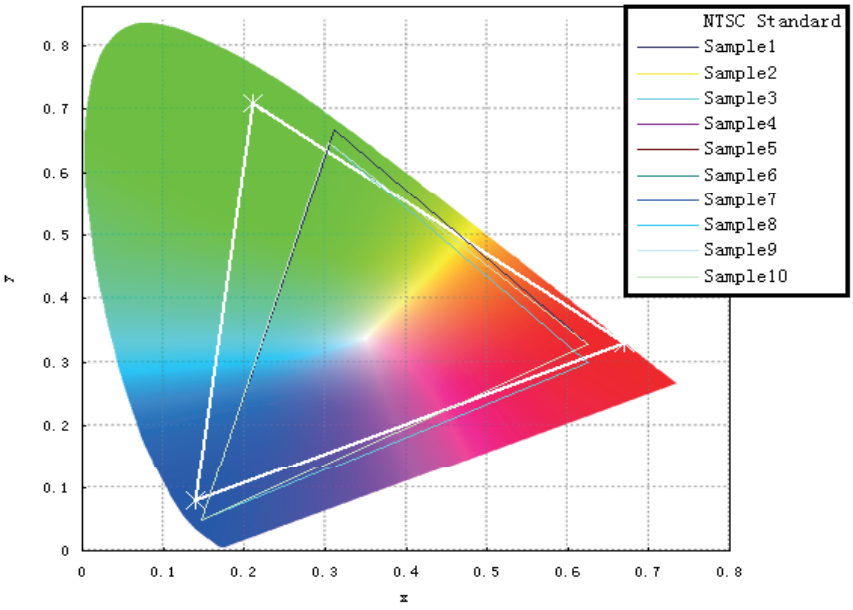
	L0	L1	L2	L3	L4	L5	L6	L7
L0	■							
L1		■						
L2			■					
L3				■				
L4					■			
L5						■		
L6							■	
L7								■

Response time of gray to gray:
Measurement equipment: DMS501 or similar equipments.
Test method: we define 8 grays L0-L7,the grays of L0-L7 were defined as:0,36,73, 109, 146, 182, 219, 255. Theoutputsignalsofphotodetectoraremeasuredwhentheinputsignalsarechanged from "Lx" to "Ly", x, y= [0, 7]. The response time is defined as the time interval between the 10% and 90% of amplitudes. The result of the test can be noted as below:

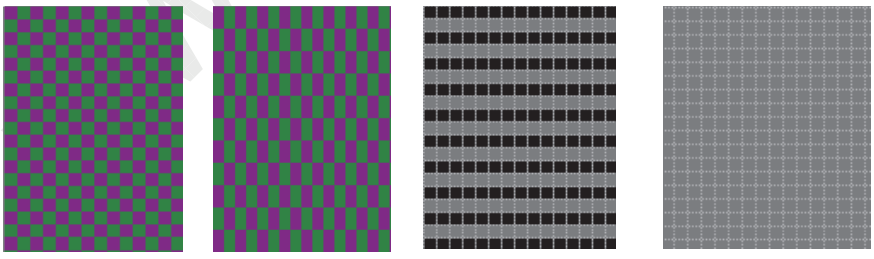
Note 6: Color Coordinates of CIE 1931
The test condition is at ILED=20mA and measured on the surface of LCD module at 25℃.
Measurement equipment:CS2000 or similar equipments
The Color Coordinate (CIE 1931) is the measurement of the center of the display shown in below figure.

Note 7: Definition of Color of CIE Coordinate and NTSC Ratio.

$$S = \frac{\text{area of RGB triangle}}{\text{area of NTSC triangle}} \times 100\%$$



Note 8: Flicker
- Measurement equipment :CA-210 or similar equipments
- Measuring temperature: Ta=25℃.
- Test method: JEITA method
- Test pattern : Refer to below(Test Pattern should be full-fill of display screen)



1 Dot Inversion, 2 Dot Inversion , Line Inversion , Frame Inversion
The point should be marked is, for line and frame inversion, the background of Flicker Test Pattern
- "gray " are defined as middle gray scale .For example, RGB 24bit "gray" defined as below:

R7	R6	R5	R4	R3	R2	R1	R0	G7	G6	G5	G4	G3	G2	G1	G0	B7	B6	B5	B4	B3	B2	B1	B0
1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0

For Dot inversion, the RGB data for first pixel is (127, 0, 127), the RGB data for the second pixel is (0, 127 , 0).

●Frame Frequency Requirement before test: The LCD must be tuned to more than 65HZ before measu rement.

●Measurement Point: the center of display active area

●Conversion of Flicker ratio:

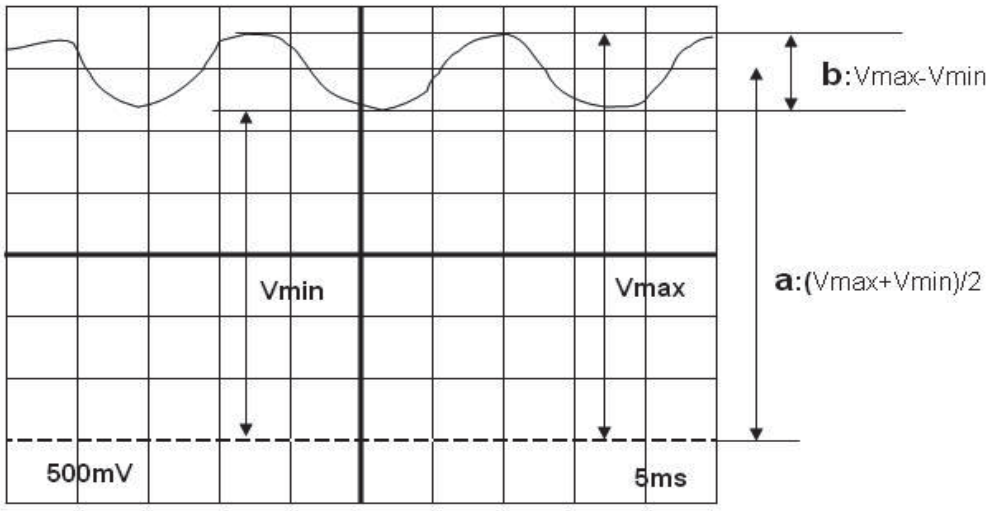
Flicker [dB] = 10 x log[Px/P0]

Where

Px: Maximum power spectrum of AC component after passing through integrator

P0: Power spectrum of DC component after passing through integrator

AC component=b (Refer to below diagram)



Note 9: gamma curve control

●For gamma curve control, HUAWEI' s request as below:

●1,the whole curve' s tolerance must control within +/-0.3, HUAWEI will test the gray scale below: 0, 8, 16, 25, 33, 41, 49, 58, 66, 74, 82, 90, 99, 107, 115, 123, 132, 140, 148, 156, 165, 173, 181, 189, 19 7,206, 214, 222, 230, 239, 247, 255

Note 10:Crosstalk

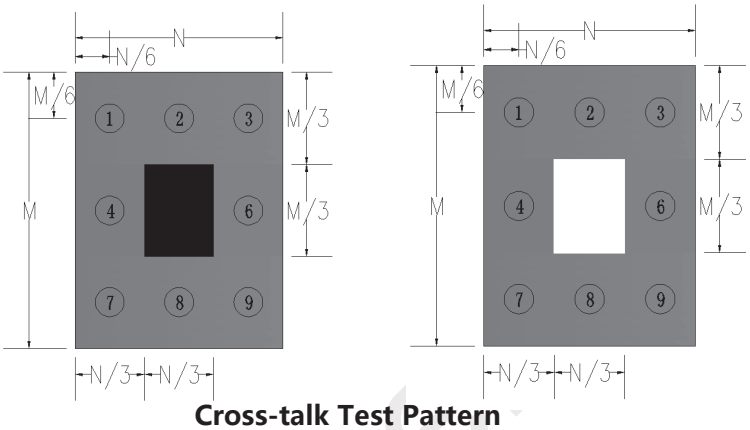
●There should be no visible cross-talk in normal direction of the display when the two " Cross-talk Test Patterns " below are loaded.

●Measurement equipment:CS2000 or similar equipments

●The point should be marked is, the background of Cross-talk Test Pattern- "gray " are defined as middle gray scale . For example, RGB 24bit "gray" defined as below:

R7	R6	R5	R4	R3	R2	R1	R0	G7	G6	G5	G4	G3	G2	G1	G0	B7	B6	B5	B4	B3	B2	B1	B0
1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0

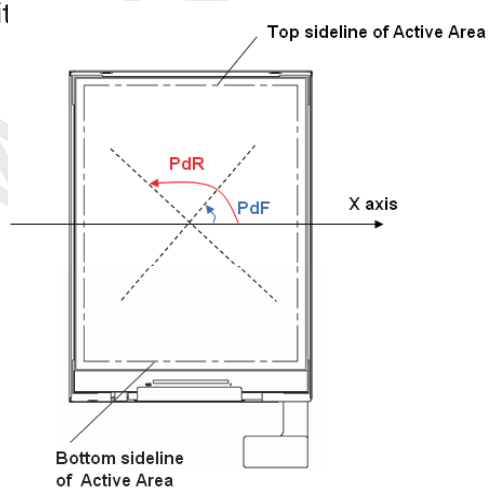
●△Bpn = Bpn (gray) / Bpn (white)
Which n means the dot No. In the Cross-talk Test Pattern ;
Bpn (gray) means the brightness of the No.n spots in Cross-talk Test Pattern;
Bpn (white) means the brightness of the No.n spots in Full white Test Pattern;
●△Bp (Max.) = Maximum value in △Bp1~△Bp9, except the No. 5 spot.
●△Bp (Min.) = Minimum value in △Bp1~△Bp9, except the No.5 spot.
●△CT=△Bp (Max.)/△Bp(Min.).
●△CT must be less than 1.10



Cross-talk Test Pattern

Note 11: Reflectance Ratio
●Measurement equipment : X-rite SP64
●Measurement parameter: Reflectance Ratio @550nm

Note 12: Polarization Direction Definition
●Viewing direction is normal user viewing direction which is vertical to the display surface
●The polarizer which is closer to viewer is defined as Front Polarizer
●The polarizer which is on the rear side of viewer is defined as Rear Polarizer
●The X axis is defined as parallel line to top & bottom sidelines of the Active Area
●PdF which is marked in blue arrow is polarization degree of Front polarizer
●PdB which is marked in red arrow is polarization degree of Back polarizer
●The polarization degree parameter must be indicated in range of 0deg to 180deg according to above definit



Note 13: **Definition of Luminance decrease ratio**
- Refer to the graph of note 9.
- Test pattern : Full White
- The luminance decrease ratio is calculated by using following formula:

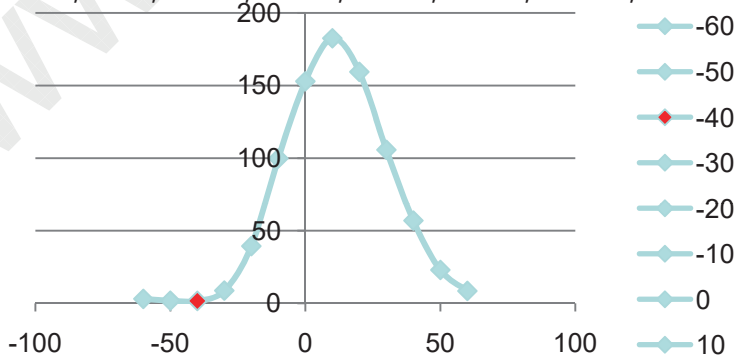
$$\text{Luminance decrease Ratio} = 1 - \frac{\text{Luminance test at } \theta_L/\theta_R/\psi_T/\psi_B=30^\circ}{\text{Luminance test at } \theta_L/\theta_R/\psi_T/\psi_B=0^\circ}$$

Note 14: **Definition of Contrast decrease ratio**
- Refer to the graph of note 9.
- Using contrast test method.
- The contrast decrease ratio is calculated by using following formula:

$$\text{Contrast decrease Ratio} = 1 - \frac{\text{Contrast test at } \theta_L/\theta_R/\psi_T/\psi_B=30^\circ}{\text{Contrast test at } \theta_L/\theta_R/\psi_T/\psi_B=0^\circ}$$

Note15: Color Shift JNCD
- For JNCD measure:
- Fix on one pattern like white pattern,
- On the condition θ=0 F=0°, we can get the color coordinate (u1', v1') and onθL=30° we can get anot her color coordinate (u2', v2')
- Delta = Square Root((u2' - u1')^2 + (v2' - v1')^2)
- JNCD stands for "Just Noticeable Color Difference"
- For the (u', v') color space JNCD=0.0040.
- 2JNCD means Delta u' v' <0.0080
- For color shift we need to measure white/red/green/blue pattern.
- This Requirement is from our customer and we have test some of our phone display and the result is OK.

Note 16: **Definition of gray inversion angle**
- Refer to the graph of note 9.
- Using luminance test method.
- Test pattern : 128 gray
- If the viewing direction is 12 o' clock ,then test the luminance while θ=-60°,θ=-50°, θ=-40°, θ=-30°, θ=-20°, θ=-10°, θ=0°, θ=10°, θ=20°, θ=30°, θ=40°, θ=-50°, θ=60°. The luminance test as figure below:

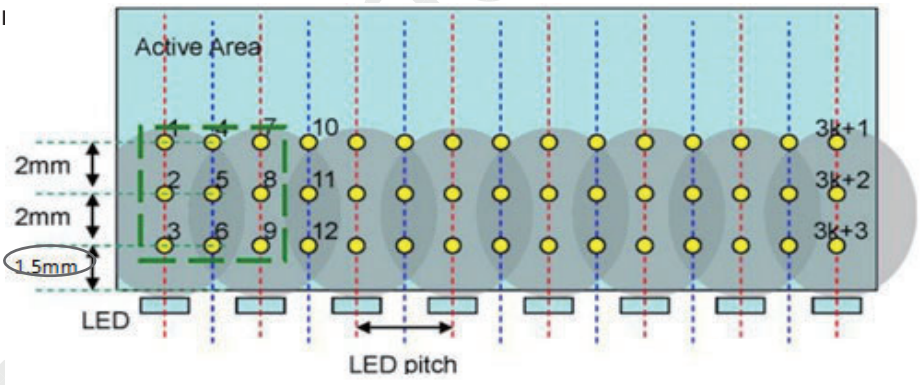


Note 17: **After image judgment**
Power on the LCD 1 hour at tessellated picture(8*8), then switch to 128 gray picture or Flicker picture, if the afterimage can' t be seen within 3 minutes, the LCD is OK.

Note 18: **CABC Test**
●Measurement equipment :CS-2000 or similar equipments
●Testing picture: CABC Brightness-Gray and APL FIX gamma test picture.
●Test method:
●Power on LCD, test Brightness-Gray picture, drawing the brightness-gray curve, confirm save the power ' s scale.
Test APL FIX gamma picture, drawing the APL FIX gamma curve, assurance the curve is smooth.

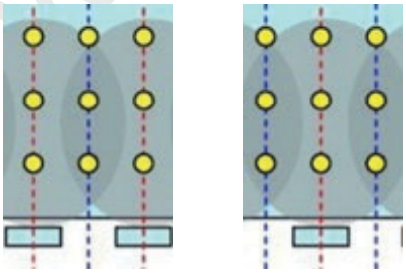
Note 19: Hot spot Test
●(Based on VESA-2.0-306-1)
●Equipment used by: Imaging Photometer system
●The goal of this measurement is to evaluate the uniformity of between the worst case bright and dark s pots found along the LED launching area of the module.

1. The backlight is to be measured ad the module level, using the drive circuit contained on the LCD mo dule or the recommended circuit.
2. The backlight shall be allowed to warm up for 1 minute for this test.
3. The display shall be driven with all white pixels with the contrast set to optimal.
4. The luminance shall be measured directly in front of the LEDs("Hot areas") and directly between th e LEDs("Dark areas") along the launching area edge of the panel. The measurement spot size of th e "hot" and "dark" locations shall be 5mm in diameter.
5. Hot Spot ui



Hot spot uniformity=L Min/L Max

●Every near 9 points define



Note 20: Color uniformity

●Measurement Conditions

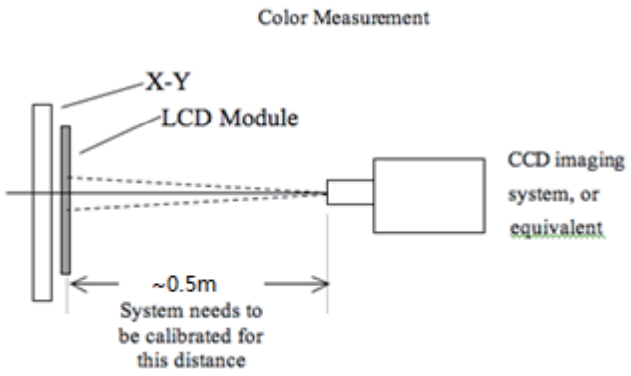
Recommended measuring equipment for color is ICPMI16 Colorimeter or similar CCD type equipment. The optical characteristics are determined after the unit has been 'ON' and stable at the following con ditions:

Maximum brightness

Dark environment

Ambient temperature at 25°C ± 2°C

●Optical measurement system

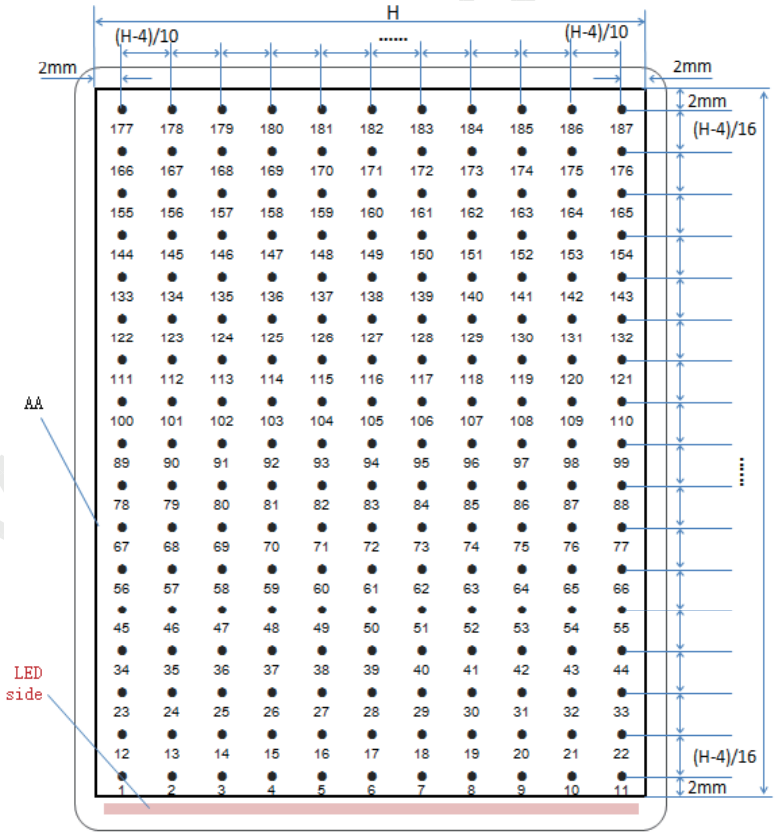


●Total 187 measure points should set as shown in the following figures. The CIE 1976 Standards shall be used.

●The color difference is calculated by using following formula:

Max (△u' v' -A) (the max △u' v' value between two random point of 187 point)

Max (△u' v' -B) (the max △u' v' value between two adjacent point in column and row of 187poin t)



5.0 RELIABLITY TEST

The Reliability test items and its conditions are shown in below.

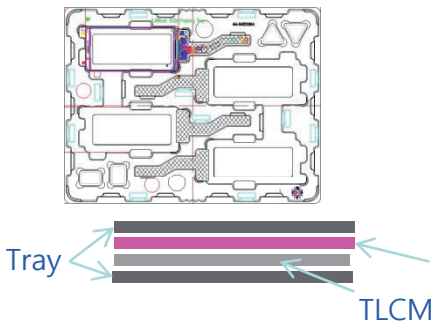
<Table 17. Reliability Test Parameters >

No	Test Items	Conditions
1	High temperature storage test	80℃, 72hr
2	Low temperature storage test	-40℃, 72hr
3	High temperature & high humidity (operation test)	60℃，90%, 240hr
4	Low temperature operation test	-20℃, 72hr
5	高温重启实验	60℃，72hr ，每次待机10s
6	Thermal Shock Test	-40℃~80℃，100cycle
7	Image sticking	5*5chess,2hr, L127，5s消失
8	低温适应性	-30℃, 1hr
9	8585存储	85℃，85%, 240hr
10	UV	一个循环包含4个小时的UV暴晒(60℃，UV-A，340nm，0.63W/m2)和4个小时的湿度凝露(50℃)，试验持续96小时（包含12个8小时的循环）。
11	极限电压高温工作	-20℃/16H
12	极限电压低温工作	60℃/16H
13	Module Packing	1.47G,5-200Hz,Random, +X, +Y,±Z / 30min
14	Drop	1Angle,3Edge,6Face,60cm

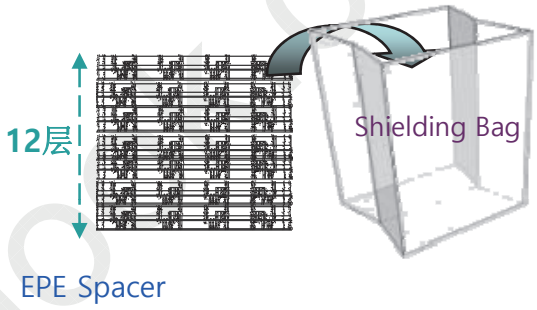
6.0 PACKING INFORMATION(产品形态：TLCM)

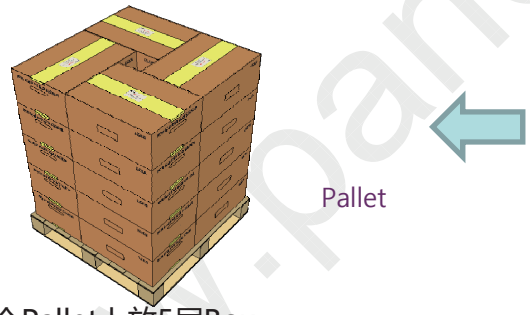
Packing procedure:

-. 将 4pcs TLCM 平放入Tray
TP正面朝上放置
产品上层放置EPE Spacer（粉色）

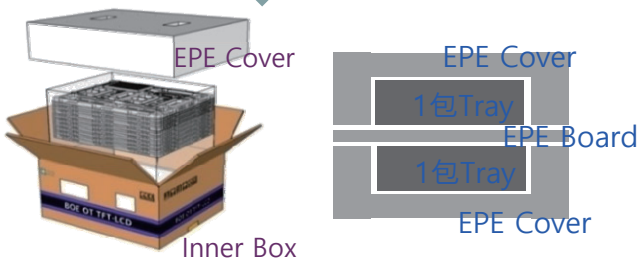


-. 将12pcs PET Tray 套入Shielding Bag
-. Tray 无需旋转码放
-. 顶部&底部各1pcs 空Tray





-. 每个Pallet上放5层Box
1层4箱, 旋转码放
共计20ea Box
-. Pallet外进行缠膜包装
-. 1600pcs Panel / Pallet



- .将2包平放入Inner Box
上下放置EPE Cover, 中间放置EPE Board
-. 80pcs/Box

6.1 Packing Note(产品形态：TLCM)

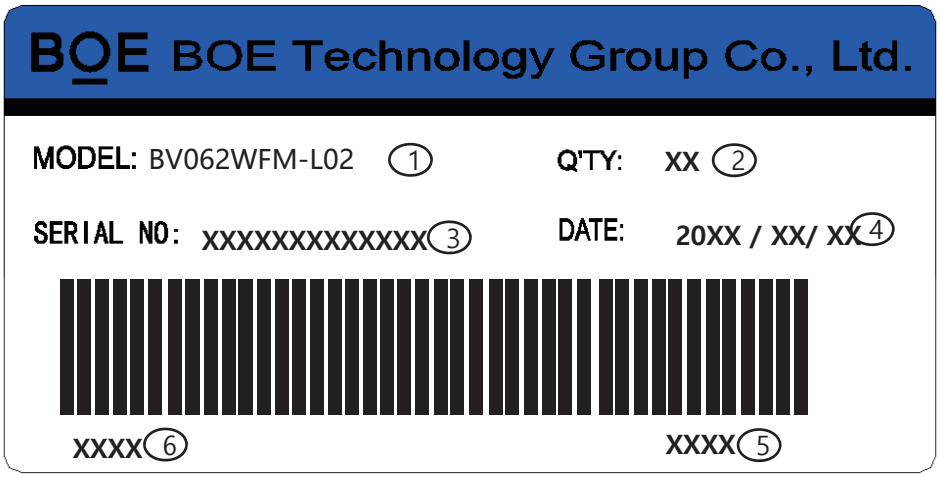
- Box Dimension: 500mm(W) x 400mm(D) x 290mm(H)
- Package Quantity in one Box: 80pcs

6.2 Box label (产品形态: TLCM)

蓝色字体为后打印标识, 说明如下:

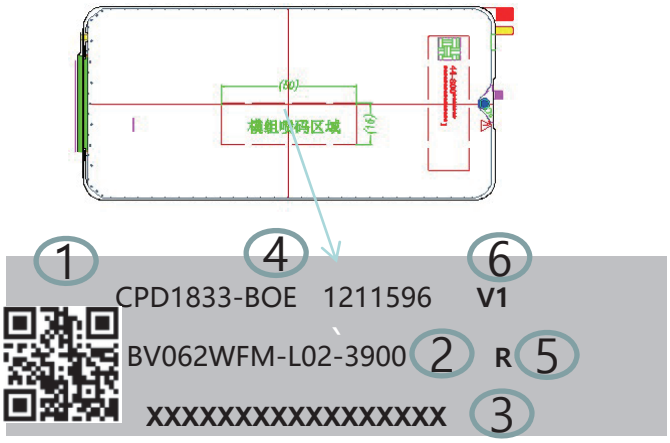
Label Size: 110mm*55mm

1. FG-CODE
2. Box 产品数量
3. Box ID, 编码规则如下
4. Box Packing 日期
5. FG-CODE 后四位
6. 二维码号



序列号	1	2	3	4	5	6	7	8	9	10	11	12	13
代码	X	X	X	3	X	X	X	X	X	X	X	X	X
描述	GBN代码		等级	B3	年份		月	Rev	序列号				

7.0 Product Label



Remark：

喷码区域：50mm*15mm（三行喷码）

1. MDL ID 对应二维码, 二维码尺寸: 4.5mm× 4.5mm
   其中二维码格式为QR码
2. 产品内部FG-CODE
3. MDL ID, 编码规则如下
4. 客户端产品名称&料号
5. 是否经过Rework 标识(如经过, 有 R 标识)
6. 版本号 项目EN阶段为V1, 量产后为A0
   (后续产品如有变更, 版本号为A1, A2.....)

序列号	1	2	3	4	5	6	7	8	9	10	11	12	13	14
代码	X	X	X	X	X	X	X	X	X	X	X	X	X	X
描述	产品短号(二维码号)				年		月	日		流水码				
	人员维护				月: 1~9, A、B、C					0~9, A~Z, 无I O				

8.0 Handling & Cautions

8.1 Mounting Method

- The panel of the LCD consists of two thin glasses with polarizers which easily get damaged. So extreme care should be taken when handling the LCD.
- Excessive stress or pressure on the glass of the LCD should be avoided. Care must be taken to insure that no torsional or compressive forces are applied to the LCD unit when it is mounted.
- 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.
- To determine the optimum mounting angle, refer to the viewing angle range in the specification for each model.
- Mount a LCD module with the specified mounting parts.

8.2 Caution of LCD Handling and Cleaning

- 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.
- The polarizers on the surface of panel are made from organic substances. Be very careful for chemicals not to touch the polarizers or it leads the polarizers to be deteriorated.
- If the use of a chemical is unavoidable, use soft cloth with solvent（recommended below) to clean the LCD ‘s surface with wipe lightly.
  -IPA(Isopropyl Alcohol), Ethyl Alcohol, Trichlorotriflorothane
- Do not wipe the LCD's surface with dry or hard materials that will damage the polarizers and others. Do not use the following solvent.
  -Water, Ketone, Aromatics
- It is recommended that the LCD be handled with soft gloves during assembly, etc. The polarizers on the LCD's surface are vulnerable to scratch and thus to be damaged by sharp particles.
- Do not drop water or any chemicals onto the LCD's surface.
- A protective film is supplied on the LCD and should be left in place until the LCD is required for operation.
- 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.

8.3 Caution Against Static Charge

- 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.
- 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.
- Avoid the use work clothing made of synthetic fibers. We recommend cotton clothing or other conductivity-treated fibers.
- 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.

8.4 Caution For operation

- It is indispensable to drive the LCD within the specified voltage limit since the higher Voltage than the limit causes the shorter LCD's life. An electro-chemical reaction due to DC causes undesirable deterioration of the LCD so that the use of DC drive should avoid.
- Do not connect or disconnect the LCD to or from the system when power is on.
- Never use the LCD under abnormal conditions of high temperature and high humidity.
- 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.
- 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.
- Do not display the fixed pattern for a long time because it may develop image sticking due to the LCD structure. If the screen is displayed with fixed pattern, use a screen saver.

8.5 Packaging

- Modules use LCD element, and must be treated as such.
  -Avoid intense shock and falls from a height.
  -To prevent modules from degradation, do not operate or store them exposed directly to sunshine or high temperature/humidity for long periods.

8.6 Storage

- A slight dew depositing on terminals is a cause for electro-chemical reaction resulting in terminal open circuit. Relative humidity of the environment should therefore be kept below 60%RH.
- Original protective film should be used on LCD' s surface (polarizer). Adhesive type protective film should be avoided, because it may change color and/or properties of the polarizers.
- Do not store the LCD near organic solvents or corrosive gasses.
- Keep the LCD safe from vibration, shock and pressure.
- Black or white air-bubbles may be produced if the LCD is stored for long time in the lower temperature or mechanical shocks are applied onto the LCD.
- In the case of storing for a long period of time for the purpose or replacement use, the following ways are recommended.
  -Store in a polyethylene bag with sealed so as not to enter fresh air outside in it.
  -Store in a dark place where neither exposure to direct sunlight nor light is.
  -Keep temperature in the specified storage temperature range.
  -Store with no touch on polarizer surface by the anything else. If possible, store the LCD in the packaging situation LCD when it was delivered.

8.7 Safety

- For the crash damaged or unnecessary LCD, it is recommended to wash off liquid crystal by either of solvents such as acetone and ethanol an should be burned up later.
- In the case the LCD is broken, watch out whether liquid crystal leaks out or not. If your hands touch the liquid crystal, wash your hands cleanly with water an soap as soon as possible.
- 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.
- If the liquid crystal should get in your eyes, flush your eyes with running water for at least fifteen minutes.
- If the liquid crystal touches your skin or clothes, remove it and wash the affected part of your skin or clothes with soap and running water.

9.0 APPENDIX

Mechanical Drawing
Drawing Attachment: Front

Mechanical Drawing
Drawing Attachment: Back