B3 TV070WXM-TS0 Product Specification Rev.P0

BUYER	
SUPPLIER	HEFEI BOE Optoelectronics Technology CO., LTD
FG-Code	TV070WXM-TS0-39P0

ITEM	BUYER SIGNATURE	DATE

ITEM	SUPPLIER SIGNATURE	DATE
Prepared		
Reviewed		
Approved		

HEFEI BOE OPTOELECTRONICS TECHNOLOGY

REVISION HISTORY

REV.	ECN No.	DESCRIPTION OF CHANGES	DATE	PREPARED

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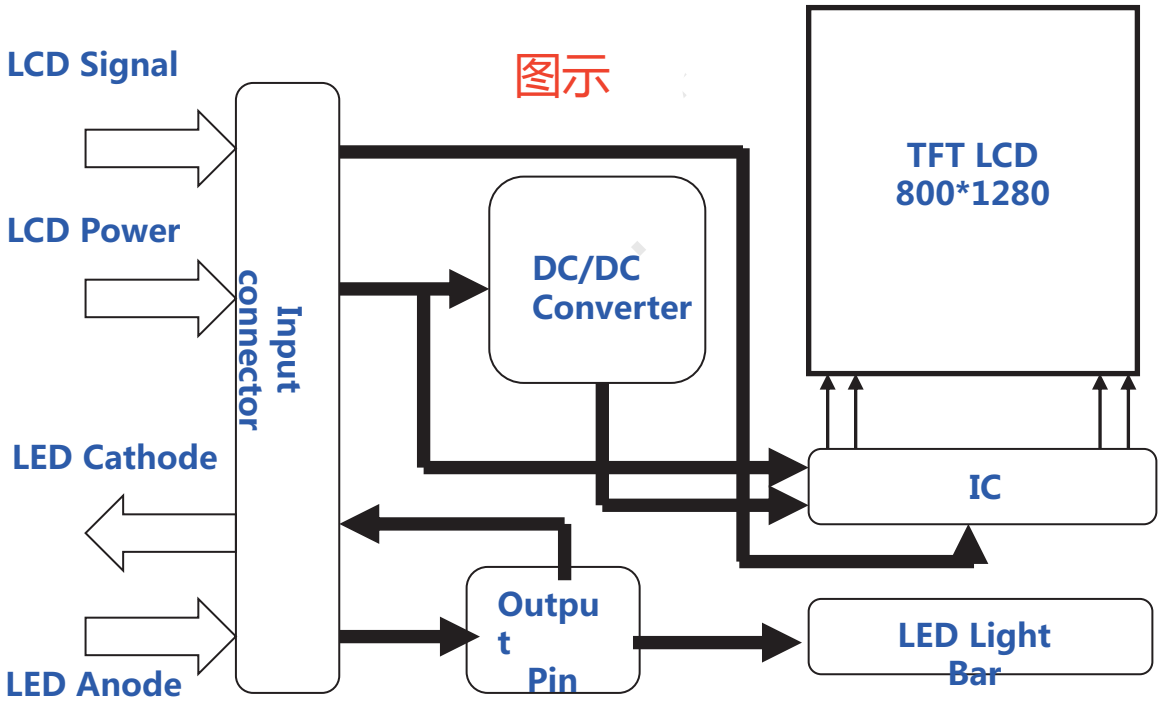
1.0 GENERAL DESCRIPTION

1.1 Introduction

TV070WXM-TS0 is a color active matrix TFT LCD TLCM using amorphous silicon TFT 's (Thin Film Transistors) as an active switching devices. This TLCM has a 7 inch diagonally measured active area with WXGA resolutions (800 horizontal by 1280 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

- 4 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	94.2(W) x 150.72 (H)	mm	
Number Of Pixels	800(H) ×1280(V)	pixels	
Pixel Pitch	39.25(H) ×RGB×117.75(V)	mm	
Pixel Arrangement	Pixels RGB stripe arrangement		
Display Mode	Normally Black		
Display Colors	16.7M(Real 8bits)	colors	
Surface Treatment	HC + AG25		
Contrast Ratio	900:1		
Viewing Angle(CR>10)	CR 10:1, typθ 80° ; CR 100:1, typ θ 75°	deg.	
Response Time	25	ms	
Color Gamut	typ 50		
Brightness	typ 400	cd/m2	
Power Consumption	P_{panel} : 0.330(max.)	watt	
	P_{BL} : 1.403(max.)		
	P_{total} : 1.733(max.)		
Outline Dimension	100.66X162.17 (typ.)	mm	
Weight	74.5 (typ.)	gram	

<Table 2. Touch Panel Specifications>

Parameter		Specification				Remarks
TP Structure		SLOC				
Sensing Method		Mutual Capacitance				
Number Of Touch		5				
Performance	Sensitivity(mm)	Φ7mm				
	Report Rate	90Hz				
	Finger Separation	-				
	Response Time	<30ms				
	Accuracy(mm)	Center	1.5	Edge	2.5	@Φ7mm
	Precision(mm)					
	Linearity(mm)		1.5		2.5	
	Jitter(mm)		1.2		2.5	
SNR(dB)		≥20				
Pen Type & Pen Size		Touch Ic 在客户端，无此项规格				
Glove Touch						
Hover						
Palm & Face Rejection(Φ30mm)						
Temperature Shock Self-adaption						
Anti Water	Spray					
	Water Drop					
Gesture Support	Success Rate					
	Gesture Type					
Power Consumption(Typ.) Active/Idle/Sleep						

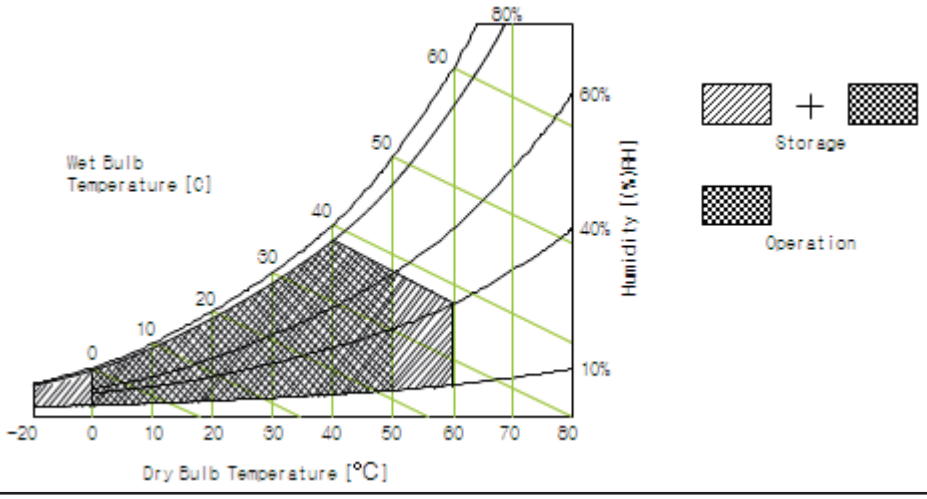
2.0 ABSOLUTE MAXIMUM RATINGS

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

< Table 3. Absolute Maximum Ratings>

Parameter		Symbol	Min.	Max.	Unit	Remarks
Power Supply	LCD Module	VBAT		15.5	V	Ta = 25 ℃
		VDD	-0.3	7.0	V	
	BLU	VLED		15.5	V	
		ILED		21.5	mA	
Operating Temperature		T_{OP}	-20	65	℃	Note 1
		T_{SUR}			℃	
Storage Temperature		T_{ST}	-40	85	℃	
Storage Humidity		Hst	10	95	%RH	

Note : 1) Temperature and relative humidity range are shown in the figure below.
Wet bulb temperature should be 39 ℃ max. and no condensation of water.



3.0 ELECTRICAL SPECIFICATIONS

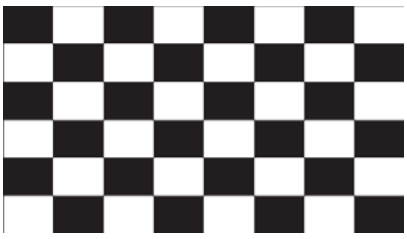
3.1 TFT LCD Module

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

Parameter		Symbol	Values			Unit	Notes
			Min.	Typ.	Max.		
Power Supply Voltage		VDD	3	3.3	3.6	V	
		VBAT			15.5	V	
		VRP	0	300	360	mV	Ripple
Power Supply Current		IDD	90	120	140	mA	Note 1
		IBAT			21.5	mA	
Power Consumption		PLCD	250.0	290.0	330.0	W	
Rush current		IRUSH		0.7	1	A	Note 2
CMOS Interface	Input Voltage	VIH			460	V	
		VIL	-40			V	
	Output Voltage	VOH	-50	-	50	V	
		VOL	1.1	1.2	1.3	V	

Notes : 1. The supply voltage is measured and specified at the interface connector of LCM.
The current draw and power consumption specified is for VBAT=3.8V, Frame rate f_V=60Hz and Clock frequency = 156.8MHz. Test Pattern of power supply current

a) Typ : Mosaic 8 x 6 Pattern(L0/L255)



b) Max : skip 1H1V dot(L0/L255)

2. The duration of rush current is about 2ms and rising time of Power Input is 1ms(min)

3.2 Back-Light Unit

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

Parameter	Symbol	Values			Unit	Notes
		Min.	Typ.	Max.		
LED Supply Voltage	VLED			5	V	Note 1
	VRP		300	360	mV	Ripple
LED Forward Current	ILED			21.5	mA	
Power Consumption	PLED	1037.0	1220.0	1403.0	mW	
Rush current	IRUSH		0.7	1	A	
LED Quantity	QLED		20		EA	
LED Life Time	TLED	20000			Hrs	Note 2

Notes: 1. PLED = VLED ×ILED (Without LED converter transfer efficiency)

2. The life time of LED, 10,000Hrs, is determined as the time at which luminance of the LED is 50% compared to that of initial value at the typical LED current on condition of continuous operating at 25 ± 2°C.

3.33INPUT 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	VLED	P	LED Anode	-
2	VLED	P	LED Anode	-
3	VLED	P	LED Anode	-
4	VLED	P	LED Anode	-
5	FB1	P	LED Cathode	-
6	FB2	P	LED Cathode	-
7	FB3	P	LED Cathode	-
8	FB4	P	LED Cathode	-
9	CABC	O	CABC PWM signal output	-
10	RESET	I	Reset signal to LCD	-
11	VPP	P	NC	Internal use only
12	GND	P	Ground	-
13	MIPI 2P	I	MIPI differential data2 input plus	-
14	GND	P	Ground	-
15	MIPI 2N	I	MIPI differential data2 input minus	-
16	MIPI 1P	I	MIPI differential data1 input plus	-
17	GND	P	Ground	-
18	MIPI 1N	I	MIPI differential data1 input minus	-
19	MIPI CLKP	I	MIPI differential clock input plus	-
20	GND	P	Ground	-
21	MIPI CLKN	I	MIPI differential clock input minus	-
22	MIPI 0P	I	MIPI differential data0 input plus	-
23	GND	P	Ground	-
24	MIPI 0N	I	MIPI differential data0 input minus	-
25	NC	-	NC	-

Pin No.		Symbol	Description	I/O
26	GND	P	Ground	-
27	LOGIC_1V8	P	1.8V logic signal to LCD	-
28	MIPI 3P	I	MIPI differential data3 input plus	-
29	VDD3V3	P	3.3V power input to LCD	-
30	MIPI 3N	I	MIPI differential data3 input minus	-
31	VDD3V3	P	3.3V power input to LCD	-
32	GND	P	Ground	-
33	VDD3V3	P	3.3V power input to LCD	-
34	VGH	O	For ESD	Only for detecting the VGH voltage

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 >

NO.	Name	No.	Name
1	GND	23	TX1
2	GDN	24	TX2
3	RX1	25	TX3
4	RX2	26	TX4
5	RX3	27	TX5
6	RX4	28	TX6
7	RX5	29	TX7
8	RX6	30	TX8
9	RX7	31	TX9
10	RX8	32	TX10
11	RX9	33	TX11
12	RX10	34	TX12
13	RX11	35	TX13
14	RX12	36	TX14
15	RX13	37	TX15
16	RX14	38	TX16
17	RX15	39	TX17
18	RX16	40	TX18
19	RX17	41	TX19
20	RX18	42	TX20
21	GND	43	GND
22	GND	44	GND

3.4.4 Pin assignment for fingerprint identification

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

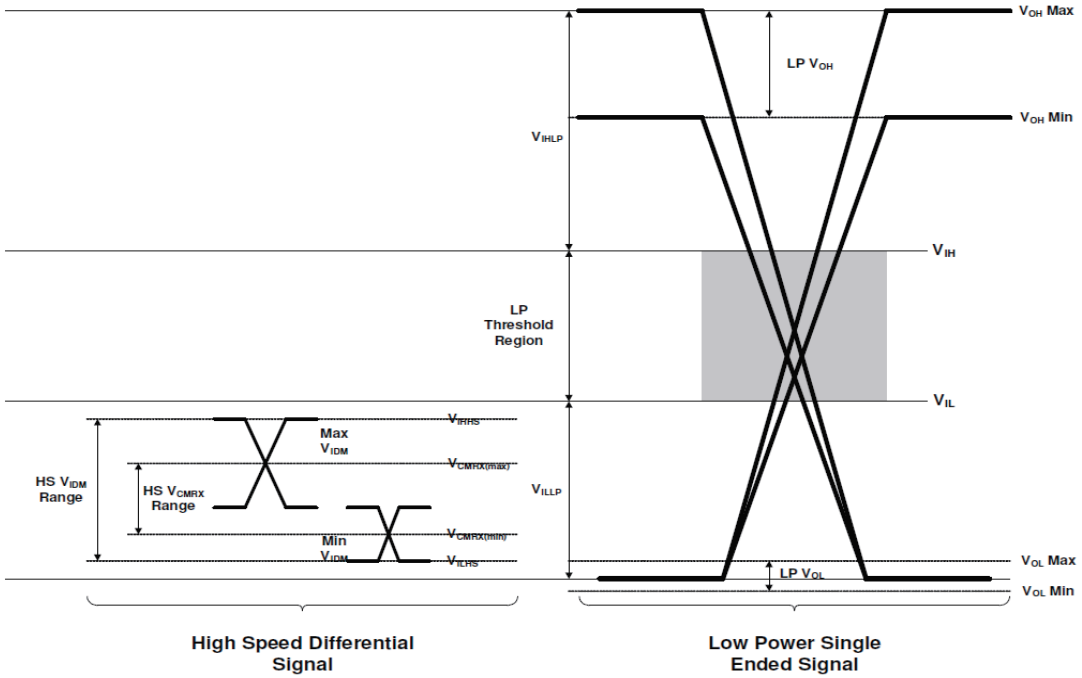
< Table10. Pin assignment for fingerprint >

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(3.3 V) 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

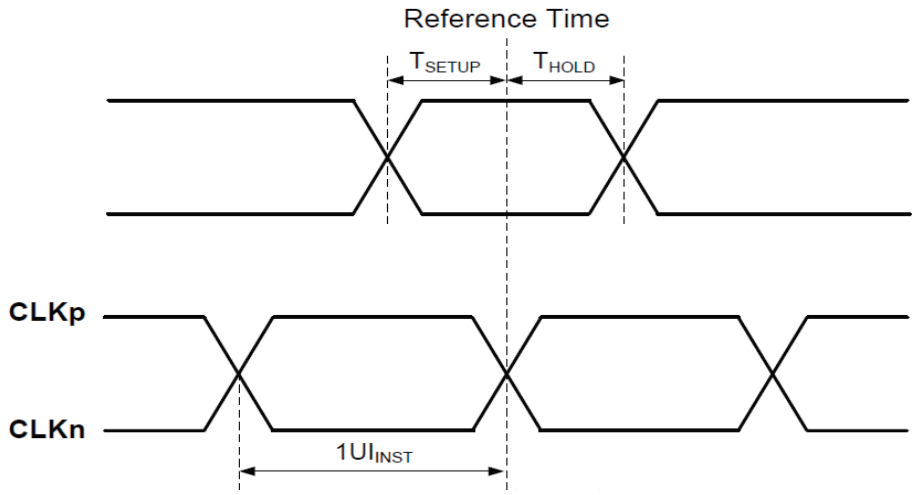
3.5.2 DC Specification

< Table11. DC Specification >

Parameter	Symbol	Min	Typ	Max	Unit	Condition
MIPI digital operation current	I_{VCCIF}	9	12	15	mA	
MIPI digital stand-by current	$I_{VCCIFST}$	-	200	-	uA	
MIPI Characteristics for High Speed Receiver						
Single-ended input low voltage	V_{ILHS}	-40	-	-	mV	
Single-ended input high voltage	V_{IHHS}	-	-	460	mV	
Common-mode voltage	V_{CMRXDC}	70	-	330	mV	
Differential input impedance	Z_{ID}	80	100	125	Ω	
HS transmit differential voltage($V_{OD}=V_{DP}-V_{DN}$)	$\|V_{OD}\|$	85	200	250	mV	
MIPI Characteristics for Low Power Receiver						
Pad signal voltage range	V_I	-50	-	1350	mV	
Ground shift	V_{GNDSH}	-50	-	50	mV	
Output low level	V_{OL}	-50	-	50	mV	
Output high level	V_{OH}	1.1	1.2	1.3	V	



3.5.3 AC Specification



$1UI_{INST}$ = 1 ns @ 1Gpbs (MIPI input data rate : 1 Gbps => Clock frequency : 500MHz => $1UI_{INST}$: 1 ns

< Timing Diagram of MIPI Transmitter>

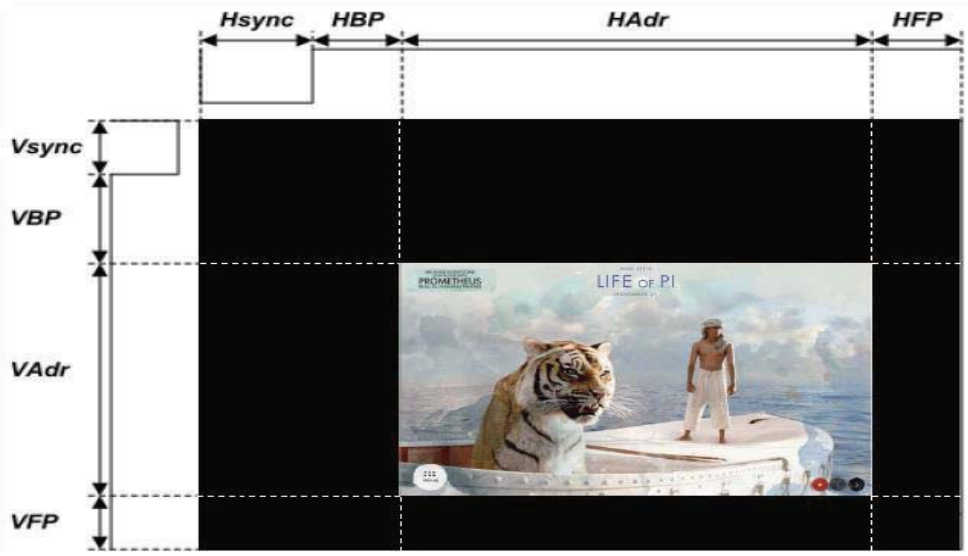
< Table12. AC Specification >

Description	Symbol	Condition	Min	Typ	Max	Unit
Data to Clock Setup Time	T_{SETUP}	-	0.15	-	-	UI_{INST}
Clock to Data Hold Time	T_{HOLD}	-	0.15	-	-	UI_{INST}

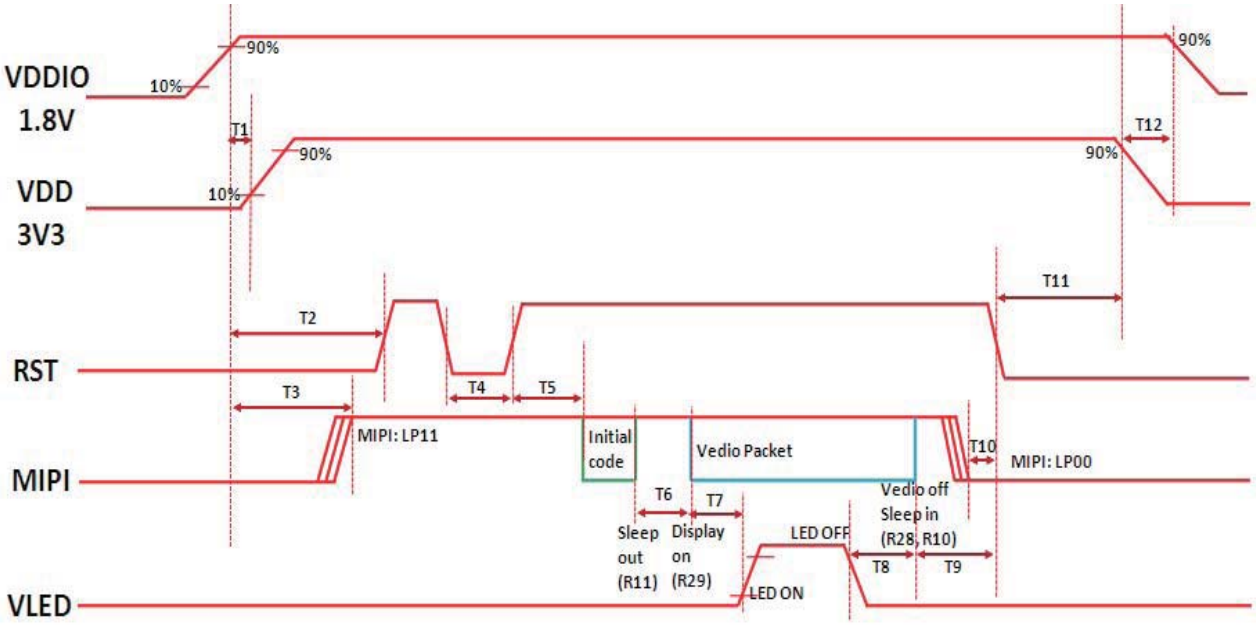
3.6 Interface timing Parameter

< Table13. Timing Parameter >

Item			Symbol	min	typ	max	UNIT
LCD	Frame Rate		-		60		Hz
	Pixels Rate		-		75.77		MHz
Timing	DCLK	Frequency	fCLK	410	468	500	MHz
		Period	Tclk	4	4.44	4.8	ns
	Horizontal	Horizontal total time	tHP		970		t_{CLK}
		Horizontal Active time	tHadr		800		t_{CLK}
		Horizontal Pulse Width	tHsync				t_{CLK}
		Horizontal Back Porch	tHBP	100			t_{CLK}
		Horizontal Front Porch	tHFP	70			t_{CLK}
	Vertical	Vertical total time	tvp		1302		t_H
		Vertical Active time	tVadr		1280		t_H
		Vertical Pulse Width	tVsync				t_H
		Vertical Back Porch	tVBP	8			t_H
		Vertical Front Porch	tVFP	14			t_H
Bit Rate			TX SPD (Mbps)		455		Mbps
Lane					4		Lane



3.8 Power Sequence



< Table15. Sequence Table >

Parameter	Value			Units
	Min.	Typ.	Max.	
T1	0.01		5	(ms)
T2	20		100	(ms)
T3	0		T2	(ms)
T4	0.01		1	(ms)
T5	50		100	(ms)
T6	120		200	(ms)
T7		35		(ms)
T8		35		(ms)
T9	50		100	(ms)
T10		0		(ms)
T11		0		(ms)
T12		0		(ms)

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	400	480	cd/m2	Note 1
Maximum Brightness of Black Pattern	Bblk	=0°			0.4	cd/m2	
Brightness Uniformity	▵Bp	=0°	80	90	95	%	Note 2
Color Uniformity	Δu'v' (w.r.t. center)	=0°	80	90	95	%	Note20 Sign the limit sample shall prevail.
	Δu'v'	=0°	80	90	95	%	
	Δu'v' (worst neighbor	=0°	80	90	95	%	
Viewing Angle	θL	Cr≥10	75	80	90	deg	Note 3
	θ_R		75	80	90		
	ψ_T		75	80	90		
	ψ_B		75	80	90		
Contrast Ratio	Cr	θ=0° FF=0°	700	900	1300	-	Note 4
Response Time	Tr+Tf			25	35	ms	Note 5
	Tgray					ms	
Color Coordinate of CIE1931	**Rx**	θ=0°	0.583	0.603	0.623	-	Note 6
	Ry		0.325	0.345	0.365		
	Gx		0.305	0.325	0.345		
	Gy		0.543	0.563	0.583		
	Bx		0.134	0.154	0.174		
	By		0.097	0.117	0.137		
	Wx		0.2760	0.3060	0.3360		
	Wy		0.2910	0.3210	0.3510		
NTSC Ratio	NTSC	CIE1931	45%	50%	55%	%	Note 7
Color Temperature	CT		6300	6800	7500		
Flicker	amount	-			10	dB	Note 8
Gamma	-		2.20	2.40	2.60		Note 9

Item	Symbol	Condition	Min	Typ	Max	Unit	Note
Crosstalk	▵CT	-			1	%	Note 10
Reflectance	Rf	@550nm	2	5.5	6.5	%	Note 11
Polarization Direction of Front Polarizer	PdF		-1	0	1	deg	Note 12
Polarization Direction of Rear Polarizer	PdR		89	90	91	Deg	

Note1:Luminance measurement

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

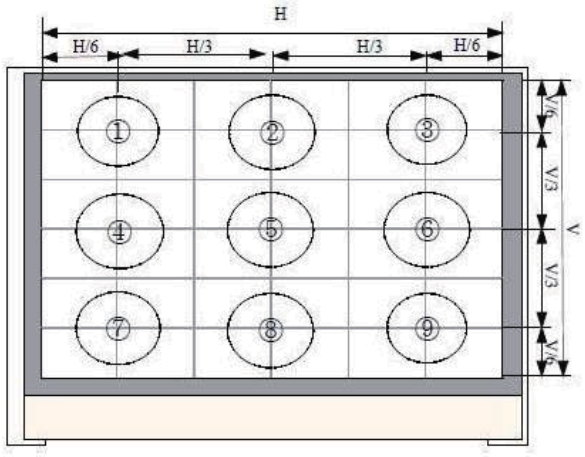
●The data are measured after LEDs are lighted on for more than 5 minutes and LCM displays are fully white. The brightness is the average value of 9 measured spots. Measurement equipment CS2000 or si milar equipments(Field of view:1deg,Distance:50cm)

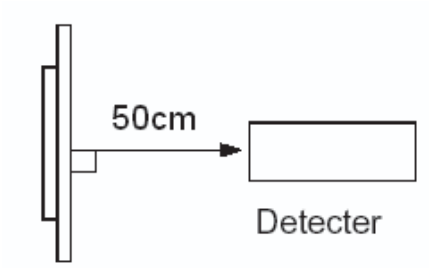
●Measuring surroundings: Dark room.

●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℃.

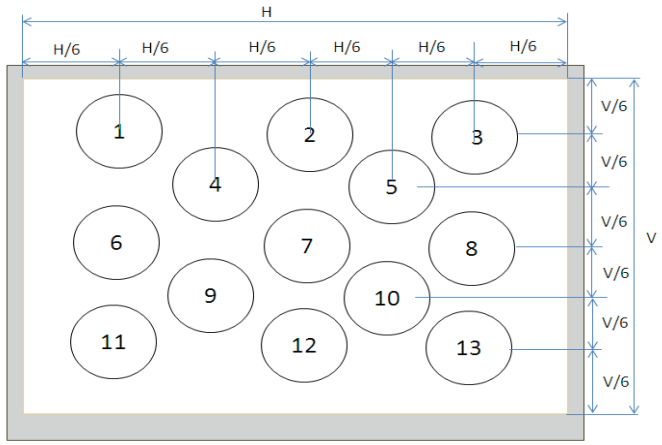
●Measurement equipment:CS2000 or similar equipments

●The luminance uniformity is calculated by using following formula:

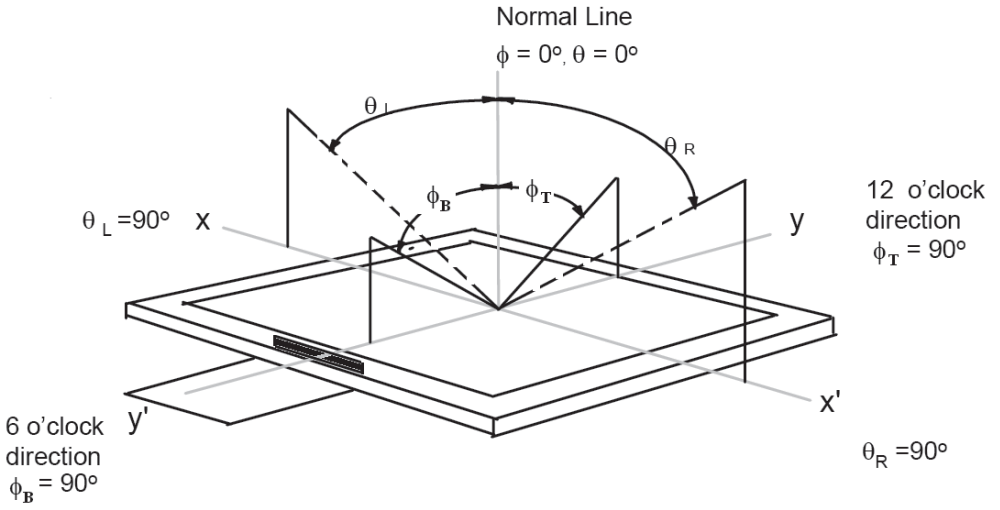
●△Bp = Bp (Min.) / Bp (Max.)×100 (%)

●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.

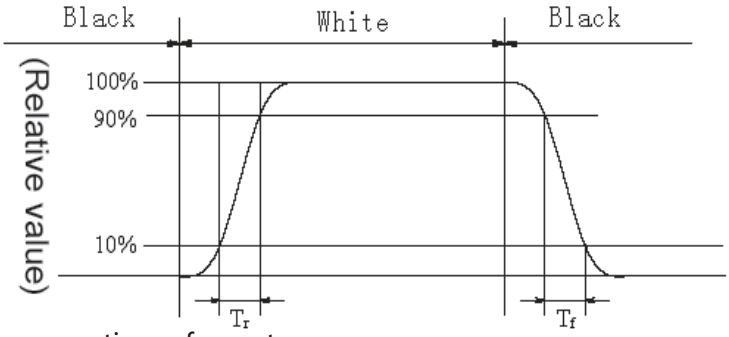


Note4:**ThedefinitionofContrastRatio** (Test LCM using CS2000 or similar equipments):

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

(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 fi gures below.



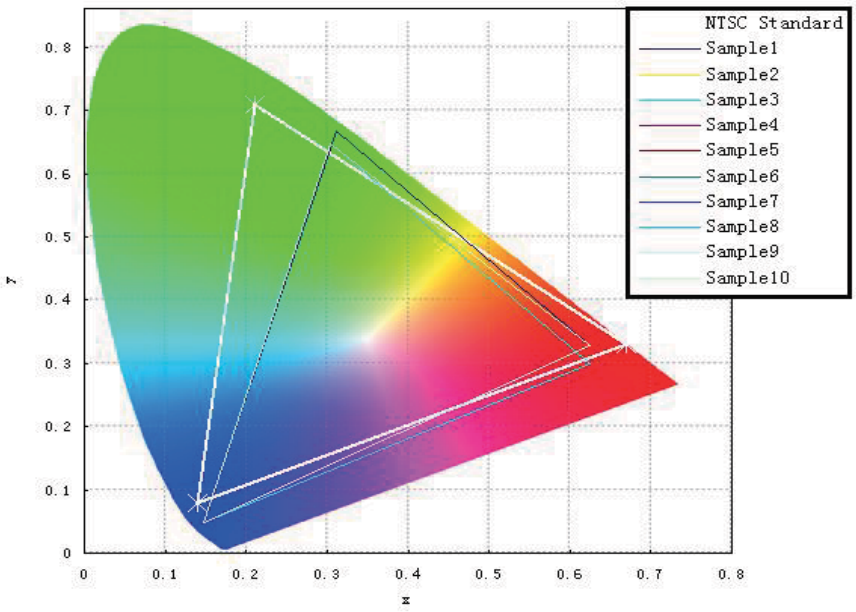
	L0	L1	L2	L3	L4	L5	L6	L7
L0	■							
L1		■						
L2			■					
L3				■				
L4					■			
L5						■		
L6							■	
L7								■

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, 25 5. 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:

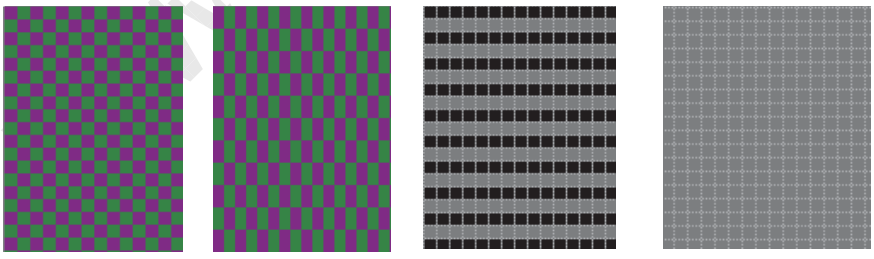
Note 6: Color Coordinates of CIE 1931
The test condition is at ILED=20mA and measured on the surface of LCD module at 25℃.
Measurement equipment:CS2000 or similar equipments
The Color Coordinate (CIE 1931) is the measurement of the center of the display shown in below figure.

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:

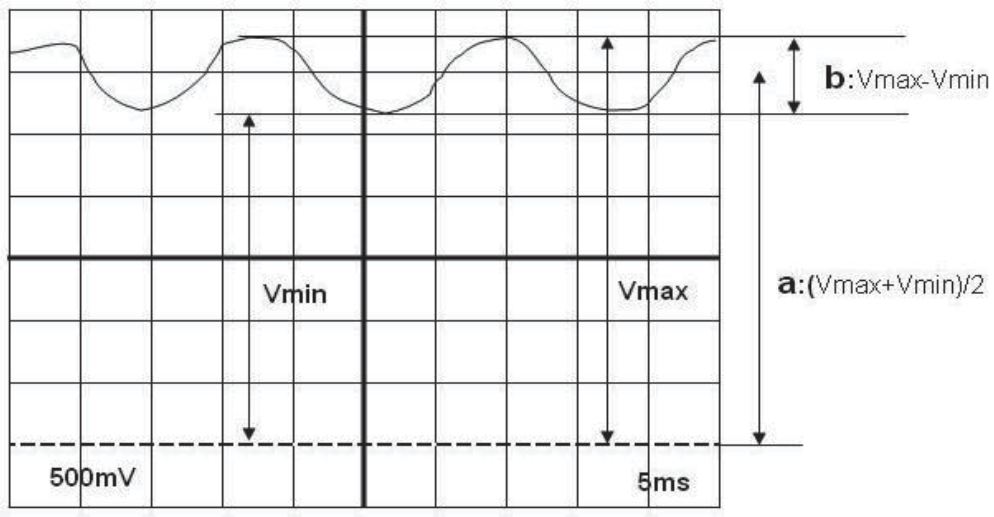
Flicker [dB] = 10 x log[Px/P0]

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**

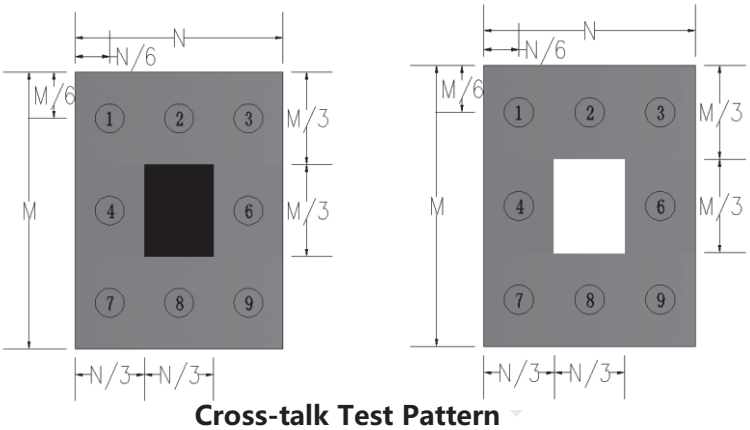
●There should be no visible cross-talk in normal direction of the display when the two ” Cross-talk Test Patterns ” below are loaded.

●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

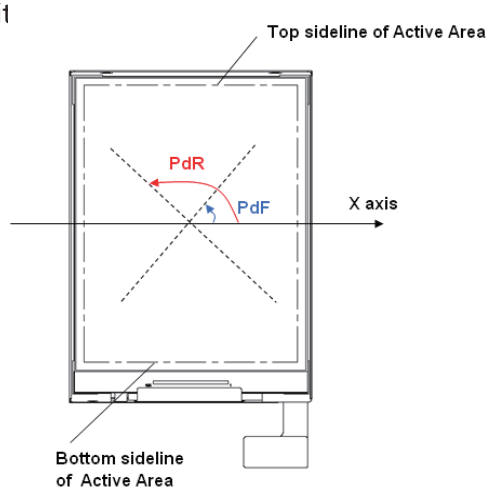
●△Bpn = Bpn (gray) / Bpn (white)
Which n means the dot No. In the Cross-talk Test Pattern ;
Bpn (gray) means the brightness of the No.n spots in Cross-talk Test Pattern;
Bpn (white) means the brightness of the No.n spots in Full white Test Pattern;
●△Bp (Max.) = Maximum value in △Bp1~△Bp9, except the 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 abov
e 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:

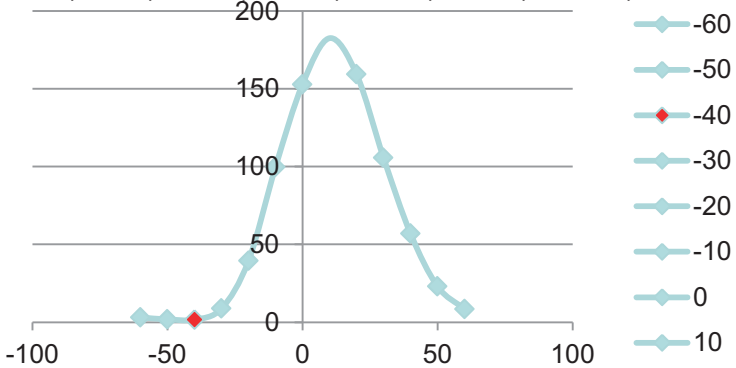
$$\text{Contrast decrease Ratio} = 1 - \frac{\text{Contrast test at } \theta_L/\theta_R/\psi_T/\psi_B=30^\circ}{\text{Contrast test at } \theta_L/\theta_R/\psi_T/\psi_B=0^\circ}$$

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:

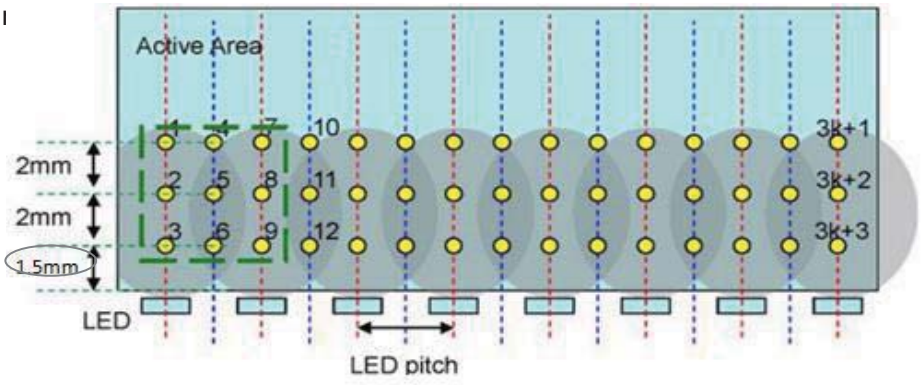


Note 17: **After image judgment**
Power on the LCD 1 hour at tessellated picture(8*8)，then switch to 128 gray picture or Flicker picture, if the afterimage can’ t be seen within 3 minutes, the LCD is OK.

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.

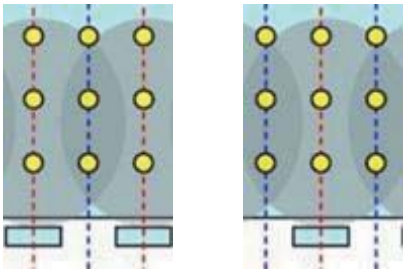
Note 19: Hot spot Test
●(Based on VESA-2.0-306-1)
●Equipment used by: Imaging Photometer system
●The goal of this measurement is to evaluate the uniformity of between the worst case bright and dark s pots found along the LED launching area of the module.

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

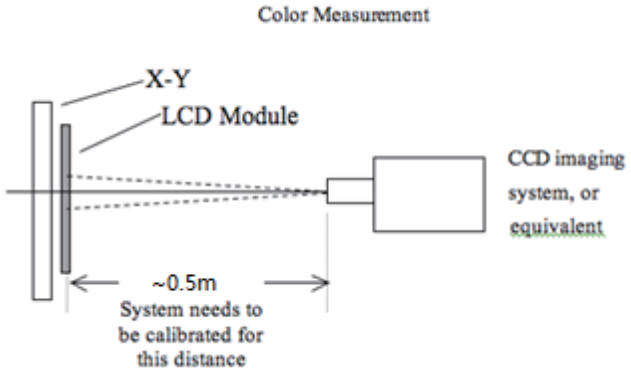
Recommended measuring equipment for color is ICPMI16 Colorimeter or similar CCD type equipment. The optical characteristics are determined after the unit has been 'ON' and stable at the following con ditions:

Maximum brightness

Dark environment

Ambient temperature at 25°C ± 2°C

●Optical measurement system

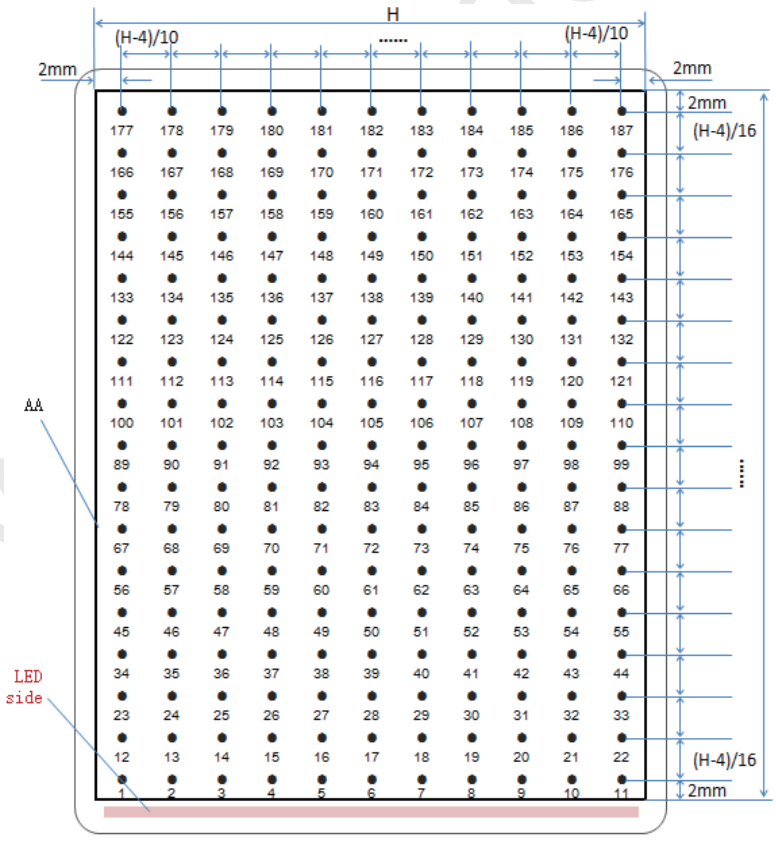


●Total 187 measure points should set as shown in the following figures. The CIE 1976 Standards shall be used.

●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 187point)



5.0 RELIABLITY TEST

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

<Table 17. Reliability Test Parameters >

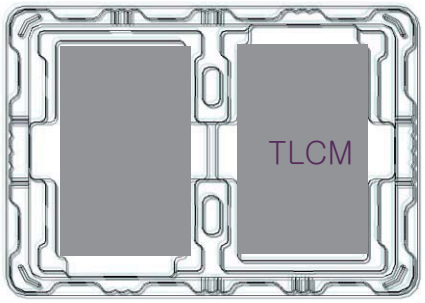
No	Test Items	Conditions
1	High temperature storage test	60℃, 240hr
2	Low temperature storage test	-20℃, 240hr
3	Temperature Humidity operation	60℃,90%, 240hr
4	Low temperature operation test	-20℃, 240hr
5	High temperature operation test	60℃ , 240hr
6	Thermal Shock Test	-40℃-85℃ , 20cycle
7	8585	85℃, 85%,120hr
8		
9		
10		
11		
12		
13		
14		
…		

6.0 PACKING INFORMATION(产品形态：)

Packing procedure:

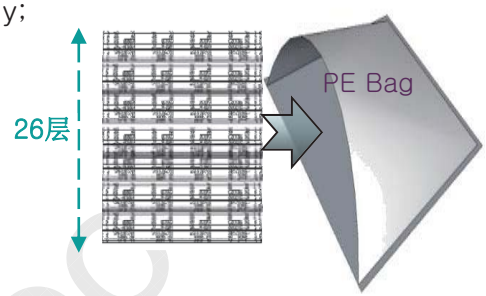
-. 将 2pcs TLCM CG向下平放入Tray

-. 产品上下放置EPE Spacer



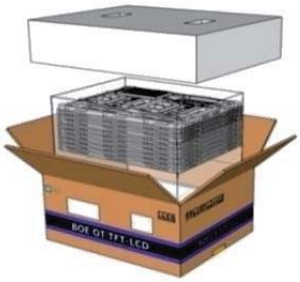
-. 将26pcs PET Tray 平放入PE Bag;

-. Tray 无需旋转放置，顶部1pcs 空Tray;



-. .将PET Tray堆码后平放入Inner Box 上下放置EPE Board

-. 容量：50pcs/Inner Box



-. 每个Pallet上放3层Box
1层8箱,共计24ea Box

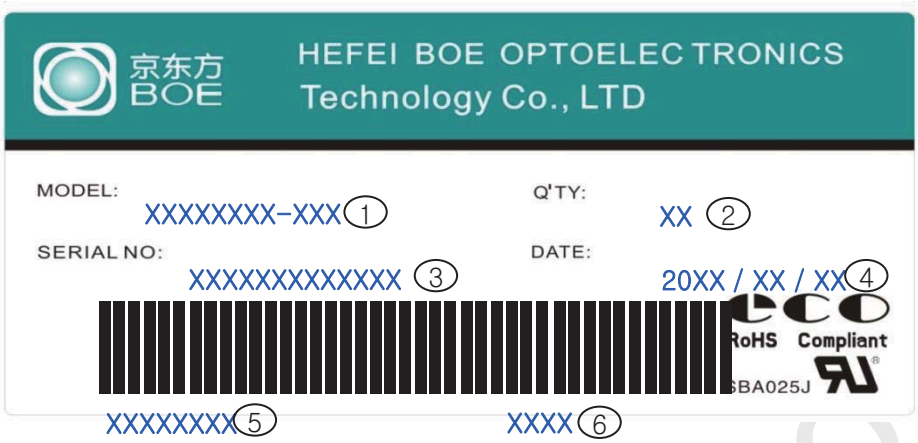
-. Pallet外进行缠膜包装

-. 容量: 1200pcs/Pallet

6.1 Packing Note(产品形态：LCM)

- Box Dimension: 375mm(W) x 280mm(D) x 290mm(H)
- Package Quantity in one Box: 25pcs

6.2 Box label (产品形态：TLCM)



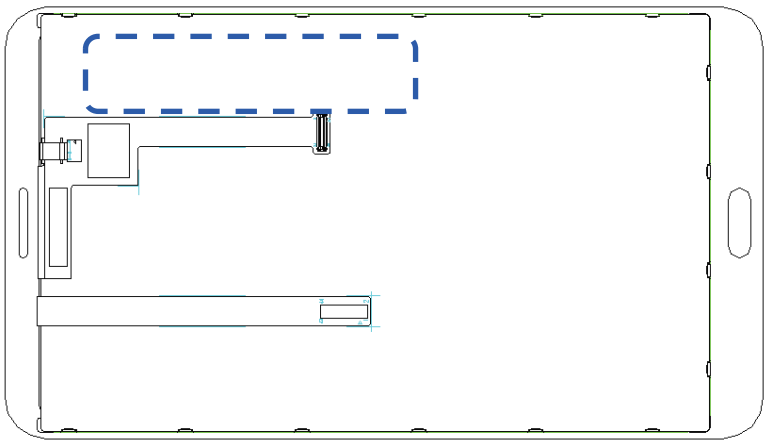
蓝色字体为后打印标识, 说明如下:

Label Size: 115mm*55mm

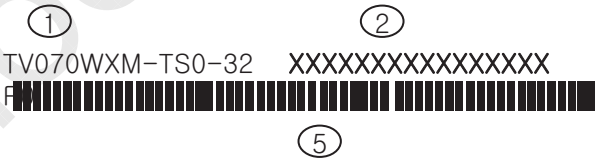
1. **FG-CODE**
2. **Box 产品数量**
3. **Box ID, 编码规则如下**
4. **Box Packing 日期**
5. 客户产品料号
   S GRADE： 待反馈
   A GRADE： 待反馈
6. **FG-CODE 后四位**

序列号	1	2	3	4	5	6	7	8	9	10	11	12	13
代码	4	J	P	3	1	2	7	0	0	0	1	H	D
描述	GBN代码		等级	B3	年份		月	Rev	序列号				

7.0 Product Label



Remark:
喷码至背板标识位置
1. FG-CODE:
   黑色CG TV070WXM-TS0-32P0
   白色CG TV070WXM-TS1-32P0
   金色CG TV070WXM-TS2-32P0
2. MDL ID
3. MDL ID 对应条纹码



MDL ID 编码规则

序列号	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
代码	X	X	P	3	5	B	7	3	2	P	0	0	0	1	E	E	J
描述	GBN代码		等级	B3	年	月	日	FG Code后四位				序列号					

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.

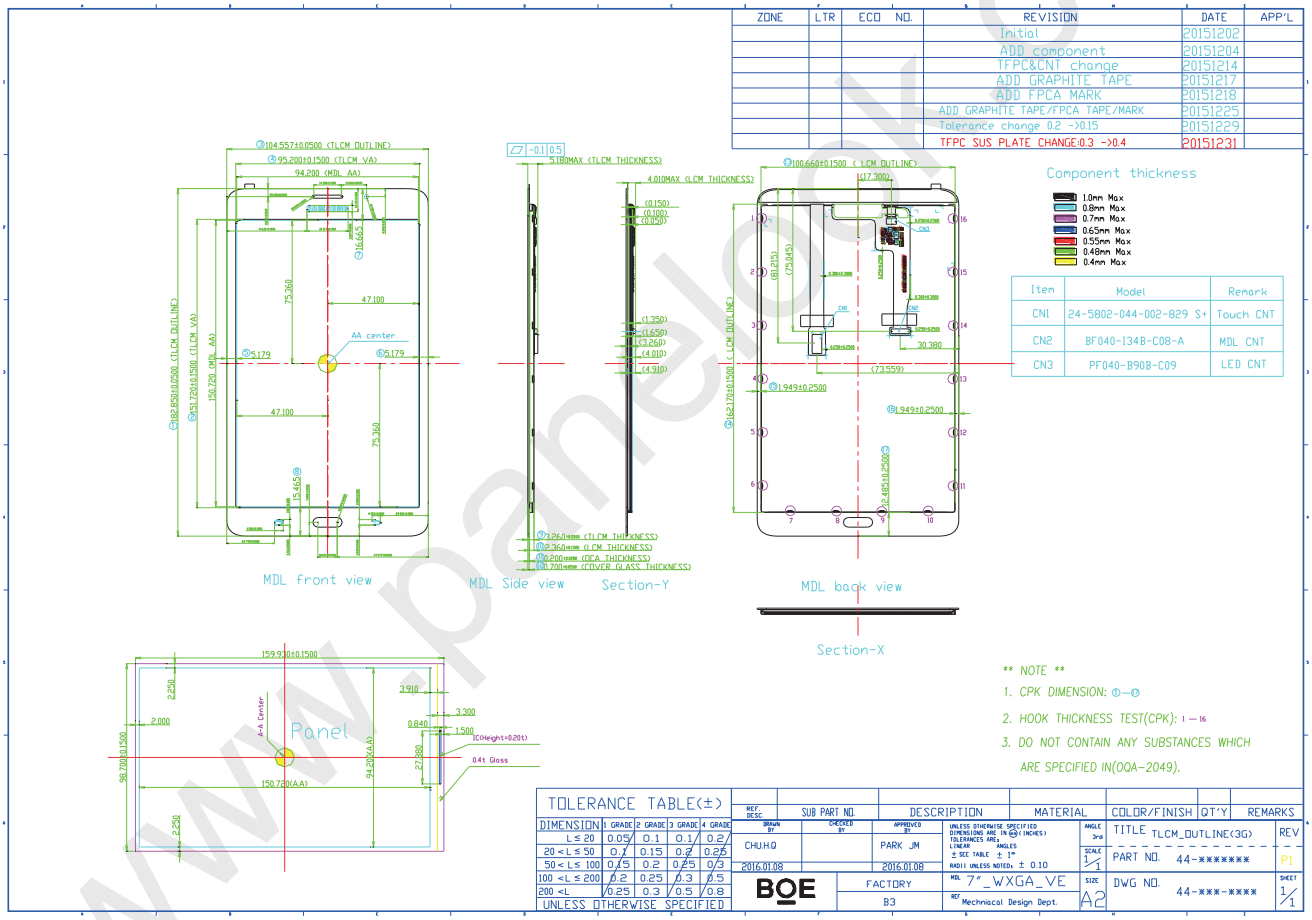
8.6 Storage

- 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.

Mechanical Drawing



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