



深圳显昶光电科技有限公司

Shenzhen Xianyang Optoelectronic Technology Co., Ltd

PRODUCTION SPECIFICATION OF AMOLED MODULE

MODULE NO.: XY012WVC01

Customer Name:			
Customer Part Number:			
Approved By:		Date:	

Prepared By	Checked By	Approved By

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1 Scope

This Specification defines AMOLED manufactured by Shanghai Top Display Optoelectronics Limited, from here on refer as TDO. In the case of any unspecified item, it may require both TDO and the party designs this module into its product to workout a solution.

2 Features

2.1 Product Applications

Smart Watch

2.2 Product Features

- 1) Display color: 16.7M (RGB x 8bits)
- 2) Display format: 1.2"(390RGBx390)
- 3) Pixel arrangement : Real RGBarrangement
- 4) Interface : MIPI
- 5) Driver IC: RM69330

3 Maximum Rating

Parameter	Symbol	Spec			Unit	Note
		Min.	Typ.	Max.		
Analog/boost power volXYge	VCI	-0.3	-	5.5	V	-
I/O volXYge	VDDIO	-0.3	-	5.5	V	-
Operating temperature	Top	-20	-	60	°C	-
Storage temperature	Tstg	-30	-	70	°C	-

4 Mechanical Specifications

Item	Specification	unit
Dimension outline	33.99(V) x 33.62(W) x 0.78(T)	mm
Encapsulation Glass outline	φ38.21	mm
Number of dots	390RGB*390	dots
Active area	φ30.42	mm
Diagonal size	1.19	inch
Pixel pitch	78 x 78	μm
Glass thickness (LTPS/encapsulation glass)	0.3 / 0.2	mm
Weight	TBD	g



5 Electrical Specifications

5.1 Electrical Characteristics

5.1.1 Power Characteristic:

Item	Symbol	Min.	Typ.	Max.	Unit	Remark
AMOLED Power positive	ELVDD	4.55	4.6	4.65	V	-
AMOLED power Negative	ELVSS	-2.45	-2.4	-2.35	V	Ref
DigiXYI Power supply	VDDIO	1.65	1.8	1.95	V	Ref
Analog Power supply	VCI	2.7	2.8	2.9	V	Ref

1) Normal Mode

Power Supply: IOVCC=1.8V VCI=2.8V with power IC RT4723

Frame Frequency: $F_{frame} = 60\text{HZ}$ @ 25degC, Brightness 350 nits, Command Mode,

Display Condition	Symbol	Min.	Typ.	Max.	Unit	Remark
100% Pixel On 350nits	power	-	155	175	mW	Ref

2) Idle Mode

Power Supply: IOVCC=1.8V VCI=2.8V

Frame Frequency: $F_{frame} = 15\text{HZ}$ @ 25degC, Brightness:30nits, OPR:10%,Command Mode

Display Condition	Symbol	Min.	Typ.	Max.	Unit	Remark
10% Pixel On 30 nits	power	-	8.9	10.5	mA	Supplied by Driver IC

5.2 I/O Connection and Block Diagrams

5.2.1 AMOLED Pin Assignments

#	Pin name	I/O	Description
1	GND	Power	Ground
2	GND	Power	Ground
3	GND	Power	Ground
4	RESET	I	OLED Device reset signal (0 : enable ; 1 : Disable)
5	TE	O	Synchronous signal output from panel to avoid tearing effect
6	GND	Power	Ground

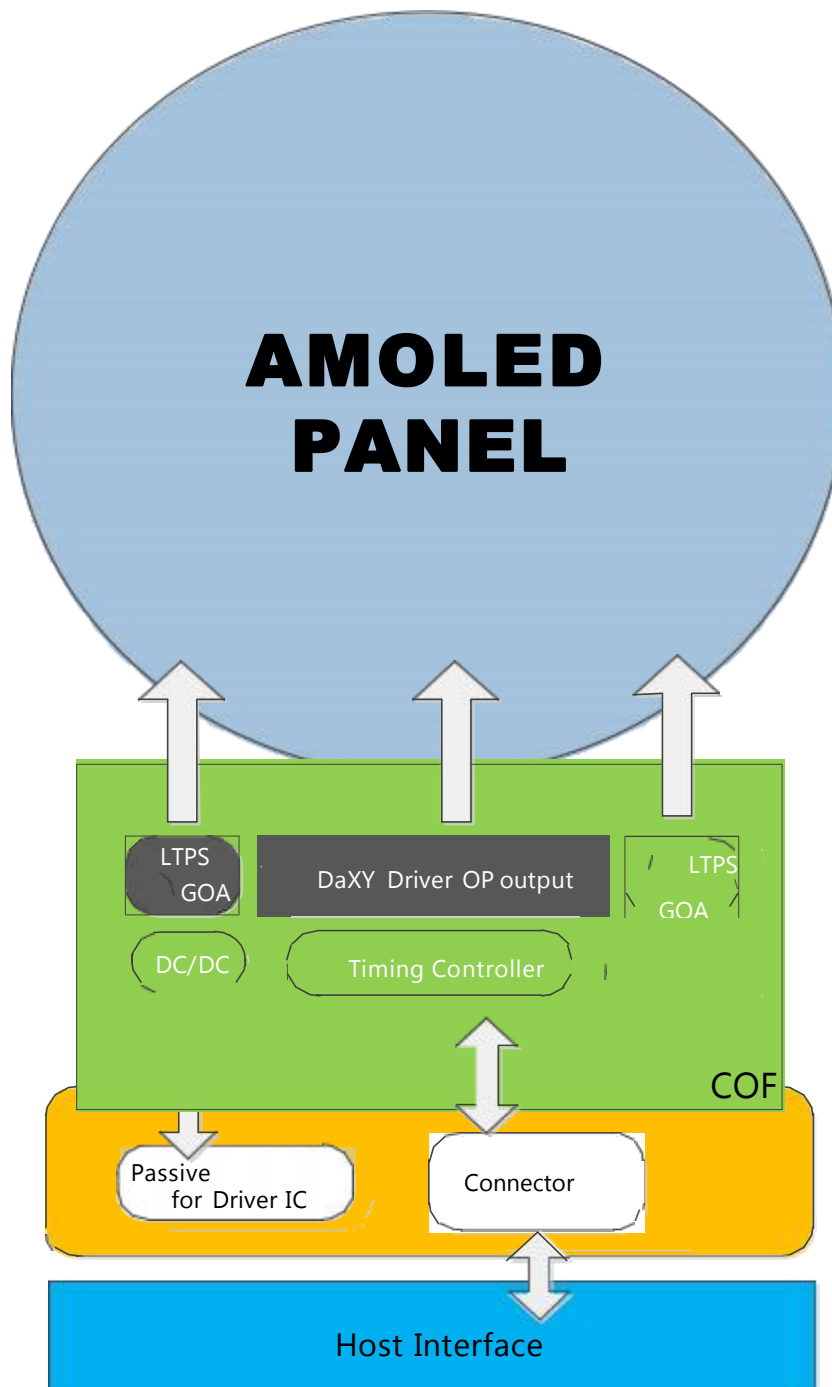
7	NC	-	-
8	NC	-	-
9	IOVCC	Power	OLED Power supply for interface system
10	GND	Power	Ground
11	NFC_B	I/O	NFC TX2
12	NFC_A	I/O	NFC TX1
13	VBAT	Power	AMOLED power
14	VBAT	Power	AMOLED power
15	VBAT	Power	AMOLED power
16	GND	Power	Ground
17	D0N	I/O	MIPI daXY 0 negative signal
18	D0P	I/O	MIPI daXY 0 positive signal
19	GND	Power	Ground
20	CLKN	I	MIPI strobe negative signal
21	CLKP	I	MIPI strobe positive signal
22	GND	Power	Ground
23	MTP_PWR	POWER	Power supply for OTP
24	VCC	POWER	OLED Power supply for analog system

5.2.2 CTP Pin Assignments

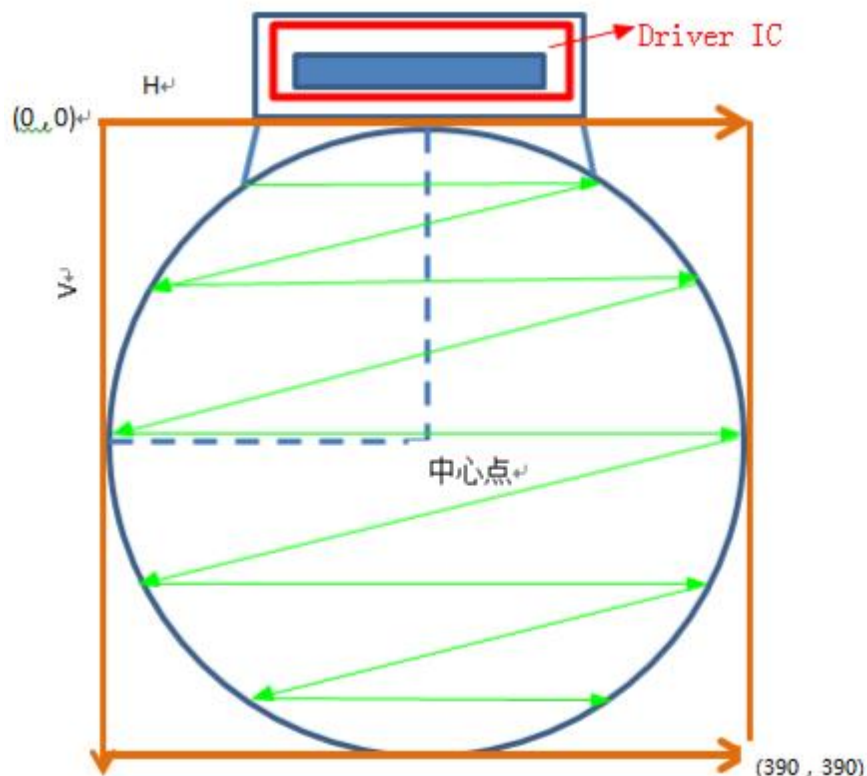
#	Pin name	I/O	Description
1	GND	Power	Ground
2	RESET	I/O	TP Reset
3	LIGHT_INT	I/O	ALS INT
4	VDD_TP	Power	Power supply for TP analog system
5	VDD	Power	Power supply for TP digiXY1 system andALS device
6	GND	Power	Ground
7	SWDIO	I/O	TP SWDIO
8	SCL	I/O	TP/ALS I2C CLK
9	SDA	I/O	TP/ALS I2C DaXY
10	TP_IRF	I/O	TP INT

5.3 Initial CODE

TBD

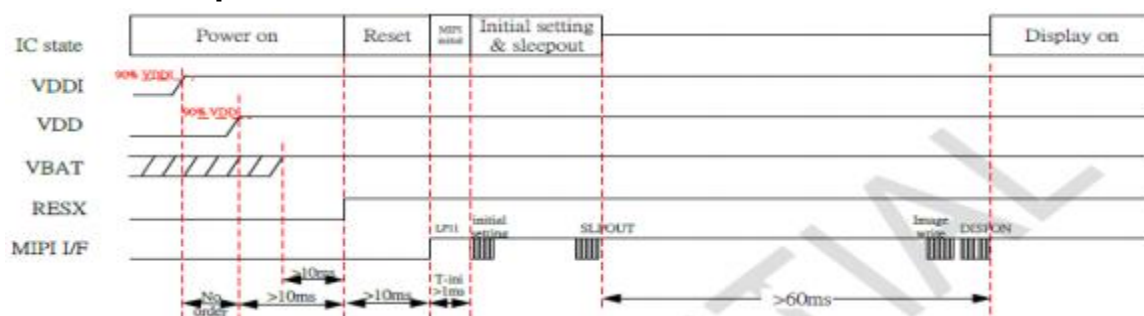


5.4 Graphic memory writing direction

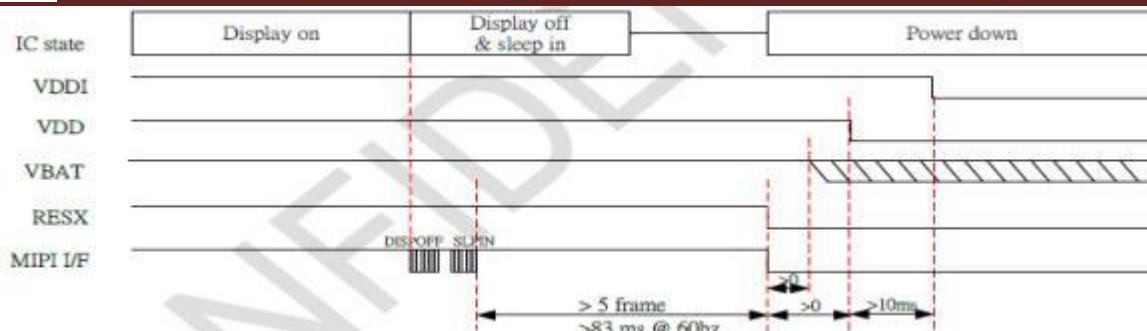


5.5 Recommended Operating Sequence

5.5.1 Power on sequence

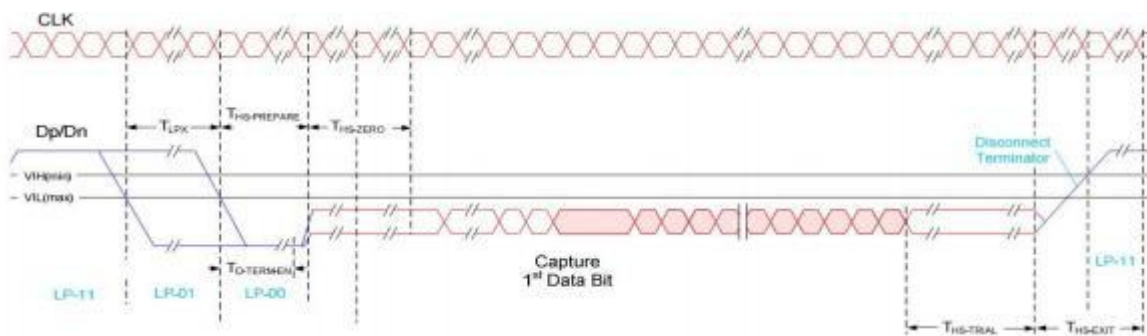


5.5.2 Power off sequence

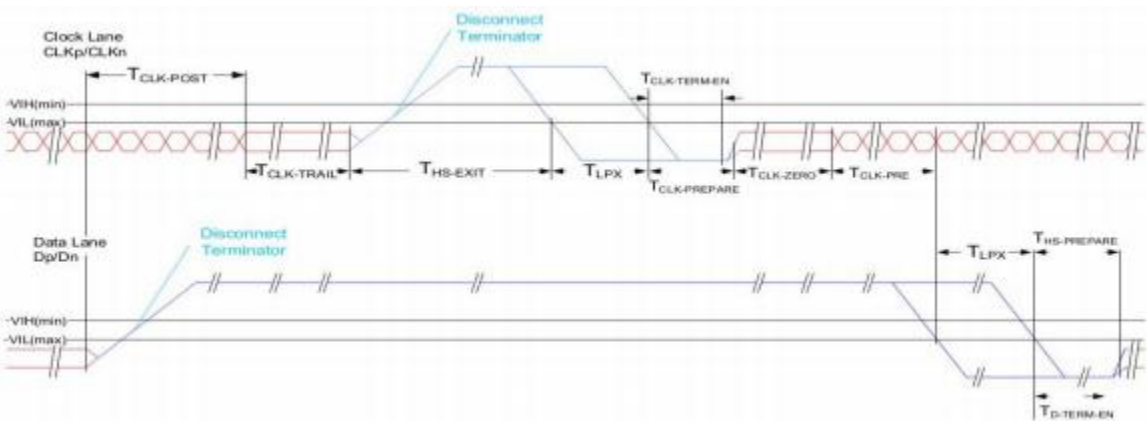


5.6 AC Characteristics (MIP)

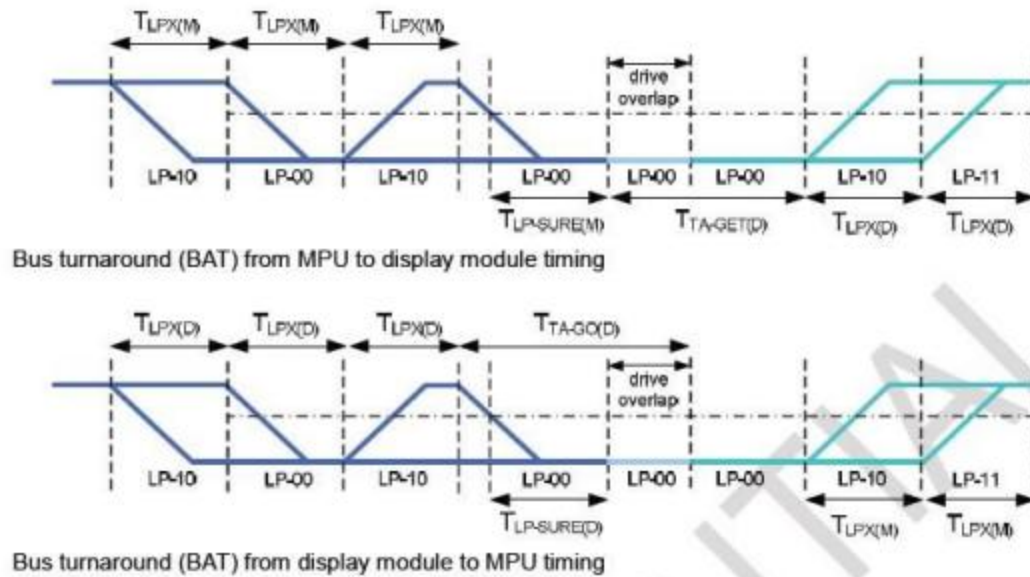
5.6.1 HS DaXY TransmissionBurst



5.6.2 HS Clock Transmission



5.6.3 Turnaround Procedure



5.6.4 Timing Parameters

Symbol	Description	Min	Typ	Max	Unit
TREOT	30%-85% rise time and fall time	-	-	35	ns
TCLK-MISS	Timeout for receiver to detect absence of Clock transitions and disable the Clock Lane HS-RX.	-	-	60	ns
TCLK-POST*1	Time that the transmitter continues to send HS clock after the last associated DaXY Lane has transitioned to LP Mode. Interval is defined as the period from the end of THS-TRAIL to the beginning of TCLK-TRAIL.	60ns + 52*UI (For DCS)	-	-	ns



TCLK-PRE	Time that the HS clock shall be driven by the transmitter prior to any associated DaXY Lane beginning the transition from LP to HS mode.	8	-	-	ns
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TCLK-SETTLE	Time interval during which the HS receiver shall ignore any Clock Lane HS transitions, sXYrting from the beginning of TCLK-PRE.	95	-	300	ns
TCLK-TERM-EN	Time for the Clock Lane receiver to enable the HS line termination, sXYrting from the time point when Dn crosses VIL,MAX.	Time for Dn to reach VTERM-EN		38	ns
THS-SETTLE	Time interval during which the HS receiver shall ignore any DaXY Lane HS transitions, sXYrting from the beginning of THSPREPREARE.	85 ns + 6*UI		145 ns + 10*UI	ns
TEOT	Time from sXYrt of THS-TRAIL or TCLK-TRAIL period to sXYrt of LP-11 sXYte	-	-	105ns+48*UI	ns
THS-EXIT(1)	time to drive LP-11 after HS burst	100	-	-	ns
THS-PREPARE	Time to drive LP-00 to prepare for HS transmission	40ns + 4*UI	-	85ns+6*UI	ns
THS-PREPARE + THS-ZERO	THS-PREPARE + Time to drive HS-0 before the Sync sequence	145ns + 10*UI	-	-	ns
THS-SKIP	Time-out at RX to ignore transition	40	-	55ns+4*UI	ns



	period of EoT				
THS-TRAIL	Time to drive flipped differential sXYte after last payload daXY bit of a HS transmission burst	$60 + 4 \cdot UI$	-	-	ns
TLPX	Length of any Low-Power sXYte period	50	-	-	ns

Ratio TLPX	Ratio of TLPX(MASTER)/TLPS(SLA VE) between Master and Slave side	2/3	-	3/2	ns
TXY-GET	Time to drive LP-00 by new TX	5*TLPX	5*TLPX	5*TLPX	ns
TXY-GO	Time to drive LP-00 after Turnaround Request	4*TLPX	4*TLPX	4*TLPX	ns
TXY-SURE	Time-out before new TX side sXYrts driving	TLPX	-	2*TLPX	ns

5.6.5 Timing requirements for RESETB

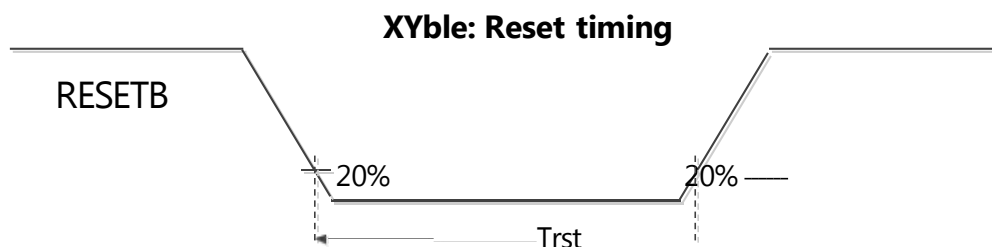
When RESETB of the reset pin equals to Low, it will be in the condition of reset. When it is in the condition of reset, it will make the device recover the initial set.

However, in order to avoid the reset noise cause reset, there is a mechanism to judge about whether the reset is needed or not.

The closed interval of Low can be shown as the following.

(Test condition: VDDIO=1.65V~3.6V, VSS=0V,XY=-20°C~+70°C)

Parameter	Symbol	Conditions	Spec			Unit
			Min.	Typ.	Max.	
Reset low pulse width	Trst	-	20	-	-	μs



6 Electro-Optical Specification

Test condition : IOVCC=1.8V , VCI=2.8V ,XY=25°C

Item	Symbol	Condition	Value			Unit	Note
			Min	Typ	Max		
Luminance		$\theta=0^\circ$ $\Phi=0^\circ$	315	350	385	cd/m ²	Note 1
Uniformity			85		-	%	Note 2
Viewin	Left	θ_L	80	85	-		
	Right	θ_R	80	85	-		



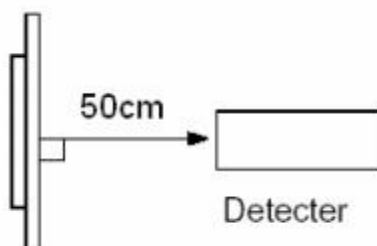
g Angle	Top	ψ_T	Cr $\geq$ 200	80	85	-	Deg.	Note 3
	Bottom	ψ_B		80	85	-		
Contrast Ratio		CR	$\theta=0^\circ$	50000	100000	-	-	Note 4

Response Time		Tr+Tf	$\phi=0^\circ$	-	2	3	ms	Note 5
Color Coordinate of CIE1931	Red	X	$\theta=0_\circ$ $\phi=0^\circ$	0.656	0.686	0.716	-	-
		Y		0.283	0.313	0.343		
	Green	X		0.185	0.235	0.285		
		Y		0.675	0.725	0.775		
	Blue	X		0.113	0.143	0.173		
		Y		0.014	0.044	0.074		
	White	X		0.28	0.3	0.32		
		Y		0.29	0.31	0.33		
NTSC Ratio		NTSC	CIE1931	TBD	103	-	%	-
Flicker		-	-	-	-	-30	dB	-
Gamma		-	-	2.0	2.2	2.4		Note 6
CrossXYlk		ΔCT				1.1		Note 7

Note 1: Luminance measurement

The test condition is measured on the surface of AMOLED module at 25°C.

- Measurement equipment CS2000 or similar equipment (Field of view:1deg,DisXYnce:50cm)
- Measuring surroundings: Darkroom.
- Measuring temperature: XY=25°C.
- Adjust operating volXYge to get optimum contrast at the center of the display.



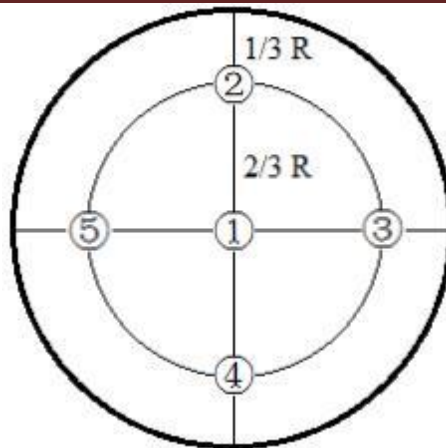
Note 2: Uniformity

The luminance uniformity is calculated by using following formula:

$$\Delta Bp = Bp (\text{Min.}) / Bp (\text{Max.}) \times 100 (\%)$$

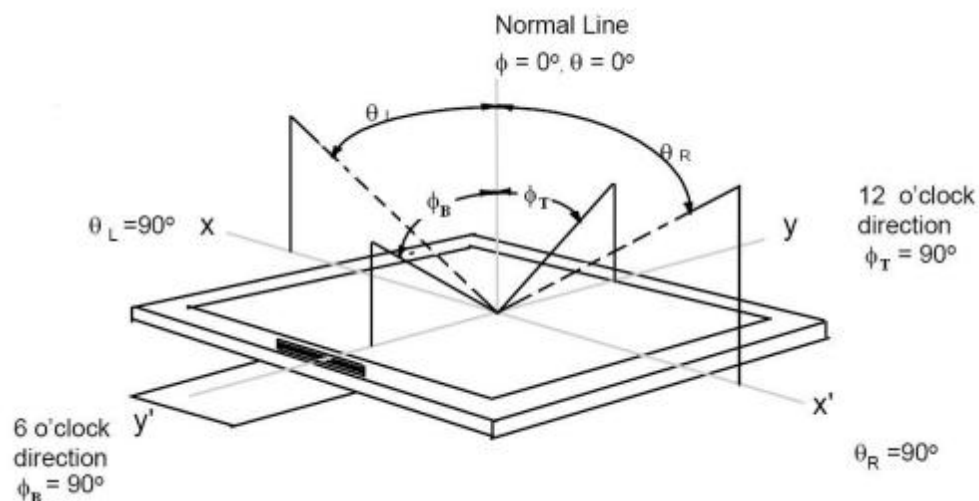
Bp (Max.) = Maximum brightness in 5 measured spots

Bp (Min.) = Minimum brightness in 5 measured spots.



Note 3: The definition of Viewing Angle

Refer to the graph below marked by θ and ϕ

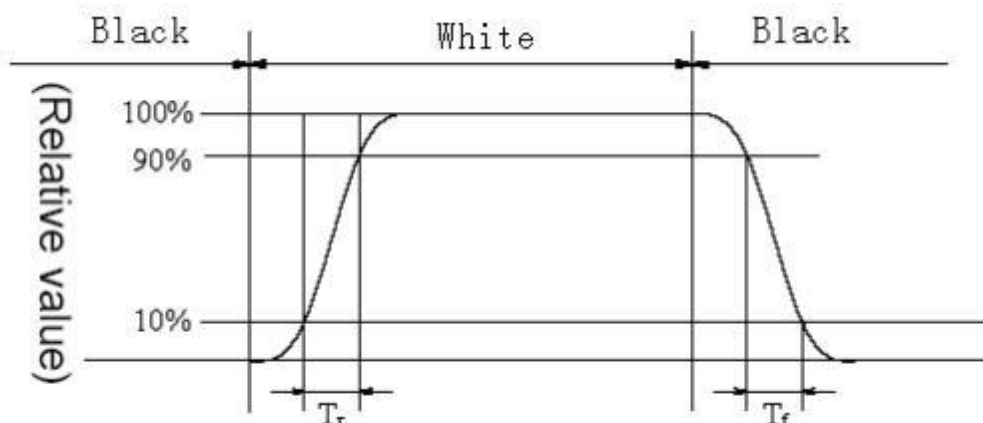


Note 4: The definition of Contrast Ratio:

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

Note 5: Definition of Response time.

The output signals of photo detector are measured when the input signals are changed from "black" to "white" (VolXYge falling time) and from "white" to "black" (VolXYge rising time), respectively. The response time is defined as the time interval between the 10% and 90% of amplitudes. Refer to figure as below.



Note 6: Gamma curve

The whole curve's tolerance must control within ± 0.3 , test the grayscale below:

8, 16, 25, 33, 41, 49, 58, 66, 74, 82, 90, 99, 107, 115, 123, 132, 140, 148, 156, 165, 173, 181,

189, 197, 206, 214, 222, 230, 239,

255 Note 7: CrossXYlk

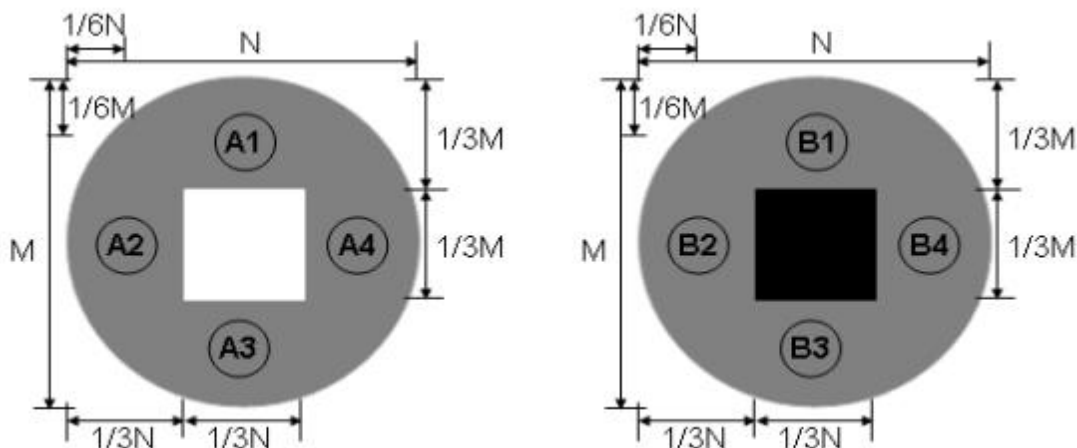
There should be no visible cross-XYlk in normal direction of the display when the two "Cross-XYlk Test Patterns" below are loaded.

ΔB_p (Max.) = Maximum value in

$\Delta B_{p1} \sim \Delta B_{p4}$. ΔB_p (Min.) = Minimum value in $\Delta B_{p1} \sim \Delta B_{p4}$.

$\Delta CT = \Delta B_p(\text{Max.}) / \Delta B_p(\text{Min.})$.

ΔCT must be less than 1.10



Cross-XYlk Test Pattern

7 Reliability

7.1 EnvironmenXYI Test

7.2 Electrical Test

Item(Display)	Main spec	Note
Air Discharge	$\pm 4\text{kV}$, 150pF/330 Ω (Module level)	5Points, Each 2times. No degradation of OLED performance after this test.
ConXYct Discharge	$\pm 4\text{kV}$, 150pF/330 Ω (Module level)	

7.3 Mechanical Test

Item	Main spec	Note
Drop Test	Drop the packing from 75cm height, 3 times for 6-faces, 3-edges and 1-corner	Package
Vibration-proof test	2g, f=10->55->10Hz apply in each of X, Y, and Z direction for 30 min	Package

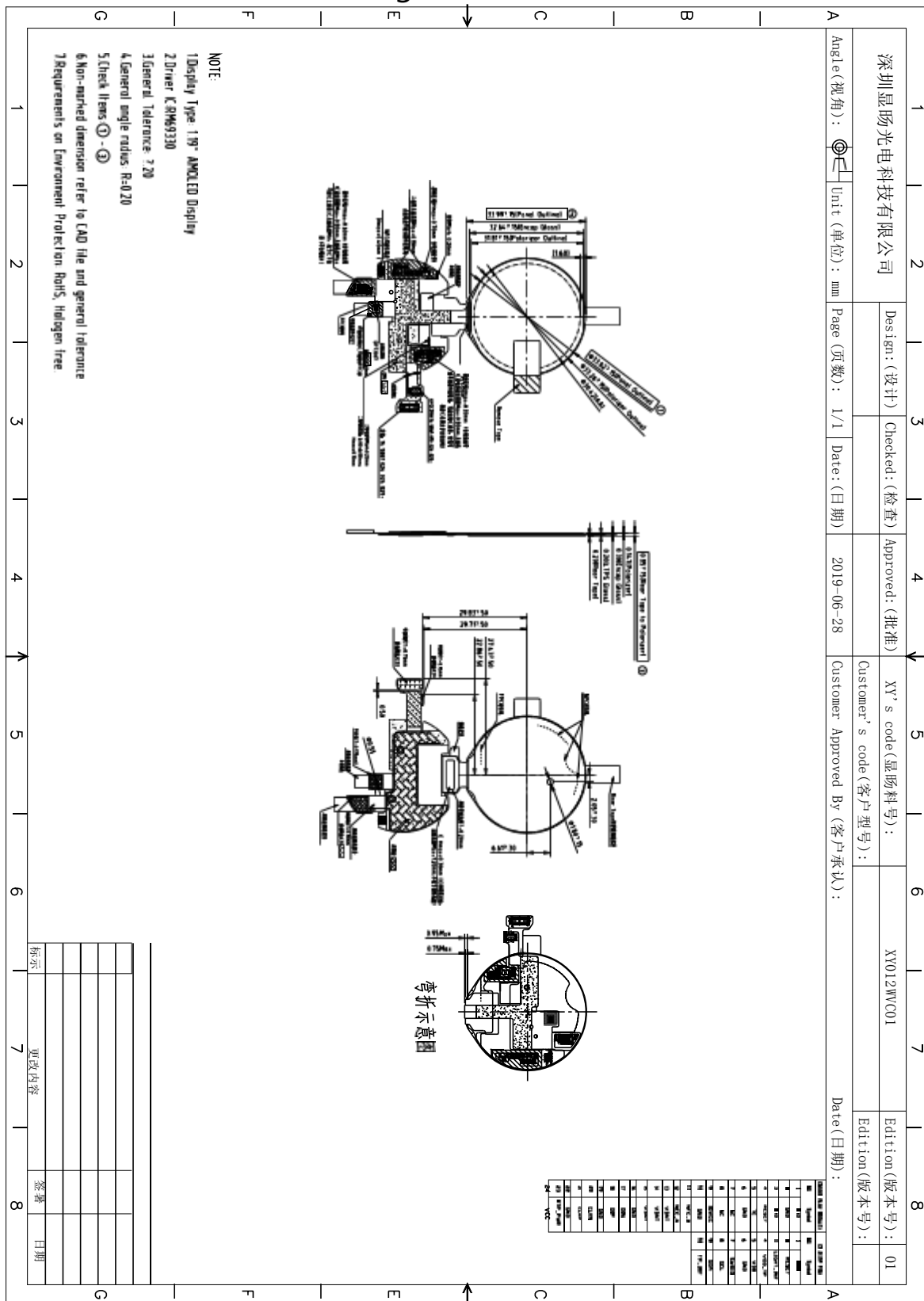
8 Handling Precautions

- When cleaning ITO pad, avoid using hard and abrasive material or corrosive solution
- Keep module away from direct sunlight or fluorescent light, and keep it at room temperature and humidity
- Strong impact & pressure on module and packing is prohibited
- Following normal power on/off sequence is necessary for preventing abnormal display or permanent damage to display
- Optimal contrast ratio under ideal volXYge is AMOLED module's characteristic, hence it is recommended a volXYge control function available
- Image sticking may occur if an image displays for an extended period of time
- When interfered by system's overall mechanical design, an abnormal display may occur



8. Host side should place a surge-prevent circuit at power trace (ie: VCI, Vddi) to protect AMOLED module.

9 Outline Dimension Drawing



10 The Control of Hazardous substances

The Control of Hazardous substances refer to TDO document 《有害物质管控标准书》 (Standard document for the Control of Hazardous substances) TDO-IS-110, the latest version.