

2.4" AMOLED

Product Specification

Customer Name	
Module size	2.4" 450RGB*600
Module Part No	ID-024EGOIN152-01
Date	2025-12-16
Version	Ver.01

Customer Signature	Date	BOE	Date
		Prepared by :	
		Approved by :	

Revision History

Rev.	ECN No.	Description of Change	Date	Prepared
01	-	Initial Issue	2025/12/16	

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1 Module basic Specification

1.1 Module application

- ◆ This module has a 2.4 inch diagonally measured active area with 450RGBx600 resolutions (450 horizontal by 600 vertical pixel arrays). Each pixel is divided into RED, GREEN, BLUE dots.
- ◆ This module is display terminals for sports camera and smart home.

1.2 Display Module Specification

1.2.1 Display Module specification

No	Display Module specification	Support (Y/N)	Remarks
Display	Gamma Correction, RGB Separate γ Correction Function	Y	
	PCD(Panel Crack Detection)	N	
	Command mode	Y	
	Video mode	Y	
	Display module brightness value OTP in Register	Y	
	Brightness Dimming	Y	
	AOD (Always On Display)	Y	
	AOD RTC (Always On Display Real_Time Clock)	N	
	CGM(Color Gamut Mapping)	N	

1.2.2 Display Panel specification

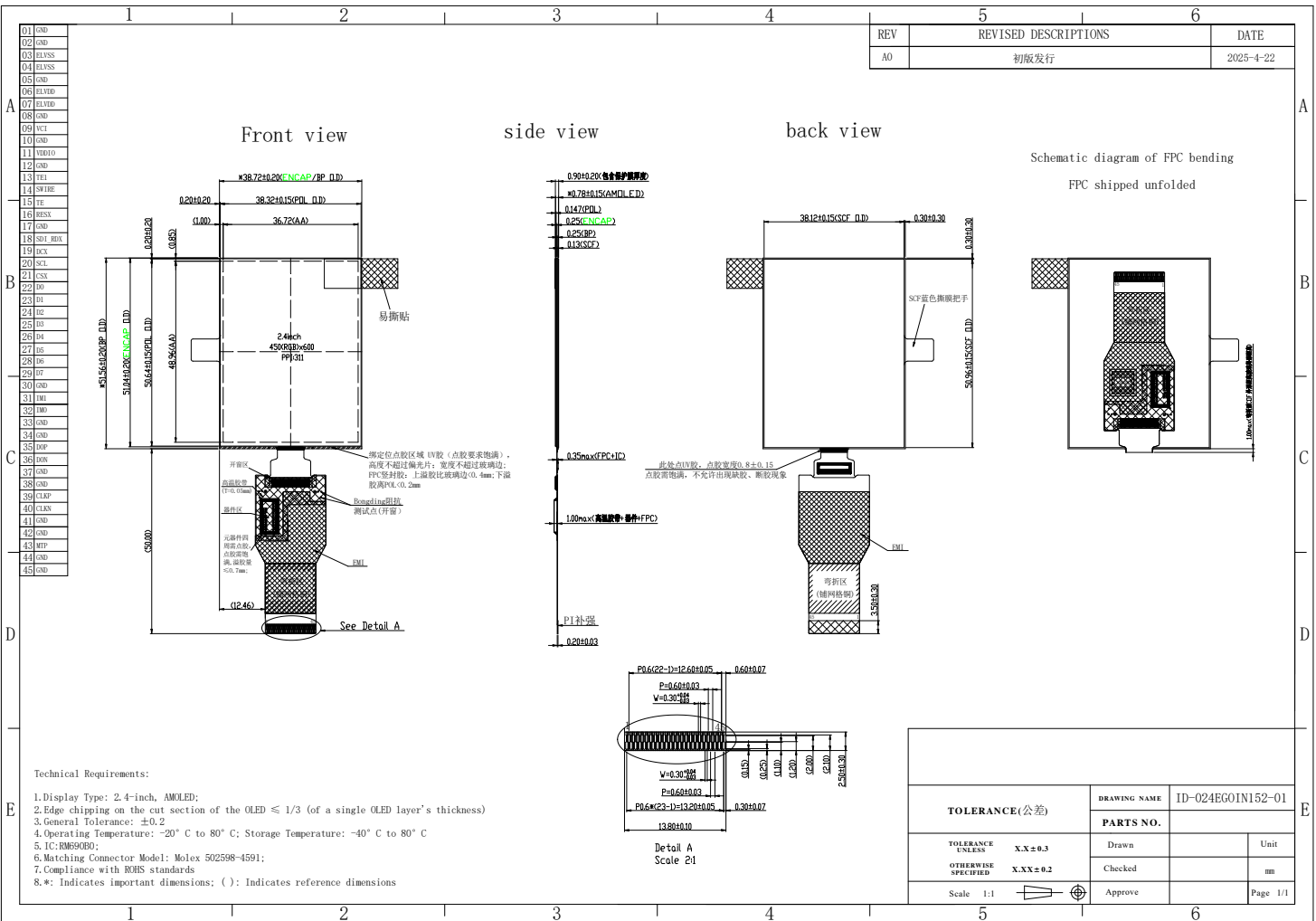
No	Item	Specification	Unit	Remarks
1	Display type	Rigid AMOLED		
2	Display Size	2.4"	Inch	
3	Active Area	36.72*48.96	mm	

4	Panel outline(H x V)	38.72*51.56	mm	
5	Pixel Size	81.6 x 81.6	um	
6	Pixel Pitch	81.6	um	
7	Pixel Per inch	311	PPI	
8	Resolution	450RGB*600		
9	Color Depth	16.7M(24bit)		
10	Viewing Direction	All direction		
11	Pixel Aspect Ratio	3:4		
12	Frame rate	60	Hz	
13	Drive mux	1:6		
14	Driver IC (Type)	RM690B0		
15	Driver IC/ RAM Size	1/3RAM		
16	Panel bonding type	COF		
17	Interface	MCU/MIPI		
18	TFT Technology Type	LTPS		
19	Encap glass height	0.25	mm	
20	TFT glass height	0.25	mm	
21	Frit glue width	≥0.4	mm	
22	Panel gate scan direction	COF 对侧向 COF 侧		
23	Power consumption	480	mW	
24	Panel Thickness	0.5	mm	
25	Polarizer Type	0.147	mm	
26	SCF	0.13	mm	
27	Brightness	800	cd/m	
28	contrast ratio	1000000:1		
29	Color shift (L/R/U/D 30°)	4	JNCD	
30	Operation Temperature	-20~+80	deg	
31	Storage Temperature	-40~+80	deg	

2 Mechanical Drawing

2.1 Module Drawing

Drawing name	Version	ME Engineer	Change content	Update date
Display Module Drawing	A1			2025-12-16



3 Optical Specifications

Test condition: VCI= 3.3V, VDDIO=1.8V , ELVDD=3.6V ,ELVSS=-3.6V,Ta=25°C

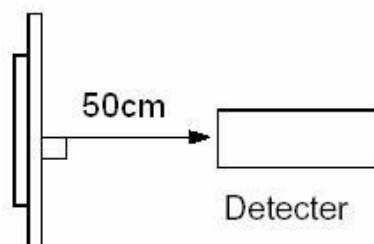
Item		Symbol	Condition	Min	Typ	Max	Unit	Note
Luminance (with pol&lens)		Normal mode Bp	$\theta=0^{\circ} \phi=0^{\circ}$	720	800	880	cd/m2	
Uniformity		ΔBp		90	--	--	%	
Viewing Angle	Left	θL	$Cr \geq 10$	80	--	--	deg	
	Right	θR		80	--	--		
	Top	ψT		80	--	--		
	Bottom	ψB		80	--	--		
Contrast Ratio		Cr	$\theta=0^{\circ} \phi=0^{\circ}$	10000 00: 1		--	-	
Response Time		Tr		--	--	2	ms	
		Tf		--	--	2	ms	
		Tgray		--	--	2	ms	
Color Coordin ate of CIE193 1	Red	x	$\theta=0^{\circ} \phi=0^{\circ}$	-0.04	0.674	+0.04		
		y			0.326			
	Green	x			0.230			
		y			0.681			
	Blue	x			0.139			
		y			0.048			
	White	x			0.300			
		y			0.310			
Color temperature		CT		7000	7500	8000	K	
Flicker		amount	60HZ @Interval screen(间隔画面)	--	--	-30	dB	
		amount	60HZ @255Gray	--	--	-50	dB	
Gamma		Normal mode		2.0	2.2	2.4		
Polarization direction of front polarizer		PdF		--	135	--	deg	

Color shift		$\theta L=30^\circ$	--	3	4	JNCD	
		$\theta R=30^\circ$	--	3	4	JNCD	
		$\psi T=30^\circ$	--	3	4	JNCD	
		$\psi B=30^\circ$	--	3	4	JNCD	
OLED lifetime	LT95	$T_a=25^\circ\text{C}$	30000	--	--	Hrs.	
Color gamut	DCI-P3	Ratio	97	100		%	

3.1 : Luminance measurement

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

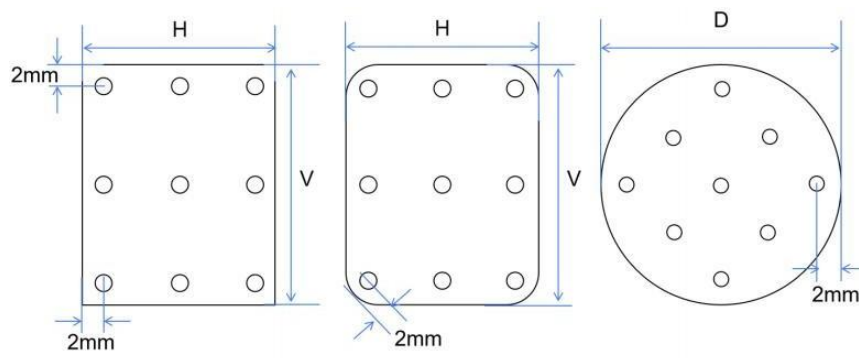
- The data are measured after OLEDs are lighted on for more than 5 minutes and displays
- equipment CS2000/CS2000A or similar equipments (Field of view:1deg,Distance:50cm)
- Measuring surroundings: Dark room.
- Adjust operating voltage to get optimum contrast at the center of the display.
- Measured value at the center point of panel must be after more than 5 minutes while light up



3.2 : Uniformity

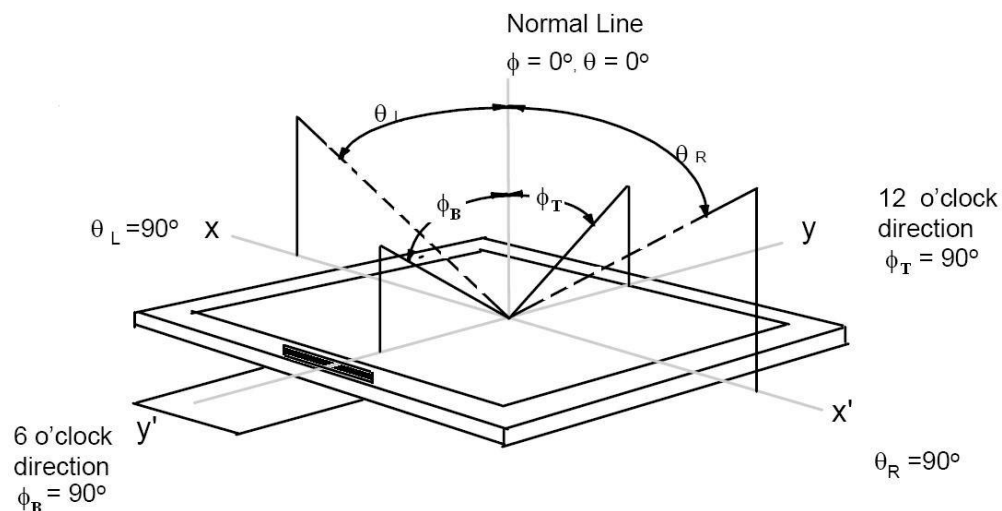
- The test condition is at 25°C and measured on the surface of display module
- Measurement equipment: CS2000/CS2000A or similar equipment.
- The luminance uniformity is calculated by using following formula.

$$\Delta Bp = Bp \text{ (Min.)} / Bp \text{ (Max.)} \times 100 \text{ (\%)}$$
- $Bp \text{ (Max.)}$ = Maximum brightness in 9 measured spots
- $Bp \text{ (Min.)}$ = Minimum brightness in 9 measured spots.



3.3 : The definition of Viewing Angle

Refer to the graph below marked by θ and ϕ



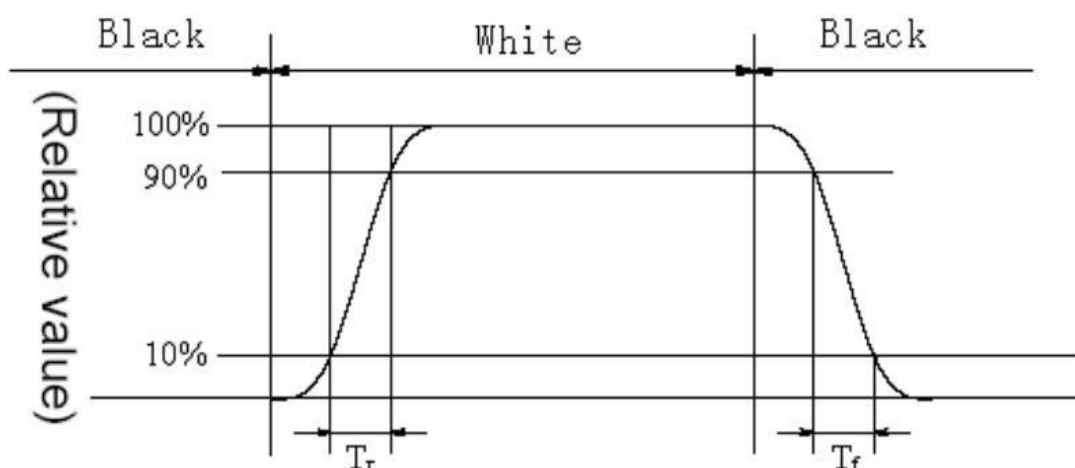
3.4 : The definition of Contrast Ratio (Test OLED using CS2000/CS2000A or similar equipments):

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

(Contrast Ratio is measured in optimum common electrode voltage. Black state display pure black color and luminance < 0.002 nits.)

3.5 : Definition of Response time. (Test module using DMS 803 or similar equipment):

The output signals of photo detector are measured when the input signals 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 80% of amplitudes. Refer to figure as below.



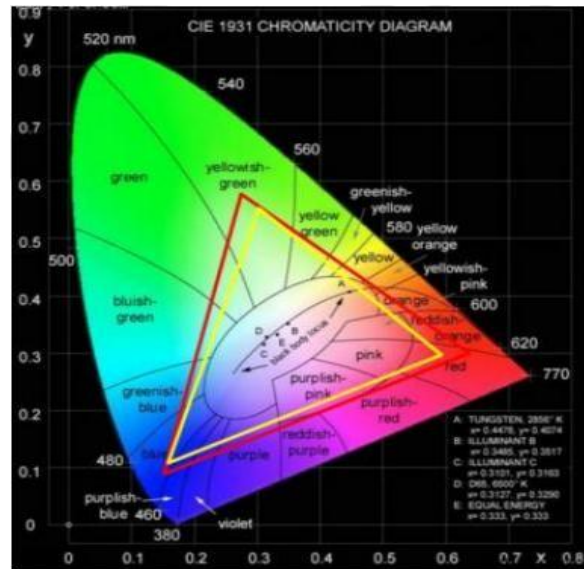
Response time of gray to gray:

- Measurement equipment: DMS803 or similar equipment.
- Test method: we define 8 grays L0-L7, the grays of L0-L7 were defined as: 0, 36, 73, 109, 146, 182, 219, 255. The output signals of photo detector are measured when the input signals are changed 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:

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

3.6 : Definition of Color of CIE Coordinate and DCI-P3 Ratio.

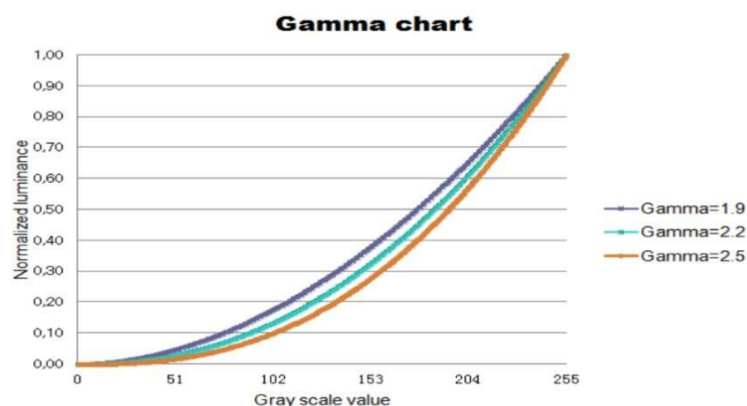
$$S = \frac{\text{area of RGB triangle}}{\text{area of DCI - P3 triangle}} \times 100\%$$



3.7 : gamma curve control

- For gamma curve control, request as below:
- the whole curve's tolerance must control within +/-0.3, will test the gray scale below: 0~255gray, interval 8 gray (0,8,16,24.....255)
- According to below formula chart the curves

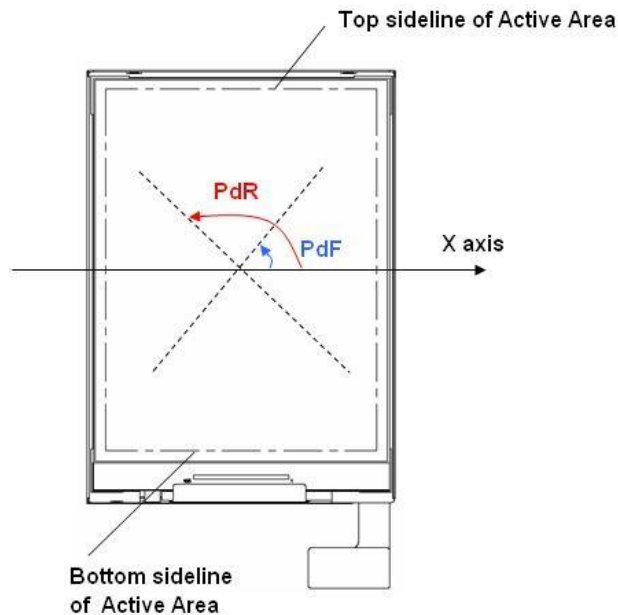
$$TR\%x = \sqrt{\frac{Gx - G0}{G255 - G0}}$$



3.8 Polarization Direction Definition

- Viewing direction is normal user viewing direction which is vertical to the display surface
- 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
- The polarization degree parameter must be indicated in range of 0deg to 180deg according to above definition
- The angle definition of Polarization: The angle between polarized axis of Polarizer and zero of OLED
- Reference: Transmission axis 90deg for normal OLED POL; 45deg for normal OLED POL; TBD for sunglass POL;



- PdF which is marked in blue arrow is polarization degree of Front polarizer
- The polarization degree parameter must be indicated in range of 0deg to 180deg according to above definition
- The angle definition of Polarization: The angle between polarized axis of Polarizer and zero of OLED
- Reference: Transmission axis 90deg for normal OLED POL; 45deg for normal OLED POL; TBD for sunglass POL;

Polarization Definition

3.9 : Color Shift JNCD

- For JNCD measure:
- Fix on one pattern like white pattern,
- On the condition $\theta=0$ $F=0^\circ$, we can get the color coordinate (u_1', v_1') and on $\theta_L=30^\circ$ we can get another color coordinate (u_2', v_2')
- $\Delta = \text{Square Root}((u_2' - u_1')^2 + (v_2' - v_1')^2)$
- JNCD stands for "Just Noticeable Color Difference"
- For the (u', v') color space $\text{JNCD}=0.0040$.
- 2JNCD means $\Delta u'v' < 0.0080$
- For color shift we need to measure white/red/green/blue pattern.

3.10 OLED lifetime

- Test samples 5pcs;
- Measurement equipment: CS2000/CS2000A or similar equipment.
- At room temperature(25°C), light the module with typical value brightness, display a white pattern,
- To record the brightness every 24 hours.
- LT95>290h.

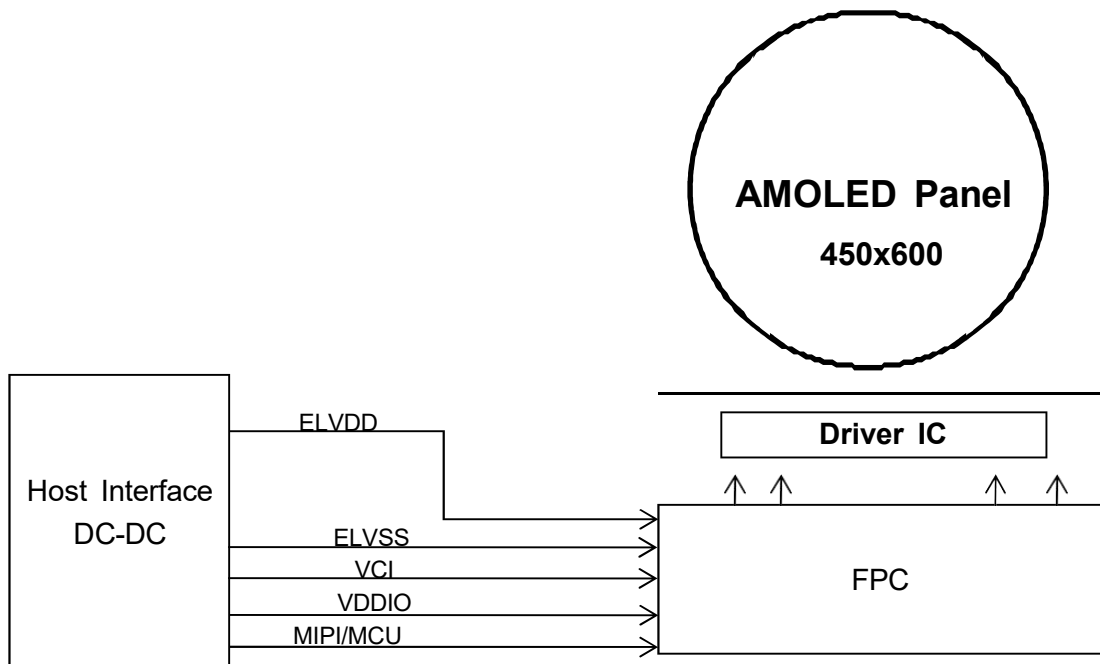
4 Pin Assignments

AMOLED Interface Definition

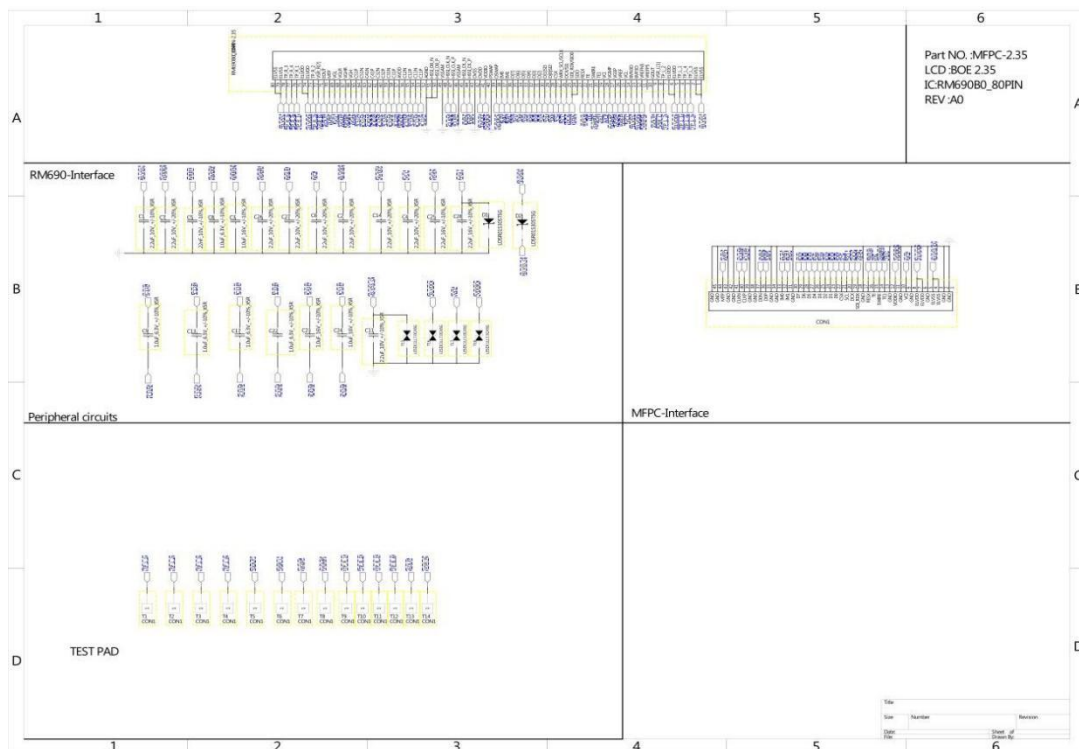
AMOLED Pin No.	Symbol	I/O	Function
1	GND	Power	Ground.
2	GND	Power	Ground.
3	ELVSS	Power	Negative Power supply for Panel
4	ELVSS	Power	Negative Power supply for Panel
5	GND	Power	Ground.
6	ELVDD	Power	Positive Power supply for Panel
7	ELVDD	Power	Positive Power supply for Panel
8	GND	Power	Ground.
9	VCI	Power	Power supply for display driver IC analog system.
10	GND	Power	Ground.
11	VDDIO	Power	Power supply for display driver IC interface and logic system
12	GND	Power	Ground.
13	TE1	O	IC Status active reporting pin.
14	SWIRE	O	Swire protocol setting pin of Power IC
15	TE	O	Tearing effect output pin to synchronize MCU to frame writing, activated by S/W command. When this pin is not activated, this pin is output low.
16	RESX	I	Display driver reset, must be applied to properly initialize the chip. Signal is active low.
17	GND	Power	Ground.
18	SDI_RD X	I/O	RDX: Reads strobe signal to write data when RDX is "Low" in 80-series MPU interface.

19	DCX	I	Display data / command selection in 80-series MPU I/F
20	SCL	I	WRX : Writes strobe signal to write data when WRX is "Low" in 80-series MPU I/F.
21	CSX	I	Chip select input pin ("Low" enable) in 80-series MPU I/F
22	D0	I/O	8-bit bi-directional data bus for 80-series MPU I/F and 8-bit input data bus for RGB I/F.
23	D1	I/O	
24	D2	I/O	
25	D3	I/O	
26	D4	I/O	
27	D5	I/O	
28	D6	I/O	
29	D7	I/O	
30	GND	Power	Ground.
31	IM1	I	IM[10]=00,MIPI interface IM[10]=11,MCU interface
32	IM0	I	
33	GND	Power	Ground.
34	GND	Power	Ground.
35	D0P	I/O	Differential data signals if MIPI interface.
36	D0N	I/O	Differential data signals if MIPI interface.
37	GND	Power	Ground.
38	GND	Power	Ground.
39	CLKP	I	Differential clock signals if MIPI interface.
40	CLKN	I	Differential clock signals if MIPI interface.
41	GND	Power	Ground.
42	GND	Power	Ground.
43	MTP	Power	MTP programming power supply. Must be left open or connected to GND in normal condition
44	GND	Power	Ground.
45	GND	Power	Ground.

5 Schematic Circuit Diagram



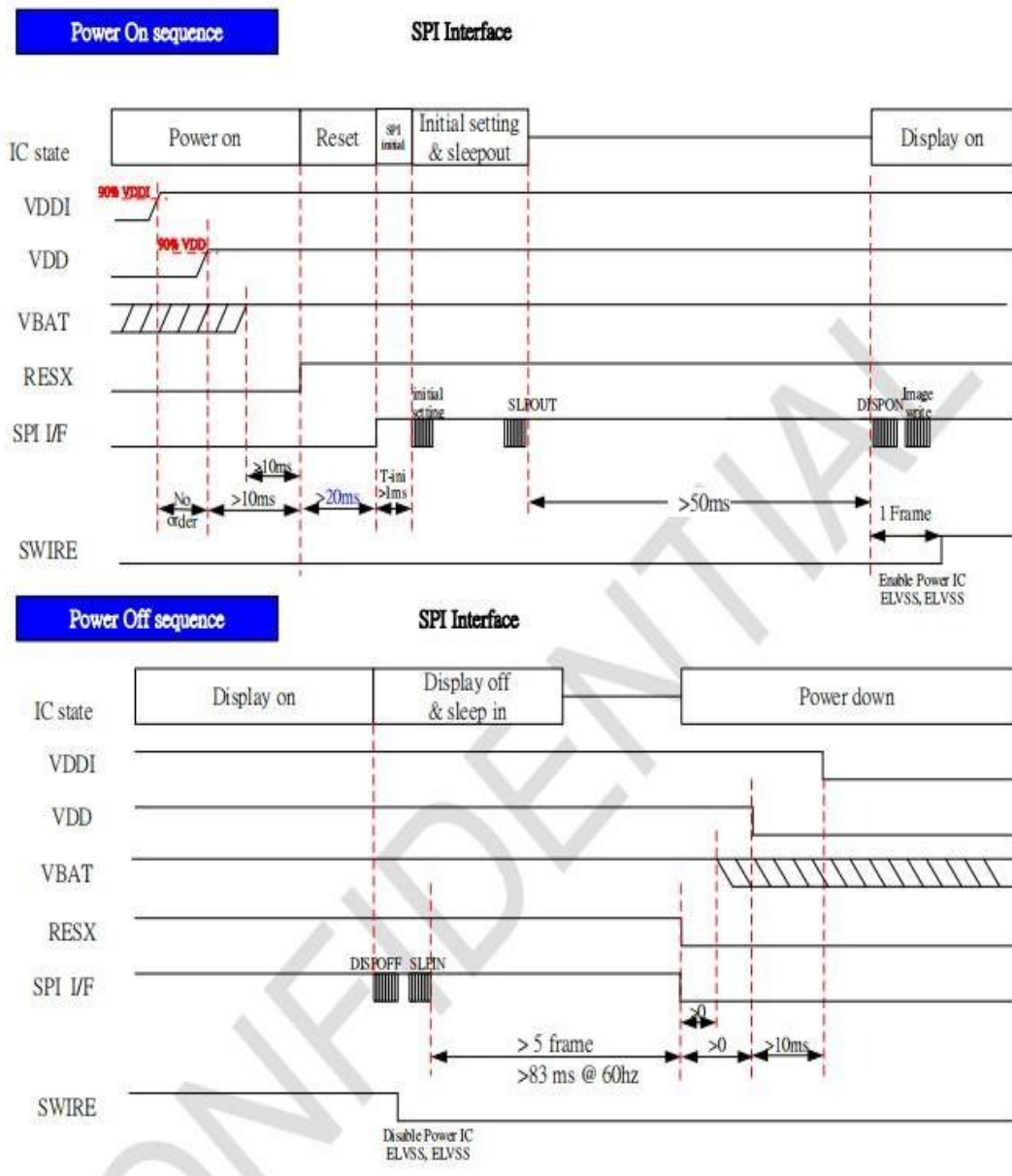
MFPC Schematic Diagram



6 Timing Characteristics

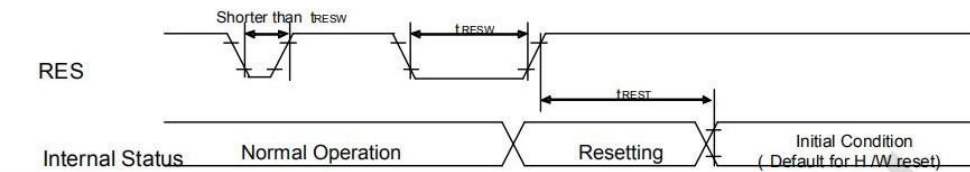
6.1 Power on/off Sequence

6.1.1 Display panel Power on sequence



6.2 Reset Timing Sequence Requirement

6.2.1 Display panel reset timing:



Reset input timing:

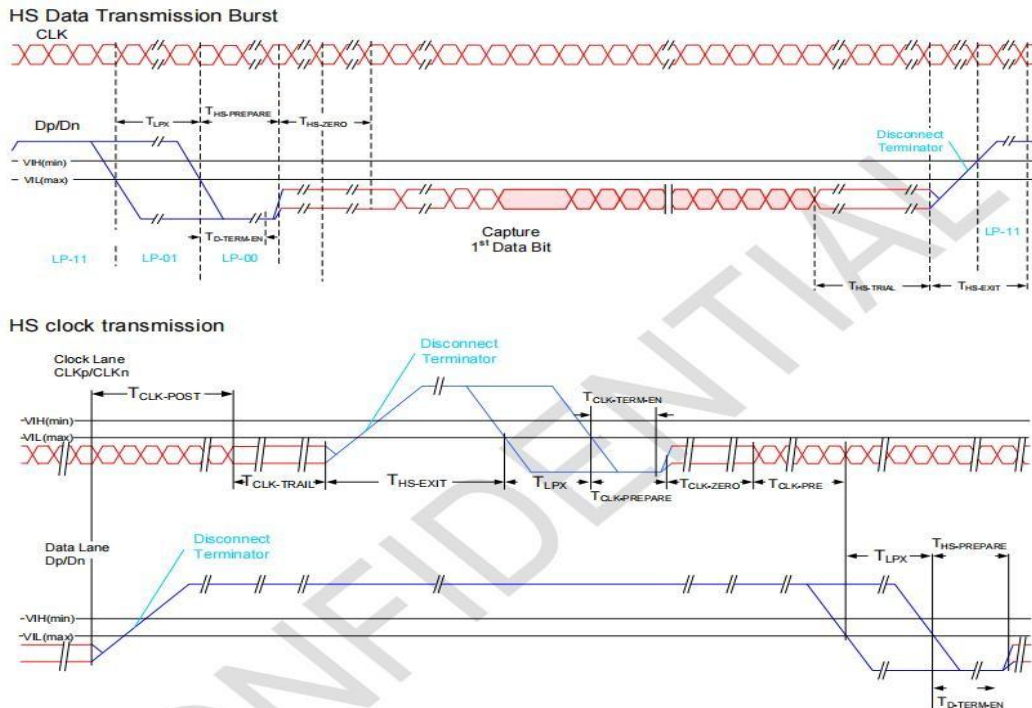
VDDI=1.65 to 3.3V, VDD=2.7 to 3.6V, AGND=DGND=0V, T_a =-40 to 85°C

Symbol	Parameter	Related Pins	MIN	TYP	MAX	Note	Unit
t_{RESW}	*1) Reset low pulse width	RESX	30	-	-	-	μ s
t_{REST}	*2) Reset complete time	-	-	-	20	When reset applied during Sleep in mode	ms
		-	-	-	120	When reset applied during Sleep out mode	ms

6.3 Communication Interface timing

6.3.1 MIPI-DSI Interface & MCU Characteristics

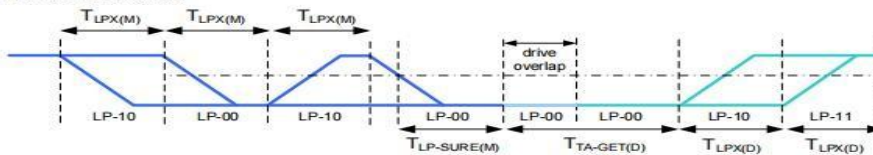
MIPI:



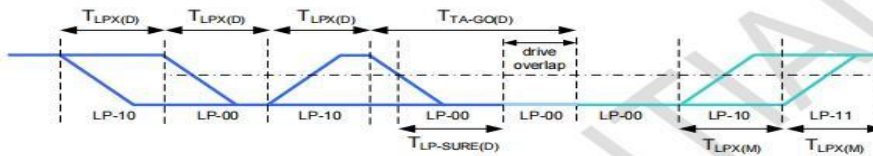
Timing Parameters:

Parameter	Description	Min	Typ	Max	Unit
$T_{CLK-POST}$	Time that the transmitter continues to send HS clock after the last associated Data Lane has transitioned to LP Mode. Interval is defined as the period from the end of $T_{HS-TRAIL}$ to the beginning of $T_{CLK-TRAIL}$.	$60ns + 52*UI$			ns
$T_{CLK-TRAIL}$	Time that the transmitter drives the HS-0 state after the last payload clock bit of a HS transmission burst.	60			ns
$T_{HS-EXIT}$	Time that the transmitter drives LP-11 following a HS burst.	300			ns
$T_{CLK-TERM-EN}$	Time for the Clock Lane receiver to enable the HS line termination, starting from the time point when Dn crosses $V_{IL,MAX}$.	Time for Dn to reach $V_{TERM-EN}$		38	ns
$T_{CLK-PREPARE}$	Time that the transmitter drives the Clock Lane LP-00 Line state immediately before the HS-0 Line state starting the HS transmission.	38		95	ns
$T_{CLK-PRE}$	Time that the HS clock shall be driven by the transmitter prior to any associated Data Lane beginning the transition from LP to HS mode.	8			UI
$T_{CLK-PREPARE} + T_{CLK-ZERO}$	$T_{CLK-PREPARE}$ + time that the transmitter drives the HS-0 state prior to starting the Clock.	300			ns
$T_{D-TERM-EN}$	Time for the Data Lane receiver to enable the HS line termination, starting from the time point when Dn crosses $V_{IL,MAX}$.	Time for Dn to reach $V_{TERM-EN}$		$35 ns + 4*UI$	
$T_{HS-PREPARE}$	Time that the transmitter drives the Data Lane LP-00 Line state immediately before the HS-0 Line state starting the HS transmission	$40ns + 4*UI$		$85 ns + 6*UI$	ns
$T_{HS-PREPARE} + T_{HS-ZERO}$	$T_{HS-PREPARE}$ + time that the transmitter drives the HS-0 state prior to transmitting the Sync sequence.	$145ns + 10*UI$			ns
$T_{HS-TRAIL}$	Time that the transmitter drives the flipped differential state after last payload data bit of a HS transmission burst	$60ns + 4*UI$			ns

Turnaround Procedure



Bus turnaround (BAT) from MPU to display module timing



Bus turnaround (BAT) from display module to MPU timing

Low Power Mode :

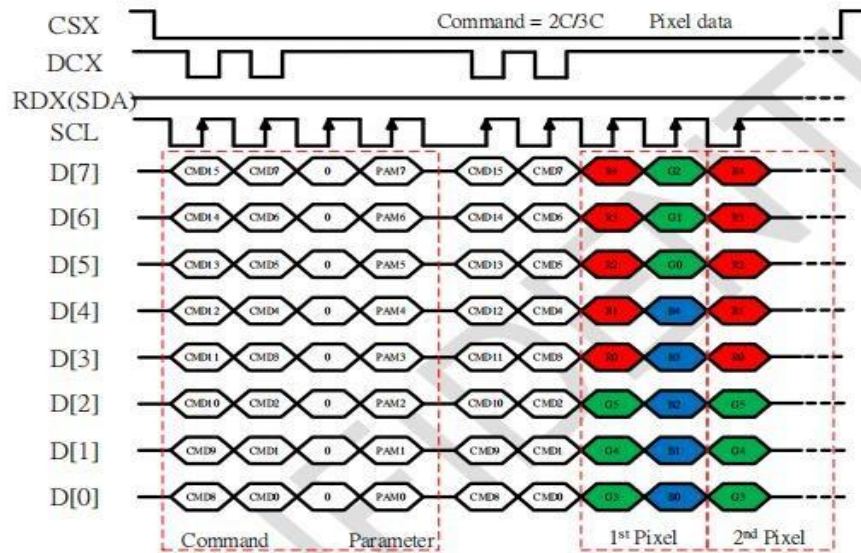
Parameter	Description	Min	Typ	Max	Unit	Notes
$T_{LPX(M)}$	Transmitted length of any Low-Power state period of MCU to display module	50		150	ns	1,2
$T_{TA-SURE(M)}$	Time that the display module waits after the LP-10 state before transmitting the Bridge state (LP-00) during a Link Turnaround.	$T_{LPX(M)}$		$2*T_{LPX(M)}$	ns	2
$T_{LPX(D)}$	Transmitted length of any Low-Power state period of display module to MCU	50		150	ns	1,2
$T_{TA-GET(D)}$	Time that the display module drives the Bridge state (LP-00) after accepting control during a Link Turnaround.		$5*T_{LPX(D)}$		ns	2
$T_{TA-GO(D)}$	Time that the display module drives the Bridge state (LP-00) before releasing control during a Link Turnaround.		$4*T_{LPX(D)}$		ns	2
$T_{TA-SURE(D)}$	Time that the MPU waits after the LP-10 state before transmitting the Bridge state (LP-00) during a Link Turnaround.	$T_{LPX(D)}$		$2*T_{LPX(D)}$	ns	2

NOTE:

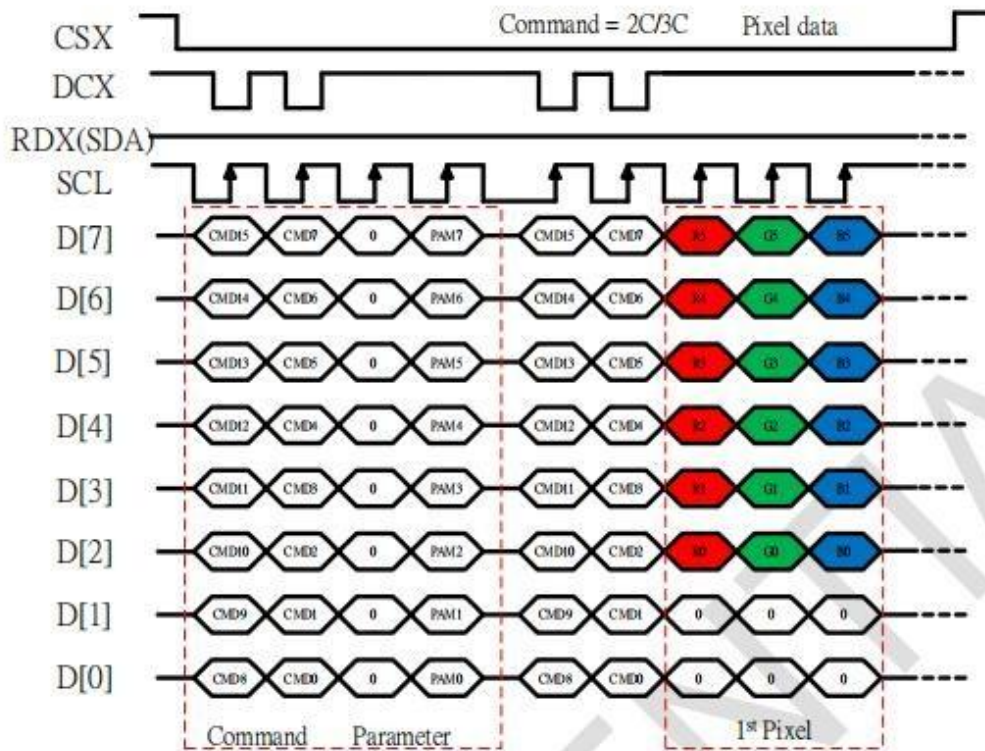
- T_{LPX} is an internal state machine timing reference. Externally measured values may differ slightly from the specified values due to asymmetrical rise and fall times.
- Transmitter-specific parameter

MCU:

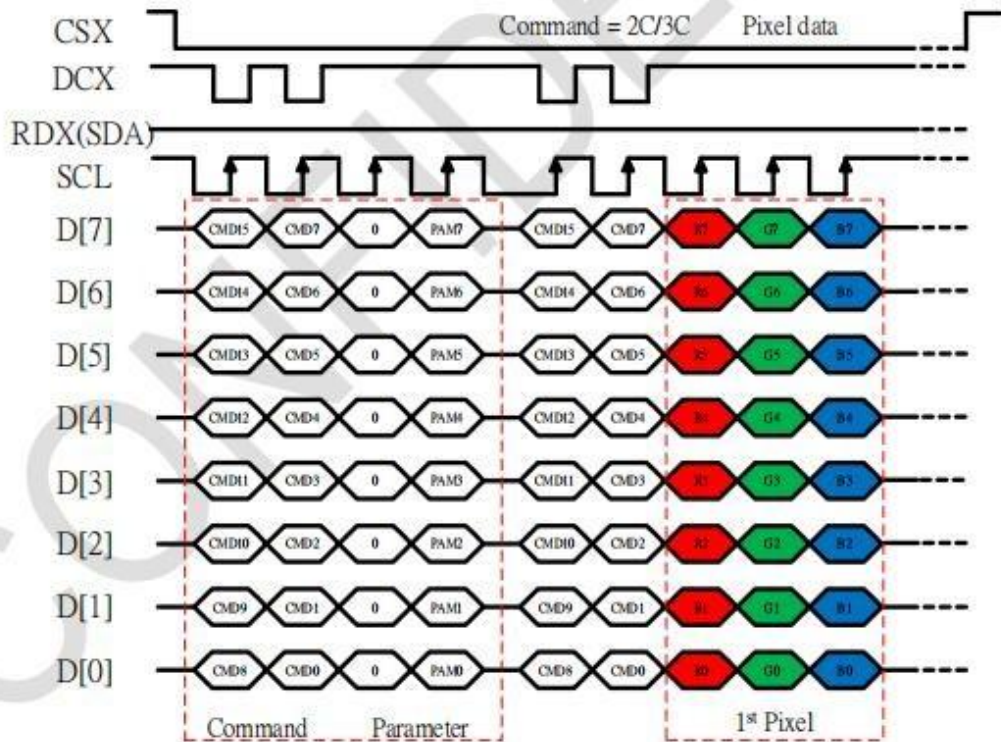
The basic command format and IFPF (0x3A00, interface pixel format) is equal to 5:



The basic command format and IFPF (0x3A00, interface pixel format) is equal to 6:



The basic command format and IFPF (0x3A00, interface pixel format) is equal to 7:



6.3 Initial sequence Characteristics

Power on Initial Code For MIPI:

Porch Setting:VBP=6;VFP=4;VSW=2;HBP=24;HFP=24;HSP=4
Mipi Speed=456MHz; **DCLK=**18.5MHz

```
0xFE 0x00;  
0x2A 0x00 0x10 0x01 0xD1;  
0x2B 0x00 0x00 0x02 0x57;  
0x35 0x00;  
0x51 0xFF;  
0x30 0x00 0x01 0x02 0x56;  
0x12 0x00;  
0x11;  
wait 120ms;  
0x29;
```

Power on Initial Code For MCU:

```
0xFE 0x20;  
0x26 0x0A;  
0x24 0x80;  
0xFE 0x00;  
0x2A 0x00 0x10 0x01 0xD1;  
0x2B 0x00 0x00 0x02 0x57;  
0x35 0x00;  
0x51 0xFF;  
0x30 0x00 0x01 0x02 0x56;  
0x12 0x00;  
0x11;  
wait 120ms;  
0x29;
```

Power off Code:

```
0x28;  
0x10  
wait 5 Frames;// 83ms@60Hz  
mipi low;  
reset pull low
```

Enter Idle Mode Code:

```
0xFE 0x00;  
0x39;
```

Exit Idle Mode Code:

```
0xFE 0x00;  
0x51 0xFF;  
wait 50ms;  
0x38;
```

Enter HBM Mode Code:

```
0xFE 0x00;  
0x66 0x02;
```

Exit HBM Mode Code:

```
0xFE 0x00;  
0x66 0x00;
```

7 Electrical Specifications

7.1 DC Characteristics Requirements

Item	Symbol	Values			Unit	Remark
		Min	Type	max		
Analog power supply V_o	VCI	2.7	3.3	3.6		
I/O Supply Voltage	VDDIO	1.65	1.8	3.3	V	
OLED input voltage	ELVDD	2.0	3.6	6	V	
OLED input voltage	ELVSS	-4.7	-3.6	-0.4	V	
Input High Voltage	VIH	$0.8 \cdot V_{DDI}$	--	V_{DDI}	V	
Input Low Voltage	VIL	0	--	$0.2 \cdot V_{DDI}$	V	
Output High Voltage	VOH	$0.8 \cdot V_{DDI}$	--	V_{DDI}	V	
Output Low Voltage	VOL	0	--	$0.2 \cdot V_{DDI}$	V	
Frame Frequency (60Hz)	frame		60		HZ	

7.2 Power Consumption of Display

Power Supply: VDDIO=1.8V VCI=3.3V ELVDD=3.6V ELVSS=-3.6V

Item		Symbol		Condition	Symbol	Min.	Typ.	Max.	Uni	Remark	
ELVDD		ELVDD		Normal	-	-	3.6	-	V	External Power External Power	
ELVSS		ELVSS		Normal	-	-	-3.6	-	V		
VCI		VCI		-	-	-	3.3	-	V		
VDDIO		VDDIO		-	-	-	1.8	-	V		
Power Consumption	Display on mode (Normal)	IC	VCI	100% Pixel On,60Hz	Ivci	-	3.1	3.6	mA		
					Pvci	-	10.23	11.88	mW		
					Ivddio	-	1.3	1.5	mA		
					Pvddio	-	2.34	2.7	mW		
		Panel	EL		I _{ELVDD}	-	67.1	73	mA		
					I _{ELVSS}	-	67	72.4	mA		
					Pnl	-	483	526	mW		
Frame Rate		F _{frm}		-40℃~80℃	F _{frm}	55.2	60	64.8	Hz		
				25℃		58.2	60	61.8	Hz		

8 Reliability TEST

ITEM		Condition																																																																						
Environment Reliability	Thermal Humidity Operating test (THO)	+60℃, 90%RH, 240h																																																																						
	Low Temperature Operating test (LTO)	-20℃, 240h																																																																						
	High Temperature Operating test (HTO)	80℃, 240h																																																																						
	High Temperature Storage test(HTS)	80℃, 240h																																																																						
	Low Temperature Storage test (LTS)	-40℃, 240h																																																																						
	Thermal Cycle Storage test (TST)	-40℃~+80℃, storage, 1h/cycle, 100cycle																																																																						
ESD		<table><tr><th>单体形态</th><th>测试模式</th><th>放电方式</th><th>放电等级</th><th>放电次数</th><th>判据</th><th>备注</th></tr><tr><td rowspan="12">OLED</td><td rowspan="4">不上电测试</td><td rowspan="2">接触放电</td><td>±1kV</td><td>10</td><td>C</td><td></td></tr><tr><td>±2kV</td><td>10</td><td>C</td><td></td></tr><tr><td rowspan="2">空气放电</td><td>±2kV</td><td>10</td><td>C</td><td></td></tr><tr><td>±4kV</td><td>10</td><td>C</td><td></td></tr><tr><td rowspan="8">上电测试</td><td rowspan="4">接触放电</td><td>±2kV</td><td>10</td><td>B</td><td></td></tr><tr><td>±4kV</td><td>10</td><td>B</td><td></td></tr><tr><td>±6kV</td><td>10</td><td>C</td><td></td></tr><tr><td>±2kV</td><td>10</td><td>B</td><td></td></tr><tr><td rowspan="4">空气放电</td><td>±4kV</td><td>10</td><td>B</td><td></td></tr><tr><td>±6kV</td><td>10</td><td>C</td><td>FOG 状态</td></tr><tr><td>±8kV</td><td>10</td><td>B</td><td>TLCM 状态</td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td></tr></table> 判据 A：测试过程中及测试结束后，OLED 单体能够一直保持正常工作的状态，不出现任何功能上的异常。 判据 B：测试过程中，OLED 单体受到静电脉冲干扰时，可能会出现闪屏、漏光、变暗、TP 失效等功能异常，但测试结束后，能够自动恢复正常工作的状态，为保证用户体验，要求此类异常的自动恢复时间控制在 1s 以内，恢复时间超过 1s，则判定为 C 等级 判据 C：测试过程中及测试结束后，OLED 单体受到静电脉冲干扰时可能会出现显示异常，需要手动操作比如复位等操作才能恢复正常工作的状态。 判据 D：测试过程 OLED 单体出现功能异常，并造成永久性损坏，无法通过用户操作恢复。 备注：测试步骤请参考单体认证文件。							单体形态	测试模式	放电方式	放电等级	放电次数	判据	备注	OLED	不上电测试	接触放电	±1kV	10	C		±2kV	10	C		空气放电	±2kV	10	C		±4kV	10	C		上电测试	接触放电	±2kV	10	B		±4kV	10	B		±6kV	10	C		±2kV	10	B		空气放电	±4kV	10	B		±6kV	10	C	FOG 状态	±8kV	10	B	TLCM 状态						
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