Display Future Ltd
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LCD MODULE SPECIFICATION

Model: DF-AMC0548FB-M1

This module uses ROHS materials

For customer acceptance

Customer		date
Approved		
Comments		

The standard product specification may change without prior notice in order to improve performance or quality. Please contact Display Future Ltd for updated specification and product status before design for the standard product or release of the order.	Revision	1.0
	Engineering	
	Date	2018/01/8
	Our Reference	

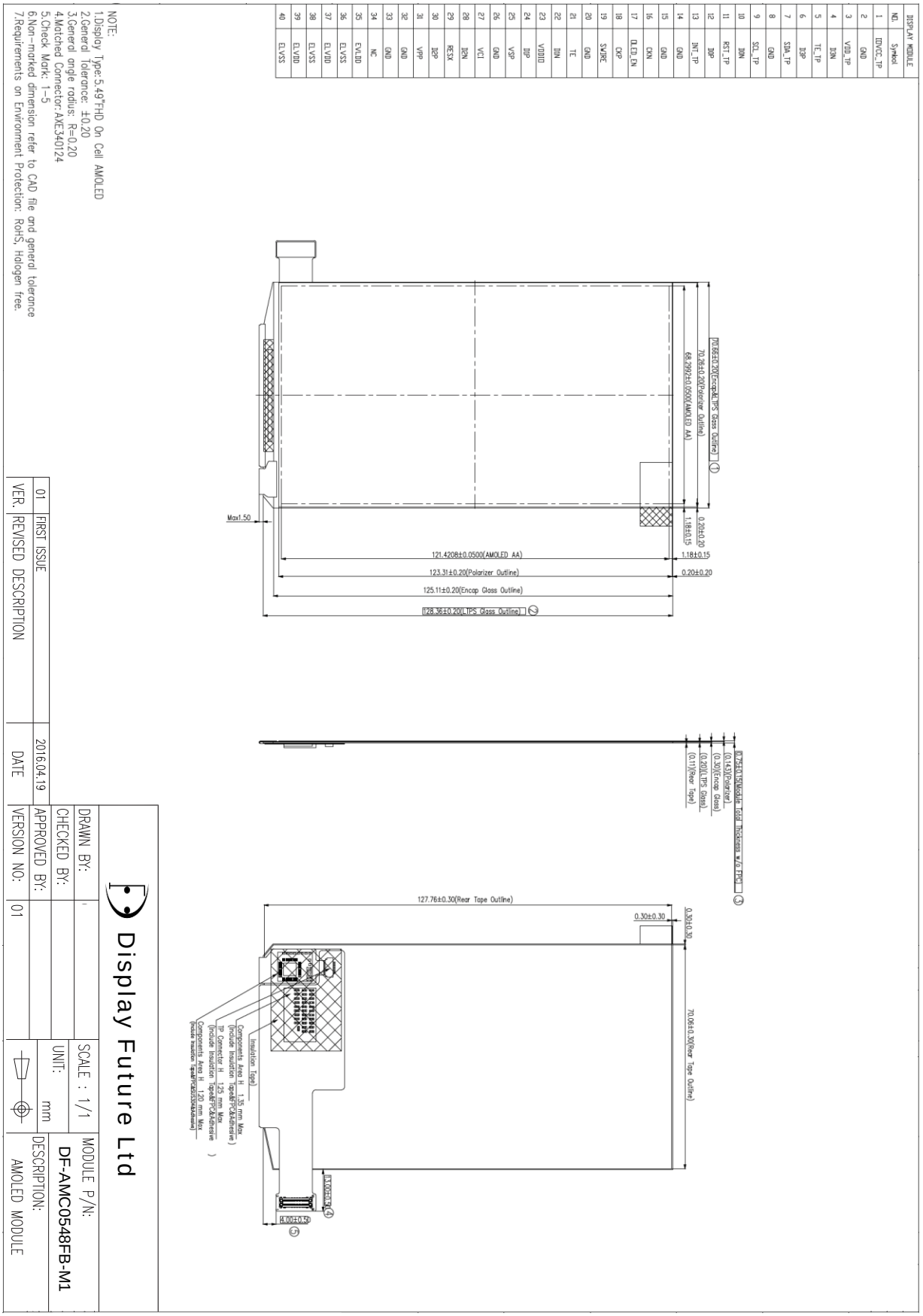
REVISION RECORD

REV NO.	REV DATE	CONTENTS	REVISED PAGE NO.
1.0	2016-04-19	First Release	

■ PHYSICAL DATA

No.	Items	Specification	Unit
1	Display Mode	AMOLED	-
2	Display Color	16.7M(RGB x 8bits)	-
3	Diagonal Size	5.49	Inch
4	Resolution	1080 RGB x 1920(Rendering)	Dots
5	Active Area	68.299(W) x 121.421(H)	mm^2
6	Outline Dimension	70.66 (W) x 128.36 (H) x 0.75 (D)	mm^3
7	Pixel Pitch	0.3162 (W) x 0.6324 (H)	mm^2
8	Driver IC	RM67191 W/RAM(Raydium)	-
9	Touch IC	S3508 or GT1151	-
10	Interface	MIPI 4 lanes	-
11	Touch screen	On-cell	-
12	Polarizer	Hard coating polarizer	-
13	Weight	TBD	g

■ EXTERNAL DIMENSIONS



■ ABSOLUTE MAXIMUM RATINGS

Items	Symbol	Min	Max	Unit	Notes
Analog/boost power voltage	VCI	-0.3	5.28	V	-
VCI I/O voltage	VCI_IF	-0.3	5.28	V	-
I/O voltage	VDDIO	-0.3	3.96	V	-
VSP voltage	VSP	-	6.5	V	-
VPP (OTP power)	VPP	-	8.64	V	-
TP power voltage	VDD3	-0.3	3.6	V	-
TP I/O digital voltage	IOVCC	1.8	3.6	V	-
Operating temperature	TOP	-20	60	℃	-
Storage temperature	TST	-30	70	℃	-

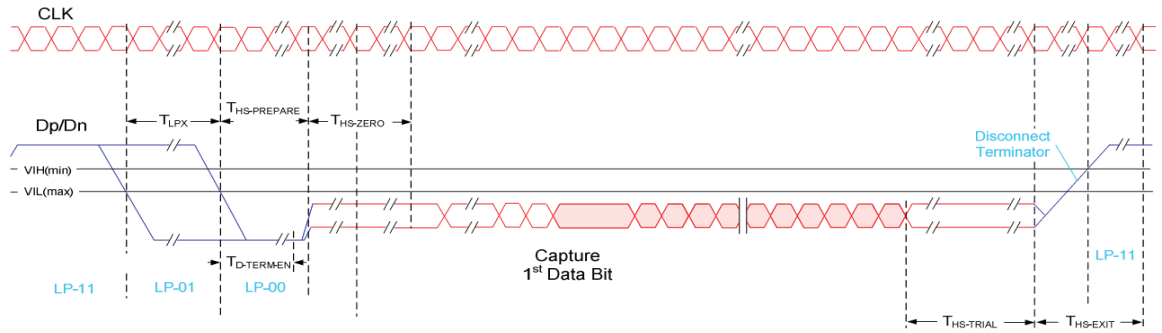
■ ELECTRICAL CHARACTERISTICS

◆DC Characteristics

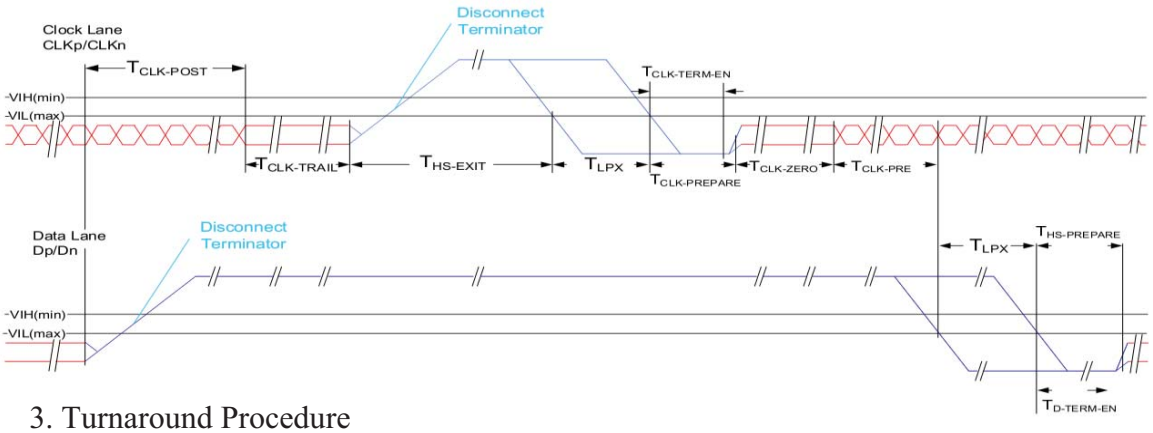
Items	Symbol	Min	Typ.	Max	Unit	Remark
AMOLED power positive	ELVDD	-	4.6	-	V	
AMOLED power negative	ELVSS	-	-2.5	-	V	Ref
Gamma voltage	VSP	6.1	6.4	6.5	V	Ref
Digital power supply	VDDI	1.65	1.8	3.6	V	Ref
Analog power supply	VCI	2.5	3.3	4.8	V	Ref
TP power supply voltage	VDD_TP	2.8	-	3.6	V	
TP logic input voltage	VIH	1.26	-	1.8	V	
	VIL	-0.3	-	0.54	V	
TP logic output voltage	VOH	1.26	-	-	V	
	VOL	-	-	0.54	V	
350 ANSI@Gray 255	$I_{ELVDD/ ELVSS}$	-	210	275	mA	VELVDD=4.6V VELVSS=-2.5V VCI=3.3V VDDIO=1.8V VSP=6.1V
	IVCI	-	2	3	mA	
	IVDDIO	-	50	60	mA	
	IVSP	-	15	17	mA	
Normal operation	Iopr	-	13.2	-	mA	VDD_TP=3V MCLK=24MHz
Monitor	Imon	-	0.43	-	mA	
Sleep	Islp	-	42	-	uA	

◆AC Characteristics

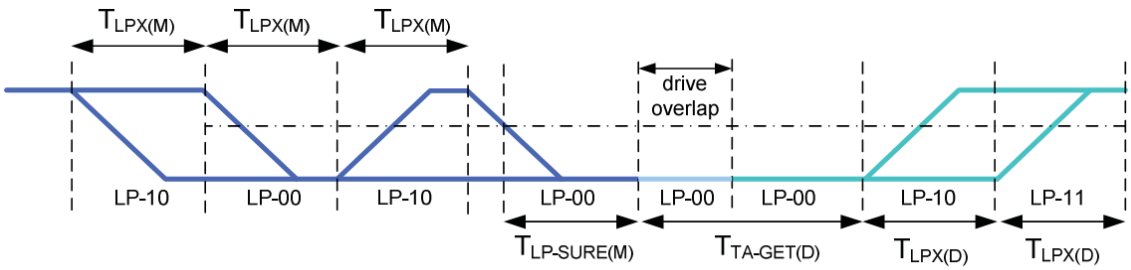
1. HS Data Transmission Burst



2. HS Clock Transmission



3. Turnaround Procedure



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 Data 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

$T_{CLK-PRE}$	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	–	–	ns
$T_{CLK-SETTLE}$	Time interval during which the HS receiver shall ignore any Clock Lane HS transitions, starting from the beginning of $T_{CLK-PRE}$.	95	–	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 VIL,MAX.	Time for Dn to reach VTERM-EN		38	ns
$T_{HS-SETTLE}$	Time interval during which the HS receiver shall ignore any Data Lane HS transitions, starting from the beginning of $T_{HSPREPARE}$.	85 ns + 6*UI		145 ns + 10*UI	ns
T_{EOT}	Time from start of THS-TRAIL or TCLK-TRAIL period to start of LP-11 state	-	–	105ns+48*UI	ns
$T_{HS-EXIT}$(1)	time to drive LP-11 after HS burst	100	–	-	ns
$T_{HS-PREPARE}$	Time to drive LP-00 to prepare for HS transmission	40ns + 4*UI	–	85ns+6*UI	ns
$T_{HS-PREPARE}$ + $T_{HS-ZERO}$	THS-PREPARE + Time to drive HS-0 before the Sync sequence	145ns + 10*UI	–	–	ns
$T_{HS-SKIP}$	Time-out at RX to ignore transition period of EoT	40	–	55ns+4*UI	ns
$T_{HS-TRAIL}$	Time to drive flipped differential state after last payload data bit of a HS transmission burst	60 + 4*UI	–	–	ns
T_{LPX}	Length of any Low-Power state period	50	–	–	ns
Ratio T_{LPX}	Ratio of $T_{LPX(MASTER)}$/$T_{LPS(SLAVE)}$ between Master and Slave side	2/3	–	3/2	ns
T_{TA-GET}	Time to drive LP-00 by new TX	5*TLPX	5*TLPX	5*TLPX	ns

T_{TA-GO}	Time to drive LP-00 after Turnaround Request	4*TLPX	4*TLPX	4*TLPX	ns
$T_{TA-SURE}$	Time-out before new TX side starts driving	TLPX	–	2*TLPX	ns

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, T_A=-20℃~+85℃)

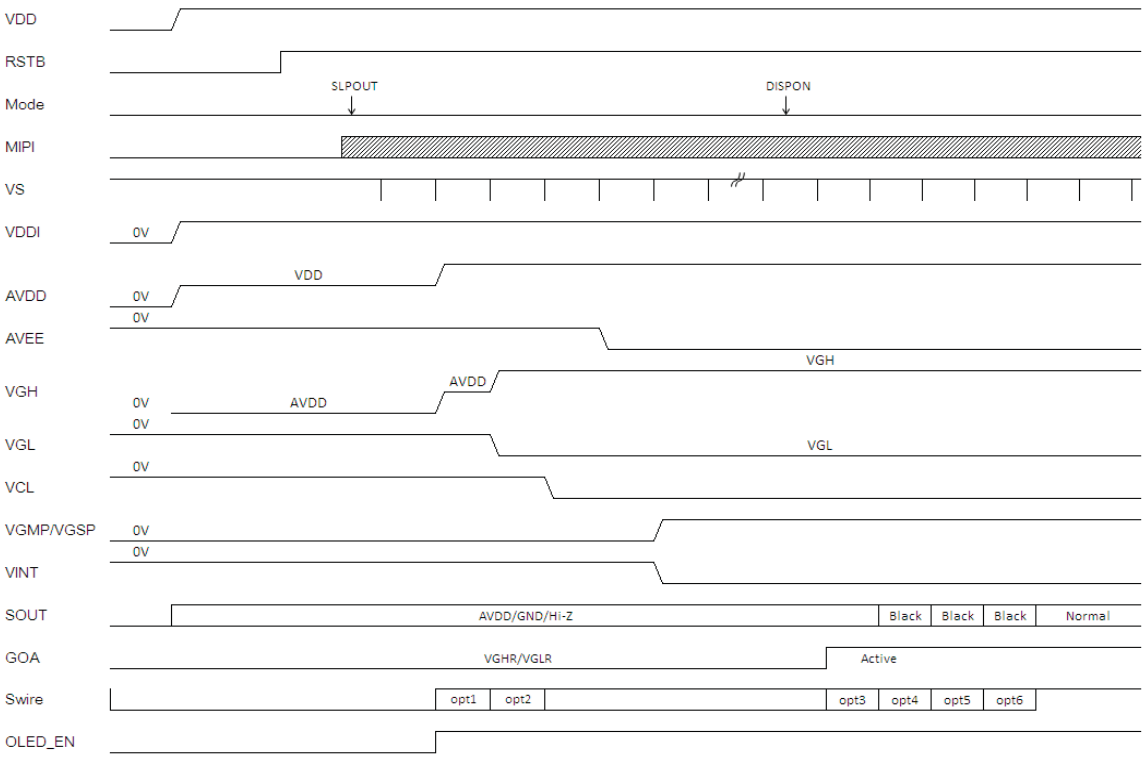
Parameter	Symbol	Conditions	Spec			Unit
			Min.	Typ.	Max.	
Reset low pulse width	Trst	–	20	–	–	μs

Table: Reset timing

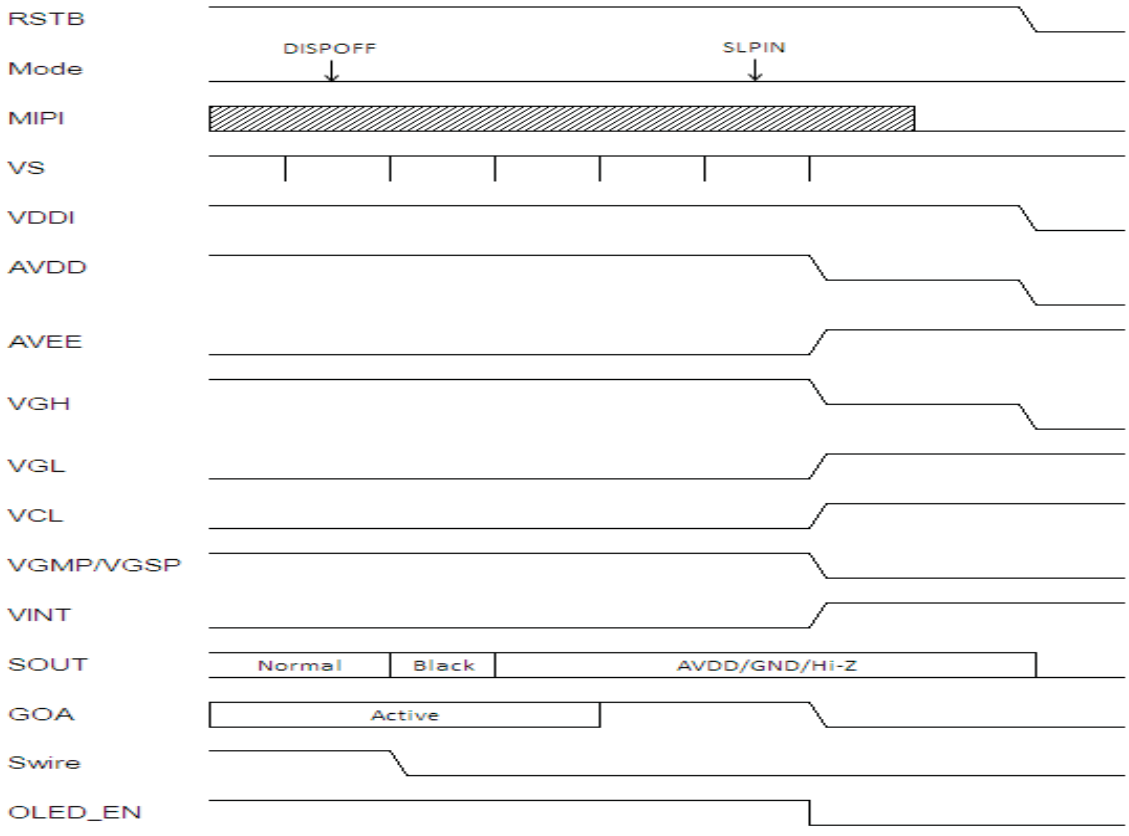
Figure: Reset timing

6. Recommended Operating Sequence

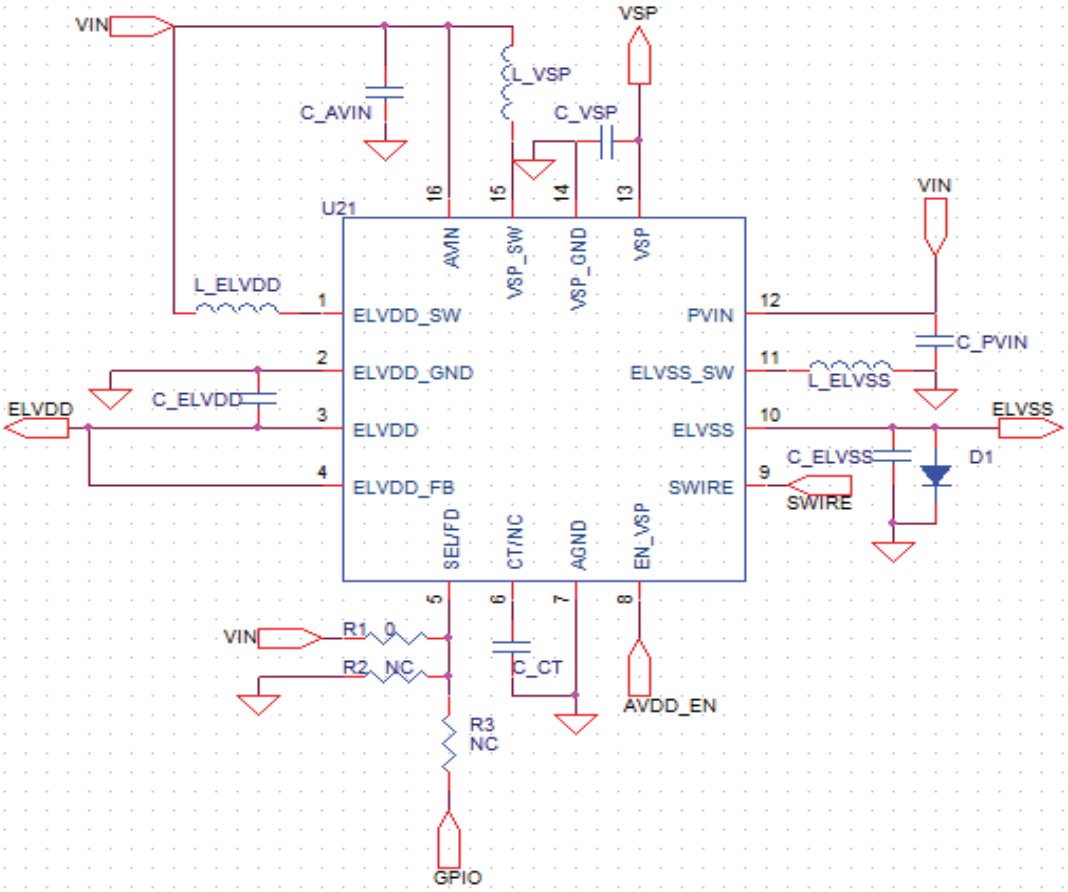
6.1 Power ON Sequence



6.2 Power OFF Sequence



◆APPLICATION CIRCUIT



■ ELECTRO-OPTICAL CHARACTERISTICS (Ta=25℃)

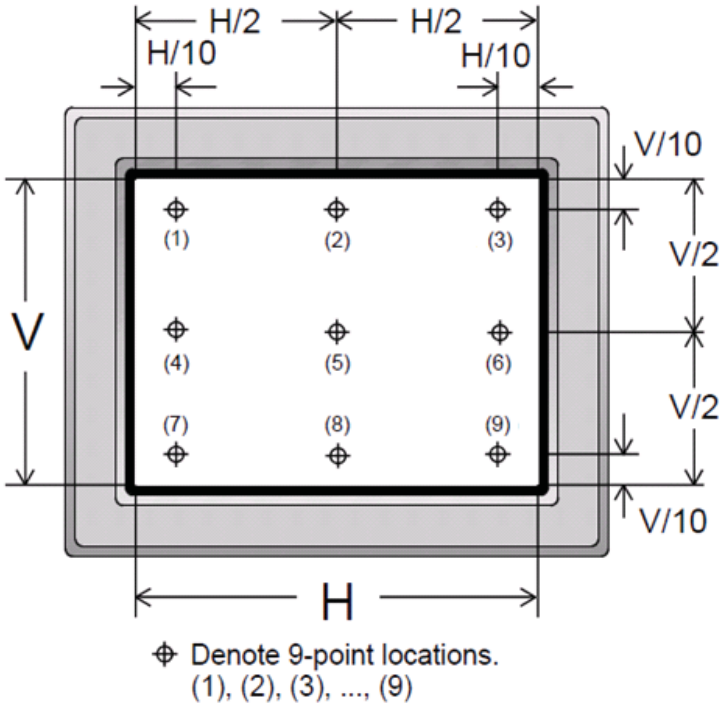
Item		Symbol	Condition	Min	Typ	Max	Unit	Remark
Brightness		Lv	Full white	300	350	-	cd/m^2	Note 2
Brightness uniformity		-	Full white	70	85	-	%	
Contrast ratio		Cr	Normal to surface	8000	10000	-	-	
CIE (x, y) chromaticity	Red	x	Normal to surface	0.63	0.66	0.69	-	Ref.
		y		0.31	0.34	0.37		
	Green	x		0.16	0.21	0.26		
		y		0.67	0.72	0.77		
	Blue	x		0.09	0.13	0.17		
		y		0.02	0.06	0.10		
	White	x		0.28	0.30	0.32	-	-
		y		0.30	0.32	0.34		
Color gamut	-	-	vs.NTSC	80	100	-	%	-
Viewing angle		-	U/D/L/R CR≥1000	80	85	-	-	-
Cross-talk		-	4% black or white window,117 gray scale	-	-	5	%	Note 3
Gamma		-	V(gray)=48,72,104, 132,164,192,224,255	1.9	2.2	2.5	-	-
Color shift		-	@30 degree	-	4	5	JNCD	Note 4
Response time		-		-	-	2	ms	Note 5

Note1: Temp.25℃，（Angle、distance）
Environmental conditions： Temp.25℃±3℃， 65± 20%RH，Dark Room。
Distance of OLED display center to measuring machine is 50cm

Note2: Brightness Uniformity definition

Measure 9 points of Display Brightness,

Brightness Uniformity=$L_{min}/L_{Max}\times$ 100%



Contrast Ratio：

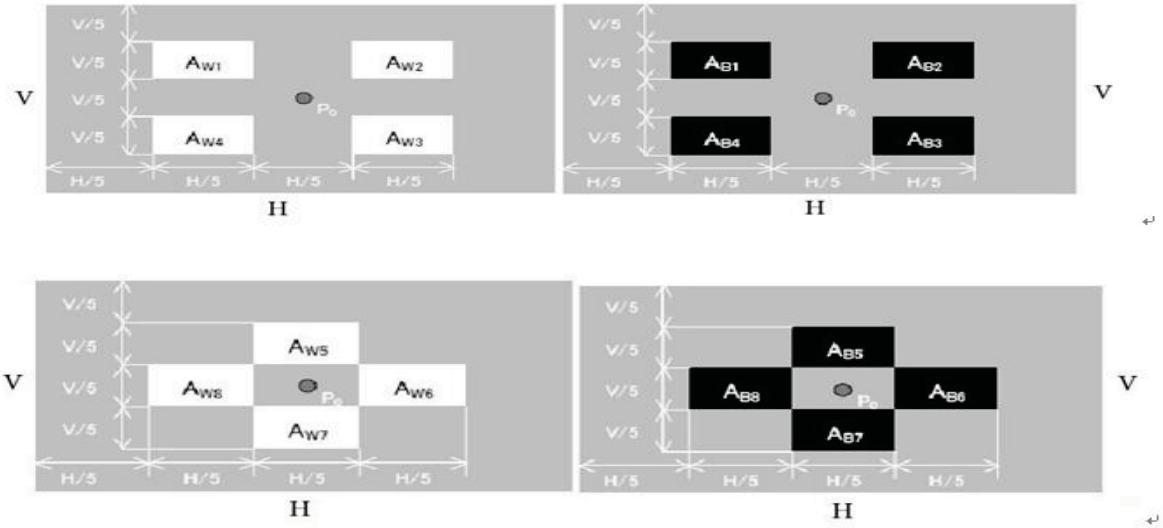
Dark Room C.R=LW/LB

LW: full white brightness of display center P0;

LB : full black brightness of display center P0

Note3: Cross-talk

4% black or white window ,117 gray background.



$$L_{W\_OFF} = \frac{L_{w1} + L_{w2} + L_{w3} + L_{w4}}{4}$$

$$L_{B\_OFF} = \frac{L_{B1} + L_{B2} + L_{B3} + L_{B4}}{4}$$

$$CT = \frac{|L_{Wi\_ON} - L_{W\_OFF}|}{L_{W\_OFF}} \times 100\% (i = 5\ to\ 8)$$

For white windows A_{Wi} (i = 5 to 8), and

$$CT = \frac{|L_{Bi\_ON} - L_{B\_OFF}|}{L_{B\_OFF}} \times 100\% (i = 5 \text{ to } 8)$$

For black windows A_{Bi} (i = 5 to 8).

The maximum cross-talk value shall be noted in the measurement report.

Note4: 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 on θ F=30° we can get another 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 requiremnet is from our customer and we have test some of our phone display and the result is OK.

Note 5: Response Time

Response time=Pixel turn on and turn off time (White<=>Black).

It is measuring transition time from 10% to 90% of luminance.

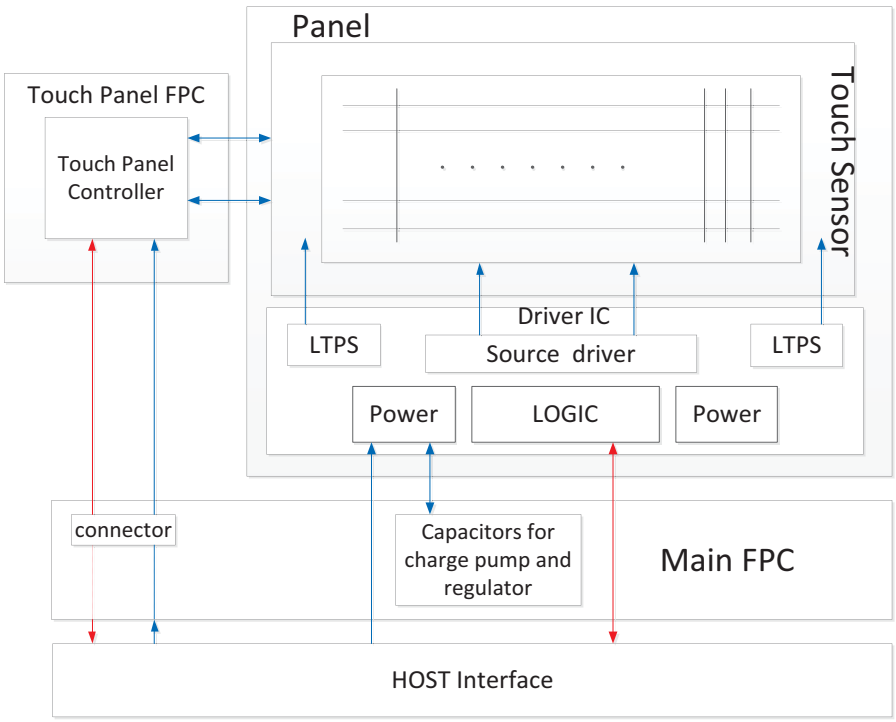
■ INTERFACE PIN CONNECTIONS

1. I/O Connection

P/N	Pin_name	I/O	Description
1	IOVCC_TP	Power	I/O Power Supply
2	GND	Power	The power ground
3	VDD_TP	Power	Digital power supply
4	D3N	I	MIPI DSI data3-
5	TE_TP	I	LCD Sync
6	D3P	I	MIPI DSI data3+
7	SDA_TP	I/O	I2C Data Input & Output
8	GND	Power	The power ground
9	SCL_TP	I/O	I2C Clock Input
10	D0N	I/O	MIPI DSI data0-
11	RST_TP	I	External Reset,Low is Active
12	D0P	I/O	MIPI DSI data0+
13	INT_TP	I	Interrupt request to the host, or Wakeup request from the host.
14	GND	Power	The power ground
15	GND	Power	The power ground
16	CKN	I	MIPI DSI clock-
17	OLED_EN	O	Power IC enable
18	CKP	I	MIPI DSI clock+
19	SWIRE	O	Power IC control pin
20	GND	Power	The power ground
21	TE	O	Tear effect output
22	D1N	I	MIPI DSI data1-
23	VDDIO	Power	Driver IC digital I/O supply
24	D1P	I	MIPI DSI data1+
25	VSP	Power	PFM's Voltage
26	GND	Power	The power ground
27	VCI	Power	Driver IC analog supply
28	D2N	I	MIPI DSI data2-
29	RESX	I	This signal will reset the device and must be applied to properly initialize the chip. Active low.
30	D2P	I	MIPI DSI data2+

31	VPP	Power	Power supply for OTP. Leave the pin to open when not in use.
32	GND	Power	The power ground
33	GND	Power	The power ground
34	NC	-	No connection
35	ELVDD	Power	AMOLED power Positive
36	ELVSS	Power	AMOLED power Negative
37	ELVDD	Power	AMOLED power Positive
38	ELVSS	Power	AMOLED power Negative
39	ELVDD	Power	AMOLED power Positive
40	ELVSS	Power	AMOLED power Negative

2. Display Module Block Diagram



■ RELIABILITY TESTS

1. Environmental Test

No	Item	Conditions	Note
1	High Temperature Operation	70℃/ 128hours	
2	Low Temperature Operation	-20℃/ 128hours	
3	High Temperature Storage	85℃ 128hrs	
4	Low Temperature Storage	-40℃ 128hrs	
5	High Temperature Humidity Operation	60℃/93％ RH96hrs	
6	High Temperature Humidity Storage	60℃/93% RH96hrs	
7	Thermal Shock	-20℃ ~ 70℃ 30min,change time ＜5min, 10 cycles	

2. Electrical Test

No	Item	Conditions
1	Air discharge	±8KV,150PF/330 Ω (Module level)
2	Contact discharge	±4KV, 150PF/330 Ω (Module level)

3. Mechanical Test

No	Item	Conditions	Note
1	Glass Strength Test	4PB, B10>100MPa	
2	Ball Drop Test	Min 0.2J@ center (Φ20mm,32.5g,62.5cm)	Module with CL
3	Shock Test	Half Sine, 60G, duration time 6 ms , 3 times for each direction , total 6 shocks	Module

4	Drop Test	GB/T4857.18-19 Test Description For Packages(1 corner, 3 edges, 6 surfaces)	Package
5	Sinusoidal Vibration Test	Frequency range:10~55Hz,Stroke:1.5mm,Sweep:10Hz~55Hz~10H 2hours for each direction of X.Y.Z.(6 hours for total, Package condition)	Package

■ CAUTIONS IN USING OLED MODULE

◆Precautions For Handling OLED Module:

1. OLED module consists of glass and polarizer. Pay attention to the following items when handling:
   i. Avoid drop from high, avoid excessive impact and pressure.
   ii. Do not touch, push or rub the exposed polarizers with anything harder than an HB pencil lead.
   iii. If the surface becomes dirty, breathe on the surface and gently wipe it off with a soft dry cloth. If it is terrible dirty, moisten the soft cloth with Isopropyl alcohol or Ethyl alcohol. Other solvents may damage the polarizer. Especially water, Ketone and Aromatic solvents.
   iv. Wipe off saliva or water drops immediately, contact the polarizer with water over a long period of time may cause deformation.
   v. Please keep the temperature within specified range for use and storage. Polarization degradation, bubble generation or polarizer peeling-off may occur with high temperature and high humidity.
   vi. Condensation on the surface and the terminals due to cold or anything will damage, stain or dirty the polarizer, so make it clean as the way of iii.
2. Do not attempt to disassemble or process the OLED Module.
3. Make sure the TCP or the FPC of the Module is free of twisting, warping and distortion, do not pull or bend them forcefully, especially the soldering pins. On the other side, the SLIT part of the TCP is made to bend in the necessary case.
4. When assembling the module into other equipment, give the glass enough space to avoid excessive pressure on the glass, especially the glass cover which is much more fragile.
5. Be sure to keep the air pressure under 120 kPa, otherwise the glass cover is to be cracked.
6. Be careful to prevent damage by static electricity:
   i. Be sure to ground the body when handling the OLED Modules.
   ii. All machines and tools required for assembling, such as soldering irons, must be properly grounded.
   iii. Do not assemble and do no other work under dry conditions to reduce the amount of static electricity generated. A relative humidity of 50%-60% is recommended.
   iv. Peel off the protective film slowly to avoid the amount of static electricity generated.
   v. Avoid to touch the circuit, the soldering pins and the IC on the Module by the body.
   vi. Be sure to use anti-static package.
7. Contamination on terminals can cause an electrochemical reaction and corrade the terminal circuit, so make it clean anytime.
8. All terminals should be open, do not attach any conductor or semiconductor on the terminals.
9. When the logic circuit power is off, do not apply the input signals.
10. Power on sequence: $V_{DD} \rightarrow V_{PP}$, and power off sequence: $V_{PP} \rightarrow V_{DD}$.
11. Be sure to keep temperature, humidity and voltage within the ranges of the spec, otherwise shorten Module’ s life time, even make it damaged.
12. Be sure to drive the OLED Module following the Specification and Datasheet of IC controller, otherwise something wrong may be seen.

13. When displaying images, keep them rolling, and avoid one fixed image displaying more than 30 seconds, otherwise the residue image is to be seen. This is the speciality of OLED.

◆Precautions For Soldering OLED Module:

1. Soldering temperature : 260°C ± 10°C.
2. Soldering time : 3-4 sec.
3. Repeating time : no more than 3 times.
4. If soldering flux is used, be sure to remove any remaining flux after finishing soldering operation. (This does not apply in the case of a non-halogen type of flux.) It is recommended to protect the surface with a cover during soldering to prevent any damage due to flux spatters.

◆ Precautions For Storing OLED Module:

1. Be sure to store the OLED Module in the vacuum bag with dessicant.
2. If the Module can not be used up in 1 month after the bag being opened, make sure to seal the Module in the vacuum bag with dessicant again.
3. Store the Module in a dark place, do not expose to sunlight or fluorescent light.
4. The polarizer surface should not touch any other objects. It is recommended to store the Module in the shipping container.
5. It is recommended to keep the temperature between 0°C and 30°C , the relative humidity not over 60%.

◆ Limited Warranty

Unless relevant quality agreements signed with customer and law enforcement, for a period of 12 months from date of production, all products (except automotive products) Display Future will replace or repair any of its OLED modules which are found to be functional defect when inspected in accordance with Display Future OLED acceptance standards (copies available upon request). Cosmetic/visual defects must be returned to Display Future within 90 days of shipment. Confirmation of such date should be based on freight documents. The warranty liability of Display Future is limited to repair and/or replacement on the terms above. Display Future will not be responsible for any subsequent or consequential events.

◆Return OLED Module Under Warranty:

1. No warranty in the case that the precautions are disregarded.
2. Module repairs will be invoiced to the customer upon mutual agreement. Modules must be returned with sufficient description of the failures or defects.