



LCD Mall Limited

Product Specification

Model Name	LM064FH02EN
Description	6.39" AMOLED with Cover Lens FHD/All viewing/AF coating 1080(RGB)*2340 Dots
Date	2020/05/15
Version	1.0

Preliminary Specification

Final Product Specification

Prepared by	Checked by	Approved by
Tina 2020/05/15	Sam 2020/05/15	David 2020/05/15

For Customer Approval

Approved By	Comment



LCD Mall Limited

Records of Revision



Contents

Version History	2
Contents	3
1 Scope	4
2 Features	4
2.1 Product Applications	4
2.2 Product Features	4
3 Mechanical Specifications	4
4 Maximum Rating	4
5 Electrical Specifications	5
5.1 Electrical Characteristics	5
5.1.1 Power Characteristic:	5
5.2 I/O Connection and Block Diagrams	6
5.2.1 Main I/O Connection	6
5.2.2 Display Module Block Diagram	6
5.3 Recommended Operating Sequence	9
5.3.1 Power on sequence	9
5.3.2 Power off sequence	9
5.4 AC Characteristics (MIPI)	10
5.4.1 HS Data Transmission Burst	10
5.4.2 HS Clock Transmission	10
5.4.3 Turnaround Procedure	10
5.4.4 Timing Parameters	11
5.4.5 Reset Timing Sequence Requirement	12
6 Touch Specifications	13
7 Electro-Optical Specification	14
8 Reliability	19
8.1 Environmental Test	19
8.2 Mechanical	20
8.3 Environmental protection	22
9 Handling Precautions	22
10 Outline Dimension Drawing	22
11 Packing Specification	23



1 Scope

This specification defines AMOLED from LCD Mall Limited, which is called lcd mall from here. In the case of any unspecified item, it may require both LCD Mall and the party designs this module into its product to work out a solution.

2 Features

2.1 Product Applications

Mobile phone

2.2 Product Features

- 1) Display color: 16.7M (RGB x 8bits)
- 2) Display format: 6.39" FHD (1080RGBx2340)
- 3) Pixel arrangement: Rendering arrangement
- 4) Interface: MIPI 4 lanes
- 5) Driver IC: RM692C9 (single COF layer), TP IC: FT3518

3 Mechanical Specifications

Item	Specification	unit	Note
Panel Dimension outline	69.84 × 150.42 × 0.643	mm	*
LTPS Glass outline	69.84 × 150.42	mm	
Encapsulation Glass outline	69.84 × 149.67	mm	
Number of dots	1080(W) x RGB x 2340(H)	dots	
Active area	68.04 × 147.42	mm	
Diagonal size	6.392	inch	
Pixel pitch	31.5 × 63.0	μm	
Glass thickness (LTPS/encapsulation glass)	0.2 / 0.3	mm	
Weight	TBD	g	

*Note: Refer to 9 Outline Dimension Drawing

4 Maximum Rating

Parameter	Symbol	Spec			Unit	Note
		Min.	Typ.	Max.		
Analog/boost power voltage	VCI	-0.3	-	5.5	V	-
VCI I/O voltage	VCI_IF	-0.3	-	5.5	V	-
I/O voltage	VDDI	-0.3	-	5.5	V	-

VSP voltage	VSP	-0.3	-	6.6	V	-
VPP(OTP power)	VPP	-	-	8.25	V	-
Operating temperature	Top	-20		70	°C	
Storage temperature	Tstg	-30		80	°C	
TP_Power Voltage	TSP_AVDD	-0.3		4.2	V	

5 Electrical Specifications

5.1 Electrical Characteristics

5.1.1 Power Characteristic:

Item	Symbol	Min.	Typ.	Max.	Unit	Remark
AMOLED Power positive	ELVDD		4.6		V	
AMOLED power Negative	ELVSS		-2.5		V	Ref
Gamma Voltage	VSP		6.4		V	Ref
Digital Power supply	VDDI	1.65	1.8	3.3	V	Ref
Analog Power supply	VCI	2.5	3.3	4.8	V	Ref
TP Power Supply voltage	TSP_AVDD	2.6	2.8	3.6	v	

Mode	Symbol	Condition	Typ.	Max.	Unit
430 nits @Gray 255	IELVDD/ELVSS	VELVDD=4.6V VELVSS=-2.5V VCI=3.3V VDDIO=1.8V VSP=6.4V	230	280	mA
	IVCI		6	10	mA
	IVDDIO		65	85	mA
	IVSP		17	25	mA

Mode	Symbol	Condition	Typ.	Max.	Unit
600 nits @Gray 255	IELVDD/ELVSS	VELVDD=4.6V VELVSS=-3.5V VCI=3.3V VDDIO=1.8V VSP=6.4V	350	390	mA
	IVCI		6	10	mA
	IVDDIO		65	85	mA
	IVSP		17	25	mA



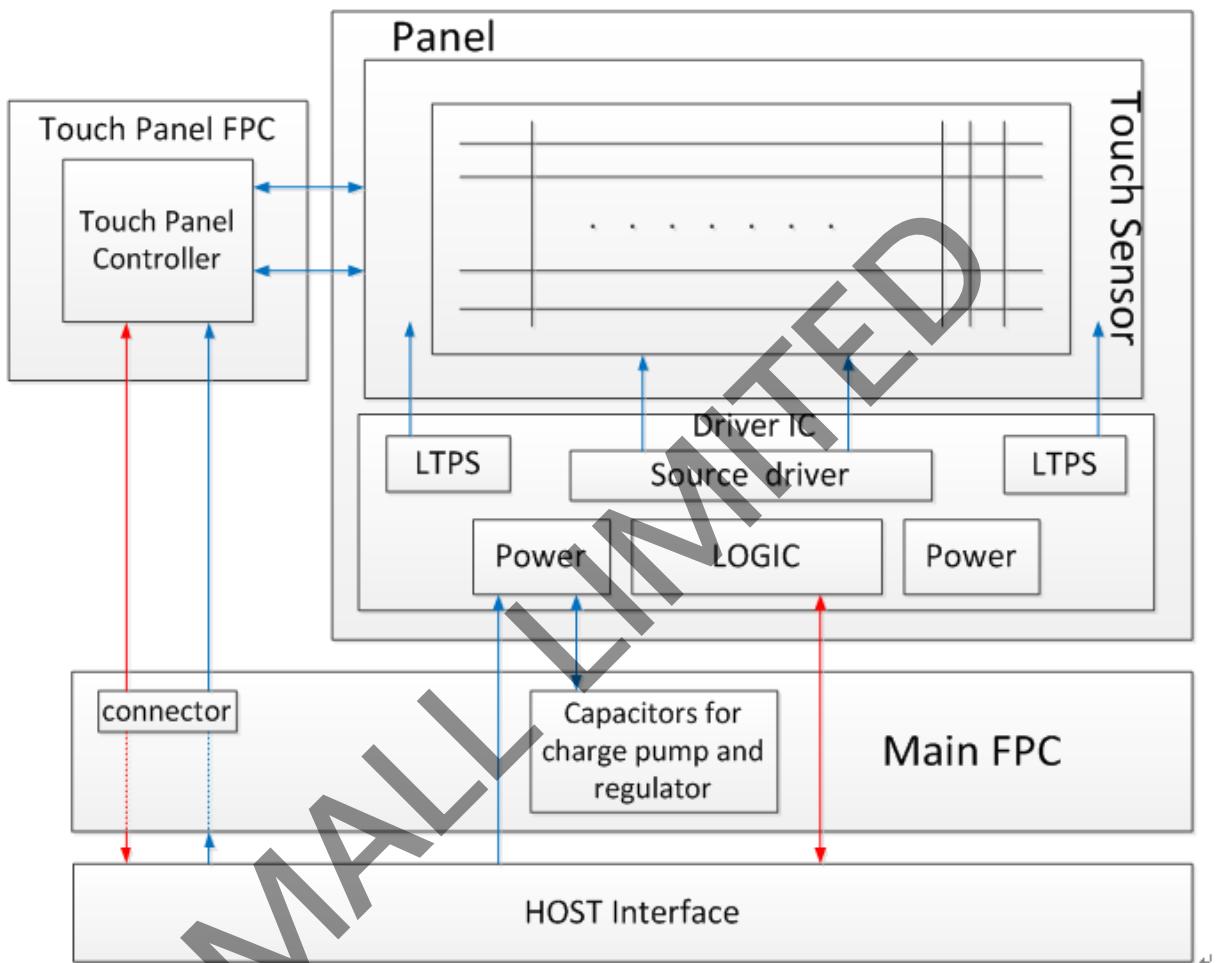
5.2 I/O Connection and Block Diagrams

5.2.1 Main I/O Connection

#	Pin_name	I/O	Description
1	AVDD	P	Driver IC power supply for charge pump
2	VCI(2.8V)	P	Driver IC analog power supply
3	VDDIO	P	Driver IC regulator power supply
4	I_SPDI	NC	NC
5	I_SPDO	NC	NC
6	I_SPCS	NC	NC
7	I_SPCK	NC	NC
8	GND	GND	GND
9	D2P	I	MIPI DSI data2+
10	D2N	I	MIPI DSI data2-
11	GND	GND	GND
12	D1P	I	MIPI DSI data1+
13	D1N	I	MIPI DSI data1-
14	GND	GND	GND
15	CKP	I	MIPI DSI clock+
16	CKN	I	MIPI DSI clock-
17	GND	GND	GND
18	D0P	I/O	MIPI DSI data0+
19	D0N	I/O	MIPI DSI data0-
20	GND	GND	GND
21	D3P	I	MIPI DSI data3+
22	D3N	I	MIPI DSI data3-
23	GND	GND	GND
24	VPP/OTP9(NC)	NC	NC
25	GND	GND	GND
26	ELVSS	I	AMOLED power Negative
27	ELVSS	I	AMOLED power Negative
28	ELVSS	I	AMOLED power Negative

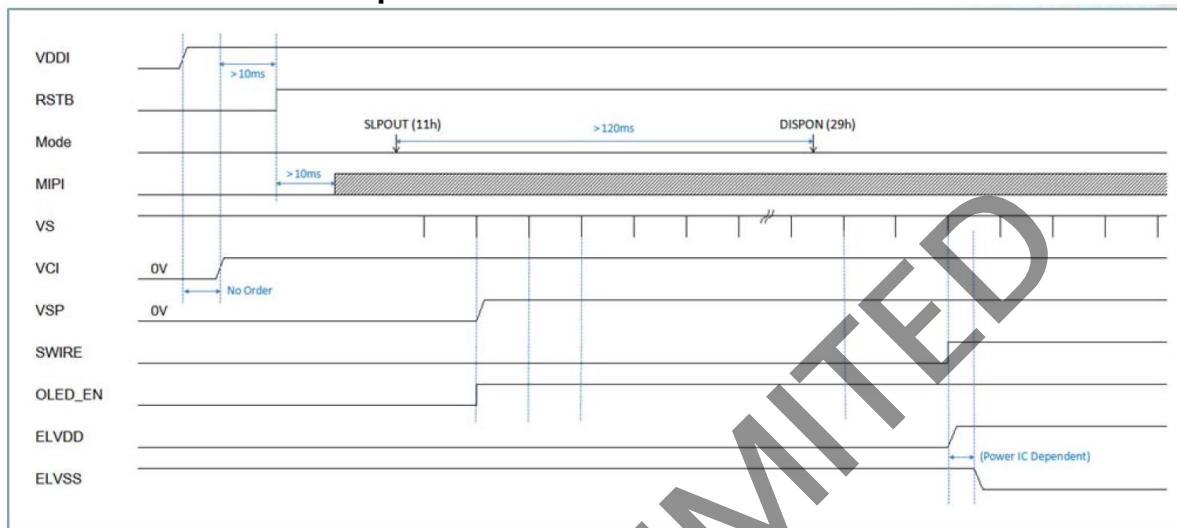
29	GND	GND	GND
30	ELVDD	I	AMOLED power Positive
31	ELVDD	I	AMOLED power Positive
32	ELVDD	I	AMOLED power Positive
33	GND	GND	GND
34	RESET	I	External Reset,Low is Active
35	AVDD_EN	O	Power IC enable
36	SWIRE	O	Power IC control pin
37	ERR_PG(NC)	NC	NC
38	PCD(NC)	NC	NC
39	TE	O	Tear effect output
40	ID0	NC	NC
41	ID1	NC	NC
42	TSP_AVDD(TP2.8)	Power	Analog Power for TSP
43	TSP_DVDD(TP1.8)	Power	Digital Power for TSP
44	TSP_TA(NC)	NC	NC
45	GND	GND	GND
46	TSP_INT	I/O	State change interrupt for TSP
47	TSP_SCL	I	Serial interface Clock for TSP
48	TSP_SDA	I/O	Serial interface Data for TSP
49	TSP_RESET	I	Active low, RESET the Touch IC
50	GND	GND	GND

5.2.2 Display Module Block Diagram

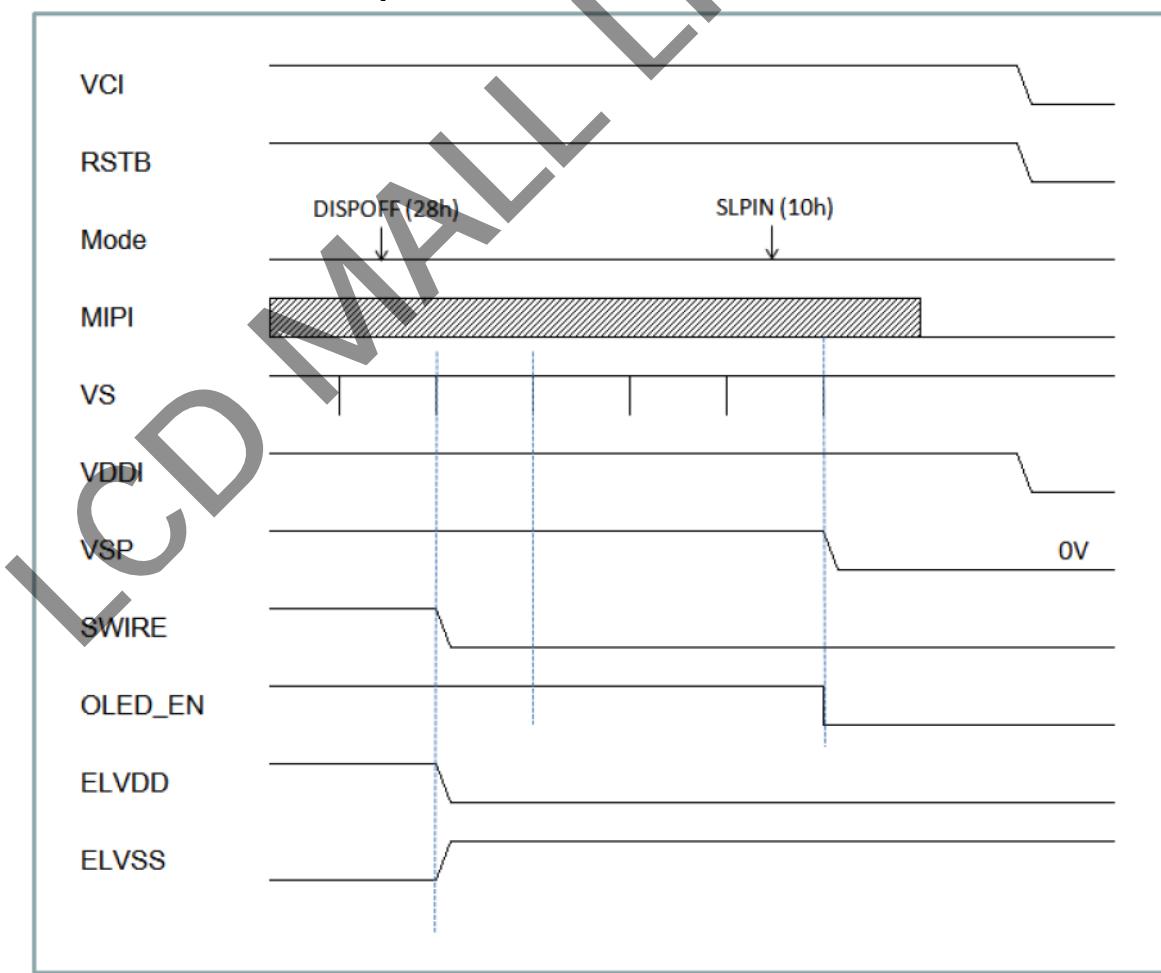


5.3 Recommended Operating Sequence

5.3.1 Power on sequence

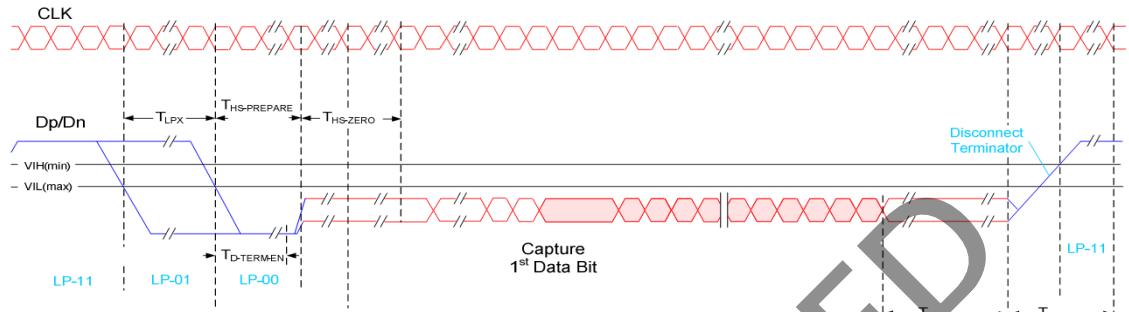


5.3.2 Power off sequence

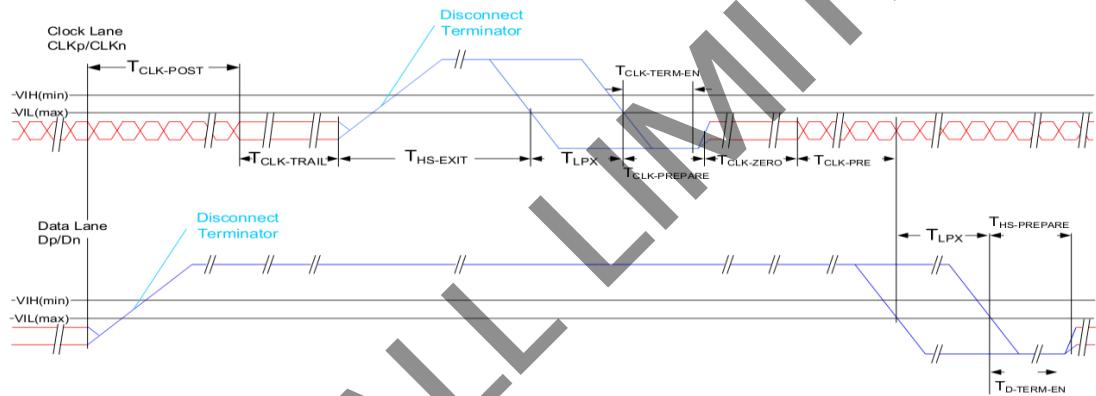


5.4 AC Characteristics (MIPI)

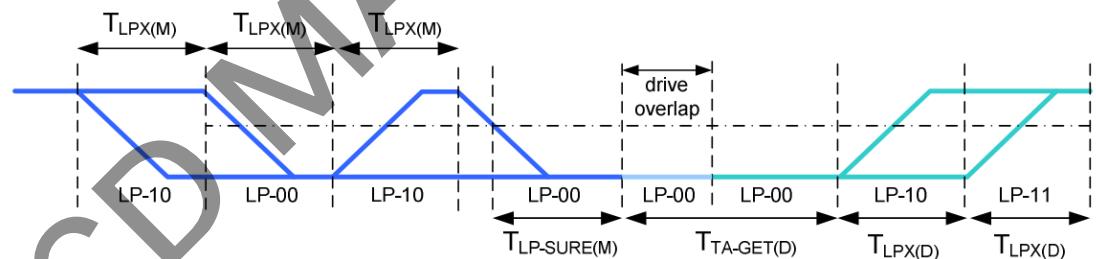
5.4.1 HS Data Transmission Burst



5.4.2 HS Clock Transmission



5.4.3 Turnaround Procedure



5.4.4 Timing Parameters

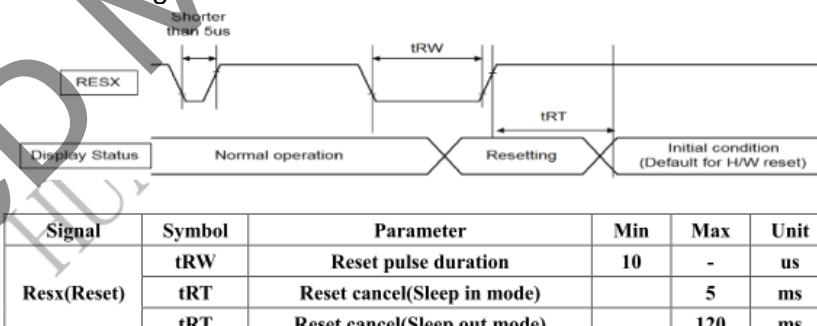
Symbol	Description	Min	Typ	Max	Unit
T_{REOT}	30%-85% rise time and fall time	-	-	35	ns
$T_{CLK-MISS}$	Timeout for receiver to detect absence of Clock transitions and disable the Clock Lane HS-RX.	-	-	60	ns
$T_{CLK-POST}^{\ast 1}$	Time that the transmitter continues to send HS clock after the last associated Data Lane has transitioned to LP Mode. Interval is defined as the period from the end of $T_{HS-TRAIL}$ to the beginning of $T_{CLK-TRAIL}$.	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 $T_{HS-TRAIL}$ or $T_{CLK-TRAIL}$ 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

$T_{HS-PREPARE} + T_{HS-ZERO}$	$T_{HS-PREPARE} + \text{Time to drive HS-0 before the Sync sequence}$	145ns + 10*UI	-	-	ns
--------------------------------	---	---------------	---	---	----

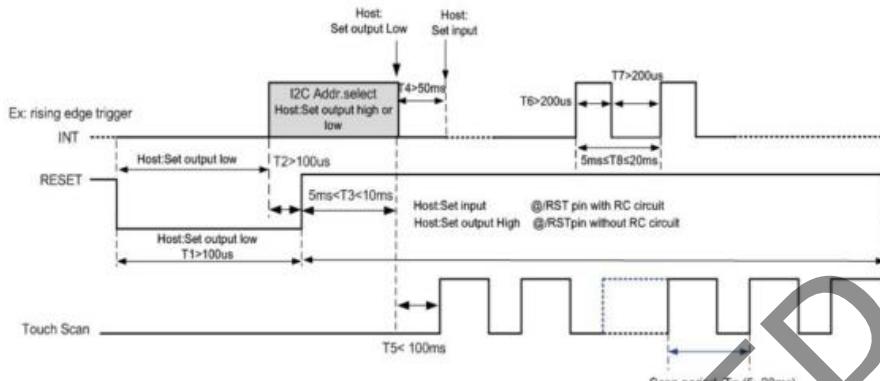
$T_{HS-SKIP}$	Time-out at RX to ignore transition period of EoT	40	-	55ns +4*UI	ns
$T_{HS-TRAIL}$	Time to drive flipped differential state after last payload data bit of a HS transmission burst	60 + 4*UI	-	-	ns
T_{LPX}	Length of any Low-Power state period	50	-	-	ns
Ratio T_{LPX}	Ratio of $T_{LPX(MASTER)}/T_{LPS(SLAVE)}$ 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

5.4.5 Reset Timing Sequence Requirement

Display panel reset timing:



TP reset timing:



Signal	Symbol	Parameter	Min	Max	Unit
TSP_RESET	T1	TSP_Reset pulse duration	100	-	us

6 Touch Specifications

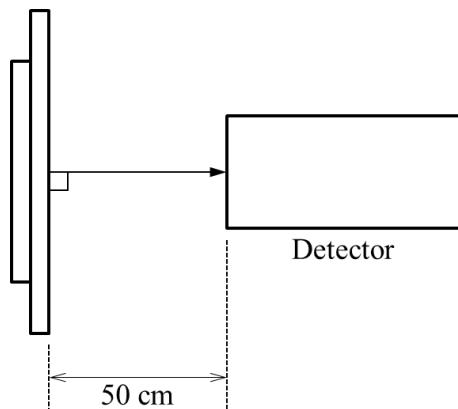
#	Pin_name	I/O	Description
1	TEST1	TEST	TEST
2	TEST2	TEST	TEST
3	GND1	GND	GND
4	TP_RST	I	Active low, RESET the Touch IC
5	TP_SDA	I/O	Serial interface Data for TSP
6	TP_SCL	I	Serial interface Clock for TSP
7	TP_INT	I/O	State change interrupt for TSP
8	NC1	NC	NC
9	IOVCC1	Power	Digital Power for TSP
10	IOVCC2	Power	Digital Power for TSP
11	GND2	GND	GND
12	VDD1	Power	Analog Power for TSP
13	VDD2	Power	Analog Power for TSP
14	GND3	GND	GND
15	TEST3	TEST	TEST
16	TEST4	TEST	TEST

7 Electro-Optical Specification

Item	Symbol	Conditions	Min.	Typ.	Max.	Unit	Remark
Brightness		Full White	387	430	473	cd/m ²	Note 1
Brightness(HBM)		HBM Mode	600			cd/m ²	
Brightness		Full White	387	430	473	cd/m ²	Note 1
Brightness Uniformity			60	70	-	%	L255 Note 2
Contrast Ratio	CR		100000	-	-		Based on CS-2000 Note 3
CIE Chromaticity	White X	Normal to surface (CIE 1931)	0.279	0.295	0.319	-	Ref.
	White Y		0.295	0.315	0.335	-	Ref.
	Red X		0.658	0.687	0.718	-	Ref.
	Red Y		0.282	0.312	0.342	-	Ref.
	Green X		0.18	0.23	0.26	-	Ref.
	Green Y		0.694	0.734	0.774	-	Ref.
	Blue X		0.113	0.143	0.173	-	Ref.
	Blue Y		0.011	0.043	0.071	-	Ref.
NTSC Coverage		NTSC		102%			
Left θ L	CR≥10	75	80	-	Deg.	Note 4	
Viewing angle		Right θ R	75	80		Deg.	Note 4
		Top φT	75	80		Deg.	Note 4
		Bottom φB	75	80		Deg.	Note 4
Color Shift		White @ 30 degree			6	JNCD	Note 5
Flicker					-30	dB	Note 6
Cross Talk					3	%	Note 7
Gamma		At brightness 430nit L20-L224	2.0	2.2	2.4		
OLED Life Time			T95≥100h				
Response time					2	Ms	Note 8

Note 1: Luminance Measurement

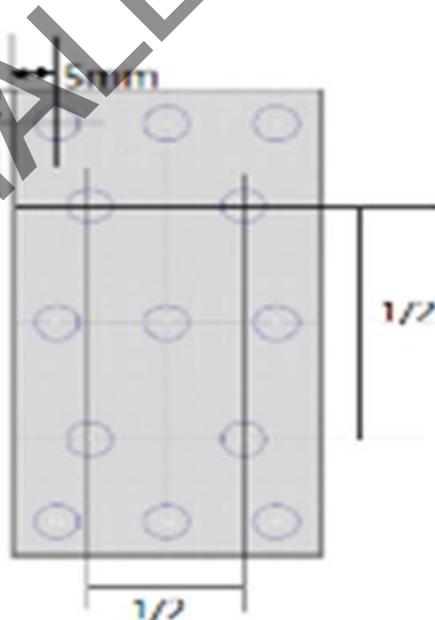
- Environmental conditions: Temp. 25°C±3°C, 65±20%RH, Dark Room.
- The data are measured after OLEDs are lighted on for more than 5 minutes and displays are fully white. The brightness is the average value of 9 measured spots. Measurement equipment: CS2000 or similar equipment. (Field of view: 1 deg., Distance: 50 cm)

**Note 2: Brightness Uniformity**

- Environmental conditions: Temp. $25^{\circ}\text{C} \pm 3^{\circ}\text{C}$, $65 \pm 20\%$ RH, Dark Room.
- Measurement equipment: CS2000 or similar equipment.
- The brightness uniformity is calculated by using following formula:
$$\text{Brightness uniformity} = \text{Bri.}(\text{Min.}) / \text{Bri.}(\text{Max.}) \times 100\%$$

$$\text{Bri.}(\text{Min.}) = \text{Minimum brightness measured in 13 measuring spots.}$$

$$\text{Bri.}(\text{Max.}) = \text{Maximum brightness measured in 13 measuring spots.}$$
- Illustration of 13 measuring spots as follows

**Note 3: Contrast Ratio**

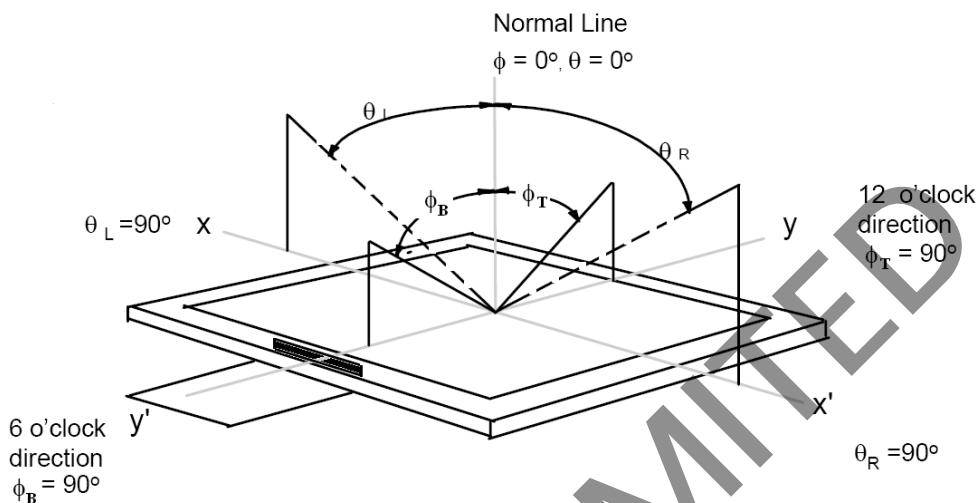
Dark Room C.R= L_w/L_b

L_w : Full white brightness of display center P0;

L_b : Full black brightness of display center P0.

Note 4: Viewing Angle

Refer to the figure below marked by θ and ϕ .



Note 5: Color Shift JNCD

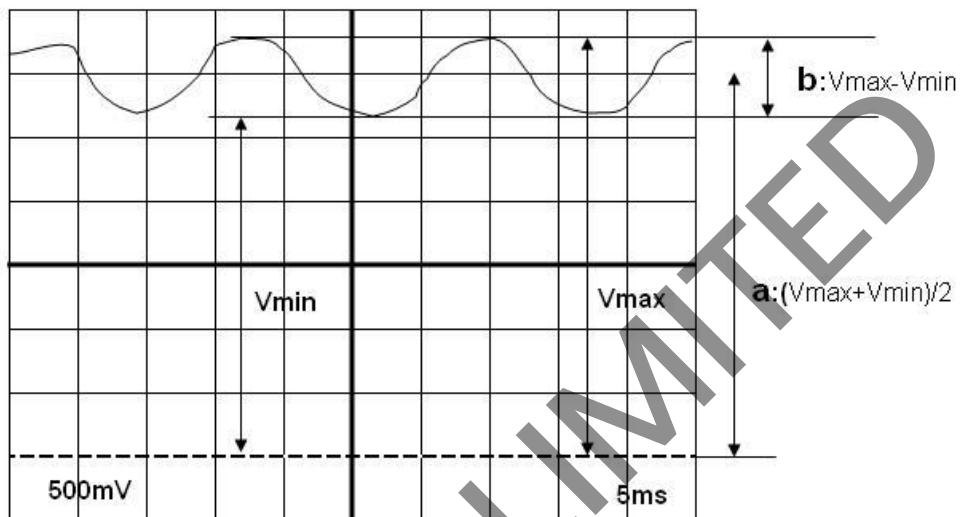
- For JNCD measure, fix on white pattern, on the condition $\theta = 0^\circ, \phi = 0^\circ$, a color coordinate (u'_1, v'_1) can be obtained and another color coordinate (u'_2, v'_2) can be obtained on $\theta_L = 30^\circ$.
- $\Delta u'v' = \text{square root } ((u'_2 - u'_1)^2 + (v'_2 - v'_1)^2)$, and JNCD stands for "Just Noticeable Color Difference". For the (u', v') color space 1 JNCD = 0.004 $\Delta u'v'$, For example, color shift less than 2 JNCD means $\Delta u'v' < 0.008$.

Note 6: Flicker

- Measurement equipment: CA-210 or similar equipment.
 - Measuring temperature: $T_a = 25^\circ C$.
 - Test method: JEITA method.
 - Test pattern: Refer to below (Test pattern should be full-fill of display screen).
 - The point should be marked is, the background of Flicker test pattern – "gray" is defined as middle gray scale. For example, RGB 24 bit "gray" is 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 |
- Frame frequency requirement before test: The display panel must be tuned to more than 60 Hz before measurement.
 - If the intensity level of the display changes as Figure below, it is considered that AC component (b) overlaps on the DC component (a). With the contrast method, the ratio of AC component to DC component is defined as the flicker amount.
 - AC component (b) is defined as $V_{\max} - V_{\min}$ and DC component (a) as $(V_{\max} + V_{\min})/2$.

and the flicker amount is calculated by the following formula:

$$\begin{aligned}\text{Flicker amount} &= \text{AC component} / \text{DC component} = b/a \\ &= (V_{\max} - V_{\min}) / [(V_{\max} + V_{\min})/2] \times 100\%\end{aligned}$$



Note 7: Crosstalk

- Measurement equipment: CS2000 or similar equipment.
- The background of crosstalk test pattern “gray” is defined as middle gray scale. For example, RGB 24 bit “gray” is defined as below

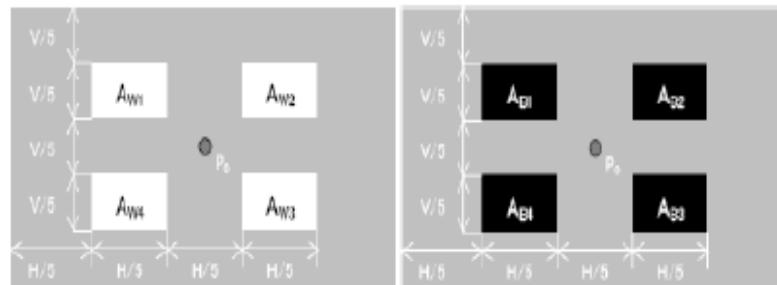
R7	R6	R5	R4	R3	R2	R1	R0	G7	G6	G5	G4	G3	G2	G1	G0	B7	B6	B5	B4	B3	B2	B1	B0
1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0

- Test pattern follows the picture below, the background is middle gray and with two black rectangle parts, each one is 1/9 of the AA size.
- Calculate the crosstalk (V) and crosstalk (H) with the formula below:

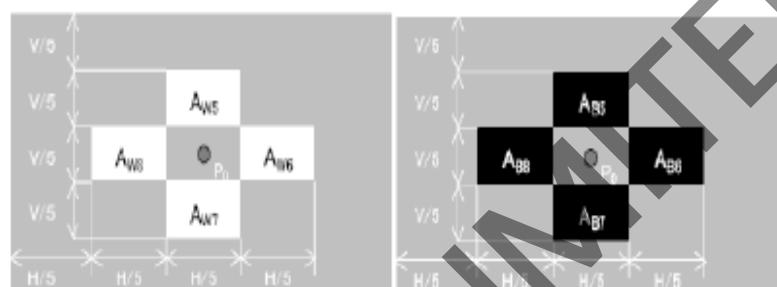
$$\text{Crosstalk (V)} = \max\left(\left|\frac{L_{V1} - L_{V2}}{L_{V2}}\right| \times 100, \left|\frac{L_{V3} - L_{V4}}{L_{V4}}\right| \times 100\right)$$

$$\text{Crosstalk (H)} = \max\left(\left|\frac{L_{H1} - L_{H2}}{L_{H2}}\right| \times 100, \left|\frac{L_{H3} - L_{H4}}{L_{H4}}\right| \times 100\right)$$

- The final crosstalk value is the maximum one between Crosstalk (V) and Crosstalk (H).



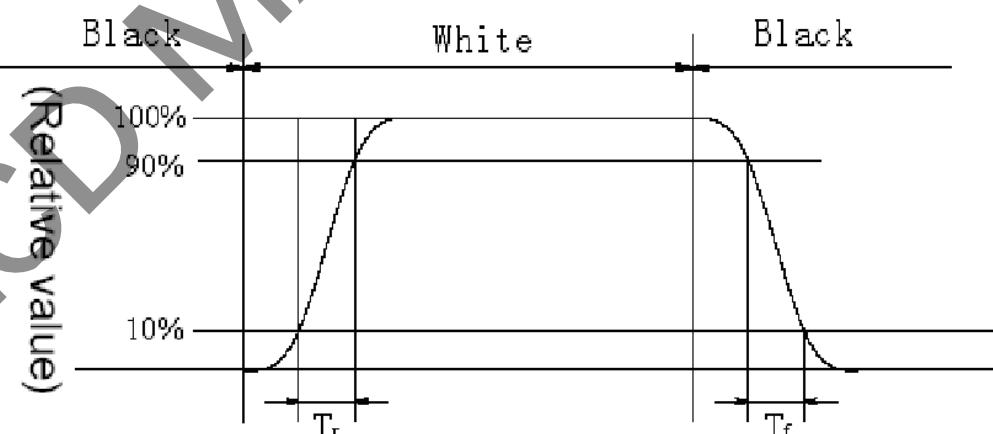
(a) $L_{W,OFF}$, $L_{B,OFF}$ measuring pattern



(b) $L_{W,ON}$, $L_{B,ON}$ measuring pattern

Note 8: Definition of Response Time

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 10% and 90% of the amplitudes, as shown in the figure below:



- Response time of gray to gray
 Measurement equipment: CS2000 or similar equipment.
 Test method: 8 grays L0 to L7 are defined, the gray level of which are 0, 36, 73, 109, 146, 182, 219, and 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 10% and 90% of the amplitudes. The result of

the test can be noted as below:

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

8 Reliability

8.1 Environmental Test

No	Item	Conditions	Note
1	High Temperature Operation 5pcs	70°C / 128 hours	Base on Full-MDL
2	Low Temperature Operation 5pcs	-20°C/120 hours	Base on Full-MDL
3	High Temperature and Humidity Operation 5pcs	60°C / 90% RH 120 hours	Base on Full-MDL
4	High Temperature Storage 5pcs	80°C / 120 hours	Base on Full-MDL
5	Low Temperature Storage 5pcs	-30°C / 120hours	Base on Full-MDL
6	Thermal Shock Storage 5pcs	-30°C (30min/cycle) /+80°C (30min/cycle) 50cycle (2hr/cycle)	Base on Full-MDL
12	ESD 测试 5pcs	Contact: ±6KV Air: ±10KV	Base on Full-MDL



LCD Mall Limited

Note 9: ESD 测试

No	Item	Conditions	Note
1	Air Discharge (Center, 20 times)	$\pm 10\text{kV}$, (Full-MDL level)	After testing - Hard defect should not happen. - If it would be recovered to normal state after resetting, it would be judged as a good state. (Class C)
2	Contact Discharge (Center, 20 times)	$\pm 6\text{kV}$, (Full-MDL level)	



8.3 Environmental protection

Item	Main spec	Note
有害物质管控	参考附件《有害物质管控标准书》	

9 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 voltage is AMOLED module's characteristic, hence it is recommended a voltage 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



LCD Mall Limited

- After considering emitting energy, you should plan your design to satisfy EMI standards.
 - Host side should place a surge-prevent circuit at power trace (ie: VCI, Vddi) to protect AMOLED module.

10 Outline Dimension Drawing

NOTE:

- 1.Display Type: 6.39" FHD AMOLED
- 2.General Tolerance: ± 0.20
- 3.General angle radius: $R=0.20$
- 4.Driver IC: RM692C9F12, TP IC: F13518;
- 5.Module FPC Connector Type: AXE650124D;
- 6.CG玻璃材质: 康宁 三代 ($T=0.7mm$)
- 7.油墨颜色: Black, 背面印2道黑, 厚度 $\leq 16\mu m$
- 8.CG正面 AF Coating, 水滴角 $>110^\circ$, 钢丝绒摩擦后 $\geq 100^\circ$
- 9.翘曲度 $\leq 0.3\text{mm}$
- 10.Check Items: 1~10;
- 11.Non-marked dimension refer to CAD file and general tolerance
- 12.Requirements on Environment Protection RoHS, Halogen free.

REV	DC/EC NUMBER	DESCRIPTION	DATE
V01	IP-FPC-001-001	First Edition	20200403
V02	IP-FPC-001-002	COP: QL-0100M	20200511
V02	IP-FPC-001-003	Mod. TPC: QL-0100M	20200511

CRITICAL DIMENSION	REFERENCE DIMENSION
DESIGNER YING JIAOZHAO	PRODUCT NUMBER LMO64FH02EN
CHECKER JIAOLAN	PART NAME MODULE
APPROVE YINANLIANG	REVISION NUMBER V02
DATE 2020.05.12	MATERIAL NUMBER

LCD Mall Limited

11 Packing Specification

