LCM Specification

☑Preliminary specification

☐Final Specification

Project No. 项目编号	TFT-H035A3HVIST4C50
Customer 客户名称	
Module No. 客户型号	
Product type 产品内容	TFT LCD Module 320 x 3RGB x 480 Dots 3.5”TFT LCD
Signature by customer: 客户确认签章： ☐Trial production ☐Mass production	

编　　制	电子审核	结构审核	批　　准
Liu.YL			

深圳市鑫洪泰电子科技有限公司

Shenzhen Hot Display Technology Co.,Ltd

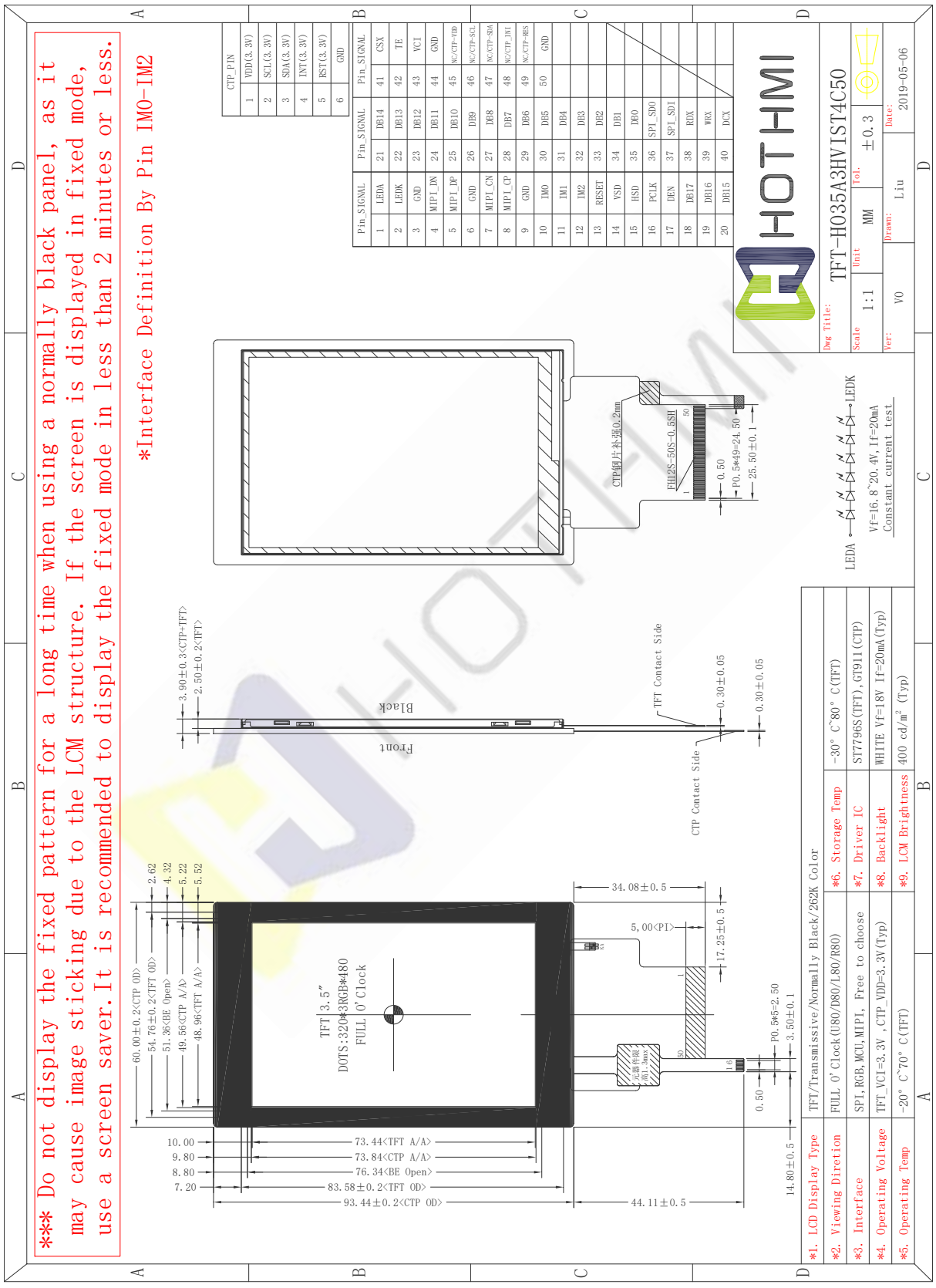
1 Document revision history :

DOCUMENT REVISION	DATE	DESCRIPTION	PREPARED BY	APPROVED BY
0	2019-5-6	First Release.	Liu.YL	

1. General Feature:

Item	Standard Value	Unit
Display Size	3.5”	--
Number of Pixels	320(H)x3(RGB)*480(V)	--
Active Area	48.96(H) *73.44(V)	mm
LCM Outline Dimension	54.76(H) ×83.58× 2.50(V)	mm
Viewing Direction	Full O’Clock	-
LCM Interface	SPI,RGB,MCU,MIPI, Free to choose	-
LCM Driver IC	ST7796S	-
LCM Driver Voltage	VCI=2.8V	V
Backlight	White LED	-
Touch Panel	Cap Touch Panel	-
CTP Driver IC	GT911	-
CTP Driver Voltage	VDD=3.3V	V
CTP I/O Digital Voltage	IOVDD=3.3V	V
Operation Temperature (TFT)	-20 ~+70	℃
Storage Temperature (TFT)	-30 ~+80	℃

2.Outline Dimensions



3. Pin Description

3.1 TFT Pin Description

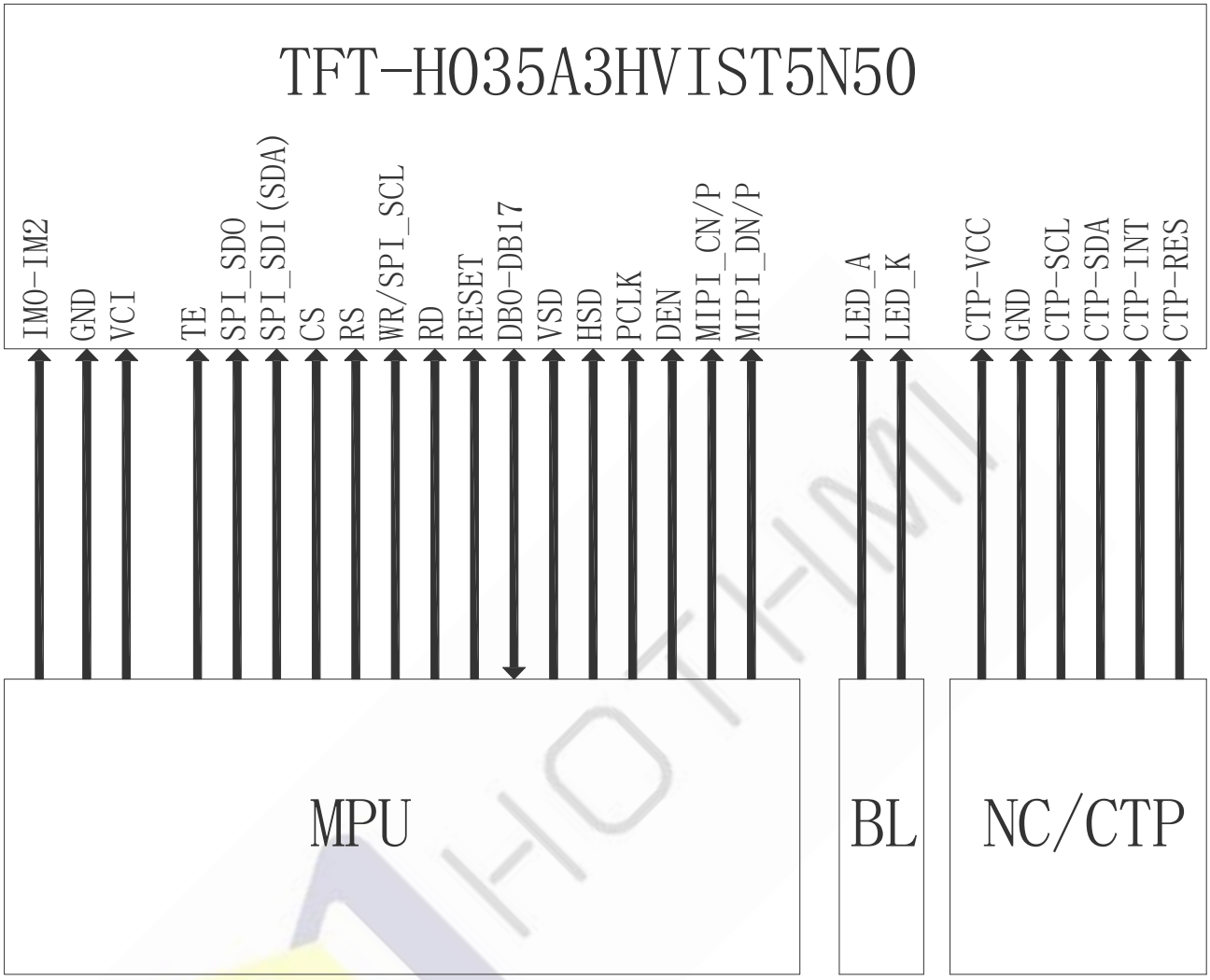
Pin NO.	Symbol	Description
1	LED_A	LED Anode
2	LED_K	LED Cathode
3	GND	Ground
4	MIPI_DN	♦ Positive polarity of low voltage differential data signal ♦ Leave the pin to open when not in use.
5	MIPI_DP	♦ Negative polarity of low voltage differential data signal ♦ Leave the pin to open when not in use.
6	GND	Ground
7	MIPI_CN	♦ Negative polarity of low voltage differential clock signal ♦ Leave the pin to open when not in use.
8	MIPI_CP	♦ Positive polarity of low voltage differential clock signal ♦ Leave the pin to open when not in use.
9	GND	Ground
10-12	IM0-IM2	The MCU interface mode select
13	RESET	LCM Reset Pin.
14	VSD	♦ Vertical synchronizing input signal for RGB interface. ♦ If not used, please fix this pin at GND.
15	HSD	♦ Horizontal synchronizing input signal for RGB interface. ♦ If not used, please fix this pin at GND.
16	PCLK	♦ Dot clock signal for RGB interface. ♦ If not used, please fix this pin at GND.
17	DEN	♦ Data enable signal for RGB interface. ♦ If not used, please fix this pin at GND.
18-35	DB17-DB0	Data Bus. If not used, please fix this pin at GND.
36	SPI_SDO	♦ SPI interface output pin. If not used, let this pin open. ♦ The data is outputted on the falling edge of the SCL signal.
37	SPI_SDI	♦ SPI interface input/output pin. ♦ The data is latched on the rising edge of the SCL signal ♦ If not used, please fix this pin at GND.
38	RDX	♦ Read enable in 8080 MCU parallel IF. Low-active. ♦If not used, please fix this pin at GND.
39	WRX/SPI_SCL	♦ Write enable in MCU parallel interface ♦ In SPI mode, this pin is used as SCL. ♦ If not used, please fix this pin at GND.

Pin NO.	Symbol	Description
40	DCX	♦ Display data/command selection pin in parallel IF. ♦ If not used, please fix this pin at GND.
41	CSX/SPI_CS	♦ Chip select input pin (“Low” enable). ♦ If not used, please fix this pin at GND.
42	TE	♦ Tearing effect signal is used to synchronize MCU to frame memory writing. ♦ If not used, please let this pin open.
43	VCI	Analog Power
44	GND	Ground
45	NC/CTP_VDD	♦ Power supply input for CTP. ♦ If not used, please let this pin open.
46	NC/CTP-SCL	♦ CTP Serial clock signal. ♦ If not used, please let this pin open.
47	NC/CTP-SDA	♦ CTP Serial data input signal. ♦ If not used, please let this pin open.
48	NC/CTP-INT	♦ CTP_External interrupt to the host. ♦ If not used, please let this pin open.
49	NC/CTP-RES	♦ CTP Reset Pin. ♦ If not used, please let this pin open.
50	GND	Ground

3.2 CTP Pin Description

Pin NO.	Symbol	Description
1	VDD	Power supply input for CTP.
2	SCL	CTP Serial clock signal.
3	SDA	CTP Serial data input signal.
4	INT	CTP_External interrupt to the host.
5	RST	CTP Reset Pin.
6	GND	Ground

3.3 Wiring Diagram



*Interface definition by Pin IM0-IM2

The MCU interface mode select				
IM2	IM1	IM0	MCU interface mode	Data Pin
0	0	0	80-18bit parallel I/F	DB[17:0]
0	0	1	80-9bit parallel I/F	DB[8:0]
0	1	0	80-16bit parallel I/F	DB[15:0]
0	1	1	80-8bit parallel I/F	DB[7:0]
1	0	1	3L-SPI	SDA,SDO
1	1	0	MIPI I/F	MIPI_CN/P,MIPI_DN/P
1	1	1	4-line 8bit serial I/F	SDA,SDO

4. Electrical Characteristics

4-1 TFT LCD Module Operating Conditions

Item	Symbol	Condition	Min	Type	Max	Uint
Interface logic circuits	IOVCC	-	1.65	1.80	3.30	V
Analog Power supply	VCI	-	2.50	2.80	3.30	V
TFT Gate on voltage	VGH	-	10.0	-	16.0	V
TFT Gate off voltage	VGL	-	-16.0	-	-10.0	V

4-2 LED back light specification (pera chip)

Item	Symbol	Condition	Min	Type	Max	Uint
Forward voltage	Vt	If=20mA	16.8	18.0	20.4	V
Forward current	Ipn	/1-chip	-	20	-	mA
Luminance(With LCD)	Lv	If=20mA	-	400	-	cd/㎡
Luminous color	White					

4-3 CTP Operating Conditions

Item	Symbol	Condition	Min	Type	Max	Uint
Power Supply Voltages	VDD	-	2.80	-	3.30	V
I/O Digital Voltage	IOVDD	-	1.80	-	3.30	V
Operating Temperature	Topr	-	-10	-	60	℃
Storage Temperature	Tstg	-	-20	-	70	℃

5. OPTICAL SPECIFICATION

5.1 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 (Goniometer 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 . The center of the measuring spot on the Display surface shall stay fixed. The backlight should be operating for 30 minutes prior to measurement.

5.2 Optical Specifications

Parameter		Symbol	Condition	Min.	Typ.	Max.	Unit	Remark
Viewing Angle Range	Horizontal	Θ L	CR>10	-	80	-	Deg.	Note 1
		Θ R		-	80	-	Deg.	
	Vertical	Θ U		-	80	-	Deg.	
		Θ D		-	80	-	Deg.	
Contrast ratio		CR	Θ = 0°	-	700	-		Note2
Color Gamut		CG		-	-	-	%	
White Chromaticity		Wx	Θ = 0°	-	0.309	-		
		Wy		-	0.332	-		
Reproduction of color	Red	Rx		-	0.660	-		Note4 (Based on C Light)
		Ry		-	0.325	-		
	Green	Gx		-	0.277	-		
		Gy		-	0.568	-		
	Blue	Bx		-	0.145	-		
		By		-	0.072	-		
Response Time (Rising + Falling)		Tr+Tf	Θ = 0° Ta= 25℃	-	30	-	ms	Note5
Transmittance		Tr		-	-		%	Note3

Note:

1.Viewing angle is the angle at which the contrast ratio is greater than 10. The viewing angles are determined for the horizontal or 3, 9 o’ clock direction and the vertical or 6, 12 o’ clock direction with respect to the optical axis which is normal to the LCD surface (see FIGURE 1).

2.Contrast measurements shall be made at viewing angle of Θ = 0 and at the center of the LCD surface. Luminance shall be measured with all pixels in the view field set first to white, then to the dark (black)

state . (see FIGUR 1) Luminance Contrast Ratio (CR) is defined mathematically.

$$CR = \frac{\text{Luminance when displaying a white raster}}{\text{Luminance when displaying a black raster}}$$

3.Transmittance is the Value without APF and without CG.

4.The color chromaticity coordinates specified in the above table shall be calculated from the spectral data measured with all pixels first in red, green, blue and white. Measurements shall be made at the center of the panel.

5.The electro-optical response time measurements shall be made as FIGURE 2 by switching the "data" input signal ON and OFF. The times needed for the luminance to change from 10% to 90% is Tr, and 90% to 10% is Tf.

Figure1 Measurement Set Up

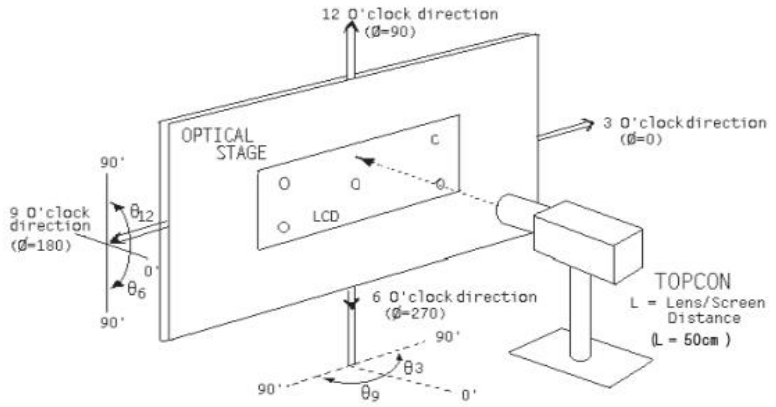
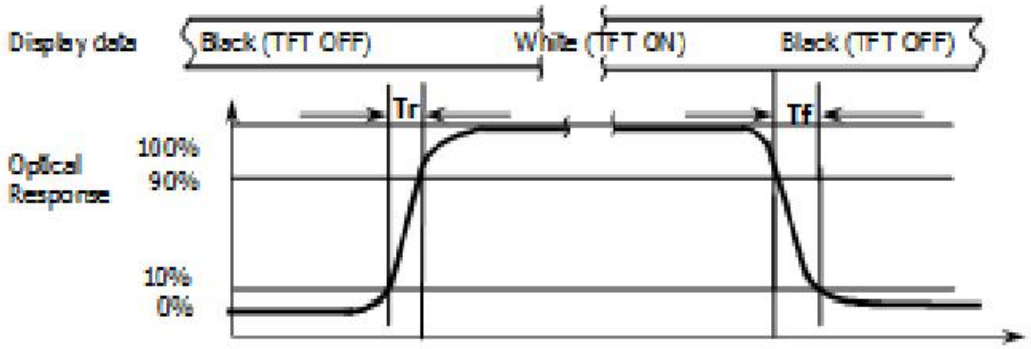


Figure2 Response Time Testing

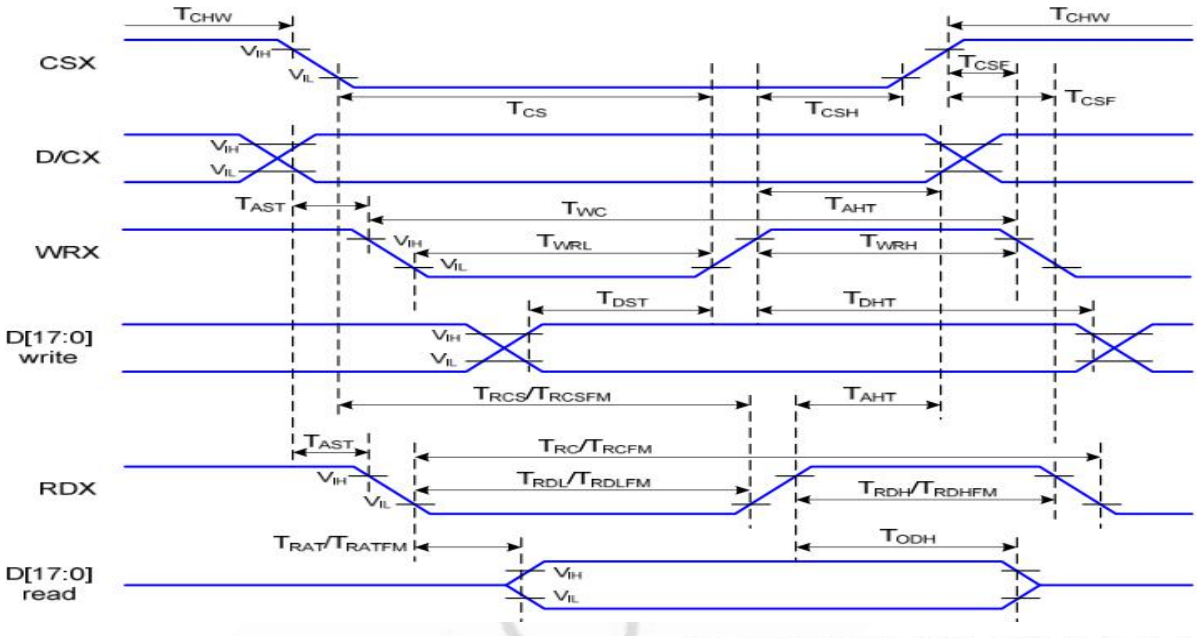


6. Timing Characteristics of Input Signals

6-1 CTP Characteristics

Omitted here, see GT911 specification for details

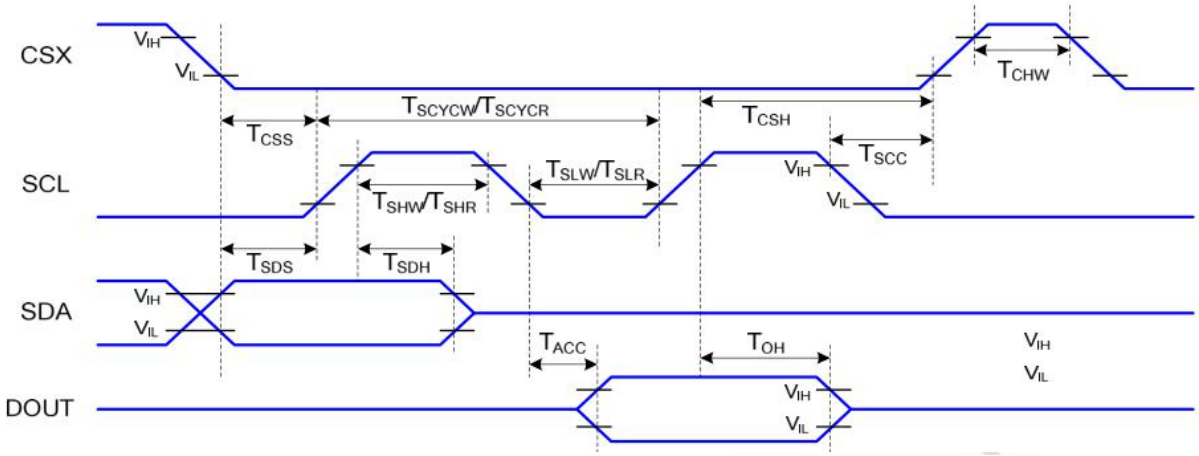
6-2 TFT 8080 Series MCU Parallel Interface Characteristics: 18/16/9/8-bit Bus



VDDI=1.8V,VDDA=2.8V, AGND=DGND=0V, Ta=25 ℃

Signal	Symbol	Parameter	Min	Max	Unit	Description
D/CX	T_{AST}	Address setup time	0		ns	-
	T_{AHT}	Address hold time (Write/Read)	10		ns	
CSX	T_{CHW}	Chip select "H" pulse width	0		ns	-
	T_{CS}	Chip select setup time (Write)	15		ns	
	T_{RCS}	Chip select setup time (Read ID)	45		ns	
	T_{RCSFM}	Chip select setup time (Read FM)	355		ns	
	T_{CSF}	Chip select wait time (Write/Read)	10		ns	
	T_{CSH}	Chip select hold time	10		ns	
WRX	T_{WC}	Write cycle	66		ns	
	T_{WRH}	Control pulse "H" duration	15		ns	
	T_{WRL}	Control pulse "L" duration	15		ns	
RDX (ID)	T_{RC}	Read cycle (ID)	160		ns	When read ID data
	T_{RDH}	Control pulse "H" duration (ID)	90		ns	
	T_{RDL}	Control pulse "L" duration (ID)	45		ns	
RDX (FM)	T_{RCFM}	Read cycle (FM)	450		ns	When read from frame memory
	T_{RDHFM}	Control pulse "H" duration (FM)	90		ns	
	T_{RDLFM}	Control pulse "L" duration (FM)	355		ns	
D[17:0]	T_{DST}	Data setup time	10		ns	For CL=30pF
	T_{DHT}	Data hold time	10		ns	
	T_{RAT}	Read access time (ID)	-	40	ns	
	T_{RATFM}	Read access time (FM)	-	340	ns	
	T_{ODH}	Output disable time	20	80	ns	

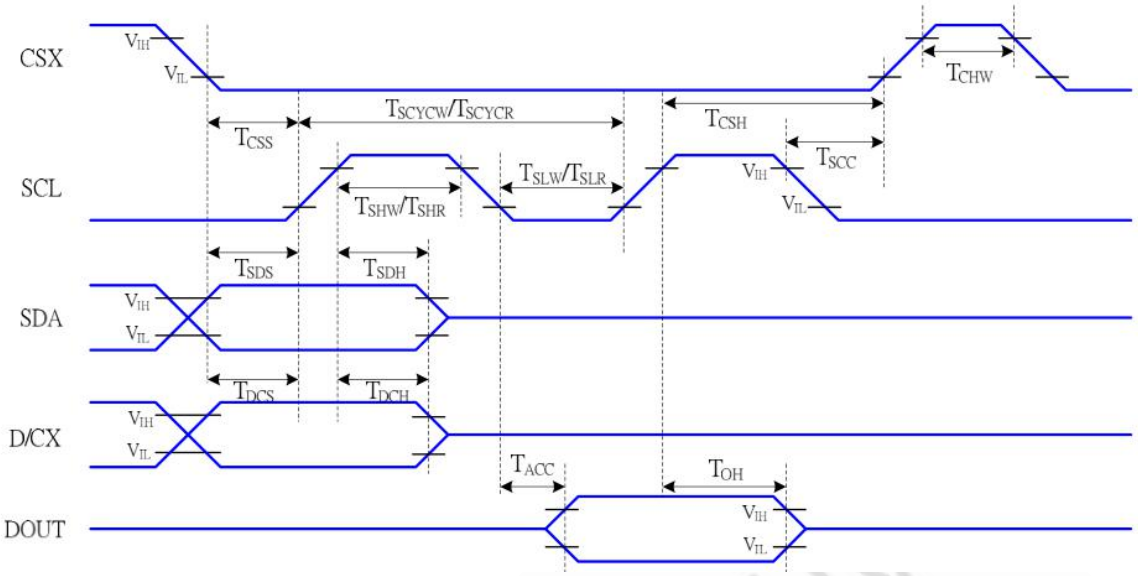
6-3 TFT Serial Interface Characteristics (3-line serial)



VDDI=1.8V,VDDA=2.8V, AGND=DGND=0V, Ta=25 ℃

Signal	Symbol	Parameter	Min	Max	Unit	Description
CSX	T_{CSS}	Chip select setup time (write)	15		ns	
	T_{CSH}	Chip select hold time (write)	15		ns	
	T_{CSS}	Chip select setup time (read)	60		ns	
	T_{SCC}	Chip select hold time (read)	65		ns	
	T_{CHW}	Chip select “H” pulse width	40		ns	
SCL	T_{SCYCW}	Serial clock cycle (Write)	66		ns	
	T_{SHW}	SCL “H” pulse width (Write)	15		ns	
	T_{SLW}	SCL “L” pulse width (Write)	15		ns	
	T_{SCYCR}	Serial clock cycle (Read)	150		ns	
	T_{SHR}	SCL “H” pulse width (Read)	60		ns	
	T_{SLR}	SCL “L” pulse width (Read)	60		ns	
SDA (DIN)	T_{SDS}	Data setup time	10		ns	
	T_{SDH}	Data hold time	10		ns	
DOUT	T_{ACC}	Access time	10	50	ns	For maximum CL=30pF
	T_{OH}	Output disable time	15	50	ns	For minimum CL=8pF

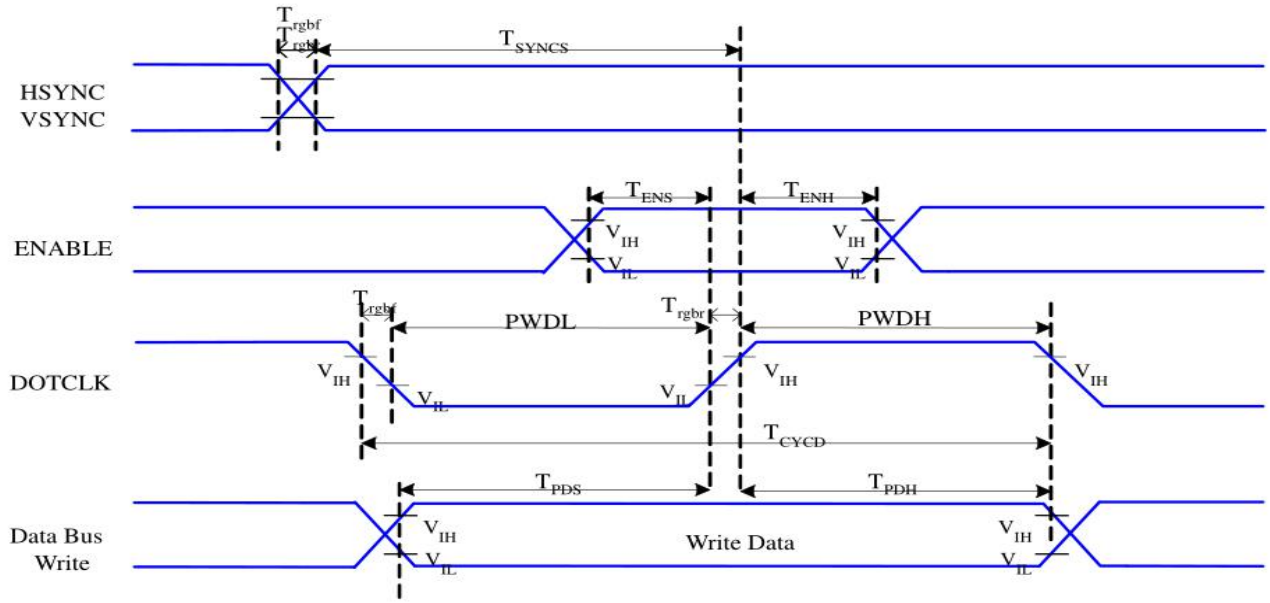
6-4 TFT Serial Interface Characteristics (4-line serial)



VDDI=1.8V,VDDA=2.8V, AGND=DGND=0V, Ta=25 ℃

Signal	Symbol	Parameter	MIN	MAX	Unit	Description
CSX	T_{CSS}	Chip select setup time (write)	15		ns	
	T_{CSH}	Chip select hold time (write)	15		ns	
	T_{CSS}	Chip select setup time (read)	60		ns	
	T_{SCC}	Chip select hold time (read)	65		ns	
	T_{CHW}	Chip select "H" pulse width	40		ns	
SCL	T_{SCYCW}	Serial clock cycle (Write)	66		ns	-write command & data ram
	T_{SHW}	SCL "H" pulse width (Write)	15		ns	
	T_{SLW}	SCL "L" pulse width (Write)	15		ns	
	T_{SCYCR}	Serial clock cycle (Read)	150		ns	-read command & data ram
	T_{SHR}	SCL "H" pulse width (Read)	60		ns	
	T_{SLR}	SCL "L" pulse width (Read)	60		ns	
D/CX	T_{DCS}	D/CX setup time	10		ns	
	T_{DCH}	D/CX hold time	10		ns	
SDA (DIN)	T_{SDS}	Data setup time	10		ns	
	T_{SDH}	Data hold time	10		ns	
DOUT	T_{ACC}	Access time	10	50	ns	For maximum CL=30pF
	T_{OH}	Output disable time	15	50	ns	For minimum CL=8pF

6-5 TFT RGB Interface Characteristics

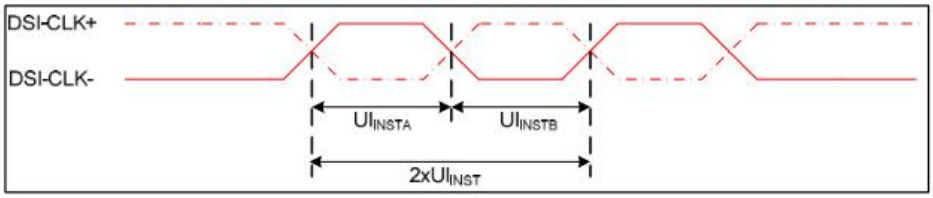


VDDI=1.8V,VDDA=2.8V, AGND=DGND=0V, Ta=25℃

Signal	Symbol	Parameter	MIN	MAX	Unit	Description
HSYNC, VSYNC	T_{SYNCS}	VSYNC, HSYNC Setup Time	15	-	ns	
ENABLE	T_{ENS}	Enable Setup Time	15	-	ns	
	T_{ENH}	Enable Hold Time	15	-	ns	
DOTCLK	PWDH	DOTCLK High-level Pulse Width	30	-	ns	
	PWDL	DOTCLK Low-level Pulse Width	30	-	ns	
	T_{CYCD}	DOTCLK Cycle Time	66	-	ns	
	Trghr, Trghf	DOTCLK Rise/Fall time	-	15	ns	
DB	T_{PDS}	PD Data Setup Time	15	-	ns	
	T_{PDH}	PD Data Hold Time	15	-	ns	

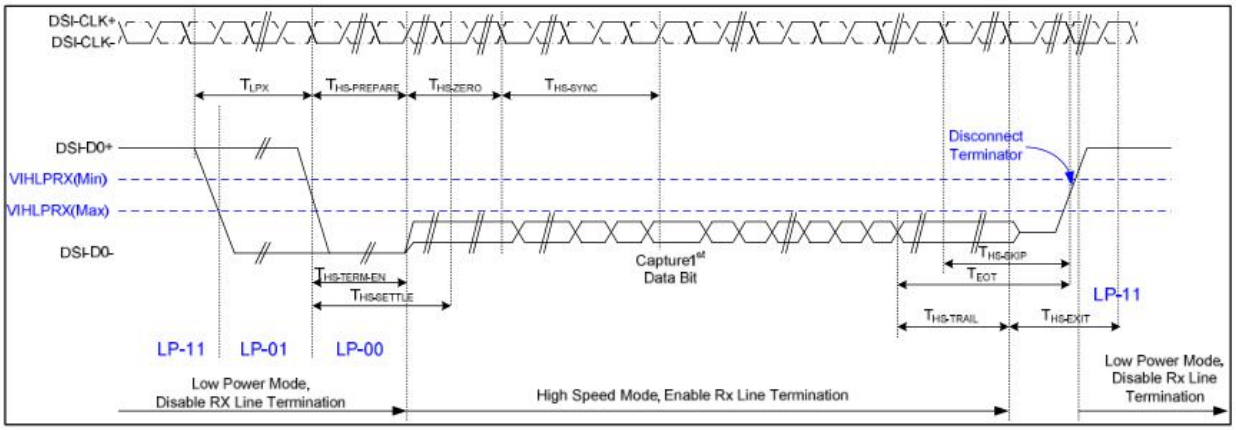
6-6 TFT MIPI Interface Characteristics

High Speed Mode – Clock Channel Timing



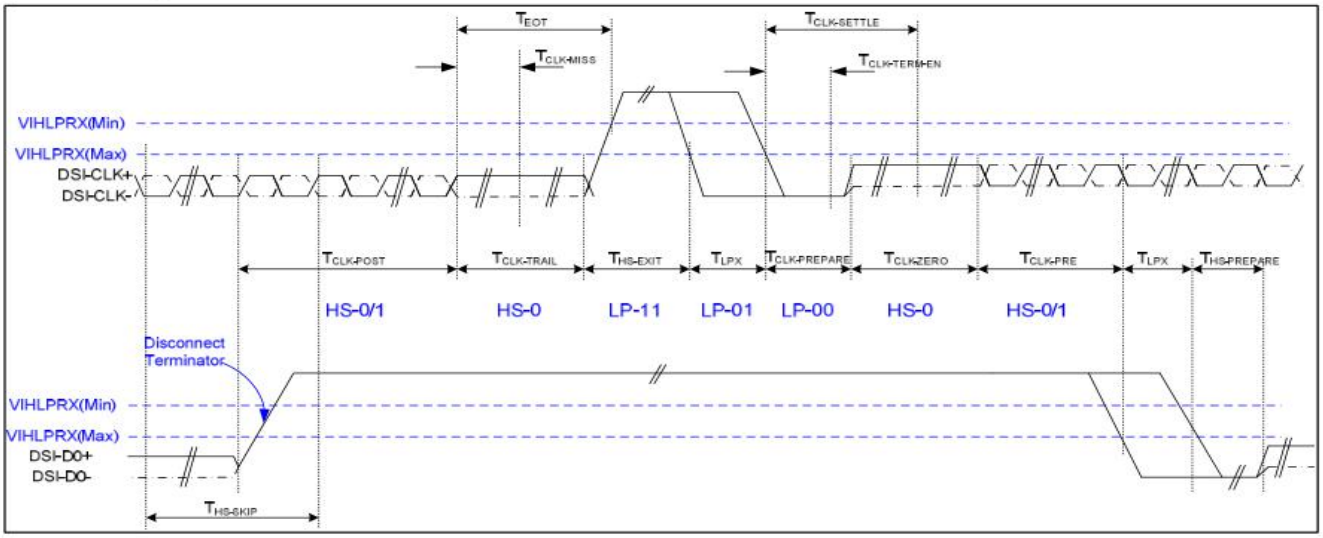
Signal	Symbol	Parameter	MIN	MAX	Unit	Description
DSI-DATA_P/N	2xUI INST	Double UI instantaneous	4	25	ns	
DSI-DATA_P/N	UI INSTA ,UI INSTB	UI instantaneous Half	2	12.5	ns	

High-Speed Data Transmission



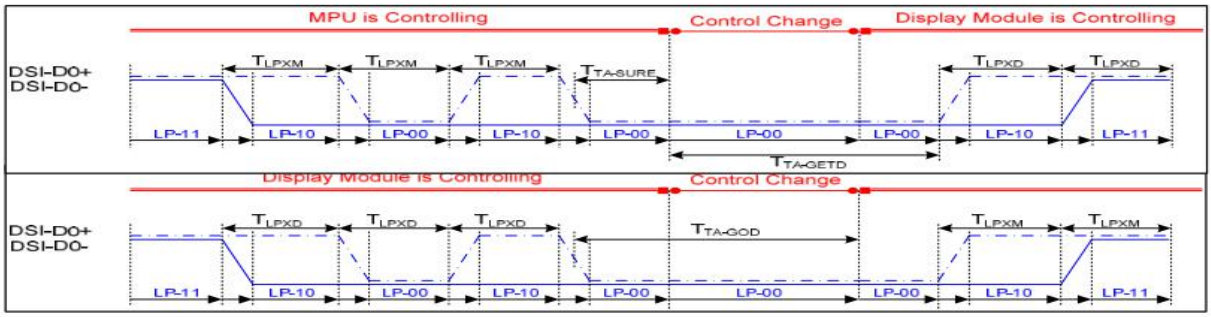
Parameter	Symbol	MIN	TYP	MAX	Unit
Time to drive LP-00 to prepare for HS transmission	$T_{HS-PREPARE}$	40+4UI		85+6UI	ns
Time from start of t HS-TRAIL or t CLK-TRAIL period to start of LP-11 state	T_{EOT}			105+12UI	ns
Time to enable data receiver line termination measured from when Dn crosses VILMAX	$T_{HS-TERM-EN}$			35+4UI	ns
Time to drive flipped differential state after last payload data bit of a HS transmission	$T_{HS-TRAIL}$	60+4UI			ns
Time-out at RX to ignore transition period of EoT	$T_{HS-SKIP}$	40		55+4UI	ns
Time to drive LP-11 after HS burst	$T_{HS-EXIT}$	100			ns
Length of any Low-Power state period	T_{LPX}	50			ns
Sync sequence period	$T_{HS-SYNC}$		8UI		ns
Minimum lead HS-0 drive period before the Sync sequence	$T_{HS-ZERO}$	105+6UI			ns

Switching the Clock Lane between Clock Transmission and Low-Power Mode



Parameter	Symbol	MIN	TYP	MAX	Unit
Time that the transmitter shall continue sending HS clock after the last associated Data Lane has transitioned to LP mode	$T_{CLK-POST}$	60+52UI			ns
Detection time that the clock has stopped toggling	$T_{CLK-MISS}$			60	ns
Time to drive LP-00 to prepare for HS clock transmission	$T_{CLK-PREPARE}$	38		95	ns
Minimum lead HS-0 drive period before starting Clock	$T_{CLK-PREPARE}$ +$T_{CLK-ZERO}$	300			ns
Time to enable Clock Lane receiver line termination measured from when Dn cross VIL,MAX	$T_{HS-TERM-EN}$			38	ns
Minimum time that the HS clock must be set prior to any associated date lane beginning the transmission from LP to HS mode	$T_{CLK-PRE}$	8			UI
Time to drive HS differential state after last payload clock bit of a HS transmission burst	$T_{CLK-TRAIL}$	60			ns

Bus Turnaround Procedure



Parameter	Symbol	MIN	TYP	MAX	Unit
Length of any Low-Power state period : Master side	T_{LPX}	50		75	ns
Length of any Low-Power state period : Slave side	T_{LPX}	47.5	50	52.5	ns
Ratio of T_{LPX} (MASTER)/ T_{LPX} (SLAVE) between Master and Slave side	Ratio T_{LPX}	2/3		3/2	
Time-out before new TX side start driving	$T_{TA-SURE}$	T_{LPX}		2 T_{LPX}	ns
Time to drive LP-00 by new TX	T_{TA-GET}		5 T_{LPX}		ns
Time to drive LP-00 after Turnaround Request	T_{TA-GO}		4 T_{LPX}		ns

7. RELIABILITY TEST

7-1 Temperature and Humidity

Test Item	Test Condition	Check Time
High Temp Storage	Ta= 80℃	240 hrs
Low Temp Storage	Ta= -30℃	240 hrs
High Temp Operation	Ta= 70℃	240 hrs
Low Temp Operation	Ta= -20℃	240 hrs
High Temp & High Humidity Operation	Ta=60℃ H=90%RH	240 hrs

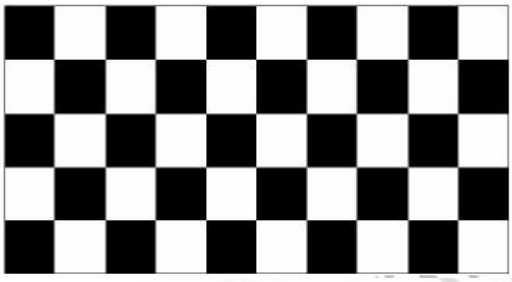
Note: (1) Ta : Ambient temperature

(2) All judgments of display are performed after temp of panel returns to room temperature

(3) Display function should be no change under normal operating condition.

(4)Under no condensation of dew

(5)LCD only guarantee the above 5 test items. INX wouldn’t guarantee the others not shown as the above ones..



(a) Test Pattern (chess board Pattern)

(b) Gray Pattern

7-2 Shock and Vibration

ITEMS	CONDITIONS
Packing Shock (Non-Operation)	● Shock level:980m/s^2 ● Waveform:1/2 Sine wave,6msec ● ±X, ±Y ±Z,each axis 1 times
Packing Vibration (Non-Operation)	● Frequency range:8-33.3HZ ● Stoke:1.0mm ● Sweep: 10Hz-50Hz ● x,y,z 2 hours for each direction

7-3 Electrostatic Discharge

TEST ITEM	CONDITIONS
ESD (Non-operation)	150pF,330Ω， Contact±4KV,Air :±8KV.Note 1
	200pF,0Ω， ±200V Contact test.Note 2

Note:Measure Point:

1.LCD glass and metal bezel

2.IF connector pins

8.HANDDLING & CAUTIONS

8-1 Caution For Operation

♦Since the LCM 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 maybe broken.

♦It is indispensable to drive the LCM within the specified voltage limit since the higher voltage than the limit causes LCM's life shorter. An electro-chemical reaction due to DC causes undesirable deterioration of the LCM so that the use of DC drive should avoid.

♦Do not connect or disconnect the LCM to or from the system when power is on.

♦Never use the LCM under abnormal conditions of high temperature and high humidity.

♦When expose to drastic fluctuation of temperature(hot to cold or cold to hot), the LCM may be affected; specifically, drastic temperature fluctuation from cold to hot, produces dew on the LCM's surface which may affect the operation of the polarizer on the LCM.

♦Response time will be extremely delay at lower temperature than the operating temperature range and on the other hand LCM may turn black at temperature above its operational range. However those phenomenon do not mean malfunction or out of order with the LCM. The LCM 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 when using a normally black panel, as it may cause image sticking due to the LCM structure. If the screen is displayed in fixed mode, use a screen saver.It is recommended to display the fixed mode in less than 2 minutes or less.

♦Do not disassemble and/or re-assemble LCM module

7-2 Caution Against Static Charge

♦The LCM 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 LCM, wear non-charged material gloves. And the conducting wrist to the earth and the conducting shoes to the earth are necessary

9.LCD display initialization code

```
Void ST7796Spanelinitialcode(void)
{    //(MCU initial code)
     RST=1;
     Delay(200);
     RST=0;
     Delay(800);
     RST=1;
     Delay(800);

     Delay(120);    // Delay 120ms
     WriteComm(0x11); // Sleep Out
     Delay(120);     // Delay 120ms
     WriteComm(0xf0) ;
     WriteData(0xc3) ;

     WriteComm(0xf0) ;
     WriteData(0x96) ;

     WriteComm(0x36);
     WriteData(0x48);       //48 （左上角起始，右下角结束）IC在下,正常显示0度 X=320,Y=480
                            //28（右上角起始，左下角结束）IC在下 90度     X=480,Y=320
                            //E8 (左下角起始，右上角结束）IC在下 270度 X=480,Y=320
     WriteComm(0x3A);
     WriteData(0x55);

     WriteComm(0xB4);
     WriteData(0x01);

     WriteComm(0xB7) ;
     WriteData(0xC6) ;

     WriteComm(0xe8);
     WriteData(0x40);
     WriteData(0x8a);
     WriteData(0x00);
     WriteData(0x00);
     WriteData(0x29);
     WriteData(0x19);
```

```
WriteData(0xa5);
WriteData(0x33);

WriteComm(0xc2);
WriteData(0xa7);

WriteComm(0xc5);
WriteData(0x19);

WriteComm(0xe0); //Positive Voltage Gamma Control
WriteData(0xf0);
WriteData(0x00);
WriteData(0x08);
WriteData(0x0e);
WriteData(0x0d);
WriteData(0x1a);
WriteData(0x37);
WriteData(0x54);
WriteData(0x47);
WriteData(0x2b);
WriteData(0x16);
WriteData(0x15);
WriteData(0x1a);
WriteData(0x1d);

WriteComm(0xe1); //Negative Voltage Gamma Control
WriteData(0xf0);
WriteData(0x02);
WriteData(0x06);
WriteData(0x0c);
WriteData(0x0e);
WriteData(0x29);
WriteData(0x34);
WriteData(0x44);
WriteData(0x47);
WriteData(0x2b);
WriteData(0x17);
WriteData(0x16);
WriteData(0x19);
WriteData(0x1d);
```

```
    WriteComm(0xf0);
    WriteData(0x3c);
    WriteComm(0xf0);
    WriteData(0x69);

    //WriteComm(0x21); //Display ON

    Delay(120);     //Delay 120ms
    WriteComm(0x29); //Display ON
    Delay(120);
}



Void ST7796SPanelSleepInMode (void)
{
Write command 0x10;
Delayms (120);
}
Void ST7796SPanelSleepOutMode (void)
{
Write command 0x11;
Delayms (120);
}
```

- - - END - - -