

# LCM Specification

Preliminary specification

Final Specification

Project No. 项目编号	TFT-H021A1HQIST4C40		
Customer 客户名称			
Module No. 客户型号			
Product type 产品内容	TFT LCD Module 480 x 3RGB x 480Dots 2.1" TFT LCD		
Signature by customer: 客户确认签章:			
<input type="checkbox"/> Trial production <input type="checkbox"/> 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

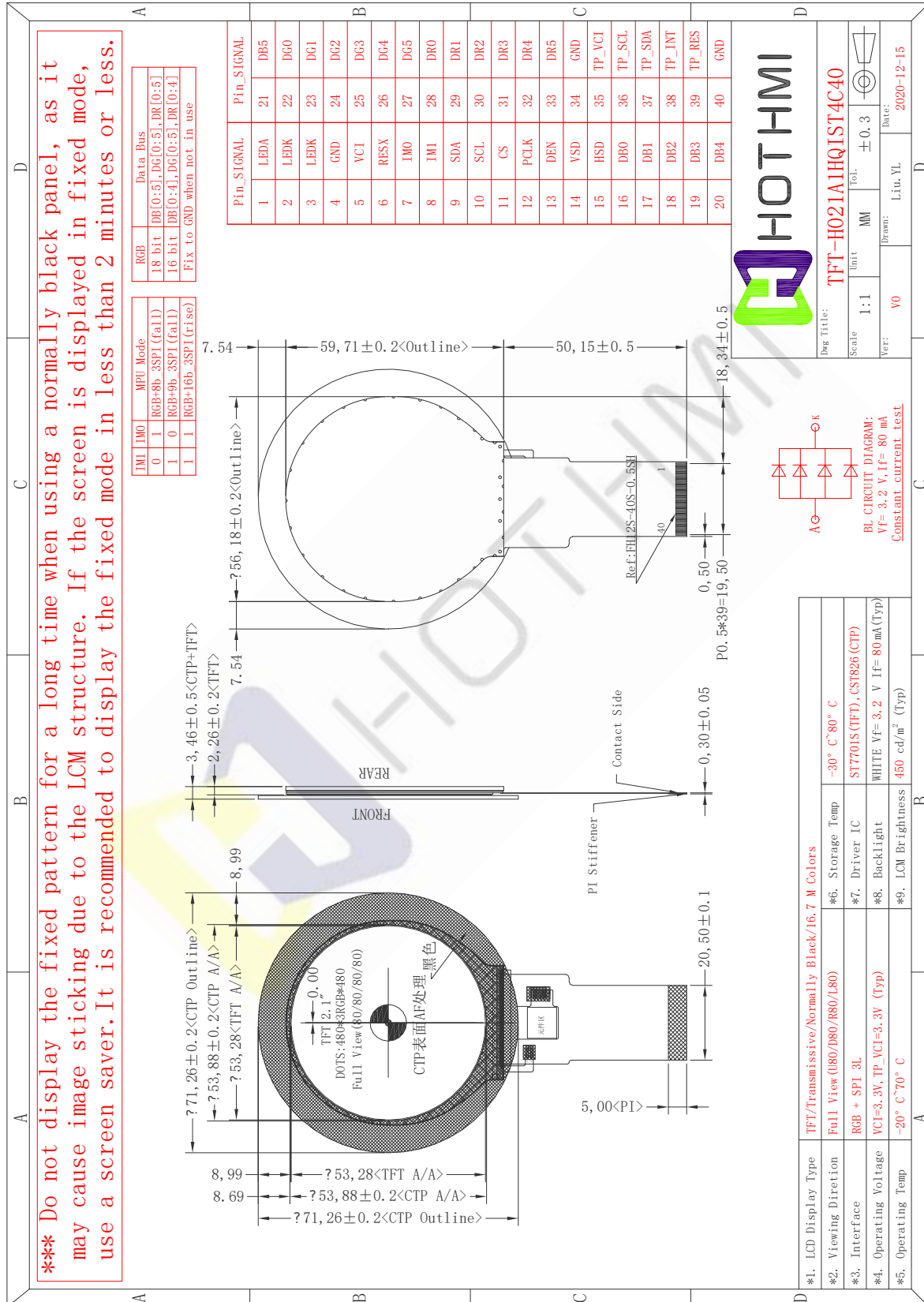
**1 Document revision history :**

DOCUMENT REVISION	DATE	DESCRIPTION	PREPARED BY	APPROVED BY
0	2020-12-15	First Release.	Liu.YL	

## 1. General Feature:

Item	Standard Value	Unit
Display Size	2.1"	--
Number of Pixels	480(H)x3(RGB)*480(V)	--
Active Area	Φ53.28(H) *Φ53.28(V)	mm
LCM Outline Dimension	Φ71.26(H) ×Φ71.26(V)× 3.46(D)	mm
Viewing Direction	Full O'clock	-
LCM Interface	RGB+3 SPI	-
LCM Driver IC	ST7701S	-
Display colors	16.7M	-
LCM Driver Voltage	IOVCC=1.8V,VCI=3.3V (Typ)	V
Backlight	White LED	-
Touch Panel	CTP Touch Panel	-
CTP Driver IC	CST826	-
CTP Driver Voltage	3.3	V
CTP I/O Digital Voltage	3.3	V
Operation Temperature	-20~70	°C
Storage Temperature	-30~80	°C

## 2. Outline Dimensions



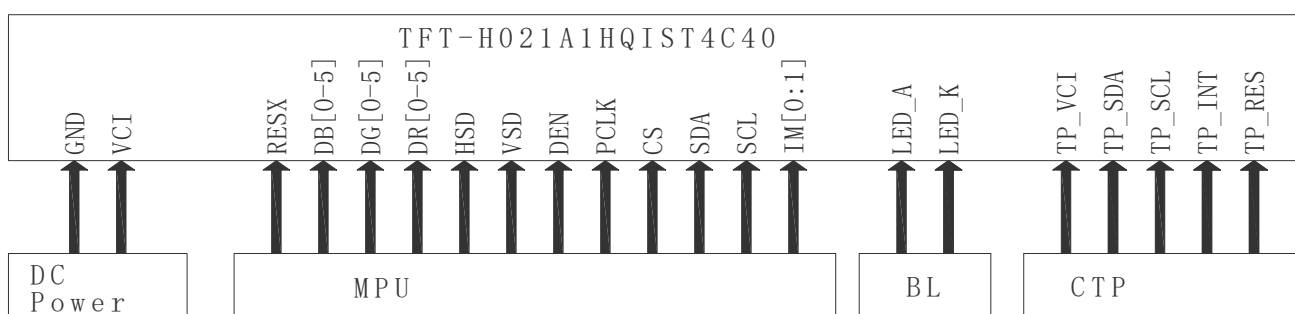
### 3. Pin Description

#### 3.1 Pin Description

Pin NO.	Symbol	Description
1	LED_A	LED Anode
2,3	LED_K	LED Cathode
4	GND	Ground
5	VCI	Analog Power
6	RESX	TFT Reset Pin
7	IM0	The System interface mode select
8	IM1	The System interface mode select
9	SDA	Serial data input/output bidirectional pin
10	SCL	Serial clock input
11	CS	A chip select signal
12	PCLK	Dot clock signal for RGB interface operation
13	DEN	Data enable signal for RGB interface operation
14	VSD	Frame synchronizing signal for RGB interface operation
15	HSD	Line synchronizing signal for RGB interface operation
16-21	DB0-DB5	Data bus
22-27	DG0-DG5	Data bus
28-33	DR0-DR5	Data bus
34	GND	Ground
35	TP_VCI	Touch Power supply
36	TP_SCL	Touch IIC Clock signal
37	TP_SDA	Touch IIC Data signal
38	TP_INT	Touch Interrupt
39	TP_RES	Touch Reset Signal
40	GND	Ground

---END---

#### 3.2 Wiring Diagram



## 4. Electrical Characteristics

### 4-1 TFT LCD Module Operating Conditions

Item	Symbol	Condition	Min	Type	Max	Unit
Interface logic circuits	IOVCC	-	1.65	1.80	3.60	V
Analog Power supply	VCI	-	2.60	2.80	3.60	V
TFT Gate on voltage	VGH	-	10.0	12.0	16.0	V
TFT Gate off voltage	VGL	-	-15.0	-12.0	-10.0	V

### 4-2 LED back light specification (pera chip)

Item	Symbol	Condition	Min	Type	Max	Unit
Forward voltage	Vt	If=20mA	2.8	3.2	3.6	V
Forward current	Ipn	/1-chip	-	80	-	mA
Luminance(With LCD)	Lv	If=40mA	350	450	550	cd/m <sup>2</sup>
Luminous color	White					

**NOTE:Constant current test**

### 4-3 CTP Operating Conditions

Item	Symbol	Condition	Min	Type	Max	Unit
Power Supply Voltages	VDD	-	2.50	2.80	3.60	V
I/O Digital Voltage	IOVDD	-	-	2.80	-	V
Operating Temperature	Topr	-	-20	-	70	°C
Storage Temperature	Tstg	-	-30	-	80	°C

## 4. OPTICAL SPECIFICATION

### 4.1 Overview

The test of Optical specifications shall be measured in a dark room (ambient luminance 1lux and temperature = 25 ± 2°C) 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  $\theta$  and  $\Phi$  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.

### 4.2 Optical Specifications

Parameter		Symbol	Condition	Min.	Typ.	Max.	Unit	Remark
Viewing Angle Range	Horizontal	$\Theta$ L	CR>10	-	80	-	Deg.	Note 1
		$\Theta$ R		-	80	-	Deg.	
	Vertical	$\Theta$ U		-	80	-	Deg.	
		$\Theta$ D		-	80	-	Deg.	
Contrast ratio		CR	$\Theta = 0^\circ$	800	1000	-		Note2
Color Gamut		CG		64	69	-	%	
White Chromaticity		Wx		-	0.300	-		
		Wy		-	0.326	-		
Reproduction of color	Red	Rx	$\Theta = 0^\circ$	-	0.655	-		Note4 (Based on C Light)
		Ry		-	0.327	-		
	Green	Gx		-	0.284	-		
		Gy		-	0.594	-		
	Blue	Bx		-	0.138	-		
		By		-	0.111	-		
Response Time (Rising + Falling)		Tr+Tf	$\Theta = 0^\circ$ Ta= 25°C	-	30	35	ms	Note5
Transmittance		Tr		-	4.0		%	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  $\Theta = 0$  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.

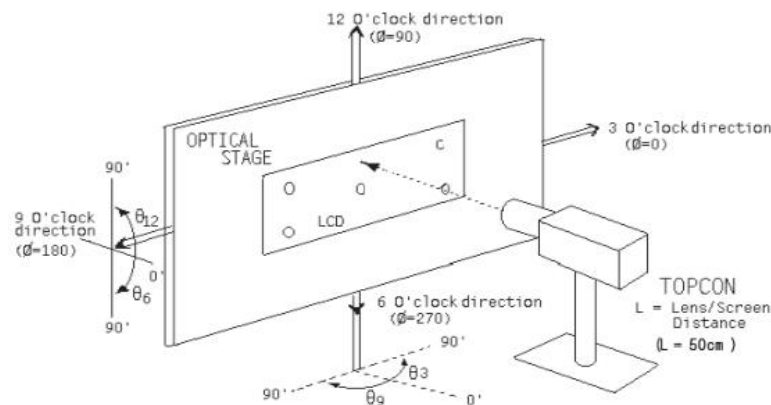
$$CR = \frac{\text{Luminance when displaying a white raster}}{\text{Luminance when displaying a black raster}}$$

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

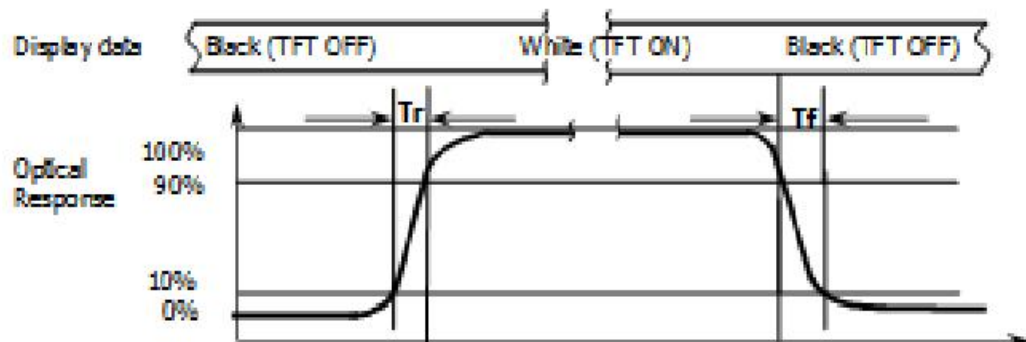
4. The color chromaticity coordinates specified in the above table shall be calculated from the spectral data measured with all pixels first in red, green, blue and white. Measurements shall be made at the center of the panel.

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  $T_r$ , and 90% to 10% is  $T_f$ .

**Figure1 Measurement Set Up**



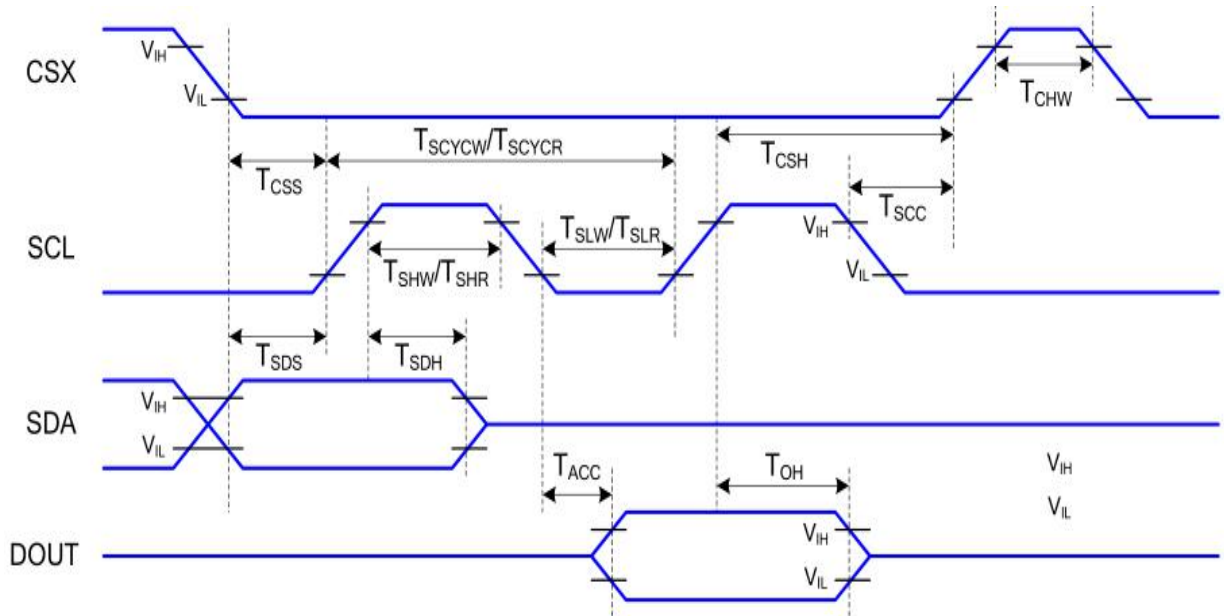
**Figure2 Response Time Testing**





## 6. Timing Characteristics of Input Signals

### 6-1 Serial Interface Characteristics

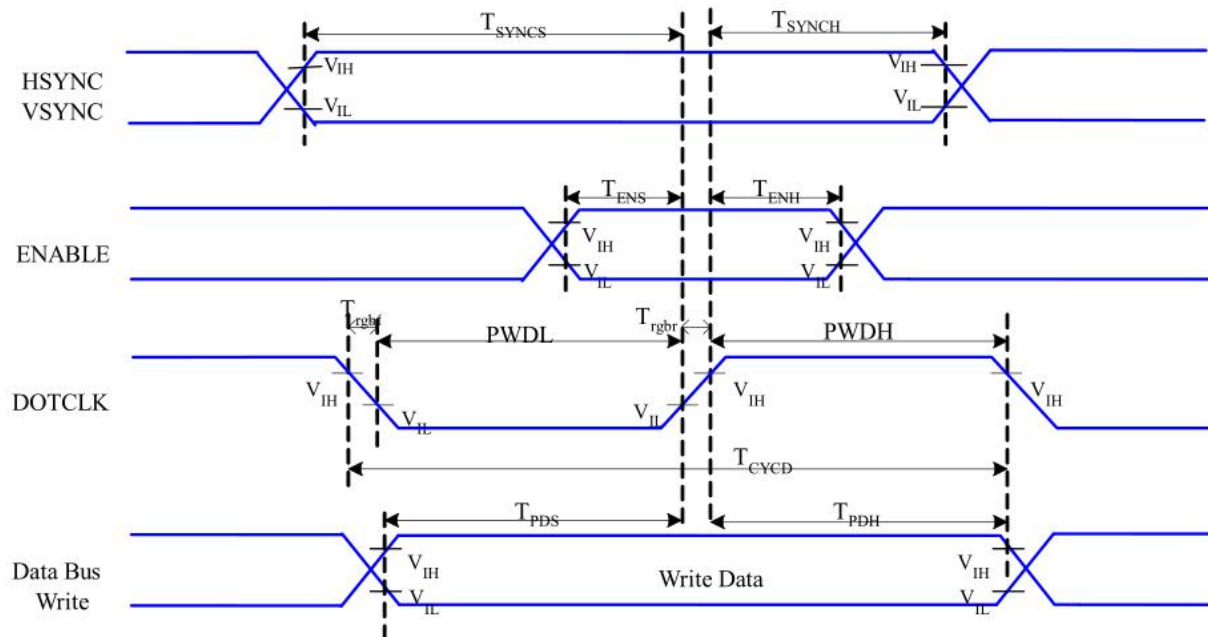


VDDI=1.8, VDD=2.8, AGND=DGND=0V, Ta=25°C

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)	60		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	

Note : The rising time and falling time ( $T_r$ ,  $T_f$ ) of input signal are specified at 15 ns or less. Logic high and low levels are specified as 30% and 70% of VDDI for Input signals.

## 6-2 RGB Interface Characteristics



VDDI=1.8, VDD=2.8, AGND=DGND=0V, Ta=25 °C

Signal	Symbol	Parameter	MIN	MAX	Unit	Description
HSYNC, VSYNC	$T_{SYNCS}$	VSYNC, HSYNC Setup Time	5	-	ns	
ENABLE	$T_{ENS}$	Enable Setup Time	5	-	ns	
	$T_{ENH}$	Enable Hold Time	5	-	ns	
DOTCLK	PWDH	DOTCLK High-level Pulse Width	15	-	ns	
	PWDL	DOTCLK Low-level Pulse Width	15	-	ns	
	$T_{CYCD}$	DOTCLK Cycle Time	33	-	ns	
	Trghr, Trghf	DOTCLK Rise/Fall time	-	15	ns	
DB	$T_{PDS}$	PD Data Setup Time	5	-	ns	
	$T_{PDH}$	PD Data Hold Time	5	-	ns	

Parameter	Symbol	Min.	Typ.	Max.	Unit
Horizontal Sync. Width	hpw	1	-	255	Clock
Horizontal Sync. Back Porch	hbp	1	--	255	Clock
Horizontal Sync. Front Porch	hfp	1	--	-	Clock
Vertical Sync. Width	vs	1	--	254	Line
Vertical Sync. Back Porch	vbp	1	--	254	Line
Vertical Sync. Front Porch	vfp	2	--	--	Line

Note1: Typical value are related to the setting frame rate is 60Hz.

## 7. RELIABILITY TEST

### 7-1 Temperature and Humidity

Test Item	Test Condition	Check Time
High Temp Storage	Ta= 80°C	120 hrs
Low Temp Storage	Ta= -30°C	120 hrs
High Temp Operation	Ta= 70°C	120 hrs
Low Temp Operation	Ta= -20°C	120 hrs
High Temp & High Humidity Operation	Ta=60°C H=90%RH	120 hrs

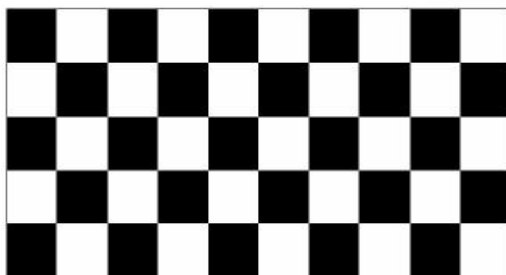
Note: (1) Ta : Ambient temperature

(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)\*INX 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)	<ul style="list-style-type: none"> <li>● Shock level:980m/s<sup>2</sup></li> <li>● Waveform:1/2 Sine wave,6msec</li> <li>● ±X, ±Y ±Z,each axis 1 times</li> </ul>
Packing Vibration (Non-Operation)	<ul style="list-style-type: none"> <li>● Frequency range:8-33.3HZ</li> <li>● Stoke:1.0mm</li> <li>● Sweep: 10Hz-50Hz</li> <li>● x,y,z 2 hours for each direction</li> </ul>

### 7-3 Electrostatic Discharge

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

```
/*
//Our test board parameters are for reference only(C8051F340+SSD1963)
//480*480
#define HDP COL-1 //Hsync Display period
#define VDP ROW-1 //Vertical Display period

#define HT 530 //Horizontal total period = (HT + 1) pixels
#define HPS 53 //Horizontal Sync Pulse Start Position = (HPS + 1) pixels
#define LPS 18 //Horizontal Display Period Start Position = LPS pixels
#define HPW 30 //Horizontal Sync Pulse Width = (HPW + 1) pixels

#define VT 800 //Vertical Total = (VT + 1) lines
#define VPS 22 //Vertical Sync Pulse Start Position = VPS lines
#define FPS 10 //Vertical Display Period Start Position = FPS lines
#define VPW 1 //Vertical Sync Pulse Width = (VPW + 1) lines
*/
//Frame Rate:60Hz
Void Panel_initial_code(void)
{
    SPI_CS=0;
    SPI_RES=1;
    Delays (100);
    SPI_RES=0;
    Delays (1000);
    SPI_RES=1;
    Delays (1000);

    SPI_WriteComm(0xFF);
    SPI_WriteData(0x77);
    SPI_WriteData(0x01);
    SPI_WriteData(0x00);
    SPI_WriteData(0x00);
    SPI_WriteData(0x10);

    SPI_WriteComm(0xC0);
    SPI_WriteData(0x3B);
    SPI_WriteData(0x00);
```

```
SPI_WriteComm(0xC1);  
SPI_WriteData(0x0B); //VBP  
SPI_WriteData(0x02);
```

```
SPI_WriteComm(0xC2);  
SPI_WriteData(0x00);  
SPI_WriteData(0x02);
```

```
SPI_WriteComm(0xCC);  
SPI_WriteData(0x10);
```

```
SPI_WriteComm(0xCD);  
SPI_WriteData(0x00);
```

```
SPI_WriteComm ( 0xB0); //Positive Voltage Gamma Control  
SPI_WriteData ( 0x02);  
SPI_WriteData ( 0x13);  
SPI_WriteData ( 0x1B);  
SPI_WriteData ( 0x0D);  
SPI_WriteData ( 0x10);  
SPI_WriteData ( 0x05);  
SPI_WriteData ( 0x08);  
SPI_WriteData ( 0x07);  
SPI_WriteData ( 0x07);  
SPI_WriteData ( 0x24);  
SPI_WriteData ( 0x04);  
SPI_WriteData ( 0x11);  
SPI_WriteData ( 0x0E);  
SPI_WriteData ( 0x2C);  
SPI_WriteData ( 0x33);  
SPI_WriteData ( 0x1D);
```

```
SPI_WriteComm ( 0xB1); //Negative Voltage Gamma Control  
SPI_WriteData ( 0x05);  
SPI_WriteData ( 0x13);  
SPI_WriteData ( 0x1B);  
SPI_WriteData ( 0x0D);  
SPI_WriteData ( 0x11);  
SPI_WriteData ( 0x05);  
SPI_WriteData ( 0x08);
```

```
SPI_WriteData ( 0x07);  
SPI_WriteData ( 0x07);  
SPI_WriteData ( 0x24);  
SPI_WriteData ( 0x04);  
SPI_WriteData ( 0x11);  
SPI_WriteData ( 0x0E);  
SPI_WriteData ( 0x2C);  
SPI_WriteData ( 0x33);  
SPI_WriteData ( 0x1D);
```

```
SPI_WriteComm(0xFF);  
SPI_WriteData(0x77);  
SPI_WriteData(0x01);  
SPI_WriteData(0x00);  
SPI_WriteData(0x00);  
SPI_WriteData(0x11);
```

```
SPI_WriteComm(0xB0);  
SPI_WriteData(0x5d);//5d
```

```
SPI_WriteComm(0xB1); //VCOM amplitude setting  
SPI_WriteData(0x43);
```

```
SPI_WriteComm(0xB2); //VGH Voltage setting  
SPI_WriteData(0x81);
```

```
SPI_WriteComm(0xB3);  
SPI_WriteData(0x80);
```

```
SPI_WriteComm(0xB5); //VGL Voltage setting  
SPI_WriteData(0x43);
```

```
SPI_WriteComm(0xB7);  
SPI_WriteData(0x85);
```

```
SPI_WriteComm(0xB8);  
SPI_WriteData(0x20);
```

```
SPI_WriteComm(0xC1);  
SPI_WriteData(0x78);
```

```
SPI_WriteComm(0xC2);  
SPI_WriteData(0x78);
```

```
SPI_WriteComm(0xD0);  
SPI_WriteData(0x88);
```

```
SPI_WriteComm(0xE0);  
SPI_WriteData(0x00);  
SPI_WriteData(0x00);  
SPI_WriteData(0x02);
```

```
SPI_WriteComm(0xE1);  
SPI_WriteData(0x03);  
SPI_WriteData(0xA0);  
SPI_WriteData(0x00);  
SPI_WriteData(0x00);  
SPI_WriteData(0x04);  
SPI_WriteData(0xA0);  
SPI_WriteData(0x00);  
SPI_WriteData(0x00);  
SPI_WriteData(0x00);  
SPI_WriteData(0x00);  
SPI_WriteData(0x20);  
SPI_WriteData(0x20);
```

```
SPI_WriteComm(0xE2);  
SPI_WriteData(0x00);  
SPI_WriteData(0x00);  
SPI_WriteData(0x00);  
SPI_WriteData(0x00);  
SPI_WriteData(0x00);  
SPI_WriteData(0x00);  
SPI_WriteData(0x00);  
SPI_WriteData(0x00);  
SPI_WriteData(0x00);  
SPI_WriteData(0x00);  
SPI_WriteData(0x00);  
SPI_WriteData(0x00);  
SPI_WriteData(0x00);  
SPI_WriteData(0x00);
```



```
SPI_WriteComm(0xE3);  
SPI_WriteData(0x00);  
SPI_WriteData(0x00);  
SPI_WriteData(0x11);  
SPI_WriteData(0x00);
```

```
SPI_WriteComm(0xE4);  
SPI_WriteData(0x22);  
SPI_WriteData(0x00);
```

```
SPI_WriteComm(0xE5);  
SPI_WriteData(0x05);  
SPI_WriteData(0xEC);  
SPI_WriteData(0xA0);  
SPI_WriteData(0xA0);  
SPI_WriteData(0x07);  
SPI_WriteData(0xEE);  
SPI_WriteData(0xA0);  
SPI_WriteData(0xA0);  
SPI_WriteData(0x00);  
SPI_WriteData(0x00);  
SPI_WriteData(0x00);  
SPI_WriteData(0x00);  
SPI_WriteData(0x00);  
SPI_WriteData(0x00);  
SPI_WriteData(0x00);  
SPI_WriteData(0x00);  
SPI_WriteData(0x00);
```

```
SPI_WriteComm(0xE6);  
SPI_WriteData(0x00);  
SPI_WriteData(0x00);  
SPI_WriteData(0x11);  
SPI_WriteData(0x00);
```

```
SPI_WriteComm(0xE7);  
SPI_WriteData(0x22);  
SPI_WriteData(0x00);
```

```
SPI_WriteComm(0xE8);  
SPI_WriteData(0x06);
```

```
SPI_WriteData(0xED);  
SPI_WriteData(0xA0);  
SPI_WriteData(0xA0);  
SPI_WriteData(0x08);  
SPI_WriteData(0xEF);  
SPI_WriteData(0xA0);  
SPI_WriteData(0xA0);  
SPI_WriteData(0x00);  
SPI_WriteData(0x00);  
SPI_WriteData(0x00);  
SPI_WriteData(0x00);  
SPI_WriteData(0x00);  
SPI_WriteData(0x00);  
SPI_WriteData(0x00);  
SPI_WriteData(0x00);
```

```
SPI_WriteComm(0xEB);  
SPI_WriteData(0x00);  
SPI_WriteData(0x00);  
SPI_WriteData(0x40);  
SPI_WriteData(0x40);  
SPI_WriteData(0x00);  
SPI_WriteData(0x00);  
SPI_WriteData(0x00);
```

```
SPI_WriteComm(0xED);  
SPI_WriteData(0xFF);  
SPI_WriteData(0xFF);  
SPI_WriteData(0xFF);  
SPI_WriteData(0xBA);  
SPI_WriteData(0x0A);  
SPI_WriteData(0xBF);  
SPI_WriteData(0x45);  
SPI_WriteData(0xFF);  
SPI_WriteData(0xFF);  
SPI_WriteData(0x54);  
SPI_WriteData(0xFB);  
SPI_WriteData(0xA0);  
SPI_WriteData(0xAB);  
SPI_WriteData(0xFF);
```

```
SPI_WriteData(0xFF);  
SPI_WriteData(0xFF);
```

```
SPI_WriteComm(0xEF);  
SPI_WriteData(0x10);  
SPI_WriteData(0x0D);  
SPI_WriteData(0x04);  
SPI_WriteData(0x08);  
SPI_WriteData(0x3F);  
SPI_WriteData(0x1F);
```

```
SPI_WriteComm(0xFF);  
SPI_WriteData(0x77);  
SPI_WriteData(0x01);  
SPI_WriteData(0x00);  
SPI_WriteData(0x00);  
SPI_WriteData(0x13);
```

```
SPI_WriteComm(0xEF);  
SPI_WriteData(0x08);
```

```
SPI_WriteComm(0xFF);  
SPI_WriteData(0x77);  
SPI_WriteData(0x01);  
SPI_WriteData(0x00);  
SPI_WriteData(0x00);  
SPI_WriteData(0x00);
```

```
SPI_WriteComm(0x36);  
SPI_WriteData(0x00);
```

```
SPI_WriteComm(0x3A);  
SPI_WriteData(0x66); //0x66 18bit;0x55 16bit
```

```
SPI_WriteComm(0x11);  
Delays (120);  
SPI_WriteComm(0x29);  
Delays (120);
```

```
}
```

```
Void Panel_SleepIn_Mode (void)
{
SPI_WriteComm(0x28);
Delays (120);
SPI_WriteComm(0x10);
Delays (120);
}
Void Panel_SleepOut_Mode (void)
{
SPI_WriteComm(0x11);
Delays (120);
SPI_WriteComm(0x29);
Delays (120);
}
```

--- END ---