

LCM Specification

Preliminary specification

Final Specification

Project No. 项目编号	TFT-H040A1PVIST3N40		
Customer 客户名称			
Module No. 客户型号			
Product type 产品内容	TFT LCD Module 480 x 3RGB x 480 Dots 4.0" 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
Y. L			

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1 Document revision history :

DOCUMENT REVISION	DATE	DESCRIPTION	PREPARED BY	APPROVED BY
0	2019-4-25	First Release.	Y.L	

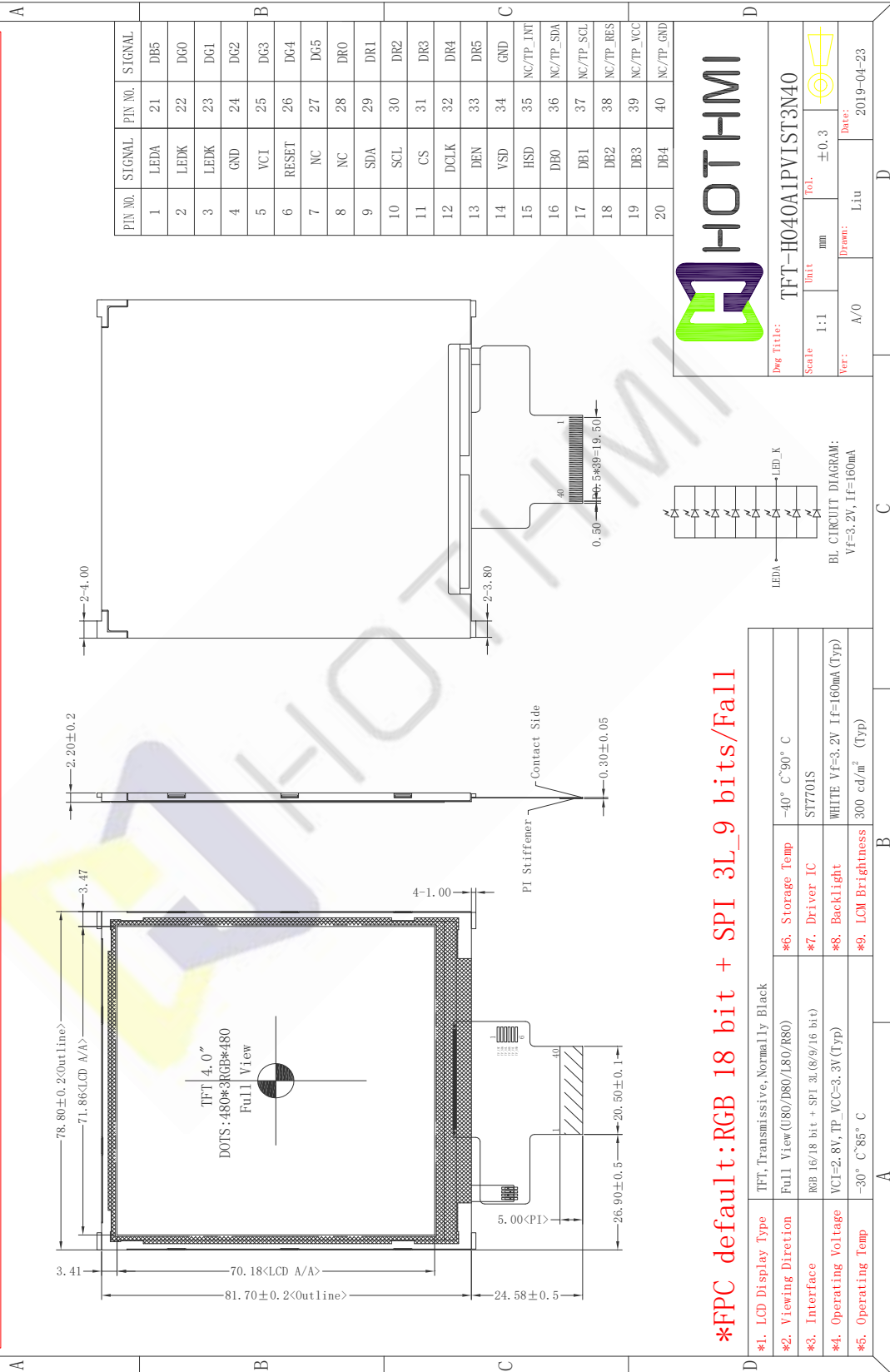


1. General Feature:

Item	Standard Value	Unit
Display Size	4.0"	--
Number of Pixels	480(H)x3(RGB)*480(V)	--
Active Area	71.86(H) *70.18(V)	mm
Outline Dimension	78.80(H) ×81.70× 2.20(V)	mm
Viewing Direction	FULL O'Clock	-
Interface	RGB + SPI 3L	-
LCM Driver IC	ST7701S	-
LCM Driver Condition	VCI=3.3V	V
Backlight	White LED	-
Touch Panel	Without Touch Panel	-
CTP Driver IC	---	
CTP Driver Condition	---	
Operation Temperature	-30~85	°C
Storage Temperature	-40~90	°C

2. Outline Dimensions

*** Do not display the fixed pattern for a long time because it may develop image sticking due to the LCM structure. If the screen is displayed with fixed pattern, use a screen saver. It is recommended to display the fixed mode for no more than 2 minutes or less.



*FPC default: RGB 18 bit + SPI 3L_9 bits/Fall

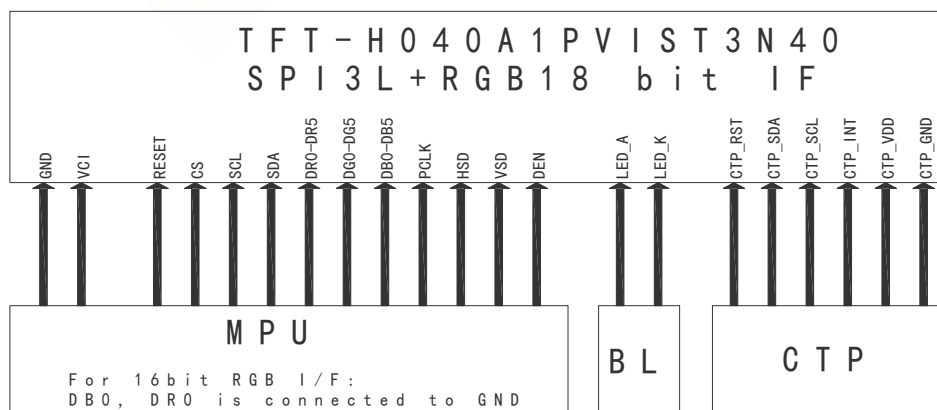
*1. LCD Display Type	TFT, Transmissive, Normally Black	*6. Storage Temp	-40° C~90° C
*2. Viewing Direction	Full View (180/080/L80/R80)	*7. Driver IC	ST7701S
*3. Interface	RGB 16/18 bit + SPI 3L(8/9/16 bit)	*8. Backlight	WHITE VF=3.2V IF=160mA (Typ)
*4. Operating Voltage	VCI=2.8V, TP_VCC=3.3V(Typ)	*9. LCM Brightness	300 cd/m ² (Typ)
*5. Operating Temp	-30° C~85° C		

3. Pin Description

3.1 Pin Description

Pin NO.	Symbol	Description
1	LED_A	LED Anode(+3.2V/160mA)
2,3	LED_K	LED Cathode
4	GND	Ground
5	VCI	Analog Power(3.0 ~ 3.6 V)
6	RESET	Reset input
7,8	NC	No Connector
9	SDA	Serial data input/output bidirectional pin for SPI Interface.
10	SCL	Serial clock input for SPI interface
11	CS	A chip select signal
12	PCLK	Pixel clock input pin
13	DEN	Data input enable. Display access is enabled when DE is "L".
14	VSD	Vertical sync signal.
15	HSD	Horizontal sync signal.
16-21	DB0-DB5	Blue data bus.
22-27	DG0-DG5	Green data bus.
28-33	DR0-DR5	Red data bus.
34	GND	Ground
35	NC/TP_INT	TP function pin.If not used, let this pin open.
36	NC/TP_SDA	TP function pin.If not used, let this pin open.
37	NC/TP_SCL	TP function pin.If not used, let this pin open.
38	NC/TP_RES	TP function pin.If not used, let this pin open.
39	NC/TP_VCC	TP function pin.If not used, let this pin open.
40	NC/TP_GND	TP function pin.If not used, let this pin open.
---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	-	-	-	-	V
Analog Power supply	VCI	-	3.0	3.3	3.6	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	Unit
Forward voltage	Vt	If=20mA	3.0	3.2	3.4	V
Forward current	Ipn	/1-chip	-	160	-	mA
Luminance(With LCD)	Lv	If=160mA	-	300	-	cd/m ²
Luminous color	White					

4-3 CTP Operating Conditions

Item	Symbol	Condition	Min	Type	Max	Unit
Power Supply Voltages	VDD	-	2.8	3.30	3.60	V
I/O Digital Voltage	IOVDD	-	2.8	3.30	3.60	V

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°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 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	\ominus L	CR>10	70	80	-	Deg.	Note 1
		\ominus R		70	80	-	Deg.	
	Vertical	\ominus U		70	80	-	Deg.	
		\ominus D		70	80	-	Deg.	
Contrast ratio		CR	$\ominus = 0^\circ$	640	800	-		Note2
Color Gamut		CG		55	60	-	%	
White Chromaticity		Wx		-	(0.302)	-		
		Wy		-	(0.325)	-		
Reproduction of color	Red	Rx	$\ominus = 0^\circ$	-	(0.624)	-		Note4 (Based on C Light)
		Ry		-	(0.329)	-		
	Green	Gx		-	(0.288)	-		
		Gy		-	(0.522)	-		
	Blue	Bx		-	(0.136)	-		
		By		-	(0.137)	-		
Response Time (Rising + Falling)		Tr+Tf	$\ominus = 0^\circ$ Ta= 25°C	-	25	35	ms	Note5
Transmittance(with Polarizer)		Tr		-	(4.2)	-	%	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 $\ominus = 0$ 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

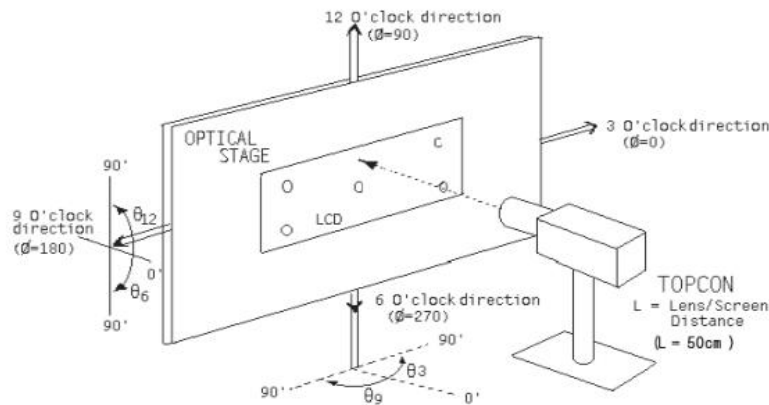
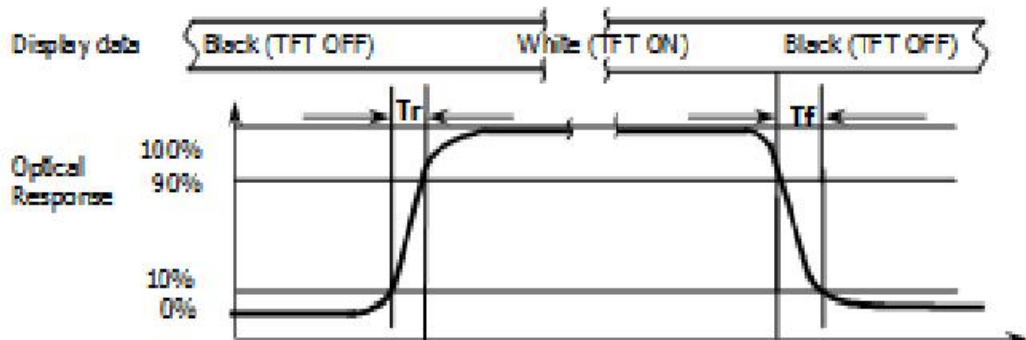
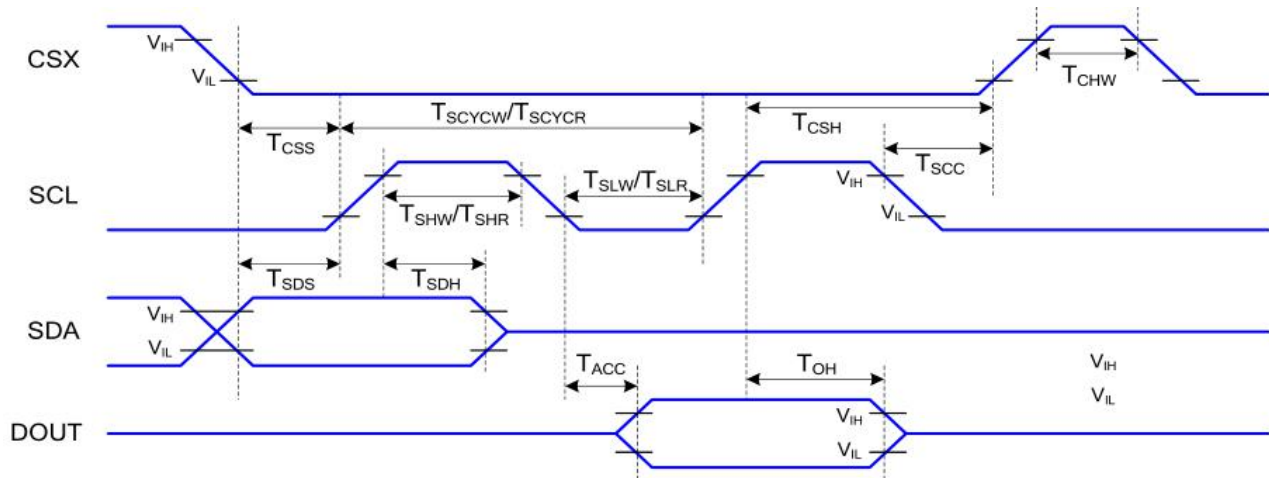


Figure2 Response Time Testing



6. Timing Characteristics of Input Signals

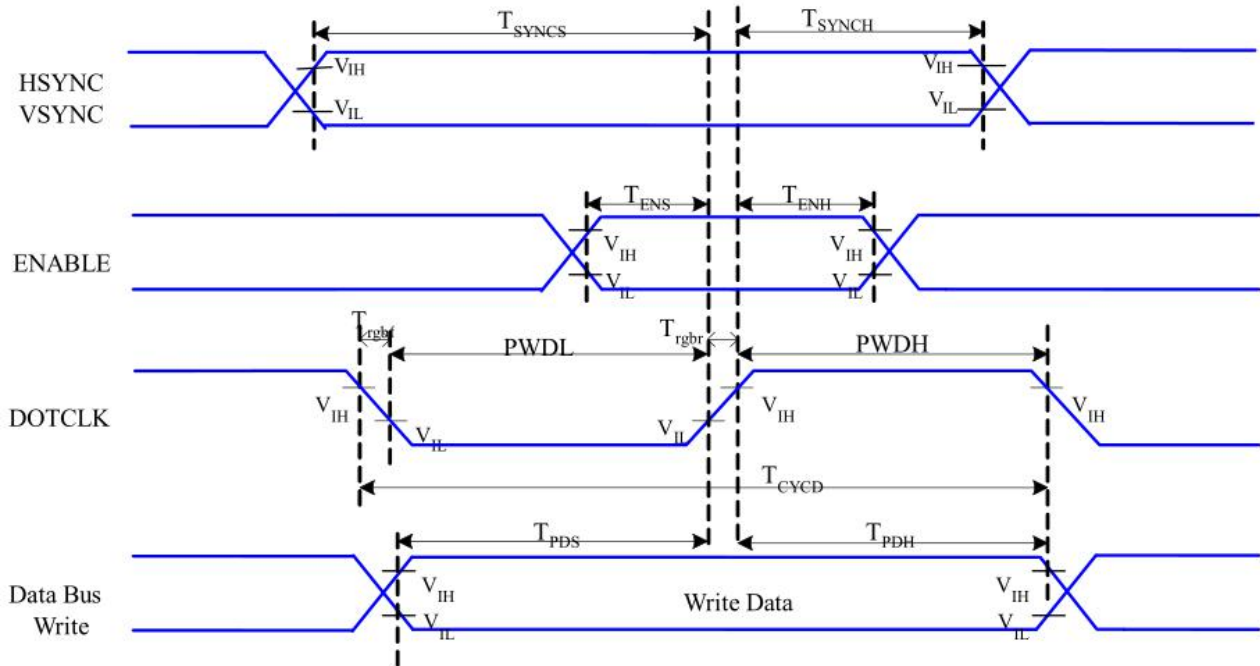
6-1 Serial Interface Characteristics (3-line serial)



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	

6-2 RGB Interface Characteristics



VDDI=1.8, VDD=2.8, AGND=DGND=0V, $T_a=25\text{ }^\circ\text{C}$

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	
	T_{rgbr}, T_{rgbf}	DOTCLK Rise/Fall time	-	15	ns	
DB	T_{PDS}	PD Data Setup Time	5	-	ns	
	T_{PDH}	PD Data Hold Time	5	-	ns	

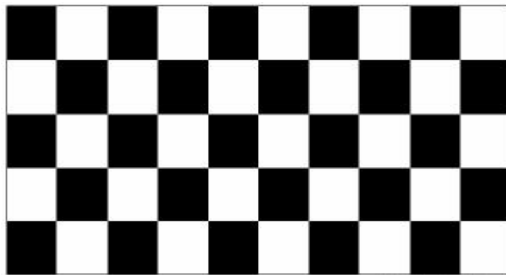
7. RELIABILITY TEST

7-1 Temperature and Humidity

TEST ITEMS	CONDITIONS	NOTE
High Temperature Storage	Ta=+90 o C, 240hrs	
Low Temperature Storage	Ta=-40 o C, 240hrs	
High Temperature Operation	Ta=+85 o C, 240hrs	
Low Temperature Operation	Ta=-30 o C, 240hrs	
High Temperature and High Humidity (Operating)	Ta=+60 o C, 90%RH, 240hrs	

Note: (1) All tests above are practiced at module type.

(2) There is no display function NG issue occurred, all the cosmetic specification is judged before the reliability stress.



(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"> ● Shock level:980m/s² ● Waveform:1/2 Sine wave,6msec ● ±X, ±Y ±Z,each axis 1 times
Packing Vibration (Non-Operation)	<ul style="list-style-type: none"> ● 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,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. HANDLING & 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 may be 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 be avoided.

◆ 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 exposed 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 delayed 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 phenomena 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 because it may develop image sticking due to the LCM structure. If the screen is displayed with fixed pattern, use a screen saver. It is recommended to display the fixed mode for no more than 2 minutes or less.

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

7-2 Caution Against Static Charge

◆ The LCM uses C-MOS LSI drivers, so customers are recommended that any unused input terminal would be connected to V_{DD} or V_{SS}, do not input any signals before power is turned on, and ground your 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 of 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

```

/*****/
/* Panel Name : HSD4.0IPS(HSD040BPN1-A00) */
/* Resulation : 480x480 */
/* Inversion : 2dot */
/* Porch : vbp=15 , vfp=12 */
/* Line Time : 32us */
/* Frame Rate : 60hz */
/*****/

Void Panel_initial_code(void)
{
//-----Reset sequence-----//
LCD_RESET=1;
Delaysms(1); //Delay 1ms
LCD_RESET=0;
Delaysms(10); //Delay 10ms
LCD_RESET=1;
Delaysms(120); //Delay 120ms
//-----//

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(0x10);
SPI_WriteComm(0xC0);
SPI_WriteData(0x3B);
SPI_WriteData(0x00);
SPI_WriteComm(0xC1);
SPI_WriteData(0x0D);
    
```

```
SPI_WriteData(0x02);  
SPI_WriteComm(0xC2);  
SPI_WriteData(0x21);  
SPI_WriteData(0x08);  
SPI_WriteComm(0xCD);  
SPI_WriteData(0x00);//18-bit/pixel: MDT=0:D[21:16]=R,D[13:8]=G,D[5:0]=B(CDH=00) ;
```

```
SPI_WriteComm(0xB0);  
SPI_WriteData(0x00);  
SPI_WriteData(0x11);  
SPI_WriteData(0x18);  
SPI_WriteData(0x0E);  
SPI_WriteData(0x11);  
SPI_WriteData(0x06);  
SPI_WriteData(0x07);  
SPI_WriteData(0x08);  
SPI_WriteData(0x07);  
SPI_WriteData(0x22);  
SPI_WriteData(0x04);  
SPI_WriteData(0x12);  
SPI_WriteData(0x0F);  
SPI_WriteData(0xAA);  
SPI_WriteData(0x31);  
SPI_WriteData(0x18);  
SPI_WriteComm(0xB1);  
SPI_WriteData(0x00);  
SPI_WriteData(0x11);  
SPI_WriteData(0x19);  
SPI_WriteData(0x0E);  
SPI_WriteData(0x12);  
SPI_WriteData(0x07);  
SPI_WriteData(0x08);  
SPI_WriteData(0x08);  
SPI_WriteData(0x08);  
SPI_WriteData(0x22);  
SPI_WriteData(0x04);  
SPI_WriteData(0x11);  
SPI_WriteData(0x11);  
SPI_WriteData(0xA9);  
SPI_WriteData(0x32);
```

```
SPI_WriteData(0x18);
SPI_WriteComm(0xFF);
SPI_WriteData(0x77);
SPI_WriteData(0x01);
SPI_WriteData(0x00);
SPI_WriteData(0x00);
SPI_WriteData(0x11);
SPI_WriteComm(0xB0);
SPI_WriteData(0x60);
SPI_WriteComm(0xB1);
SPI_WriteData(0x30);
SPI_WriteComm(0xB2);
SPI_WriteData(0x87);
SPI_WriteComm(0xB3);
SPI_WriteData(0x80);
SPI_WriteComm(0xB5);
SPI_WriteData(0x49);
SPI_WriteComm(0xB7);
SPI_WriteData(0x85);
SPI_WriteComm(0xB8);
SPI_WriteData(0x21);
SPI_WriteComm(0xC1);
SPI_WriteData(0x78);
SPI_WriteComm(0xC2);
SPI_WriteData(0x78);
Delay(20);
SPI_WriteComm(0xE0);
SPI_WriteData(0x00);
SPI_WriteData(0x1B);
SPI_WriteData(0x02);
SPI_WriteComm(0xE1);
SPI_WriteData(0x08);
SPI_WriteData(0xA0);
SPI_WriteData(0x00);
SPI_WriteData(0x00);
SPI_WriteData(0x07);
SPI_WriteData(0xA0);
SPI_WriteData(0x00);
SPI_WriteData(0x00);
SPI_WriteData(0x00);
```

SPI_WriteData(0x44);
SPI_WriteData(0x44);
SPI_WriteComm(0xE2);
SPI_WriteData(0x11);
SPI_WriteData(0x11);
SPI_WriteData(0x44);
SPI_WriteData(0x44);
SPI_WriteData(0xED);
SPI_WriteData(0xA0);
SPI_WriteData(0x00);
SPI_WriteData(0x00);
SPI_WriteData(0xEC);
SPI_WriteData(0xA0);
SPI_WriteData(0x00);
SPI_WriteData(0x00);
SPI_WriteComm(0xE3);
SPI_WriteData(0x00);
SPI_WriteData(0x00);
SPI_WriteData(0x11);
SPI_WriteData(0x11);
SPI_WriteComm(0xE4);
SPI_WriteData(0x44);
SPI_WriteData(0x44);
SPI_WriteComm(0xE5);
SPI_WriteData(0x0A);
SPI_WriteData(0xE9);
SPI_WriteData(0xD8);
SPI_WriteData(0xA0);
SPI_WriteData(0x0C);
SPI_WriteData(0xEB);
SPI_WriteData(0xD8);
SPI_WriteData(0xA0);
SPI_WriteData(0x0E);
SPI_WriteData(0xED);
SPI_WriteData(0xD8);
SPI_WriteData(0xA0);
SPI_WriteData(0x10);
SPI_WriteData(0xEF);
SPI_WriteData(0xD8);
SPI_WriteData(0xA0);


```
SPI_WriteComm(0xE6);  
SPI_WriteData(0x00);  
SPI_WriteData(0x00);  
SPI_WriteData(0x11);  
SPI_WriteData(0x11);  
SPI_WriteComm(0xE7);  
SPI_WriteData(0x44);  
SPI_WriteData(0x44);  
SPI_WriteComm(0xE8);  
SPI_WriteData(0x09);  
SPI_WriteData(0xE8);  
SPI_WriteData(0xD8);  
SPI_WriteData(0xA0);  
SPI_WriteData(0x0B);  
SPI_WriteData(0xEA);  
SPI_WriteData(0xD8);  
SPI_WriteData(0xA0);  
SPI_WriteData(0x0D);  
SPI_WriteData(0xEC);  
SPI_WriteData(0xD8);  
SPI_WriteData(0xA0);  
SPI_WriteData(0x0F);  
SPI_WriteData(0xEE);  
SPI_WriteData(0xD8);  
SPI_WriteData(0xA0);  
SPI_WriteComm(0xEB);  
SPI_WriteData(0x02);  
SPI_WriteData(0x00);  
SPI_WriteData(0xE4);  
SPI_WriteData(0xE4);  
SPI_WriteData(0x88);  
SPI_WriteData(0x00);  
SPI_WriteData(0x40);  
SPI_WriteComm(0xEC);  
SPI_WriteData(0x3C);  
SPI_WriteData(0x00);  
SPI_WriteComm(0xED);  
SPI_WriteData(0xAB);  
SPI_WriteData(0x89);  
SPI_WriteData(0x76);
```

```
SPI_WriteData(0x54);
SPI_WriteData(0x02);
SPI_WriteData(0xFF);
SPI_WriteData(0xFF);
SPI_WriteData(0xFF);
SPI_WriteData(0xFF);
SPI_WriteData(0xFF);
SPI_WriteData(0xFF);
SPI_WriteData(0x20);
SPI_WriteData(0x45);
SPI_WriteData(0x67);
SPI_WriteData(0x98);
SPI_WriteData(0xBA);
SPI_WriteComm(0xFF);
SPI_WriteData(0x77);
SPI_WriteData(0x01);
SPI_WriteData(0x00);
SPI_WriteData(0x00);
SPI_WriteData(0x00);
SPI_WriteComm(0x3A);
SPI_WriteData(0x66);//55/50=16bit(RGB565);66=18bit(RGB666);77或默认不写3AH是
=24bit(RGB888)
SPI_WriteComm(0x11);
Delay(120);
SPI_WriteComm(0x29);
Delay(20);
}
```

Void Sleep in (void)

```
{  
SPI_WriteComm(0x28); //Enter display off  
Delays (120); //Delay 120ms  
SPI_WriteComm(0x10); //Enter sleep in  
}
```

Void Sleep out (void)

```
{  
SPI_WriteComm(0x11); //Enter sleep out  
Delays (120); //Delay 120ms  
SPI_WriteComm(0x29); //Enter display on  
}
```

--END--