

LCM Specification

Preliminary specification

Final Specification

Project No. 项目编号	TFT-H035A3HVIST5N50		
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:

<input type="checkbox"/> Trial production		<input type="checkbox"/> Mass production	
编 制	电子审核	结构审核	批 准
Y.L			

深圳市鑫洪泰电子科技有限公司

Shenzhen Hot Display Technology Co., Ltd

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1 Document revision history :

DOCUMENT REVISION	DATE	DESCRIPTION	PREPARED BY	APPROVED BY
0	2019-5-6	First Release.	Y.L	





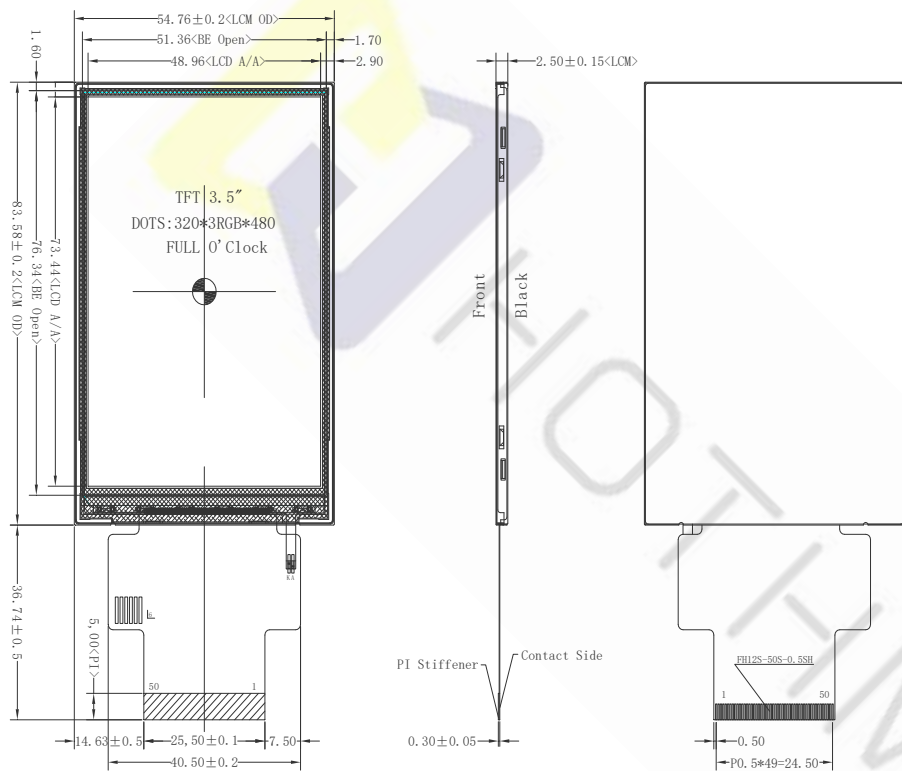
1. General Feature:

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) x83.58 x 2.50(V)	mm
Viewing Direction	Full O'Clock	-
LCM Interface	SPI,RGB,MCU,MIP1, Free to choose	-
LCM Driver IC	ST7796S	-
LCM Driver Voltage	VCI=2.8V	V
Backlight	White LED	-
Touch Panel	Without Touch Panel	-
CTP Driver IC	---	-
CTP Driver Voltage	VDD=2.8V	V
CTP I/O Digital Voltage	---	V
Operation Temperature	-20~70	°C
Storage Temperature	-30~80	°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.



PIN NO.	SIGNAL	PIN NO.	SIGNAL	PIN NO.	SIGNAL
1	LEDA	21	DB14	41	CSX
2	LEDK	22	DB13	42	TE
3	GND	23	DB12	43	VCI
4	MIPI_DN	24	DB11	44	GND
5	MIPI_DP	25	DB10	45	NC/CTP-VDD
6	GND	26	DB9	46	NC/CTP-SCL
7	MIPI_CN	27	DB8	47	NC/CTP-SDA
8	MIPI_CP	28	DB7	48	NC/CTP-IM1
9	GND	29	DB6	49	NC/CTP-RES
10	IM0	30	DB5	50	GND
11	IM1	31	DB4		
12	IM2	32	DB3		
13	RESET	33	DB2		
14	VSD	34	DB1		
15	HSD	35	DB0		
16	PCLK	36	SPI_SDO		
17	DEN	37	SPI_SDI		
18	DB17	38	RDX		
19	DB16	39	WRX		
20	DB15	40	DCX		

*Interface Definition By Pin IM0-IM2

*1. LCD Display Type	TFT, Transmissive, Normally Black	*6. Storage Temp	-30° C~80° C
*2. Viewing Direction	FULL 0° Clock (U80/D80/L80/R80)	*7. Driver IC	ST7796S
*3. Interface	SPI, RGB, MCU, MIPI, Free to choose	*8. Backlight	WHITE Vf=18V If=20mA(Typ)
*4. Operating Voltage	LCM_VCI=3.3V ,CTP_VDD=2.8V(Typ)	*9. LCM Brightness	500 cd/m ² (Typ)
*5. Operating Temp	-20° C~70° C		



BL CIRCUIT DIAGRAM:
Vf=18V, If=20mA



Dwg Title: TFT-H035A3HV1ST5N50			
Scale: 1:1	Unit: MM	Tol: ±0.3	
Ver: A/0	Drawn: Liu	Date: 2019-05-06	



3. Pin Description

3.1 Pin Description

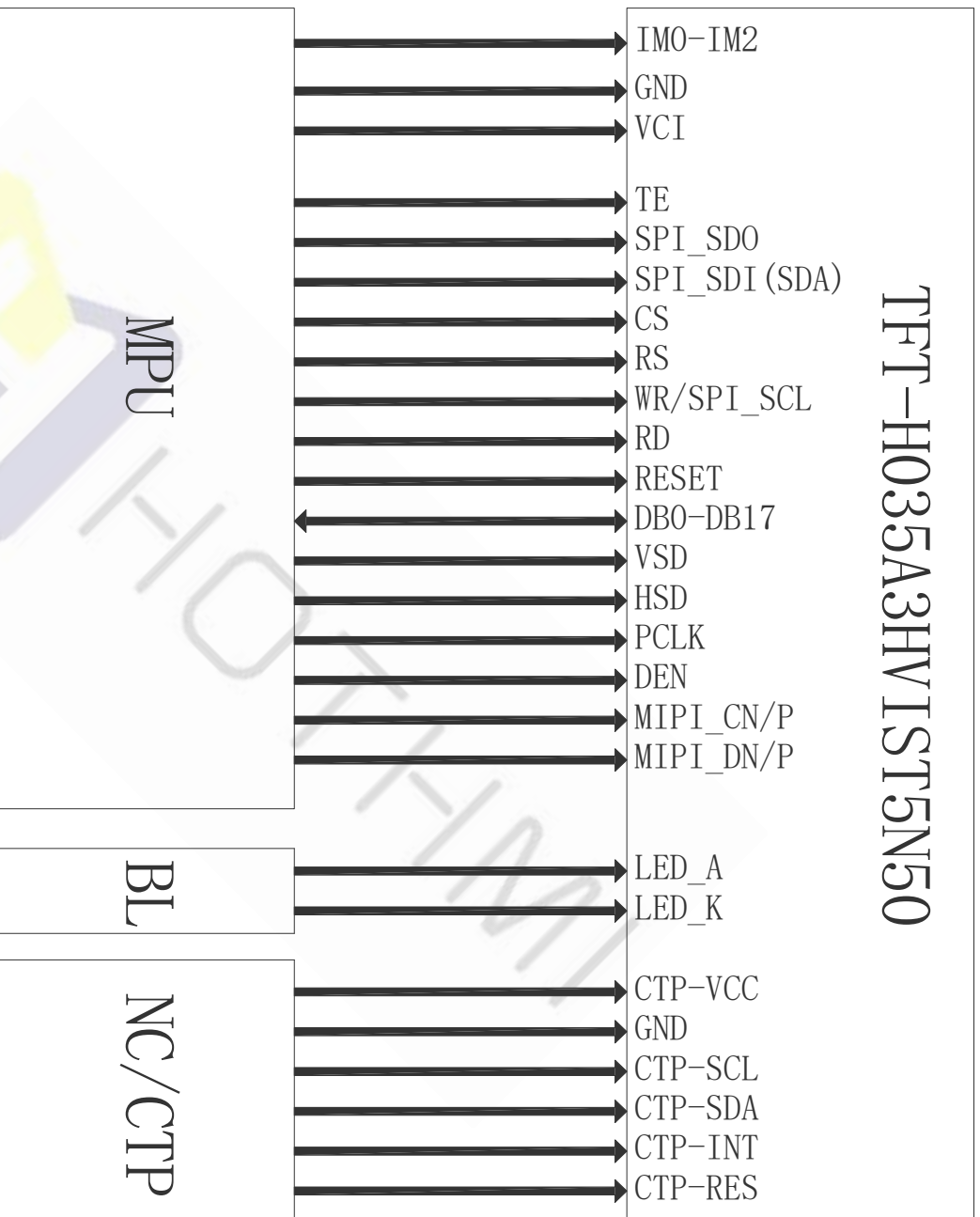
Pin NO.	Symbol	Description
1	LED_A	LED Anode
2	LED_K	LED Cathode
3	GND	Ground
4	MIP1_DN	<ul style="list-style-type: none"> ◆ Positive polarity of low voltage differential data signal ◆ Leave the pin to open when not in use.
5	MIP1_DP	<ul style="list-style-type: none"> ◆ Negative polarity of low voltage differential data signal ◆ Leave the pin to open when not in use.
6	GND	Ground
7	MIP1_CN	<ul style="list-style-type: none"> ◆ Negative polarity of low voltage differential clock signal ◆ Leave the pin to open when not in use.
8	MIP1_CP	<ul style="list-style-type: none"> ◆ 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	<ul style="list-style-type: none"> ◆ Vertical synchronizing input signal for RGB interface. ◆ If not used, please fix this pin at GND.
15	HSD	<ul style="list-style-type: none"> ◆ Horizontal synchronizing input signal for RGB interface. ◆ If not used, please fix this pin at GND.
16	PCLK	<ul style="list-style-type: none"> ◆ Dot clock signal for RGB interface. ◆ If not used, please fix this pin at GND.
17	DEN	<ul style="list-style-type: none"> ◆ 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_SD0	<ul style="list-style-type: none"> ◆ 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	<ul style="list-style-type: none"> ◆ 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	<ul style="list-style-type: none"> ◆ Read enable in 8080 MCU parallel IF. Low-active. ◆ If not used, please fix this pin at GND.
39	WRX/SPI_SCL	<ul style="list-style-type: none"> ◆ 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	<ul style="list-style-type: none">◆ Display data/command selection pin in parallel IF.◆ If not used, please fix this pin at GND.
41	CSX/SPI_CS	<ul style="list-style-type: none">◆ Chip select input pin (“Low” enable).◆ If not used, please fix this pin at GND.
42	TE	<ul style="list-style-type: none">◆ 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	<ul style="list-style-type: none">◆ Power supply input for CTP.◆ If not used, please let this pin open.
46	NC/CTP-SCL	<ul style="list-style-type: none">◆ CTP Serial clock signal.◆ If not used, please let this pin open.
47	NC/CTP-SDA	<ul style="list-style-type: none">◆ CTP Serial data input signal.◆ If not used, please let this pin open.
48	NC/CTP-INT	<ul style="list-style-type: none">◆ CTP_External interrupt to the host.◆ If not used, please let this pin open.
49	NC/CTP-RES	<ul style="list-style-type: none">◆ CTP Reset Pin.◆ If not used, please let this pin open.
50	GND	Ground



3.2 Wiring Diagram



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	MIPPI I/F	MIPPI_CN/P, MIPPI_DN/P
1	1	1	4-1line 8bit serial I/F	SDA, SDO



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	3.30	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	Unit
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	-	500	-	cd/m ²
Luminous color	White					

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	-	-	-	-	°C
Storage Temperature	Tstg	-	-5	-	-	°C



4. OPTICAL SPECIFICATION

4.1 Overview

The test of Optical specifications shall be measured in a dark room (ambient luminance Lux 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.

4.2 Optical Specifications

Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit	Remark
Viewing Angle Range	Horizontal	CR>10	⊕ L	80	-	Deg.	Note 1
			⊕ R	80	-	Deg.	
	⊕ U		80	-	Deg.		
	Vertical	⊕ = 0°	⊕ D	80	-	Deg.	Note 2
Contrast ratio	CR		700	-			
Color Gamut	CG		-	-	-	%	
White Chromaticity	Wx	⊕ = 0°	-	0.309	-		Note 4
	Wy		-	0.332	-		
	Rx		-	0.660	-		
Reproduction of color	Red	Ry	-	0.325	-		Note 4 (Based on C Light)
		Gx	-	0.277	-		
	Gy	-	0.568	-			
	Bx	-	0.145	-			
	Blue	By	-	0.072	-		
Response Time (Rising + Falling)	Tr+Tf	⊕ = 0° Ta= 25°C	-	30	-	ms	Note 5
Transmittance	Tr		-	-	-	%	Note 3

Note:

- 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).
- 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

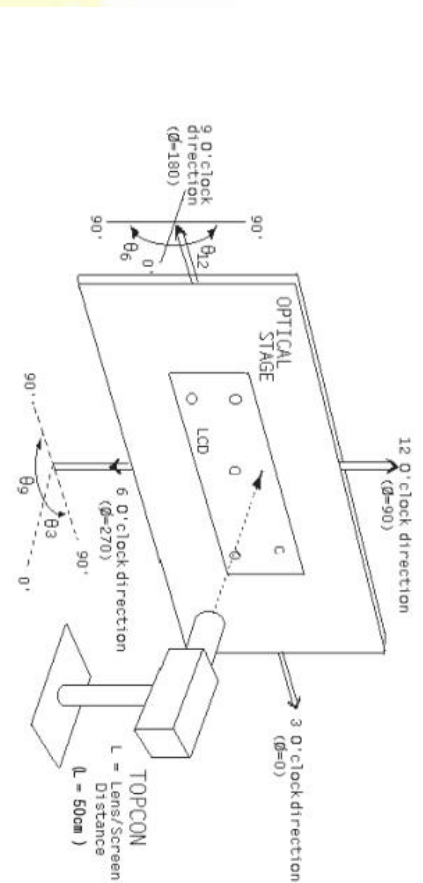
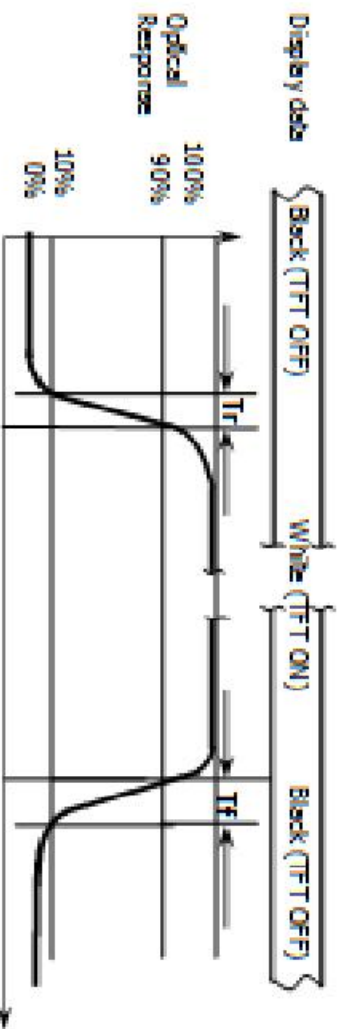
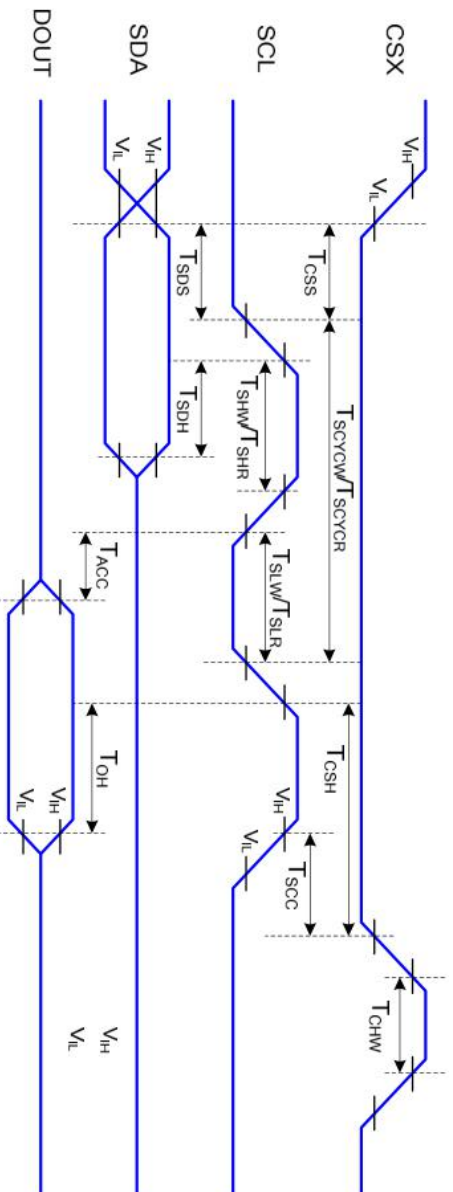


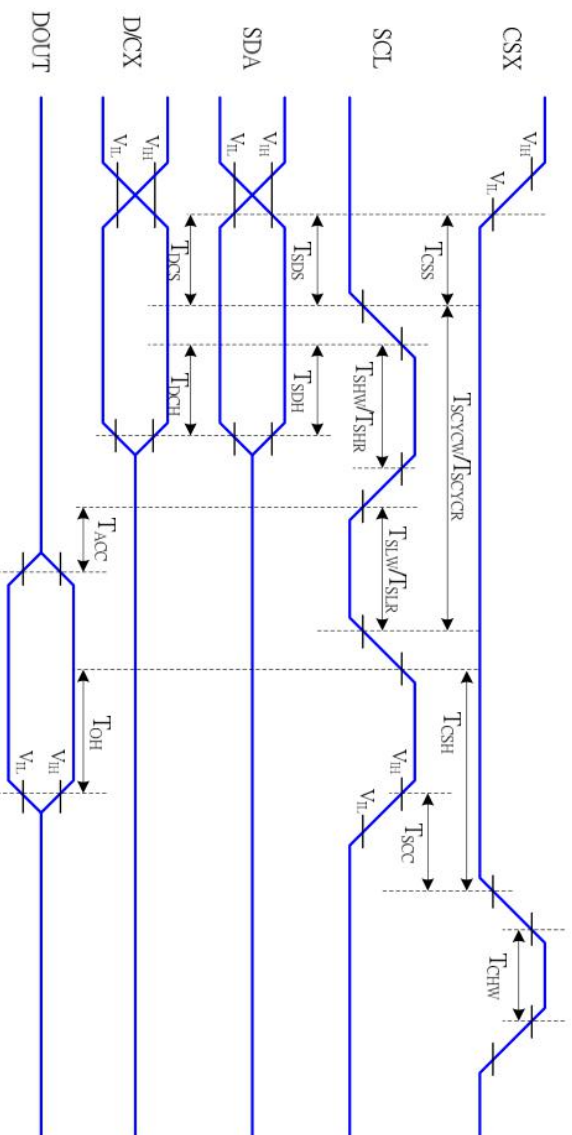
Figure2 Response Time Testing



**6-2 LCM Serial Interface Characteristics (3-line serial)**

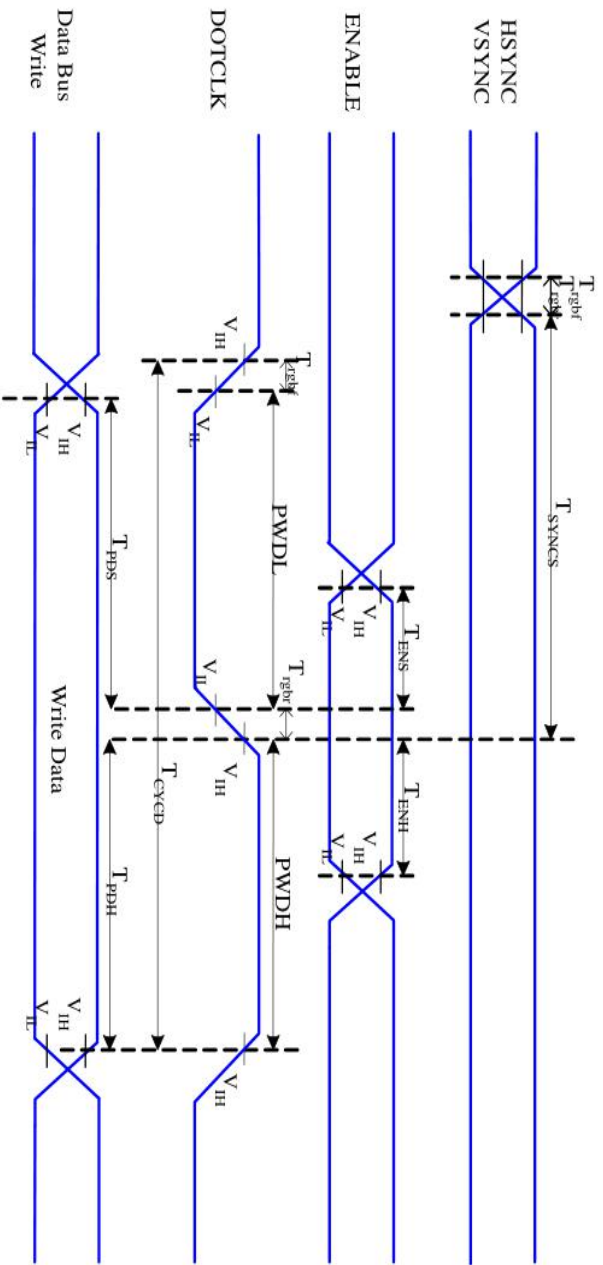
VDDI=1.8V, VDDA=2.8V, AGND=DGND=0V, Ta=25 °C

Signal	Symbol	Parameter	Min	Max	Unit	Description
CSX	T_{CSS}	Chip select setup time (write)	15		ns	
	T_{CSDH}	Chip select hold time (write)	15		ns	
	T_{CSS}	Chip select setup time (read)	60		ns	
CSX	T_{SCC}	Chip select hold time (read)	65		ns	
	T_{CHW}	Chip select "H" pulse width	40		ns	
	T_{SCYCW}	Serial clock cycle (Write)	66		ns	
SCL	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 For minimum CL=8pF
	T_{OHD}	Output disable time	15	50	ns	

**6-3 LCM Serial Interface Characteristics (4-line serial)**

VDDI=1.8V, VDDA=2.8V, 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	
CSX	T _{CSS}	Chip select setup time (read)	60		ns	
	T _{SCC}	Chip select hold time (read)	65		ns	
SCL	T _{CHW}	Chip select "H" pulse width	40		ns	-write command & data ram
	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	
SCL	T _{SLR}	SCL "L" pulse width (Read)	60		ns	-read command & data ram
	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 For minimum CL=8pF
	T _{OH}	Output disable time	15	50	ns	

**6-4 LCM RGB Interface Characteristics**

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

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



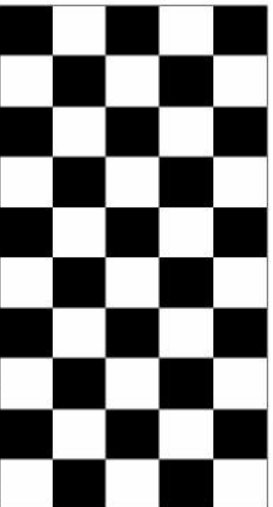
7. RELIABILITY TEST

7-1 Temperature and Humidity

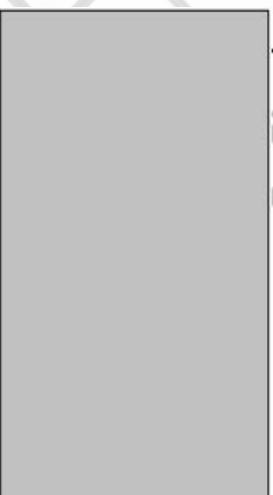
Test Item	Test Condition	Check Time
High Temp Storage	Ta= 80℃	240 hrs
Low Temp Storage	Ta= -30℃	240 hrs
High Temp Operation	Ta= 70℃	240 hrs
Low Temp Operation	Ta= -20℃	240 hrs
High Temp & High Humidity Operation	Ta=60℃ H=90%RH	240 hrs

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)*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"> ● 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,330Ω, Contact±4KV,Air :±8KV.Note 1 200pF,0Ω, ±200V Contact test.Note 2

Note:Measure Point:

- 1.LCD glass and metal bezel
- 2.I.F 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 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 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 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 ST7796SPanelInitcode(void)
```

```
{
```

```
T.B.D
```

```
}
```

```
Void ST7796SPanelSleepInMode (void)
```

```
{
```

```
Write command 0x10;
```

```
Delayms (120);
```

```
}
```

```
Void ST7796SPanelSleepOutMode (void)
```

```
{
```

```
Write command 0x11;
```

```
Delayms (120);
```

```
}
```

```
----END----
```