

液晶模组规格书

LCM Specification

初定规格 Preliminary specification

正式规格 Official specifications

项目编号 Project No.	TFT-H040A12DHIIL3C40		
客户名称 Customer			
客户型号 Module No.			
产品描述 Product Description	TFT LCD Module 320 x 3RGB x 320 Dots 4.0 " TFT LCD		
客户确认签章: Signature by customer:			
<input type="checkbox"/> 小批量试产 Trial production <input type="checkbox"/> 大批量生产 Mass production			
编制	电子审核	结构审核	批准
Liu.YL			

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Document revision history :

版本 Version	日期 DATE	修改说明 Modify description	编制 PREPARED BY
0	2021-10-11	First Release.	Liu. YL

一、基本特征 General Feature:

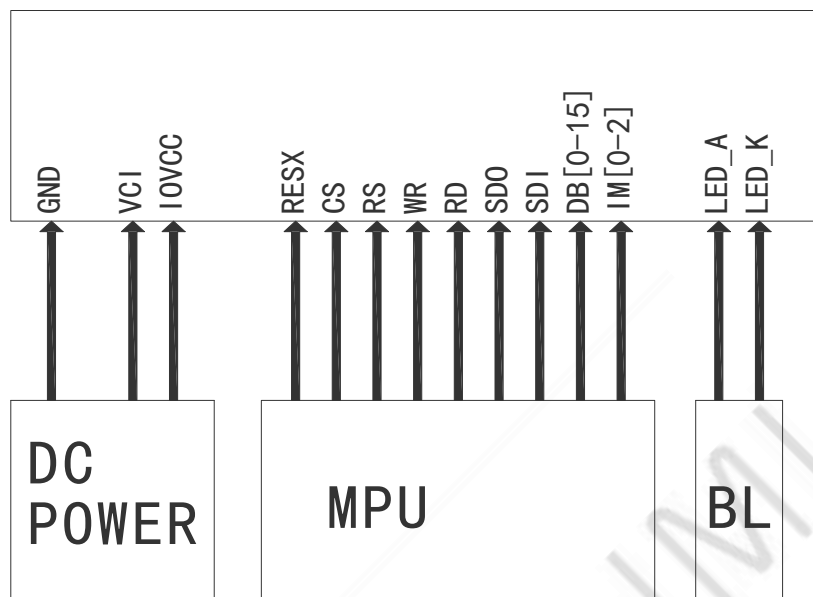
项目 Item	标准值 Standard Value	单位 Unit
显示尺寸 Display Size	4.0"	--
分辨率 Number of Pixels	320 (H) x3 (RGB) *320 (V)	--
显示区域 Active Area	71.14 (H) * 69.82 (V)	mm
外形尺寸 Outline Dimension	83.90 (H) * 83.90 (V) * 3.21 (D) <TFT+CTP>	mm
观看方向 Viewing Direction	全视角 Full 0' Clock	-
接口 Interface	SPI 3L/SPI 4L/MCU 8bit/MCU 16bit	-
驱动芯片 Driver IC	ILI9488	-
驱动电压 Driver Condition	VCI=2.8V, IOVCC=1.8V	V
背光 Backlight	白色 LED White LED	-
触摸屏 Touch Panel	带触摸屏 Whit Touch Panel	-
触摸屏驱动芯片 CTP Driver IC	FT6336	
摸屏驱动电压 CTP Driver Condition	VDD=3.3V	
液晶工作温度 Operation Temperature	-20 ~ 70	℃
液晶储存温度 Storage Temperature	-30 ~ 80	℃

三、引脚说明 Pin Description

3.1 模组引脚说明 TFT Pin Description

引脚编号 Pin NO.	标号 Symbol	详细描述 Description
1	GND	Ground
2	CTP_INT	CTP function pin, do not need to be left floating
3	CTP_SDA	
4	CTP_SCL	
5	CTP_RES	
6	SDO	Serial data output
7	VCI	Analog Power(2.6 ~ 3.3 V, 2.8V Type)
8	IOVCC	I/O Power(1.75 ~ 3.3 V, 1.8V Type)
9	SDI	Serial data input/output bi-direction pin
10	CS	Chip select input signal
11	RS	Data/Command Selection (L: Command/H:Parameter)
12	WR	MCU: WRX pin, serves as a write signal SPI: SCL pin as Serial Clock when operates in the serial interface
13	RD	MCU: Serve as a read signal
14-29	DB[0-15]	Data bus. Connect unused to GND.
30	RESX	Global reset pin. Active low to enter reset state.
31	IM0	Select the interface mode
32	IM1	
33	GND	Ground
34-37	LED_K	LED Cathode
38	LED_A	LED Anode
39	GND	Ground
40	IM2	Select the interface mode
---END---		

3.2 接线说明 Wiring instructions



3.3 选择接口 Select the interface mode

IM2	IM1	IM0	Interface	Data Pins
GND	IOVCC	GND	MCU 16-bit bus	DB [15:0]
GND	IOVCC	IOVCC	MCU 8-bit bus	DB [7:0]
IOVCC	GND	IOVCC	3-line SPI	SDA/SDO
IOVCC	IOVCC	IOVCC	4-line SPI	SDA/SDO

四、电气特性 Electrical Characteristics

4-1 TFT 模组工作条件 TFT LCD Module Operating Conditions

项目 Item	标号 Symbol	条件 Condition	最小值 Min	典型值 Type	最大值 Max	单位 Unit
I/O 电源 I/O Power	IOVCC	-	1.75	1.8	3.3	V
数字电源 Digital Power	VCI	-	2.6	2.8	3.3	V
TFT 栅极导通电压 TFT Gate on voltage	VGH	-	10.0	12.0	14.0	V
TFT 栅极关断电压 TFT Gate off voltage	VGL	-	-14.0	-12.0	-10.0	V

4-2 背光工作条件 LED back light specification

项目 Item	标号 Symbol	条件 Condition	最小值 Min	典型值 Type	最大值 Max	单位 Unit
工作电压 Forward voltage	Vt	If=20mA /1-chip	12.0	-	12.80	V
工作电流 Forward current	Ipn		-	40	-	mA
亮度 (带 LCD) Luminance (With LCD)	Lv	If=40mA	-	350	-	cd/m ²
颜色 Luminous color			白色 White			

4-3 触摸屏工作条件 CTP Operating Conditions

项目 Item	标号 Symbol	条件 Condition	最小值 Min	典型值 Type	最大值 Max	单位 Unit
模拟电源 Digital Power	VDD	-	2.8	3.30	3.60	V
I/O 数字电源 I/O Digital Power	IOVDD	-	2.8	3.30	3.60	V
工作温度 Operation Temperature	-	-	-20	-	70	°C
储存温度 Storage Temperature	-	-	-30	-	80	°C

五、液晶光学规格 TFT OPTICAL SPECIFICATION

5.1 概述 Overview

The test of Optical specifications shall be measured in a dark room (ambient luminance 1lux and temperature = 25 °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 光学规格 Optical Specifications

参数 Parameter		标号 Symbol	条件 Condition	最小值 Min.	典型值 Typ.	最大值 Max.	单位 Unit	备注 Remark			
视角范围 Viewing Angle Range	水平 Horizontal	⊙L	CR>10	-	80	-	Deg.	Note 1			
		⊙R		-	80	-	Deg.				
	垂直 Vertical	⊙U		-	80	-	Deg.				
		⊙D		-	80	-	Deg.				
对比度 Contrast ratio		CR	$\Theta = 0^\circ$	800	1000	-		Note2			
色域 Color Gamut		CG		55	60	-	%				
白色色度 White Chromaticity		Wx	$\Theta = 0^\circ$	-0.03	0.292	+0.03		Note4 (Based on C Light)			
		Wy			0.328						
色彩还原 Reproduct ion of color	红 Red	Rx									
		Ry									
	绿 Green	Gx									
		Gy									
	蓝 Blue	Bx									
		By									
响应时间 (上升 + 下降) Response Time (Rising + Falling)		Tr+Tf	$\Theta = 0^\circ$ Ta= 25°C	-	25	35	ms	Note5			

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

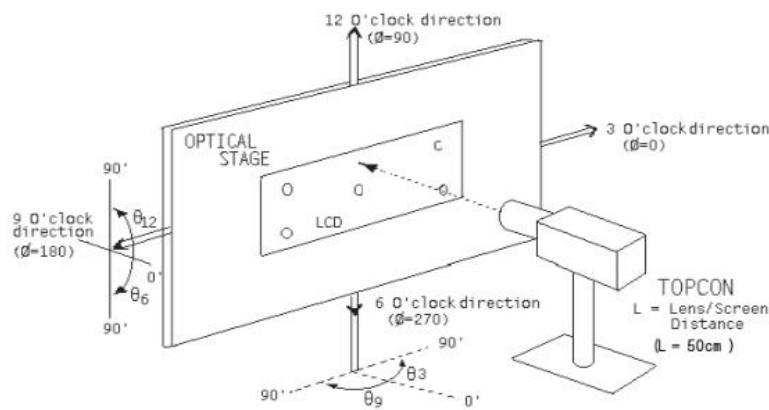
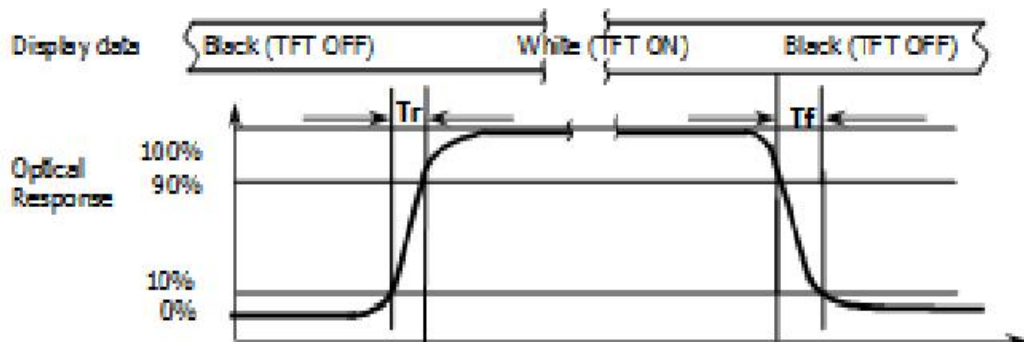
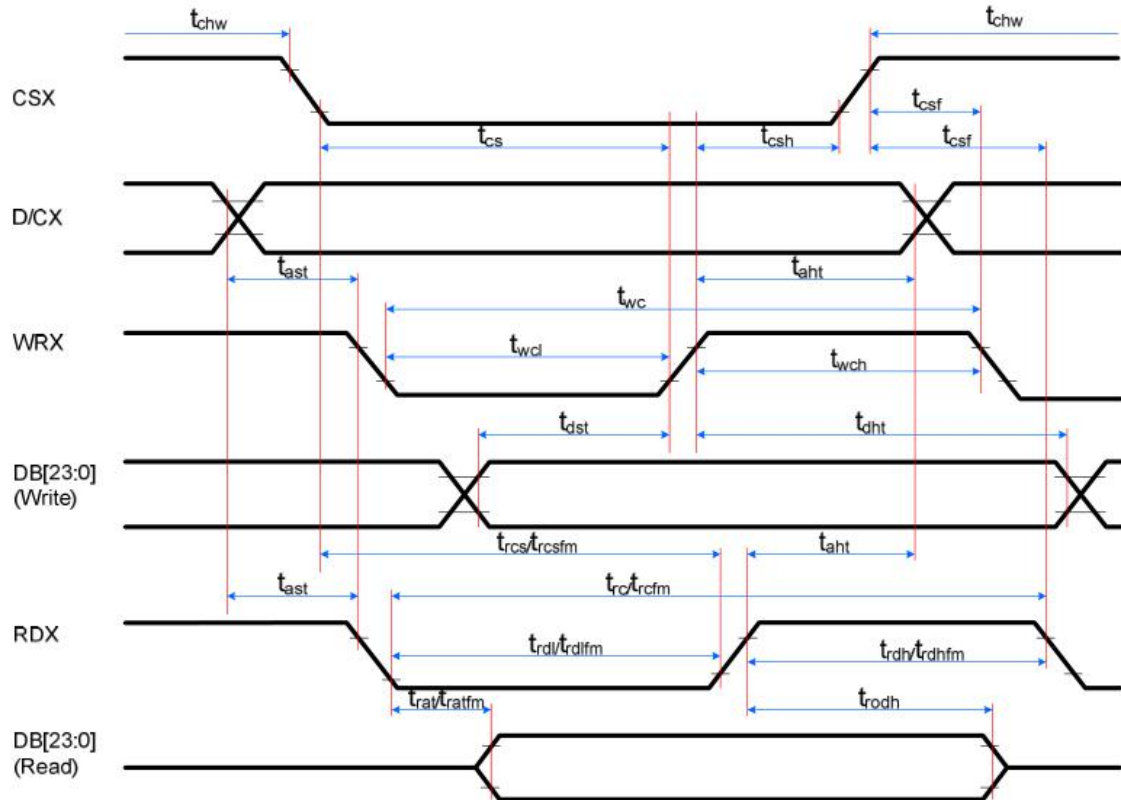


Figure2 Response Time Testing



六、时序特性 Timing Characteristics

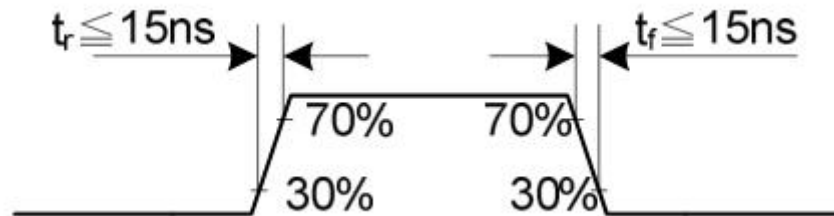
6-1 MCU 接口时序特性 / MCU interface timing characteristics



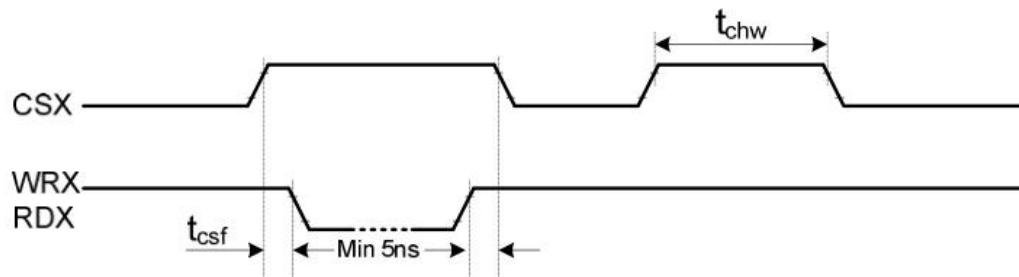
Signal	Symbol	Parameter	min	max	Unit	Description
DCX	tast	Address setup time	0	-	ns	-
	that	Address hold time (Write/Read)	0	-	ns	-
CSX	tchw	CSX "H" pulse width	0	-	ns	-
	tcs	Chip Select setup time (Write)	15	-	ns	-
	trcs	Chip Select setup time (Read ID)	45	-	ns	-
	trcsfm	Chip Select setup time (Read FM)	355	-	ns	-
	tcsf	Chip Select Wait time (Write/Read)	0	-	ns	-
WRX	twc	Write cycle	30	-	ns	-
	twrh	Write Control pulse H duration	15	-	ns	-
	twrl	Write Control pulse L duration	15	-	ns	-
RDX (FM)	trcfm	Read Cycle (FM)	450	-	ns	When read from Frame Memory
	trdhfm	Read Control H duration (FM)	90	-	ns	
	trdlfm	Read Control L duration (FM)	355	-	ns	
RDX (ID)	trc	Read cycle (ID)	160	-	ns	When read ID data
	trdh	Read Control pulse H duration	90	-	ns	
	trdl	Read Control pulse L duration	45	-	ns	
DB [23:0], DB [17:0], DB [15:0], DB [8:0], DB [7:0]	tdst	Write data setup time	10	-	ns	For maximum, CL=30pF For minimum, CL=8pF
	tdht	Write data hold time	10	-	ns	
	trat	Read access time	-	40	ns	
	tratfm	Read access time	-	340	ns	
	trod	Read output disable time	20	80	ns	

Notes:

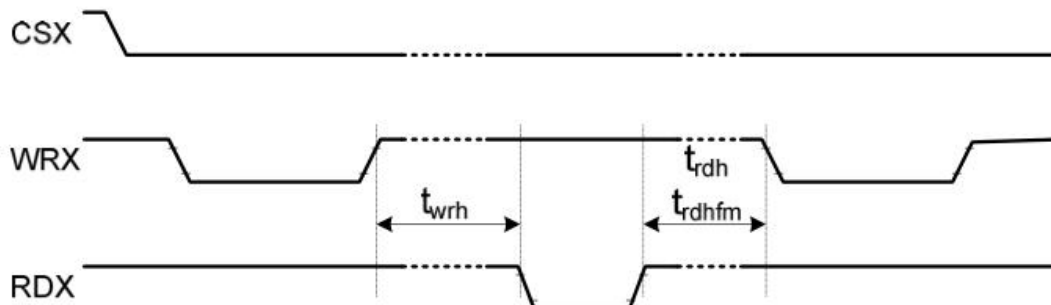
1. $T_a = -30$ to 70 ° C, $IOVCC = 1.65V$ to $3.3V$, $VCI = 2.5V$ to $3.3V$, $AGND = DGND = 0V$
2. Logic high and low levels are specified as 30% and 70% of $IOVCC$ for input signals.
3. Input signal rising time and falling time:



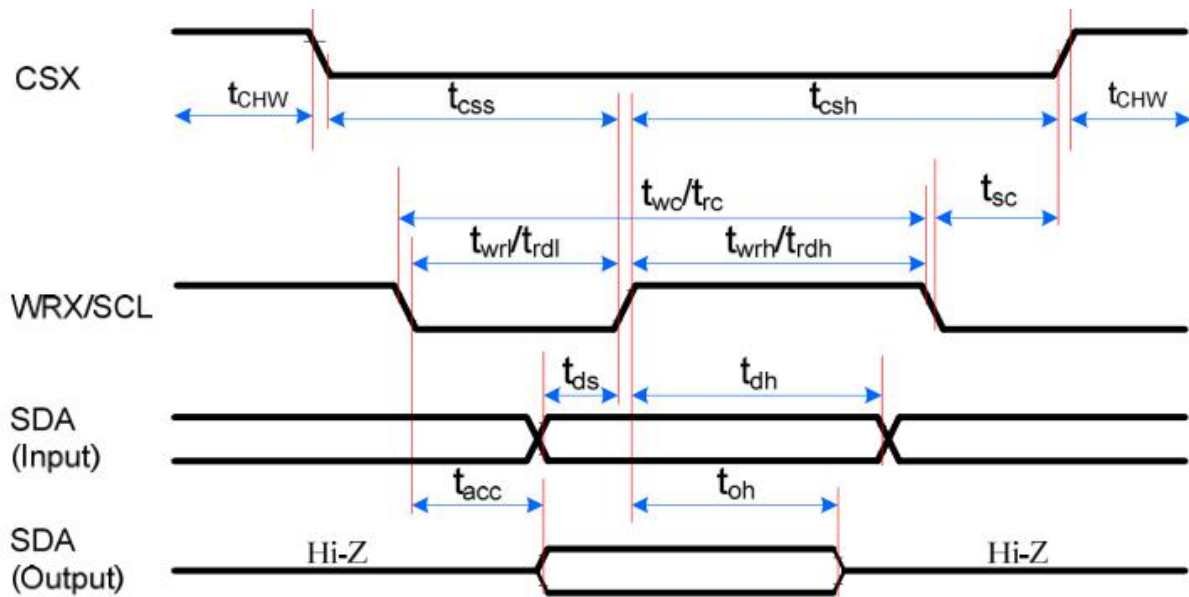
4. The CSX timing:



5. The Write to Read or the Read to Write timing:

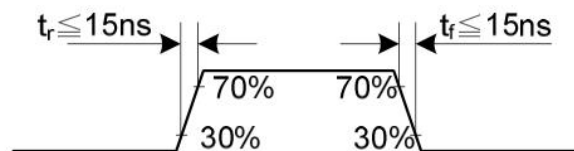


6-2 SPI 3L 接口时序特性 / SPI 3L interface timing characteristics

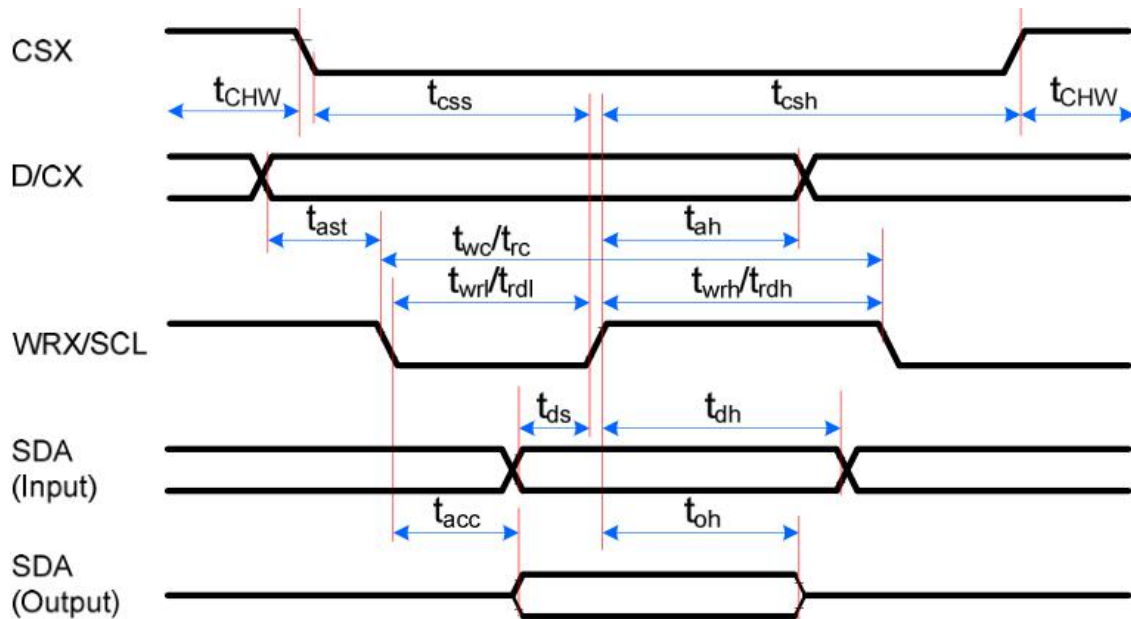


Signal	Symbol	Parameter	min	max	Unit	Description
CSX	t_{sc}	SCL-CSX	15	-	ns	
	t_{chwh}	CSX H Pulse Width	40	-	ns	
	t_{csw}	Chip select time (Write)	60	-	ns	
	t_{csh}	Chip select hold time (Read)	65	-	ns	
SCL	t_{wc}	Serial Clock Cycle (Write)	66	-	ns	
	t_{wrh}	SCL H Pulse Width (Write)	15	-	ns	
	t_{wrl}	SCL L Pulse Width (Write)	15	-	ns	
	t_{rc}	Serial Clock Cycle (Read)	150	-	ns	
	t_{rdh}	SCL H Pulse Width (Read)	60	-	ns	
	t_{rdl}	SCL L Pulse Width (Read)	60	-	ns	
SDA/SDI (Input)	t_{ds}	Data setup time (Write)	10	-	ns	
	t_{dh}	Data hold time (Write)	10	-	ns	
SDA/SDO (Output)	t_{acc}	Access time (Read)	10	50	ns	For maximum CL=30pF
	t_{oh}	Output disable time (Read)	15	50	ns	For minimum CL=8pF

Note: $T_a = -30$ to 70 °C, $IOVCC = 1.65V$ to $3.6V$, $VCI = 2.5V$ to $3.6V$, $AGND = DGND = 0V$, $T = 10 \pm 0.5ns$

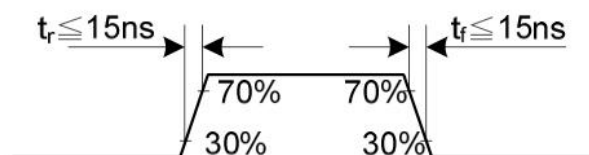


6-3 SPI 4L 接口时序特性 / SPI 4L interface timing characteristics



Signal	Symbol	Parameter	min	max	Unit	Description
CSX	tsc	SCL-CSX	15	-	ns	
	tchw	CSX H Pulse Width	40	-	ns	
	tcss	Chip select time (Write)	60	-	ns	
	tcsh	Chip select hold time (Read)	65	-	ns	
SCL	twc	Serial Clock Cycle (Write)	66	-	ns	
	twrh	SCL H Pulse Width (Write)	15	-	ns	
	twrl	SCL L Pulse Width (Write)	15	-	ns	
	trc	Serial Clock Cycle (Read)	150	-	ns	
	trdh	SCL H Pulse Width (Read)	60	-	ns	
	trdl	SCL L Pulse Width (Read)	60	-	ns	
SDA/SDI (Input)	tds	Data setup time (Write)	10	-	ns	
	tdh	Data hold time (Write)	10	-	ns	
SDA/SDO (Output)	tacc	Access time (Read)	10	50	ns	For maximum CL=30pF
	toh	Output disable time (Read)	15	50	ns	For minimum CL=8pF

Note: Ta = -30 to 70 °C, IOVCC = 1.65V to 3.6V, VCI = 2.5V to 3.6V, AGND = DGND = 0V, T = 10+/-0.5ns



七、可靠性测试 RELIABILITY TEST

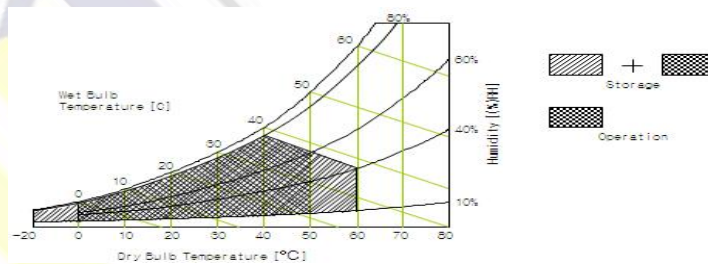
7-1 温度和湿度 Temperature and Humidity

测试项目 TEST ITEMS	条件 CONDITIONS	注释 NOTE
高温储存 High Temperature Storage	Ta=+80 o C, 240hrs	
低温储存 Low Temperature Storage	Ta=-30 o C, 240hrs	
高温运行试验 High Temperature Operation	Ta=+70 o C, 240hrs	
低温运行试验 Low Temperature Operation	Ta=-20 o C, 240hrs	
高温高湿（运行测试） High Temperature and High Humidity (Operating)	Ta=+60 o C, 90%RH, 240hrs	

注释 Note:

1. 液晶驱动电压。由于液晶材料的特性，该电压随环境温度而变化。Liquid Crystal driving voltage. Due to the characteristics of LC Material, this voltage varies with environmental temperature.

2. 温度和相对湿度范围如下图所示。湿球温度最高应为39℃。 并且没有冷凝水。Temperature and relative humidity range are shown in the figure below. Wet bulb temperature should be 39 °C max. and no condensation of water.



3. 产品经可靠性测试后，仅保证功能正常，无任何致命缺陷（不显示、线路缺陷、显示异常等）。After the reliability test, the product only guarantee function normally without any fatal defect (non-display, line defect, abnormal display etc).

7-2 冲击和振动 Shock and Vibration

测试项目 TEST ITEMS	条件 CONDITIONS
包装冲击(非操作) 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
包装振动(非操作) 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 静电放电测试 Electrostatic Discharge

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

测量点 Measure Point:

1. LCD玻璃和金属边框 LCD glass and metal bezel
2. 连接器引脚 IF connector pins

八、处理和注意事项 HANDLING & CAUTIONS

8-1 操作注意事项 Caution For Operation

◆由于液晶模组是玻璃材质，请勿对其施加强烈的机械冲击或静载荷。请小心搬运，因为冲击、振动和粗心的搬运可能会严重影响产品。如果从高处坠落或受到强烈冲击，玻璃可能碎了。

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.

◆在规定的电压限制内驱动 LCM 是必不可少的，因为高于限制的电压会导致 LCM 的寿命缩短。由直流引起的电化学反应会导致 LCM 出现不良劣化，因此应避免使用直流驱动。

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.

◆请勿在电源开启时将 LCM 连接到系统或从系统断开连接。

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

◆切勿在高温高湿的异常条件下使用 LCM。

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

◆当暴露于剧烈的温度波动（热到冷或冷到热）时，LCM可能会受到影响；具体来说，从冷到热的剧烈温度波动会在 LCM 表面产生露水，这可能会影响 LCM 上偏振片的运行。

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.

◆在低于工作温度范围的温度下，响应时间将极度延迟，另一方面，在高于其工作范围的温度下，LCM 可能会变黑。然而，这些现象并不意味着 LCM 出现故障或故障。一旦温度恢复到正常运行的推荐温度范围，LCM 将恢复正常运行。

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.

◆为防止LCD产生图像残留，在使用常黑面板时不要长时间显示固定图案。如果LCD需要显示固定图案，建议时间少于 2 分钟或者更短的时间内刷新显示内容一次或多次。强烈建议使用黑色图像或移动图像作为屏幕保护程序。

In order to prevent the LCD from producing image retention, do not display a fixed pattern for a long time when using a normally black panel. If the LCD needs to display a fixed pattern, it is recommended to refresh the display one or more times in less

than 2 minutes or less. It is strongly recommended to use a black image or moving image as a screen saver.

8-2 防静电措施 Caution Against Static Charge

◆LCM 使用 C-MOS LSI 驱动器，因此建议客户将任何未使用的输入端连接到 Vdd 或 Vss，上电前不要输入任何信号，并将您的身体、工作/装配区、装配设备接地 防止静电。

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.

◆缓慢去除保护膜，保持去除方向与面板表面不垂直约 30 度，如有可能，在离子风机等 ESD 控制装置下，工作室湿度应保持在 50%RH 以上，以减少静电风险

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.

◆避免使用合成纤维制成的工作服。我们推荐棉质衣服或其他经过导电处理的纤维。

Avoid the use work clothing made of synthetic fibers. We recommend cotton clothing or other conductivity-treated fibers.

◆在处理 LCM 时，请戴上不带电材料的手套。对地导电手腕和对地导电鞋是必需的

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

九、初始化代码 LCD display initialization code

```
Void Panel_Initial_code(void)
{
    //分辨率: 320x320
    //接口: MCU/SPI

    WriteComm(0xE0);
    WriteData(0x00);WriteData(0x07);WriteData(0x0F);WriteData(0x04);WriteData(0x11);
    WriteData(0x06);WriteData(0x39);WriteData(0x67);WriteData(0x4E);WriteData(0x02);
    WriteData(0x0A);WriteData(0x09);WriteData(0x2D);WriteData(0x33);WriteData(0x0F);
    WriteComm(0xE1);
    WriteData(0x00);WriteData(0x0F);WriteData(0x14);WriteData(0x03);WriteData(0x10);
    WriteData(0x06);WriteData(0x33);WriteData(0x34);WriteData(0x45);WriteData(0x06);
    WriteData(0x0E);WriteData(0x0C);WriteData(0x2A);WriteData(0x30);WriteData(0x0F);

    WriteComm(0xC0); WriteData(0x14);WriteData(0x14);
    WriteComm(0xC1); WriteData(0x45);
    WriteComm(0xC5); WriteData(0x00);WriteData(0x55);WriteData(0x80);

    WriteComm(0x36); WriteData(0x08);
    WriteComm(0x3A); WriteData(0x55); //Interface Pixel Format

    WriteComm(0xB1); WriteData(0xB0);WriteData(0x11); //Frame rate 60HZ
    WriteComm(0xB4); WriteData(0x02);
    WriteComm(0xB6); WriteData(0x02);WriteData(0x02);

    WriteComm(0xE9); WriteData(0x00);
    WriteComm(0xF7); WriteData(0xA9);WriteData(0x51);WriteData(0x2C);WriteData(0x82);

    WriteComm(0x2a); WriteData(0x00);WriteData(0x00);WriteData(0x01);WriteData(0x3f);
    WriteComm(0x2b); WriteData(0x00);WriteData(0xa0);WriteData(0x01);WriteData(0xdf);

    WriteComm(0x21);
    WriteComm(0x11);
    Delay(120);
    WriteComm(0x29);
}
```

```
#define ROW 320 //显示的列数
#define COL 320 //显示的行数

void BlockWrite(unsigned int Xstart,unsigned int Xend,unsigned int Ystart,unsigned
int Yend) reentrant
{
    WriteComm(0x2a);WriteData(Xstart>>8);WriteData(Xstart&0xff);WriteData(Xend>>8);
    WriteData(Xend&0xff);

    WriteComm(0x2b);WriteData(Ystart>>8);WriteData(Ystart&0xff);WriteData(Yend>>8);
    WriteData(Yend&0xff);

    WriteComm(0x2c);
}

void DispColor(unsigned int color)
{
    unsigned int i, j;
    BlockWrite(0, COL-1, 0, ROW-1);

    CS0=0;
    RS=1;
    RDO=1;

    DBH=color>>8;
    DBL=color;

    for(i=0;i<ROW;i++)
    {
        for(j=0;j<COL;j++)
        {
            WRO=0;
            WRO=1;
        }
    }
    CS0=1;
}
```

```
Void EnterSleep_Code(void)
{
WriteComm(0x28) //Display off
Delays(10);
WriteComm(0x10); // Internal oscillator will be stopped
Delays(120);
}
```

```
Void ExitSleep_Code(void)
{
WriteComm(0x11); // Sleep out
Delays(120);
WriteComm(0x29) //Display on
}
```

--END--