LCD Module Instructions

产品描述 Product Description	TFT LCD Module 480 x 3RGB x 272 Dots 4.3 Inch TFT LCD

一、基本特征 General Feature:

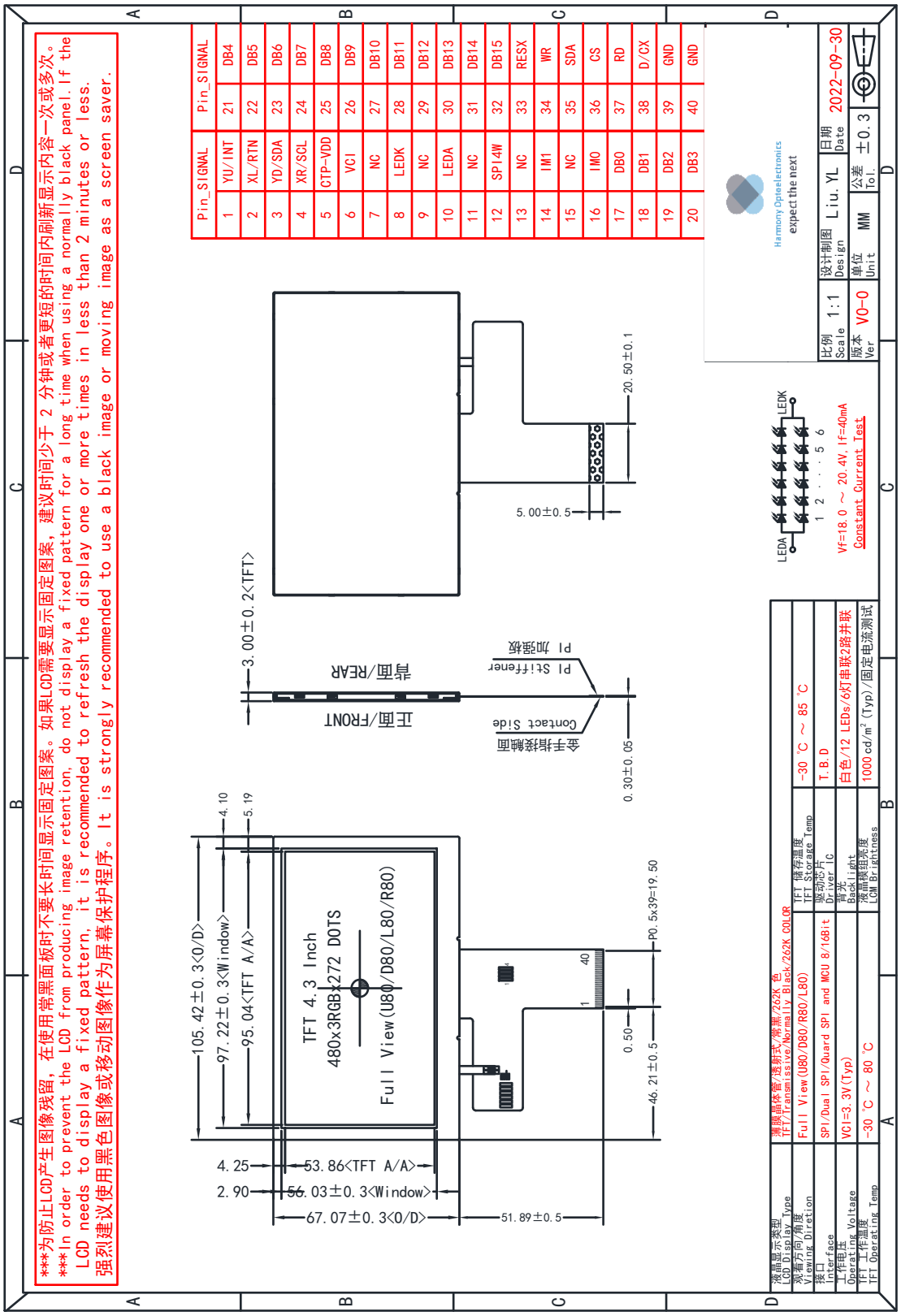
项目 Item	标准值 Standard Value			单位 Unit
显示尺寸 Display Size	4.3			英寸 Inch
分辨率 Number of Pixels	480（H）*3(RGB)* 272（V）			点 dots
显示区域 Active Area	95.04（H）* 53.86（V）			毫米 mm
外形尺寸 Outline Dimension	105.46(H) * 67.11(V) * 3.00(D)<TFT> 105.46(H) * 67.11(V) * 4.60(D)<TFT+CTP> 105.46(H) * 67.11(V) * 4.30(D)<TFT+CTP>			毫米 mm
观看方向 Viewing Direction	全 视角 FULL O'clock			-
端口 Interface	支持 SPI/双 SPI/Quard SPI 和 MCU 8 位和 16 位接口 Supports SPI/Dual SPI/Quard SPI and MCU 8-bit and 16-bit interfaces			-
驱动芯片 Driver IC	T.B.D			-
驱动电压 Driver Condition	VCI=3.3V(Typ)			伏 V
背光 Backlight	白色 LED/12 颗/6 颗串联 2 路并联 White LED/12 PCS/6 PCS serial 2 ways parallel			-
触摸屏 Touch Panel	☑不带触摸屏 Without TP	☑带电阻触摸屏 With RTP	☑带电容触摸屏 With CTP	-
电容触摸屏驱动芯片 CTP Driver IC	GT911			-
电容触摸屏驱动电压 CTP Driver Condition	VDD=3.3V			伏 V
TFT 工作环境温度 TFT Operation AT	-30 ～ +80			摄氏度 ℃
TFT 储存环境温度 TFT Storage AT	-30 ～ +85			摄氏度 ℃

注释 Note:

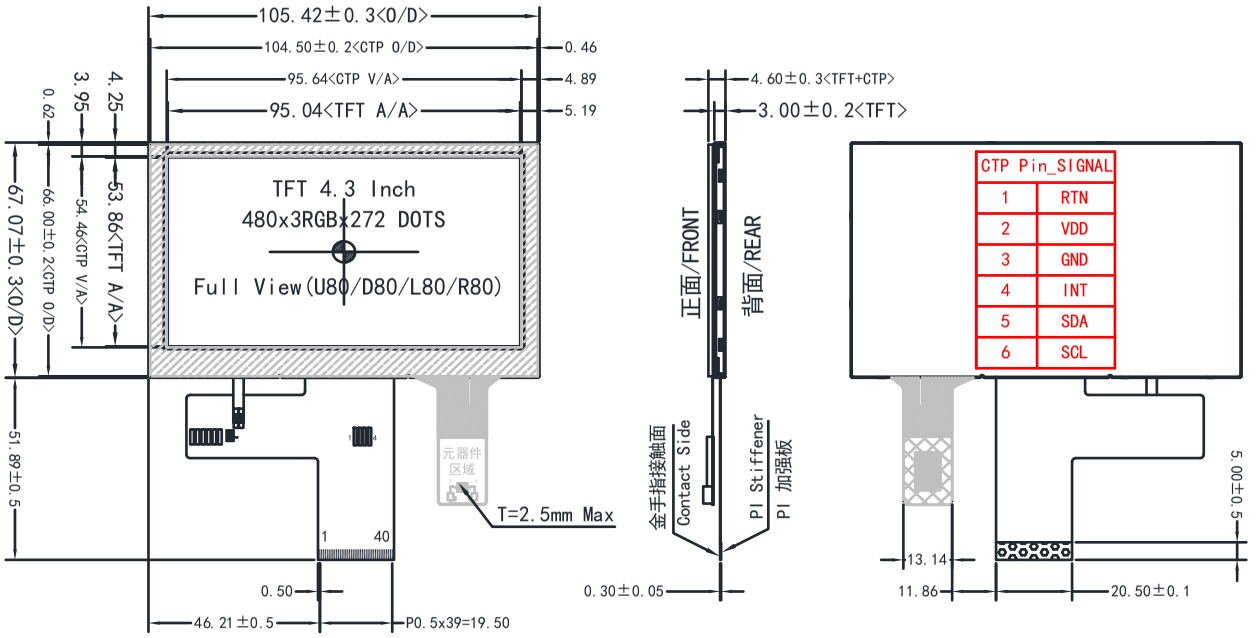
1、建议 TFT 模组不要长时间在最高环境温度或最高亮度状态下工作，否则会影响 TFT 模组的使用寿命和性能

It is recommended that TFT modules do not work at maximum ambient temperature or maximum luminance for long periods of time, which would otherwise affect the useful life and performance of TFT modules

二、外形尺寸 Outline Dimensions



***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。
***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.
强烈建议使用黑色图像或移动图像作为屏幕保护程序。It is strongly recommended to use a black image or moving image as a screen saver.



CTP Pin_SIGNAL	
1	RTN
2	VDD
3	GND
4	INT
5	SDA
6	SCL

Pin_SIGNAL		Pin_SIGNAL	
1	YU/INT	21	DB4
2	XL/RTN	22	DB5
3	YD/SDA	23	DB6
4	XR/SCL	24	DB7
5	CTP-VDD	25	DB8
6	VCI	26	DB9
7	NC	27	DB10
8	LEDK	28	DB11
9	NC	29	DB12
10	LEDA	30	DB13
11	NC	31	DB14
12	SPI4W	32	DB15
13	NC	33	RESX
14	IM1	34	WR
15	NC	35	SDA
16	IM0	36	CS
17	DB0	37	RD
18	DB1	38	D/CX
19	DB2	39	GND
20	DB3	40	GND

*CTP 搭配一条同面FFC使用 (L=100mm)
*CTP used with one same side FFC (L=100mm)

液晶显示类型 LCD Display Type	薄膜晶体管/透射式/常黑/262K 色 TFT/Transmissive/Normally Black/262K COLOR		
观看方向/角度 Viewing Diretion	Full View(U80/D80/R80/L80)	TFT 储存温度 TFT Storage Temp	-30 ℃ ～ 85 ℃
接口 Interface	SPI/Dual SPI/Quard SPI and MCU 8/16Bit	驱动芯片 Driver IC	T.B.D
工作电压 Operating Voltage	VCI=3.3V(Typ)	背光 Backlight	白色/12 LEDs/6灯串联2路并联
TFT 工作温度 TFT Operating Temp	-30 ℃ ～ 80 ℃	液晶模组亮度 LCM Brightness	850 cd/m² (Typ)/固定电流测试

Vf=18.0 ～ 20.4V, If=40mA
Constant Current Test

Harmony Optoelectronics
expect the next

比例 Scale	1:1	设计制图 Design	Liu.YL	日期 Date	2022-12-14
版本 Ver	V0-1	单位 Unit	MM	公差 Tol.	±0.3

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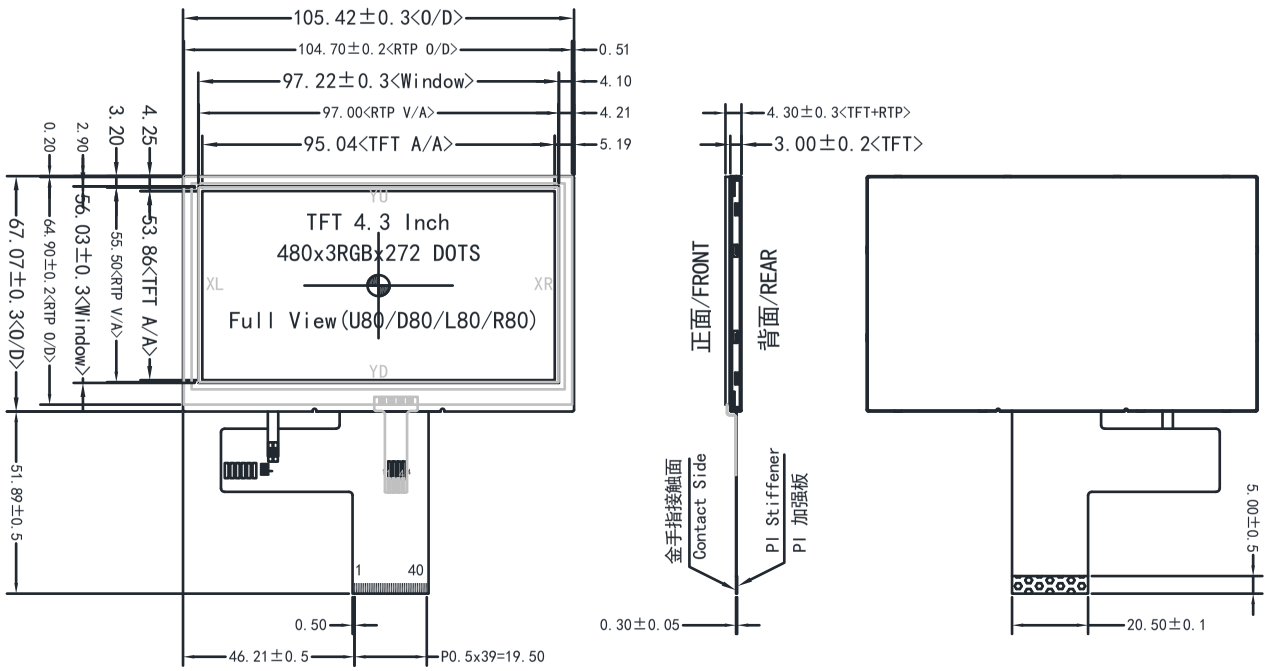

Pin	SIGNAL	Pin	SIGNAL
1	YU/INT	21	DB4
2	XL/RTN	22	DB5
3	YD/SDA	23	DB6
4	XR/SCL	24	DB7
5	CTP-VDD	25	DB8
6	VCI	26	DB9
7	NC	27	DB10
8	LEDK	28	DB11
9	NC	29	DB12
10	LEDA	30	DB13
11	NC	31	DB14
12	SPI4W	32	DB15
13	NC	33	RESX
14	IM1	34	WR
15	NC	35	SDA
16	IM0	36	CS
17	DB0	37	RD
18	DB1	38	D/CX
19	DB2	39	GND
20	DB3	40	GND

注释1：电阻触摸屏除少许银浆线路，其它部分为透明，能看到铁框开窗
Note 1: Resistor touch in addition to a little silver paste line, the other parts of the transparent, you can see the iron frame open window

液晶显示类型 LCD Display Type	薄膜晶体管/透射式/常黑/262K 色 TFT/Transmissive/Normally Black/262K COLOR		
观看方向/角度 Viewing Diretion	Full View(U80/D80/R80/L80)	TFT 储存温度 TFT Storage Temp	-30 ℃ ～ 85 ℃
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Vf=18.0 ～ 20.4V, If=40mA
Constant Current Test

Harmony Optoelectronics
expect the next

比例 Scale	1:1	设计制图 Design	Liu. YL	日期 Date	2022-12-14
版本 Ver	V0-2	单位 Unit	MM	公差 Tol.	±0.3

三、引脚说明 Pin Description

3.1.模组引脚说明 TFT Pin Description

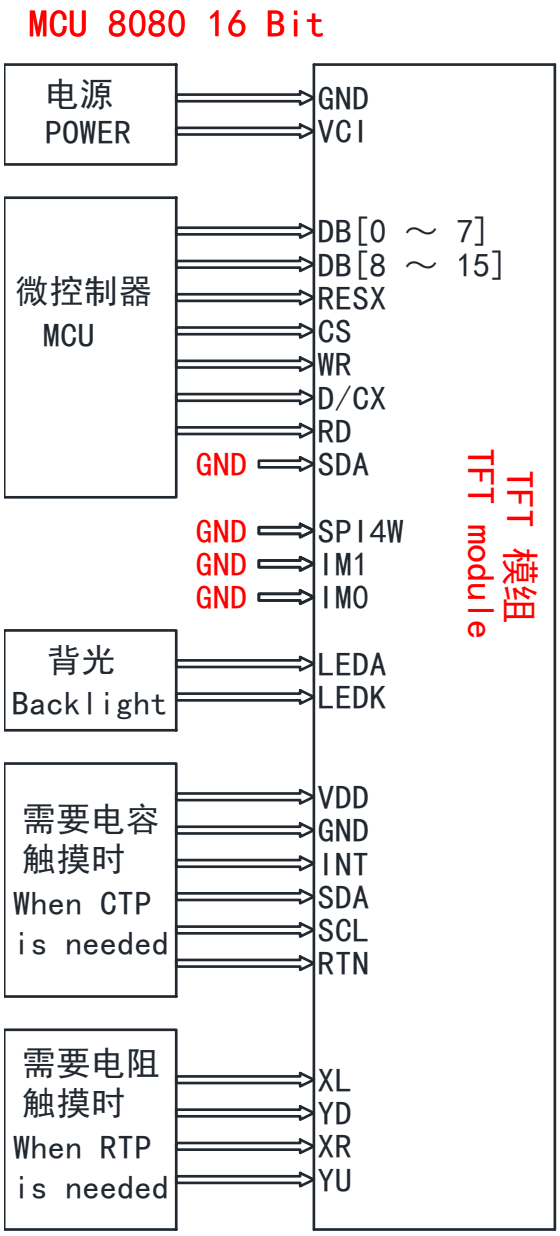
引脚编号 Pin NO.	标号 Symbol	详细描述 Description
1	YU/INT	电阻触摸控制引脚，不使用时不连接 Res touch control pins, not connected when not in use
2	XL/RTN	电阻触摸控制引脚，不使用时不连接 Res touch control pins, not connected when not in use
3	YD/SDA	电阻触摸控制引脚，不使用时不连接 Res touch control pins, not connected when not in use
4	XR/SCL	电阻触摸控制引脚，不使用时不连接 Res touch control pins, not connected when not in use
5	CTP-VDD	电容触摸电源 CTP Power supply
6	VCI	电源 Power supply
7	NC	不连接 No connection
8	LEDK	LED阴极 LED cathode
9	NC	不连接 No connection
10	LEDA	LED阳极 LED anode
11	NC	不连接 No connection
12	SPI4W	标准 SPI 3/4线选择 Standard SPI 3/4-wire Select. SPI4W="VCI", 4-wire SPI.SPI4W="GND", 3-wire SPI
13	NC	不连接 No connection
14	IM1	接口选择，由IM【1 ～ 0】引脚设置 Interface selection, set by IM [1 ～ 0] pins
15	NC	不连接 No connection
- 接下页 - - Continued on next page -		

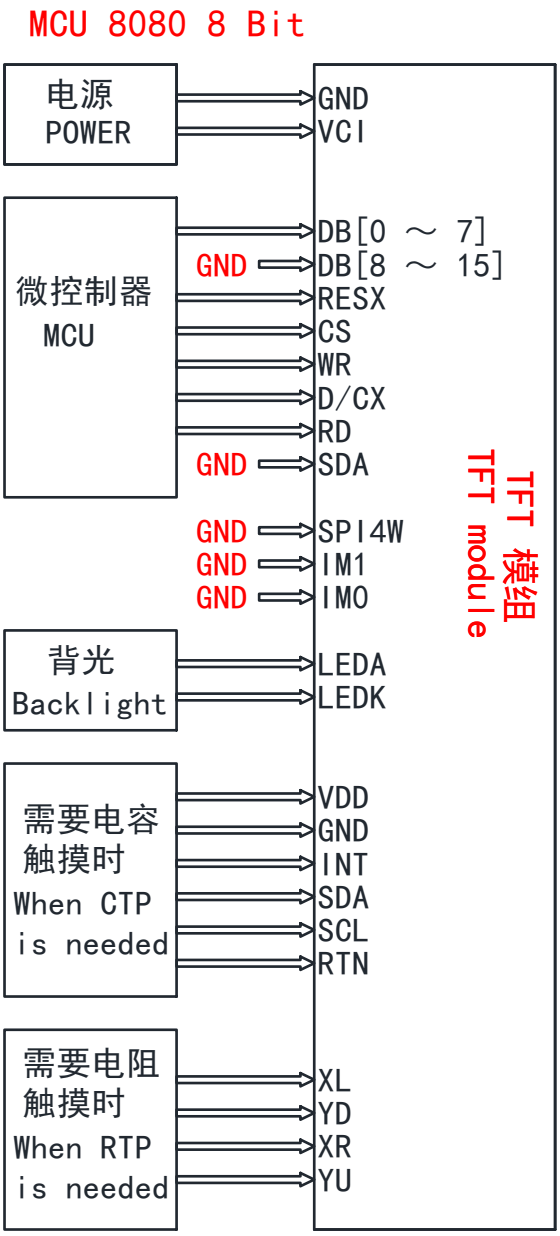
引脚编号 Pin NO.	标号 Symbol	详细描述 Description
16	IM0	接口选择，由IM【1 ～ 0】引脚设置 Interface selection, set by IM [1 ～ 0] pins
17 ～ 24	DB[0 ～ 7]	并行接口数据总线 Parallel Interface Data Bus
25 ～ 32	DB[8 ～15]	并行接口数据总线 Parallel Interface Data Bus
33	RESX	全局复位。低电平有效，内部拉高 Global reset. Active low, Internal pull high
34	WR	●在MCU并行接口中写启用 Write enable in the MCU parallel interface ●在SPI接口中时钟输入，内部拉高 Clock input in SPI interface, pull high internally
35	SDA	串行通信数据输入和输出，内部拉低。 Serial communication data input and output, internal pull low.
36	CS	片选，内部拉高 Chip select, internal pull high
37	RD	在MCU并行接口中读取使能输入，内部拉高。 Read the enable input in the MCU parallel interface and pull it high internally.
38	D/CX	数据或命令标志，内部拉高。 Data or Command flag,Internal pull high. DCX = “VCI” is data; DCX = “GND” is command
39 ～ 40	GND	电源地 Power supply ground
- 结束 - - END -		

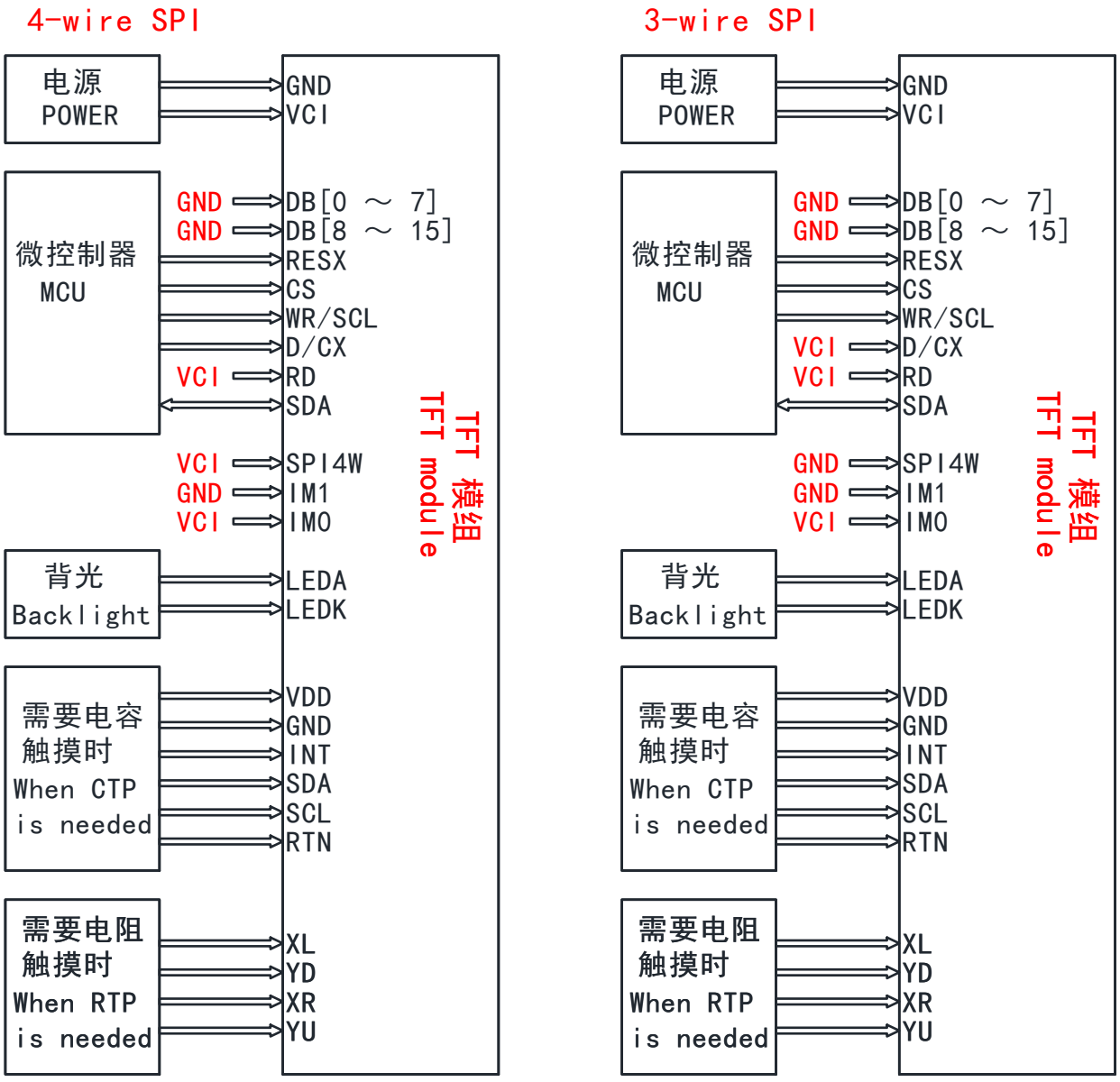
3.2. CTP 引脚说明 CTP Pin Description

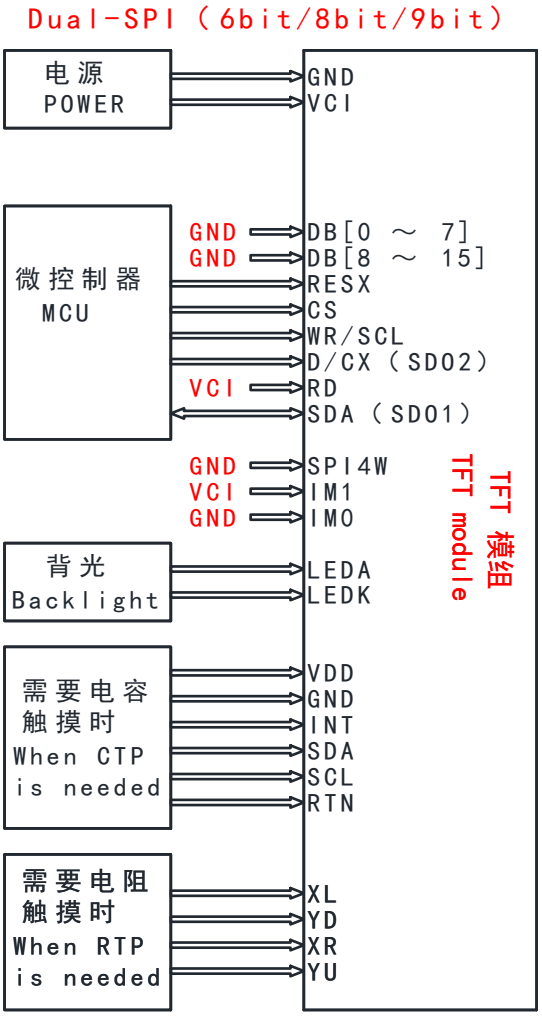
引脚编号 Pin NO.	标号Symbol	详细描述 Description
1	RTN	系统复位 System reset
2	VDD	电源 Power supply
3	GND	电源地 Power supply ground
4	INT	中断信号 Interrupt signal
5	SDA	IIC数据信号 IIC data signal
6	SCL	IIC时钟信号 IIC clock signal
- 结束 - - END -		

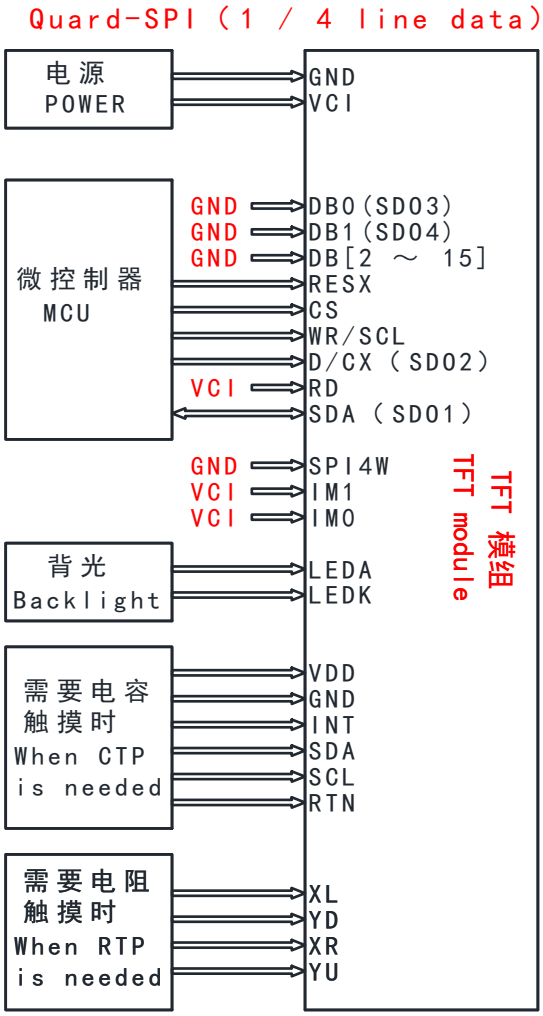
3.3. 引脚连接说明 Pin Connection Descriptio






4-wire SPI
电源
POWER
GND
VCI
微控制器
MCU
GND
GND
DB[0 ～ 7]
DB[8 ～ 15]
RESX
CS
WR/SCL
D/CX
VCI
RD
SDA
VCI
GND
VCI
SPI4W
IM1
IM0
TFT 模组
TFT module
背光
Backlight
LEDA
LEDK
需要电容
触摸时
When CTP
is needed
VDD
GND
INT
SDA
SCL
RTN
需要电阻
触摸时
When RTP
is needed
XL
YD
XR
YU
3-wire SPI
电源
POWER
GND
VCI
微控制器
MCU
GND
GND
DB[0 ～ 7]
DB[8 ～ 15]
RESX
CS
WR/SCL
VCI
VCI
D/CX
RD
SDA
GND
GND
VCI
SPI4W
IM1
IM0
TFT 模组
TFT module
背光
Backlight
LEDA
LEDK
需要电容
触摸时
When CTP
is needed
VDD
GND
INT
SDA
SCL
RTN
需要电阻
触摸时
When RTP
is needed
XL
YD
XR
YU





寄存器41H Register 41H	接口 Interface
0x00H	6bit Dual-SPI
0x01H	8bit Dual-SPI
0x02H	9bit Dual-SPI

操作码 OP Code	接口 Interface
0x02H	1L data or cmd QSPI
0x32H	4L data QSPI
0x12H	

说明 1：6/8/9 bit Dual-SPI 选择由寄存器 0x41H

Description 1: 6/8/9 bit Dual-SPI selection by register 0x41H

说明 2: 1 /4 线数据 Quard-SPI 选择由操作码决定

Description 2: 1 /4 line data Quard-SPI selection is determined by opcode

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
数字电源 Digital Power	VCI	-	-0.3	-	4.0	伏 V
接口工作电压 IO Supply Voltage	IOVCC	-	-0.3	-	4.0	伏 V
输入电压范围 Input Voltage Range	VIN	-	-0.3	-	IOVCC +0.3	伏 V

注释 Note:

1. 超过上面列出的极限值可能会导致驱动 IC 永久损坏。 这些值仅用于测试。IC 应在芯片特性条件下正常运行。 如果不满足这些条件，IC 操作可能会出错，可靠性可能会下降。

That the exceeds the Limiting Value listed above it may cause the driver IC permanent damage. These values are for test only. IC should be operated under the Chip Characteristic conditions for normal operation. If these conditions are not met, IC operation may be error and the reliability may be deteriorated.

2. 参数在工作温度范围内有效，除非另有说明。 除非另有说明，所有电压均相对于 GND。

Parameters are valid over operating temperature range unless otherwise specified. All voltages are with respect to GND unless otherwise noted.

3. 确保 IOVCC、VCI 的电压电平始终符合正确的关系：1.7V ≦ IOVCC ≦ VCC ≦ 3.6V。

Insure the voltage levels of IOVCC, VCI, always matches the correct relation: 1.7V ≦ IOVCC ≦ VCC ≦ 3.6V.

4. VIN 应小于或等于 3.6V。 (VIN ≤ 3.6V)。

VIN should be less than or equal to 3.6V. (VIN ≦ 3.6V).

5. 面板显示质量取决于面板负载，在低温/高温下可能有不同的性能。

Panel display quality depends on panel loading, and it may have the different performance at low/high temperature.

4-2 TFT 面板工作条件 TFT Panel 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
数字电源 Digital Power	VCI	-	3.1	3.3	3.6	伏 V
接口工作电压 IO Supply Voltage	IOVCC	-	1.7	-	VCI	伏 V
输入电压范围 Input Voltage Range	VIN	-	3.1	3.3	3.6	伏 V
待机电流 Standby Current	Isc	No Load@ FR=60Hz	-	-	-	微安 uA
工作电流 Operation Current	Ioc		-	-	-	毫安 mA

4-3 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	VF	If=3.2V/20mA /1-chip	18.0	-	20.4	伏 V
工作电流 Forward current	IF		-	40	-	毫安 mA
亮度（带 LCD） Luminance(With LCD)	Lv	Without TP	-	1000	-	坎德拉/平方米 cd/m^2
		With TP	-	850	-	
LED 寿命 LED life time	Hr	Ta=25±3 ℃	20,000	30,000	-	小时 Hour

注释 Note:

1. LED 寿命 (Hr) 定义为在 Ta=25±3 ℃,上表所示的典型电压电流值条件下持续工作直至亮度低于 50% 的时间。

LED life time (Hr) can be defined as the time in which it continues to operate under the condition:Ta=25±3 ℃, typical IL value indicated in the above table until the brightness becomes less than 50%.

2. 以上结果是按 MTBF 計算方式预估判定的 LED 失效时间，实际测试 LED 在 Ta=25±3 ℃点亮 5000H，亮度衰减 8%.

The above results are estimated and judged by the MTBF calculation method of the LED failure time. The actual test LED is lit for 5000H at Ta=25±3 ℃, and the brightness decays by 8%.

五、液晶光学规格 TFT OPTICAL SPECIFICATION

5.1 概述 Overview

光学规格的测试应在暗室（环境亮度 1lux，温度=25 2℃）中使用亮度计系统（测角仪系统和TOPCON BM-5)设备进行测量,测试单元应位于大约 在 θ 和 Φ 等于 0 的视角下,距 LCD 表面 50cm 的距离。 显示面上测量点的中心应保持固定。 测量前背光应工作 30 分钟。

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 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	Θ左/L	CR>10	-	80	-	Deg.	Note 1
		Θ右/R		-	80	-	Deg.	
	垂直 Vertical	Θ上/U		-	80	-	Deg.	
		Θ下/D		-	80	-	Deg.	
对比度 Contrast ratio		CR	Θ = 0°	640	800	-	-	Note2
色域 Color Gamut		CG	CIE1931	45	50	-	%	
白色色度 White Chromaticity		Wx	Θ = 0°	-0.03	0.320	+0.03	-	
		Wy			0.345		-	
色彩还原 Reproduction of color	红 Red	Rx			0.629		-	Note4 (Based on C Light)
		Ry			0.326		-	
	绿 Green	Gx			0.337		-	
		Gy			0.546		-	
	蓝 Blue	Bx			0.136		-	
		By			0.143		-	
响应时间（上升 + 下降） Response Time (Rising + Falling)		Tr＋Tf	Θ = 0° Ta= 25℃	-	30	40	ms	Note5

注释 Note:

1. 视角是对比度大于10的角度。视角确定为相对于光轴的水平或3、9点钟方向和垂直或6、12点钟方向 垂直于 LCD 表面（见图 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. 对比度测量应在 θ= 0 的视角和 LCD 表面的中心进行。 亮度测量时，视场中的所有像素首先设置为白色，然后设置为暗（黑色）状态。（参见图 1）亮度对比度（CR）是通过数学定义的。

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. 透射率是没有 APF 和没有 CG 的值。

Transmittance is the Value without APF and without CG.

4. 上表中规定的色度坐标应由所有像素首先测量的光谱数据计算为红色、绿色、蓝色和白色。 测量应在面板的中心进行。

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. 电光响应时间测量应如图 2 所示，通过打开和关闭“数据”输入信号来进行。 亮度从10%变化到90%所需的时间是Tr，90%到10%是Tf。

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

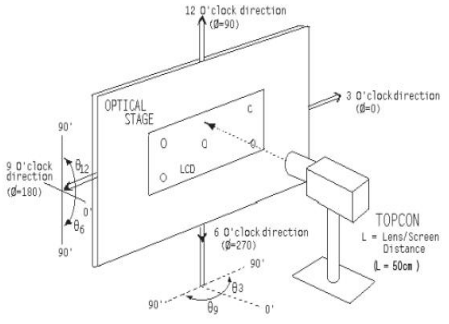


图 1

Optical response

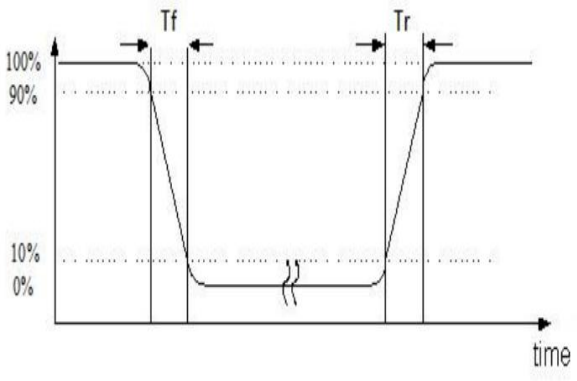
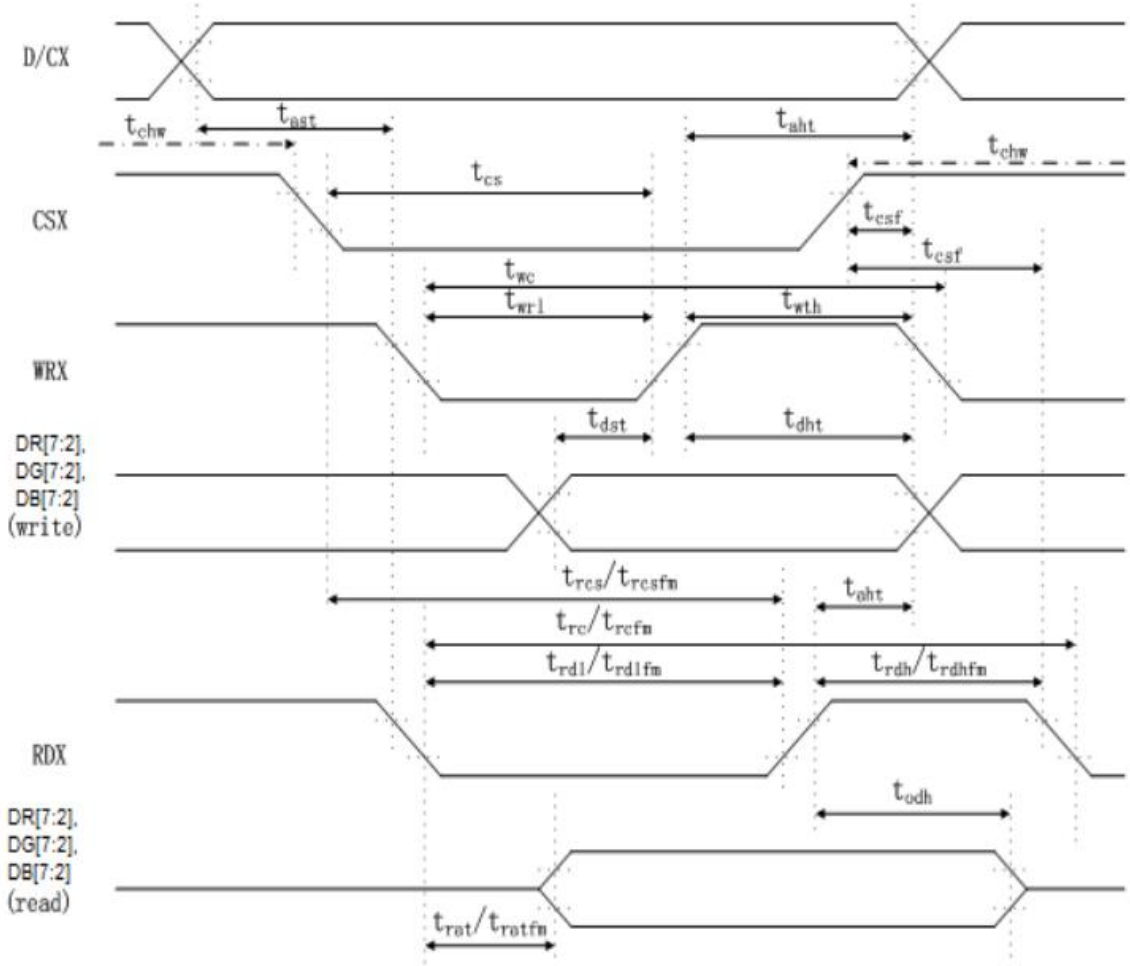


图 2

六、交流特性 AC characteristic

6.1. 时序 Timing

1）并行 MCU 16/8 位 BUS Parallel MCU 16/8-bit BUS



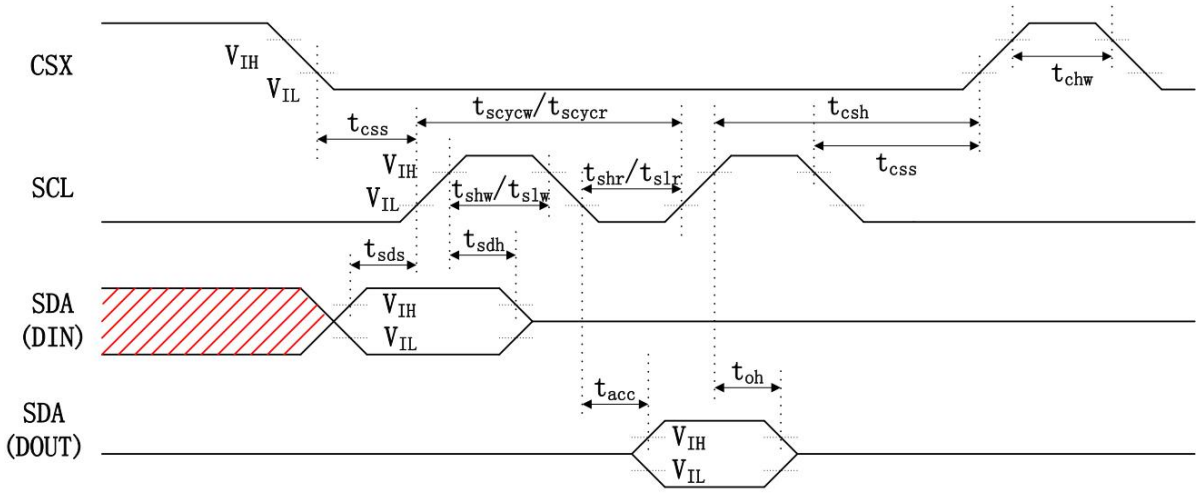
Note: Logic high and low levels are specified as 30% and 70% of IOVCC for Input signals.

Signal	Symbol	Parameter	MIN	MAX	UNIT	Description
D/CX	T_{AST}	Address Setup Time	0		ns	
	T_{AHT}	Address Hold Time (W/R)	10		ns	
CSX	T_{CHW}	"S" "H" Pulse Width	25		ns	
	T_{CS}	Chip Select Setup Time(W)	10		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 (W/R)	10		ns	

Signal	Symbol	Parameter	MIN	MAX	UNIT	Description
WRX	T_{WC}	Write Cycle	50		ns	MCU 16 Bit Format (5-6-5): Twc>100ns (see "6.4.8.") MCU 16 Bit Format (6-6-6): Twc>66ns (see "6.4.9." Figure 6.4.9.4) Other Format Twc>50ns
	T_{WRH}	Control Pulse H Duration	T_{WC} /2		ns	
	T_{WRL}	Control Pulse L Duration	T_{WC} /2		ns	
RDX	T_{RC}	Read Cycle(ID)	160		ns	When Read ID
	T_{RDH}	Control Pulse H Duration(ID)	T_{RC} /2		ns	
	T_{RDL}	Control Pulse L Duration(ID)	T_{RC} /2		ns	
RDX	T_{RCFM}	Read Cycle(FM)	450		ns	When Read From Frame Memory
	T_{RDHFM}	Control Pulse H Duration(FM)	T_{RCFM} /2		ns	
	T_{RDLFM}	Control Pulse L Duration(FM)	T_{RCFM} /2		ns	
DR[7:2], DG[7:2], DB[7:2]	T_{DST}	Data Setup Time	10		ns	CLmax=30pF Clmin=8pF
	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	

2) 显示屏串行接口（SPI/Dual-SPI/Quad-SPI）

Display Serial Interface (SPI/Dual-SPI/Quad-SPI)



Signal	Symbol	Parameter	MIN	MAX	UNIT	Description
CSX	T_{CSS}	Chip Select Setup Time	10		ns	
	T_{CSH}	Chip Select Hold Time	30		ns	
	T_{CHW}	Chip Select "H" Pulse Width	30		ns	
SCL	T_{SCYCW}	Serial Clock Cycle(Write)	12.5		ns	QSPI 4 lane format (5-6-5): T_{SCYCW} >25ns (see "6.4.12.") QSPI 4 lane format (6-6-6): T_{SCYCW} >16ns(see "6.4.13") Other Format T_{SCYCW} >12.5ns
	T_{SHW}	S"L" "H" Pulse Width(Write)	T_{SCYCW} /2		ns	
	T_{SLW}	S"L" "L" Pulse Width(Write)	T_{SCYCW} /2		ns	
	T_{SCYCR}	Serial Clock Cycle(Read)	150		ns	
	T_{SHR}	S"L" "H" Pulse Width(Read)	T_{SCYCR} /2		ns	
	T_{SLR}	S"L" "L" Pulse Width(Read)	T_{SCYCR} /2		ns	
SDA(DIN) /(DOUT)	T_{SDS}	Data Setup Time	5		ns	
	T_{SDH}	Data Hold Time	5		ns	
	T_{ACC}	Access Time	5	50	ns	CLmax=30pF CLmin=8pF
	T_{OH}	Output Disable Time	10		ns	

Signal	Symbol	Parameter	MIN	MAX	UNIT	Description
CSX	T_{CSS}	Chip Select Setup Time	10		ns	
	T_{CSH}	Chip Select Hold Time	30		ns	
	T_{CHW}	Chip Select "H" Pulse Width	30		ns	
SCL	T_{SCYCW}	Serial Clock Cycle(Write)	12.5		ns	
	T_{SHW}	S "L" "H" Pulse Width(Write)	T_{SCYCW} /2		ns	
	T_{SLW}	S "L" "L" Pulse Width(Write)	T_{SCYCW} /2		ns	
	T_{SCYCR}	Serial Clock Cycle(Read)	150		ns	
	T_{SHR}	S "L" "H" "Pulse Width(Read)	T_{SCYCR} /2		ns	
	T_{SLR}	S"L" "L" Pulse Width(Read)	T_{SCYCR} /2		ns	
D/CX	T_{DCS}	D/CX Setup Time	5		ns	
	T_{DCH}	D/CX Hold Time	5		ns	
SDA(DIN) (DOUT)	T_{SDS}	Data Setup Time	5		ns	
	T_{SDH}	Data Hold Time	5		ns	
	T_{ACC}	Access Time	5	50	ns	CLmax=30pF CLmin=8pF
	T_{OH}	Output Disable Time	10		ns	

(1)、四路 SPI 接口 Quad-SPI Interface

TFT 支持四路 SPI 接口用于 MCU 和 TFT 之间的通信。

四个数据通道的串行接口使用。CSX（芯片启用）、WRX（串行时钟）和 SDA（串行数据输入/输出 1）、DCX（串行数据输入 2）、DB0（串行数据输入 3）和 DB1（串行数据输入 4）。

将 IM<1:0>设置为 2'b11 以启用 QSPI 接口。

每个传输有三个部分：操作码（CSX 下降沿后的第一个字节）、地址和数据。操作码用于区分 MCU 和 TFT 之间的不同操作，如下表所示

TFT supports Quad SPI interfaces for communication between MCU and TFT.

Four data lane serial interface use: CSX (chip enable), WRX (serial clock) and SDA (serial data input/output 1), DCX (serial data input 2), DB0 (serial data input 3) and DB1 (serial data input 4).

Set IM<1:0> as 2’b11 to enable QSPI Interface.

Each transmission has three part: op-code (first byte after CSX falling edge), Address and Data.op-code used to distinguish different operations between MCU and TFT, as below table shows

操作码 op-code	操作 Operation	说明 Description
02H	写命令 Write Command	一般来说，这个操作用于写寄存器。 当地址为 "2C "时，下面的数据被确定为 RAM 数据。这不是一个好的选择 因为它的访问速度很慢。 In general, this operation used to write registers.When the address is “2C”, the following data is identified as RAM data. It’s not a good choice because of its slowly accessing rate.
03H	读取命令 Read Command	从 TFT 读取寄存器内容 Read register content from TFT
12H	写 RAM 数据 Write RAM data	地址必须是 "2C"，计时需要 24 个周期 The address must be “2C” and the timing takes 24 cycles
32H	写 RAM 数据 Write RAM data	地址必须是 "2C"，计时需要 6 个周期 The address must be “2C” and the timing takes 6 cycles

注 1：每次传输必须以 CSX 上升沿结束。

Note1: Each transmission must end with CSX rising edge.

初始化代码 Initialization code

```
Void Panel_initial_code(void)
{
    //---------------------Reset sequence----------//
    LCD_RESET=1;
    Delayms(1); //Delay 1ms
    LCD_RESET=0;
    Delayms(10); //Delay 10ms
    LCD_RESET=1;
    Delayms(120);  //Delay 120ms
    //-------------------------------------------------------------------------//
    //H043A22_4.3IPS initcode_pixel 5-6-5 mode--MCU 16bit

    WriteComm(0xff);
    WriteData(0xa5);

    WriteComm(0xE7);
    WriteData(0x10);

    WriteComm(0x35); //TE_ interface_en
    WriteData(0x00);//01

    WriteComm(0x36);       //调整显示方向
    WriteData(0xc0);

    WriteComm(0x3A);       //
    WriteData(0x01);//01---565, 00---666

    WriteComm(0x41);
    WriteData(0x03); //0x00--6bit   SPI
                          //0x01--8bit    SPI/MCU
                          //0x02--9bit    SPI
                          //0x03--16bit   MCU
    WriteComm(0x44);
    WriteData(0x15);

    WriteComm(0x45);
    WriteData(0x15);
```

```
WriteComm(0x7d);
WriteData(0x03);

WriteComm(0xc1);
WriteData(0xbb);

WriteComm(0xc2);
WriteData(0x05);

WriteComm(0xc3);
WriteData(0x10);

WriteComm(0xc6);
WriteData(0x3e);

WriteComm(0xc7);
WriteData(0x25);

WriteComm(0xc8);
WriteData(0x11);

WriteComm(0x7a);
WriteData(0x5f);

WriteComm(0x6f);
WriteData(0x44);

WriteComm(0x78);
WriteData(0x70);

WriteComm(0xc9);
WriteData(0x00);

WriteComm(0x67);
WriteData(0x21);

//gate_ed
WriteComm(0x51);
WriteData(0x0a);
```

```
WriteComm(0x52);
WriteData(0x76);

WriteComm(0x53);
WriteData(0x0a);

WriteComm(0x54);
WriteData(0x76);
////sorce
WriteComm(0x46);
WriteData(0x0a);

WriteComm(0x47);
WriteData(0x2a);

WriteComm(0x48);
WriteData(0x0a);

WriteComm(0x49);
WriteData(0x1a);

WriteComm(0x56);
WriteData(0x43);

WriteComm(0x57);
WriteData(0x42);

WriteComm(0x58);
WriteData(0x3c);

WriteComm(0x59);
WriteData(0x64);

WriteComm(0x5a);
WriteData(0x41);

WriteComm(0x5b);
WriteData(0x3c);
```

```
WriteComm(0x5c);
WriteData(0x02);

WriteComm(0x5d);
WriteData(0x3c);

WriteComm(0x5e);
WriteData(0x1f);

WriteComm(0x60);
WriteData(0x80);

WriteComm(0x61);
WriteData(0x3f);

WriteComm(0x62);
WriteData(0x21);

WriteComm(0x63);
WriteData(0x07);

WriteComm(0x64);
WriteData(0xe0);

WriteComm(0x65);
WriteData(0x02);

WriteComm(0xca);
WriteData(0x20);

WriteComm(0xcb);
WriteData(0x52);

WriteComm(0xcc);
WriteData(0x10);

WriteComm(0xcD);
WriteData(0x42);

WriteComm(0xD0);
```

```
WriteData(0x20);

WriteComm(0xD1);
WriteData(0x52);

WriteComm(0xD2);
WriteData(0x10);

WriteComm(0xD3);
WriteData(0x42);

WriteComm(0xD4);
WriteData(0x0a);

WriteComm(0xD5);
WriteData(0x32);

///test  mode
WriteComm(0xf8);
WriteData(0x03);

WriteComm(0xf9);
WriteData(0x20);

////gammma   0930
WriteComm(0x80);
WriteData(0x00);
WriteComm(0xA0);
WriteData(0x00);

WriteComm(0x81);
WriteData(0x06);
WriteComm(0xA1);
WriteData(0x06);

WriteComm(0x82);
WriteData(0x02);
WriteComm(0xA2);
WriteData(0x02);
```

```
WriteComm(0x86);
WriteData(0x0e);
WriteComm(0xA6);
WriteData(0x0c);

WriteComm(0x87);
WriteData(0x1c);
WriteComm(0xA7);
WriteData(0x1c);

WriteComm(0x83);
WriteData(0x33);
WriteComm(0xA3);
WriteData(0x33);

WriteComm(0x84);
WriteData(0x24);
WriteComm(0xA4);
WriteData(0x24);

WriteComm(0x85);
WriteData(0x3f);
WriteComm(0xA5);
WriteData(0x3f);

WriteComm(0x88);
WriteData(0x0b);
WriteComm(0xA8);
WriteData(0x0b);

WriteComm(0x89);
WriteData(0x14);
WriteComm(0xA9);
WriteData(0x14);

WriteComm(0x8a);
WriteData(0x1a);
WriteComm(0xAa);
WriteData(0x1a);
```

```
WriteComm(0x8b);
WriteData(0x0a);
WriteComm(0xAb);
WriteData(0x0a);

WriteComm(0x8c);
WriteData(0x14);
WriteComm(0xAc);
WriteData(0x08);

WriteComm(0x8d);
WriteData(0x17);
WriteComm(0xAd);
WriteData(0x07);

WriteComm(0x8e);
WriteData(0x16);
WriteComm(0xAe);
WriteData(0x06);

WriteComm(0x8f);
WriteData(0x1b);
WriteComm(0xAf);
WriteData(0x07);

WriteComm(0x90);
WriteData(0x04);
WriteComm(0xB0);
WriteData(0x04);

WriteComm(0x91);
WriteData(0x0a);
WriteComm(0xB1);
WriteData(0x0a);

WriteComm(0x92);
WriteData(0x16);
WriteComm(0xB2);
WriteData(0x15);
```

```
WriteComm(0xff);
WriteData(0x00);

WriteComm(0x21);
WriteData(0x00);

WriteComm(0x11);
WriteData(0x00);

Delay_ms(700);

WriteComm(0x29);
WriteData(0x00);

Delay_ms(100);
}
```