液 晶 模 组 说 明 书

LCD Module Instructions

☑初定规格 Preliminary specification

☐正式规格 Official specifications

项目编号 Project No.	HTM-H043A28-MCU&SPI-A01 Series
产品描述 Product Description	TFT LCD Module 480(RGB)x 272 Pixels 4.3 Inch HTM

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Signature by customer:

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HotDisplay Technology Co.,Ltd

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内容
substance

一、基本特征 General Feature

项目 Item	标准值 Standard Value			单位 Unit
TFT 显示尺寸 TFT Display Size	4.3			英寸 Inch
TFT 分辨率 TFT Number of Pixels	480(RGB) (H) x 272 (V)			像素 Pixel
TFT 显示有效区域 TFT Display Active Area	95.04 (H) x 53.86 (V)			毫米 mm
TFT 模组外形尺寸 TFT Module Dimensions	124.50 (H) x 71.20 (V) x 6.80 (D) <TK+PCB> 124.50 (H) x 71.20 (V) x 8.40 (D) <CTP+TK+PCB>			毫米 mm
TFT 观看方向 TFT Viewing Direction	U85/D85/R85/L85 (Typ.)			度数 Deg.
TFT 模组接口 TFT Module Interfaces	SPI(Default), QSPI, MCU 8Bit			-
TFT 驱动芯片 TFT Driver IC	NV3041			-
电容触摸屏驱动芯片 CTP Driver IC	GT911			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 ℃
触摸屏 Touch Panel	☑不带触摸屏 No TP	☑带电阻触摸屏 Have RTP	☑带电容触摸屏 Have CTP	-

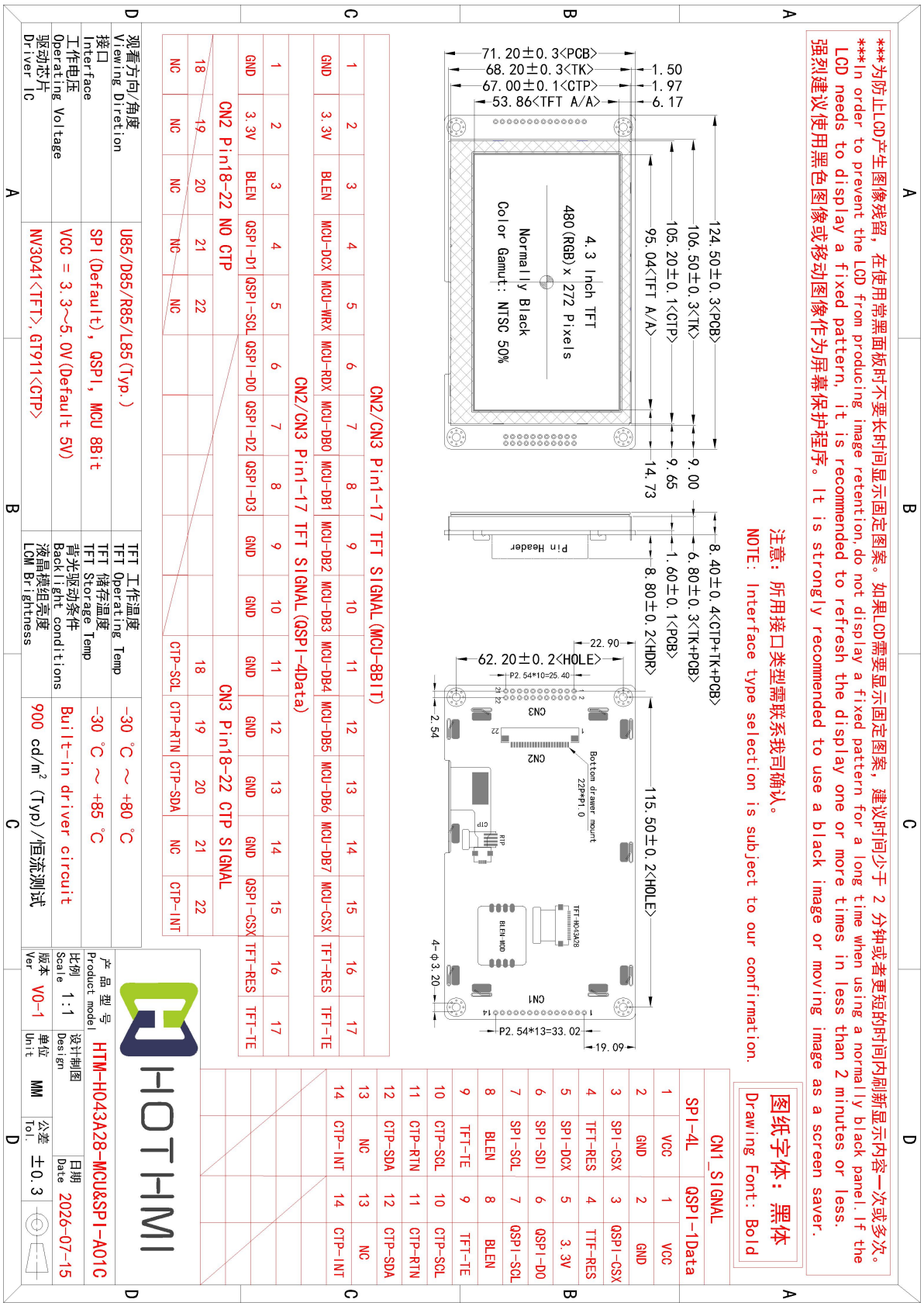
注释 Note:

1. 默认四线标准 SPI 接口，若需要其他接口，请联系我司确认。

Default interface: SPI-4L. Contact us for confirmation if other interfaces are required.

二、外形尺寸 Outline Dimensions

HTM-H043A28-MCU&SPI-A01C_V0-1 <Have CTP_900cd/m²>

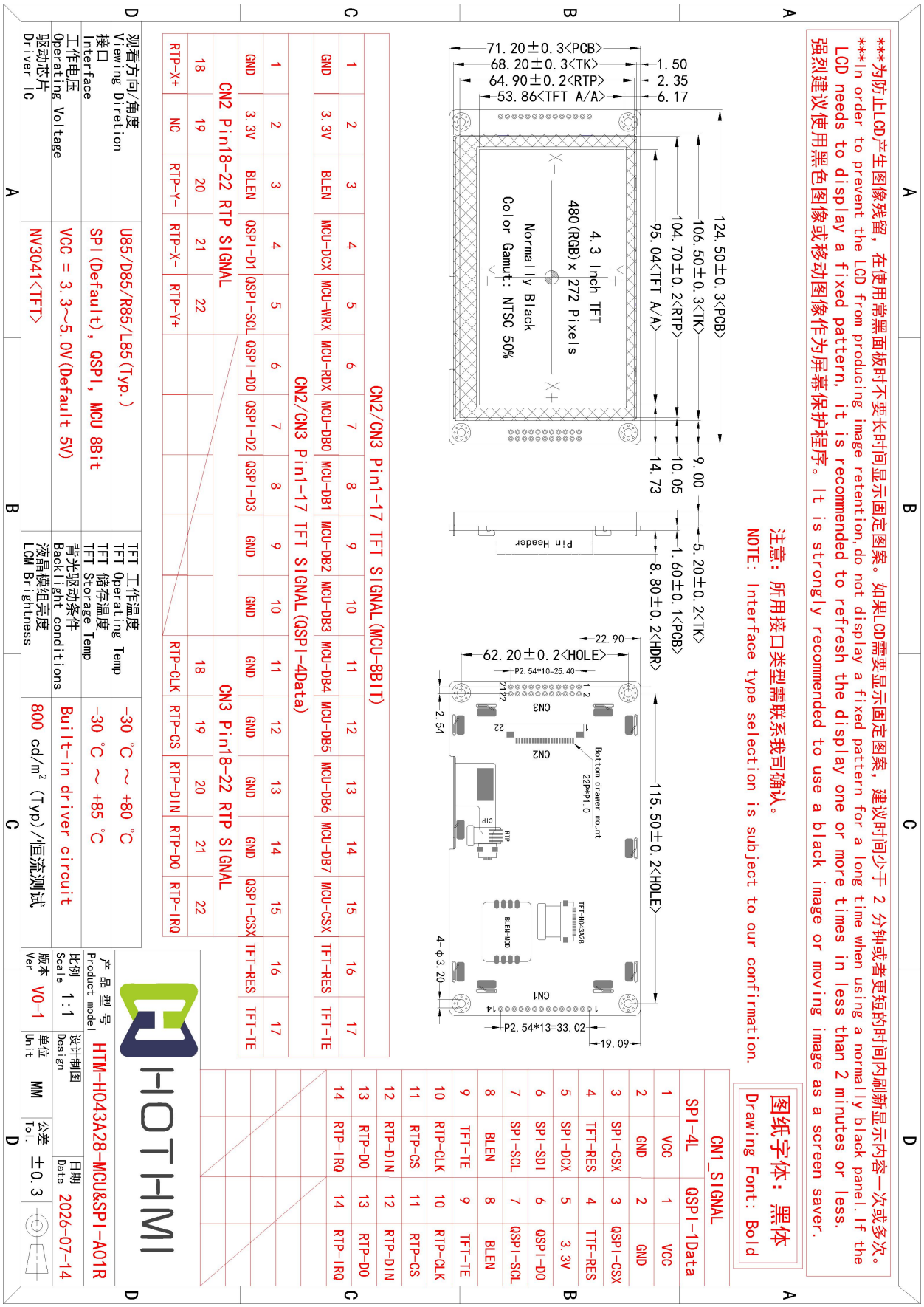


HTM-H043A28-MCU&SPI-A01R_V0-1 <Have RTP_800cd/m²>

***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.

注意：所用接口类型需联系我司确认。
NOTE: Interface type selection is subject to our confirmation.

图纸字体：黑体
Drawing Font: Bold



CN1_SIGNAL			
	SPI-4L	QSPI-1Data	
1	VCC	1	VCC
2	GND	2	GND
3	SPI-CSX	3	QSPI-CSX
4	TFT-RES	4	TFT-RES
5	SPI-DCX	5	3.3V
6	SPI-SDI	6	QSPI-DO
7	SPI-SCL	7	QSPI-SCL
8	BLEN	8	BLEN
9	TFT-TE	9	TFT-TE
10	RTP-CLK	10	RTP-CLK
11	RTP-CS	11	RTP-CS
12	RTP-DIN	12	RTP-DIN
13	RTP-DO	13	RTP-DO
14	RTP-IRQ	14	RTP-IRQ

CN2/CN3 Pin1-17 TFT SIGNAL(MCU-8BIT)																
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
GND	3.3V	BLEN	MCU-DCX	MCU-WRX	MCU-RDX	MCU-DB0	MCU-DB1	MCU-DB2	MCU-DB3	MCU-DB4	MCU-DB5	MCU-DB6	MCU-DB7	MCU-CSX	TFT-RES	TFT-TE

CN2/CN3 Pin1-17 TFT SIGNAL(QSPI-4Data)																
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
GND	3.3V	BLEN	QSPI-D1	QSPI-SCL	QSPI-D0	QSPI-D2	QSPI-D3	GND	GND	GND	GND	GND	GND	QSPI-CSX	TFT-RES	TFT-TE

CN2 Pin18-22 RTP SIGNAL				
18	19	20	21	22
RTP-X+	NC	RTP-Y-	RTP-X-	RTP-Y+

CN3 Pin18-22 RTP SIGNAL				
18	19	20	21	22
RTP-CLK	RTP-CS	RTP-DIN	RTP-DO	RTP-IRQ

观看方向/角度 Viewing Diretion	U85/D85/R85/L85(Typ.)
接口 Interface	SPI(Default), QSPI, MCU 8Bit
工作电压 Operating Voltage	VCC = 3.3~5.0V(Default 5V)
驱动芯片 Driver IC	NV3041<TFT>

TFT 工作温度 TFT Operating Temp	-30 ℃ ~ +80 ℃
TFT 储存温度 TFT Storage Temp	-30 ℃ ~ +85 ℃
背光驱动条件 Backlight conditions	Built-in driver circuit
液晶模组亮度 LCM Brightness	800 cd/m² (Typ)/恒流测试

产品型号 Product model	HTM-H043A28-MCU&SPI-A01R		
比例 Scale	1:1	设计制图 Design	
单位 Unit	MM	日期 Date	2026-07-14
版本 Ver	V0-1	公差 Tol.	±0.3

三、引脚说明 Pin Description

3.1 模组 CN1 引脚说明 HTM CN1 Pin Description

引脚编号 Pin NO.	标号 Symbol	详细描述 Description
1	VCC	电源输入（3.3V-5V，默认5V） Power input(3.3V-5V, Default 5V)
2	GND	电源地 Power supply ground
3	TFT-CSX	芯片选择引脚，低电平使能（SPI/QSPI共用） Chip selection pin,Low enable(SPI/QSPI Shared)
4	TFT-RES	显示屏复位信号，低电平有效 TFT reset signal, active low
5	TFT-DCX	四线SPI接口显示数据/指令选择（三线SPI/QSPI接口拉高） SPI-4L Interface Display data/command selection(SPI-3L and QSPI interfaces pull up)
6	SPI-SDI QSPI-D0	SPI接口写数据引脚 SPI data output pin (MOSI) QSPI数据线第0位 QSPI data line 0
7	TFT-SCL	串行时钟引脚（SPI/QSPI共用） Serial clock pin(SPI/QSPI Shared)
8	BLEN	背光控制（高电平开启，低电平关闭，默认接低） Backlight control (High for ON, Low for OFF; default tied low)
9	TFT-TE	显示屏撕裂效应信号 TFT Tearing Effect Signal
10	RTP-CLK CTP-SCL	电阻触摸屏SPI时钟引脚 RTP SPI clock pin 电容触摸屏IIC时钟引脚 CTP IIC clock pin
11	RTP-CS CTP-RTN	电阻触摸屏片选引脚，低电平使能 RTP chip select pin, active low 电容触摸屏复位引脚 CTP reset pin

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引脚编号 Pin NO.	标号 Symbol	详细描述 Description
12	RTP-DIN CTP-SDA	电阻触摸屏SPI输入引脚 RTP SPI MISO pin 电容触摸屏IIC数据引脚 CTP IIC data pin
13	RTP-DOUT	电阻触摸屏SPI输出引脚 RTP SPI MOSI pin
14	RTP-IRQ CTP-INT	电阻触摸屏中断引脚 RTP interrupt pin 电容触摸屏中断引脚 CTP interrupt pin
引脚1-9为显示屏引脚；引脚10-14为触摸屏引脚（若不使用触摸，可不连接）。 Pins 1－9: Display interface;Pins 10－14: Touch screen interface (not connect when touch is unused).		
- 结束 - - END -		

3.2 模组 CN2/3 引脚说明 HTM CN2/3 Pin Description

引脚编号 Pin NO.	标号 Symbol	详细描述 Description
1	GND	电源地 Power supply ground
2	VDD	电源输入（3.3V） Power input(3.3V)
3	BLEN	背光控制（高电平开启，低电平关闭，默认接低） Backlight control (High for ON, Low for OFF; default tied low)
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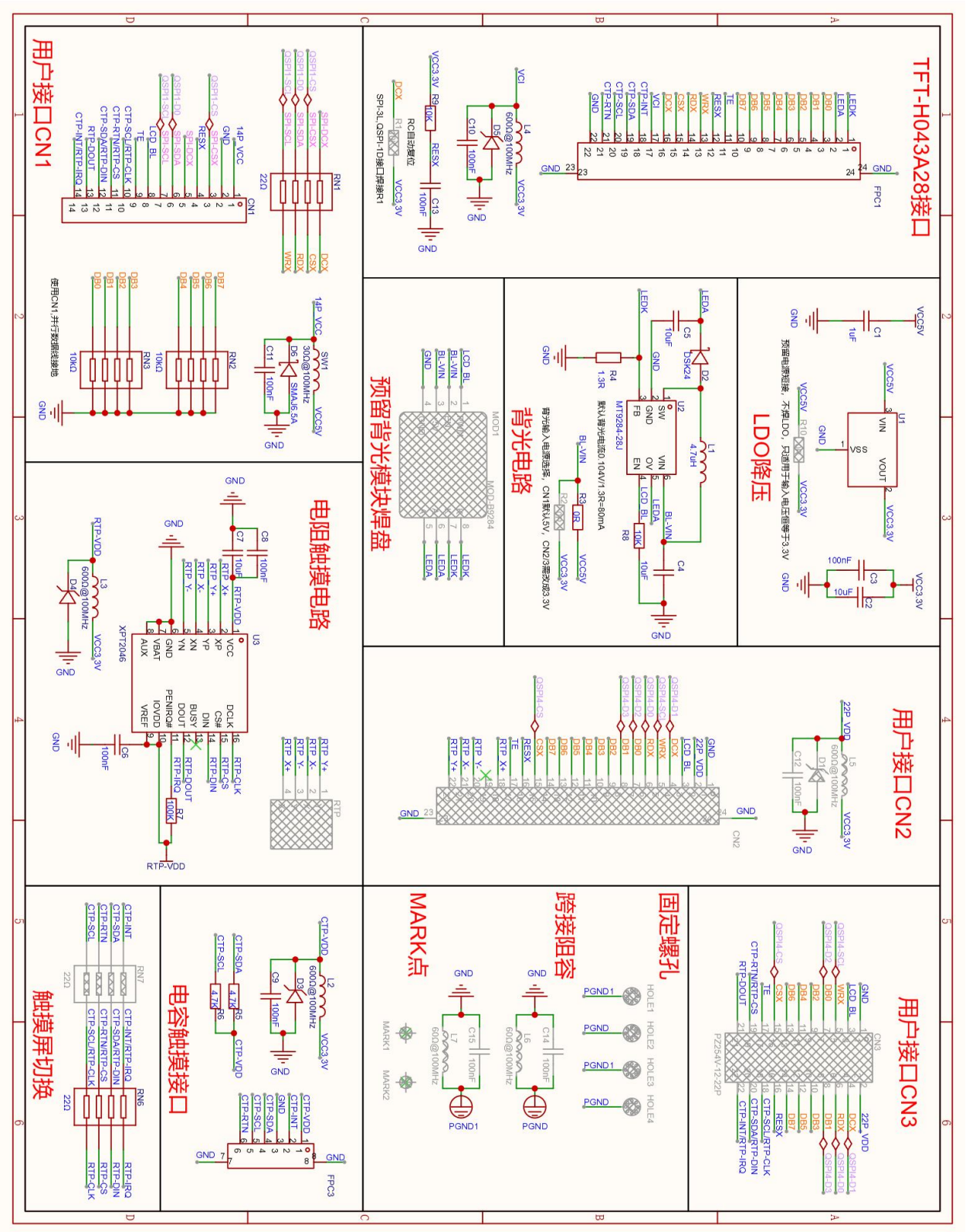
引脚编号 Pin NO.	标号 Symbol	详细描述 Description
4	MCU-DCX QSPI-D1	MCU 8080并行接口显示数据/指令选择 parallel Interface Display data/command selection QSPI数据线第1位 QSPI data line 1
5	MCU-WRX QSPI-SCL	MCU 并行接口的写操作启用 Write enable in MCU parallel interface QSPI 接口时钟引脚 QSPI clock pin
6	MCU-RDX QSPI-D0	MCU 并行接口的读取功能，低电平有效 Read enable in MCU parallel interface, Low-active QSPI数据线第0位 QSPI data line 0
7	MCU-DB0 QSPI-D2	MCU并行接口的数据总线DB0 MCU Parallel Interface Data Bus DB0 QSPI数据线第2位 QSPI data line 2
8	MCU-DB1 QSPI-D3	MCU并行接口的数据总线DB1 MCU Parallel Interface Data Bus DB1 QSPI数据线第3位 QSPI data line 3
9-14	MCU-DB2-7	MCU并行接口的数据总线DB[2-7] MCU Parallel Interface Data Bus DB[2-7]
15	TFT-CSX	芯片选择引脚，低电平使能（MCU/QSPI共用） Chip selection pin,Low enable(MCU/QSPI Shared)
16	TFT-RES	显示屏复位信号，低电平有效 TFT reset signal, active low
17	TFT-TE	显示屏撕裂效应信号 TFT Tearing Effect Signal
↑以上Pin1-17为显示屏引脚，CN2/CN3接口定义相同 Pins 1 - 17 above are display pins, CN2 and CN3 have the same pin definition ↓以下Pin18-22为触摸屏引脚，CN2/CN3接口定义不同 Pins 18 - 22 below are touch panel pins, CN2 and CN3 differ in pin definitions		
- 下一页 - - Next page -		

引脚编号 Pin NO.	标号 Symbol	详细描述 Description
18(CN2)	RTP-X+	电阻触摸"X+"坐标输入 RTP "X+" Position Input
19(CN2)	NC	此引脚未连接，保持悬空 This pin is unconnected and shall remain floating
20(CN2)	RTP-Y-	电阻触摸"Y-"坐标输入 RTP "Y-" Position Input
21(CN2)	RTP-X-	电阻触摸"X-"坐标输入 RTP "X-" Position Input
22(CN2)	RTP-Y+	电阻触摸"Y+"坐标输入 RTP "Y+" Position Input
↑以上 5 行是 CN2 触摸屏引脚 Above 5 rows: CN2 touch panel pins ↓以下 5 行是 CN3 触摸屏引脚 Below 5 rows: CN3 touch panel pins		
18(CN3)	RTP-CLK CTP-SCL	电阻触摸屏SPI时钟引脚 RTP SPI clock pin 电容触摸屏IIC时钟引脚 CTP IIC clock pin
19(CN3)	RTP-CS CTP-RTN	电阻触摸屏片选引脚，低电平使能 RTP chip select pin, active low 电容触摸屏复位引脚 CTP reset pin
20(CN3)	RTP-DIN CTP-SDA	电阻触摸屏SPI输入引脚 RTP SPI MISO pin 电容触摸屏IIC数据引脚 CTP IIC data pin
21(CN3)	RTP-DOUT	电阻触摸屏SPI输出引脚 RTP SPI MOSI pin
22(CN3)	RTP-IRQ CTP-INT	电阻触摸屏中断引脚 RTP interrupt pin 电容触摸屏中断引脚 CTP interrupt pin
- 结束 - - END -		

3.4 参考电路图 Reference Circuit Diagram



说明 1：为了方便调试，我司可以提供配套的开发板

Note 1: For debugging convenience, we can provide a supporting development board.

四、电气特性 Electrical Characteristics

4-1 HTM 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
HTM 输入电源 CN1 Module power input	VCC	-	3.3	5.0	5.5	伏 V
HTM 输入电源 CN2/3 Module power input	VDD	-	-	3.3	-	伏 V
TFT 输入电源 TFT power input	VCI	-	3.0	-	3.3	伏 V
TFT 接口工作电压 IO Supply Voltage	IOVCC	-	-	-	-	伏 V
TFT 工作电流 Operation Current	Ioc	-	-	-	-	毫安 mA
TFT 待机电流 Standby Current	Isc	-	-	-	-	微安 uA
TFT 工作温度 TFT Operating Temp	TOPR	-	-30	+25	+80	摄氏度 ℃
TFT 储存温度 TFT Storage Temp	TSTG	-	-30	+25	+85	摄氏度 ℃

备注 Notes：

1. HTM 输入电源为用户使用接口电源，TFT 输入电源为 PCB 内部显示屏接口电源。
Module input power is for the user interface; display input power is the internal power for the PCB’s TFT interface.
2. CN1 接口 VCC 电压支持 5V 输入，CN2/3 接口 VDD 仅支持 3.3V 输入
The CN1 interface supports 5V input for its VCC supply, while the VDD supply of the CN2 and CN3 interfaces only supports 3.3V input.

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	VF	内置电路 built-in circuit	3.3	5.0	5.5	伏特 V
工作电流 Forward current	IF		360	230	210	毫安 mA
亮度（HTM） Luminance(HTM)	Lv	不带触摸 No TP	Type -100	1000	Type +100	坎德拉/平方米 cd/m^2
		带电容触摸屏 Have CTP		900		
		带电阻触摸屏 Have RTP		800		
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	85	-	Deg.	Note 1
		Θ右/R		80	85	-	Deg.	
	垂直 Vertical	Θ上/U		80	85	-	Deg.	
		Θ下/D		80	85	-	Deg.	
对比度 Contrast ratio		CR	Θ = 0°	800	1000	-	-	Note2
色域 Color Gamut		CG	CIE1931	40	50	-	%	
白色色度 White Chromaticity		Wx	Θ = 0°	-0.03	0.305	+0.03	-	Note4 (Based on C Light)
		Wy			0.336		-	
色彩还原 Reproduction of color	红 Red	Rx			0.603		-	
		Ry			0.307		-	
	绿 Green	Gx			0.314		-	
		Gy			0.557		-	
	蓝 Blue	Bx			0.145		-	
		By			0.0153		-	
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

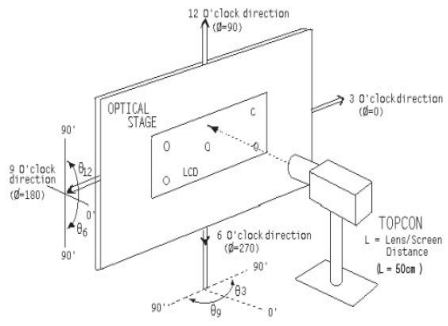


图 1

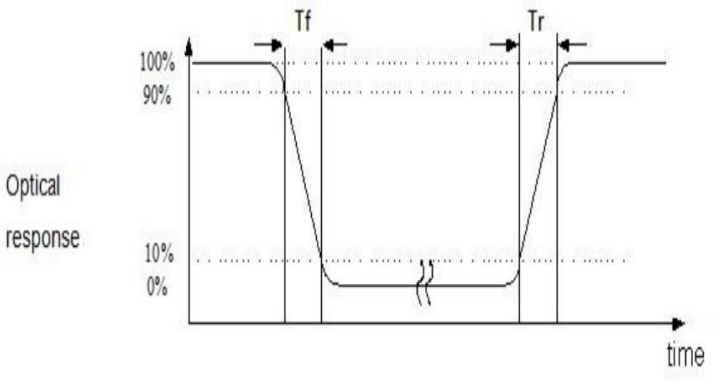


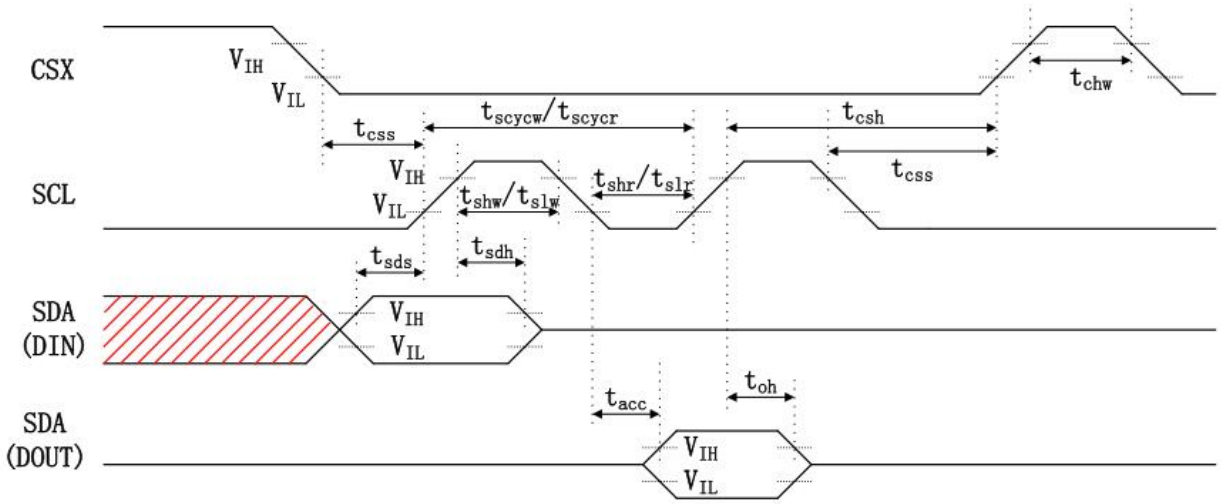
图 2

六、交流特性 AC characteristic

6.1 数据传输时序 Data Transfer Timing

6.1.1 SPI/QSPI 数据传输时序图参考

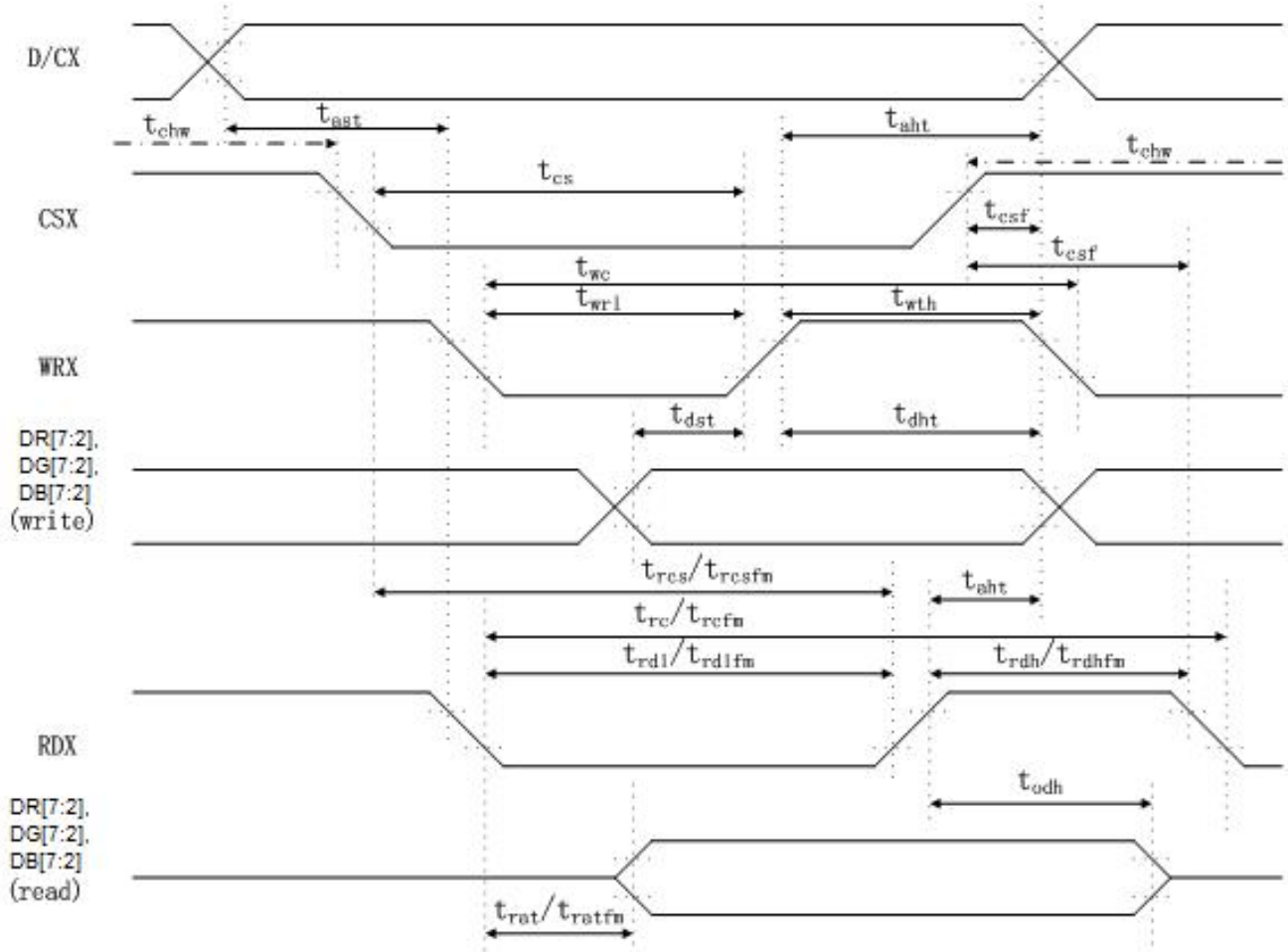
SPI/QSPI Data Transfer Timing Diagram Reference



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	

6.1.2 MCU 并口数据传输时序图参考

MCU parallel Data Transfer Timing Diagram Reference



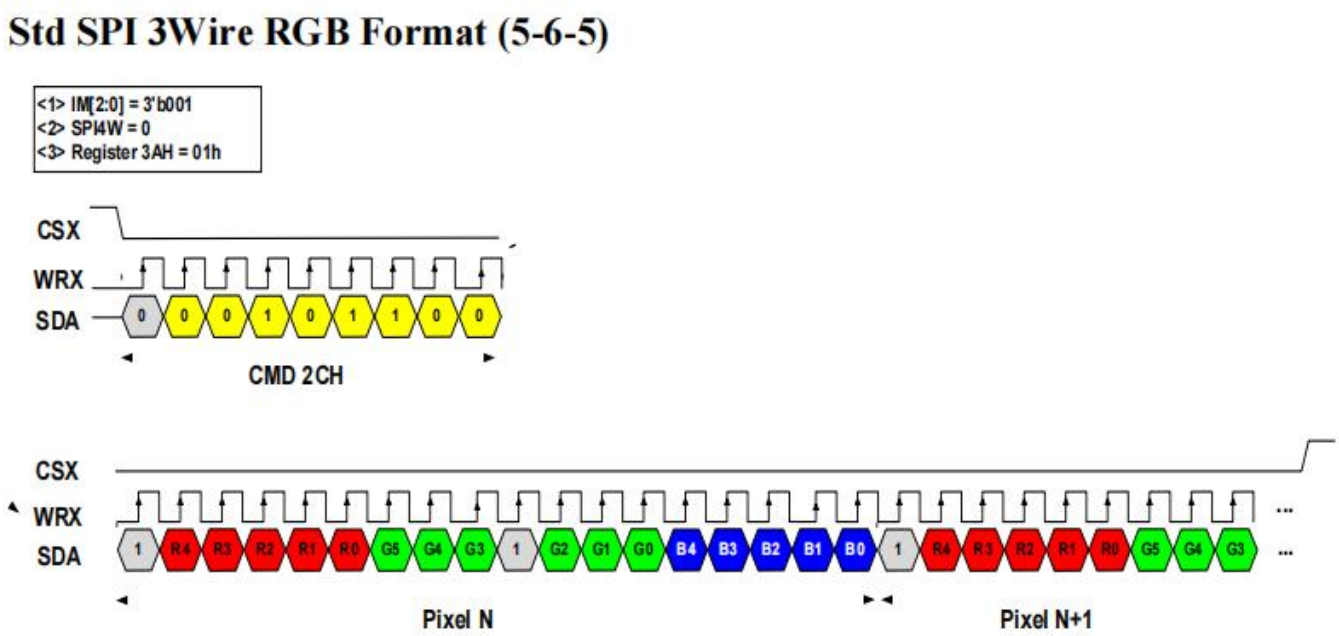
Signal	Symbol	Parameter	MIN	MAX	UNIT	Description
D/CX	T_{AST}	Address Setup Time	0		ns	
	T_{AHT}	Address Hold Time (W/R)	10		ns	
CSX	T_{CHW}	"S" "H" Pulse Width	25		ns	
	T_{CS}	Chip Select Setup Time(W)	10		ns	
	T_{RCS}	Chip Select Setup Time (Read ID)	45		ns	
	T_{RCSFM}	Chip Select Setup Time (Read FM)	355		ns	
	T_{CSF}	Chip Select Wait Time (W/R)	10		ns	

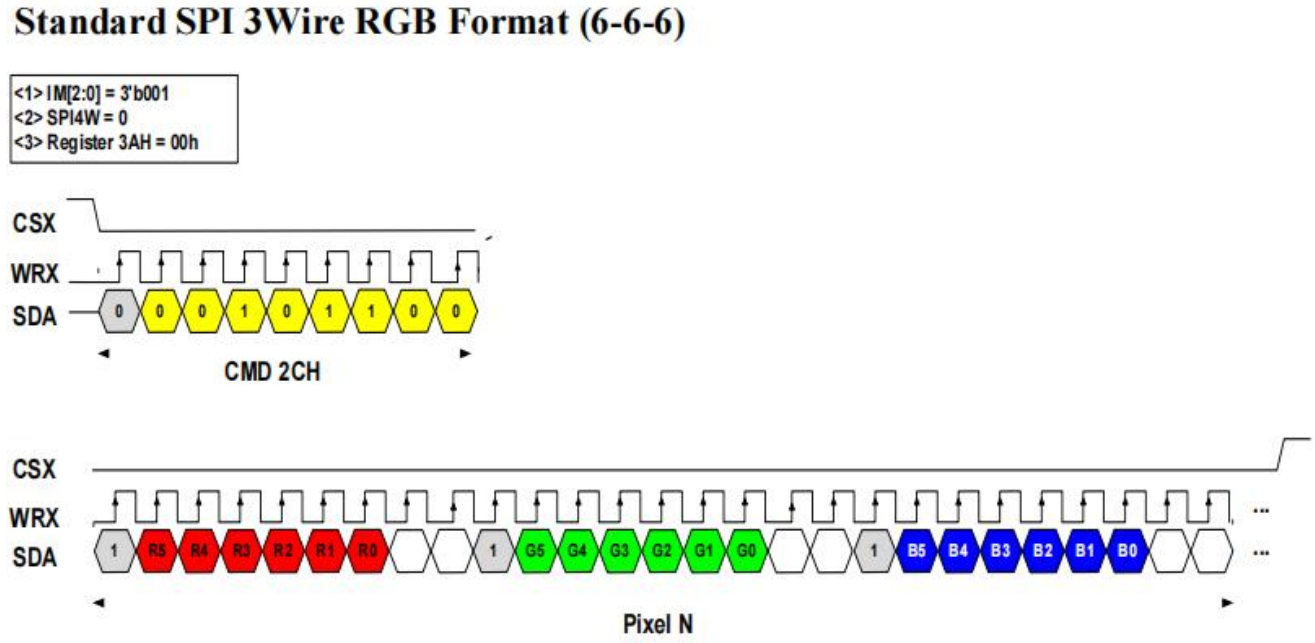
Signal	Symbol	Parameter	MIN	MAX	UNIT	Description
WRX	T_{WC}	Write Cycle	50		ns	MCU 16 Bit Format (5-6-5): Twc>100ns (see "6.4.8.") MCU 16 Bit Format (6-6-6): Twc>66ns (see "6.4.9." Figure 6.4.9.4) Other Format Twc>50ns
	T_{WRH}	Control Pulse H Duration	T_{WC} /2		ns	
	T_{WRL}	Control Pulse L Duration	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	

6.1.3 各接口下像素数据写入显存的传输格式示意图

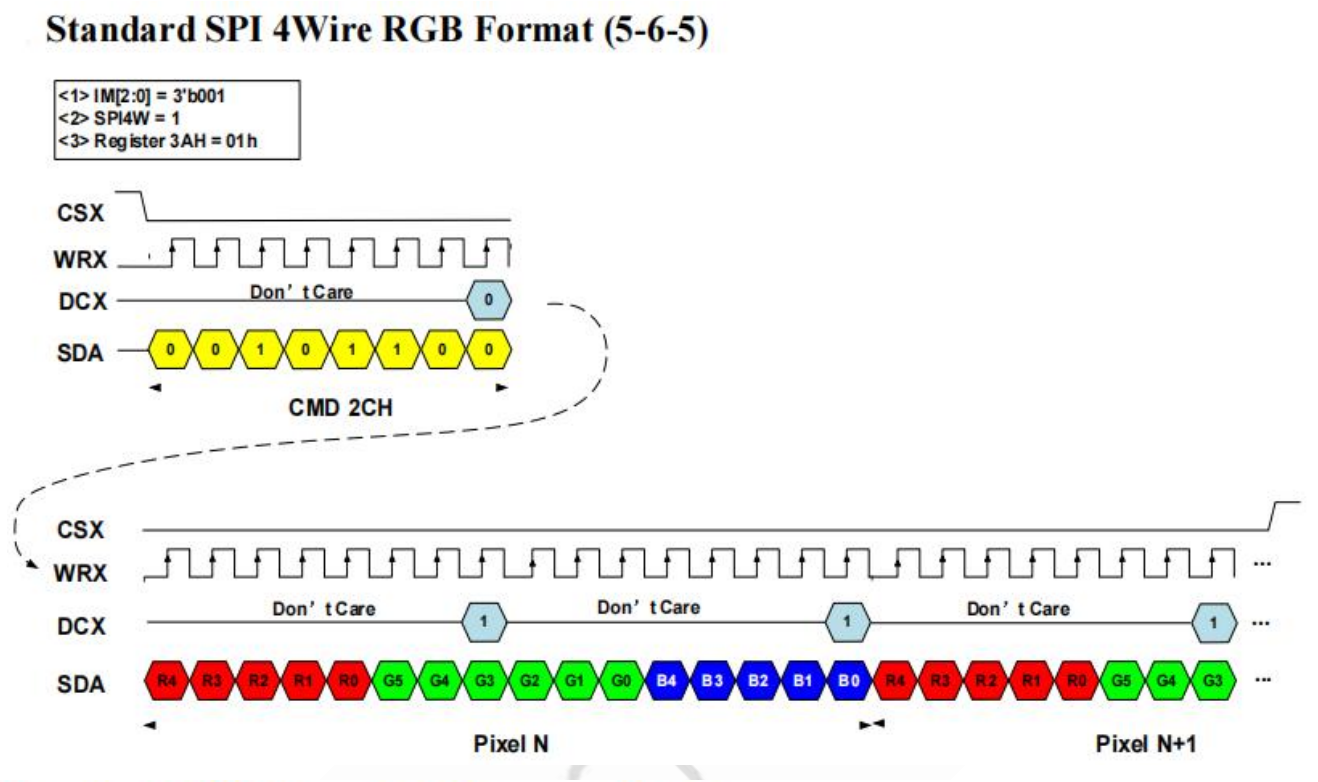
Pixel Data Write Transfer Format Diagram to Display Memory by Interface

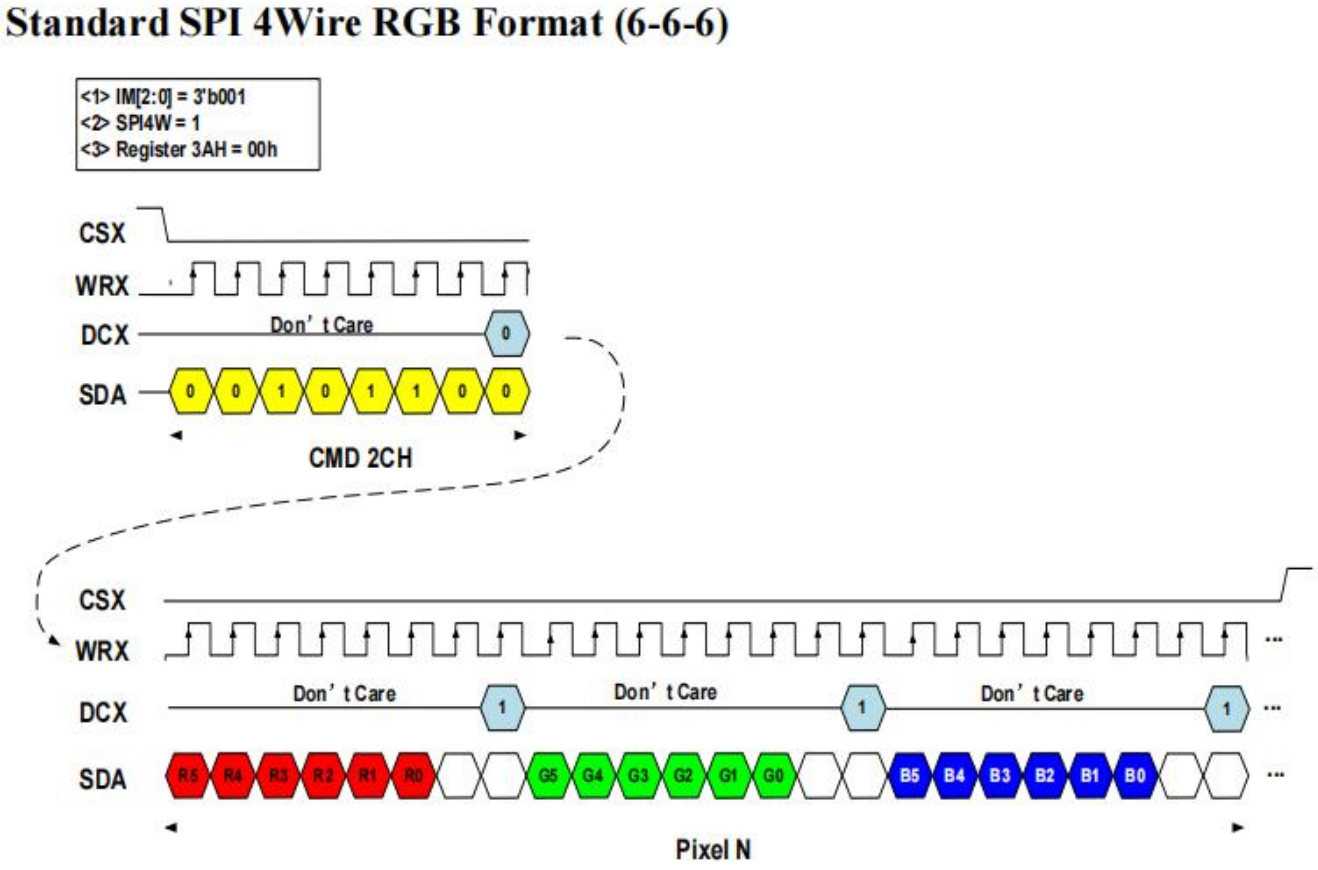
①标准三线 SPI 接口显示数据写入格式 Std SPI 3-Wire Display Data Writing Format





②标准四线 SPI 接口显示数据写入格式 Std SPI 4-Wire Display Data Writing Format

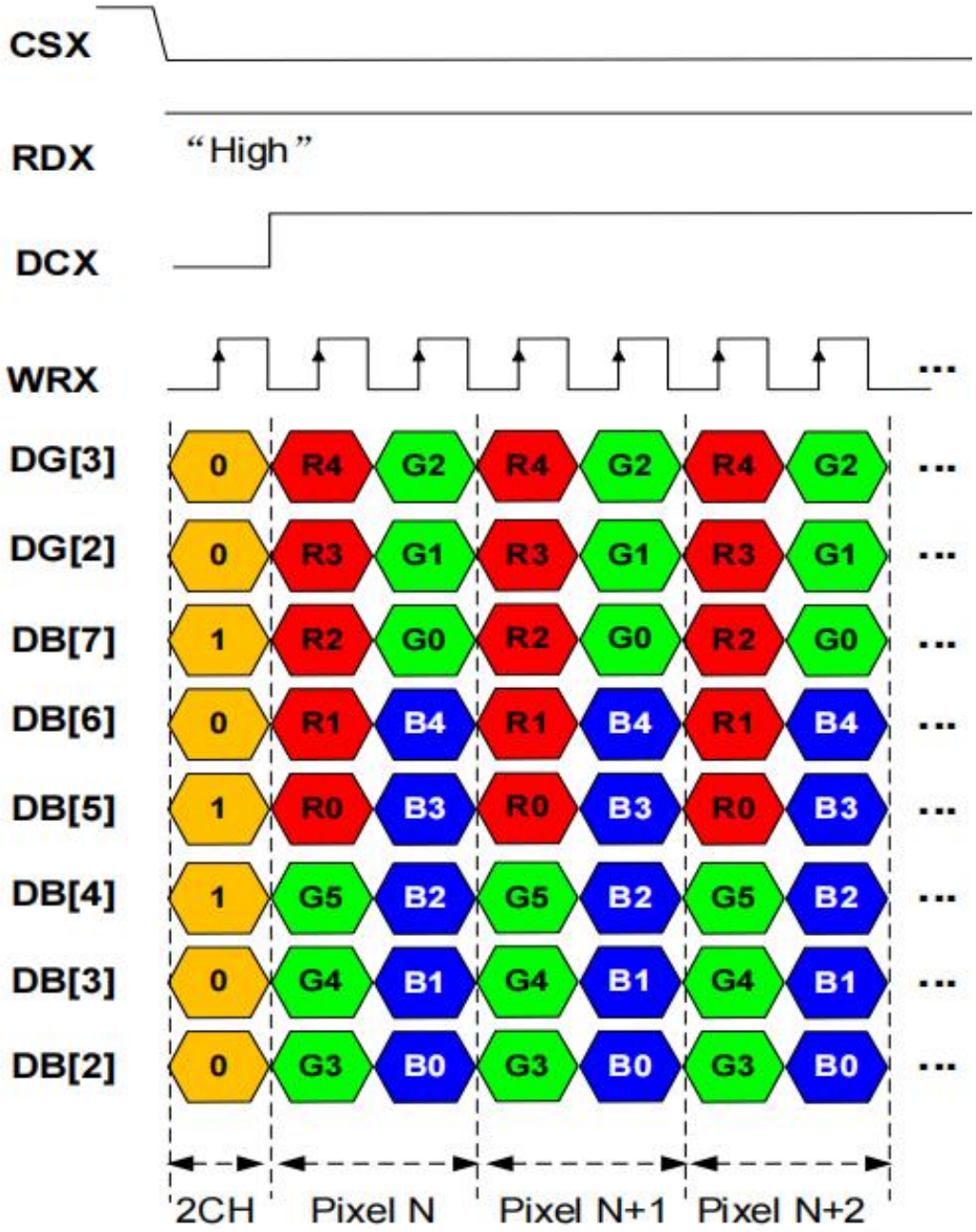




③8 位 MCU 并行接口显示数据写入格式 Parallel MCU 8Bit Display Data Writing Format

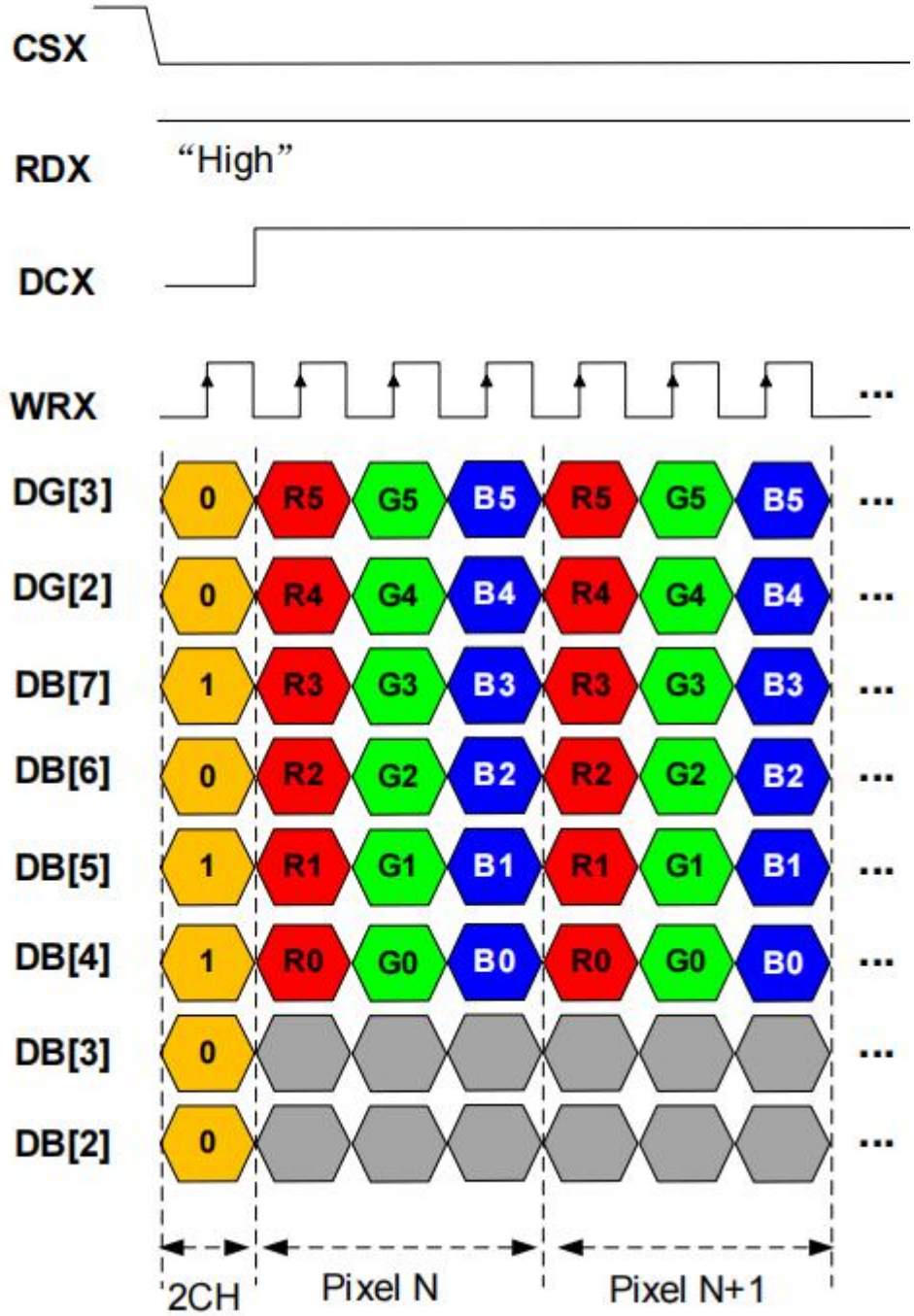
MCU 8 Bit RGB Format (5-6-5)

<1> IM[2:0] = 3'b000
<2> Register 41H[1:0] = 2'b01
<3> Register 3AH = 01h



MCU 8 Bit RGB Format (6-6-6)

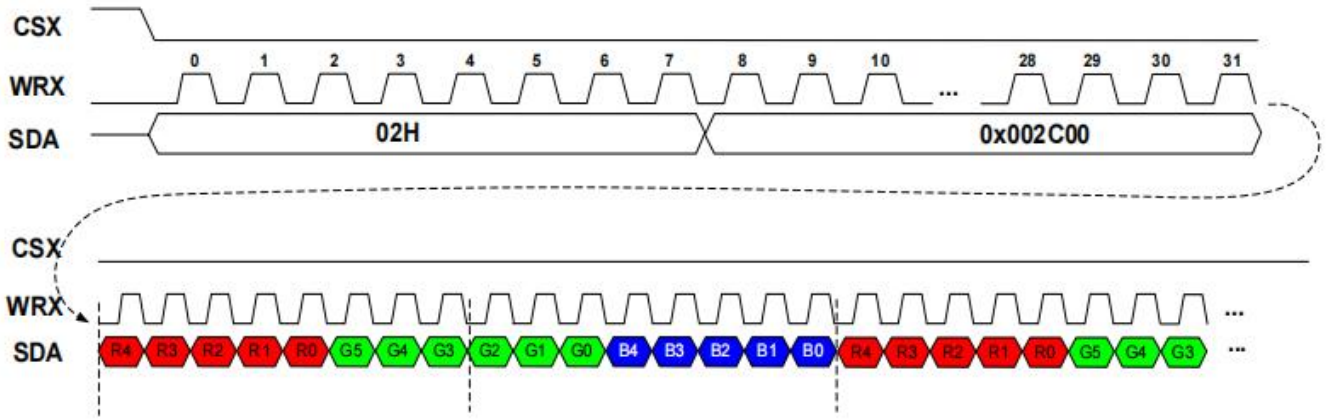
<1> IM[2:0] = 3'b000
<2> Register 41H[1:0] = 2'b01
<3> Register 3AH = 00h



④单通道 QSPI 接口显示数据写入格式 QSPI 1-lane Display Data Writing Format

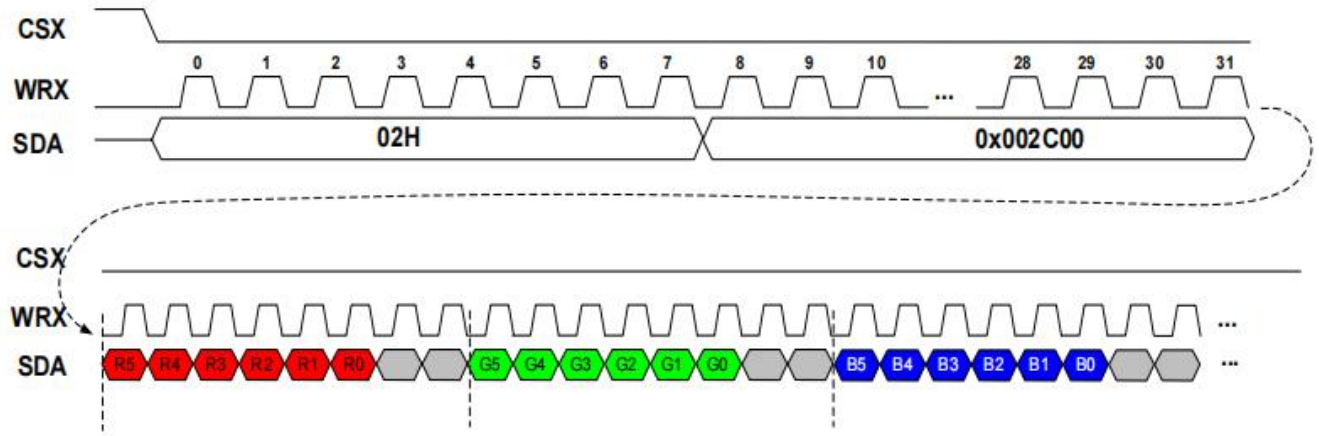
QSPI 1 lane RGB Format (5-6-5)

<1> IM[2:0] = 3'b011
<2> Register 3AH = 01h



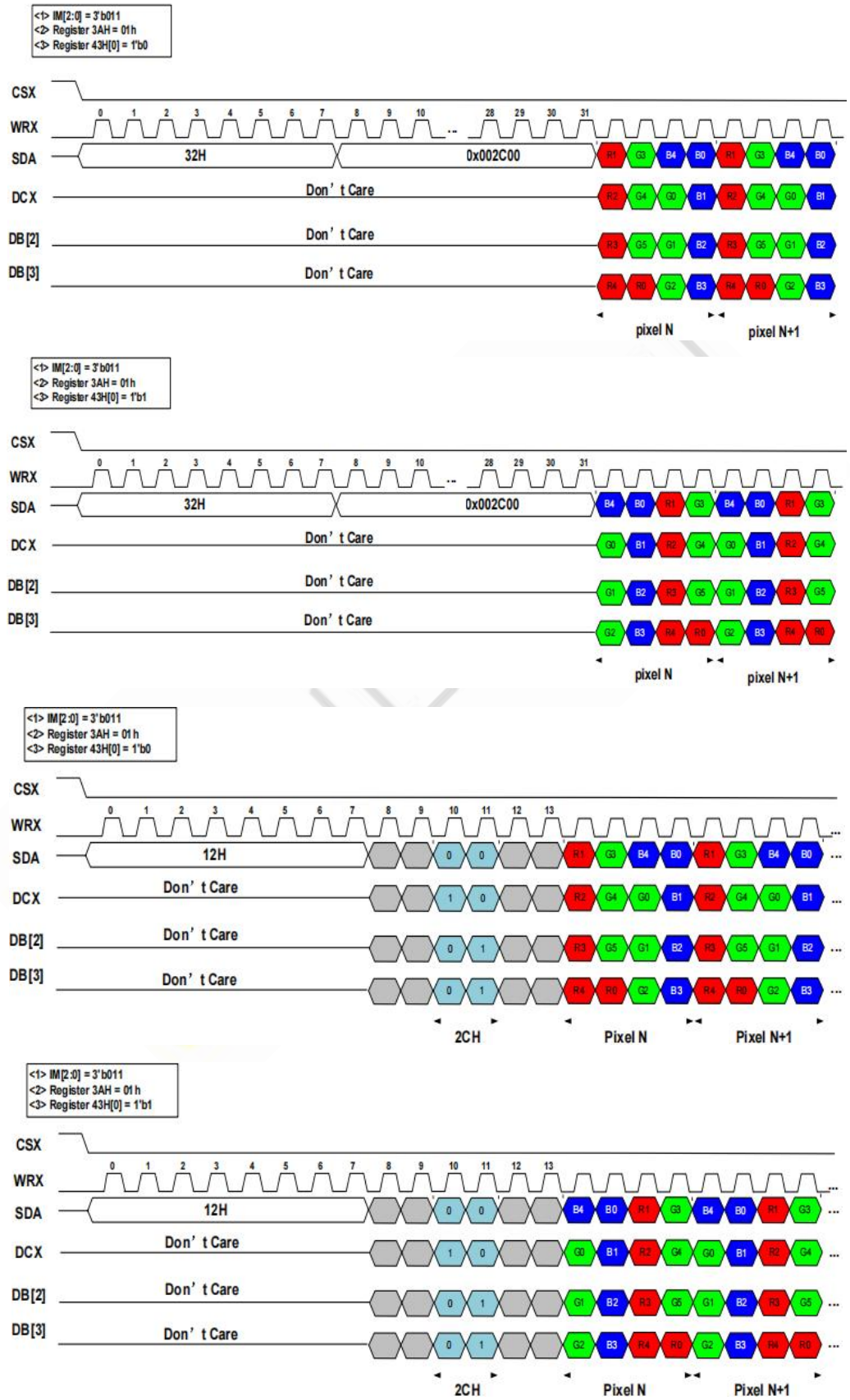
QSPI 1 lane RGB format(6-6-6)

<1> IM[2:0] = 3'b011
<2> Register 3AH = 00h

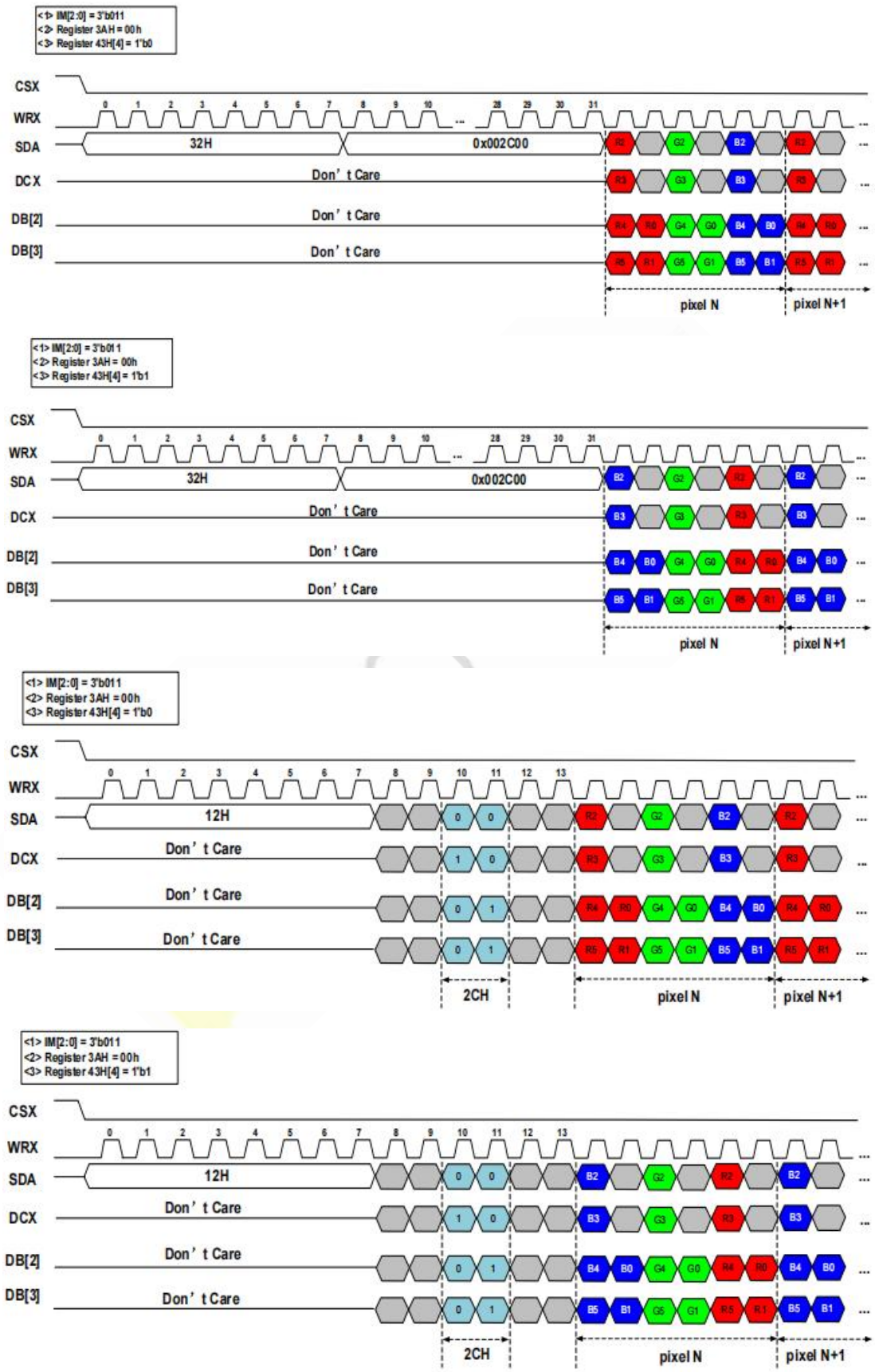


⑤四通道 QSPI 接口显示数据写入格式 QSPI 4-lane Display Data Writing Format

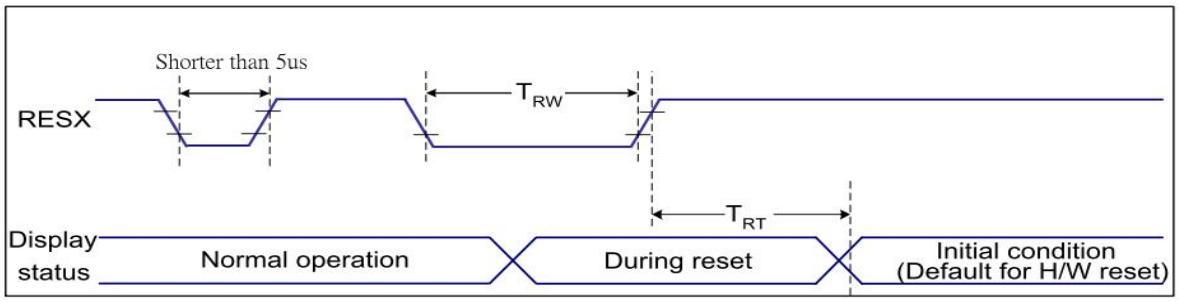
QSPI 4 lane RGB format(5-6-5)



QSPI 4 lane RGB format(6-6-6)



6.2 复位时序 Reset Timing



VDDI=1.65 to 3.3V, VDD=2.4 to 3.3V, AGND=DGND=0V, Ta=25℃

Related Pins	Symbol	Parameter	MIN	MAX	Unit
RESX	TRW	Reset pulse duration	10	-	us
	TRT	Reset cancel	-	5 (Note 1, 5)	ms
				120 (Note 1, 6, 7)	ms

Notes:

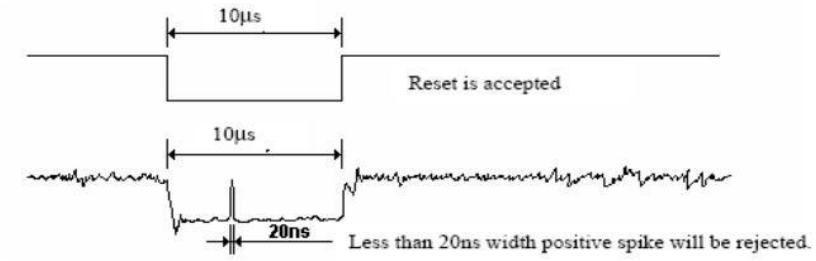
1. The reset cancel includes also required time for loading ID bytes, VCOM setting and other settings from NVM (or similar device) to registers. This loading is done every time when there is HW reset cancel time (tRT) within 5 ms after a rising edge of RESX.

2. Spike due to an electrostatic discharge on RESX line does not cause irregular system reset according to the table below:

RESX Pulse	Action
Shorter than 5us	Reset Rejected
Longer than 9us	Reset
Between 5us and 9us	Reset starts

3. During the Resetting period, the display will be blanked (The display is entering blanking sequence, which maximum time is 120 ms, when Reset Starts in Sleep Out –mode. The display remains the blank state in Sleep In –mode.) and then return to Default condition for Hardware Reset.

4. Spike Rejection also applies during a valid reset pulse as shown below:



5. When Reset applied during Sleep In Mode.

6. When Reset applied during Sleep Out Mode.

7. It is necessary to wait 5msec after releasing RESX before sending commands. Also Sleep Out command cannot be sent for 120msec.

6.3 电源开启/关闭顺序 Power On/Off Sequence

IOVCC 和 VCI 可以按任何顺序应用或断电。 在关机序列期间，如果 LCD 处于休眠模式，则 VCI 和 IOVCC 必须在至少 120 毫秒内断电。 如果 LCD 处于休眠模式，VCI 和 IOVCC 可以在 RESX 释放后至少 0 毫秒内断电。 CSX 可以在任何时间应用，也可以永久接地。 RESX 的优先级高于 CSX。

IOVCC and VCI can be applied or powered down in any order. During the Power Off sequence, if the LCD is in the Sleep Out mode, VCI and IOVCC must be powered down with minimum 120msec. If the LCD is in the Sleep In mode, VCI and IOVCC can be powered down with minimum 0msec after the RESX is released. CSX can be applied at any timing or can be permanently grounded. RESX has high priority over CSX.

非受控断电是指在没有受控断电序列的情况下取出电池的情况。 它不会损坏模块或主机接口。

The uncontrolled power-off means a situation which removed a battery without the controlled power off sequence. It will neither damage the module or the host interface.

如果发生不受控制的断电，显示屏将变为空白，显示屏上不会有任何可见效果（空白显示）并保持空白，直到“Power On Sequence”启动它。

If uncontrolled power-off happened, the display will go blank and there will not any visible effect on the display (blank display) and remains blank until “Power On Sequence” powers it up.

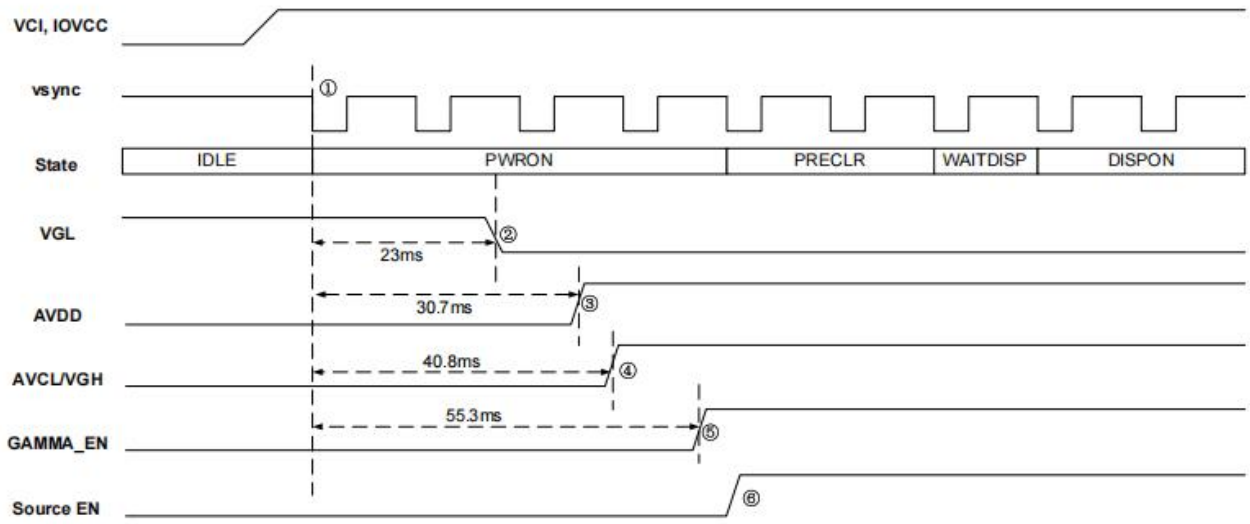
备注 Notes:

1. 如果不满足电源顺序，TFT 不会损坏。
   TFT will not be damaged if the power sequence is not met.
2. 在电源开/关序列期间，显示面板上不会有异常的可见效果。
   There will be no abnormal visible effects on the display panel during the Power On/Off Sequences.
3. 在 Power On Sequence 结束和收到 Sleep Out 命令之前，以及在收到 Sleep In 命令和 Power Off Sequence 之间，显示屏上不会出现异常可见的效果。
   There will be no abnormal visible effects on the display between the end of Power On Sequence and before receiving the Sleep Out command, and also between receiving the Sleep In command and the Power Off Sequence.
4. 如果开机序列期间主机没有稳定地保持 RESX 线,则有必要在主机开机序列完成后应用硬件复位 (RESX) 以确保 正确的操作。 否则，无法保证所有功能。
   If the RESX line is not steadily held by the host during the Power On Sequence, then it will be necessary to apply the Hardware Reset (RESX) after the completion of the Host Power On Sequence to ensure correct operations. Otherwise, all the functions are not guaranteed.

电源开/关顺序如下图所示

The power on/off sequence is illustrated below

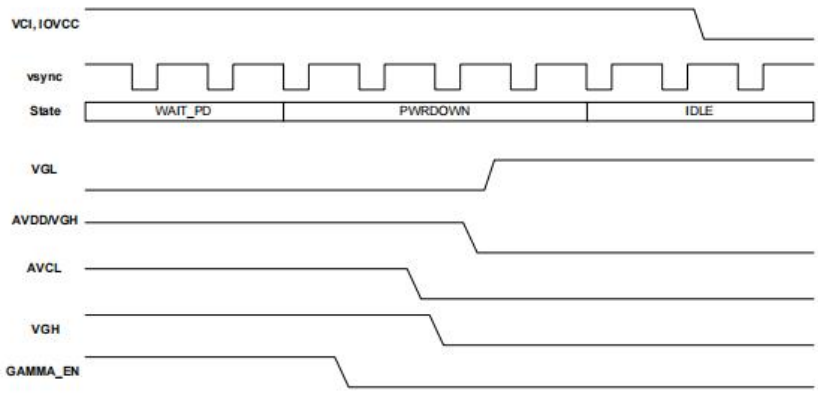
Power On Sequence



No.	Description	Min. Time
1	After VCI/IOVCC become stable , reset finished and host send command "11H"	Decide by host 11H command
2	VGL from 0V to -11.5V	23ms
3	AVDD from VCI to 6.6V	30.7ms
4	AVCL from 0 to -5V and VGH from AVDD to 15.4	40.8ms
5	Gamma output enable	55.3ms
6	Source output enable	Decide by host "29H" command

Power Off Sequence

When host sends "10H" command, State from WAIT_PD to PWRDOWN, in which power disabled sequentially.



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=+85 ℃, 120hrs	
低温储存 Low Temperature Storage	Ta=-30 ℃, 120hrs	
高温运行试验 High Temperature Operation	Ta=+80 ℃, 120hrs	
低温运行试验 Low Temperature Operation	Ta=-30 ℃, 120hrs	
高温高湿（运行测试） High Temperature and High Humidity (Operating)	Ta=+60 ℃, 90%RH, 120hrs	

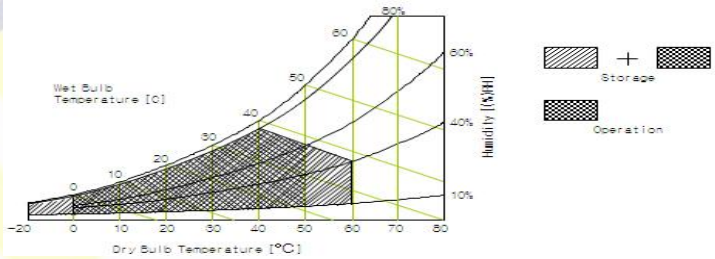
注释 Note:

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 ℃ 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, abormal display etc).

4. 所有显示判断均在面板温度恢复到室温2小时后进行

All display judgments are made after the panel temperature returns to room temperature for 2 hours

5. Ta：环境温度

Ta：Ambient temperature

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)	● Shock level:980m/s^2 ● Waveform:1/2 Sine wave,6msec ● ±X, ±Y ±Z,each axis 1 times
包装振动(非操作) Packing Vibration (Non-Operation)	● 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,330Ω, Contact±4KV,Air :±8KV.Note 1
	200pF,0Ω, ±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 HANDDLING & 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.

♦强烈的光照会导致 LCD 偏光片和彩色滤光片退化。 不准在强光或高温高湿下长期存放或直接运行。

Strong sunlight can cause LCD polarizers and color filters to degrade. Long-term storage or direct operation under strong light or high temperature and humidity is not allowed.

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，工作室内湿度应保持在 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 Initialisation code

```
Void Panel_Initial_code(void)
{
    //================上电复位操作===============//
    LCD_RESET=1;
    Delayms(1);      //Delay 1ms
    LCD_RESET=0;
    Delayms(10);     //Delay 10ms
    LCD_RESET=1;
    Delayms(120);    //Delay 120ms
    //=============================================//
    //SPI, MCU 接口初始化代码共用   SPI, MCU interface initialisation code share
    //---------Start Initial Code ------//
    SPI_WriteComm(0xff);
    WriteData(0xa5);
    WriteComm(0xE7);//TE_output_en
    WriteData(0x10);
    WriteComm(0x35);//TE_ interface_en
    WriteData(0x01);
    WriteComm(0x3A);
    WriteData(0x01);//00---666//01--565
    WriteComm(0x40);
    WriteData(0x01);
    WriteComm(0x41);
    WriteData(0x01);//01--8bit//03--16bit
    WriteComm(0x55);
    WriteData(0x01);
    WriteComm(0x44);
    WriteData(0x15);
    WriteComm(0x45);
    WriteData(0x15);
    WriteComm(0x7d);
    WriteData(0x03);
    WriteComm(0xc1);
    WriteData(0xab);
    WriteComm(0xc2);
    WriteData(0x17);
    WriteComm(0xc3);
    WriteData(0x10);
```

```
WriteComm(0xc6);
WriteData(0x3a);
WriteComm(0xc7);
WriteData(0x25);
WriteComm(0xc8);
WriteData(0x11);
WriteComm(0x7a);
WriteData(0x49);
WriteComm(0x6f);
WriteData(0x2f);

WriteComm(0x78);
WriteData(0x4b);
WriteComm(0x73);
WriteData(0x08);
WriteComm(0x74);
WriteData(0x12);
WriteComm(0xc9);
WriteData(0x00);
WriteComm(0x67);
WriteData(0x11);

WriteComm(0x51);
WriteData(0x20);
WriteComm(0x52);
WriteData(0x7c);
WriteComm(0x53);
WriteData(0x1c);
WriteComm(0x54);
WriteData(0x77);

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(0x01);

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);

WriteComm(0xe5);
WriteData(0x06);
WriteComm(0xe6);
WriteData(0x00);
WriteComm(0x6e);
WriteData(0x14);
//gammma 01
WriteComm(0x80);
WriteData(0x04);
WriteComm(0xA0);
WriteData(0x00);
WriteComm(0x81);
WriteData(0x07);
WriteComm(0xA1);
WriteData(0x05);
WriteComm(0x82);
WriteData(0x06);
WriteComm(0xA2);
WriteData(0x04);
WriteComm(0x83);
WriteData(0x39);
WriteComm(0xA3);
WriteData(0x39);
WriteComm(0x84);
WriteData(0x3a);
WriteComm(0xA4);
WriteData(0x3a);
```

```
WriteComm(0x85);
WriteData(0x3f);
WriteComm(0xA5);
WriteData(0x3f);
WriteComm(0x86);
WriteData(0x2c);
WriteComm(0xA6);
WriteData(0x2a);
WriteComm(0x87);
WriteData(0x43);
WriteComm(0xA7);
WriteData(0x47);
WriteComm(0x88);
WriteData(0x08);
WriteComm(0xA8);
WriteData(0x08);
WriteComm(0x89);
WriteData(0x0f);
WriteComm(0xA9);
WriteData(0x0f);
WriteComm(0x8a);
WriteData(0x17);
WriteComm(0xAa);
WriteData(0x17);
WriteComm(0x8b);
WriteData(0x10);
WriteComm(0xAb);
WriteData(0x10);
WriteComm(0x8c);
WriteData(0x16);
WriteComm(0xAc);
WriteData(0x16);
WriteComm(0x8d);
WriteData(0x14);
WriteComm(0xAd);
WriteData(0x14);
WriteComm(0x8e);
WriteData(0x11);
WriteComm(0xAe);
WriteData(0x11);
```

```
    WriteComm(0x8f);
    WriteData(0x14);
    WriteComm(0xAf);
    WriteData(0x14);

    WriteComm(0x90);
    WriteData(0x06);
    WriteComm(0xB0);
    WriteData(0x06);
    WriteComm(0x91);
    WriteData(0x0f);
    WriteComm(0xB1);
    WriteData(0x0f);
    WriteComm(0x92);
    WriteData(0x16);
    WriteComm(0xB2);
    WriteData(0x16);
    WriteComm(0xff);
    WriteData(0x00);

    WriteComm(0x11);
    Delayms (200);
    WriteComm(0x29);
    Delayms (120);
}

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

文档修订记录

Document revision history

版本 Version	日期 DATE	修改说明 Modify description	编著 Editorial
0-0	2026-07-17	初次编制 First compilation.	C N

- - 结束 - -

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