

# SPECIFICATIONS

Version: V1

This module uses ROHS material

**PRODUCT:** TFT LCD MODULE

**MODEL NO:** HT0240DI04A

**SUPPLIER:** HTDisplay

**ISSUED DATE:** 2020-8-14

- Preliminary Specification  
 Final Product Specification

HTDisplay		Customer
Prepared by	Suo	Approved By
Reviewed by	Max zhang	
Quality Dept	Shipin peng	Date
Approved by	Ruxun wang	

## Beijing HTDisplay Electronic Co.,Ltd

Address: 5F Bld. #5, 7 East Rongchang St., Yizhuang Dvpt. Zone,  
Daxing District, Beijing 100176 CHINA

Tel: (86) 10 67806456 Fax: (86) 10 67805529

Email:sales@htdisplay.com [www.htdisplay.com](http://www.htdisplay.com)

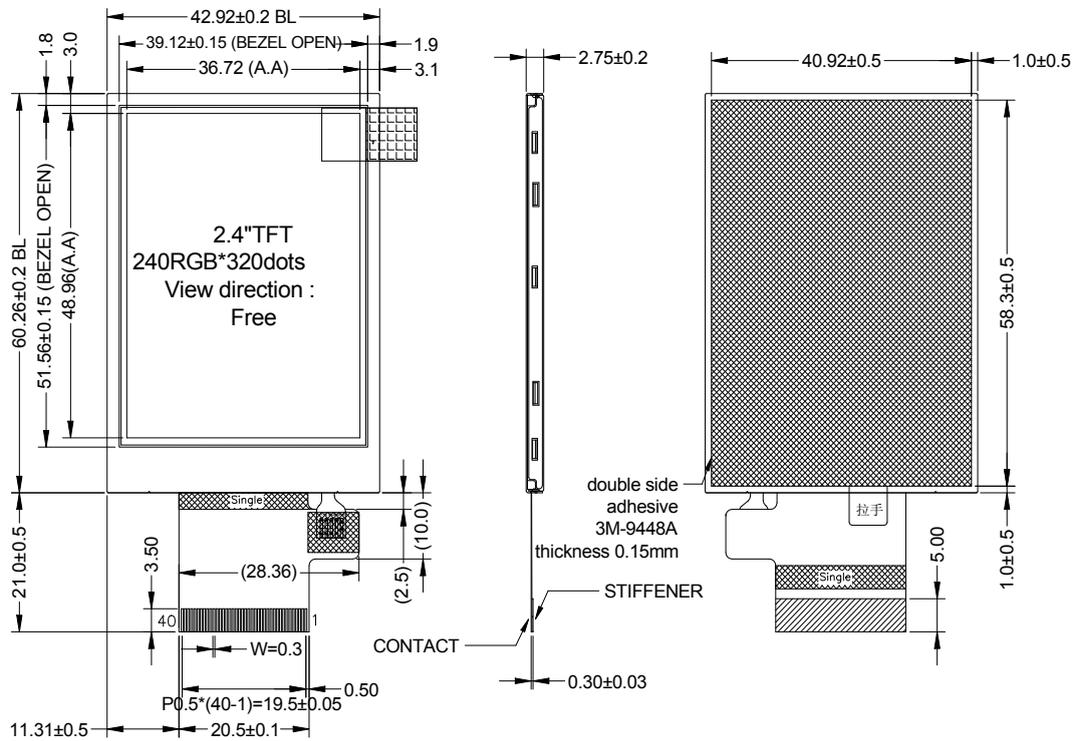


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## 1. General information

Feature	Spec	Unit
LCD size	2.4	inch
Resolution	240 RGB x 320 Dots	---
Pixel pitch (WxH)	0.153 x 0.153	mm
Active area	36.72 (W) x 48.96(H)	mm
Viewing area	39.12 (W) x 51.56 (H)	mm
Display Mode	IPS,NB	---
LCM Outline (WxHxT)	42.92 × 60.26 × 2.75	mm
With/Without TP	Without	---
Weight (g)	14.8	g
TFT Driver IC	ST7789V	---
TFT Interface	MCU/RGB	---
TFT Input voltage	2.8	V
TFT Power consumption	21	mW
Backlight Power consumption	240	mW
LCM brightness	450	cd/m <sup>2</sup>

## 2. Mechanical drawing



## 3. Absolute maximum ratings

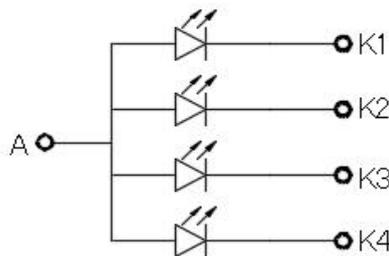
Item	Symbol	Min.	Max.	Unit
Supply Voltage	VCI	-0.3	4.6	
Input voltage	VIN	-0.3	VCI+0.5	V
Output voltage	VO	-0.3	VCI+0.5	V
Operating temperature	TOP	-20	70	°C
Storage temperature	TST	-30	80	°C
Humidity	RH	--	90%(Max60 °C)	RH

#### 4. Electrical characteristics

Item	Symbol	Min.	Typ.	Max.	Unit
System Voltage	VCI	2.4	2.8	3.3	V
Input Current	I <sub>dd</sub>	--	7	--	mA
Input voltage 'H' level	V <sub>IH</sub>	0.7V <sub>CC</sub>	--	V <sub>CC</sub>	V
Input voltage 'L' level	V <sub>IL</sub>	V <sub>SS</sub>	--	0.3V <sub>CC</sub>	V
Output voltage 'H' level	V <sub>OH</sub>	0.8V <sub>CC</sub>	--	V <sub>CC</sub>	V
Output voltage 'L' level	V <sub>OL</sub>	V <sub>SS</sub>		0.2V <sub>CC</sub>	V

#### 5. Backlight characteristics

Item	Symbol	Min.	Typ.	Max.	Unit	Condition
Forward Current	I <sub>f</sub>	72	80	88	mA	
Forward Voltage	V <sub>f</sub>	2.8	3.0	3.3	V	
LED Life Time	L <sub>L</sub>	--	30000	--	Hrs	T <sub>a</sub> =25°C



BACKLIGHT: 4 CHIP-WHITE LED  
 I<sub>f</sub>=80mA (constant current)  
 V<sub>f</sub>=2.8V~3.3V

Figure 2

Note1: Under LCM operating, the stable forward current should be inputted. And forward voltage is for reference only.

Note2: Optical performance should be evaluated at T<sub>a</sub>=25°C. if LED is driven by high current, high ambient temperature & Humidity condition. The life time of LED will be reduced. Operating life means brightness goes down to 50% initial brightness. Typical operating life time is estimated data.

## 6. Electro-optical characteristics

### Optical Specification

Item		Symbol	Condition	Min.	Typ.	Max.	Unit	Note
Transmittance (with Polarizer)		T(%)	Θ=0 Normal Viewing angle	—	4.65	—	%	
Transmittance (without Polarizer)		T(%)		—	--	—	%	
Contrast Ratio		CR		1000	1500	—	—	(1)(2)
Response Time		TON+TOFF		—	35	45	msec	(1)(3)
Color Gamut	(%)			—	70	—	%	C-light
Color Chromaticity (CIE1931)	White	W <sub>X</sub>		0.287	0.307	0.327	—	(1)(4) CF glass C-light
		W <sub>Y</sub>		0.314	0.334	0.354		
	Red	R <sub>X</sub>		0.632	0.652	0.672	—	
		R <sub>Y</sub>		0.312	0.332	0.352		
	Green	G <sub>X</sub>		0.256	0.276	0.296	—	
		G <sub>Y</sub>	0.562	0.582	0.602			
	Blue	B <sub>X</sub>	0.121	0.141	0.161	—		
		B <sub>Y</sub>	0.071	0.091	0.101			
Viewing Angle	Hor.	Θ <sub>L</sub>	CR>10	—	80	—	—	(1)(4) Measuring with normal polarizer, Reference Only
		Θ <sub>R</sub>		—	80	—		
	Ver.	Θ <sub>U</sub>		—	80	—		
		Θ <sub>D</sub>		—	80	—		
Optimal View Direction				Free				(5)

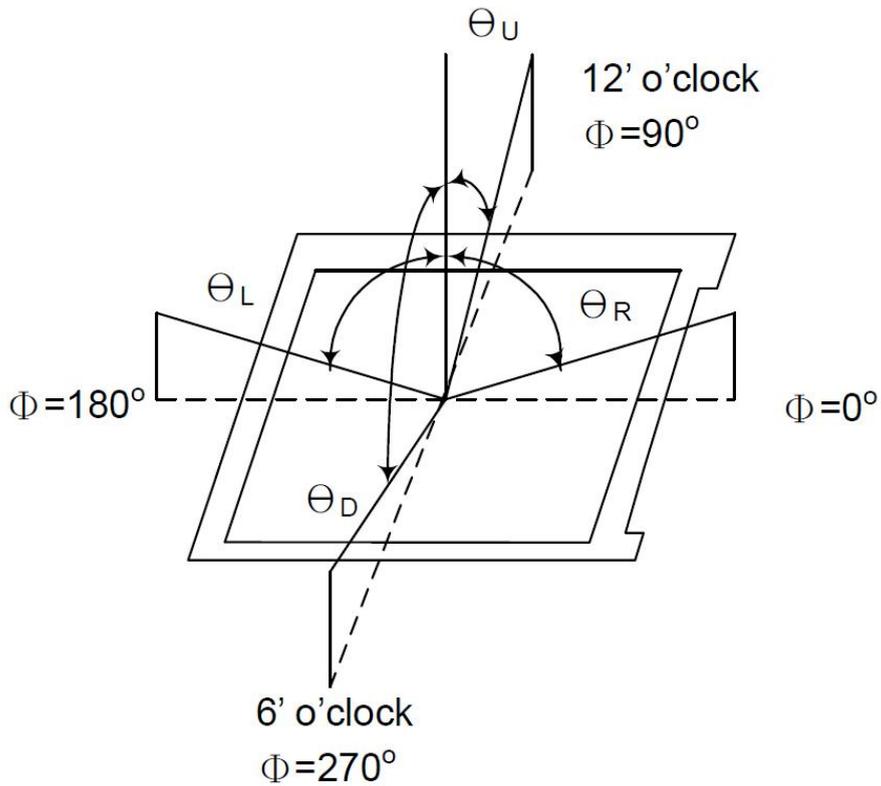
#### Measuring Condition

- Measuring surrounding : dark room
- Ambient temperature:25°C±2°C
- 15min.warm-up time

#### Measuring Equipment

- FPM520 of Waster Display technologies, INC., which utilized SR-3 for Chromaticity and BM-5A for other optical characteristics.

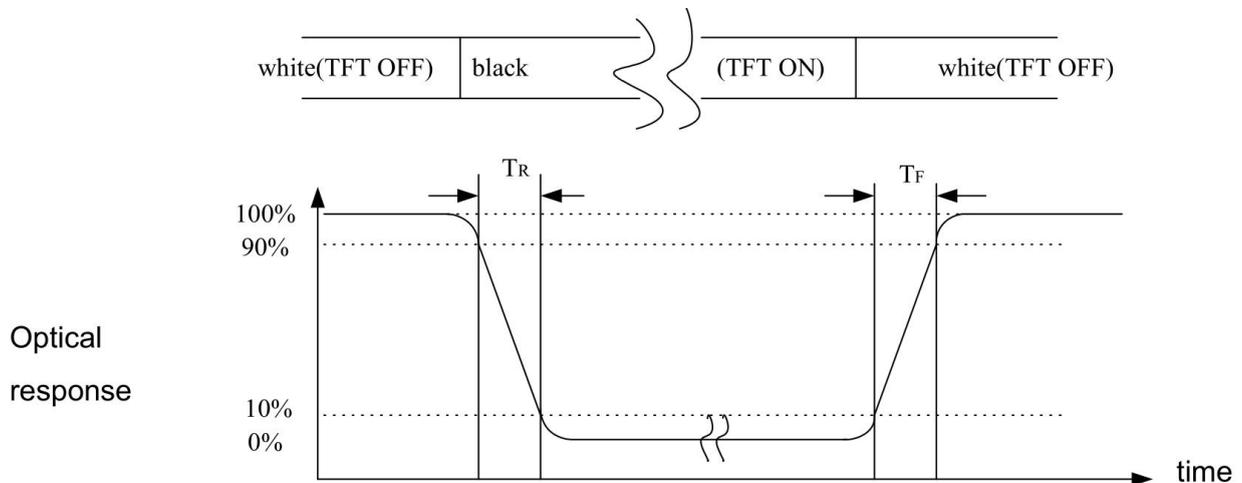
Note 1: Definition of Viewing Angle:



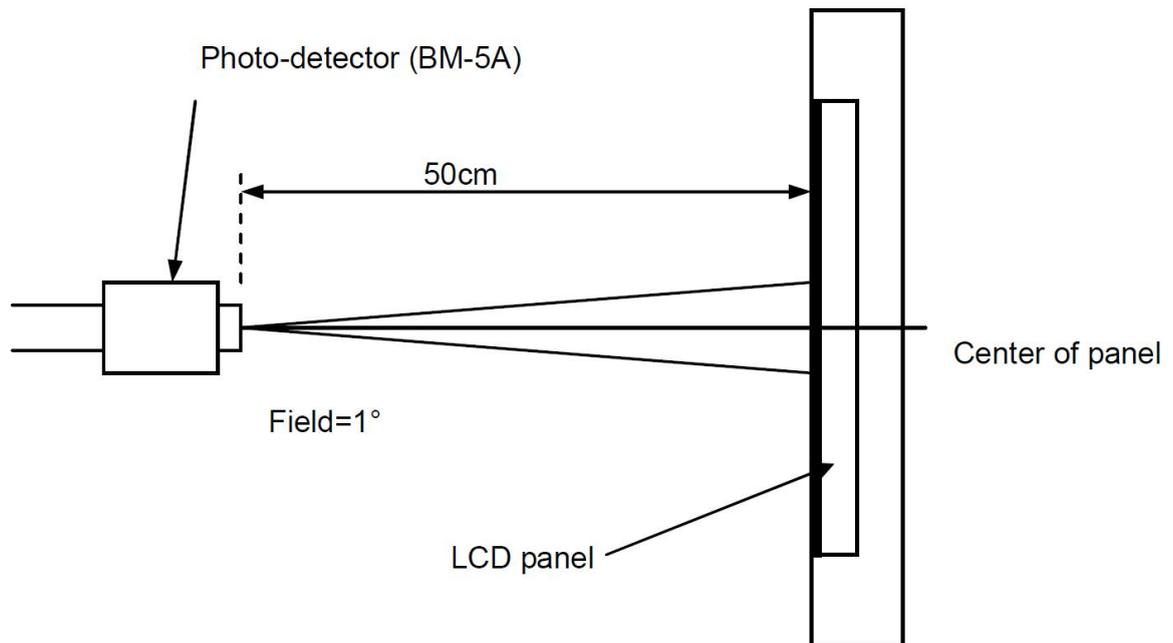
Note 2: Definition of Contrast Ratio (CR):  
measured at the center point of panel

$$CR = \frac{\text{Luminance with all pixels white}}{\text{Luminance with all pixels black}}$$

Note 3: Definition of Response Time : Sum of  $T_R$  and  $T_F$



Note (4) Definition of optical measurement setup



## 7. Read/Write timing

### 8080 Series MCU Parallel Interface Characteristics: 18/16/9/8-bit Bus

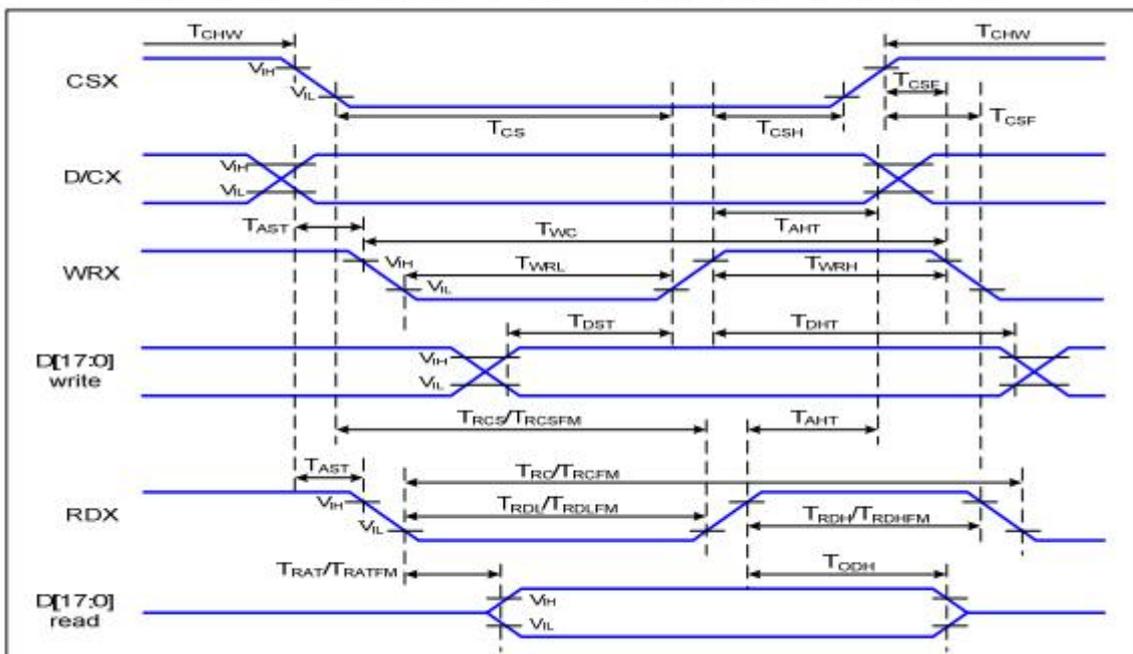
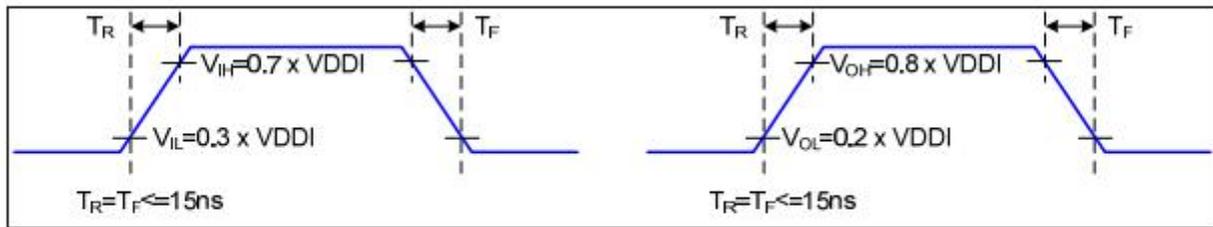


Figure 1 Parallel Interface Timing Characteristics (8080-Series MCU Interface)

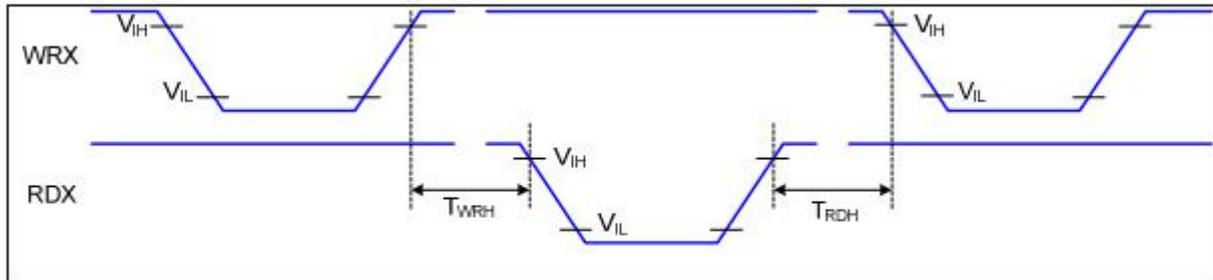
VDD1=1.65 to 3.3V, VDD=2.4 to 3.3V, AGND=DGND=0V, Ta= -30 to 70 °C

Signal	Symbol	Parameter	Min	Max	Unit	Description
D/CX	T <sub>AST</sub>	Address setup time	0		ns	-
	T <sub>AHT</sub>	Address hold time (Write/Read)	10		ns	
CSX	T <sub>CHW</sub>	Chip select "H" pulse width	0		ns	-
	T <sub>CS</sub>	Chip select setup time (Write)	15		ns	
	T <sub>RCS</sub>	Chip select setup time (Read ID)	45		ns	
	T <sub>RCSFM</sub>	Chip select setup time (Read FM)	355		ns	
	T <sub>CSF</sub>	Chip select wait time (Write/Read)	10		ns	
	T <sub>CSH</sub>	Chip select hold time	10		ns	
WRX	T <sub>WC</sub>	Write cycle	66		ns	
	T <sub>WRH</sub>	Control pulse "H" duration	15		ns	
	T <sub>WRL</sub>	Control pulse "L" duration	15		ns	
RDX (ID)	T <sub>RC</sub>	Read cycle (ID)	160		ns	When read ID data
	T <sub>RDH</sub>	Control pulse "H" duration (ID)	90		ns	
	T <sub>RDL</sub>	Control pulse "L" duration (ID)	45		ns	
RDX (FM)	T <sub>RCFM</sub>	Read cycle (FM)	450		ns	When read from frame memory
	T <sub>RDHFM</sub>	Control pulse "H" duration (FM)	90		ns	
	T <sub>RDLFM</sub>	Control pulse "L" duration (FM)	355		ns	
D[17:0]	T <sub>DST</sub>	Data setup time	10		ns	For CL=30pF
	T <sub>DHT</sub>	Data hold time	10		ns	
	T <sub>RAT</sub>	Read access time (ID)		40	ns	
	T <sub>RATFM</sub>	Read access time (FM)		340	ns	
	T <sub>ODH</sub>	Output disable time	20	80	ns	

**Table 4 8080 Parallel Interface Characteristics**

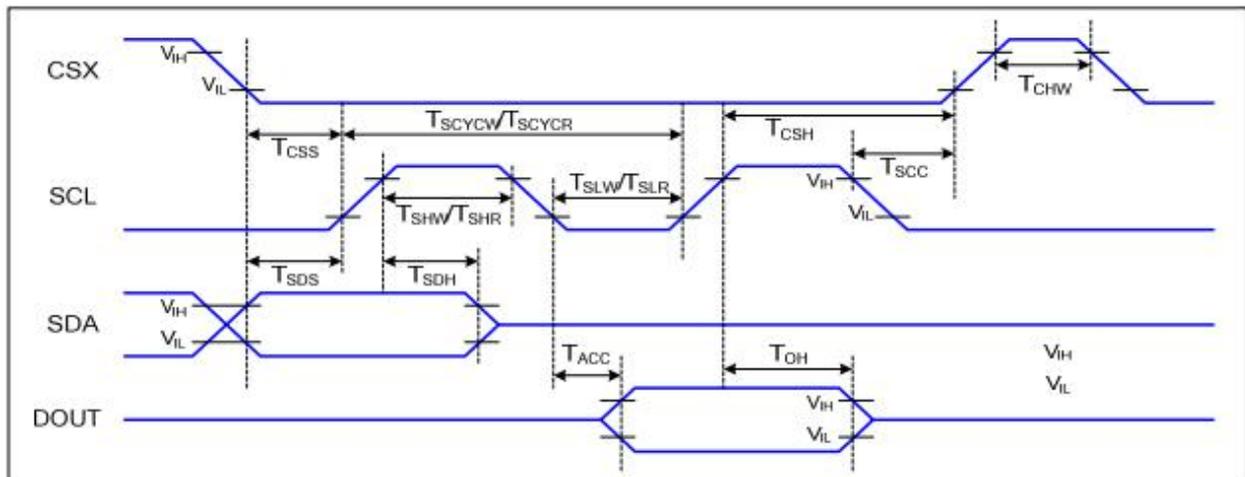


**Figure 2 Rising and Falling Timing for I/O Signal**



**Figure 3 Write-to-Read and Read-to-Write Timing**

**Serial Interface Characteristics (3-line serial):**



**Figure 4 3-line serial Interface Timing Characteristics**

Signal	Symbol	Parameter	Min	Max	Unit	Description
CSX	$T_{CSS}$	Chip select setup time (write)	15		ns	
	$T_{CSH}$	Chip select hold time (write)	15		ns	
	$T_{CSS}$	Chip select setup time (read)	60		ns	
	$T_{SCC}$	Chip select hold time (read)	65		ns	
	$T_{CHW}$	Chip select "H" pulse width	40		ns	
SCL	$T_{SCYCW}$	Serial clock cycle (Write)	66		ns	
	$T_{SHW}$	SCL "H" pulse width (Write)	15		ns	
	$T_{SLW}$	SCL "L" pulse width (Write)	15		ns	
	$T_{SCYCR}$	Serial clock cycle (Read)	150		ns	
	$T_{SHR}$	SCL "H" pulse width (Read)	60		ns	
	$T_{SLR}$	SCL "L" pulse width (Read)	60		ns	
SDA (DIN)	$T_{SDS}$	Data setup time	10		ns	
	$T_{SDH}$	Data hold time	10		ns	
DOUT	$T_{ACC}$	Access time	10	50	ns	For maximum CL=30pF
	$T_{OH}$	Output disable time	15	50	ns	For minimum CL=8pF

Table 5 3-line serial Interface Characteristics

Serial Interface Characteristics (4-line serial):

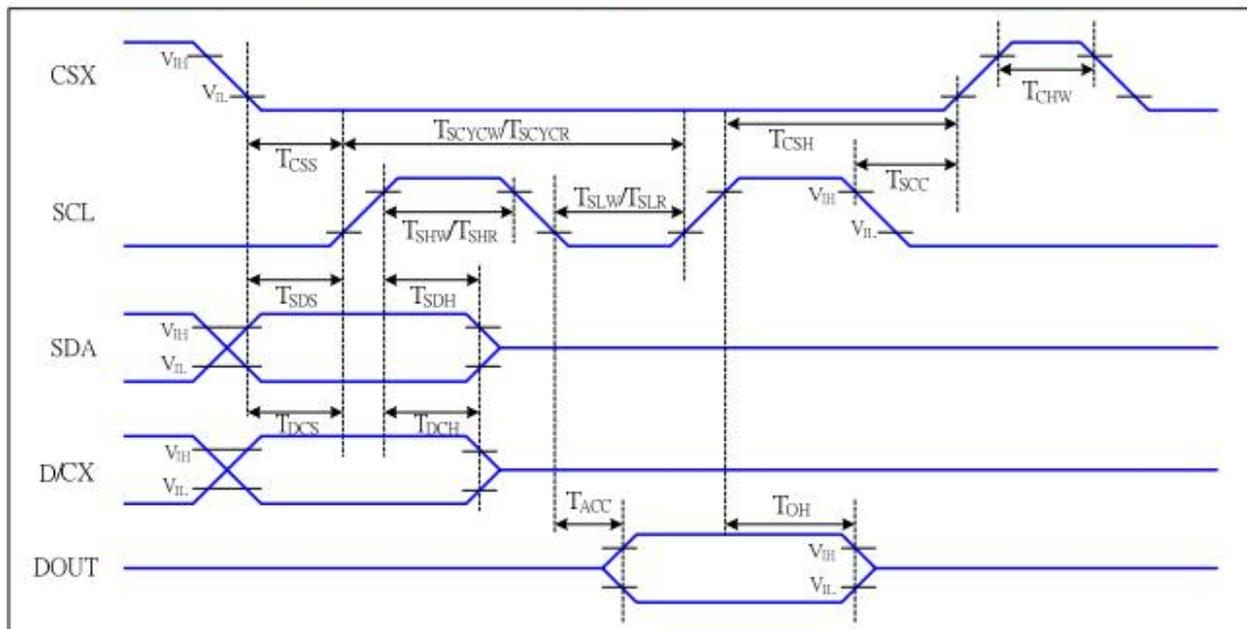


Figure 5 4-line serial Interface Timing Characteristics

VDDI=1.65 to 3.3V, VDD=2.4 to 3.3V, AGND=DGND=0V, Ta=-30 to 70 °C

Signal	Symbol	Parameter	MIN	MAX	Unit	Description
CSX	T <sub>CSS</sub>	Chip select setup time (write)	15		ns	
	T <sub>CSH</sub>	Chip select hold time (write)	15		ns	
	T <sub>CSS</sub>	Chip select setup time (read)	60		ns	
	T <sub>SCC</sub>	Chip select hold time (read)	65		ns	
	T <sub>CHW</sub>	Chip select "H" pulse width	40		ns	
SCL	T <sub>SCYCW</sub>	Serial clock cycle (Write)	66		ns	-write command & data ram
	T <sub>SHW</sub>	SCL "H" pulse width (Write)	15		ns	
	T <sub>SLW</sub>	SCL "L" pulse width (Write)	15		ns	
	T <sub>SCYCR</sub>	Serial clock cycle (Read)	150		ns	-read command & data ram
	T <sub>SHR</sub>	SCL "H" pulse width (Read)	60		ns	
	T <sub>SLR</sub>	SCL "L" pulse width (Read)	60		ns	
D/CX	T <sub>DCS</sub>	D/CX setup time	10		ns	
	T <sub>DCH</sub>	D/CX hold time	10		ns	
SDA (DIN)	T <sub>SDS</sub>	Data setup time	10		ns	
	T <sub>SDH</sub>	Data hold time	10		ns	
DOUT	T <sub>ACC</sub>	Access time	10	50	ns	For maximum CL=30pF
	T <sub>OH</sub>	Output disable time	15	50	ns	For minimum CL=8pF

Table 6 4-line serial Interface Characteristics

**RGB Interface Characteristics:**

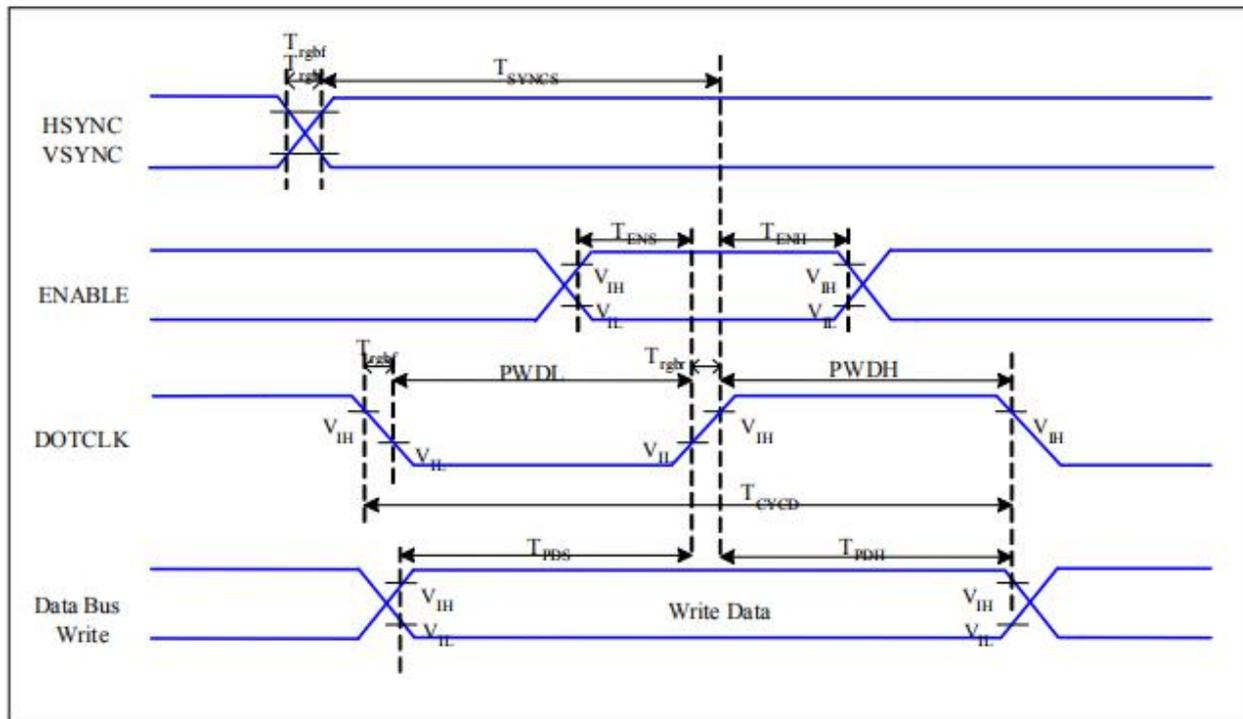


Figure 6 RGB Interface Timing Characteristics

VDDI=1.65 to 3.3V, VDD=2.4 to 3.3V, AGND=DGND=0V, Ta=-30 ~ 70 ℃

Signal	Symbol	Parameter	MIN	MAX	Unit	Description
HSYNC, VSYNC	T <sub>SYNCS</sub>	VSYNC, HSYNC Setup Time	30	-	ns	
ENABLE	T <sub>ENS</sub>	Enable Setup Time	25	-	ns	
	T <sub>ENH</sub>	Enable Hold Time	25	-	ns	
DOTCLK	PWDH	DOTCLK High-level Pulse Width	60	-	ns	
	PWDL	DOTCLK Low-level Pulse Width	60	-	ns	
	T <sub>CYCD</sub>	DOTCLK Cycle Time	120	-	ns	
	Trghr, Trghf	DOTCLK Rise/Fall time	-	20	ns	
DB	T <sub>PDS</sub>	PD Data Setup Time	50	-	ns	
	T <sub>PDH</sub>	PD Data Hold Time	50	-	ns	

**Table 7 18/16 Bits RGB Interface Timing Characteristics**

Signal	Symbol	Parameter	MIN	MAX	Unit	Description
HSYNC, VSYNC	T <sub>SYNCS</sub>	VSYNC, HSYNC Setup Time	20	-	ns	
ENABLE	T <sub>ENS</sub>	Enable Setup Time	20	-	ns	
	T <sub>ENH</sub>	Enable Hold Time	20	-	ns	
DOTCLK	PWDH	DOTCLK High-level Pulse Width	20	-	ns	
	PWDL	DOTCLK Low-level Pulse Width	20	-	ns	
	T <sub>CYCD</sub>	DOTCLK Cycle Time	55	-	ns	
	Trghr, Trghf	DOTCLK Rise/Fall time	-	10	ns	
DB	T <sub>PDS</sub>	PD Data Setup Time	20	-	ns	
	T <sub>PDH</sub>	PD Data Hold Time	20	-	ns	

**Table 8 6 Bits RGB Interface Timing Characteristics**

### 7.4.5 Reset Timing:

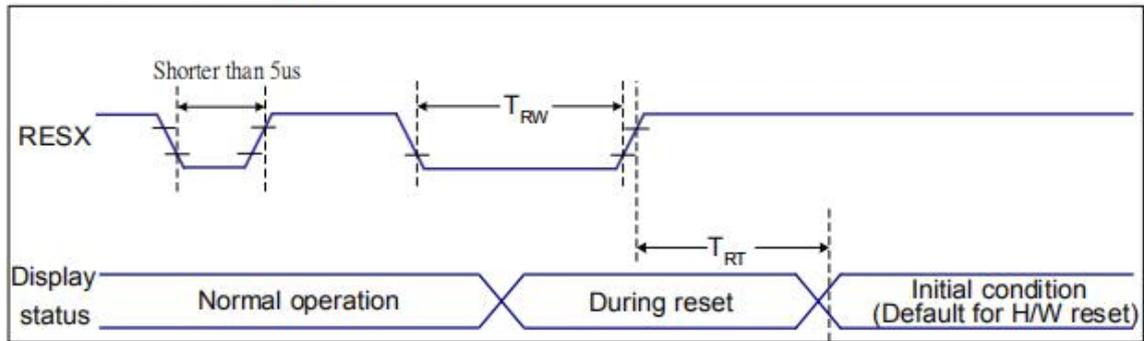


Figure 7 Reset Timing

$V_{DD1}=1.65$  to  $3.3V$ ,  $V_{DD}=2.4$  to  $3.3V$ ,  $AGND=DGND=0V$ ,  $T_a=-30 \sim 70 \text{ } ^\circ\text{C}$

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

Table 9 Reset Timing

Note: This section is only for reference, Details please refer to the IC specification.

## 8. Interface description

### TFT interface

No.	SYMBOL	Description
1	GND	System ground.
2~3	VCI	Power Supply (+2.8V)
4	IM2	The MCU interface mode select
5	IM1	
6	IM0	
7	RESET	This signal will reset the device and must be applied to properly initialize the chip. Signal is active low.
8	CS	Chip selection pin .
9	DC(SPI-SCK)	Display data/command selection pin in parallel interface. -This pin is used to be serial interface clock. DCX='1': display data or parameter. DCX='0': command data.
10	WR(SPI-RS)	Write enable in MCU parallel interface. - Display data/command selection pin in 4-line serial interface. - Second Data lane in 2 data lane serial interface.
11	RD	-Read enable in 8080 MCU parallel interface.
12	VSYNC	Vertical (Frame) synchronizing input signal for RGB interface operation.
13	HSYNC	Horizontal (Line) synchronizing input signal for RGB interface operation.
14	ENABLE	Data enable signal for RGB interface operation.
15	DOTCLK	Dot clock signal for RGB interface operation.
16	SDA	SPI interface input/output pin.
17~34	DB0~DB17	MCU parallel interface data bus.
35	SDO	SPI interface output pin.
36	LED-A	LED power anode.
37~40	LEDK[1:4]	LED power cathode.

MCU interface mode select

IM3	IM2	IM1	IM0	MPU Interface Mode	Data pin
0	0	0	0	80-8bit parallel I/F	DB[7:0]
0	0	0	1	80-16bit parallel I/F	DB[15:0]
0	0	1	0	80-9bit parallel I/F	DB[8:0]
0	0	1	1	80-18bit parallel I/F	DB[17:0],
0	1	0	1	3-line 9bit serial I/F	SDA: in/out
				2 data lane serial I/F	SDA: in/out WRX: in
0	1	1	0	4-line 8bit serial I/F	SDA: in/out

## 9. Reliability test conditions

No.	Test Item	Test condition	Remark
1	High Temperature Storage	80°C±2°C 240H	IEC60068-2-1:2007 GB2423.2-2008
2	Low Temperature Storage	-30°C±2°C 240H	IEC60068-2-1:2007 GB2423.1-2008
3	High Temperature Operation	70°C±3°C 240H	IEC60068-2-1:2007 GB2423.2-2008
4	Low Temperature Operation	-20°C±3°C 240H	IEC60068-2-1:2007 GB2423.1-2008
5	High Temperature /Humidity Storage	40°C±3°C 90%RH 240H	IEC60068-2-78:2007 GB2423.3-2006
6	Temperature Cycle	-30°C↔25°C↔80°C 5min 30min ↔25°C , 5min after 10cycle, Restore 4H at 25°C	IEC60068-2-14:1984 GB2423.22-2002
7	Vibration Test	10Hz~150Hz, 100m/s <sup>2</sup> , 120min	IEC60068-2-6:1982 GB/T2423.10-1995
8	Mechanical shock	100G ±X,±Y,±Z 3times for each direction	IEC60068-2-27:1987 GB/T2423.5-1995
9	Packing vibration test	0.015G <sup>2</sup> /Hz from 50~200Hz 6dB/Octave from 200~500Hz 2hours for each direction of X,Y,Z	IEC60068-2-34 GB/T2423.11

10	Dropping test	Drop to the ground from 0.5m height, one time, every side of carton. (Packing condition)	IEC60068-2-32:1990 GB/T2423.8-1995
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**Note1:**

The component placed on a vibrating platform as it is assembled in the machine, wires included, is subjected to sinusoidal vibration in all directions XYZ

**Note2:**

After completing the reliability test, leave the samples under the room temperature and for the following inspection items:

1. No clearly visible defects or deterioration of display quality allowed.
2. No function-related abnormalities.
3. Connected parts still connecting tightly.
4. Display characteristics fulfill initial value contrast ratio should be at least 30% of initial value.

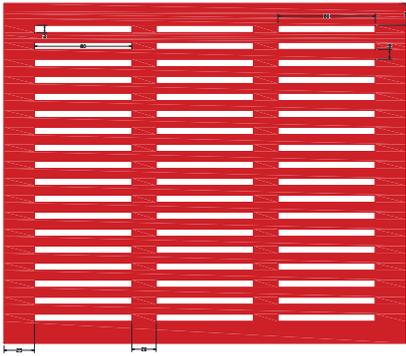
## 10. Storage and use precautions

**When storing and using the LCD modules, the following precaution are necessary:**

- 10.1 Store them in a sealed polyethylene bag. If properly sealed, there is no need for the desiccant.
- 10.2 Store them in a dark place. Do not expose to sunlight or fluorescent light, keep the temperature between 0°C and 35°C, and keep the relative humidity between 40%RH and 60%RH.
- 10.3 The LCD modules should be stored in the room without acid, alkali and harmful gas.
- 10.4 The polarizer surface should not come in contact with any other objects (We advise you to store them in the anti-static electricity container in which they were shipped).
- 10.5 The LCD modules should be no falling and violent shocking during transportation, and also should avoid excessive press, water, damp and sunshine.
- 10.6 Liquid crystals solidify under low temperature (below the storage temperature range) leading to defective orientation or the generation of air bubbles (black or white). Air bubbles may also be generated if the module is subject to a low temperature.
- 10.7 If the LCD modules have been operating for a long time showing the same display patterns, the display patterns may remain on the screen as ghost images and a slight contrast irregularity may also appear. A normal operating status can be gained by suspending use for some time. It should be noted that this phenomenon does not adversely affect performance reliability.
- 10.8 The display panel is made of glass. Do not subject it to a mechanical shock by dropping it from a high place, etc.
- 10.9 If the display panel is damaged and the liquid crystal substance inside it leaks out, be sure not to get any in your mouth, if the substance comes into contact with your skin or clothes, promptly wash it off using soap and water.
- 10.10 Do not apply excessive force to the display surface or the adjoining areas since this may cause the color tone to vary.

- 10.11 The polarizer covering the display surface of the LCD module is soft and easily scratched. Handle this polarizer carefully.
- 10.12 If the display surface is contaminated, gently wipe it with a soft dry cloth. If still not completely clear, moisten cloth with one of the following solvents:
- Isopropyl alcohol
  - Ethyl alcohol
- Solvents other than those mentioned above may damage the polarizer. Especially, do not use the following:
- Water
  - Ketone
  - Aromatic solvents
- 10.13 Do not attempt to disassemble the LCD Module.
- 10.14 If the logic circuit power is off, do not apply the input signals.
- 10.15 To prevent destruction of the elements by static electricity, be careful to maintain an optimum work environment.
- Be sure to ground the body when handling the LCD Modules.
  - Tools required for assembly, such as soldering irons, must be properly ground.
  - To reduce the amount of static electricity generated, do not conduct assembly and other work under dry conditions
  - The LCD Module is coated with a film to protect the display surface. -
  - Be care when peeling off this protective film since static electricity may be generated.
  - Exposed area of the printed circuit board.
  - Terminal electrode sections

## **11. Packing**

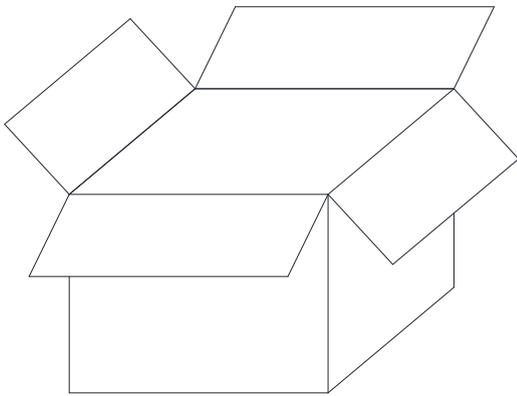


(1)

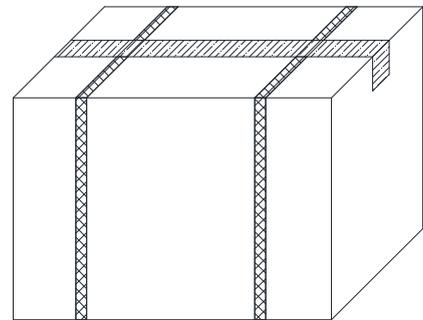
(1) Place the module into the pearl cotton tray.

(2) Place the pear cotton tray into the carton.

(3) Wrap the carton well.



(2)



(3)