


SPECIFICATIONS FOR LCD MODULE

CUSTOMER	
MODEL	SCT028023-V01
CUSTOMER APPROVED	

APPROVED BY	CHECKED BY	ORGANIZED BY
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0158

RECORDS OF REVISIONS

Revision No	Revision Date	Description
Ver: A0	2019-12-20	First release

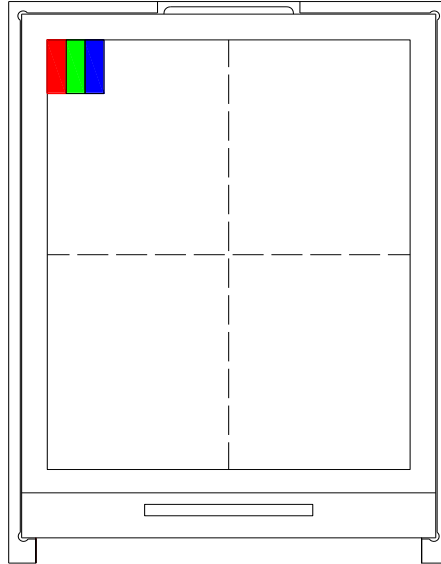
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- Interface Timing
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1. General Description

This LCM **SCT028023-V01** is a TFT LCD module, **240 (RGB) x 320** dots graphic, and power supply circuit. Display mode is **Normal Black**, The 262K color can be display.

This TFT-LCD has **2.83** inch diagonally measured active display area with **QVGA** resolution.



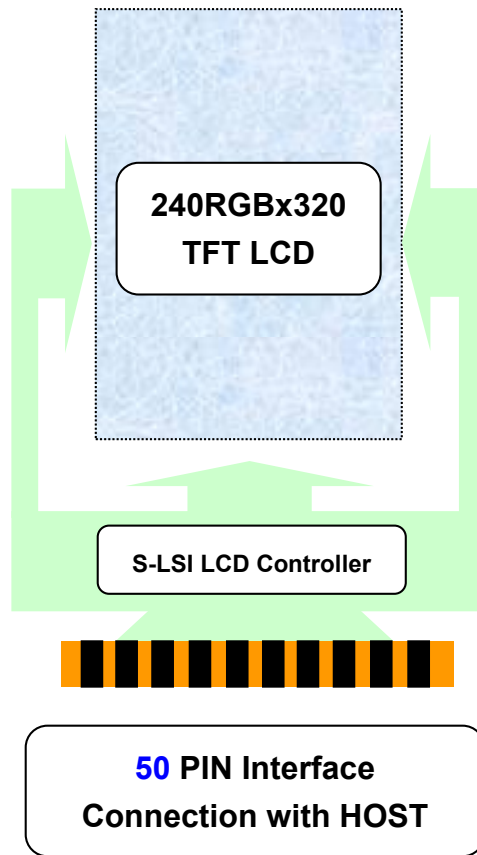
1.1 Mechanical Specifications

Item	Nominal Dimension	Unit
Dot Matrix	240 x RGB x 320	Dots
Module Size (W×H×T)	50.00 x 69.20 x 2.5	mm.
Active Area (W×H)	43.20 x 57.60	mm.
Pixel arrangement	RGB Stripe	mm.
Dot Pitch (W×H)	0.18 x 0.18	mm.
Color depth	262K (MAX)	colors
Interface	MCU, SPI, RGB	-
Driving IC	ST7789V	-

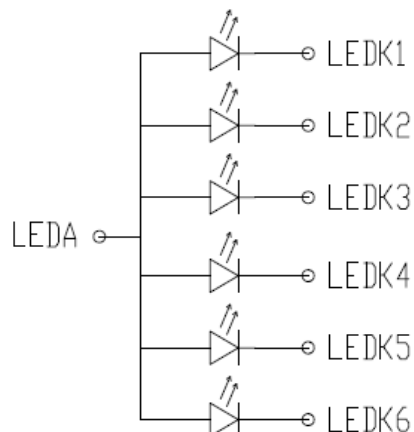
1.2 Display Specifications

Item	Nominal Dimension	Unit
Operating temperature	-20 ~70	□
Storage temperature	-30~80	□
LCD Type	a-Si TFT	-
LCD Mode	TN / Normal Black	-
Backlight Type	LED x 6	PCS

1.3 Block Diagram



1.4 Back-light Unit



1.5 Interface Pin

Pin No	Pin Symbol	Type	Description				
1	GND	P	Ground				
2-5	NC	-	No connected				
6	IOVCC	P	Power supply for I/O				
7	IOVCC	P	Power supply for I/O				
8	VCI	P	Power supply for analog				
9	VCI	P	Power supply for analog				
10	IM2	I	Interface Mode Select.				
			IM2	IM1	IM0	MPU Interface Mode	Data pin
11	IM1	I	0	0	0	8080 18-bit Interface	DB[17:0]
			0	0	1	8080 9-bit Interface	DB[8:0]
			0	1	0	8080 16-bit Interface	DB[15:0]
			0	1	1	8080 8-bit Interface	DB[7:0]
12	IM0	I	1	0	0	Reserve	--
			1	0	1	3SPI	SDA,SDO
			1	1	1	4Line SPI	SDA, SDO
13	RESET	I	Chip reset signal				
14	CS	I	Chip Select signal				
15	DC (SCL)	I	Data or Command selection. 0:Command; 1:Data (serial interface clock)				
16	WR (DC)	I	Write signal (Display data/command selection pin in 4-line serial interface.)				
17	RD	I	Read signal				
18	VSYNC	I	Vertical sync input.				
19	HSYNC	I	Horizontal sync input.				
20	ENABLE	I	Data enable input.				
21	DOTCLK	I	Pixel clock input.				
22	SDA	I	Serial data input.				
23-28	DB0 - DB5 (B0 - B5)	I/O	Data bus				
29-34	DB6 - DB11 (G0 - G5)	I/O	Data bus				
35-40	DB12 - DB17 (R0 - R5)	I/O	Data bus				
41	SDO	O	Serial data output				
42	GND	P	Ground				

43	LEDA	P	LED light, anode
44	LEDK1	P	LED light, cathode.
45	LEDK2	P	LED light, cathode.
46	LEDK3	P	LED light, cathode.
47	LEDK4	P	LED light, cathode.
48	LEDK5	P	LED light, cathode.
49	LEDK6	P	LED light, cathode.
50	GND	P	Ground

2. Interface Timing

7.4.1 8080 Series MCU Parallel Interface Characteristics: 18/16/9/8-bit Bus

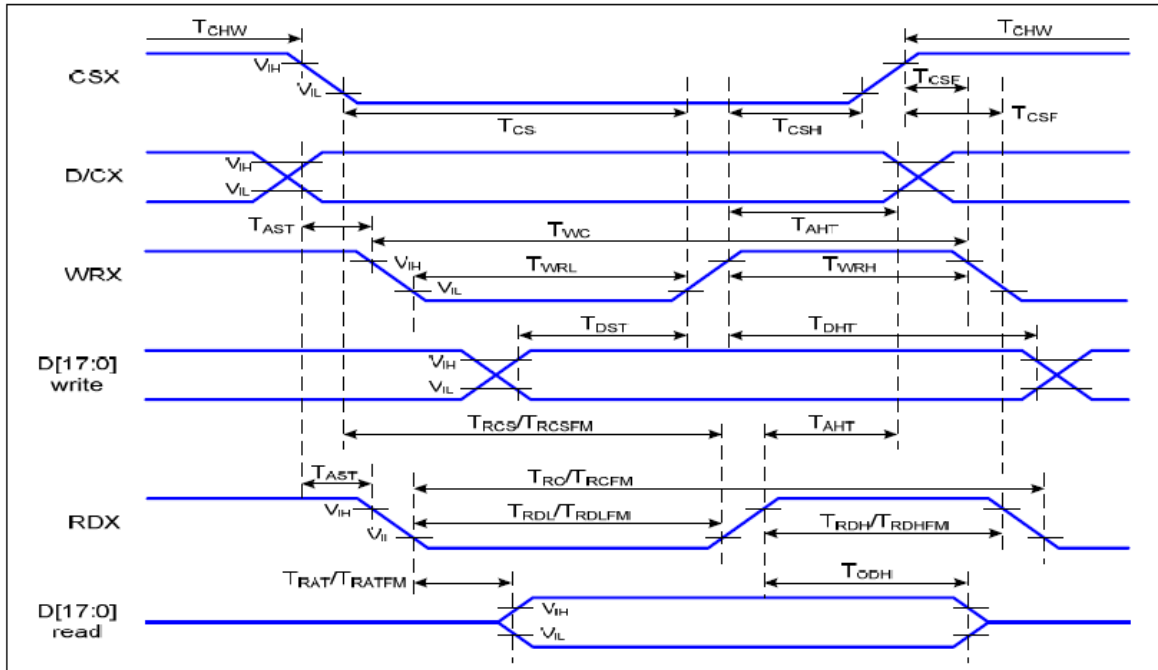


Figure 1 Parallel Interface Timing Characteristics (8080-Series MCU Interface)

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
D/CX	T _{AST}	Address setup time	0		ns	-
	T _{AHT}	Address hold time (Write/Read)	10		ns	
CSX	T _{CHW}	Chip select "H" pulse width	0		ns	-
	T _{CS}	Chip select setup time (Write)	15		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 (Write/Read)	10		ns	
	T _{CSH}	Chip select hold time	10		ns	
WRX	T _{WC}	Write cycle	66		ns	-
	T _{WRH}	Control pulse "H" duration	15		ns	
	T _{WRL}	Control pulse "L" duration	15		ns	
RDX (ID)	T _{RC}	Read cycle (ID)	160		ns	When read ID data
	T _{RDH}	Control pulse "H" duration (ID)	90		ns	
	T _{RDL}	Control pulse "L" duration (ID)	45		ns	
RDX (FM)	T _{RCFM}	Read cycle (FM)	450		ns	When read from frame memory
	T _{RDHFM}	Control pulse "H" duration (FM)	90		ns	
	T _{RDLFM}	Control pulse "L" duration (FM)	355		ns	
D[17:0]	T _{DST}	Data setup time	10		ns	For CL=30pF

	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

Table 4 8080 Parallel Interface Characteristics

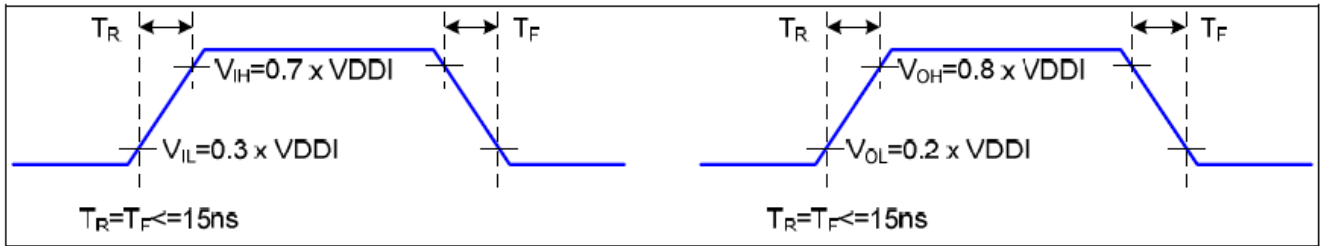


Figure 2 Rising and Falling Timing for I/O Signal

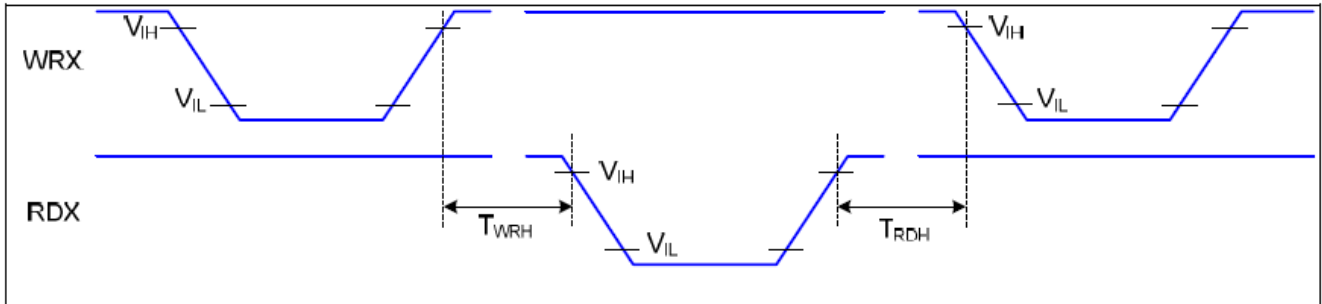


Figure 3 Write-to-Read and Read-to-Write Timing

Note: The rising time and falling time (T_r , T_f) of input signal and fall time are specified at 15 ns or less. Logic high and low levels are specified as 30% and 70% of VDDI for Input signals.

7.4.2 Serial Interface Characteristics (3-line serial):

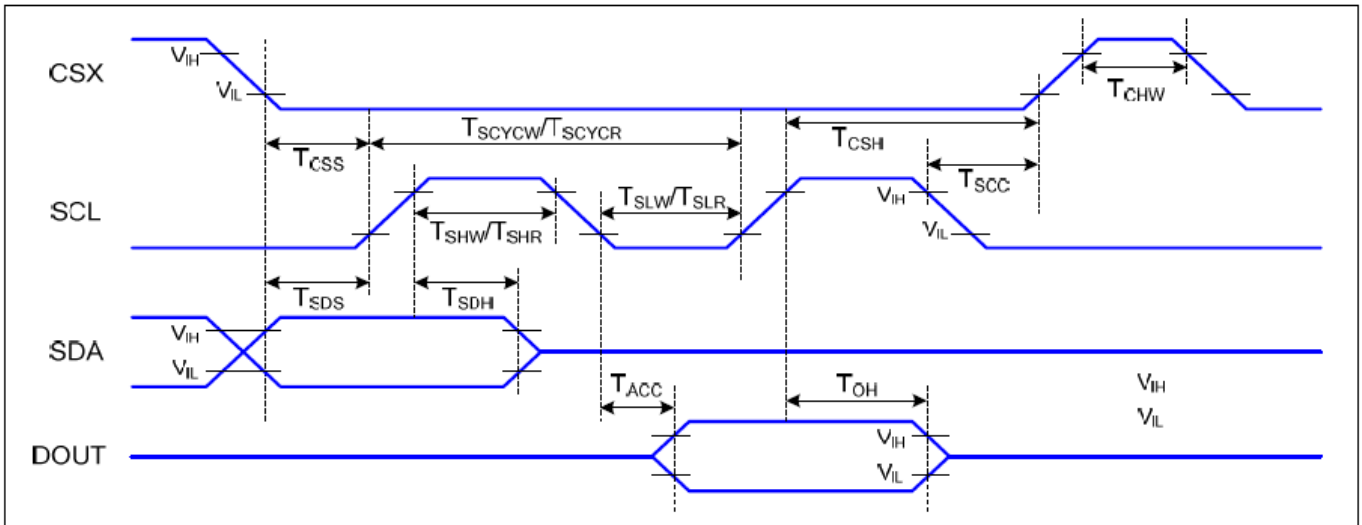


Figure 4 3-line serial Interface Timing Characteristics

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 _{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

Note : The rising time and falling time (Tr, Tf) of input signal are specified at 15 ns or less. Logic high and low levels are specified as 30% and 70% of VDDI for Input signals.

7.4.3 Serial Interface Characteristics (4-line serial):

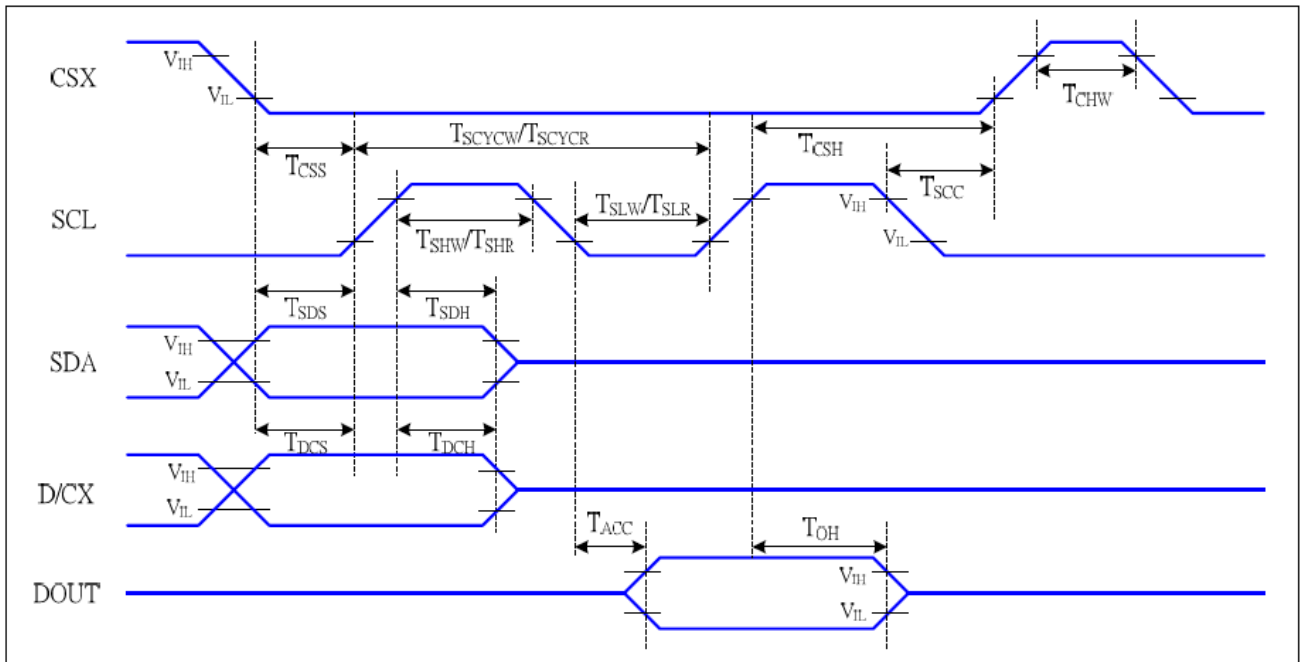


Figure 5 4-line serial Interface Timing Characteristics

$V_{DDI}=1.65$ to $3.3V$, $V_{DD}=2.4$ to $3.3V$, $AGND=DGND=0V$, $T_a=-30$ to 70 °C

Signal	Symbol	Parameter	MIN	MAX	Unit	Description
CSX	T_{CSS}	Chip select setup time (write)	15		ns	
	T_{CSH}	Chip select hold time (write)	15		ns	
	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	-write command & data ram
	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	-read command & data ram
	T_{SHR}	SCL "H" pulse width (Read)	60		ns	
	T_{SLR}	SCL "L" pulse width (Read)	60		ns	
D/CX	T_{DCS}	D/CX setup time	10		ns	
	T_{DCH}	D/CX hold time	10		ns	
SDA (DIN)	T_{SDS}	Data setup time	10		ns	
	T_{SDH}	Data hold time	10		ns	
DOUT	T_{ACC}	Access time	10	50	ns	For maximum $CL=30pF$
	T_{OH}	Output disable time	15	50	ns	For minimum $CL=8pF$

Table 6 4-line serial Interface Characteristics

Note : The rising time and falling time (T_r , T_f) of input signal are specified at 15 ns or less. Logic high and low levels are specified as 30% and 70% of V_{DDI} for Input signals.

7.4.4 RGB Interface Characteristics:

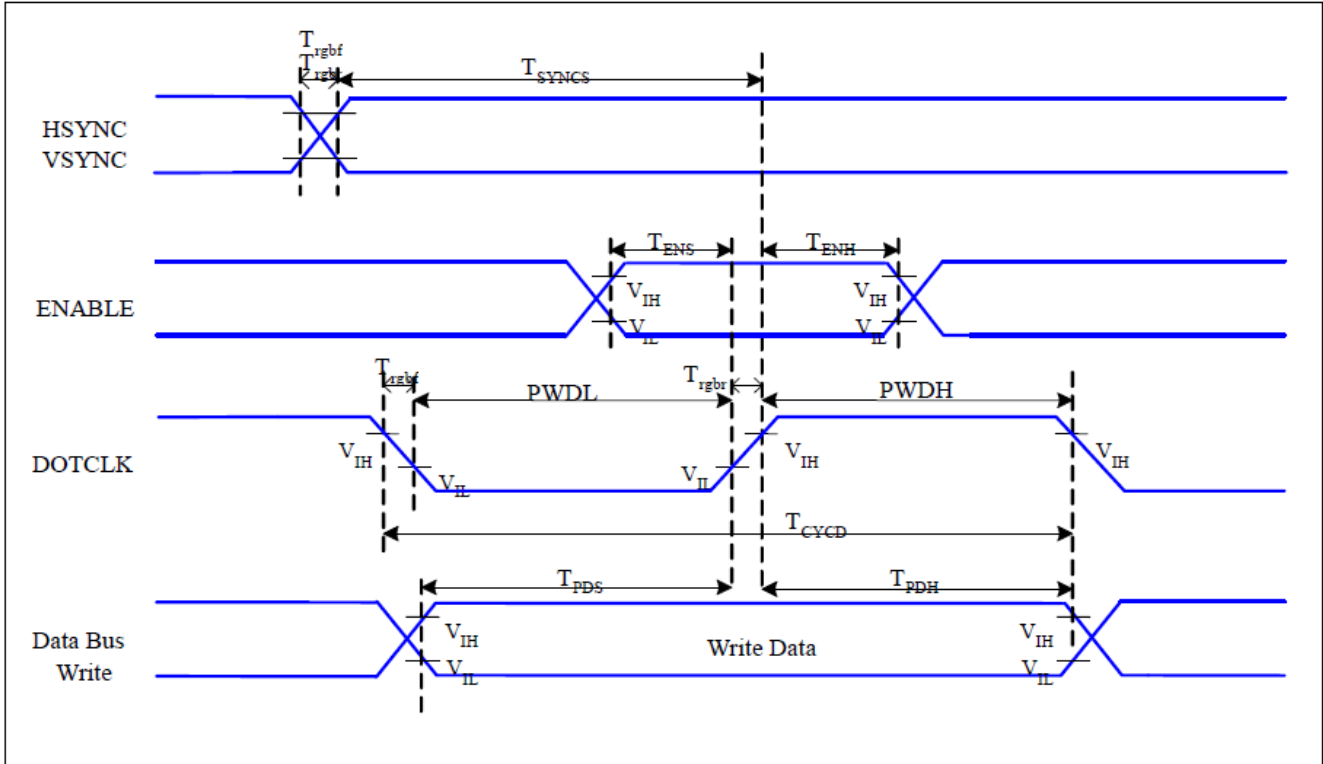


Figure 6 RGB Interface Timing Characteristics

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

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

	T_{ENH}	Enable Hold Time	20	-	ns	
DOTCLK	PWDH	DOTCLK High-level Pulse Width	20	-	ns	
	PWDL	DOTCLK Low-level Pulse Width	20	-	ns	
	T_{CYCD}	DOTCLK Cycle Time	55	-	ns	
	Trghr, Trghf	DOTCLK Rise/Fall time	-	10	ns	
DB	T_{PDS}	PD Data Setup Time	20	-	ns	
	T_{PDH}	PD Data Hold Time	20	-	ns	

Table 8 6 Bits RGB Interface Timing Characteristics

7.4.5 Reset Timing:

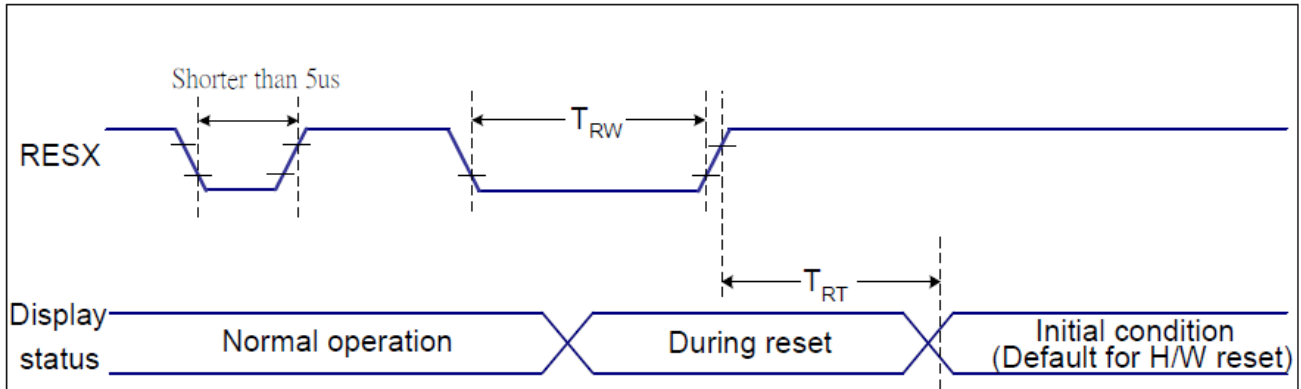


Figure 7 Reset Timing

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

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:

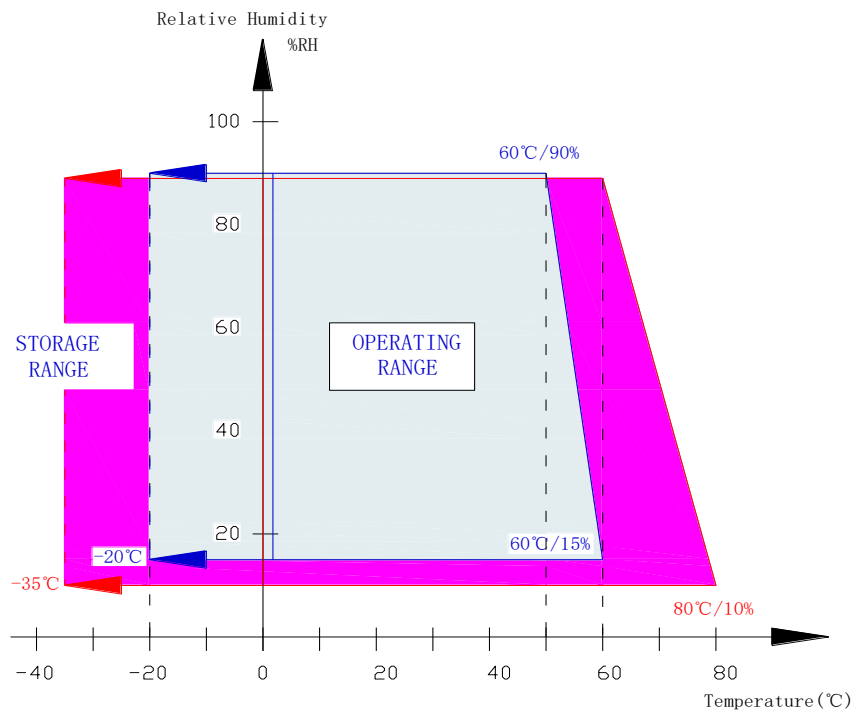
3. Electrical Characteristics

3.1 Absolute Maximum Ratings

Item	Symbol	Min	Max	Unit
Supply voltage for System	VCI	-0.3	+4.6	V
Supply voltage for Interface Operation	IOVCC	-0.3	+4.6	V
Operate temperature range	TOP	-20	70	□
Storage temperature range	TST	-30	80	□

Note:

- (1) 90%RH maximum humidity, 60°C maximum wet-bulb temperature When operated at a temperature lower than 0°C, the LCD worked slowly and the screen appeared low-contrast images due to the characteristics of LC(Liquid Crystal).
- (2) If any fixed pattern is displayed on LCD for minutes, image-sticking phenomenon may occur.
- (3) Degradation could occur to pixels' TFT when DC BIOS is input into its gate-signal under POWER OFF WAITING STAND-BY & SLEEP MODE. Therefore, LCD should be turn off then.
- (4) Please operate a LCD module on the basis of the recommended S/W(Register)



Temperature & Humidity Graph at Absolute Environment

DATA). If you want to change any part of the S/W, you must take driver's confirmation.

3.2 DC Characteristics

$T_a = 25^\circ\text{C}$

Item	Symbol	Min	Typ	Max	Unit	Condition
Supply voltage for System	VCI	2.4	2.75	3.3	V	
Supply voltage for Interface Operation	IOVCC	1.65	1.8	3.3	V	
Input high level voltage	V_{IH}	0.8IOVCC	--	IOVCC	V	
Input low level voltage	V_{IL}	0	--	0.2IOVCC	V	
Power supply current	I_{DD}	--	--	30	mA	
Backlight forward voltage	V_F	--	3.1	--	V	
Backlight forward current	I_F	--	--	120	mA	

4. Optical characteristics

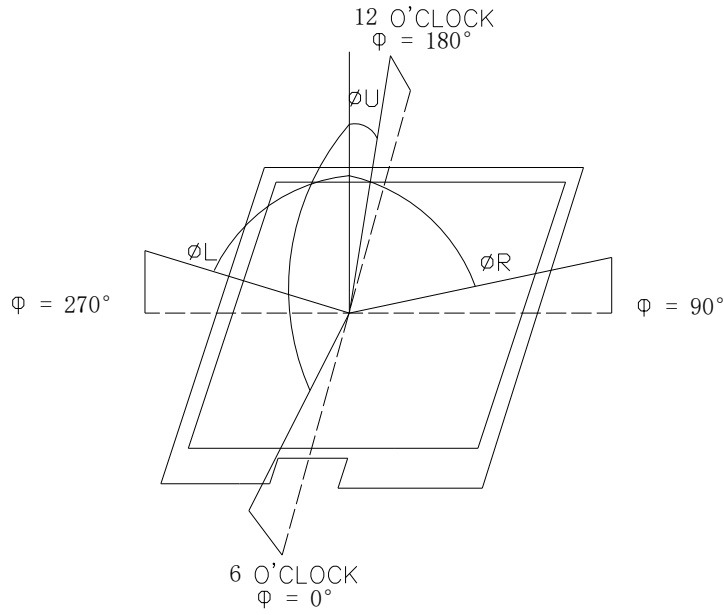
Parameter		Symbol	Condition	Min	Typ	Max	Unit	Note
Viewing angle		Left	$CR \geq 10$		80		Degree	(2)
		Right			80		Degree	
		Up			80		Degree	
		Down			80		Degree	
Color Chromaticity	Red	Rx	$\theta = 0$ Normal viewing angle	-0.05	0.641	+0.05		Color Chromaticity
		Ry			0.337			
	Green	Gx			0.274			
		Gy			0.560			
	Blue	Bx			0.141			
		By			0.113			
	White	Wx			0.308			
		Wy			0.330			
Contrast ratio		CR	optimal	600	800	-		(1)
Response time		$T_r + T_f$		-	30	-	ms	(3)
Luminance on surface $I_f = 120\text{mA}$		L_v	Normally $\theta_x = \theta_y = 0$	650	700	-	cd/m^2	

Note (1) Definition of contrast ratio

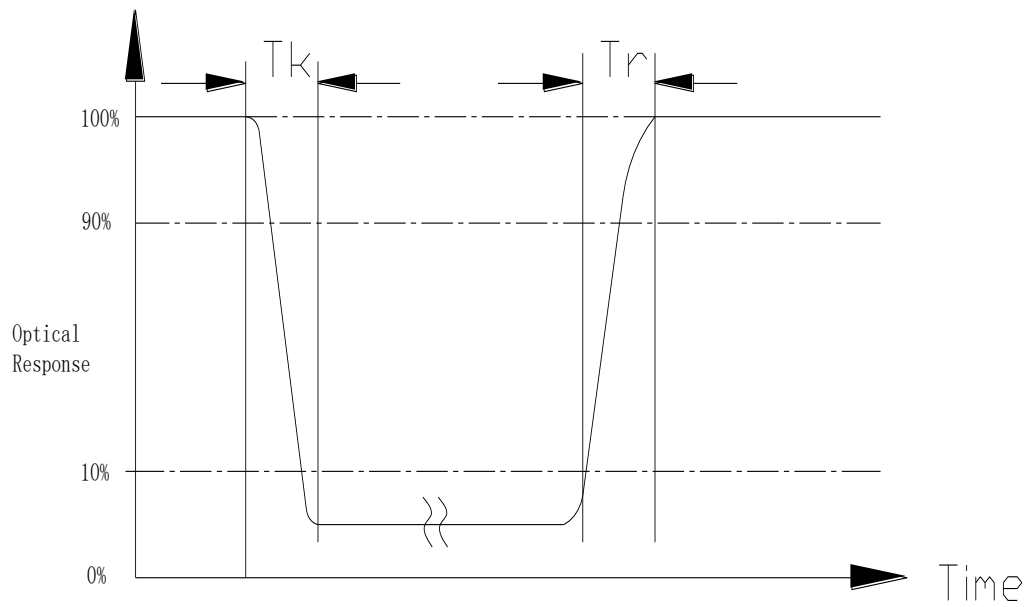
Measured at the center point of panel

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

Note (2) Definition of viewing angle



Note (3) Definition of response time: $T_r + T_f$



5. Reliability

5.1 Reliability Condition

Item No	Item	Condition	Remark
1	High temperature Operating	70°C, 240Hours	Finish product (With polarizer)
2	Low temperature Operating	-20°C, 240 Hours	Finish product (With polarizer)
3	High temperature Storage	80°C, 240 Hours	Finish product (With polarizer)
4	Low temperature Storage	-30°C, 240 Hours	Finish product (With polarizer)
5	High temperature & humidity Storage	60°C, 90%RH, 240 Hours	Finish product (With polarizer)
6	Thermal Shock Storage (No operation)	-30°C , 30min.<=> 80°C , 30min. 100 Cycles	Finish product (With polarizer)
7	ESD test	Voltage:±8KV R:330 ohm,C:150pF Air discharge,10 times	Finish product (With polarizer)
8	Vibration test	0.015G*G/Hz from 5-200HZ, -6dB/Octave from 200-500HZ 2 hours for each direction of X. Y. Z. (6 hours for total)	Finish product (With polarizer)
9	Drop test	Packed, 60cm free fall 1 corner, 3 edges, 6 surfaces	Finish product (With polarizer)

*One single product test for only one item.

* Judgment after test: keep in room temperature for more than 2 hours.

- Current consumption < 2 times of initial value
- Contrast > 1/2 initial value
- Function: work normally

5.2 Inspection plan

Class	Item	Judgment	Class
Packing & Indicate	1.Outside and inside package	“Model no.” , “lot no.” and “quantity” Should indicate on the package.	Minor
	2.Model mixed and quantity	Other model mixed.....rejected. Quantity short or over....rejected.	Critical
	3.Product indication	“Model no.” should indicate on the product	Major
Assembly	4.Dimension,LCD glass scratch And scribe defect	According to specification or drawing	Major
Appearance	5.Viewing area	Polarizer edge or LCD’s sealing line is visible in the viewing arearejected	Minor
	6.Blemish 、 black spot 、 White spot in the LCD And LCD glass cracks	According to standard of visual inspection (inside viewing area)	Minor
	7. Blemish 、 black spot White spot and scratch on the polarizer	According to standard of visual inspection (inside viewing area)	Minor
	8.Bubble in polarizer	According to standard of visual inspection (inside viewing area)	Minor
	9.LCD’s rainbow color	Strong deviation color (or Newton ring) of LCDrejected. Or according to limited sample (if needed, and inside viewing area)	Minor
	10.FPC	Burned area or wrong part number is on FPC. The symbol, character, and mark of FPC are unidentifiable. The stripped solder mask, A>1.0mm 0.3mm < stripped solder mask or visible circuit, A<1.0mm,and the number is □4 pieces. Particle between circuits in solder mask.. Circuit is peeled off or cracked. Any circuit risen or exposed. 0.2mm< Area of solder ball, A is □0.4mm,the number of solder ball is □3 pieces. The magnitude of solder ball, A is>0.4mm.	Minor

5.3 Standard of visual inspection

Class	Item	Judgment	Class
Electrical	11.Electrical and optical characteristics (contrast 、 VOP 、 chromaticity...etc)	According to specification or drawing. (inside viewing area)	Critical
	12.Missing pattern	Missing dot 、 line 、 character.....rejected	Critical
	13.Short circuit 、 wrong pattern display	Non display 、 wrong pattern display 、 current consumption out of specification.....rejected	Critical
	14.Pin hole 、 pattern deformity	According to standard of visual inspection	Minor
	15.Black spot 、 white spot 、 black line 、 white line 、 slant line 、 background uneven 、 color uneven	Strong deviation color.....rejected Or according to limited sample full off screen (all black) ...disregards	Minor
	16.Stick image (retention image)	Fixed test picture within two hours...rejected	Minor

Class	Item	Judgment														
Minor	· Blemish 、 black spot 、 white spot in the LCD.	(A) Round type: unit: mm <table border="1" style="margin-left: 20px;"> <thead> <tr> <th>Diameter (mm.)</th> <th>Acceptable Q'ty</th> </tr> </thead> <tbody> <tr> <td>0.2<A</td> <td>0</td> </tr> </tbody> </table> <p>Note: A= (Length +Width) / 2</p>	Diameter (mm.)	Acceptable Q'ty	0.2<A	0										
	Diameter (mm.)	Acceptable Q'ty														
0.2<A	0															
· Blemish 、 black spot 、 white spot and scratch on th polarizer	(B) Liner type: unit: mm <table border="1" style="margin-left: 20px;"> <thead> <tr> <th>Length</th> <th>Width</th> <th>Acceptable Q'ty</th> </tr> </thead> <tbody> <tr> <td>---</td> <td>W ≤ 0.03</td> <td>Disregard</td> </tr> <tr> <td>L ≤ 5</td> <td>0.03 < W ≤ 0</td> <td>3</td> </tr> <tr> <td>L ≤ 5</td> <td>0.05 < W ≤ 0.07</td> <td>1</td> </tr> <tr> <td>---</td> <td>0.07 < W</td> <td>Follow round type</td> </tr> </tbody> </table>	Length	Width	Acceptable Q'ty	---	W ≤ 0.03	Disregard	L ≤ 5	0.03 < W ≤ 0	3	L ≤ 5	0.05 < W ≤ 0.07	1	---	0.07 < W	Follow round type
Length	Width	Acceptable Q'ty														
---	W ≤ 0.03	Disregard														
L ≤ 5	0.03 < W ≤ 0	3														
L ≤ 5	0.05 < W ≤ 0.07	1														
---	0.07 < W	Follow round type														
Minor	Bubble in polarizer	unit: mm <table border="1" style="margin-left: 20px;"> <thead> <tr> <th>Diameter</th> <th>Acceptable Q'ty</th> </tr> </thead> <tbody> <tr> <td>A ≤ 0.3</td> <td>Disregard</td> </tr> <tr> <td>0.3 < A ≤ 0.5</td> <td>1</td> </tr> <tr> <td>0.5 < A</td> <td>0</td> </tr> </tbody> </table>	Diameter	Acceptable Q'ty	A ≤ 0.3	Disregard	0.3 < A ≤ 0.5	1	0.5 < A	0						
Diameter	Acceptable Q'ty															
A ≤ 0.3	Disregard															
0.3 < A ≤ 0.5	1															
0.5 < A	0															
Minor	Pin hole 、 Pattern deformity	unit: dot size <table border="1" style="margin-left: 20px;"> <thead> <tr> <th>Diameter</th> <th>Acc. Q'ty</th> </tr> </thead> <tbody> <tr> <td>0.4 < Φ</td> <td>0</td> </tr> </tbody> </table>	Diameter	Acc. Q'ty	0.4 < Φ	0										
Diameter	Acc. Q'ty															
0.4 < Φ	0															

6. Precaution

6.1 Handling

- (1) Protect the panel from static, it may cause damage to the CMOS Gate Array IC.
- (2) Use fingerstalls with soft gloves in order to keep display clean during the incoming inspection and assembly process.
- (3) If the liquid crystal material leaks from the panel, it should be kept away from the eyes or mouth. In case of contact with hands, legs or clothes, it must be washed away thoroughly with soap.
- (4) The desirable cleaners are water, IPA (Isopropyl Alcohol) or Hexane. Don't use Ketone type materials (ex. Acetone), Ethyl alcohol, Toluene, Ethyl acid or Methyl chloride. It might permanent damage to the polarizer due to chemical reaction.
- (5) Pins of I/F connector shall not be touched directly with bare hands.
- (6) Refrain from strong mechanical shock and / or any force to the panel. In addition to damage, this may cause improper operation or damage to the panel.
- (7) Note that polarizers are very fragile and could be easily damaged. Do not press or scratch the surface harder than a B pencil lead.
- (8) Wipe off water droplets or oil immediately. If you leave the droplets for a long time, staining and discoloration may occur.
- (9) If the surface of the polarizer is dirty, clean it using some absorbent cotton or soft cloth.

6.2 Storage

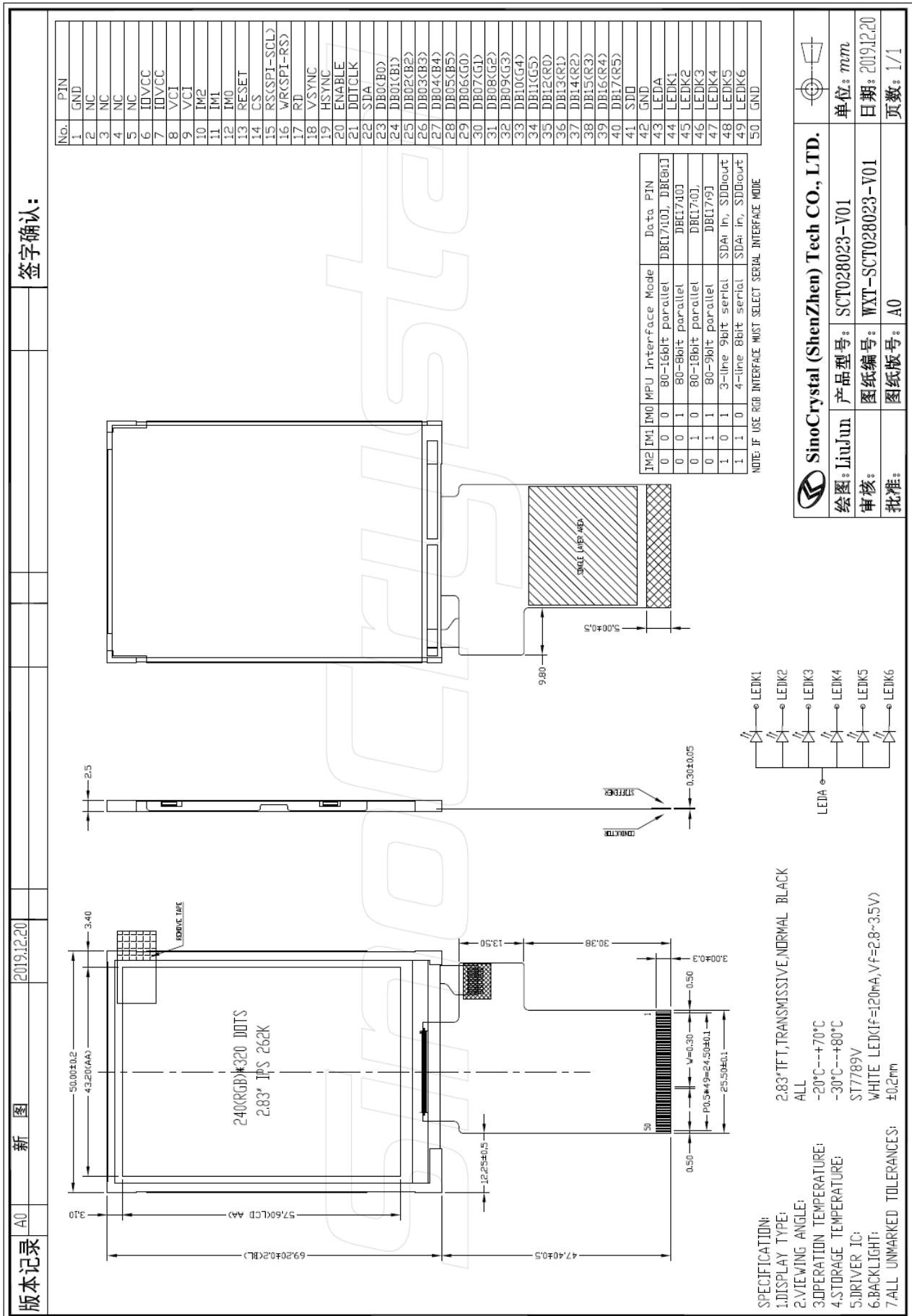
- (1) Do not leave the panel in high temperature, and high humidity for a long time. It is highly recommended to store the panel with temperature from 0 to 35°C and relative humidity of less than 70%.
- (2) The panel shall be stored in a dark place. It is prohibited to apply sunlight or fluorescent light during the store.

6.3 Operation

- (1) The LCD shall be operated within the limits specified. Operation at values outside of these limits may shorten life, and/or harm display images.
- (2) Do not exceed the absolute maximum rating value. (the supply voltage variation, Input voltage variation in part contents and environmental temperature and so on). Otherwise the panel may be damaged.
- (3) If the panel displays the same pattern continuously for a long period of time, it can be the situation when the image" Sticks" to the screen.

7. Outline Dimension

Refer to SCT028023-V01 drawing.



SinoCrystal (ShenZhen) Tech CO., LTD.

绘图: LiuJun 产品型号: SCT028023-V01 单位: mm

审核: 图纸编号: WXT-SCT028023-V01 日期: 2019.12.20

批准: 图纸版号: A0 页数: 1/1

8. Packing method

8.1 Packing Quantity (TBD)

8.2 Flowing chart (TBD)