SPECIFICATIONS FOR LCD MODULE

CUSTOMER	
MODEL	**SCT020017-V01**
CUSTOMER APPROVED	

APPROVED BY	CHECKED BY	ORGANIZED BY
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RECORDS OF REVISIONS

Version	Content	Date
A0	First Issue	2021-07-17

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1. General Description

This Module SCT020017-V01 is TFT Liquid Crystal Display Module. This specification covers the delivery requirements for the liquid crystal display module delivered by quality to Customer.

1.1. Mechanical & Display Specifications

Item	Standard value	Unit
LCD Size	2.0	inch
Dot Matrix	240(RGB) × 320	pixel
Module Size	35.60 × 50.20 × 2.10	mm
Active Area	30.60 × 40.80	mm
Dot Pitch	0.1275 × 0.1275	mm
Pixel Configuration	R.G.B. Stripe	-
Color depth	262K	-
Display Mode	Normally black, Transmissive	-
Technology Type	a-Si	-
Viewing Direction	All	-
Gray Scale Inversion Direction	All	-
Driver IC	ST7789V	-
Interface	8bit MCU	-
LED Numbers	4 LEDs	-
Weight	TBD	g

1.2. Interface Pin

Pin No.	Symbol	Type	Description
1	LEDK	P	LED driving cathode
2	LEDA	P	LED driving anode
3	GND	P	Ground
4	VCC	P	Power supply for system
5	VDDI	P	Power supply for I/O
6	RESET	I	Chip reset signal
7	CSX	I	Chip Select signal
8	DCX	I	Display data/command selection (RS) pin in MCU parallel interface. DCX='1': display data or parameter. DCX='0': register index / command.
9	WR	I	Write signal
10	RD	I	Read signal
11-18	DB0-DB7	I/O	Data bus
19	TE	O	Tear effect output
20	GND	P	Ground

Note1: TYPE definition: I-----Input O---Output P----Power/Ground

2. Electrical Characteristics

2.1. Absolute Maximum Rating

Item	Symbol	Min.	Max.	Unit	Remark
Power Supply Voltage (Analog)	VCC	-0.3	4.6	V	
Power Supply Voltage (IO)	VDDI	-0.3	4.6	V	
Input Signal Voltage	V_{IN}	-0.3	4.6	V	Note 1
Operating Temperature	T_{OPR}	-20	+70	℃	Ambient
Storage Temperature	T_{STG}	-30	+80	℃	Ambient

Note1: VIN represent IO

2.2. DC Electrical Characteristics

2.2.1. Driving TFT LCD Panel

GND=0V, Ta=25℃

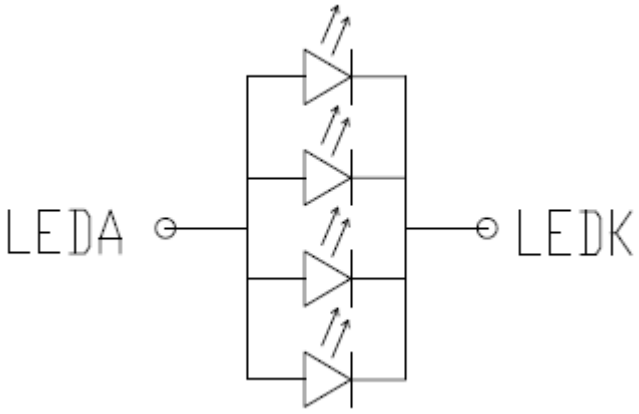
Item	Symbol	Min.	Typ.	Max.	Unit	Remark
Analog Operating Voltage	VCC	2.4	2.75	3.3	V	
Logic Operating Voltage	VDDI	1.65	1.8	3.3	V	
Logic High level input voltage	V_{IH}	0.7VDDI	-	VDDI	V	
Logic Low level input voltage	V_{IL}	0	-	0.3VDDI	V	
Logic High level output voltage	V_{OH}	0.8VDDI	-	VDDI	V	I_{OH}=-1.0mA
Logic Low level output voltage	V_{OL}	0	-	0.2VDDI	V	I_{OL}=1.0mA
Power Consumption	I_{CC}	-	TBD	-	mA	

2.2.2. Driving Backlight

Ta=25℃

Item	Symbol	Min.	Typ.	Max.	Unit	Remark
Forward Current	I_F	-	80	80	mA	Note1
Forward Current Voltage	V_F	2.75	-	3.5	V	
Operating Life Time	-	10000			hrs	

Note 1: The figure below shows the connection of backlight LED.



Note 2: One LED: I_F =20mA.

2.3. AC Electrical Characteristics

2.3.1. 8080 Series MCU Parallel Interface Characteristics: 18/16/9/8-bit Bus

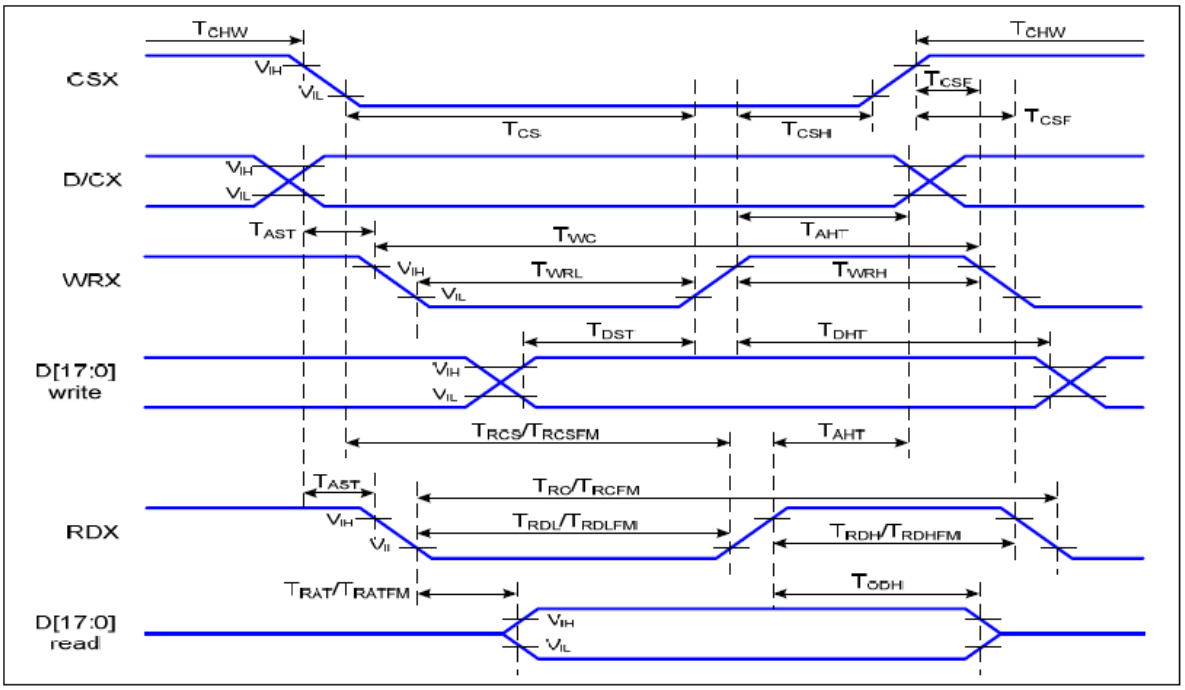


Figure 1 Parallel Interface Timing Characteristics (8080-Series MCU Interface)

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

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

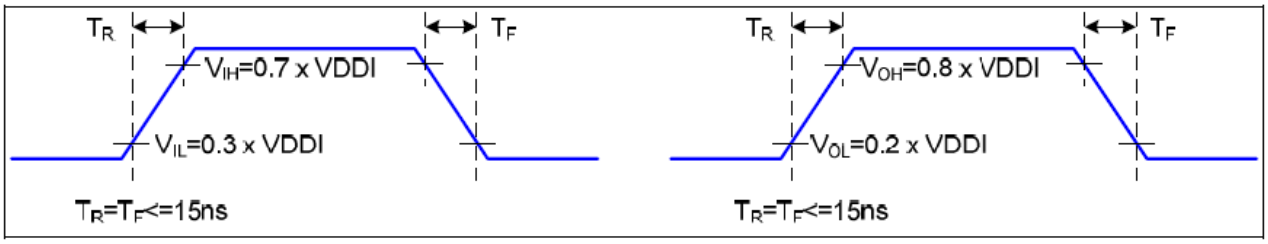


Figure 2 Rising and Falling Timing for I/O Signal

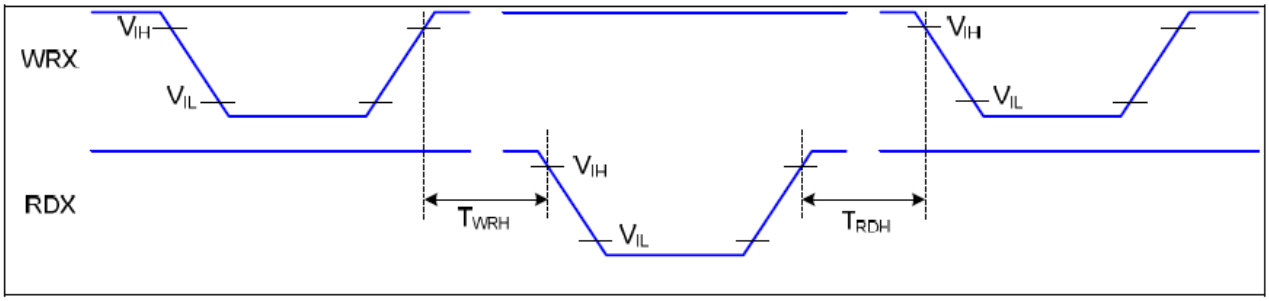


Figure 3 Write-to-Read and Read-to-Write Timing

Note: The rising time and falling time (Tr, Tf) 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.

2.3.2. Reset Timing

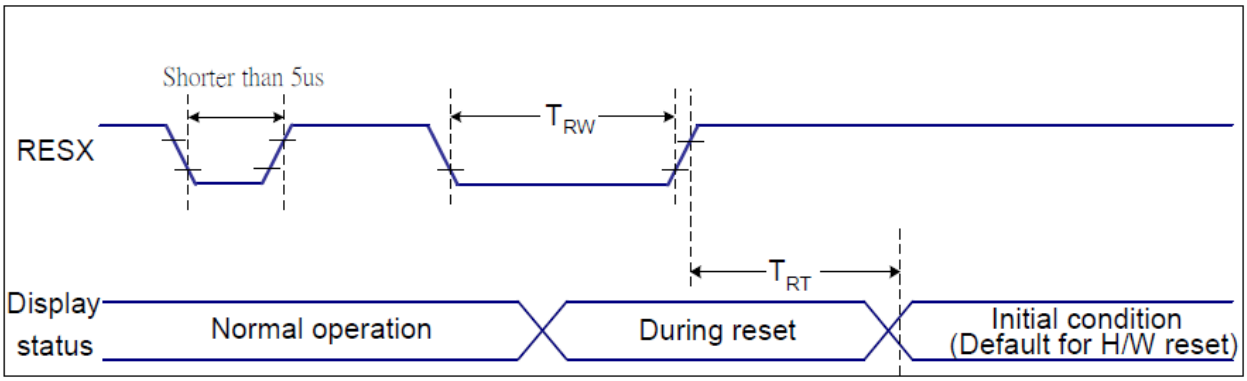


Figure 7 Reset Timing

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

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:

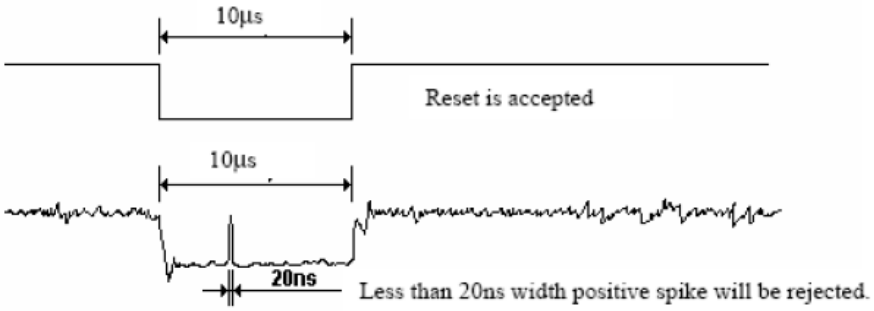
1. The reset cancel includes also required time for loading ID bytes, VCOM setting and other settings from NVM (or similar device) to registers. This loading is done every time when there is HW reset cancel time (tRT) within 5 ms after a rising edge of RESX.

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:



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.

3. Optical Characteristics

Item		Symbol	Condition	Min.	Typ.	Max.	Unit	Remark
Viewing angle		θT	CR≥10		80	-	degree	Note5
		θB			80	-		
		θL			80	-		
		θR			80	-		
Contrast Ratio		CR	θ=0° optimal	640	800	-	-	Note3
Response Time		$T_{R+}T_F$	Ta=25℃	-	35	45	ms	Note2
Color Chromaticity	White	x	θ=0°	-0.05	0.296	+0.05	-	Note6
		y			0.325			
	Red	x			0.647			
		y			0.329			
	Green	x			0.279			
		y			0.550			
	Blue	x			0.134			
		y			0.123			
Uniformity		U	θ=0°	70	80	-	%	Note7
Luminance		L	I_F=Typ.		TBD	-	cd/m^2	Note8

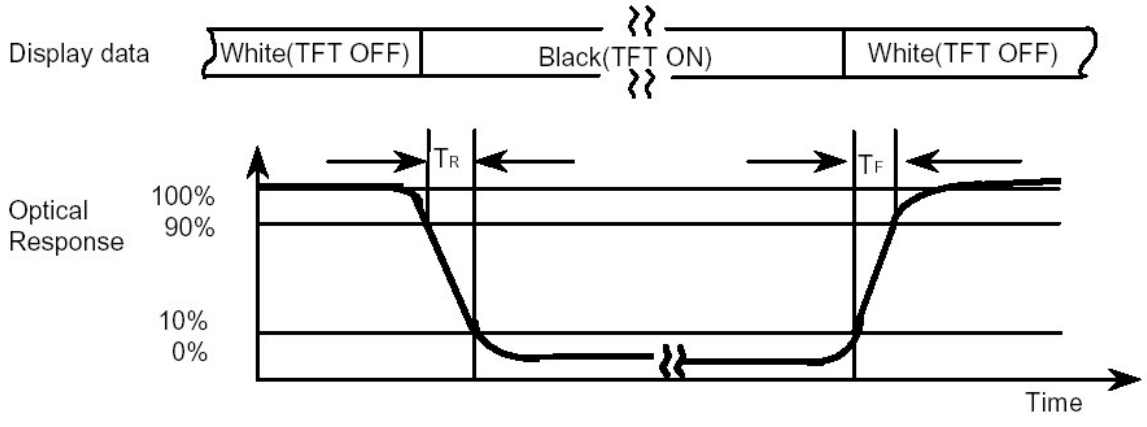
Note:

1. Test equipment setup

After stabilizing and leaving the panel alone at a given temperature for 30 minutes, the measurement should be executed. Measurement should be executed in a stable, windless, and dark room. Optical specifications are measured by Topcon BM-7 with a viewing angle of 1° at a distance of 50cm and normal direction.

2. Definition of response time: T_R and T_F

The figure below is the output signal of the photo detector.

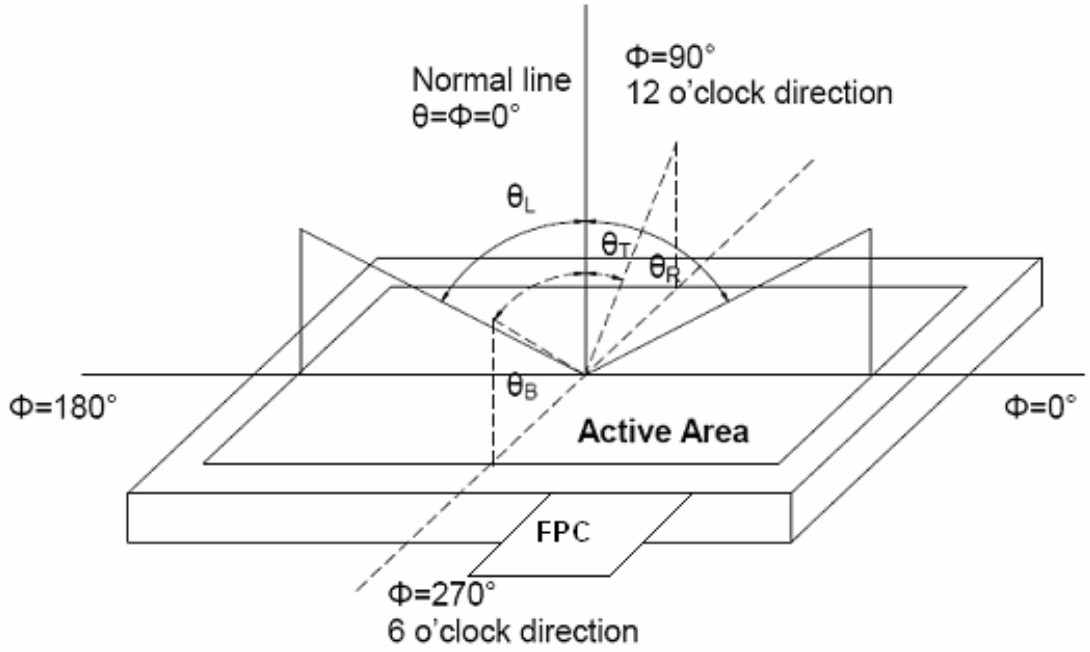


3.Definition of contrast ratio

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

4.The 100% transmission is defined as the transmission of LCD panel when all the input terminals of module are electrically opened.

5. Definition of viewing angle:



6. Definition of color chromaticity (CIE1931)

Color coordinates measured at center point of LCD.

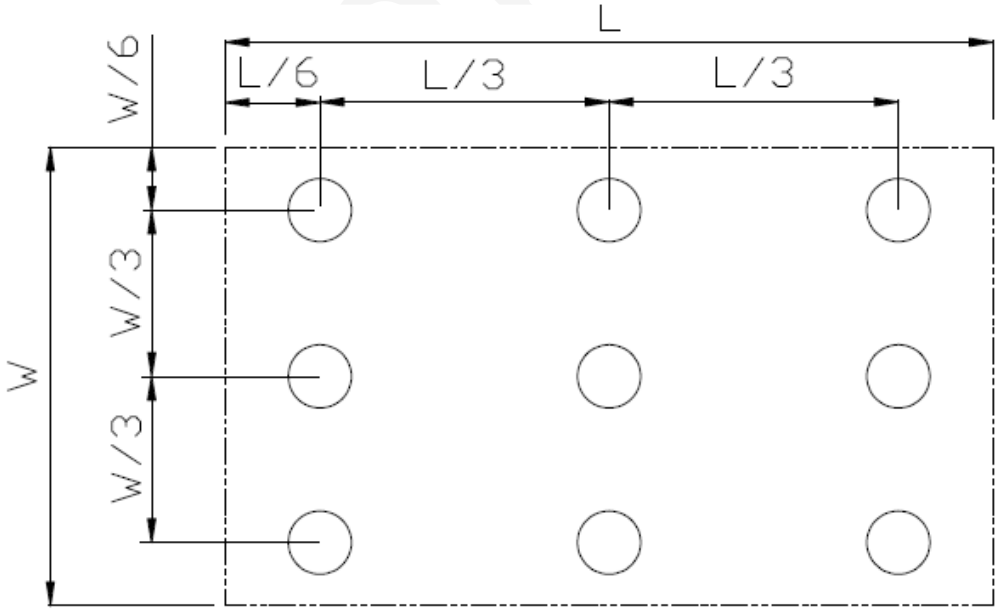
7. Definition of Luminance Uniformity

Active area is divided into 9 measuring areas (Refer Fig.). Every measuring point is placed at the center of each measuring area.

Luminance Uniformity(U) = L_{MIN} / L_{MAX}

L-------Active area length

W----- Active area width



L_{MAX}: The measured maximum luminance of all measurement position.

L_{MIN}: The measured minimum luminance of all measurement position.

8. Definition of Luminance:

Measure the luminance of white state at center point.

4. Reliability

4.1. Reliability Condition

No.	Item	Condition	Remark
1	High temperature Operating	70℃, 240hrs	Finish product (With polarizer)
2	Low temperature Operating	-20℃, 240hrs	Finish product (With polarizer)
3	High temperature Storage	80℃, 240hrs	Finish product (With polarizer)
4	Low temperature Storage	-30℃, 240hrs	Finish product (With polarizer)
5	High temperature & Humidity Storage	80℃, 90%RH, 240hrs	Finish product (With polarizer)
6	Thermal Shock Storage (No operation)	-30℃, 30min. <=> 80℃,30min. 100 Cycles	Finish product (With polarizer)
7	ESD Test	Voltage: +8KV R:330Ω, 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

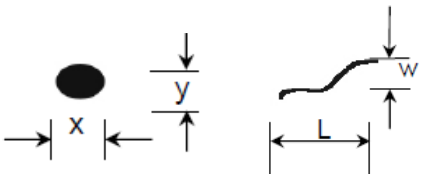
4.2. Inspection plan

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 area ..... rejected	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 LCD ..... rejected. 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
Electrical	11.Electrical and optical characteristics (contrast, VOP, chromaticity etc.)	According to standard of visual inspection (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

4.3. Standard of visual inspection

<table>
<tr><th>Class</th><th>Item</th><th>Judgment</th></tr>
<tr><td>Minor</td><td>Blemish, black spot, white spot in the LCD.

Blemish, black spot, white spot and scratch on the polarizer.

Round type Line type</td><td>(A) Round type Unit: mm
<table>
<tr><th>Diameter (mm)</th><th>Acceptable Quantity</th></tr>
<tr><td>0.25 < A</td><td>0</td></tr>
</table>
Note: A = (x + y)/2 (mm)

(B) Line type Unit: mm
<table>
<tr><th>Length</th><th>Width</th><th>Acceptable Quantity</th></tr>
<tr><td>-</td><td>W≦0.03</td><td>Acceptable</td></tr>
<tr><td>L<5</td><td>0.03<W≦0.07</td><td>3</td></tr>
<tr><td>L<5</td><td>0.03<W≦0.07</td><td>1</td></tr>
<tr><td>-</td><td>0.07<W</td><td>Follow round type</td></tr>
</table></td></tr>
<tr><td>Minor</td><td>Bubble in polarizer</td><td>Unit: mm
<table>
<tr><th>Diameter (mm)</th><th>Acceptable Quantity</th></tr>
<tr><td>A < 0.3</td><td>Acceptable</td></tr>
<tr><td>0.3 < A < 0.5</td><td>1</td></tr>
<tr><td>0.5 < A</td><td>0</td></tr>
</table></td></tr>
<tr><td>Minor</td><td>Pin hole, Pattern deformity</td><td>Unit: mm
<table>
<tr><th>Diameter (mm)</th><th>Acceptable Quantity</th></tr>
<tr><td>0.4 < A</td><td>0</td></tr>
</table></td></tr>
</table>

5. Precautions

5.1. Handling Precautions

(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.

5.2. Storage Precautions

(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℃ 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.

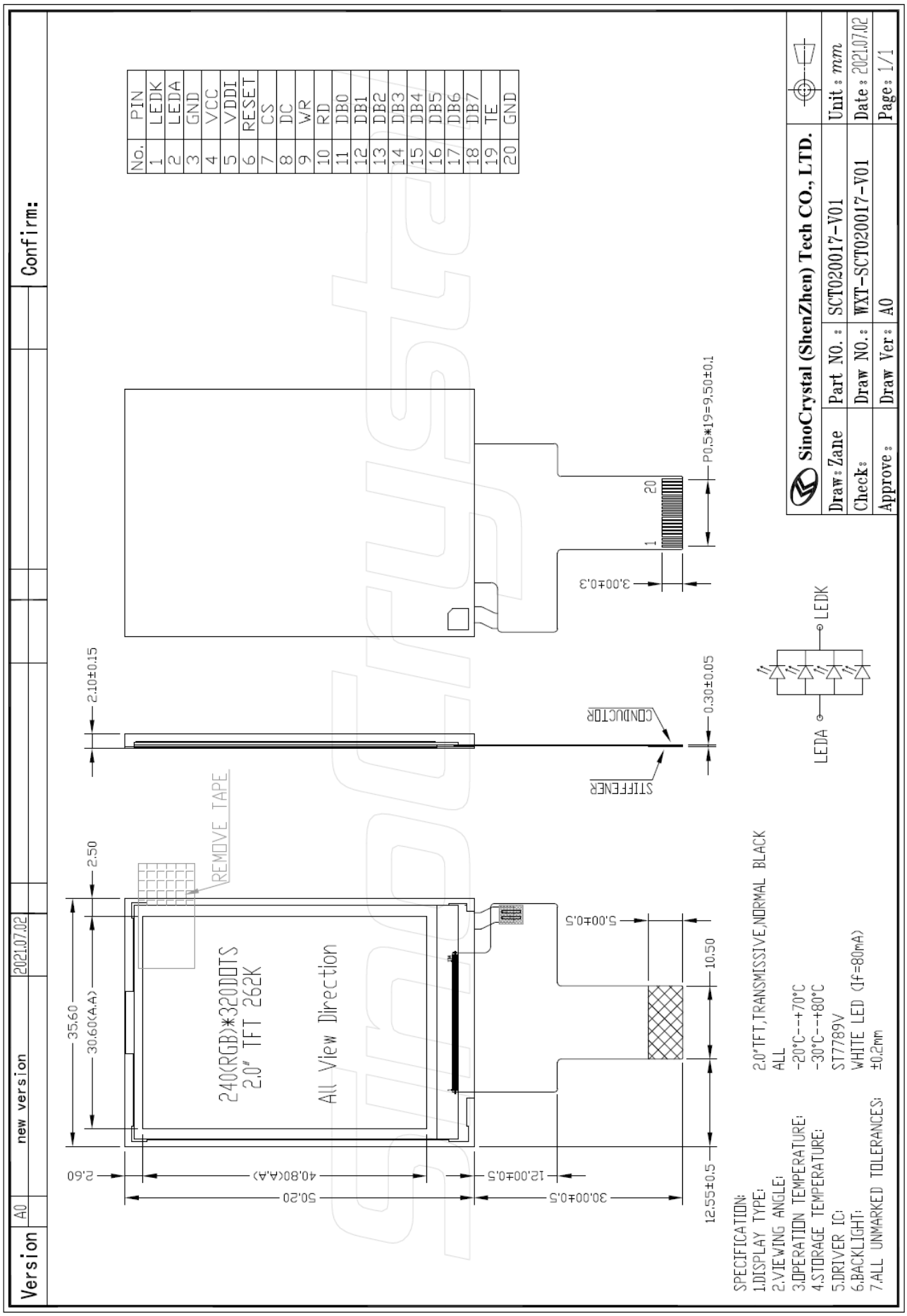
5.3. Operation Precautions

(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.

6. Outline Dimension



7. Packing Information

7.1. Packing Quantity

TBD.

7.2. Flowing chart

TBD.