SPECIFICATIONS
FOR
LCD MODULE

CUSTOMER	
MODEL	**SCT009005-V01**
CUSTOMER APPROVED	

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RECORDS OF REVISIONS

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1. General Description

This Module SCT009005-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	0.96	inch
Dot Matrix	80(RGB) × 160	pixel
Module Size	13.54 × 27.95 × 1.50	mm
Active Area	10.80 × 21.70	mm
Dot Pitch	0.135 × 0.1356	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	ST7735S	-
Interface	4-line SPI	-
LED Numbers	1 LEDs	-
Weight	TBD	g

Note: Requirements on Environmental Protection: RoHS

1.2. Interface Pin

Pin No.	Symbol	Type	Description
1	GND	P	Ground
2	DCX	I	Data / Command selection input
3	SCL	I	Serial clock
4	RST	I	Reset signal input
5	CS	I	Chip enable
6	SDA	I/O	Serial data input/output
7	GND	P	Ground
8	VCC	P	Power supply
9	LEDK	P	LED backlight cathode (Negative)
10	LEDA	P	LED backlight anode (Positive)

Note: 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	VCC	-0.3	4.6	V	
Input Signal Voltage	V_{IN}	-0.3	VCC	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℃

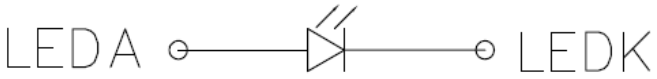
Item	Symbol	Min.	Typ.	Max.	Unit	Remark
Power Supply	VCC	2.5	3.3	3.7	V	
Logic High level input voltage	V_{IH}	0.7VCC	-	VCC	V	
Logic Low level input voltage	V_{IL}	0	-	0.3VCC	V	
Logic High level output voltage	V_{OH}	0.8VCC	-	VCC	V	I_{OH}=-1.0mA
Logic Low level output voltage	V_{OL}	0	-	0.2VCC	V	I_{OL}=1.0mA
Power Consumption	I_{CC}	-	TBD	-	mA	

2.2.2. Driving Backlight

Ta=25℃

Item	Symbol	Min.	Typ.	Max.	Unit	Remark
Forward Current	I_F	-	20	20	mA	Note1
Forward Current Voltage	V_F	2.7	-	3.5	V	
Operating Life Time	-	20000			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. 4-line Serial Interface Characteristics

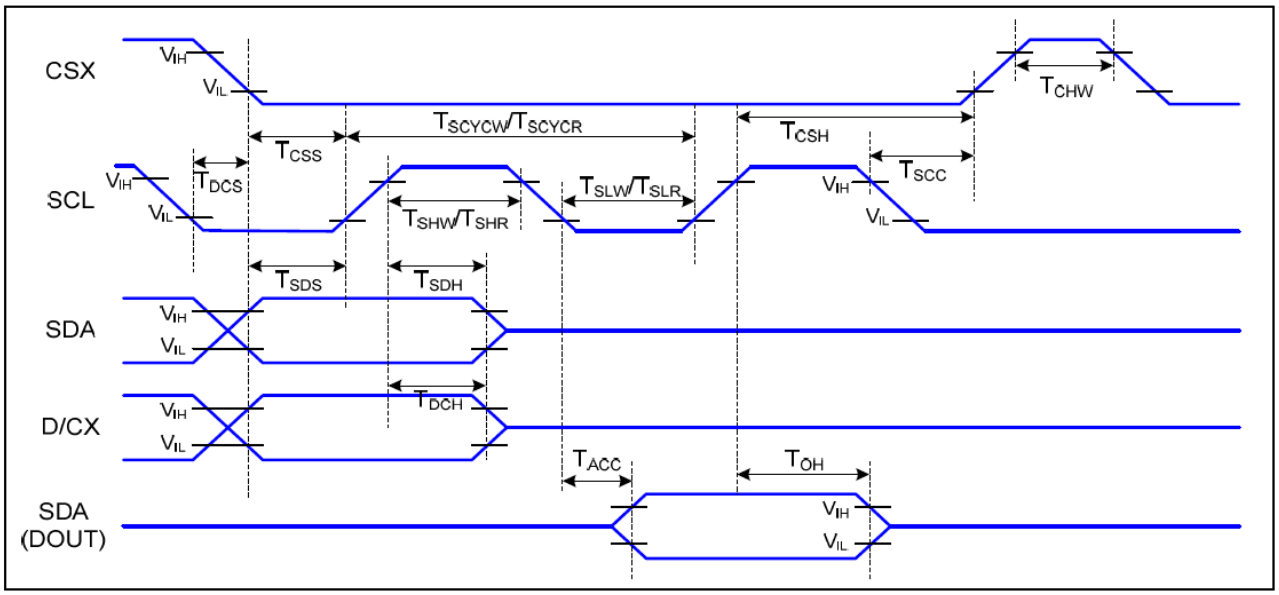


Figure 7 4-line Serial Interface Timing

Ta=25 ℃, VDDI=1.65~3.7V, VDD=2.5~4.8V

Signal	Symbol	Parameter	MIN	MAX	Unit	Description
CSX	TCSS	Chip Select Setup Time (Write)	45		ns	
	TCSH	Chip Select Hold Time (Write)	45		ns	
	TCSS	Chip Select Setup Time (Read)	60		ns	
	TSCC	Chip Select Hold Time (Read)	65		ns	
	TCHW	Chip Select “H” Pulse Width	40		ns	
SCL	TSCYCW	Serial Clock Cycle (Write)	66		ns	-Write Command & Data Ram
	TSHW	SCL “H” Pulse Width (Write)	15		ns	
	TSLW	SCL “L” Pulse Width (Write)	15		ns	
	TSCYCR	Serial Clock Cycle (Read)	150		ns	-Read Command & Data Ram
	TSHR	SCL “H” Pulse Width (Read)	60		ns	
	TSLR	SCL “L” Pulse Width (Read)	60		ns	
D/CX	TDCS	D/CX Setup Time	10		ns	
	TDCH	D/CX Hold Time	10		ns	
SDA (DIN) (DOUT)	TSDS	Data Setup Time	10		ns	For Maximum CL=30pF For Minimum CL=8pF
	TSDH	Data Hold Time	10		ns	
	TACC	Access Time	10	50	ns	
	TOH	Output Disable Time	15	50	ns	

Table 7 4-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.

3. Optical Characteristics

Item		Symbol	Condition	Min.	Typ.	Max.	Unit	Remark
Viewing angle		θT	CR≥10	75	80	-	degree	Note5
		θB		75	80	-		
		θL		75	80	-		
		θR		75	80	-		
Contrast Ratio		CR	θ=0° optimal	600	800	-	-	Note3
Response Time		$T_{R+}T_F$	Ta=25℃	-	30	35	ms	Note2
Color Chromaticity	White	x	θ=0°	-0.05	0.285	+0.05	-	Note6
		y			0.301			
	Red	x			-			
		y			-			
	Green	x			-			
		y			-			
	Blue	x			-			
		y			-			
Color Gamut (C light)		S (%)	θ=0°	-	-	-	%	Note7
Uniformity		U	θ=0°	70	80	-	%	Note8
Luminance		L	I_F=Typ.	-	450	-	cd/m^2	Note9

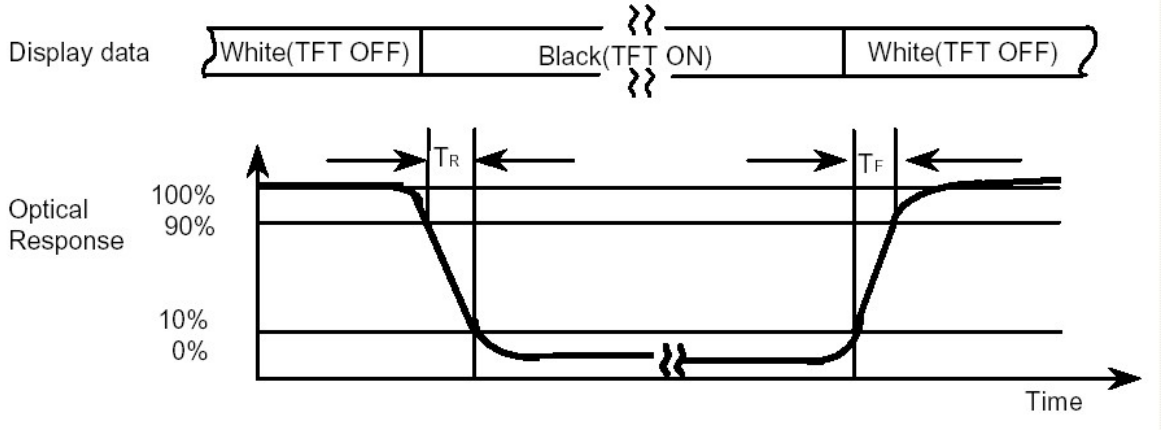
Note:

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. CA-210 of KONICA MINOLTA, which utilized for Chromaticity and BM-7 for other optical characteristics.

2. Definition of response time: T_R and T_F

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

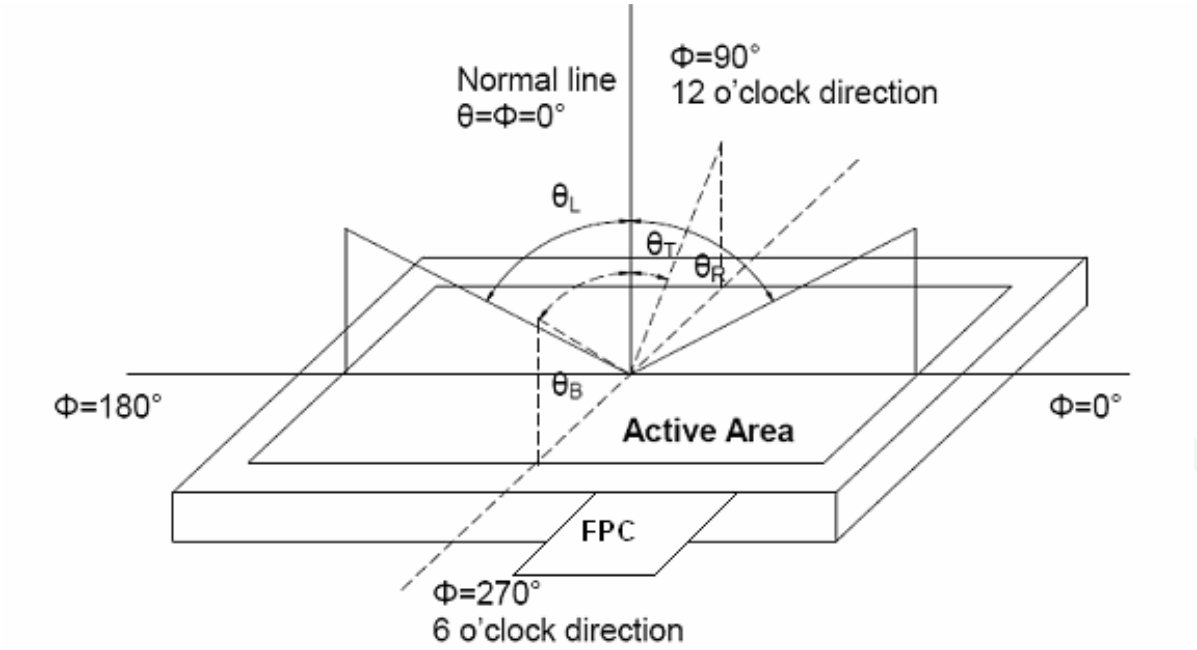


3.Definition of contrast ratio

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

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. The color gamut data comes from the LCD panel specification under the C light source environment.

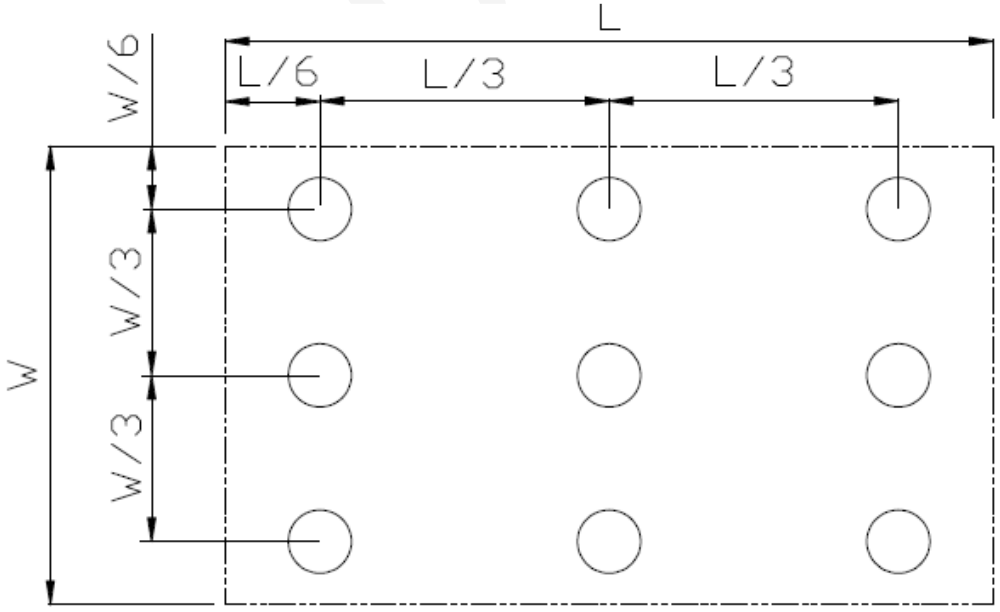
8. Definition of Luminance Uniformity

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.

9. 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	70℃, 90%RH, 240hrs	Finish product (With polarizer)
6	Thermal Shock Storage (No operation)	-30℃, 30min. <=> 70℃,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

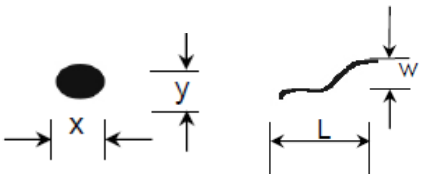
4.2. Inspection plan

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><td>Diameter (mm)</td><td>Acceptable Quantity</td></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><td>Length</td><td>Width</td><td>Acceptable Quantity</td></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><td>Diameter (mm)</td><td>Acceptable Quantity</td></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><td>Diameter (mm)</td><td>Acceptable Quantity</td></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.

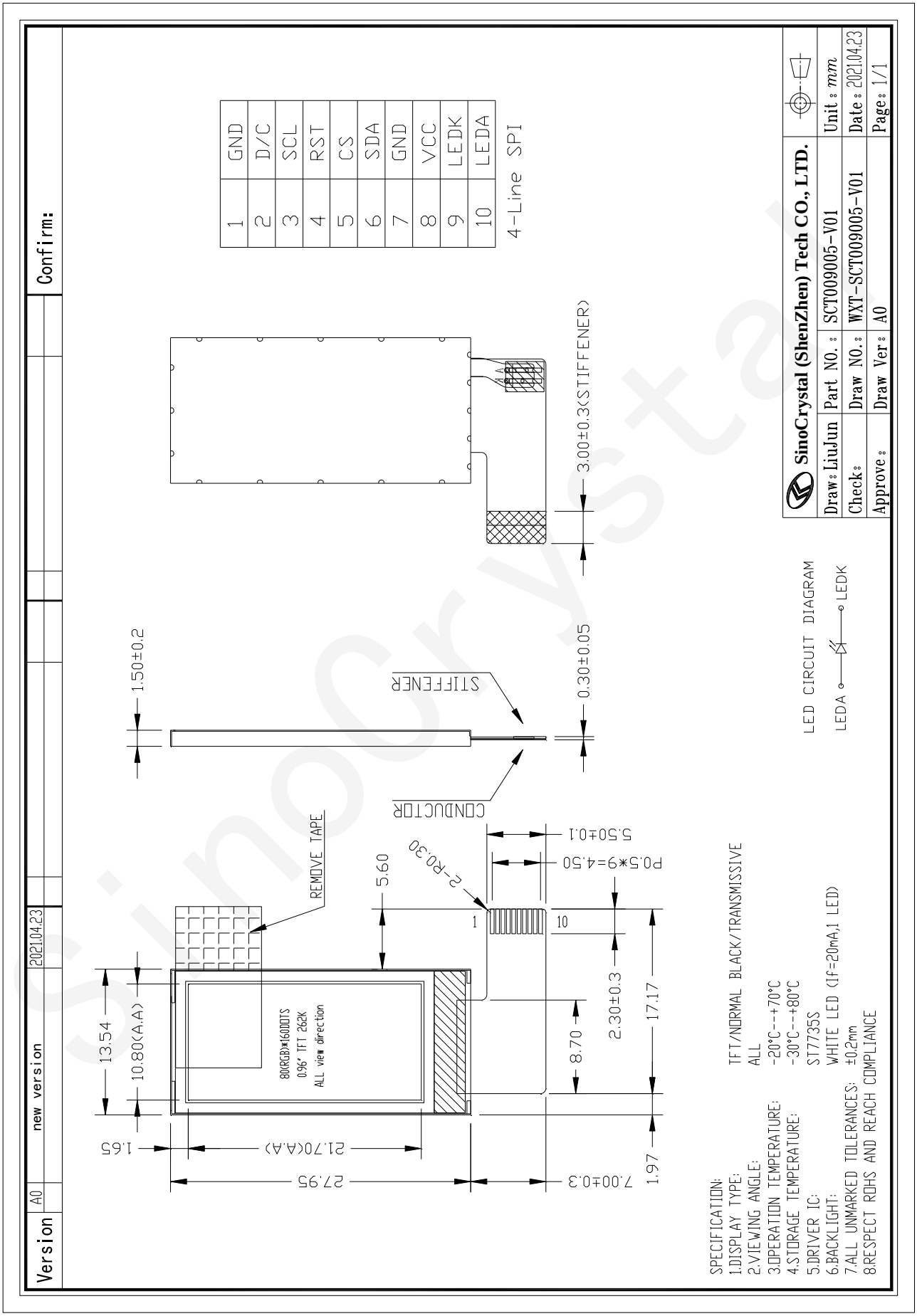
5.3. Operation Precautions

(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.