

SPECIFICATIONS

FOR

LCD MODULE

| | |
|--------------------------|----------------------|
| CUSTOMER | |
| MODEL | SCT024029-V01 |
| CUSTOMER APPROVED | |

| APPROVED BY | CHECKED BY | ORGANIZED BY |
|-------------------------------------------------------------------------------------|-------------------|---------------------|
|  | Lr.Yin | Wf.Luo |



0158

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1. General Description

This Module SCT024029-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 | 2.4 | inch |
| Dot Matrix | 240(RGB) × 320 | pixel |
| Module Size | 42.72 × 60.26 × 2.20 | mm |
| Active Area | 36.72 × 48.96 | mm |
| Dot Pitch | 0.153 × 0.153 | 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 | ST7789V2 | - |
| Interface | 4-line SPI | - |
| LED Numbers | 4 LEDs | - |
| Weight | TBD | g |

1.2. Interface Pin

| Pin No. | Symbol | Type | Description |
|---------|--------|------|-----------------------------------------------------------------------------------------------------------------------|
| 1 | GND | P | Ground |
| 2 | RESET | I | Chip reset signal |
| 3 | SCL | I | Serial clock. |
| 4 | DCX | I | Display data/command selection (RS) pin. DCX='1': display data or parameter. DCX='0': register index / command. |
| 5 | CSX | I | Chip Select signal |
| 6 | SDA | I | Serial data input |
| 7 | SDO | O | Serial data output |
| 8 | GND | P | Ground |
| 9 | VCC | P | Power supply |
| 10 | LEDA | P | LED driving anode |
| 11 | LEDK | P | LED driving cathode |
| 12 | NC | - | No connection |
| 13 | NC | - | No connection |
| 14 | NC | - | No connection |
| 15 | NC | - | No connection |
| 16 | NC | - | No connection |

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 | VCC | -0.3 | 4.6 | V | |
| Input Signal Voltage | V _{IN} | -0.3 | 4.6 | V | Note 1 |
| Operating Temperature | T _{OPR} | -20 | +70 | °C | Ambient |
| Storage Temperature | T _{STG} | -30 | +80 | °C | Ambient |

Note1: V_{IN} represent IO

2.2. DC Electrical Characteristics

2.2.1. Driving TFT LCD Panel

GND=0V, Ta=25°C

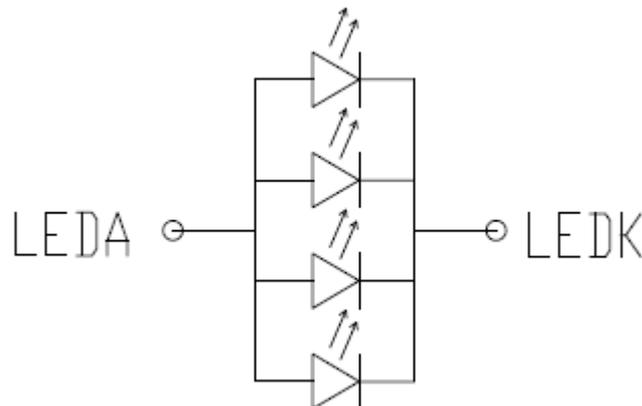
| Item | Symbol | Min. | Typ. | Max. | Unit | Remark |
|---------------------------------|-----------------|--------|------|--------|------|-------------------------|
| Operating Voltage | VCC | 2.5 | 2.75 | 3.6 | V | |
| Logic High level input voltage | V _{IH} | 0.7VCC | - | VCC | V | |
| Logic Low 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°C

| 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. 4Line SPI Serial Data Transfer Interface Characteristics

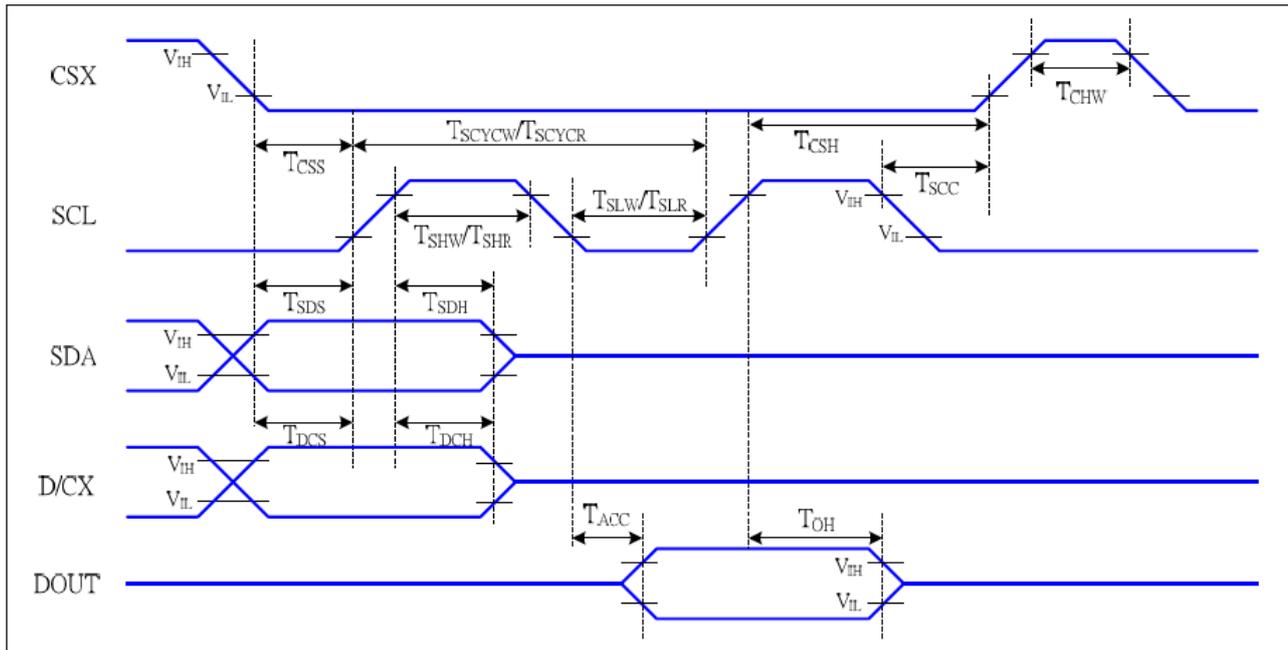


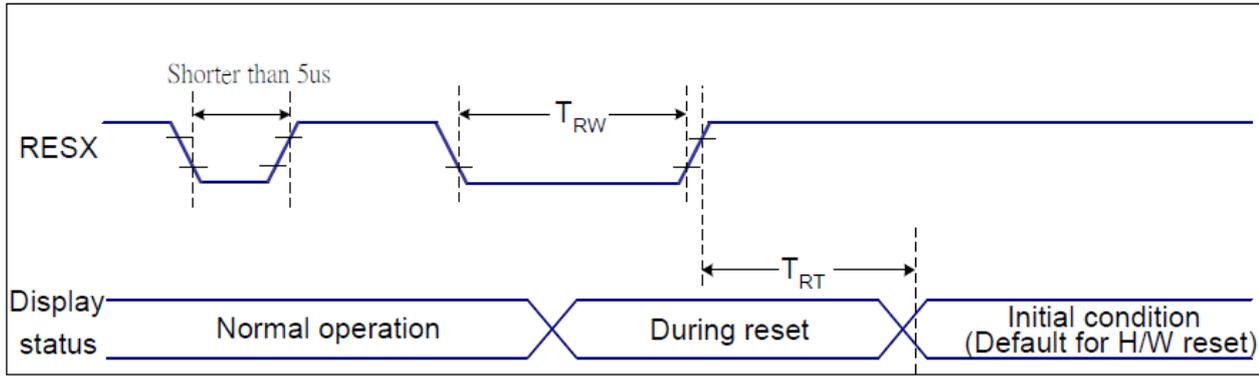
Figure 5 4-line serial Interface Timing Characteristics

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

| Signal | Symbol | Parameter | MIN | MAX | Unit | Description |
|-----------|--------------------|--------------------------------|-----|-----|------|---------------------------|
| CSX | T _{CSS} | Chip select setup 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 | |
| | T _{CSS} | Chip select hold time (write) | 15 | | ns | |
| SCL | T _{SCYCW} | Serial clock cycle (Write) | 16 | | ns | -write command & data ram |
| | T _{SHW} | SCL "H" pulse width (Write) | 7 | | ns | |
| | T _{SLW} | SCL "L" pulse width (Write) | 7 | | 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 | 7 | | ns | |
| | T _{SDH} | Data hold time | 7 | | 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 |

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.

2.3.2. Reset Timing



Reset Timing

VDDI=1.8V, VDDA=2.8V, AGND=DGND=0V, $T_a=25^\circ\text{C}$

| 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 1 Reset Timing

Notes:

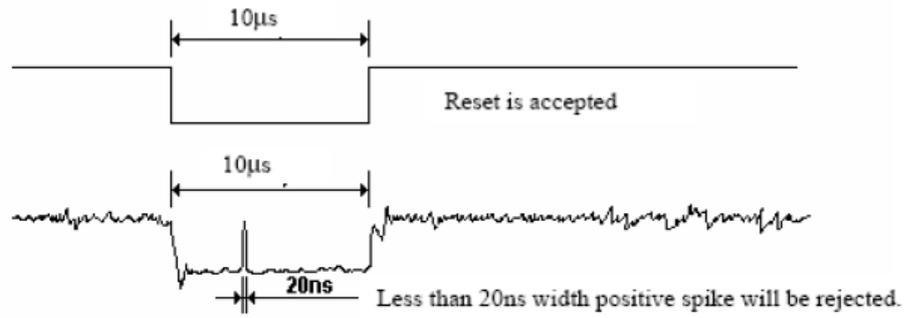
1. The reset cancel includes also required time for loading ID bytes, VCOM setting and other settings from NVM (or similar device) to registers. This loading is done every time when there is HW reset cancel time (t_{RT}) within 5 ms after a rising edge of RESX.

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.

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3. Optical Characteristics

| Item | Symbol | Condition | Min. | Typ. | Max. | Unit | Remark | | |
|--------------------|------------|-----------------------------|-------|-------|------|----------|--------|-------|-------|
| Viewing angle | θT | $CR \geq 10$ | | 80 | - | degree | Note5 | | |
| | θB | | | 80 | - | | | | |
| | θL | | | 80 | - | | | | |
| | θR | | | 80 | - | | | | |
| Contrast Ratio | CR | $\theta=0^\circ$ optimal | 640 | 800 | - | - | Note3 | | |
| Response Time | T_R | $T_a=25^\circ C$ | - | 16 | 21 | ms | Note2 | | |
| | T_F | | - | 19 | 24 | | | | |
| Color Chromaticity | White | $\theta=0^\circ$ | -0.05 | +0.05 | - | - | Note6 | | |
| | | | | | | | | x | 0.310 |
| | y | | | | | | | 0.336 | |
| | Red | | | | | | | x | 0.647 |
| | | | | | | | | y | 0.317 |
| | Green | | | | | | | x | 0.275 |
| | | | | | | | | y | 0.582 |
| | Blue | | | | | | | x | 0.140 |
| y | | 0.088 | | | | | | | |
| Uniformity | U | $\theta=0^\circ$ | 70 | 80 | - | % | Note7 | | |
| Luminance | L | $I_F=Typ.$ | | TBD | - | cd/m^2 | Note8 | | |

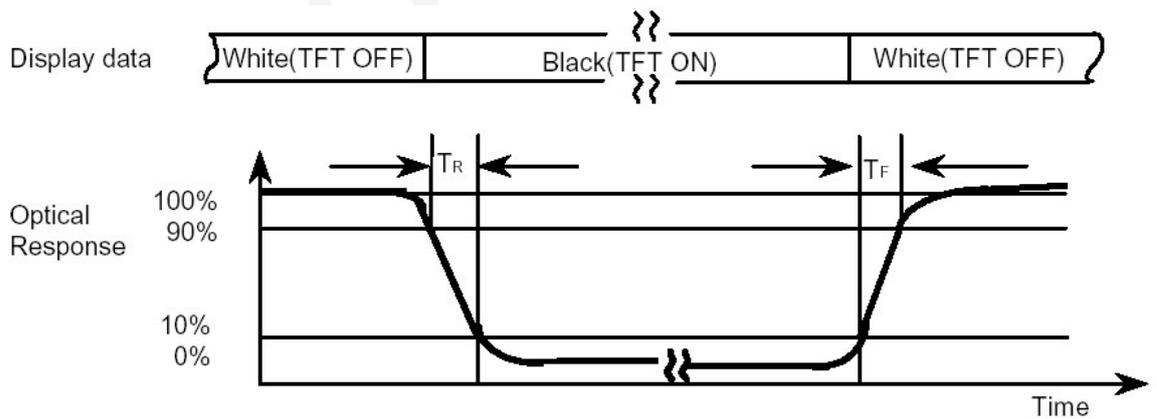
Note:

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.

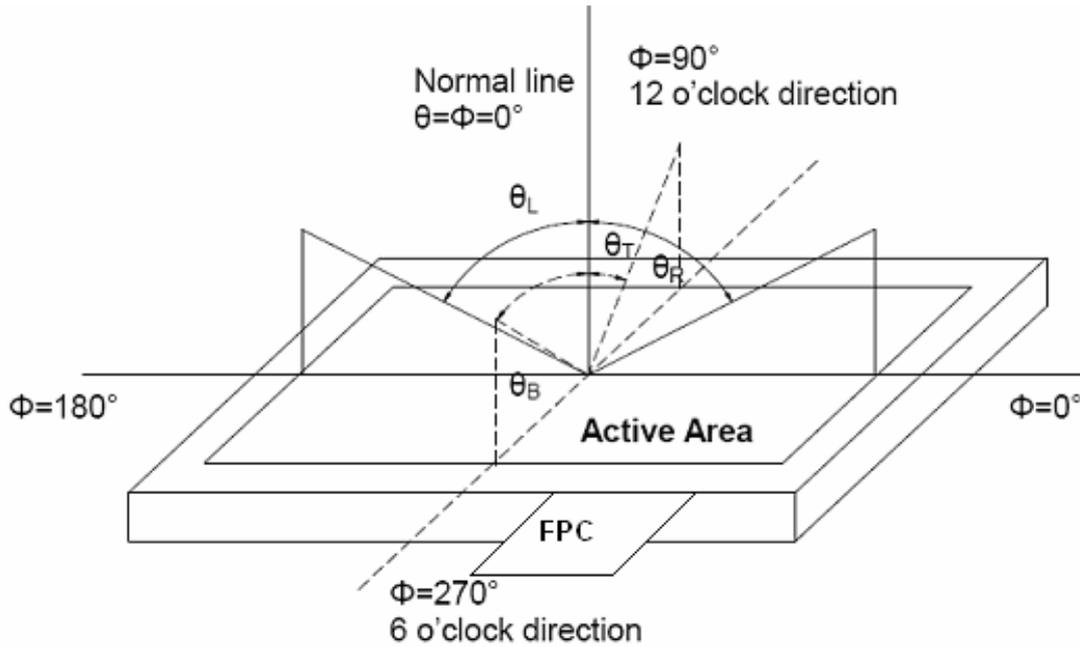


3. Definition of contrast ratio

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

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.

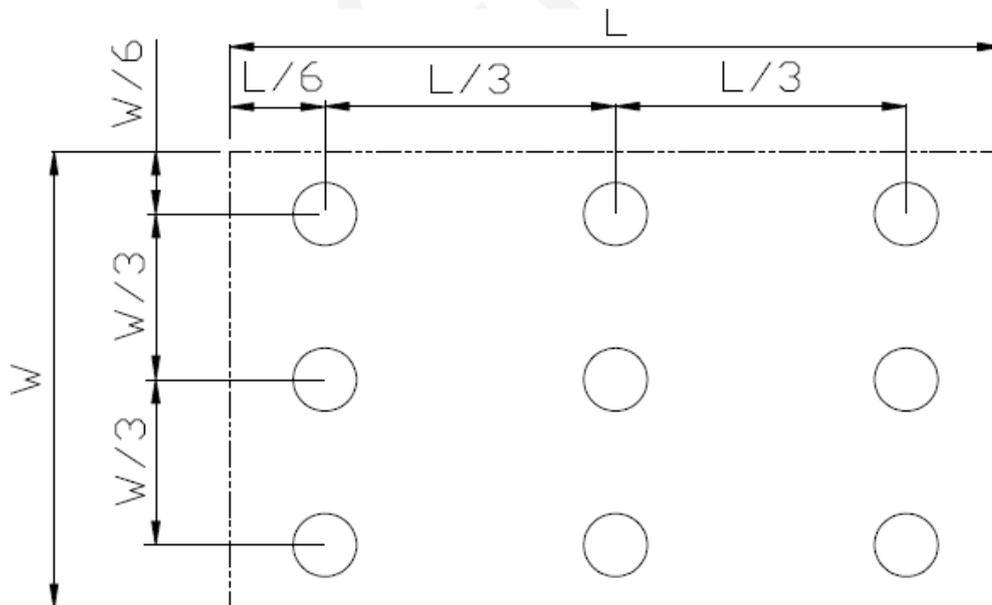
7. Definition of Luminance Uniformity

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

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

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°C, 240hrs | Finish product (With polarizer) |
| 2 | Low temperature Operating | -20°C, 240hrs | Finish product (With polarizer) |
| 3 | High temperature Storage | 80°C, 240hrs | Finish product (With polarizer) |
| 4 | Low temperature Storage | -30°C, 240hrs | Finish product (With polarizer) |
| 5 | High temperature & Humidity Storage | 80°C, 90%RH, 240hrs | 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: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, $A > 1.0\text{mm}$. $0.3\text{mm} < \text{stripped solder mask or visible circuit}$, $A < 1.0\text{mm}$,and the number is ≥ 4 pieces. Particle between circuits in solder mask. Circuit is peeled off or cracked. Any circuit risen or exposed. $0.2\text{mm} < \text{Area of solder ball}$, A is $\leq 0.4\text{mm}$,the number of solder ball is ≥ 3 pieces. The magnitude of solder ball, A is $> 0.4\text{mm}$. | 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

| Class | Item | Judgment | | | | | | | | | | | | | | |
|---------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|---------------------|------------|---------------|-----------------|---------|----------------------|---|---------|----------------------|---|---|------------|-------------------|
| Minor | Blemish, black spot, white spot in the LCD. | (A) Round type Unit: mm <table border="1"> <thead> <tr> <th>Diameter (mm)</th> <th>Acceptable Quantity</th> </tr> </thead> <tbody> <tr> <td>$0.25 < A$</td> <td>0</td> </tr> </tbody> </table> | Diameter (mm) | Acceptable Quantity | $0.25 < A$ | 0 | | | | | | | | | | |
| | Diameter (mm) | Acceptable Quantity | | | | | | | | | | | | | | |
| $0.25 < A$ | 0 | | | | | | | | | | | | | | | |
| Blemish, black spot, white spot and scratch on the polarizer. | Note: $A = (x + y)/2$ (mm) (B) Line type Unit: mm <table border="1"> <thead> <tr> <th>Length</th> <th>Width</th> <th>Acceptable Quantity</th> </tr> </thead> <tbody> <tr> <td>-</td> <td>$W \leq 0.03$</td> <td>Acceptable</td> </tr> <tr> <td>$L < 5$</td> <td>$0.03 < W \leq 0.07$</td> <td>3</td> </tr> <tr> <td>$L < 5$</td> <td>$0.03 < W \leq 0.07$</td> <td>1</td> </tr> <tr> <td>-</td> <td>$0.07 < W$</td> <td>Follow round type</td> </tr> </tbody> </table> | Length | Width | Acceptable Quantity | - | $W \leq 0.03$ | Acceptable | $L < 5$ | $0.03 < W \leq 0.07$ | 3 | $L < 5$ | $0.03 < W \leq 0.07$ | 1 | - | $0.07 < W$ | Follow round type |
| Length | Width | Acceptable Quantity | | | | | | | | | | | | | | |
| - | $W \leq 0.03$ | Acceptable | | | | | | | | | | | | | | |
| $L < 5$ | $0.03 < W \leq 0.07$ | 3 | | | | | | | | | | | | | | |
| $L < 5$ | $0.03 < W \leq 0.07$ | 1 | | | | | | | | | | | | | | |
| - | $0.07 < W$ | Follow round type | | | | | | | | | | | | | | |
| Minor | Bubble in polarizer | Unit: mm <table border="1"> <thead> <tr> <th>Diameter (mm)</th> <th>Acceptable Quantity</th> </tr> </thead> <tbody> <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> </tbody> </table> | Diameter (mm) | Acceptable Quantity | $A < 0.3$ | Acceptable | $0.3 < A < 0.5$ | 1 | $0.5 < A$ | 0 | | | | | | |
| Diameter (mm) | Acceptable Quantity | | | | | | | | | | | | | | | |
| $A < 0.3$ | Acceptable | | | | | | | | | | | | | | | |
| $0.3 < A < 0.5$ | 1 | | | | | | | | | | | | | | | |
| $0.5 < A$ | 0 | | | | | | | | | | | | | | | |
| Minor | Pin hole, Pattern deformity | Unit: mm <table border="1"> <thead> <tr> <th>Diameter (mm)</th> <th>Acceptable Quantity</th> </tr> </thead> <tbody> <tr> <td>$0.4 < A$</td> <td>0</td> </tr> </tbody> </table> | Diameter (mm) | Acceptable Quantity | $0.4 < A$ | 0 | | | | | | | | | | |
| Diameter (mm) | Acceptable Quantity | | | | | | | | | | | | | | | |
| $0.4 < A$ | 0 | | | | | | | | | | | | | | | |

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.

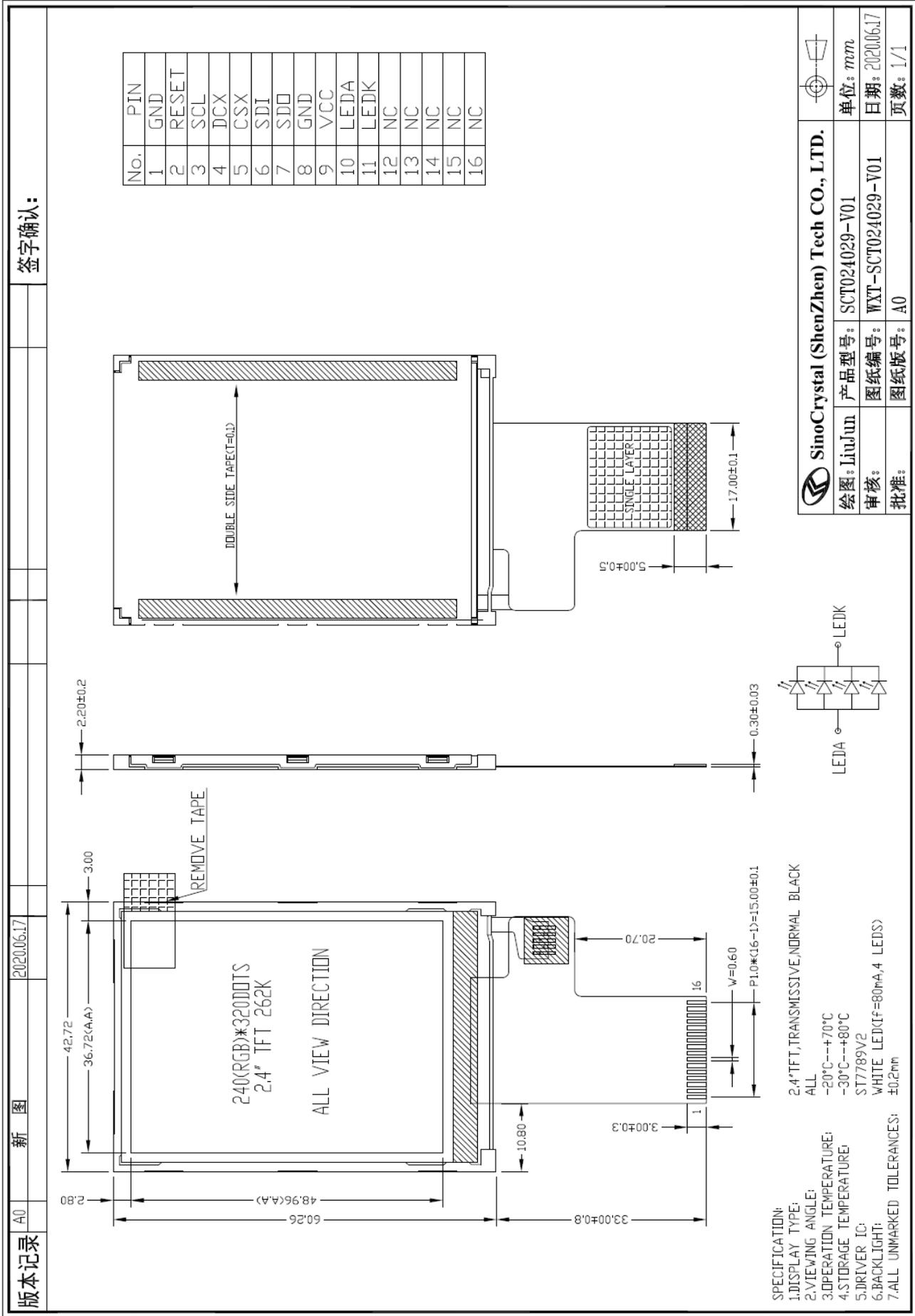
5.2. Storage Precautions

- (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°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.

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



| | | | |
|------------|----------------------------------------------|----------------|----------------|
| | SinoCrystal (ShenZhen) Tech CO., LTD. | | |
| 绘图: LiuJun | 产品型号: SCT024029-V01 | 单位: mm | 日期: 2020.06.17 |
| 审核: | 图纸编号: WXT-SCT024029-V01 | 日期: 2020.06.17 | 页数: 1/1 |
| 批准: | 图纸版号: A0 | | |

7. Packing Information

7.1. Packing Quantity

TBD.

7.2. Flowing chart

TBD.

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