

MODEL NO : LCDT28961801-SPIMODEL VERSION: 01SPEC VERSION : 2.9ISSUED DATE: 2015-12-08

- ☐ Preliminary Specification  
☒ Final Product Specification

Customer : \_\_\_\_\_

| App<br>oved by | Notes |
|----------------|-------|
|                |       |

LCD Confirmed :

| Prepared by   | Checked by    | Approved by |
|---------------|---------------|-------------|
| Tiantian.Zhao | Xiaoxing.Ding | Feng.Qin    |

This technical specification is subjected to change without notice

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[illegible]

## 1 General Specifications

| Feature                           |                                | Spec                |
|-----------------------------------|--------------------------------|---------------------|
| <b>Display Spec.</b>              | Size                           | 2.4"                |
|                                   | Resolution                     | 240(RGB)x320        |
|                                   | Technology Type                | a-si TFT            |
|                                   | Pixel Configuration            | RGB Vertical Stripe |
|                                   | Pixel pitch(mm)                | 0.153 x 0.153       |
|                                   | Display Mode                   | CT,NW               |
|                                   | Surface Treatment              | Clear Type          |
|                                   | Viewing Direction              | 12 o'clock          |
|                                   | Gray Scale Inversion Direction | 6 o'clock           |
| <b>Mechanical Characteristics</b> | LCM (W x H x D) (mm)           | 50 x 69.72          |
|                                   | Active Area(mm)                | 43.2 x 57.60        |
|                                   | With /Without TSP              | With RTP            |
|                                   | Matching Connection Type       | 18pin-0.8mm         |
|                                   | LED Numbers                    | 4                   |
|                                   | Weight (g)                     | 12                  |
| <b>Electrical Characteristics</b> | Interface                      | SPI 4 WIRE          |
|                                   | Color Depth                    | 262K                |
|                                   | Driver IC                      | st7789v2            |

Note 1: Viewing direction for best image quality is different from TFT definition. There is a 180 degree shift.

Note 2: Requirements on Environmental Protection: Q/S0002

Note 3: LCM weight tolerance:  $\pm 5\%$

## 2 Input/Output Terminals

Matched connector: 18pin-0.8mm

| PIN No. | Symbol | Description                                                                                                                                                                           |
|---------|--------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1       | GND    | Ground<br>(接地脚)                                                                                                                                                                       |
| 2       | RESET  | LCM Reset pin Signal is active low.<br>(屏复位脚, 低电平复位)                                                                                                                                  |
| 3       | SCL    | This pin is used serial interface clock in 4-wire 8-bit serial data interface.<br>(4线串口的时钟信号)<br><b>If not used, this pin should be connected to IOVCC or GND.</b><br>(不用时接IOVCC或者接地) |
| 4       | D/C    | - 4-line system (D/CX): Serves as command or parameter select.<br><b>Fix to IOVCC level when not in use.</b><br>(4线串口的寄存器/数据选择, 不用时接 IOVCC)                                           |
| 5       | CS     | Chip select pin ("Low" enable)<br>(屏驱动芯片片选脚, 低电平有效)                                                                                                                                   |
| 6       | SDA    | Serial input signal.<br>The data is applied on the rising edge of the SCL signal.<br><b>If not used, fix this pin at IOVCC or GND</b><br>(串口数据输入信号, 不用时接 IOVCC 或者接地)                  |
| 7       | SDO    | Serial output signal.<br>The data is outputted on the falling edge of the SCL signal.<br><b>If not used, open this pin</b><br>(串口数据输出信号, 不用时悬空)                                       |
| 8       | GND    | Ground<br>(接地脚)                                                                                                                                                                       |
| 9       | VCC    | Power supply for LCM (2.8V-3.3V)<br>(屏供电脚)                                                                                                                                            |
| 10      | LEDA   | Anode of Backlight (3.0V-3.4V Typical:3.2V)<br>(背光正极供电脚, 电压范围:3.0-3.4V, 典型值:3.2V)                                                                                                     |
| 11      | LEDK1  | Cathode of Backlight<br>(背光负极供电脚)                                                                                                                                                     |
| 12      | LEDK2  | Cathode of Backlight<br>(背光负极供电脚)                                                                                                                                                     |
| 13      | LEDK3  | Cathode of Backlight<br>(背光负极供电脚)                                                                                                                                                     |
| 14      | LEDK4  | Cathode of Backlight<br>(背光负极供电脚)                                                                                                                                                     |
| 15      | XL     | Touch panel control pin<br>(触摸屏控制脚)                                                                                                                                                   |
| 16      | YU     | Touch panel control pin<br>(触摸屏控制脚)                                                                                                                                                   |
| 17      | XR     | Touch panel control pin<br>(触摸屏控制脚)                                                                                                                                                   |
| 18      | YD     | Touch panel control pin<br>(触摸屏控制脚)                                                                                                                                                   |

Note1,, Please add the FPC connector type and matched one if necessary .

### 3 Absolute Maximum Ratings

GND=0V

| Item                       | Symbol          | MIN  | MAX  | Unit             | Remark         |
|----------------------------|-----------------|------|------|------------------|----------------|
| Power Voltage              | VCC             | -0.3 | 4.6  | V                | Note1          |
| Input voltage              | V <sub>IN</sub> | -0.3 | 4.6  | V                |                |
| Operating Temperature      | Top             | -20  | 70   | °C               |                |
| Storage Temperature        | Tst             | -30  | 80   | °C               |                |
| Relative Humidity<br>Note2 | RH              | --   | --95 | %                | Ta --40°C      |
|                            |                 | --   | --85 | %                | 40°C<Ta --50°C |
|                            |                 | --   | --55 | %                | 50°C<Ta --60°C |
|                            |                 | --   | --36 | %                | 60°C<Ta --70°C |
|                            |                 | --   | --24 | %                | 70°C<Ta --80°C |
| Absolute Humidity          | AH              | --   | --70 | g/m <sup>3</sup> | Ta>70°C        |

**Table 3 Absolute Maximum Ratings**

Note1: Input voltage include R0~R5, G0~G5, B0~B5, Dotclk, Hsync, Vsync, Enable, R/L, U/D.

Note2: Ta means the ambient temperature.

It is necessary to limit the relative humidity to the specified temperature range.

Condensation on the module is not allowed.

## 4 Electrical Characteristics

### 4.1 LCD Module

GND=0V, Ta=25?

| Item                          | Symbol        | MIN | TYP       | MAX       | Unit      | Remark |
|-------------------------------|---------------|-----|-----------|-----------|-----------|--------|
| Logic Supply Voltage          | IOVCC         | 2.5 | 2.8       | 3.3+/-10% | V         |        |
| Analog Supply Voltage         | VCC           | 2.5 | 2.8       | 3.3+/-10% | V         |        |
| Input Signal Voltage          | High Level    | VIH | 0.7 IOVCC | -         | IOVCC     | V      |
|                               | Low Level     | VIL | -         | -         | 0.3 IOVCC | V      |
| Output Signal Voltage         | High Level    | VOH | 0.8 IOVCC | -         | -         | V      |
|                               | Low Level     | VOL | -         | -         | 0.2 IOVCC | V      |
| (Panel+LSI) Power Consumption | Black Mode    | -   | 30        | 36        | mW        |        |
|                               | Sleeping Mode | -   | 0.047     | 0.057     | mW        |        |

Table 4.1 LCD module electrical characteristics

### 4.2 Backlight Unit

Ta=25?

| Item                        | Symbol          | MIN   | TYP   | MAX   | Unit | Remark  |
|-----------------------------|-----------------|-------|-------|-------|------|---------|
| Forward Current             | I <sub>F</sub>  | -     | 15    | -     | mA   | One LED |
| Forward Voltage             | V <sub>F</sub>  | (2.9) | 3.2   | (3.4) | V    | One LED |
| Backlight Power Consumption | W <sub>BL</sub> | -     | 192   | -     | mW   | 4 LEDs  |
| Lifetime                    | T               | -     | 20000 | -     | Hr   | One LED |

Table 4.2.1 backlight unit electrical characteristics

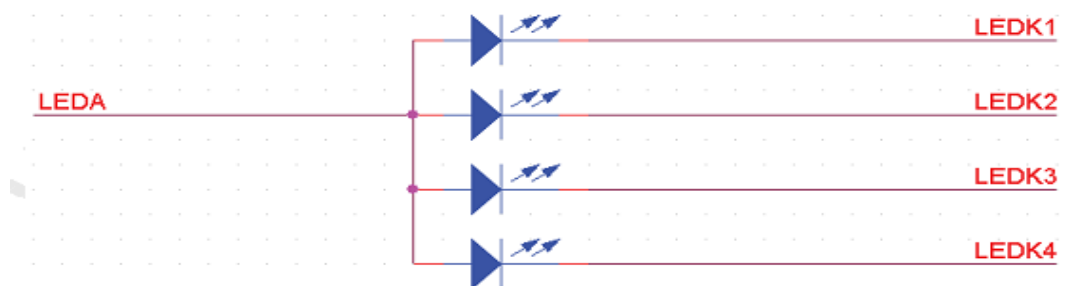
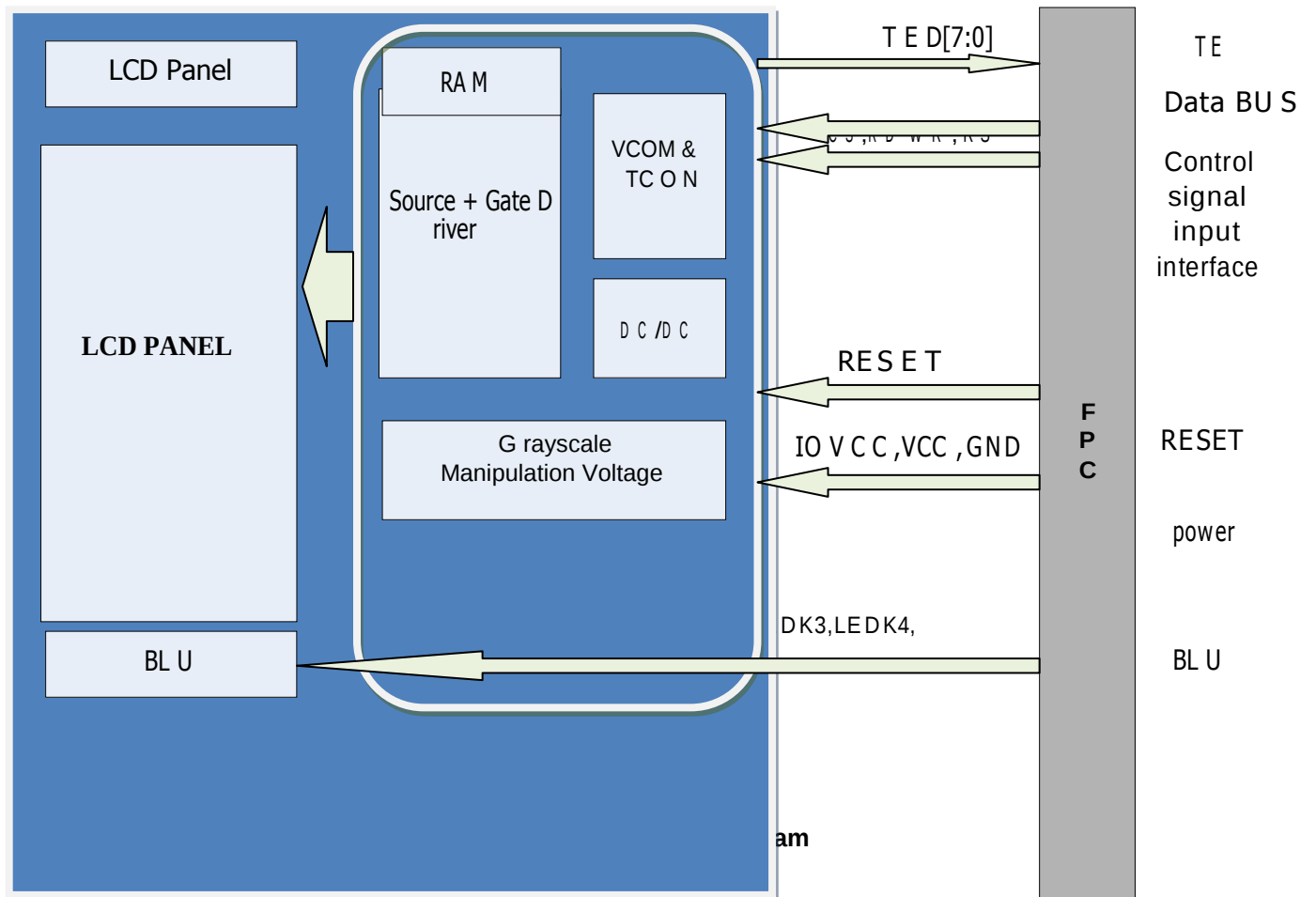
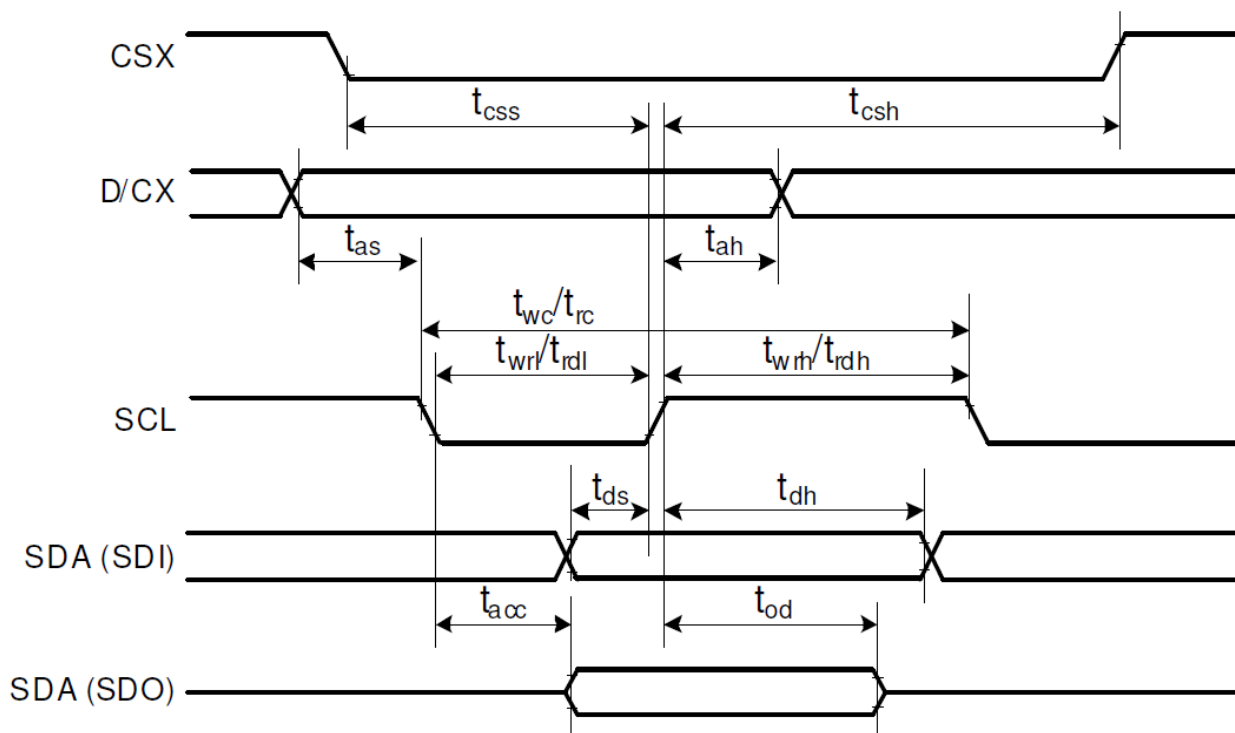


Figure 4.2.1 LED backlight circuit

### 4.3 Block Diagram



## 5 Timing Chart



| Signal             | Symbol    | Parameter                     | min | max | Unit | Description            |
|--------------------|-----------|-------------------------------|-----|-----|------|------------------------|
| CSX                | $t_{css}$ | Chip select time (Write)      | 40  | -   | ns   |                        |
|                    | $t_{csh}$ | Chip select hold time (Read)  | 40  | -   | ns   |                        |
| SCL                | $t_{wc}$  | Serial clock cycle (Write)    | 100 | -   | ns   |                        |
|                    | $t_{wrh}$ | SCL "H" pulse width (Write)   | 40  | -   | ns   |                        |
|                    | $t_{wr}$  | SCL "L" pulse width (Write)   | 40  | -   | ns   |                        |
|                    | $t_{rc}$  | Serial clock cycle (Read)     | 150 | -   | ns   |                        |
|                    | $t_{rdh}$ | SCL "H" pulse width (Read)    | 60  | -   | ns   |                        |
|                    | $t_{rdl}$ | SCL "L" pulse width (Read)    | 60  | -   | ns   |                        |
| D/CX               | $t_{as}$  | D/CX setup time               | 10  | -   |      |                        |
|                    | $t_{ah}$  | D/CX hold time (Write / Read) | 10  | -   |      |                        |
| SDA / SDI (Input)  | $t_{ds}$  | Data setup time (Write)       | 30  | -   | ns   |                        |
|                    | $t_{dh}$  | Data hold time (Write)        | 30  | -   | ns   |                        |
| SDA / SDO (Output) | $t_{acc}$ | Access time (Read)            | 10  | -   | ns   | For maximum $C_L=30pF$ |
|                    | $t_{od}$  | Output disable time (Read)    | 10  | 50  | ns   | For minimum $C_L=8pF$  |

Note:  $T_a = -30$  to  $70\text{ }^{\circ}\text{C}$ ,  $V_{DDI}=1.65\text{V}$  to  $3.3\text{V}$ ,  $V_{CI}=2.5\text{V}$  to  $3.3\text{V}$ ,  $V_{SS}=0\text{V}$

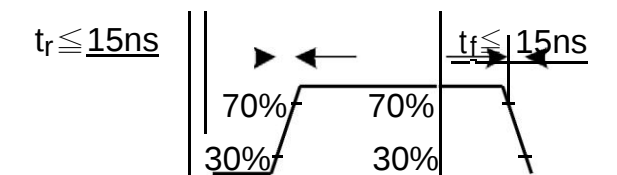


Table 5.1 timing parameter

## 5.2. Register write / read timing

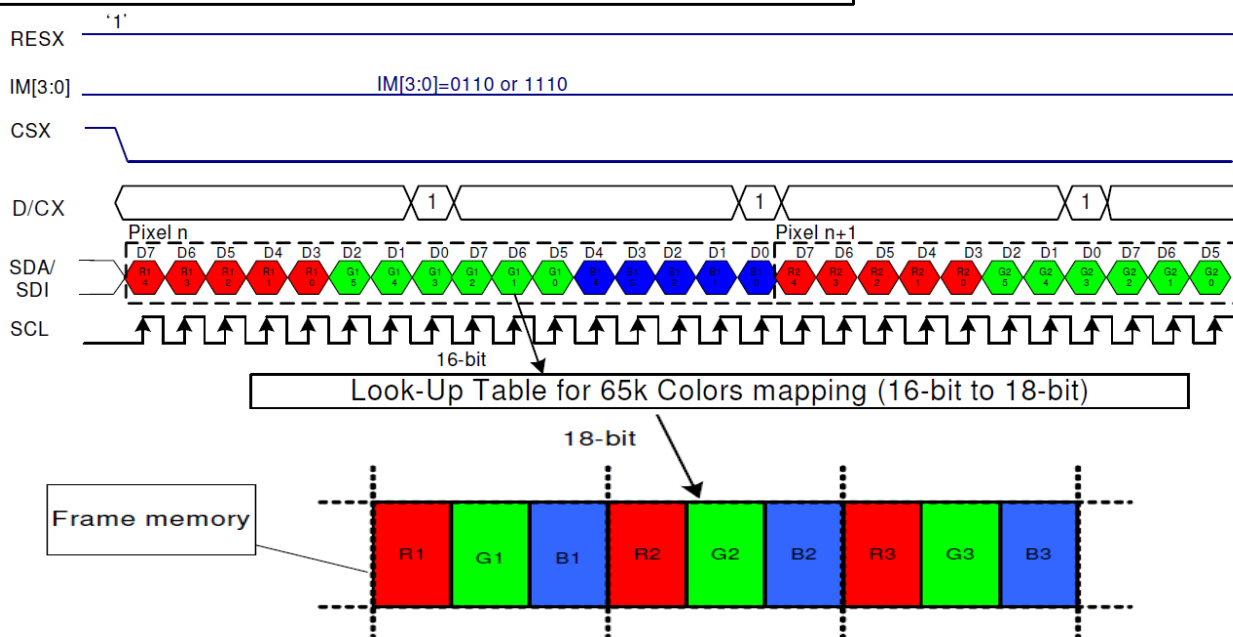
### a. Write to register

In 4-line serial interface, different display data format is available for two color depths supported by the LCM listed below.

-65k colors, RGB 5, 6, 5 -bits input.

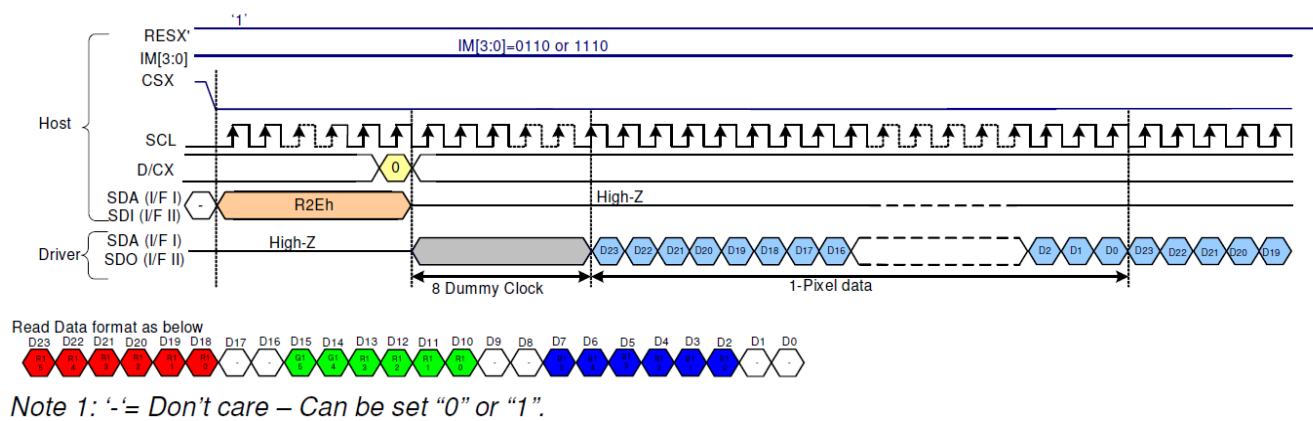
-262k colors, RGB 6, 6, 6 -bits input.

16 bit/pixel color order (R:5-bit, G:6-bit, B:5-bit), 65,536 colors



## b. Read from register

Read data through 4-line SPI mode



## CS timings

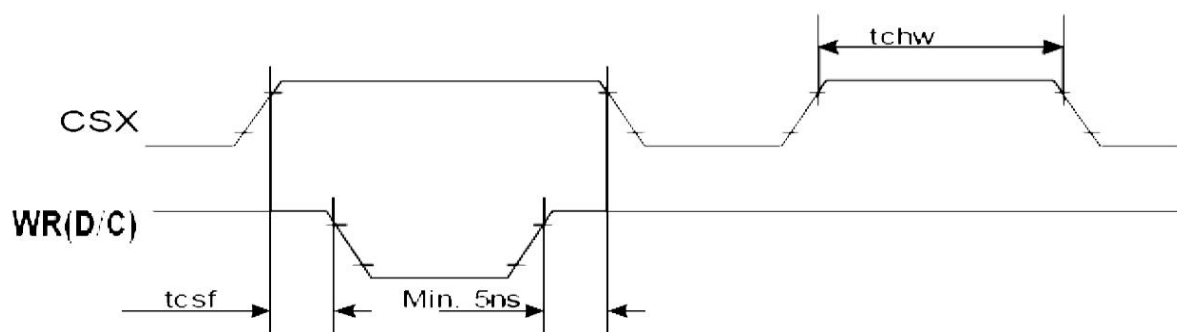


Figure 5.2.3 Chip selection timing

Write to read or read to write timings

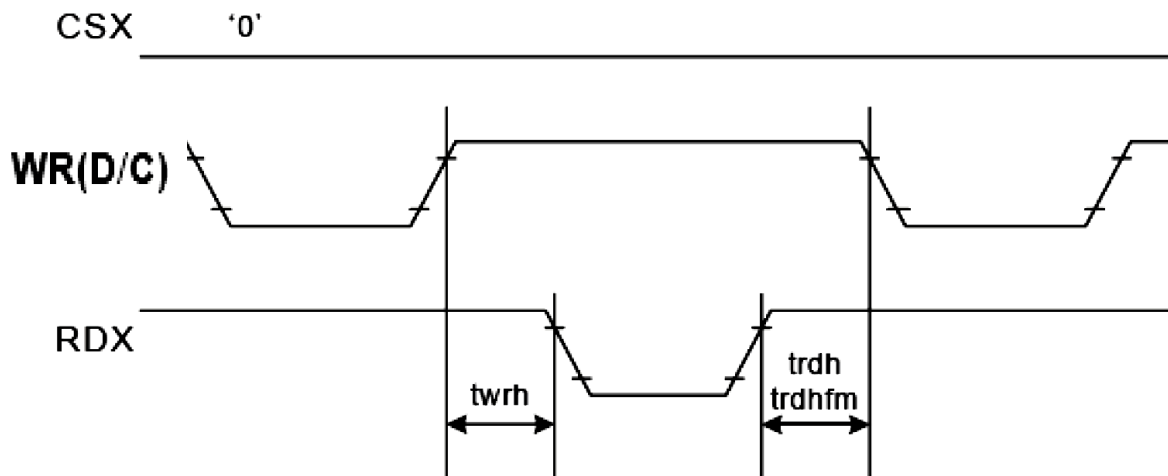
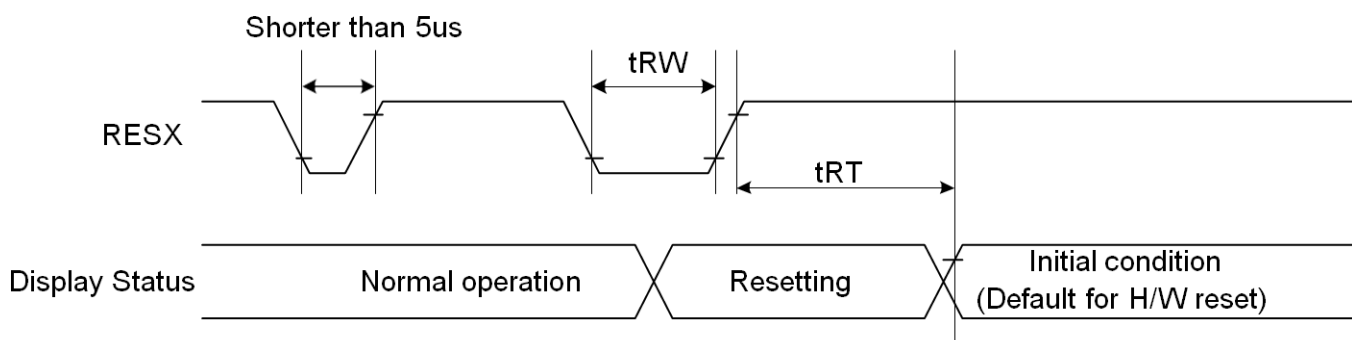


Figure 5.2.4 Write-to-read and read-to-write timing

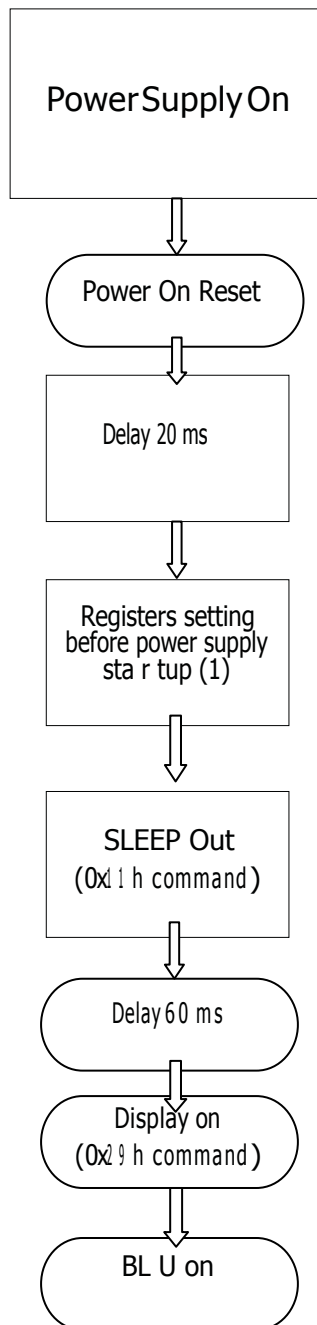
### 5. 3 Reset Timing Characteristics



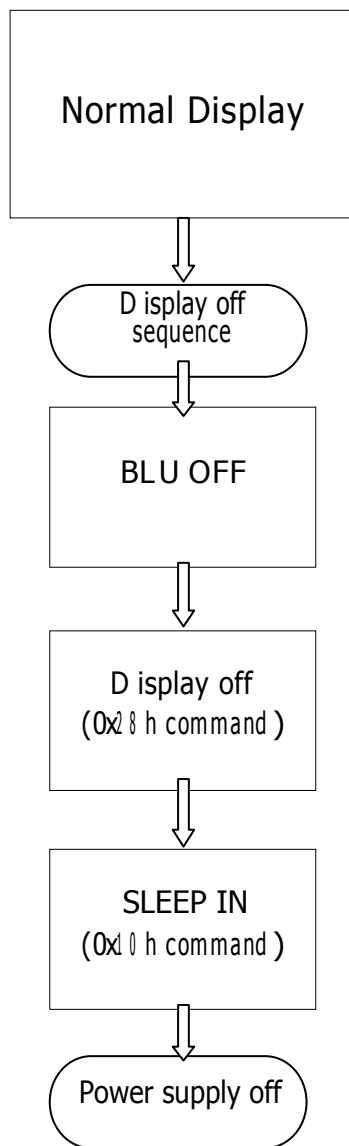
| Signal | Symbol | Parameter            | Min | Max                 | Unit |
|--------|--------|----------------------|-----|---------------------|------|
| RESX   | tRW    | Reset pulse duration | 10  |                     | uS   |
|        | tRT    | Reset cancel         |     | 5<br>(note 1,5)     | mS   |
|        |        |                      |     | 120<br>(note 1,6,7) | mS   |

Figure 5.3 RESET Timing

#### 5.4 Power on Sequence



## 5.5 Power off Sequence



## 6. Optical Characteristics

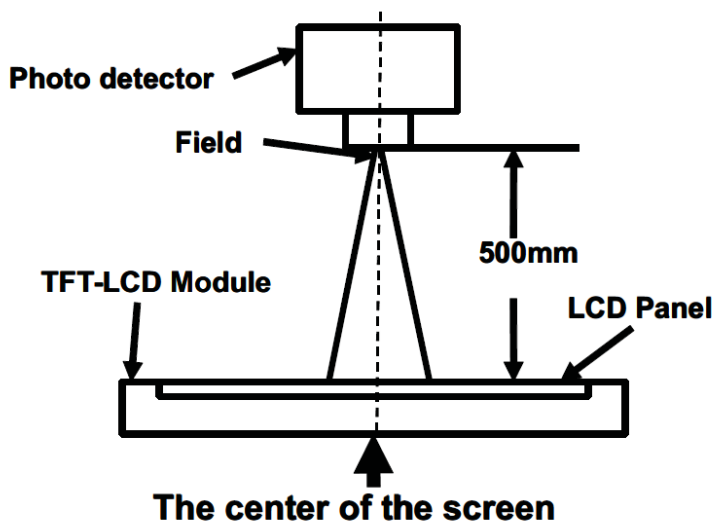
| Item           |       | Symbol           | Condition       | Min   | Typ   | Max   | Unit   | Remark   |
|----------------|-------|------------------|-----------------|-------|-------|-------|--------|----------|
| View Angles    |       | 0T               | CRŠ10           | 60    | 70    | 60    | Degree | Note2,3  |
|                |       | 0B               |                 | 50    | 60    | 50    |        |          |
|                |       | 0L               |                 | 60    | 70    | 60    |        |          |
|                |       | 0R               |                 | 60    | 70    | 60    |        |          |
| Contrast Ratio |       | CR               | 0=0°            | 400   | 500   | 400   |        | Note 3   |
| Response Time  |       | T <sub>ON</sub>  | 25 °C           |       | 20    | 30    | ms     | Note 4   |
|                |       | T <sub>OFF</sub> |                 |       |       |       |        |          |
| Chromaticity   | White | x                | Backlight is on | 0.236 | 0.286 | 0.336 |        | Note 1,5 |
|                |       | y                |                 | 0.261 | 0.311 | 0.361 |        |          |
|                | Red   | x                |                 | 0.530 | 0.580 | 0.630 |        | Note 1,5 |
|                |       | y                |                 | 0.270 | 0.320 | 0.370 |        |          |
|                | Green | x                |                 | 0.288 | 0.338 | 0.388 |        | Note 1,5 |
|                |       | y                |                 | 0.531 | 0.581 | 0.631 |        |          |
|                | Blue  | x                |                 | 0.101 | 0.151 | 0.201 |        | Note 1,5 |
|                |       | y                |                 | 0.048 | 0.098 | 0.148 |        |          |
| Uniformity     |       | U                |                 | -     | 80%   |       | %      | Note 6   |
| NTSC           |       |                  |                 | -     | 50%   |       | %      | Note 5   |
| Luminance      |       | L                |                 | 180   | 200   |       | cd/m²  | Note 7   |

Test Conditions:

1. I<sub>F</sub>= 60mA, and the ambient temperature is 25°C.
2. The test systems refer to Note 1 and Note 2.

Note 1: Definition of optical measurement system.

The optical characteristics should be measured in dark room. After 5 Minutes operation, the optical properties are measured at the center point of the LCD screen. All input terminals LCD panel must be ground when measuring the center area of the panel.



| Item           | Photo detector | Field |
|----------------|----------------|-------|
| Contrast Ratio | SR-3A          | 1°    |
| Luminance      |                |       |
| Chromaticity   |                |       |
| Lum Uniformity |                |       |
| Response Time  | BM-7A          | 2°    |

Note 2: Definition of viewing angle range and measurement system.

viewing angle is measured at the center point of the LCD by CONOSCOPE(ergo-80).

Note 3: Definition of contrast ratio

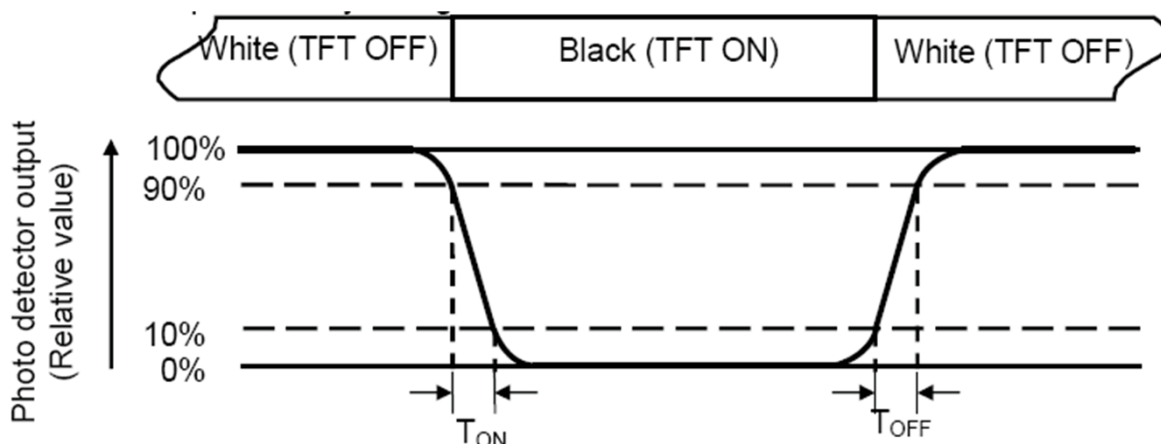
“White state “: The state is that the LCD should drive by  $V_{white}$ .

“Black state”: The state is that the LCD should drive by  $V_{black}$ .

V<sub>white</sub>: To be determined    V<sub>black</sub>: To be determined.

Note 4: Definition of Response time

The response time is defined as the LCD optical switching time interval between “White” state and “Black” state. Rise time (T<sub>ON</sub>) is the time between photo detector output intensity changed from 90% to 10%. And fall time (T<sub>OFF</sub>) is the time between photo detector output intensity changed from 10% to 90%.



Note 5: Definition of color chromaticity (CIE1931)

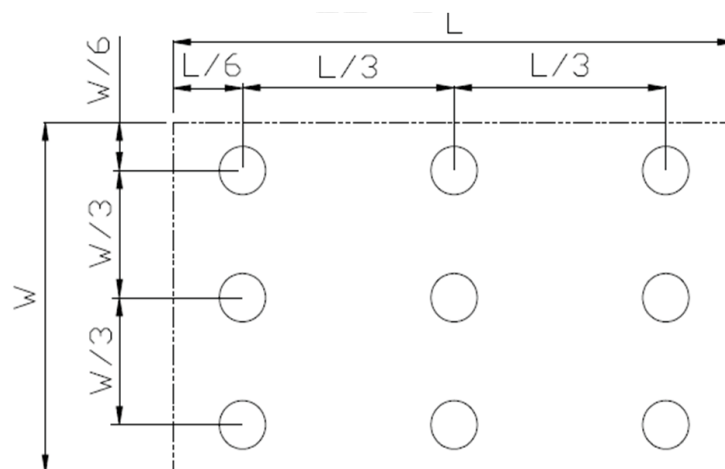
Color coordinates measured at center point of LCD.

Note 6: Definition of Luminance Uniformity

Active area is divided into 9 measuring areas (Refer Fig. 2). Every measuring point is placed at the center of each measuring area.

$$\text{Luminance Uniformity (U)} = L_{\min} / L_{\max}$$

L-----Active area length W----- Active area width



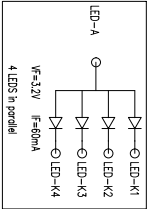
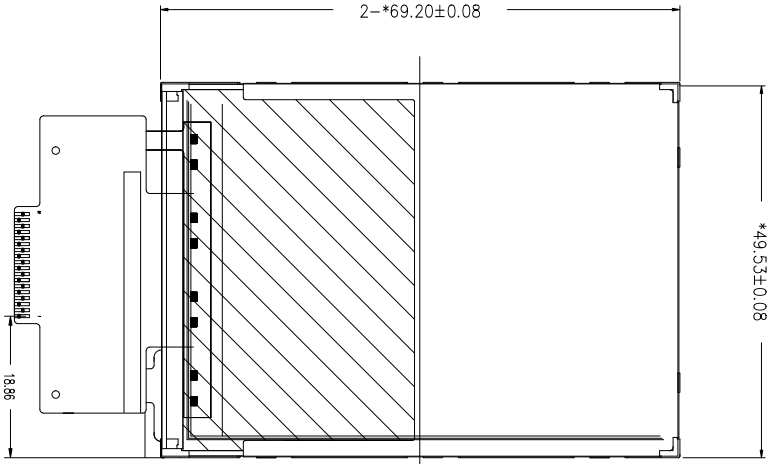
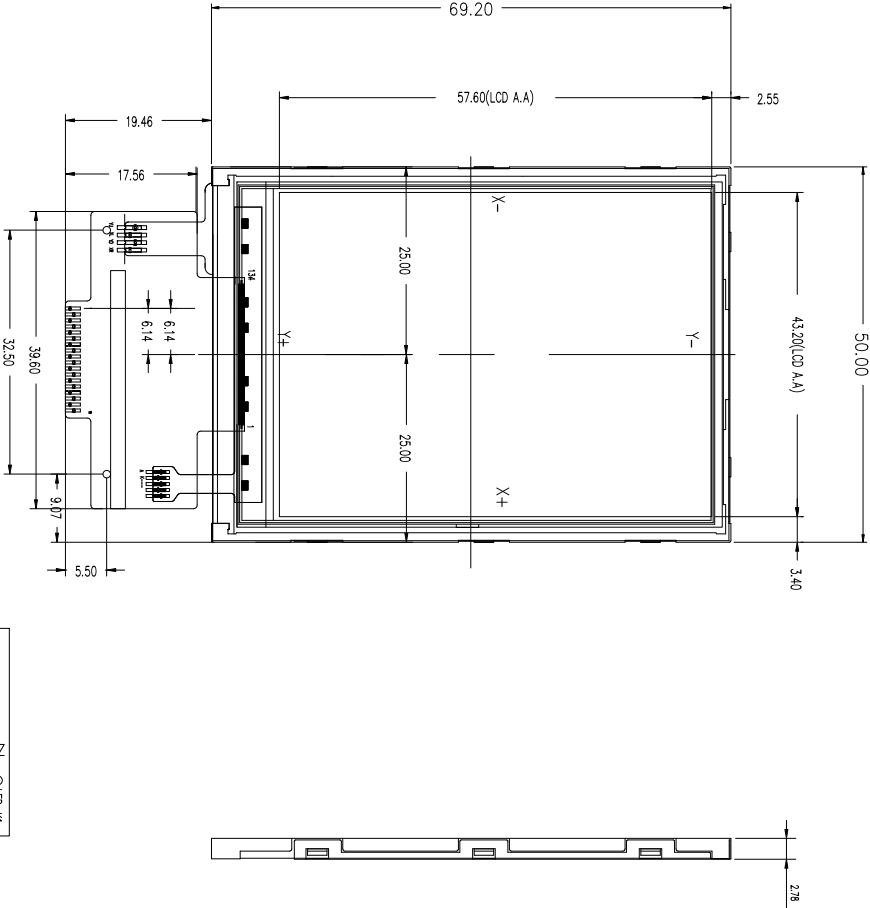
L<sub>max</sub>: The measured Maximum luminance of all measurement position.

L<sub>min</sub>: The measured Minimum luminance of all measurement position.

Note 7: Definition of Luminance:

Measure the luminance of white state at center point.

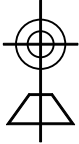
| PIN NO. | SYMBOL |
|---------|--------|
| 1       | GND    |
| 2       | RESET  |
| 3       | SCL    |
| 4       | RS     |
| 5       | CS     |
| 6       | SDA    |
| 7       | SPO    |
| 8       | GND    |
| 9       | VDD    |
| 10      | A      |
| 11      | K      |
| 12      | K      |
| 13      | K      |
| 14      | K      |
| 15      | XL     |
| 16      | VU     |
| 17      | XR     |
| 18      | VO     |



NOTES:

- 1.DISPLAY TYPE: TFT
- 2.VIEWING DIRECTION: ALL
- 3.LCD DRIVE IC: 7789
- 4.POLARIZER MODE: TRANSMISSIVE/POSITIVE
- 5.VDD : 2.5V      -3.3V, IOVDD : 1.65V-3.3V
- 6.BACKLIGHT: 4-CHIP WHITE LED PARALLEL
- 7.OPERATING TEMP: -20℃~+70℃
- 8.STORAGE TEMP: -30℃~+80℃
- 9.UNMARKER TOLERANCE: ±0.20

|              |          |                  |                                     |
|--------------|----------|------------------|-------------------------------------|
| 深圳市艾斯迪科技有限公司 |          |                  |                                     |
| UNIT: MM     | SIZE: A4 | Scale: 1/1       | GENERAL TOLERANCE: ±0.2<br>Angle=1° |
| DESIGNED:    |          | DATE: 2019-10-12 |                                     |
| CHECKED:     |          | DATE:            |                                     |
| APPROVED:    |          | DATE:            | PROJECT NO.                         |
|              |          |                  | PART NO.                            |
|              |          |                  | SHEET: 1/1                          |
|              |          |                  | REV: A                              |



PRJ(3)

## 9 Precautions for Use of LCD Modules

### 8.1 Handling Precautions

8.1.1 The display panel is made of glass. Do not subject it to a mechanical shock by dropping it from a high place, etc.

8.1.2 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.

8.1.3 Do not apply excessive force to the display surface or the adjoining areas since this may cause the color tone to vary.

8.1.4 The polarizer covering the display surface of the LCD module is soft and easily scratched. Handle this polarizer carefully.

8.1.5 If the display surface is contaminated, breathe on the surface and 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

8.1.6 Do not attempt to disassemble the LCD Module.

8.1.7 If the logic circuit power is off, do not apply the input signals.

8.1.8 To prevent destruction of the elements by static electricity, be careful to maintain an optimum work environment.

8.1.8.1 Be sure to ground the body when handling the LCD Modules.

8.1.8.2 Tools required for assembly, such as soldering irons, must be properly ground.

8.1.8.3 To reduce the amount of static electricity generated, do not conduct assembly and other work under dry conditions.

8.1.8.4 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.

### 8.2 Storage precautions

8.2.1 When storing the LCD modules, avoid exposure to direct sunlight or to the light of fluorescent lamps.

8.2.2 The LCD modules should be stored under the storage temperature range. If the LCD modules will be stored for a long time, the recommend condition is:

Temperature : 0? ~ 40? Relatively humidity: “80%

8.2.3 The LCD modules should be stored in the room without acid, alkali and harmful gas.

### 8.3 Transportation Precautions

The LCD modules should be no falling and violent shocking during transportation, and also should avoid excessive press, water, damp and sunshine.