



**RAYSTAR**

# 曜凌光電股份有限公司

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## RFJ280G-ALW-DNN

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### SPECIFICATION

CUSTOMER:

|             |  |
|-------------|--|
| APPROVED BY |  |
| PCB VERSION |  |
| DATE        |  |

FOR CUSTOMER USE ONLY

| SALES BY | APPROVED BY | CHECKED BY | PREPARED BY |
|----------|-------------|------------|-------------|
|          |             |            |             |

Release DATE:

## Revision History

| VERSION | DATE       | REVISED PAGE NO. | Note        |
|---------|------------|------------------|-------------|
| 0       | 2018/06/25 |                  | First issue |

RAYSTAR OPTRONICS

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# 1. Module Classification Information

|          |          |          |           |           |          |          |          |          |          |          |          |          |
|----------|----------|----------|-----------|-----------|----------|----------|----------|----------|----------|----------|----------|----------|
| <b>R</b> | <b>F</b> | <b>J</b> | <b>28</b> | <b>0G</b> | <b>-</b> | <b>A</b> | <b>L</b> | <b>W</b> | <b>-</b> | <b>D</b> | <b>N</b> | <b>N</b> |
| 1        | 2        | 3        | 4         | 5         | -        | 6        | 7        | 8        | -        | 9        | 10       | 11       |

| Item | Description   |  |
|------|---|--|
| 1    | R : Raystar Optronics Inc.  |  |
| 2    | Display Type : F→TFT Type, J→ Custom TFT  |  |
| 3    | Solution: A: 128x160    B:320x234    C:320x240    D:480x234    E:480x272<br>F:800x480    G:640x480    H:1024x600    I:320x480    J:240x320<br>K:1280x800    L:240x400    M:1024x768    N:128x128    O:480x800<br>P:640x320    Q:800x600    S:480x128    T:800x320 |  |
| 4    | Display Size : 2.8" TFT   |  |
| 5    | Version Code.   |  |
| 6    | Model Type:<br>A : TFT LCD<br>E : TFT+FR+CONTROL BOARD<br>J : TFT+FR+A/D BOARD<br>N : TFT+FR+A/D BOARD+CONTROL BOARD<br>S : TFT+FR+POWER BOARD (DC TO DC)<br>1 : TFT+CONTROL BOARD  | 6 : TFT+FR<br>H : TFT+D/V BOARD<br>I : TFT+FR+D/V BOARD<br>B : TFT+POWER BD  |
| 7    | Polarizer Type,<br>Temperature range,<br>View direction   | I→Transmissive, W. T, 6:00 ;    C→Transmissive, N. T, 6:00<br>L→Transmissive, W.T,12:00 ;    F→Transmissive, N.T,12:00<br>Y→Transmissive,W.T, IPS TFT ;<br>A→Transmissive, N.T, IPS TFT<br>Z→Transmissive, W.T, O-TFT<br>R→Transmissive, Super W.T, O-TFT<br>N→Transmissive, Super W.T, 6:00;<br>Q→Transmissive, Super W.T, 12:00<br>V→Transmissive, Super W.T, VA TFT |
| 8    | Backlight   | W : LED, White                      H : LED, High Light White  |
|      |   | F : CCFL, White  |
| 9    | Driver Method   | D: Digital    A: Analog    L : LVDS    M:MIPI  |
| 10   | Interface   | N : without control board    A : 8Bit    B : 16Bit<br>S:SPI Interface    R: RS232    U:USB    I: I2C   |
| 11   | TS  | N : Without TS    S : resistive touch panel<br>C : capacitive touch panel capacitive touch panel (G-F-F)<br>G : capacitive touch panel(G-G)  |

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## 2.Summary

TFT 2.8" is a TN transmissive type color active matrix TFT liquid crystal display that use amorphous silicon TFT as switching devices. This module is composed of a TFT\_LCD module, it is usually designed for industrial application and this module follows RoHs,

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### 3.General Specifications

- Size: 2.8"
- Dot Matrix: 240 x RGB x 320(TFT) dots
- Module dimension: 50.0(W) x 69.2(H) x 2.3(D) mm
- Active area: 43.2 x 57.6 mm
- Dot pitch: 0.18 x 0.18 mm
- LCD type: TFT, Normally White, Transmissive
- View Direction: 6 o'clock
- Gray Scale Inversion Direction: 12 o'clock
- Interface: SPI
- Aspect Ratio: Portrait
- Backlight Type: LED, Normally White
- With /Without TP: Without TP
- Surface: Glare

\*Color tone slight changed by temperature and driving voltage.

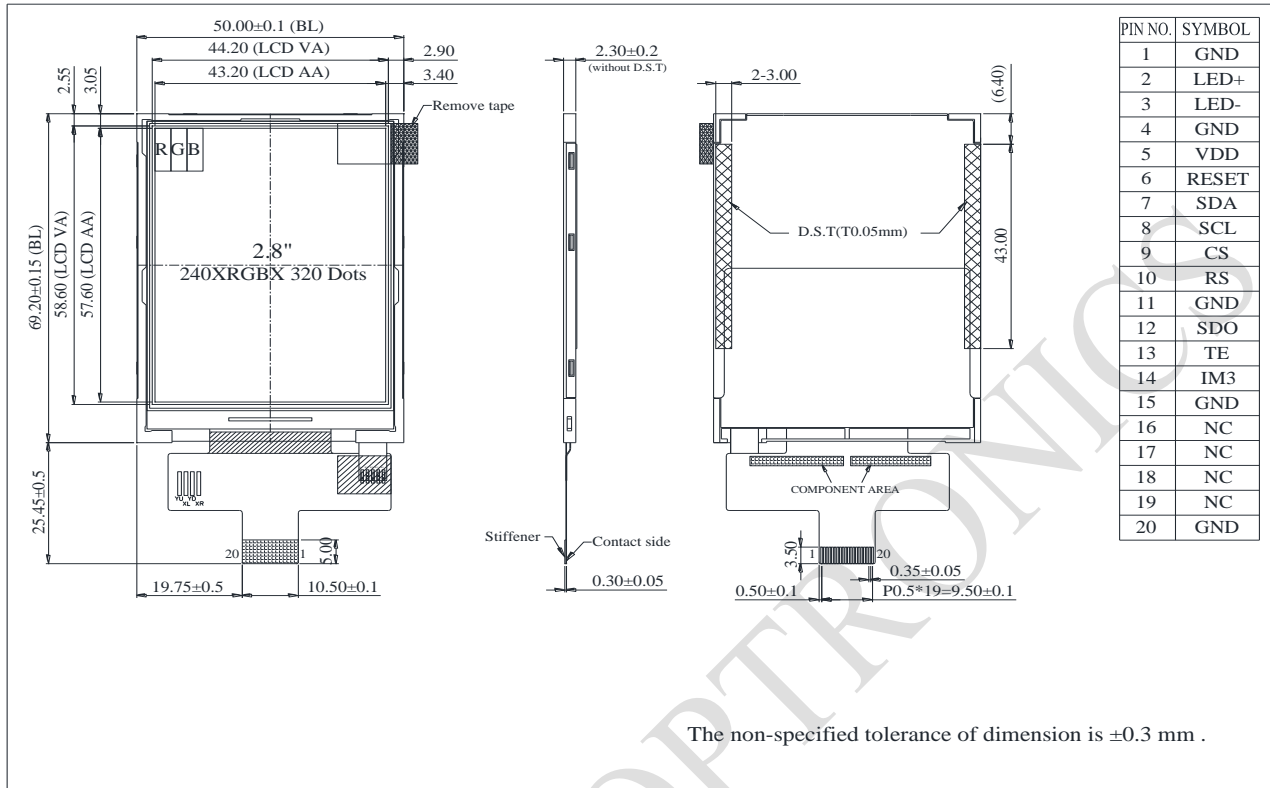
## 4.Interface

### 4.1. LCM PIN Definition

| NO | Symbol | Function  |
|----|--------|---|
| 1  | GND    | Ground  |
| 2  | LED+   | Anode of LED backlight.   |
| 3  | LED-   | Cathode of LED backlight.   |
| 4  | GND    | Ground  |
| 5  | VDD    | Power supply(TYP:2.8V).   |
| 6  | RESET  | System reset pin.   |
| 7  | SDA    | Serial data input pin and output pin(SDA) in serial bus system interface I. Serial data input pin (SDI) in serial bus system interface II. The data is inputted on the rising edge of the SCL signal. If not used, please let it open or connected to VSSD. |
| 8  | SCL    | (NWR) Write enable pin I80 parallel bus system interface. (SCL) server as serial data clock in serial bus system interface when IFSEL=0. Fix it to IOVCC or VSSD level when not used.   |
| 9  | CS     | Chip select signal.<br>Low: chip can be accessed;<br>High: chip cannot be accessed. Must be connected to VSSD if not in use.  |
| 10 | RS     | Command / parameter or display data selection pin   |
| 11 | GND    | Ground  |
| 12 | SDO    | Serial data output pin (SDO) in serial bus system interface II. If not used, please open this pin.  |
| 13 | TE     | Tearing effect output.<br>If not used, please open this pin   |
| 14 | IM3    | serial interface I / serial interface II  |
| 15 | GND    | Ground  |
| 16 | NC     | No connect  |
| 17 | NC     | No connect  |
| 18 | NC     | No connect  |
| 19 | NC     | No connect  |
| 20 | GND    | Ground  |

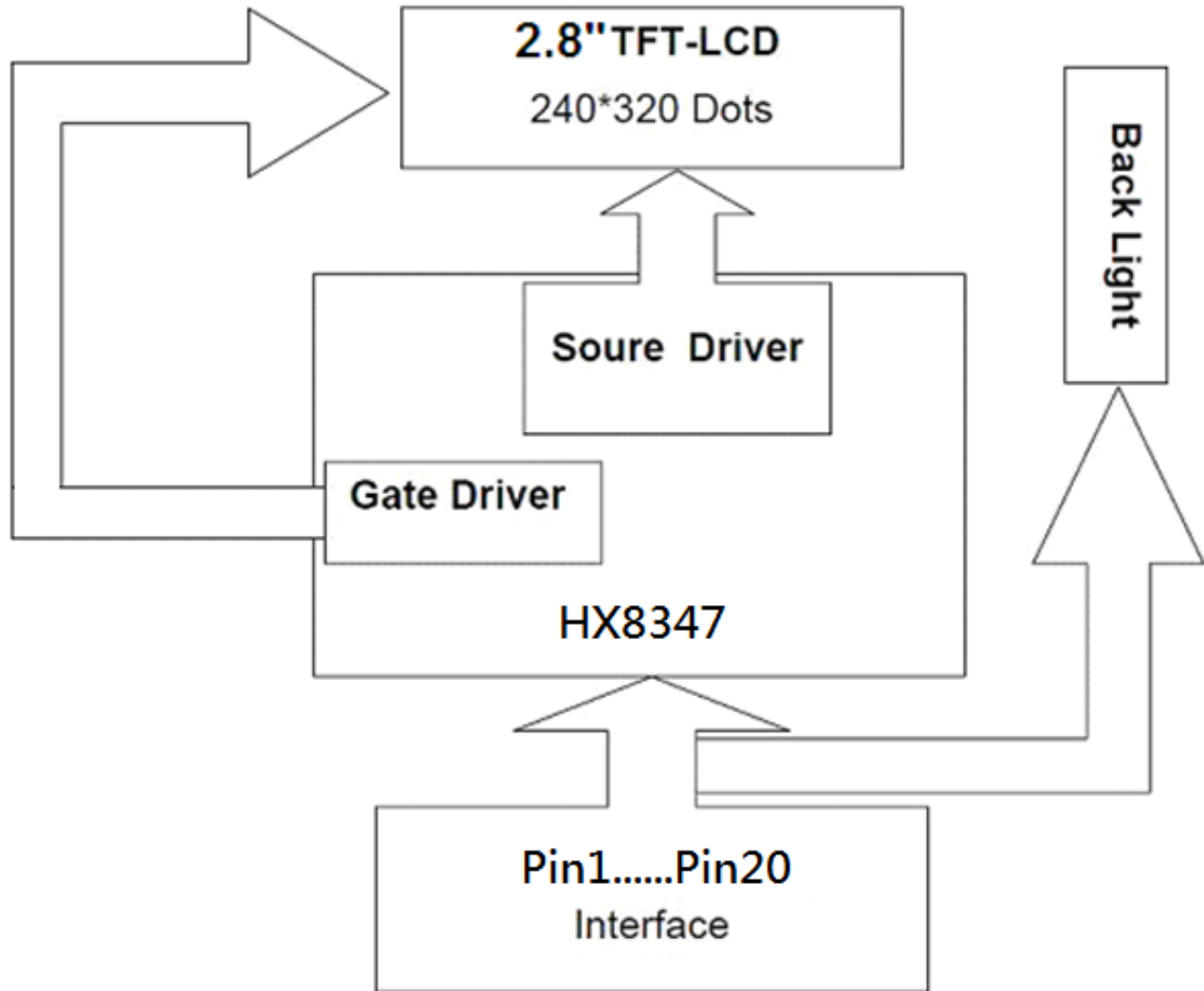


# 5. Contour Drawing



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## 6. Block Diagram



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## 7. Absolute Maximum Ratings

| Item                  | Symbol | Min | Typ | Max | Unit |
|-----------------------|--------|-----|-----|-----|------|
| Operating Temperature | TOP    | -20 | —   | +70 | °C   |
| Storage Temperature   | TST    | -30 | —   | +80 | °C   |

Note: Device is subject to be damaged permanently if stresses beyond those absolute maximum ratings listed above

- Temp.  $\leq 40^{\circ}\text{C}$ , 90% RH MAX. Temp.  $> 40^{\circ}\text{C}$ , Absolute humidity shall be less than 90% RH at  $40^{\circ}\text{C}$

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## 8. Electrical Characteristics

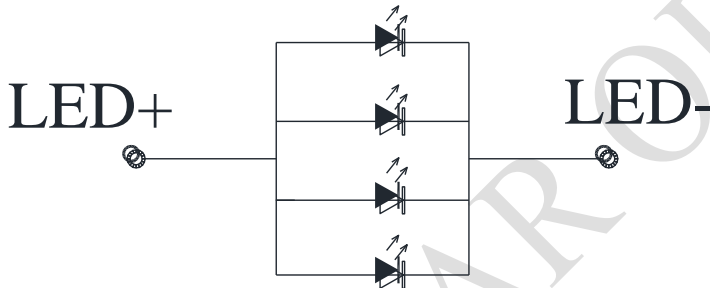
### 8.1. Operating conditions

| Item                      | Symbol          | Condition | Min | Typ | Max | Unit |
|---------------------------|-----------------|-----------|-----|-----|-----|------|
| Supply Voltage For Analog | V <sub>DD</sub> | —         | 2.4 | —   | 3.3 | V    |
| Supply Current For LCM    | I <sub>DD</sub> | —         | —   | 5   | 7.5 | mA   |

### 8.2. LED driving conditions

| Parameter         | Symbol | Min. | Typ.   | Max. | Unit | Remark     |
|-------------------|--------|------|--------|------|------|------------|
| LED current       | —      | —    | 80     | —    | mA   | —          |
| Power Consumption | —      | 224  | 256    | 272  | mW   | —          |
| LED voltage       | LED+   | 2.8  | 3.2    | 3.4  | V    | Note 1     |
| LED Life Time     | —      | —    | 30,000 | —    | Hr   | Note 2,3,4 |

Note 1 : There are 1 Groups LED



### Back Light Circuit

Note 2 : Ta = 25 °C

Note 3 : Brightness to be decreased to 50% of the initial value

Note 4 : The single LED lamp case

## 9.AC Characteristics

### 9.1. 4-wire Serial interface characteristics

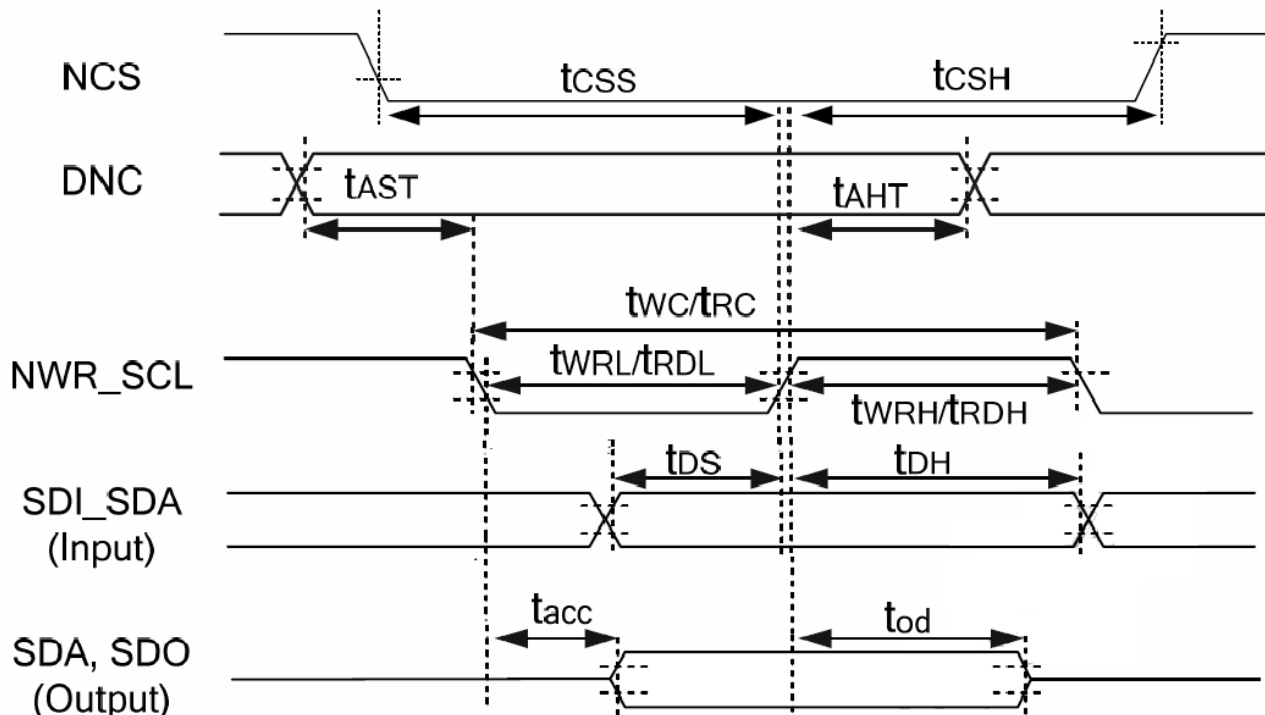


Figure 1 4-wire Serial interface characteristics

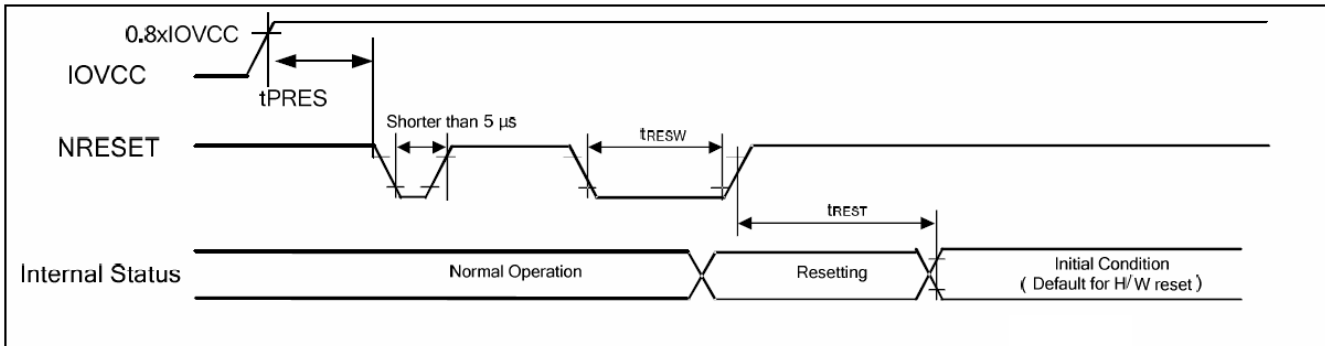
9.2. (VSSA=0V, IOVCC=1.65V to 3.3V, VCI=2.5V to 3.3V, TA=-30 to 70°C)

| Signal               | Symbol            | Parameter                      | Min. | Max. | Unit | Description                               |
|----------------------|-------------------|--------------------------------|------|------|------|---|
| NCS                  | t <sub>CSS</sub>  | Chip select setup time (Read)  | 60   | -    | ns   | -   |
|                      | t <sub>CSH</sub>  | Chip select hold time (Read)   | 65   | -    |      |   |
| DNC                  | t <sub>AST</sub>  | Address setup time             | 0    | -    | ns   | -   |
|                      | t <sub>AHT</sub>  | Address hold time (Write/Read) | 10   | -    |      |   |
| NWR_SCL<br>(Write)   | t <sub>WC</sub>   | Write cycle                    | 14   | -    | ns   | -   |
|                      | t <sub>WRH</sub>  | Control pulse "H" duration     | 6    | -    |      |   |
|                      | t <sub>WRL</sub>  | Control pulse "L" duration     | 6    | -    |      |   |
| NWR_SCL<br>(Read)    | t <sub>RC</sub>   | Read cycle                     | 150  | -    | ns   | -   |
|                      | t <sub>RDH</sub>  | Control pulse "H" duration     | 60   | -    |      |   |
|                      | t <sub>RDL</sub>  | Control pulse "L" duration     | 60   | -    |      |   |
| SDI_SDA<br>(Input)   | t <sub>DS</sub>   | Data setup time                | 6    | -    | ns   | For maximum CL=30pF<br>For minimum CL=8pF |
|                      | t <sub>DT</sub>   | Data hold time                 | 6    | -    |      |   |
| SDA, SDO<br>(Output) | t <sub>RACC</sub> | Read access time               | 10   | 50   | ns   |   |
|                      | t <sub>OD</sub>   | Output disable time            | 15   | 50   |      |   |

Note: The input signal rise time and fall time (tr, tf) is specified at 15 ns or less.

Logic high and low levels are specified as 30% and 70% of IOVCC for Input signals.

### Reset input timing

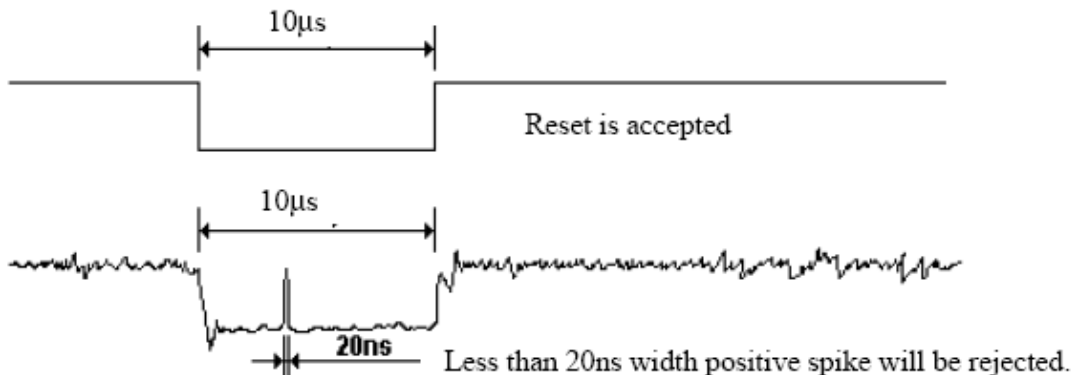


| Symbol | Parameter                                 | Related Pins   | Spec. |      |      | Note                                   | Unit |
|--------|---|----------------|-------|------|------|--|------|
|        |   |                | Min.  | Typ. | Max. |  |      |
| tRESW  | Reset low pulse width <sup>(1)</sup>      | NRESET         | 10    | -    | -    |  | us   |
| tREST  | Reset complete time <sup>(2)</sup>        | -              | -     | -    | 5    | When reset applied during STB OUT mode | ms   |
|        |   | -              | -     | -    | 120  | When reset applied during STB mode     | ms   |
| tPRES  | Reset goes high level after Power on time | NRESET & IOVCC | 1     | -    | -    | Reset goes high level after Power on   | ms   |

Note: (1) Spike due to an electrostatic discharge on NRESET line does not cause irregular system reset according to the table below.

| NRESET Pulse           | Action         |
|------------------------|----------------|
| Shorter than 5 μs      | Reset Rejected |
| Longer than 10 μs      | Reset          |
| Between 5 μs and 10 μs | Reset Start    |

- (2) 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 STB Out –mode. The display remains the blank state in STB –mode) and then return to Default condition for H/W reset.
- (3) During Reset Complete Time, VMF value in OTP will be latched to internal register during this period. This loading is done every time when there is H/W reset complete time (tREST) within 5ms after a rising edge of NRESET.
- (4) Spike Rejection also applies during a valid reset pulse as shown below:



- (5) It is necessary to wait 5msec after releasing !RES before sending commands. Also STB Out

## 10. Optical Characteristics

| Item  | Symbol | Condition.                        | Min                               | Typ. | Max. | Unit              | Remark            |
|---|--------|-----------------------------------|-----------------------------------|------|------|-------------------|-------------------|
| Response time                                     | Tr     | $\theta=0^\circ$ 、 $\phi=0^\circ$ | -                                 | 4    | -    | ms                | Note 3,5          |
|   | Tf     |                                   | -                                 | 12   | -    | ms                |                   |
| Contrast ratio                                    | CR     | At optimized viewing angle        | -                                 | 500  | -    | -                 | Note 4,5          |
| Color Chromaticity                                | White  | Wx                                | $\theta=0^\circ$ 、 $\phi=0^\circ$ | 0.26 | 0.31 | 0.36              | Note 2,6,7        |
|   |        | Wy                                |                                   | 0.28 | 0.33 | 0.38              |                   |
| Viewing angle<br>(Gray Scale Inversion Direction) | Hor.   | $\Theta_R$                        | CR $\geq 10$                      | -    | 45   | -                 | Deg.<br>Note 1    |
|   |        | $\Theta_L$                        |                                   | -    | 45   | -                 |                   |
|   | Ver.   | $\Phi_T$                          |                                   | -    | 50   | -                 |                   |
|   |        | $\Phi_B$                          |                                   | -    | 20   | -                 |                   |
| Brightness  | -      | -                                 | 400                               | 500  | -    | cd/m <sup>2</sup> | Center of display |

Ta=25±2°C

Note 1: Definition of viewing angle range

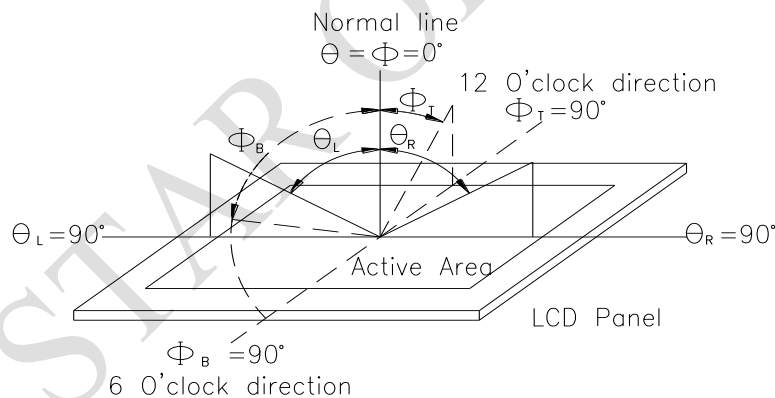
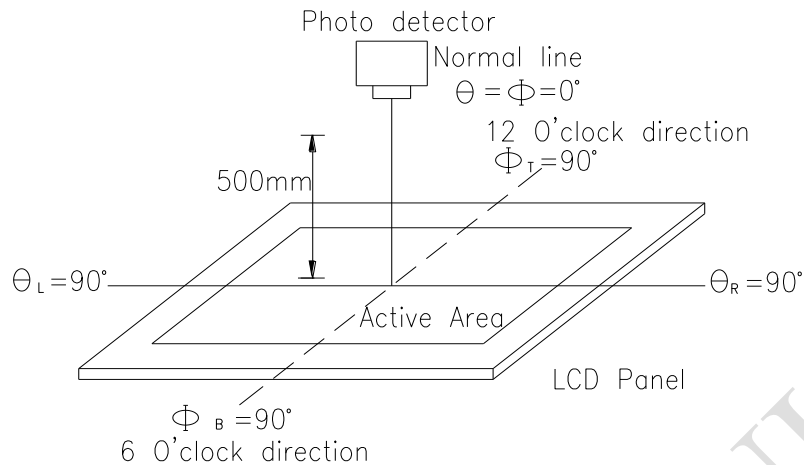


Fig. 10.1. Definition of viewing angle

Note 2: Test equipment setup:

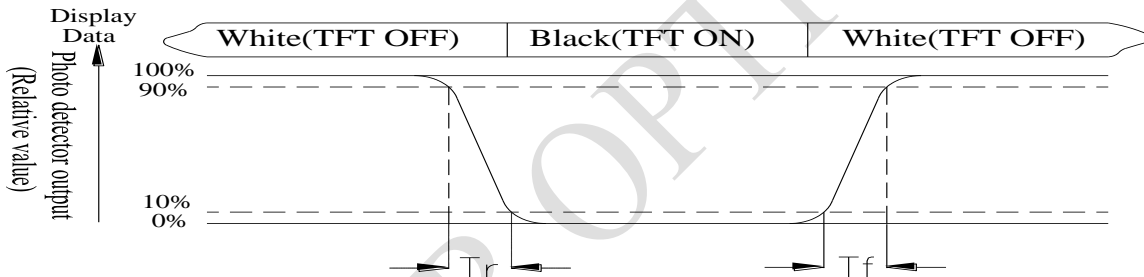
After stabilizing and leaving the panel alone at a driven temperature for 10 minutes, the measurement should be executed. Measurement should be executed in a stable, windless, and dark room. Optical specifications are measured by Topcon BM-7 or BM-5 luminance meter 1.0° field of view at a distance of 50cm and normal direction.



**Fig. 10.2. Optical measurement system setup**

**Note 3: Definition of Response time:**

The response time is defined as the LCD optical switching time interval between “White” state and “Black” state. Rise time,  $T_r$ , is the time between photo detector output intensity changed from 90% to 10%. And fall time,  $T_f$ , is the time between photo detector output intensity changed from 10% to 90%



**Note 4: Definition of contrast ratio:**

The contrast ratio is defined as the following expression.

$$\text{Contrast ratio (CR)} = \frac{\text{Luminance measured when LCD on the "White" state}}{\text{Luminance measured when LCD on the "Black" state}}$$

**Note 5: White  $V_i = V_{i50} \pm 1.5V$**

**Black  $V_i = V_{i50} \pm 2.0V$**

“±” means that the analog input signal swings in phase with VCOM signal.

“±” means that the analog input signal swings out of phase with VCOM signal.

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

**Note 6: Definition of color chromaticity (CIE 1931)**

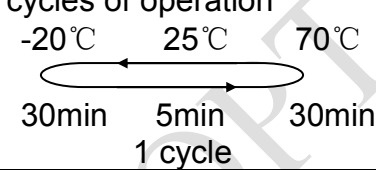
Color coordinates measured at the center point of LCD

**Note 7: Measured at the center area of the panel when all the input terminals of LCD panel are electrically opened.**



# 11. Reliability

Content of Reliability Test (Wide temperature, -20°C~70°C)

| <b>Environmental Test</b>            |  |  |             |
|--------------------------------------|--|--|-------------|
| <b>Test Item</b>                     | <b>Content of Test</b>   | <b>Test Condition</b>  | <b>Note</b> |
| High Temperature storage             | Endurance test applying the high storage temperature for a long time.  | 80°C<br>96hrs  | 2           |
| Low Temperature storage              | Endurance test applying the low storage temperature for a long time.   | -30°C<br>96hrs   | 1,2         |
| High Temperature Operation           | Endurance test applying the electric stress (Voltage & Current) and the thermal stress to the element for a long time.   | 70°C<br>96hrs  | —           |
| Low Temperature Operation            | Endurance test applying the electric stress under low temperature for a long time.   | -20°C<br>96hrs   | 1           |
| High Temperature/ Humidity Operation | The module should be allowed to stand at 40°C,90%RH max  | 40°C,90%RH<br>96hrs  | 1,2         |
| Thermal shock resistance             | The sample should be allowed stand the following 10 cycles of operation<br><div style="text-align: center;">  <p>30min    5min    30min<br/>1 cycle</p> </div> | -20°C/70°C<br>10 cycles  | —           |
| Vibration test                       | Endurance test applying the vibration during transportation and using.   | Total fixed amplitude : 1.5mm<br>Vibration<br>Frequency : 10~55Hz<br>One cycle 60 seconds to 3 directions of X,Y,Z for Each 15 minutes | 3           |
| Static electricity test              | Endurance test applying the electric stress to the terminal.   | VS=±600V(contact)<br>,±800v(air),<br>RS=330Ω<br>CS=150pF<br>10 times   | —           |

Note1: No dew condensation to be observed.

Note2: The function test shall be conducted after 4 hours storage at the normal Temperature and humidity after remove from the test chamber.

Note3: The packing have to including into the vibration testing.

| <b>LCM Sample Estimate Feedback Sheet</b>   |                               |                                     |
|---|-------------------------------|-------------------------------------|
| <b>Module Number :</b> _____  |                               |                                     |
| <b>1 、 <u>Panel Specification</u> :</b>   |                               |                                     |
| 1. Panel Type :   | <input type="checkbox"/> Pass | <input type="checkbox"/> NG , _____ |
| 2. View Direction :   | <input type="checkbox"/> Pass | <input type="checkbox"/> NG , _____ |
| 3. Numbers of Dots :  | <input type="checkbox"/> Pass | <input type="checkbox"/> NG , _____ |
| 4. View Area :  | <input type="checkbox"/> Pass | <input type="checkbox"/> NG , _____ |
| 5. Active Area :  | <input type="checkbox"/> Pass | <input type="checkbox"/> NG , _____ |
| 6. Operating Temperature :  | <input type="checkbox"/> Pass | <input type="checkbox"/> NG , _____ |
| 7. Storage Temperature :  | <input type="checkbox"/> Pass | <input type="checkbox"/> NG , _____ |
| 8. Others : _____   |                               |                                     |
| <b>2 、 <u>Mechanical Specification</u> :</b>  |                               |                                     |
| 1. PCB Size :   | <input type="checkbox"/> Pass | <input type="checkbox"/> NG , _____ |
| 2. Frame Size :   | <input type="checkbox"/> Pass | <input type="checkbox"/> NG , _____ |
| 3. Material of Frame :  | <input type="checkbox"/> Pass | <input type="checkbox"/> NG , _____ |
| 4. Connector Position :   | <input type="checkbox"/> Pass | <input type="checkbox"/> NG , _____ |
| 5. Fix Hole Position :  | <input type="checkbox"/> Pass | <input type="checkbox"/> NG , _____ |
| 6. Backlight Position :   | <input type="checkbox"/> Pass | <input type="checkbox"/> NG , _____ |
| 7. Thickness of PCB :   | <input type="checkbox"/> Pass | <input type="checkbox"/> NG , _____ |
| 8. Height of Frame to PCB :   | <input type="checkbox"/> Pass | <input type="checkbox"/> NG , _____ |
| 9. Height of Module :   | <input type="checkbox"/> Pass | <input type="checkbox"/> NG , _____ |
| 10. Others :  | <input type="checkbox"/> Pass | <input type="checkbox"/> NG , _____ |
| <b>3 、 <u>Relative Hole Size</u> :</b>  |                               |                                     |
| 1. Pitch of Connector :   | <input type="checkbox"/> Pass | <input type="checkbox"/> NG , _____ |
| 2. Hole size of Connector :   | <input type="checkbox"/> Pass | <input type="checkbox"/> NG , _____ |
| 3. Mounting Hole size :   | <input type="checkbox"/> Pass | <input type="checkbox"/> NG , _____ |
| 4. Mounting Hole Type :   | <input type="checkbox"/> Pass | <input type="checkbox"/> NG , _____ |
| 5. Others :   | <input type="checkbox"/> Pass | <input type="checkbox"/> NG , _____ |
| <b>4 、 <u>Backlight Specification</u> :</b>   |                               |                                     |
| 1. B/L Type :   | <input type="checkbox"/> Pass | <input type="checkbox"/> NG , _____ |
| 2. B/L Color :  | <input type="checkbox"/> Pass | <input type="checkbox"/> NG , _____ |
| 3. B/L Driving Voltage (Reference for LED Type) : <input type="checkbox"/> Pass <input type="checkbox"/> NG , _____ |                               |                                     |
| 4. B/L Driving Current :  | <input type="checkbox"/> Pass | <input type="checkbox"/> NG , _____ |
| 5. Brightness of B/L :  | <input type="checkbox"/> Pass | <input type="checkbox"/> NG , _____ |
| 6. B/L Solder Method :  | <input type="checkbox"/> Pass | <input type="checkbox"/> NG , _____ |
| 7. Others :   | <input type="checkbox"/> Pass | <input type="checkbox"/> NG , _____ |

>> Go to page 2 <<

Module Number : \_\_\_\_\_

**5 · Electronic Characteristics of Module :**

|                             |                               |                                     |
|-----------------------------|-------------------------------|-------------------------------------|
| 1.Input Voltage :           | <input type="checkbox"/> Pass | <input type="checkbox"/> NG , _____ |
| 2.Supply Current :          | <input type="checkbox"/> Pass | <input type="checkbox"/> NG , _____ |
| 3.Driving Voltage for LCD : | <input type="checkbox"/> Pass | <input type="checkbox"/> NG , _____ |
| 4.Contrast for LCD :        | <input type="checkbox"/> Pass | <input type="checkbox"/> NG , _____ |
| 5.B/L Driving Method :      | <input type="checkbox"/> Pass | <input type="checkbox"/> NG , _____ |
| 6.Negative Voltage Output : | <input type="checkbox"/> Pass | <input type="checkbox"/> NG , _____ |
| 7.Interface Function :      | <input type="checkbox"/> Pass | <input type="checkbox"/> NG , _____ |
| 8.LCD Uniformity :          | <input type="checkbox"/> Pass | <input type="checkbox"/> NG , _____ |
| 9.ESD test :                | <input type="checkbox"/> Pass | <input type="checkbox"/> NG , _____ |
| 10.Others :                 | <input type="checkbox"/> Pass | <input type="checkbox"/> NG , _____ |

**6 · Summary :**

Sales signature : \_\_\_\_\_

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

Date : / / \_\_\_\_\_