

## LCD MODULE

# SPECIFICATION

|                 |                   |
|-----------------|-------------------|
| <b>Model:</b>   | UE035QV-RH54-L015 |
| <b>Version:</b> | V1.0              |
| <b>Date:</b>    | 2018-06-13        |

☒ **Preliminary Specification** 样品规格书

☐ **Final Specification** 量产规格书

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## REVISION HISTORY

| Revision<br>版本号 | Date<br>日期 | Contents of Revision Change<br>修改内容 | Remark<br>备注 |
|-----------------|------------|-------------------------------------|--------------|
| V1.0            | 2018.6.13  | Preliminary release                 | All          |
|                 |            |                                     |              |
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## 1. GENERAL INFORMATION

### 1.1 Features

- 1) Pixel Arrangement: RGB Vertical Stripe
- 2) Interface Mode: 54PIN SPI\_RGB 24bits
- 3) Driver IC: ST7272A
- 4) Operation Temperature: -20~70℃
- 5) Storage Temperature: -30~80℃
- 6) Backlight Type: White LED
- 7) Display mode: Normally black,
- 8) Pixel Density: 114 PPI
- 9) LED life time: 30,000 Hours

### 1.2 Mechanical Specification

| Item<br>项目               | Specification<br>规格       | Unit<br>单位        | Remark<br>备注    |
|--------------------------|---------------------------|-------------------|-----------------|
| Pixel Driving element    | A-Si TFT                  | -                 | -               |
| Screen Size              | 3.5                       | Inch              | Diagonal        |
| Resolution               | 320(W)*3(RGB)*240(H)      | Dots              | -               |
| Interface                | 3SPI_RGB 24bits           | -                 | 54PIN           |
| Module Power Consumption | -                         | Watt              | Typ.            |
| Active Area              | 70.08(W)*52.56(H)         | mm                | -               |
| Pixel pitch (W*H)        | 0.219(W)*0.219(H)         | mm                | -               |
| Module Size (W*H*D)      | 76.84(W)*63.84(H)*3.32(D) | mm                | Tolerance: ±0.2 |
| Luminance                | 400                       | cd/m <sup>2</sup> | Typ.            |
| Viewing Direction        | All                       | O'clock           |                 |
| Display Color            | 16.7M                     | Colors            | 24bits          |

## 2. ABSOLUTE MAXIMUM RATINGS

| Item<br>项目            | Symbol<br>符号    | Min.<br>最小值 | Max.<br>最大值 | Unit<br>单位 | Remark<br>备注       |
|-----------------------|-----------------|-------------|-------------|------------|--------------------|
| Power supply1 voltage | VDD             | -0.3        | 4           | V          | Note1              |
| Power supply2 voltage | VCCIO           | -0.3        | 4           | V          | Note1              |
| LED forward current   | I <sub>F</sub>  | -0.001      | 30          | mA         | For each led,Note1 |
| LED Reverse Voltage   | V <sub>R</sub>  | -           | 5           | V          | For each led,Note1 |
| Operating temperature | T <sub>op</sub> | -20         | 70          | °C         | Note1,2            |
| Storage temperature   | T <sub>st</sub> | -30         | 80          | °C         | Note1,2            |
| Humidity              | H <sub>st</sub> | 10          | 90          | %RH        | Note1,3            |

(Ta=+25°C,DGND=AVSS=0V)

Note1:If the module exceeds the absolute maximum ratings, it may be damaged permanently. Also if the module operates with the absolute maximum ratings for a long time, the reliability may drop.

Note2: In case of temperature below 0°C,the response time of liquid crystal (LC) becomes slower and the color of panel darker than normal one.

Note3: Temp. ≤ 60°C , 90% RH MAX.

Temp. > 60°C , Absolute humidity shall be less than 90% RH.

### 3. MECHANICAL DRAWING

[illegible]

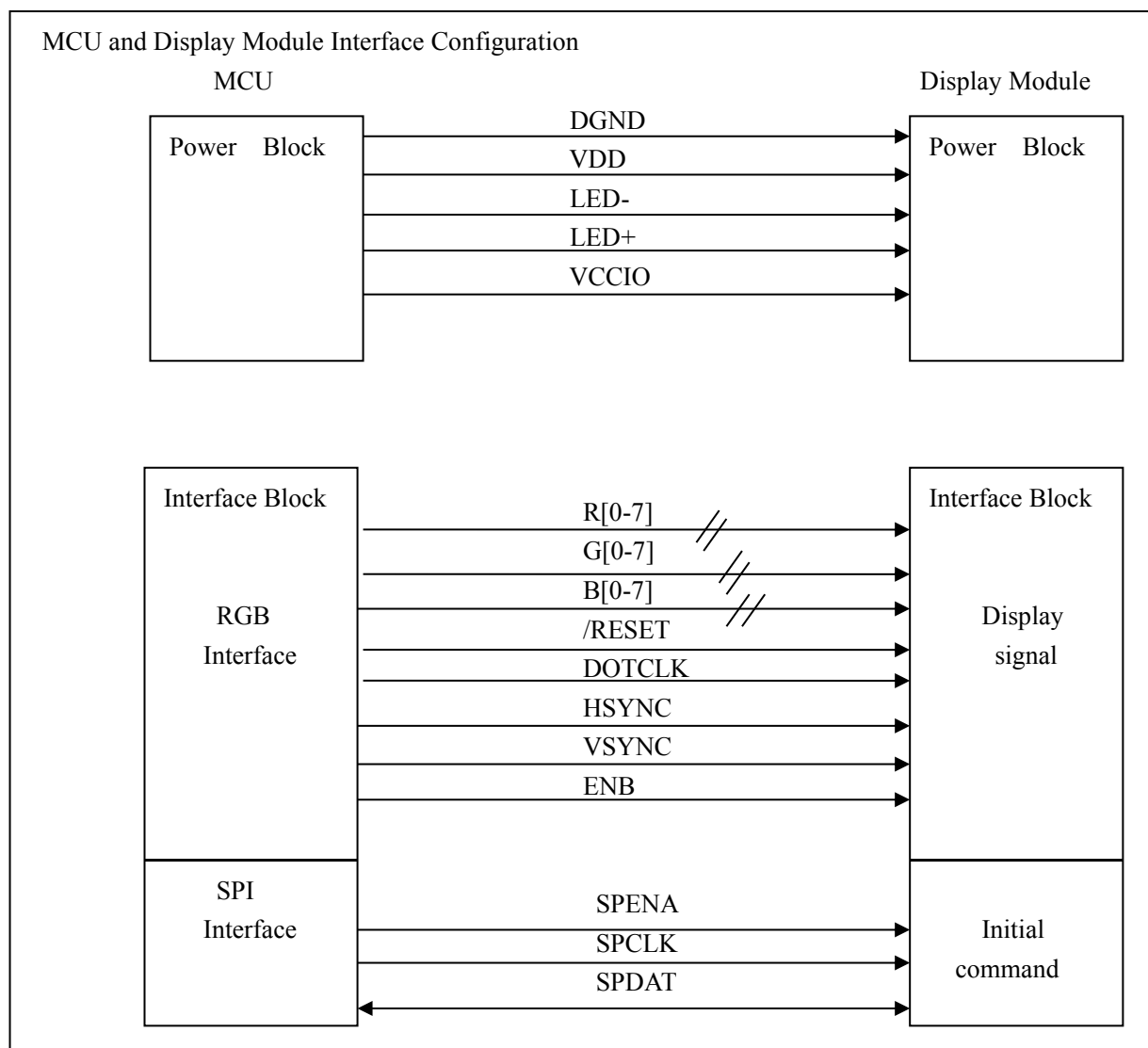
## 4. I/O CONNECTION & BLOCK DIAGRAM

### 4.1 I/O Connection

| Pin No.<br>序号 | Symbol<br>符号 | I/O | Description<br>描述                                                                   |
|---------------|--------------|-----|-------------------------------------------------------------------------------------|
| 1-2           | LEDK         | P   | Power supply for backlight cathode                                                  |
| 3-4           | LEDA         | P   | Power supply for backlight anode                                                    |
| 5-7           | NC           | -   | Dummy                                                                               |
| 8             | /RESET       | I   | Global reset pin. When /RESET is “L”, internal initialization procedure is executed |
| 9             | SPENA        | I   | Serial communication chip selection                                                 |
| 10            | SPCLK        | I   | Serial communication clock input                                                    |
| 11            | SPDAT        | I/O | Serial communication data input and output                                          |
| 12-19         | B0-B7        | I   | Blue data input                                                                     |
| 20-27         | G0-G7        | I   | Green data input                                                                    |
| 28-35         | R0-R7        | I   | Red data input                                                                      |
| 36            | HSYNC        | I   | Horizontal sync signal, default is negative polarity                                |
| 37            | VSNC         | I   | Vertical sync signal, default is negative polarity                                  |
| 38            | DOTCLK       | I   | Pixel clock input pin, default is positive polarity                                 |
| 39-40         | NC           | -   | Dummy                                                                               |
| 41            | VCCIO        | P   | Power supply for digital I/O pins.                                                  |
| 42            | VDD          | P   | Power supply for analog circuit.                                                    |
| 43-51         | NC           | -   | Dummy                                                                               |
| 52            | ENB          | I   | Data input enable. Display access is enabled when DE is “H”                         |
| 53            | DGND         | P   | Power Ground                                                                        |
| 54            | AVSS         | P   | Power Ground                                                                        |

I: Input; O: Output; P: Power

## 4.2 Block Diagram





## 5. ELECTRICAL CHARACTERISTICS

### 5.1 TFT-LCD Panel Driving Section

| Item<br>项目               | Symbol<br>符号     | Min.<br>最小值 | Typ.<br>典型值 | Max.<br>最大值 | Unit<br>单位 | Remark<br>备注 |
|--------------------------|------------------|-------------|-------------|-------------|------------|--------------|
| Power Supply1 Voltage    | VDD              | 3.0         | 3.3         | 3.6         | V          | -            |
| Power Supply2 Voltage    | VCCIO            | 3.0         | 3.3         | 3.6         | V          | -            |
| Power Supply Current     | I <sub>VDD</sub> | -           | 30          | -           | mA         | Note1        |
| Logic Input High Voltage | V <sub>IH</sub>  | 0.7VCCIO    | -           | VCCIO       | V          | -            |
| Logic Input Low Voltage  | V <sub>IL</sub>  | 0           | -           | 0.3VCCIO    | V          | -            |
| Panel Power Consumption  | P <sub>VDD</sub> | -           | 0.099       | -           | Watt       | Note1        |
| Module Power Consumption | P <sub>LCM</sub> | -           | 0.5         | -           | Watt       | Note1,2      |

(Ta=+25°C, DGND=AVSS=0V)

Note1: Measurement Conditions (Video Mode): Full Screen Red Pattern, VDD=3.3V, 60Hz Refresh.

Note2: P<sub>LCM</sub> = P<sub>VDD</sub> + P<sub>B/L</sub>, About P<sub>B/L</sub> information, inference to 5.2 Back Light Driving Section.

### 5.2 Back Light Driving Section

| Item<br>项目                  | Symbol<br>符号     | Min.<br>最小值 | Typ.<br>典型值 | Max.<br>最大值 | Unit<br>单位 | Remark<br>备注 |
|-----------------------------|------------------|-------------|-------------|-------------|------------|--------------|
| Forward Voltage             | V <sub>F</sub>   | -           | 19.2        | -           | V          | Note1        |
| Forward Current             | I <sub>F</sub>   | -           | 20          | -           | mA         | Note1        |
| Backlight Power consumption | P <sub>B/L</sub> | -           | 0.384       | -           | Watt       | Note1        |
| LED life time               | -                | 30000       | -           | -           | Hrs        | Note2        |
| LED Quantity                |                  | 6           |             |             | PCS        |              |

(Ta=+25°C, DGND=AVSS=0V)

Note1: The LED driving condition is defined for each LED module (6LED Serial, 1 LED Parallel).

For each LED : I<sub>F</sub>=20mA, V<sub>F</sub>=3.2V(Typ.)/3.4V(Max.), Ta=25°C。

Note2: The “LED life time” is defined as the module brightness decrease to 50% of original brightness at I<sub>LED</sub>=20mA(Per Led). The LED life time could be decreased if operating I<sub>LED</sub> is larger than 20mA.

LED A ○  ○ LED K

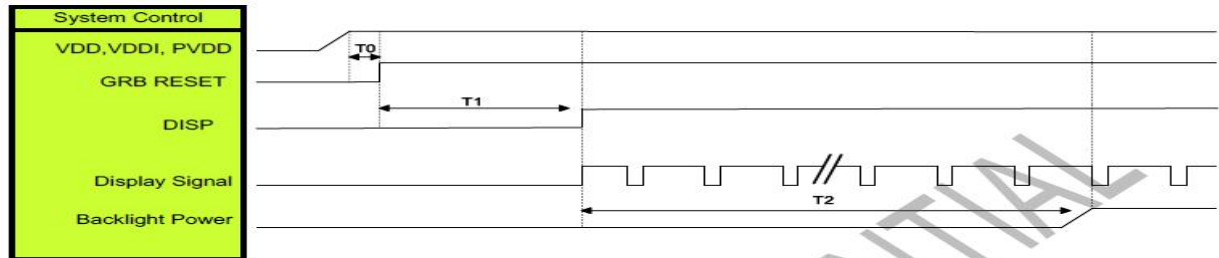
BACKLIGHT CIRCUIT DIAGRAM 20mA/LED (6LED)

LED V<sub>f</sub>:19.2V(TYP)

I<sub>f</sub>:20mA

## 5.3 Power On/Off Sequence

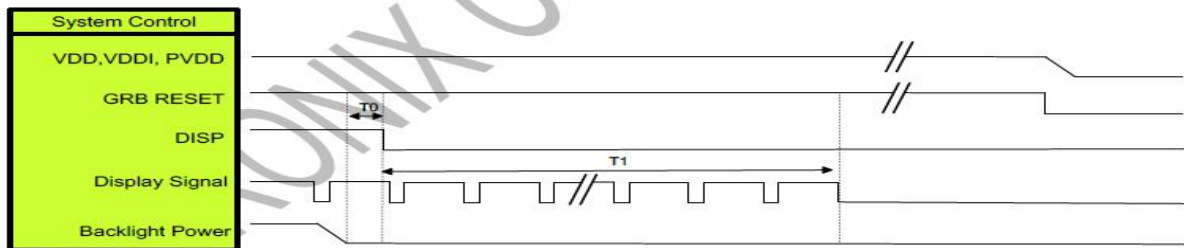
### 5.3.1 Power on sequence



| Symbol | Description                                 | Min. Time | Unit |
|--------|---------------------------------------------|-----------|------|
| T0     | System power stability to GRB RESET signal  | 0         | ms   |
| T1     | GRB RESET="High" to DISP="High"             | 10        | ms   |
| T2     | Display Signal output to Backlight Power on | 250       | ms   |

Note: Display signal: DCLK; VSYNC; HSYNC; DE; DR[7:0]; DG[7:0]; DB[7:0]

### 5.3.2 Power off sequence

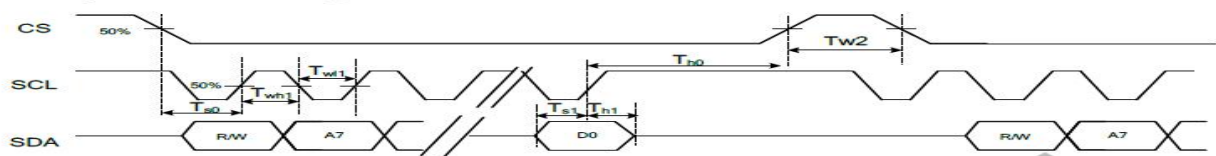


| Symbol | Description                                          | Min. Time | Unit |
|--------|------------------------------------------------------|-----------|------|
| T0     | Backlight Power off to DISP="Low"                    | 5         | ms   |
| T1     | DISP="Low" to IC internal voltage discharge complete | 80        | ms   |

Note: Display signal: DCLK; VSYNC; HSYNC; DE; DR[7:0]; DG[7:0]; DB[7:0]

## 5.4 Timing Characteristics

### 5.4.1 Timing for 3-Wire SPI Interface



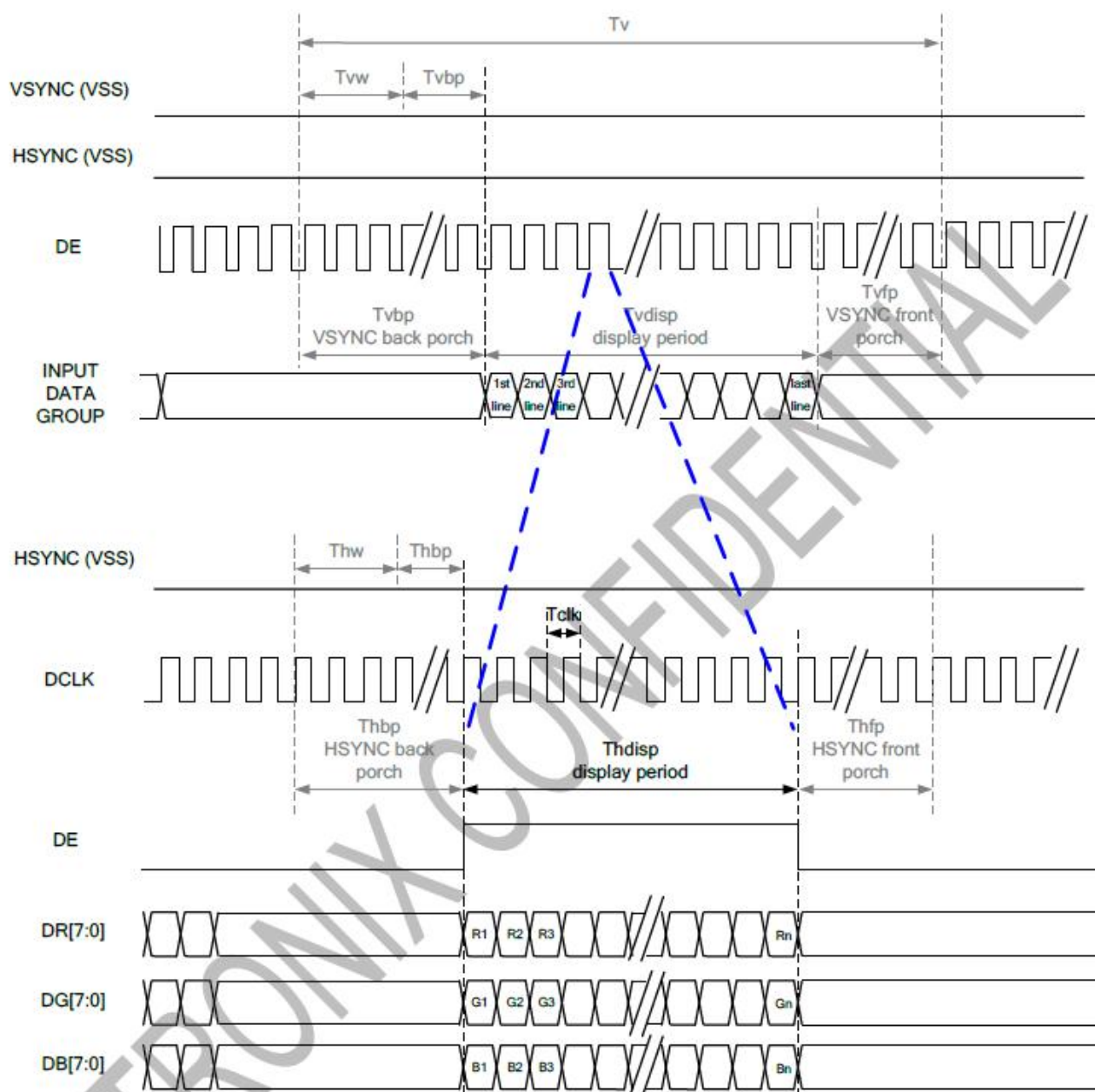
| Item                         | Symbol | Min. | Typ. | Max. | Unit | Conditions |
|------------------------------|--------|------|------|------|------|------------|
| CS Input Setup Time          | Ts0    | 50   | -    | -    | ns   |            |
| Serial Data Input Setup Time | Ts1    | 50   | -    | -    | ns   |            |
| CS Input Hold Time           | Th0    | 50   | -    | -    | ns   |            |
| Serial Data Input Hold Time  | Th1    | 50   | -    | -    | ns   |            |
| SCL Write Pulse High Width   | Twh1   | 50   | -    | -    | ns   |            |
| SCL Write Pulse Low Width    | Twl1   | 50   | -    | -    | ns   |            |
| SCL Read Pulse High Width    | Trh1   | 300  | -    | -    | ns   |            |
| SCL Read Pulse Low Width     | Trl1   | 300  | -    | -    | ns   |            |
| CS Pulse High Width          | Tw2    | 400  | -    | -    | ns   |            |

(Ta=+25°C, DGND=AVSS=0V)

### 5.4.2 Parallel 24-bit RGB Input Timing Table

| Parallel 24-bit RGB Input Timing Table |                |        |      |      |      |       |                                                                                     |
|----------------------------------------|----------------|--------|------|------|------|-------|-------------------------------------------------------------------------------------|
| Item                                   |                | Symbol | Min. | Typ. | Max. | Unit  | Note                                                                                |
| DCLK Frequency                         |                | Fclk   | 5    | 6    | 8    | MHz   |                                                                                     |
| DCLK Period                            |                | Tclk   | 125  | 167  | 200  | ns    |                                                                                     |
| HSYNC                                  | Period Time    | Th     | 325  | 371  | 438  | DCLK  |                                                                                     |
|                                        | Display Period | Thdisp |      | 320  |      | DCLK  |                                                                                     |
|                                        | Back Porch     | Thbp   | 3    | 43   | 43   | DCLK  | SYNC mode back porch control<br>by H_BLANKING[7:0] setting<br>Thbp= H_BLANKING[7:0] |
|                                        | Front Porch    | Thfp   | 2    | 8    | 75   | DCLK  |                                                                                     |
|                                        | Pulse Width    | Thw    | 2    | 4    | 43   | DCLK  |                                                                                     |
| VSYNC                                  | Period Time    | Tv     | 244  | 260  | 289  | HSYNC |                                                                                     |
|                                        | Display Period | Tvdisp |      | 240  |      | HSYNC |                                                                                     |
|                                        | Back Porch     | Tvbp   | 2    | 12   | 12   | HSYNC | SYNC mode back porch control<br>by V_BLANKING[7:0] setting<br>Tvbp= V_BLANKING[7:0] |
|                                        | Front Porch    | Tvfp   | 2    | 8    | 37   | HSYNC |                                                                                     |
|                                        | Pulse Width    | Tvw    | 2    | 4    | 12   | HSYNC |                                                                                     |

## 5.5 Timing Diagram



## 6. OPTICAL CHARACTERISTICS

| Parameter<br>参数         | Symbol<br>符号                    | Condition<br>条件                                                        | Min.<br>最小值 | Typ.<br>典型值 | Max.<br>最大值 | Unit<br>单位        | Remark<br>备注 |
|-------------------------|---------------------------------|------------------------------------------------------------------------|-------------|-------------|-------------|-------------------|--------------|
| Contrast Ratio          | C/R                             | $\theta = 0^\circ$                                                     | 640         | 800         | -           | -                 | Note(4)      |
| NTSC Ratio              | S                               | $\theta = 0^\circ$                                                     | 55          | 60          | -           | %                 | Note(7)      |
| Luminance               | L                               | $\theta = 0^\circ$                                                     | -           | 400         | -           | cd/m <sup>2</sup> | Note(5)      |
| Luminance<br>uniformity | U <sub>W</sub>                  | $\theta = 0^\circ$                                                     | 70          | 80          | -           | %                 | Note(3)      |
| Response Time           | T <sub>R</sub> + T <sub>F</sub> | 25 °C                                                                  | -           | 30          | 40          | ms                | Note(2)      |
| Color<br>Coordination   | W <sub>X</sub>                  | $\theta = 0^\circ$<br>(Center)<br>Normal<br>viewing<br>angle<br>B/L On | -0.02       | 0.317       | +0.02       | NTSC<br>(x,y)     | Note(6)      |
|                         | W <sub>Y</sub>                  |                                                                        |             | 0.339       |             |                   |              |
|                         | R <sub>X</sub>                  |                                                                        |             | 0.646       |             |                   |              |
|                         | R <sub>Y</sub>                  |                                                                        |             | 0.332       |             |                   |              |
|                         | G <sub>X</sub>                  |                                                                        |             | 0.323       |             |                   |              |
|                         | G <sub>Y</sub>                  |                                                                        |             | 0.567       |             |                   |              |
|                         | B <sub>X</sub>                  |                                                                        |             | 0.134       |             |                   |              |
|                         | B <sub>Y</sub>                  |                                                                        |             | 0.121       |             |                   |              |
| Viewing Angle           | $\theta_L$                      | C/R>10                                                                 | 70          | 80          | -           | Degree            | Note(1)      |
|                         | $\theta_R$                      |                                                                        | 70          | 80          | -           |                   |              |
|                         | $\theta_U$                      |                                                                        | 70          | 80          | -           |                   |              |
|                         | $\theta_D$                      |                                                                        | 70          | 80          | -           |                   |              |

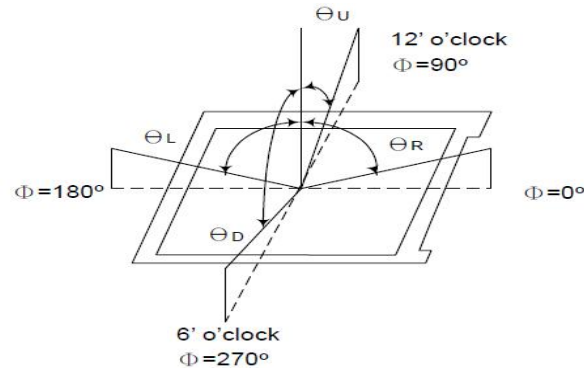
Test Conditions:

1. VDD=3.3V, I<sub>F</sub>=20mA (Backlight current), the ambient temperature is +25°C.

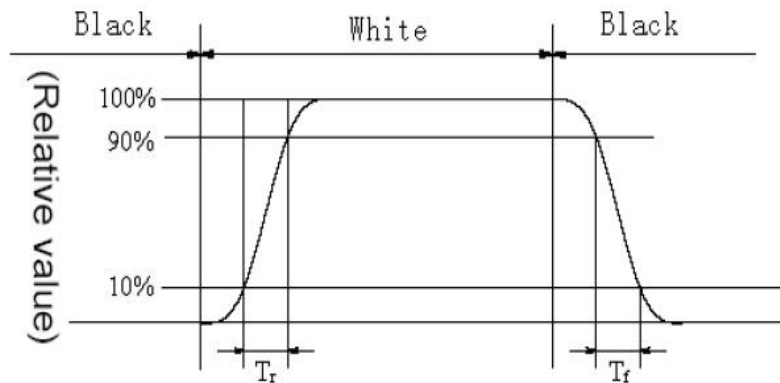


2. The test systems refer to Note 8.

**Note1:** Definition of Viewing Angle: The viewing angle range that the CR>10

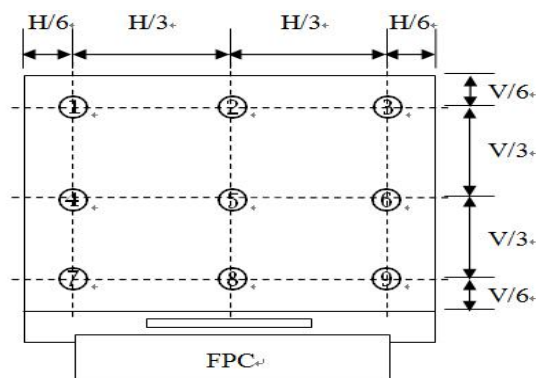


**Note2:** Definition of Response time: Sum of  $T_R$  and  $T_F$



**Note 3:** Definition of Luminance Uniformity: Active area is divided into 9 measuring areas, every measuring point is placed at the center of each measuring area.

$$\text{Luminance Uniformity} = \frac{\text{Min Luminance of white among 9-points}}{\text{Max Luminance of white among 9-points}} \times 100\%$$



**Note4:** Definition of Contrast Ratio (CR): measured at the center point of panel

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

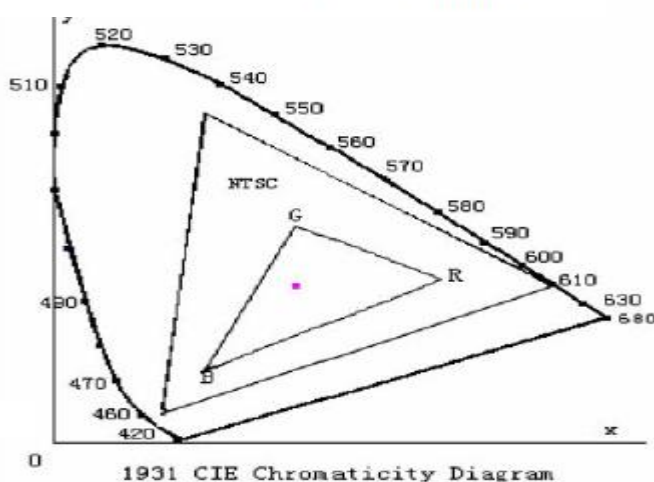
**Note 5:** Definition of Luminance: Center Luminance of white is defined as luminance values of 1 point average across the LCD surface.

**Note 6:** Definition of Color Chromaticity (CIE 1931)

Color coordinates of white & red, green, blue measured at center point of LCD.

**Note 7:** Definition of NTSC ratio:

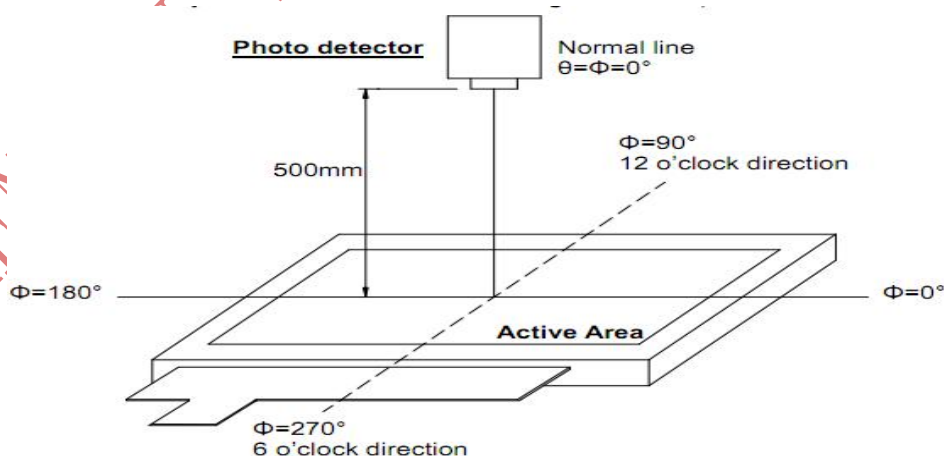
$$\text{NTSC ratio} = \frac{\text{Area of RGB triangle}}{\text{Area of NTSC triangle}}$$



**Note 8:** Definition of measurement system.

optical

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. (Response time is measured by Photo detector TOPCON BM-7, Field of view: 1°/Height: 500mm.)



## 7. RELIABILITY

| Item<br>项目                     | Test Condition<br>测试条件                                                           | Remark<br>备注 |
|--------------------------------|----------------------------------------------------------------------------------|--------------|
| High Temperature Storage       | Ta =+80°C / 240Hours                                                             | Note1,2,3    |
| Low Temperature Storage        | Ta =-30°C / 240Hours                                                             | Note1,2,3    |
| High Temperature Operating     | Ta =+70°C / 240Hours                                                             | Note1,2,3    |
| Low Temperature Operating      | Ta =-20°C / 240Hours                                                             | Note1,2,3    |
| Temperature Cycle storage Test | -30°C/30min ↔ +80°C /30min for 30cycles, Transfer time less than 5min            | Note2,3      |
| Thermal humidity storage Test  | 60°C x 90%RH / 240Hours                                                          | Note2,3      |
| Package Vibration Test         | Frequency: 10Hz~55Hz, Amplitude: 1.5mm, 1 hrs for each direction of X, Y, Z      | Note2        |
| Packing shock test             | Drop to the ground from 60cm height, 1 corner, 3 edges, 6 surfaces.              | Note2        |
| ESD                            | C=150PF, R=330 Ohm<br>Air: ±8kv, 5times(Center)<br>Contact: ±4kv, 5times(Center) | Note4        |

### Inspection after Test:

Note1: Ta is the ambient temperature of samples.

Note 2: In the standard condition, there shall be no practical problem that may affect the display function. After the reliability test, the product only guarantees operation, but doesn't guarantee all the cosmetic specification.

Note 3: Before cosmetic and function tests, the product must have enough recovery time, at least 2 hours at room temperature.

Note 4: In case of malfunction defect caused by ESD damage, if it would be recovered to normal state after resetting, it would be judged as a good part.



## 8. PACKAGE DRAWING

