# LCD MODULE

# SPECIFICATION

| | |
|---|---|
| **Model:** | UE013QV-RH13-A003B |
| **Version:** | V1.0 |
| **Date:** | 20220316 |



## Customer Confirmation

| Approved by | Notes |
|---|---|
| | |

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## VIEWE Confirmation

| Prepared by | Reviewed by | Approved by |
|---|---|---|
| | | |

# REVISION HISTORY

| Revision | Date | Contents of Revision Change | Remark |
|---|---|---|---|
| V1.0 | 20220316 | Preliminary release | All |
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# TABLE of CONTENTS

# 1. GENERAL INFORMATION

## 1.1 Features

1) Pixel Arrangement：RGB Vertical Stripe
2) Interface Mode：4 Wire SPI
3) Driver IC：GC9A01
4) Operation Temperature：-20~70℃
5) Storage Temperature：-30~80℃
6) Backlight Type：White LED
7) Display mode： Normally black,
8) Pixel Density：261 PPI
9) LED life time：30,000 Hours

## 1.2 Mechanical Specification

| Item | Specification | Unit | Remark |
|---|---|---|---|
| **Pixel Driving element** | IPS TFT | - | - |
| **Screen Size** | 1.28 | Inch | Diagonal |
| **Resolution** | 240(W)*3(RGB)*240(H) | Dots | - |
| **Interface** | 4 Wire SPI | - | - |
| **Module Power Consumption** | 0.278 | Watt | Typ. |
| **Active Area** | 32.4（⌀ ） | mm | - |
| **Pixel pitch (W*H)** | 0.135(W)*0.135(H) | mm | - |
| **Module Size (W*H*D)** | 45.5(W)*45.5(H)*2.69(D) | mm | - |
| **Luminance** | 200 | $cd/m^2$ | Typ. |
| **Viewing Direction** | All | O'clock | - |
| **Display Color** | 65K | Colors | 16 Bits |

# 2. ABSOLUTE MAXIMUM RATINGS

| Item | Symbol | Min. | Max. | Unit | Remark |
|---|---|---|---|---|---|
| Power supply1 voltage | VDD | -0.3 | 4.6 | V | Note1 |
| LED Reverse Voltage | $V_R$ | - | 5 | V | For each led,Note1 |
| Operating temperature | $T_{op}$ | -20 | 70 | °C | Note1,2 |
| Storage temperature | $T_{st}$ | -30 | 80 | °C | Note1,2 |
| Humidity | $H_{st}$ | 10 | 90 | %RH | Note1,3 |

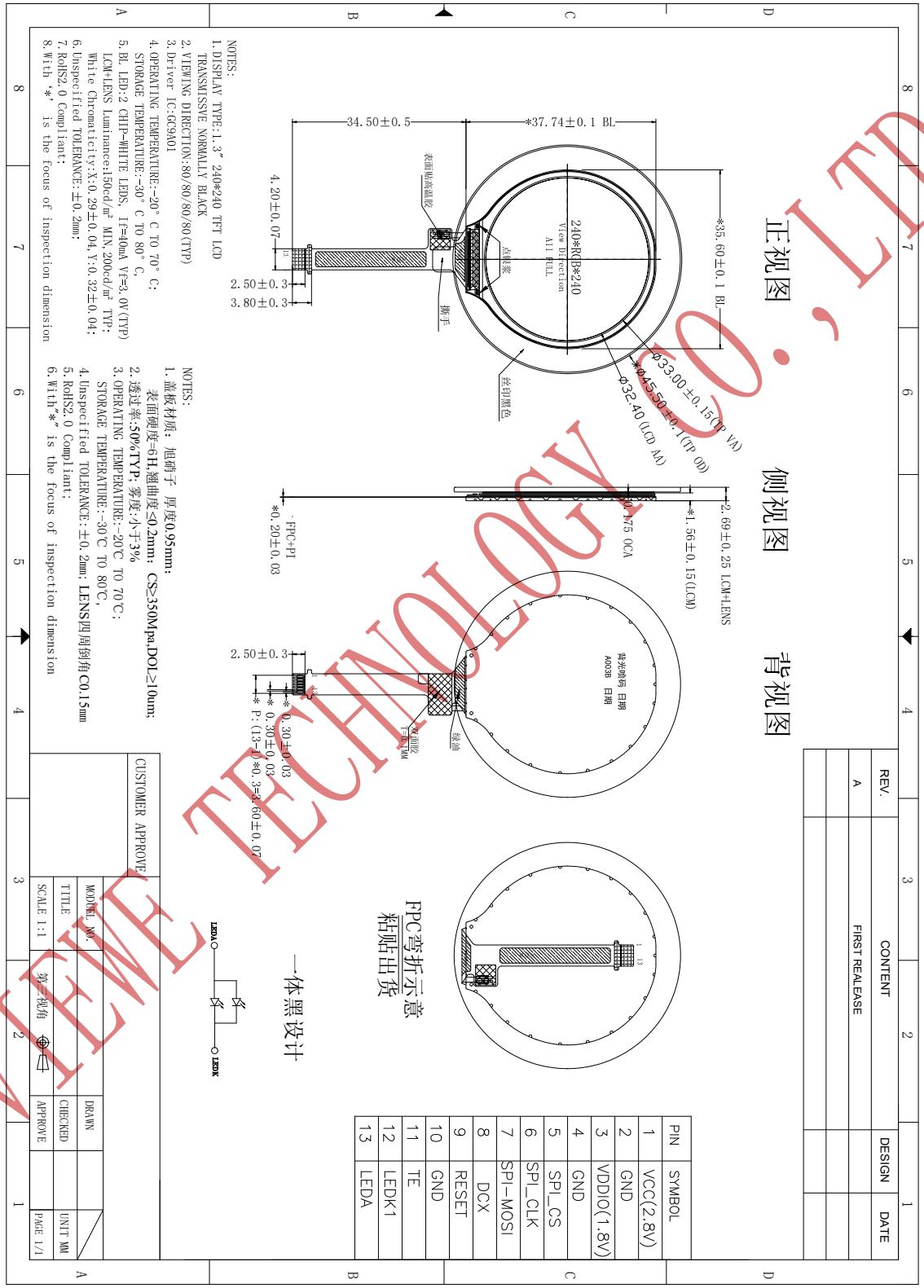
(Ta=+25°C,DGND=AVSS=0V)

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℃,the response time of liquid crystal (LC) becomes slower and the color of panel darker than normal one.

Note3: Temp. ≤ 60℃ , 90% RH MAX.
Temp. ＞60℃ , Absolute humidity shall be less than 90% RH.

# 3. MECHANICAL DRAWING



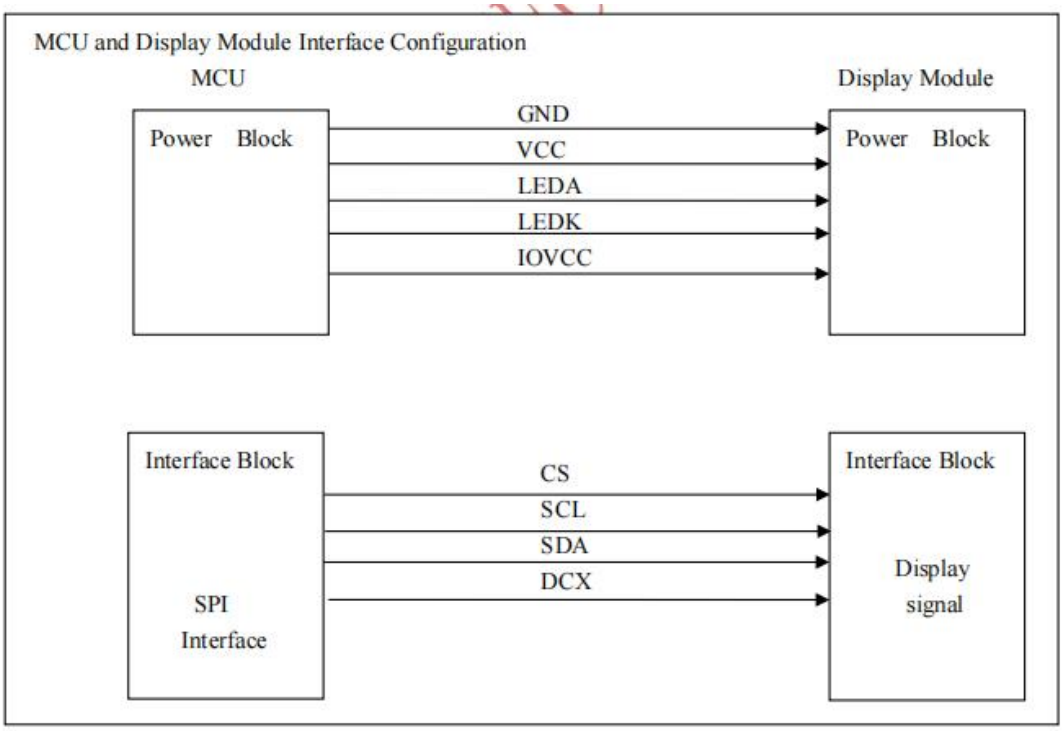
# 4. I/O CONNECTION & BLOCK DIAGRAM

## 4.1 I/O Connection

| Pin No. | Symbol | I/O | Description |
|---|---|---|---|
| 1 | VCC | P | Power supply for analog circuits |
| 2 | GND | P | Power Ground |
| 3 | VDDIO | P | Power supply for backlight cathode |
| 4 | GND | P | Power Ground |
| 5 | SPI_CS | I | Chip select pin for SPI interface |
| 6 | SPI_CLK | I | Clock select pin for SPI interface |
| 7 | SPI-MOSI | I/O | Data select pin for SPI interface |
| 8 | DCX | I | D/C select pin for SPI interface |
| 9 | RESET | I | The signal will reset the LCM, Signal is active low. |
| 10 | GND | P | Power Ground |
| 11 | TE | O | Tearing effect outputsignal. If not used, please let this pin open |
| 12 | LEDK | P | Power supply for backlight cathode |
| 13 | LEDA | P | Power supply for backlight anode |

I：Input；O：Output；P：Power

## 4.2 Block Diagram



# 5. ELECTRICAL CHARACTERISTICS

## 5.1 TFT-LCD Panel Driving Section

| Item | Symbol | Min. | Typ. | Max. | Unit | Remark |
|---|---|---|---|---|---|---|
| Power Supply1 Voltage | VCC | 2.5 | 2.8 | 3.3 | V | |
| Power Supply2 Voltage | IOVDD | 1.65 | 1.8 | 3.3 | | |
| Power Supply1 Current | $I_{VDD}$ | - | 50 | - | mA | Note1 |
| Power Supply2 Current | $I_{IOVCC}$ | | 10 | | | |
| Logic Input High Voltage | $V_{IH}$ | 0.7IOVCC | - | IOVCC | V | - |
| Logic Input Low Voltage | $V_{IL}$ | 0 | - | 0.3IOVCC | V | - |
| Panel Power Consumption | $P_{VDD}$ | - | 0.158 | - | Watt | Note1 |
| Module Power Consumption | $P_{LCM}$ | - | 0.278 | - | Watt | Note1,2 |

(Ta=+25°C, DGND=AVSS=0V)

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

Note2: $P_{LCM}$= $P_{VDD}$+ $P_{BL}$， About $P_{BL}$ information, inference to 5.2 Back Light Driving Section.

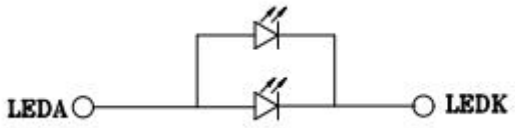
## 5.2 Back Light Driving Section

| 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 | $V_F$ | - | 3 | - | V | Note1 |
| Forward Current | $I_F$ | - | 40 | - | mA | Note1 |
| Backlight Power consumption | $P_{BL}$ | - | 0.12 | - | Watt | Note1 |
| LED life time | - | 30000 | - | - | Hrs | Note2 |
| LED Quantity | | | 2 | | PCS | |

(Ta=+25°C, DGND=AVSS=0V)

Note1: The LED driving condition is defined for

Note2:The “LED life time” is defined as the module brightness decrease to 50% of original brightness at $I_{LED}$=20mA(Per Led). The LED life time could be decreased if operating $I_{LED}$ is larger than 40mA.

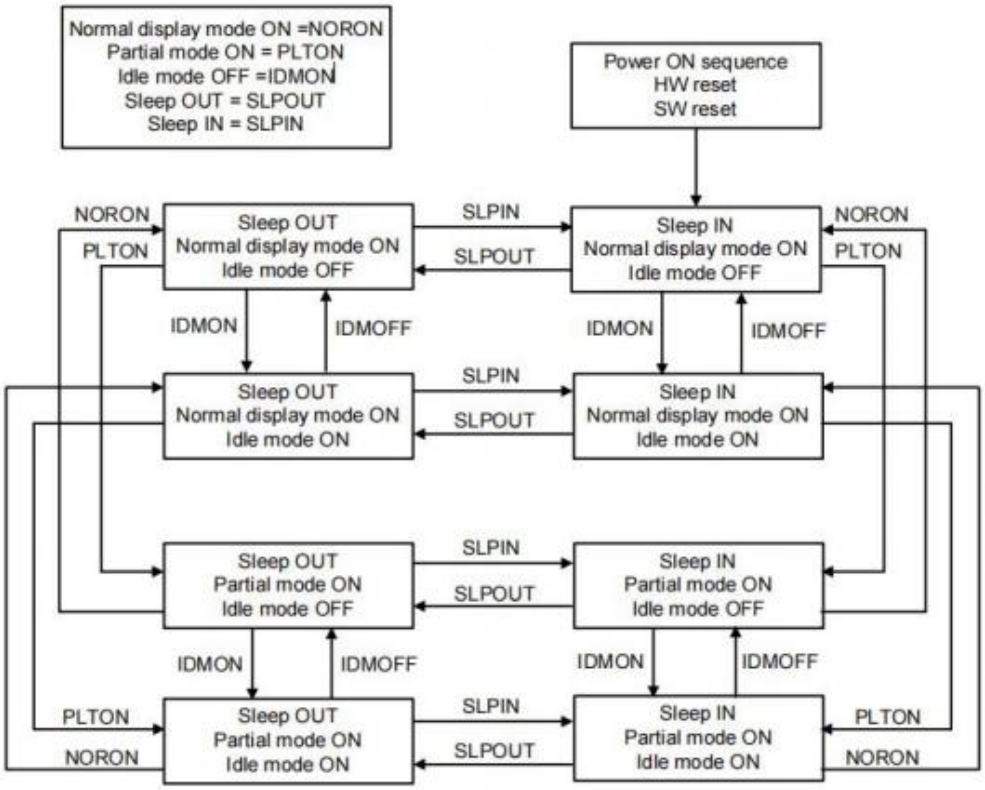


## 5.3 Power On/Off Sequence

6 level modes are defined they are in order of Maximum Power consumption to Minimum Power Consumption:

1. Normal Mode On (full display), Idle Mode Off, Sleep Out.
   In this mode, the display is able to show maximum 262,144 colors.
2. Partial Mode On, Idle Mode Off, Sleep Out.
   In this mode part of the display is used with maximum 262,144 colors.
3. Normal Mode On (full display), Idle Mode On, Sleep Out.
   In this mode, the full display area is used but with 8 colors.
4. Partial Mode On, Idle Mode On, Sleep Out.
   In this mode, part of the display is used but with 8 colors.
5. Sleep In Mode.
   In this mode, the DC : DC converter, Internal oscillator and panel driver circuit are stopped. Only the MCU interface and memory works with VDDI power supply. Contents of the memory are safe.
6. Power Off Mode.
   In this mode, both VDDB and VDDI are removed.

*Note1: Transition between modes 1-5 is controllable by MCU commands. Mode 6 is entered only when both Power supplies are removed.*




*Note 1: There is not any abnormal visual effect when there is changing from one power mode to another power mode.*

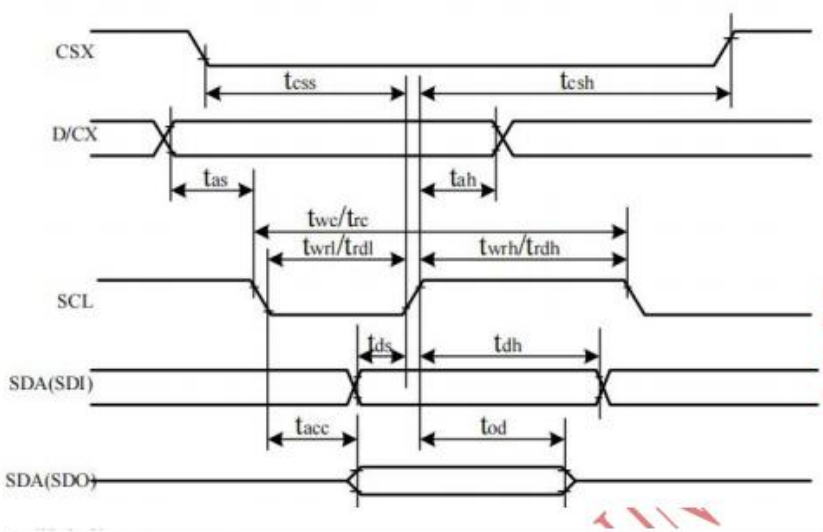
*Note 2: There is not any limitation, which is not specified by User, when there is changing from one power mode to another power mode.*

**Table 3-5 Power on/Reset/Wake Sequence Parameters**

| Parameter | Description | Min | Max | Units |
|---|---|---|---|---|
| Tris | Rise time from 0.1VDD to 0.9VDD | - | 3 | ms |
| Tpon | Time of starting to report point after powering on | 300 | - | ms |
| Tprt | Time of being low after powering on | 1 | - | ms |
| Trsi | Time of starting to report point after resetting | 300 | - | ms |
| Trst | Reset time | 5 | - | ms |

# 5.4 Timing Characteristics

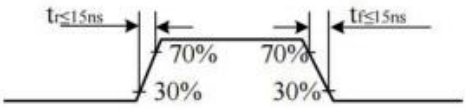
## 5.4.1 Timing for 4-Wire SPI Interface




| Signal | Symbol | Parameter | min | max | Unit | Description |
|---|---|---|---|---|---|---|
| CSX | tcss | Chip select time (Write) | 20 | - | ns | |
| | tcsh | Chip select hold time (Read) | 40 | - | ns | |
| SCL | twc | Serial Clock Cycle (Write) | 10 | - | ns | |
| | twrh | SCL "H" Pulse Width (Write) | 5 | - | ns | |
| | twrl | SCL "L" Pulse Width (Write) | 5 | - | ns | |
| | trc | Serial Clock Cycle (Read) | 150 | - | ns | |
| | trdh | SCL "H" Pulse Width (Read) | 60 | - | ns | |
| | trdl | SCL "L" Pulse Width (Read) | 60 | - | ns | |
| D/CX | tas | D/CX setup time | 10 | - | ns | |
| | tah | D/CX hold time (Write/Read) | 10 | - | ns | |
| SDA/SDI (Input) | tds | Data setup time (Write) | 5 | - | ns | |
| | tdh | Data hold time (Write) | 5 | - | ns | |
| SDA/SD0 (Output) | tacc | Access time (Read) | 10 | - | ns | |

*Note: Ta = 25 ℃, VDDI=1.65V to 3.3V, VDDB=2.5V to 3.3V, AGND=VSS=0V*

**Figure99.**



## 5.5 Timing Diagram

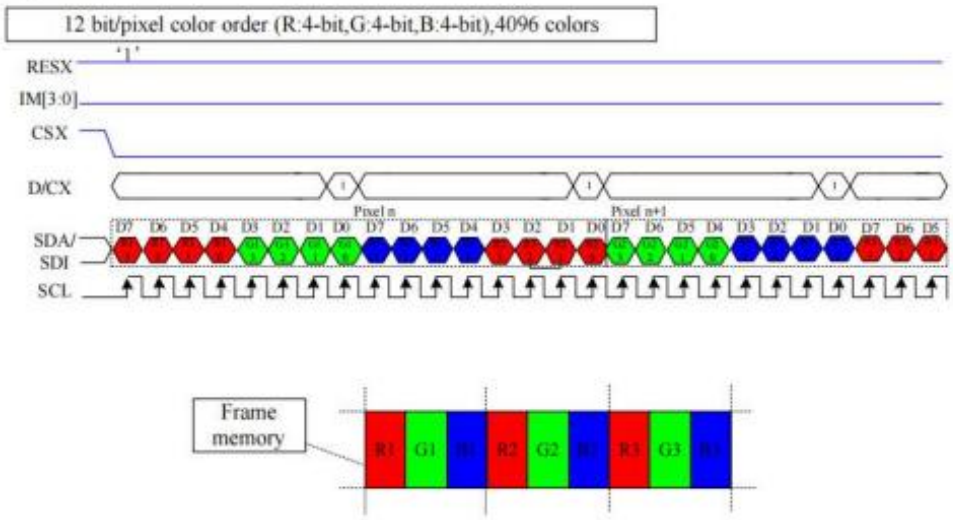
In 4-line serial interface, different display data format is available for two color depths supported by the LCM listed below.

-4k colors, RGB 4, 4, 4 -bits input.

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

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

**Figure44.**



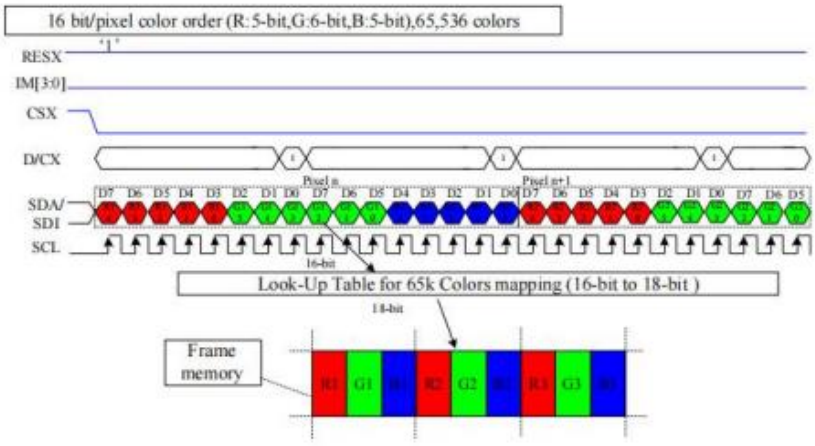

*Note 1: The pixel data with 12-bit color depth information.*

*Note 2: The most significant bits are: Rx3, Gx3 and Bx3.*

*Note 3: The least significant bits are: Rx0, Gx0 and Bx0.*

*Note 4: '-'= Don't care –Can be set "0" or "1".*

**Figure45.**



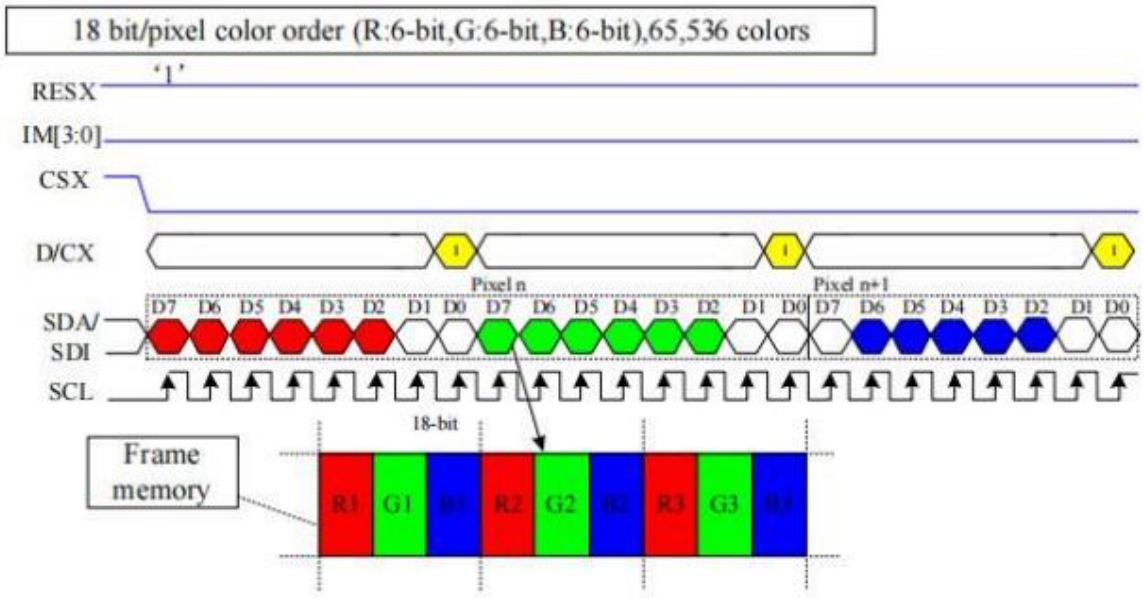

*Note 1: The pixel data with 16-bit color depth information.*

*Note 2: The most significant bits are: Rx4, Gx5 and Bx4.*

*Note 3: The least significant bits are: Rx0, Gx0 and Bx0.*

*Note 4: '-'= Don't care –Can be set "0" or "1".*

**Figure46.**




*Note 1: The pixel data with 18-bit color depth information.*

*Note 2: The most significant bits are: Rx5, Gx5 and Bx5.*

*Note 3: The least significant bits are: Rx0, Gx0 and Bx0.*

*Note 4: '-'= Don't care –Can be set "0" or "1".*

# 6. OPTICAL CHARACTERISTICS

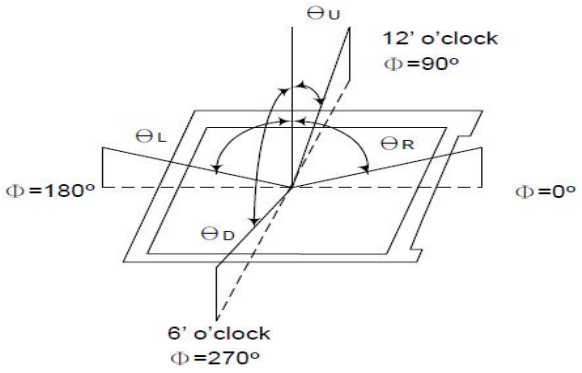
| Parameter | Symbol | Condition | Min. | Typ. | Max. | Unit | Remark |
|---|---|---|---|---|---|---|---|
| Contrast Ratio | C/R | θ = 0° | 900 | 1100 | - | - | Note(4) |
| NTSC Ratio | S | θ =0° | 55 | 60 | - | % | Note(7) |
| Luminance | L | θ =0° | 400 | 450 | - | cd/m2 | Note(5) |
| Luminance uniformity | $U_W$ | θ =0° | 70 | 80 | - | % | Note(3) |
| Response Time | $T_R$+ $T_F$ | 25 °C | - | 30 | 40 | ms | Note(2) |
| Color Coordination | $W_X$ | θ = 0° (Center) Normal viewing angle B/L On | -0.04 | 0.29 | +0.02 | NTSC (x,y) | Note(6) |
| | $W_Y$ | | | 0.32 | | | |
| | $R_X$ | | | 0.644 | | | |
| | $R_Y$ | | | 0.332 | | | |
| | $G_X$ | | | 0.323 | | | |
| | $G_y$ | | | 0.565 | | | |
| | $B_X$ | | | 0.134 | | | |
| | $B_Y$ | | | 0.124 | | | |
| Viewing Angle | θ L | C/R>10 | 80 | 85 | - | Degree | Note(1) |
| | θ R | | 80 | 85 | - | | |
| | θ U | | 80 | 85 | - | | |
| | θ D | | 80 | 85 | - | | |

Test Conditions:

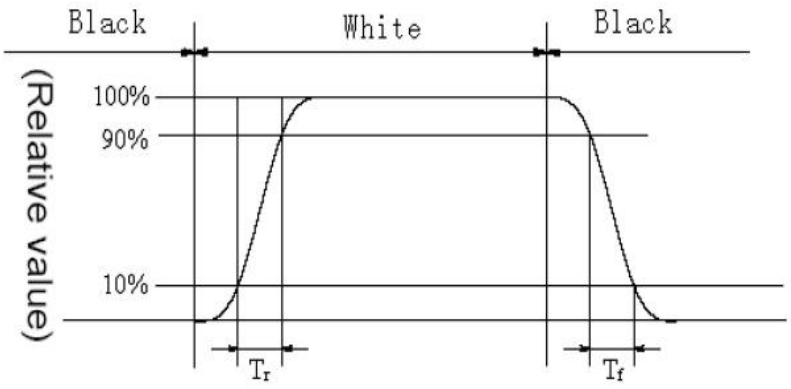
1. VDD=3.3V, $I_F$=20mA (Backlight current), the ambient temperature is+25°C.

2. The test systems refer to Note 8.

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

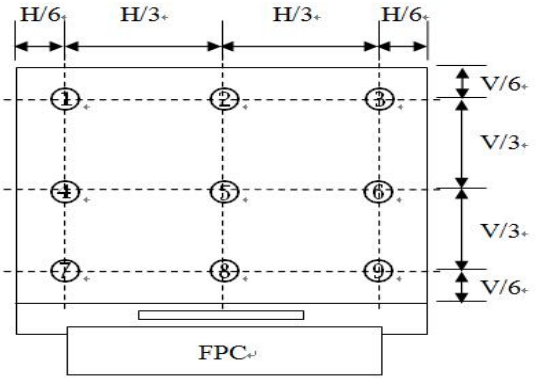



**Note2:** Definition of Response time: Sum of $T_R$ and $T_F$




**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.

$$\text{Luminance Uniformity} = \frac{\text{Min Luminance of white among 9-points}}{\text{Max Luminance of white among 9-points}} \text{ x100\%}$$




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

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

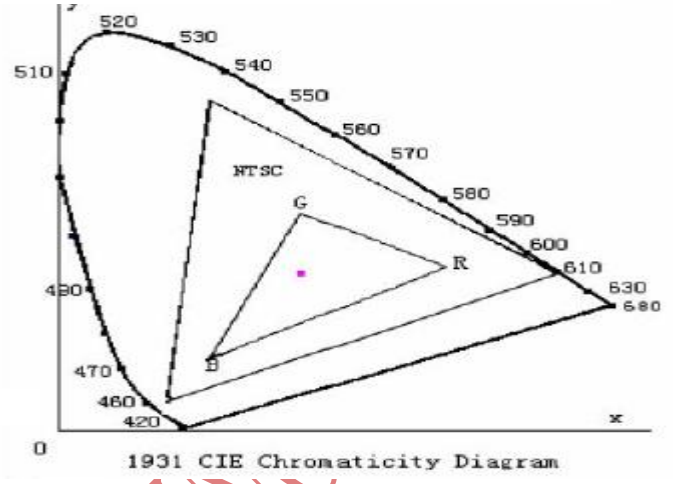
**Note 5:** Definition of Luminance: Center Luminance of white is defined as luminance values of 1point average across the LCD surface.

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

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

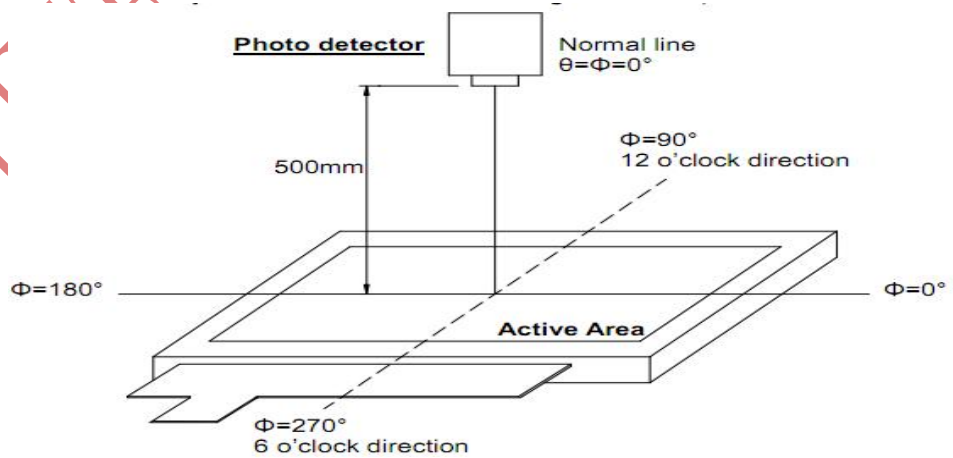
**Note 7:** Definition of NTSC ratio:

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




**Note 8:** Definition of 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.(Response time is measured by Photo detector TOPCON BM-7, Field of view: 1°/Height: 500mm.)



# 7. RELIABILITY

| Item | Test Condition | Remark |
|---|---|---|
| High Temperature Storage | Ta =+80°C / 96Hours | Note1,2,3 |
| Low Temperature Storage | Ta =-30°C / 96Hours | Note1,2,3 |
| High Temperature Operating | Ta =+70°C / 96Hours | Note1,2,3 |
| Low Temperature Operating | Ta =-20°C / 96Hours | Note1,2,3 |
| Temperature Cycle storage Test | -30°C/30min Δ+80°C /30min for 30cycles,Transfer time less than 5min | Note2,3 |
| Thermal humidity storage Test | 60°C x 90%RH / 96Hours | Note2,3 |
| Package Vibration Test | Frequency: 10Hz~55Hz,Amplitude:1.5mm, 1 hrs for each direction of X, Y, Z | 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