

|                  |      |                                                                                   |      |                  |
|------------------|------|-----------------------------------------------------------------------------------|------|------------------|
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# PRODUCT SPECIFICATION

VX400CSA-03

☐ Preliminary Specification

☐ Final Specification



**CUSTOMER:**

|                     |
|---------------------|
| <b>Made By:</b>     |
| <b>Checked By:</b>  |
| <b>Approved By:</b> |
| <b>Quality:</b>     |
| <b>Date:</b>        |
| <b>Note:</b>        |

|                     |
|---------------------|
| <b>Approved By:</b> |
| <b>Date:</b>        |
| <b>Note:</b>        |

## 2. Revision Record

| Date       | Rev.No | Page | Revision Items    | Prepared   |
|------------|--------|------|-------------------|------------|
| 2021-01-26 | V00    |      | The first release | SolonZhang |
|            |        |      |                   |            |
|            |        |      |                   |            |

## 3. General Specifications

VXT400MCSA-03 is a TFT-LCD module. It is composed of a TFT-LCD panel, driver IC, FPC, a back light unit . The 3.95'' display area contains 480X(RGB)x480 pixels and can display up to 262K colors. This product accords with ROHS environmental criterion.

| Item                  | Contents          | Unit    | Note |
|-----------------------|-------------------|---------|------|
| LCD Type              | TFT               | -       |      |
| Display color         | 262K              |         | 1    |
| Viewing Direction     | ALL               | O'Clock |      |
| Operating temperature | -20~+70           | ℃       |      |
| Storage temperature   | -30~+80           | ℃       |      |
| Module size           | 74.83X78.98X2.02  | mm      | 2    |
| Active Area(W×H)      | 71.856X70.176     | mm      |      |
| Number of Dots        | 480×480           | dots    |      |
| Controller            | ST7701S           | -       |      |
| Power Supply Voltage  | 2.8               | V       |      |
| Backlight             | 4S2P-LEDs (white) | pcs     |      |
| Weight                | ---               | g       |      |
| Interface             | RGB-18Bit+ SPI    | -       |      |

*Note 1: Color tune is slightly changed by temperature and driving voltage.*

*Note 2: Without FPC and Solder.*

[illegible]



## 5.1 Electrical Absolute Maximum Ratings.(Vss=0V ,Ta=25 °C)

| Item                 | Symbol | Min. | Max. | Unit | Note |
|----------------------|--------|------|------|------|------|
| Power Supply Voltage | VCI    | -0.3 | 4.6  | V    | 1.2  |

### Notes:

1. If the module is above these absolute maximum ratings. It may become permanently damaged. Using the module within the following electrical characteristic conditions are also exceeded, the module will malfunction and cause poor reliability.
2.  $V_{CI} > V_{SS}$  must be maintained.
3. Please be sure users are grounded when handing LCD Module.

## 5.2 Environmental Absolute Maximum Ratings.

| Item                | Storage |      | Operating |      | Note |
|---------------------|---------|------|-----------|------|------|
|                     | MIN.    | MAX. | MIN.      | MAX. |      |
| Ambient Temperature | -30°C   | 80°C | -20°C     | 70°C | 1,2  |
| Humidity            | -       | -    | -         | -    | 3    |

### Notes:

1. The response time will become lower when operated at low temperature.
2. Background color changes slightly depending on ambient temperature.  
The phenomenon is reversible.
3.  $T_a \leq 40^\circ\text{C}$ :85%RH MAX.  
 $T_a > 40^\circ\text{C}$ :Absolute humidity must be lower than the humidity of 85%RH at 40 °C.

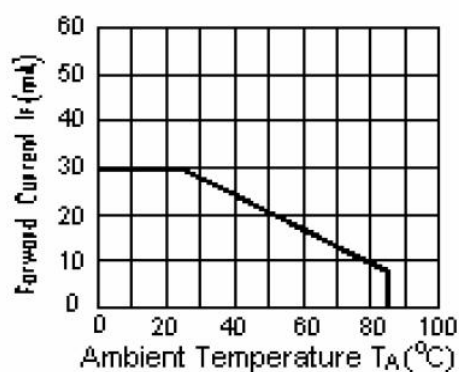
## 6. Electrical Specifications

### 6.1 Electrical characteristics( $V_{SS}=0V$ , $T_a=25^{\circ}C$ )

| Parameter     |     | Symbol   | Condition         | Min                | Typ | Max                | Unit | Note |
|---------------|-----|----------|-------------------|--------------------|-----|--------------------|------|------|
| Power supply  |     | VCI      | $T_a=25^{\circ}C$ | -                  | 2.8 | 3.3                | V    |      |
| Input voltage | 'H' | $V_{IH}$ | $V_{CI}=2.8V$     | $0.7 \cdot V_{CI}$ | -   | $V_{CI}$           | V    |      |
|               | 'L' | $V_{IL}$ | $V_{CI}=2.8V$     | 0                  | -   | $0.3 \cdot V_{CI}$ | V    |      |

### 6.2 LED backlight specification( $V_{SS}=0V$ , $T_a=25^{\circ}C$ )

| Item           | Symbol       | Condition  | Min  | Typ  | Max  | Unit  | Note |
|----------------|--------------|------------|------|------|------|-------|------|
| Supply voltage | $V_f$        | $I_f=40mA$ | 10.8 | 12.0 | 13.2 | V     |      |
| Uniformity     | $\Delta B_p$ | $I_f=40mA$ | 75   | 80   | -    | %     |      |
| Life Time      | time         | $I_f=40mA$ | 20K  | -    |      | hours | 1    |



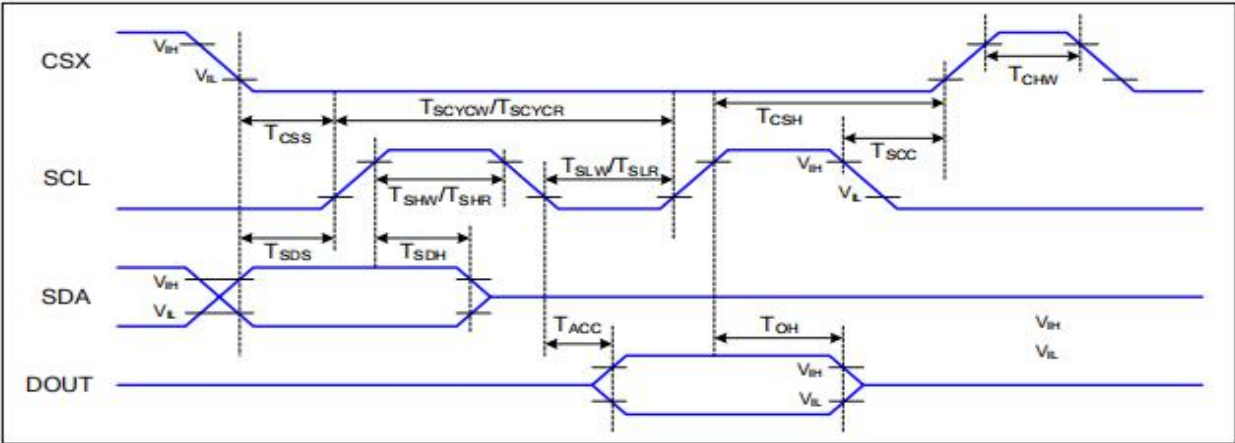
Note 1: Brightness to be decreased to 50% of the initial value at ambient temperature  $T_a=25^{\circ}C$

## 6.3 Interface signals

| Pin No. | Symbol    | I/O | Function                                               |
|---------|-----------|-----|--------------------------------------------------------|
| 1       | LEDA      | P   | LED anode.                                             |
| 2       | LEDK1     | P   | LED cathode.                                           |
| 3       | LEDK2     | P   | LED cathode.                                           |
| 4       | GND       | P   | Ground.                                                |
| 5       | VCI       | P   | Power Supply for logic.                                |
| 6       | RESET     | I   | Reset signal,Signal is active low.                     |
| 7-8     | NC        | -   | No connection.                                         |
| 9       | SDA       | I   | SPI interface data input /output pin.                  |
| 10      | SCK       | I   | Serial interface clock .                               |
| 11      | CS        | I   | Chip select input pin.                                 |
| 12      | PCLK      | I   | Dot clock signal for RGB interface operation.          |
| 13      | DE        | I   | Data enable signal for RGB interface operation.        |
| 14      | VSYNC     | I   | Frame synchronizing signal for RGB interface           |
| 15      | HSYNC     | I   | Line synchronizing signal for RGB interface operation. |
| 16-21   | DB0-DB5   | I   | B0-B5 data input .                                     |
| 22-27   | DB6-DB11  | I   | G0-G5 data input.                                      |
| 28-33   | DB12-DB17 | I   | R0-R5 data input .                                     |
| 34      | GND       | P   | Ground.                                                |
| 35-39   | NC        | -   | No connection.                                         |
| 40      | GND       | P   | Ground.                                                |

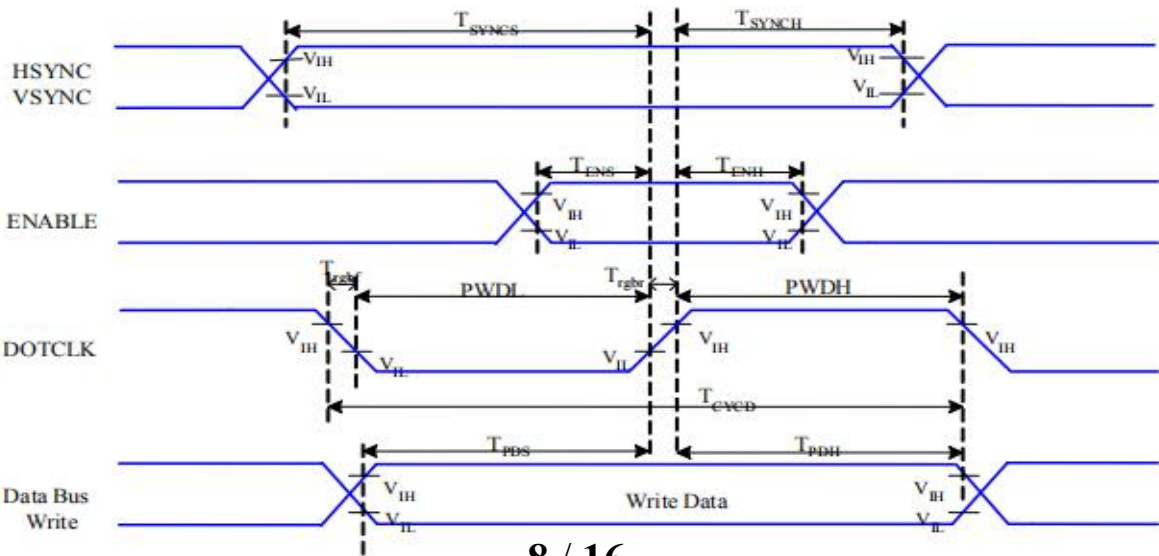
6.4 AC Characteristics

Serial Interface Characteristics (3-line serial):



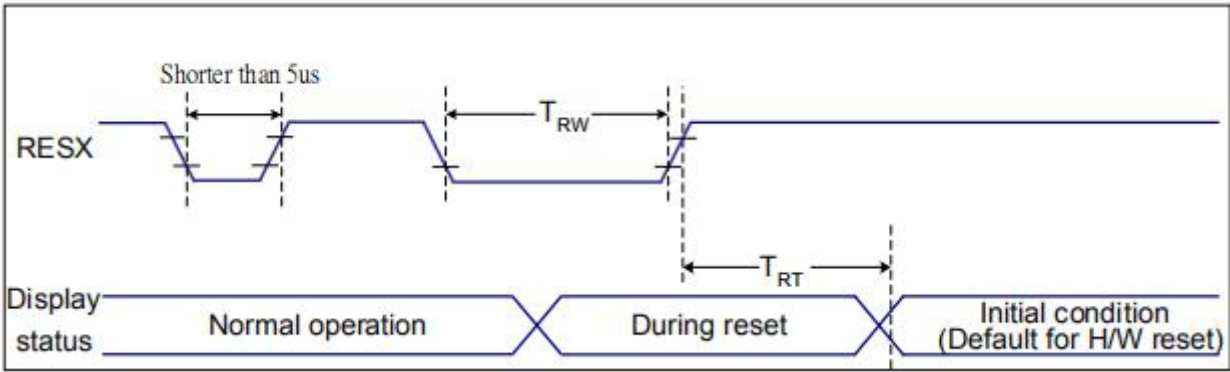
| Signal       | Symbol      | Parameter                      | Min | Max | Unit | Description |
|--------------|-------------|--------------------------------|-----|-----|------|-------------|
| CSX          | $T_{CSS}$   | Chip select setup time (write) | 15  |     | ns   |             |
|              | $T_{CSH}$   | Chip select hold time (write)  | 15  |     | ns   |             |
|              | $T_{CSS}$   | Chip select setup time (read)  | 60  |     | ns   |             |
|              | $T_{SOH}$   | Chip select hold time (read)   | 60  |     | ns   |             |
|              | $T_{CHW}$   | Chip select "H" pulse width    | 40  |     | ns   |             |
| SCL          | $T_{SCYCW}$ | Serial clock cycle (Write)     | 66  |     | ns   |             |
|              | $T_{SHW}$   | SCL "H" pulse width (Write)    | 15  |     | ns   |             |
|              | $T_{SLW}$   | SCL "L" pulse width (Write)    | 15  |     | ns   |             |
|              | $T_{SCYCR}$ | Serial clock cycle (Read)      | 150 |     | ns   |             |
|              | $T_{SHR}$   | SCL "H" pulse width (Read)     | 60  |     | ns   |             |
|              | $T_{SLR}$   | SCL "L" pulse width (Read)     | 60  |     | ns   |             |
| SDA<br>(DIN) | $T_{SDS}$   | Data setup time                | 10  |     | ns   |             |
|              | $T_{SDH}$   | Data hold time                 | 10  |     | ns   |             |

RGB Interface Timing Characteristics



| Signal       | Symbol       | Parameter                     | MIN | MAX | Unit | Description |
|--------------|--------------|-------------------------------|-----|-----|------|-------------|
| HSYNC, VSYNC | $T_{SYNCS}$  | VSYNC, HSYNC Setup Time       | 5   | -   | ns   |             |
| ENABLE       | $T_{ENS}$    | Enable Setup Time             | 5   | -   | ns   |             |
|              | $T_{ENH}$    | Enable Hold Time              | 5   | -   | ns   |             |
| DOTCLK       | PWDH         | DOTCLK High-level Pulse Width | 15  | -   | ns   |             |
|              | PWDL         | DOTCLK Low-level Pulse Width  | 15  | -   | ns   |             |
|              | $T_{CYCD}$   | DOTCLK Cycle Time             | 33  | -   | ns   |             |
|              | Trghr, Trghf | DOTCLK Rise/Fall time         | -   | 15  | ns   |             |
| DB           | $T_{PDS}$    | PD Data Setup Time            | 5   | -   | ns   |             |
|              | $T_{PDH}$    | PD Data Hold Time             | 5   | -   | ns   |             |

6.5 Reset Timing



| 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   |

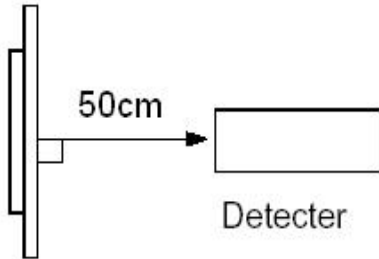
## 7. Optical Characteristics

| Item                    | Symbol                         |   | Condition                              | Min.         | Typ. | Max.         | Unit              | Note |
|-------------------------|--------------------------------|---|----------------------------------------|--------------|------|--------------|-------------------|------|
| Brightness              | Bp                             |   | $\theta=0^{\circ}$<br>$\phi=0^{\circ}$ | -            | 400  | -            | Cd/m <sup>2</sup> | 1    |
| Uniformity              | $\Delta$ Bp                    |   |                                        | 75           | 80   | -            | %                 | 1,2  |
| Viewing Angle           | 3:00                           |   | Cr≥10                                  | -            | 80   | -            | Deg               | 3    |
|                         | 6:00                           |   |                                        | -            | 80   | -            |                   |      |
|                         | 9:00                           |   |                                        | -            | 80   | -            |                   |      |
|                         | 12:00                          |   |                                        | -            | 80   | -            |                   |      |
| Contrast Ratio          | Cr                             |   | $\theta=0^{\circ}$<br>$\phi=0^{\circ}$ | 640          | 800  | -            | -                 | 4    |
| Response Time           | T <sub>r</sub> +T <sub>f</sub> |   |                                        | -            | 25   | 35           | ms                | 5    |
| Color of CIE Coordinate | W                              | x | $\theta=0^{\circ}$<br>$\phi=0^{\circ}$ | Typ<br>-0.05 | TBD  | Typ<br>+0.05 | -                 | 1,6  |
|                         |                                | y |                                        |              | TBD  |              | -                 |      |
|                         | R                              | x |                                        |              | TBD  |              | -                 |      |
|                         |                                | y |                                        |              | TBD  |              | -                 |      |
|                         | G                              | x |                                        |              | TBD  |              | -                 |      |
|                         |                                | y |                                        |              | TBD  |              | -                 |      |
|                         | B                              | x |                                        |              | TBD  |              | -                 |      |
|                         |                                | y |                                        |              | TBD  |              | -                 |      |
| NTSC Ratio              | S                              |   |                                        | 55           | 60   | -            | %                 |      |

*Note: The parameter is slightly changed by temperature, driving voltage and materiel*

*Note 1: The data are measured after LEDs are turned on for 5 minutes. LCM displays full white. The brightness is the average value of 9 measured spots. Measurement equipment*

BM-7



(Φ5mm)

*Measuring condition:*

- *Measuring surroundings: Dark room.*
- *Measuring temperature:  $T_a=25^{\circ}\text{C}$ .*
- *Adjust operating voltage to get optimum contrast at the center of the display.*

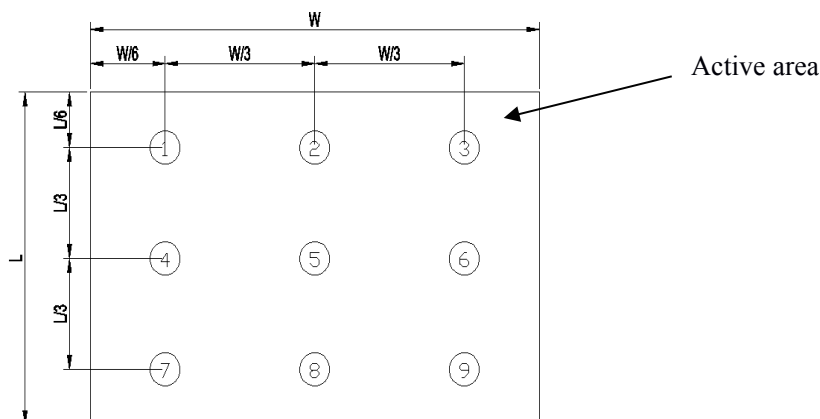
*Measured value at the center point of LCD panel after more than 5 minutes while backlight turning on.*

*Note 2: The luminance uniformity is calculated by using following formula.*

$$\Delta Bp = Bp (\text{Min.}) / Bp (\text{Max.}) \times 100 (\%)$$

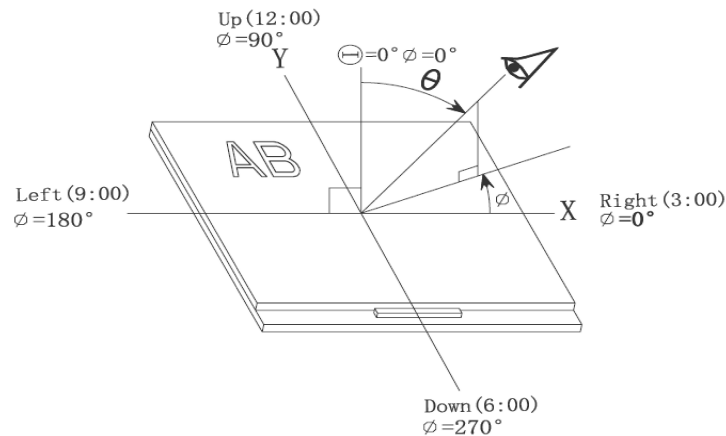
*$Bp (\text{Max.})$  = Maximum brightness in 9 measured spots*

*$Bp (\text{Min.})$  = Minimum brightness in 9 measured spots.*

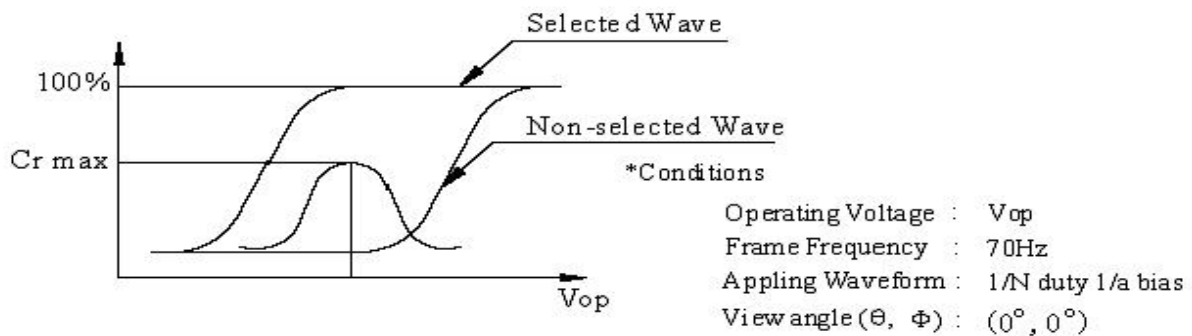


Note 3: The definition of viewing angle:

Refer to the graph below marked by  $\theta$  and  $\Phi$



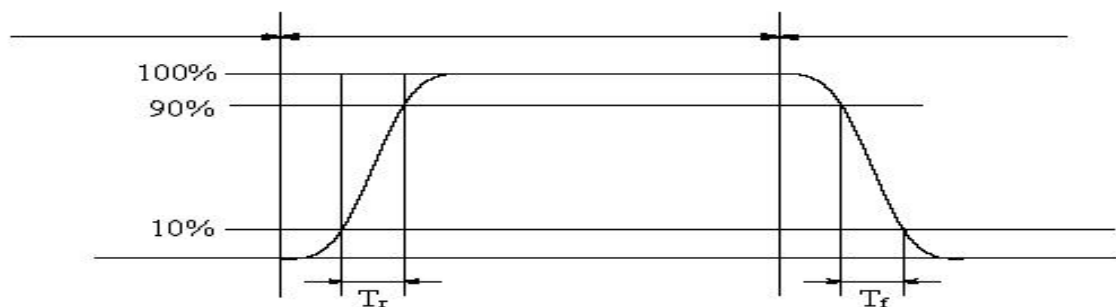
Note 4: Definition of contrast ratio.( Test LCD using DMS501)



$$\text{Contrast ratio}(Cr) = \frac{\text{Brightness of selected dots}}{\text{Brightness of non-selected dots}}$$

Note 5: Definition of Response time. (Test LCD using DMS501):

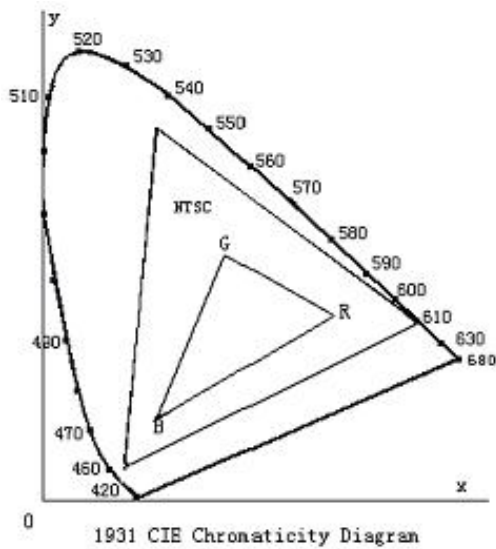
The output signals of photo detector are measured when the input signals are changed from "black" to "white" (rising time) and from "white" to "black" (falling time), respectively. The response time is defined as the time interval between the 10% and 90% of amplitudes. Refer to figure as below.



The definition of response time



Note 6: Definition of Color of CIE Coordinate and NTSC Ratio.

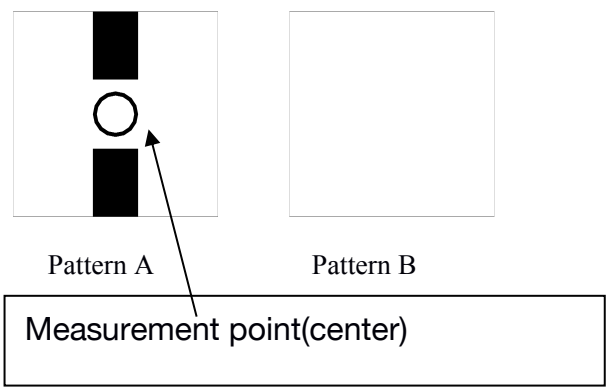


Color gamut:

$$S = \frac{\text{area of RGB triangle}}{\text{area of NTSC triangle}} \times 100\%$$

Note 7: Definition of cross talk.

Cross talk ratio(%)=|pattern A Brightness-pattern B Brightness|/pattern A Brightness\*100



Electric volume value=3F+/-3Hex

## 8. Reliability Test Items and Criteria

| Test Item                              | Test condition                                                                                                                                    | Remark         |
|----------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------|----------------|
| High Temperature Storage               | Ta = 80℃ 96hrs                                                                                                                                    | Note1,Note3, 4 |
| Low Temperature Storage                | Ta = -30℃ 96hrs                                                                                                                                   | Note1,Note3, 4 |
| High Temperature Operation             | Ts = 70℃ 96hrs                                                                                                                                    | Note2,Note3, 4 |
| Low Temperature Operation              | Ta = -20℃ 96hrs                                                                                                                                   | Note1,Note3, 4 |
| Operation at High Temperature/Humidity | +60℃, 90%RH 96hrs                                                                                                                                 | Note3, 4       |
| Thermal Shock                          | -30℃/30 min ~ +80℃/30 min for a total 10 cycles, Start with cold temperature and end with high temperature.                                       | Note3, 4       |
| Vibration Test                         | Frequency range:10~55Hz<br>Stroke:1.5mm<br>Sweep:10Hz~55Hz~10Hz<br>2 hours for each direction of X. Y. Z.<br>(6 hours for total)                  |                |
| Mechanical Shock                       | 100G 6ms,±X, ±Y, ±Z 3 times for each direction                                                                                                    |                |
| Package Vibration Test                 | Random Vibration :<br>0.015G*G/Hz from 5-200HZ,<br>-6dB/Octave<br>from 200-500HZ<br>2 hours for each direction of X. Y. Z.<br>(6 hours for total) |                |
| Package Drop Test                      | Height:60cm 1 corner, 3 edges, 6 surfaces                                                                                                         |                |
| Electro Static Discharge               | ±2KV, Human Body Mode,<br>100pF/1500Ω                                                                                                             |                |

Note 1: Ta is the ambient temperature of samples.

Note 2: Ts is the temperature of panel's surface.

Note 3: 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 don't guarantee all of the cosmetic specification.

Note 4: Before cosmetic and function test, the product must have enough recovery time,at least 2 hours at room temperature

## **9. Precautions for Use of LCD Modules**

### **9.1 Handling Precautions**

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

9.1.2 *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.*

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

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

9.1.5 *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

9.1.6 *Do not attempt to disassemble the LCD Module.*

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

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

*a. Be sure to ground the body when handling the LCD Modules.*

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

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

*d. 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.*

## **9.2 Storage precautions**

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

9.2.2 *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%*

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

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