

**Display Elektronik GmbH**

# DATA SHEET

**TFT MODULE**

**DEM 340800A VMH-PW-N**

**3,46“ TFT**

Product Specification

Version: 0

27.12.2024



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**\* Description**

This is a color active matrix TFT (Thin Film Transistor) LCD (liquid crystal display) that uses amorphous silicon TFT as a switching device. This module is composed of a Transmissive type TFT-LCD Panel, driver circuit, back-light unit. The resolution of a 3.46 " TFT-LCD contains 340xRGBx800 Pixels, and can display up to 65k/262k colors.

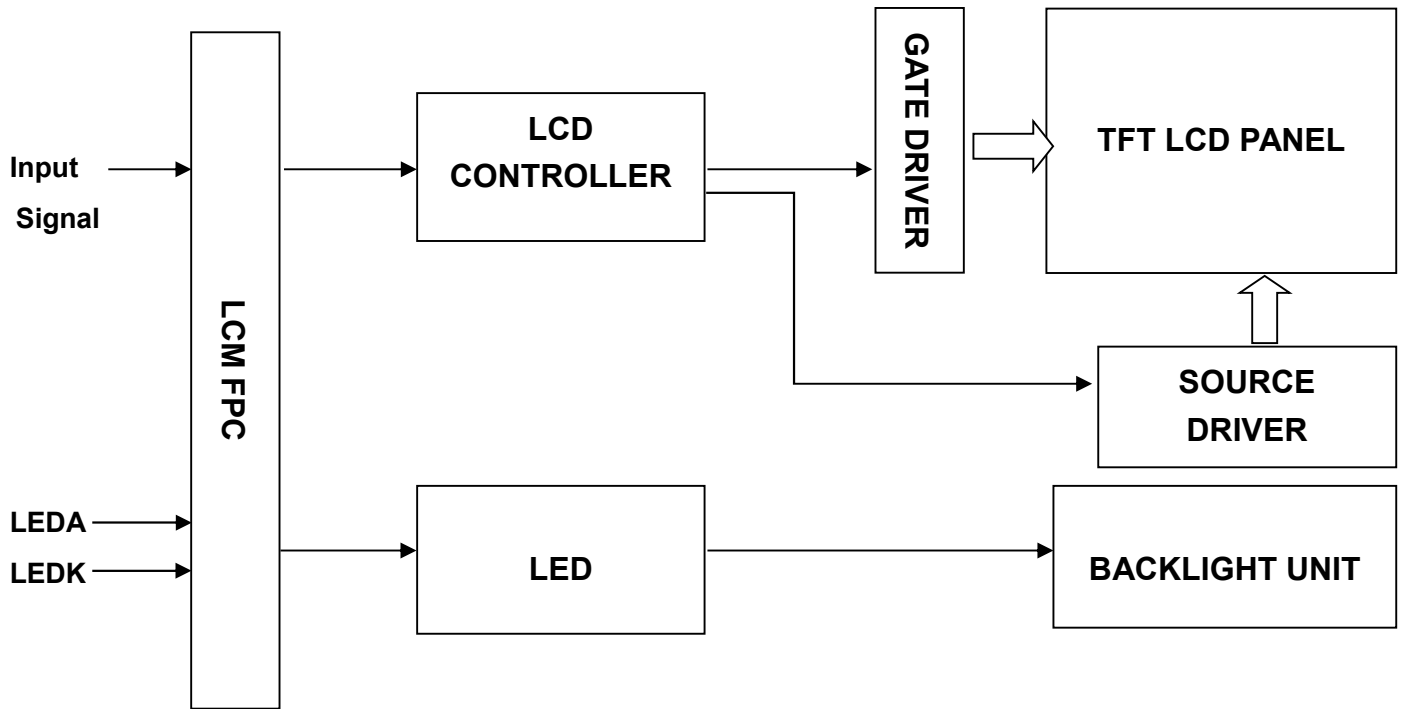
**\* Features**

| General Information Items | Specification                      | Unit    | Note |
|---------------------------|------------------------------------|---------|------|
|                           | Main Panel                         |         |      |
| Display Area(AA)          | 33.97 x *81.00 (3.46 Inch)         | mm      | -    |
| Driver Element            | TFT Active Matrix                  | -       | -    |
| Display Colors            | 65k / 262k                         | colors  | -    |
| Number of Pixels          | 340 x RGB x 800                    | dots    | -    |
| Pixel Arrangement         | RGB Vertical Stripe                | -       | -    |
| Viewing Angle             | ALL                                | o'clock | -    |
| Controller IC             | ST7701S (Sitronix)                 | -       | -    |
| LCM Interface             | 3-SPI + 16BIT-RGB                  | -       | -    |
| Display Mode              | IPS, Transmissive / Normally Black | -       | -    |
| Operating Temperature     | -20°C ~ +70°C                      | °C      | -    |
| Storage Temperature       | -30°C ~ +80°C                      | °C      | -    |

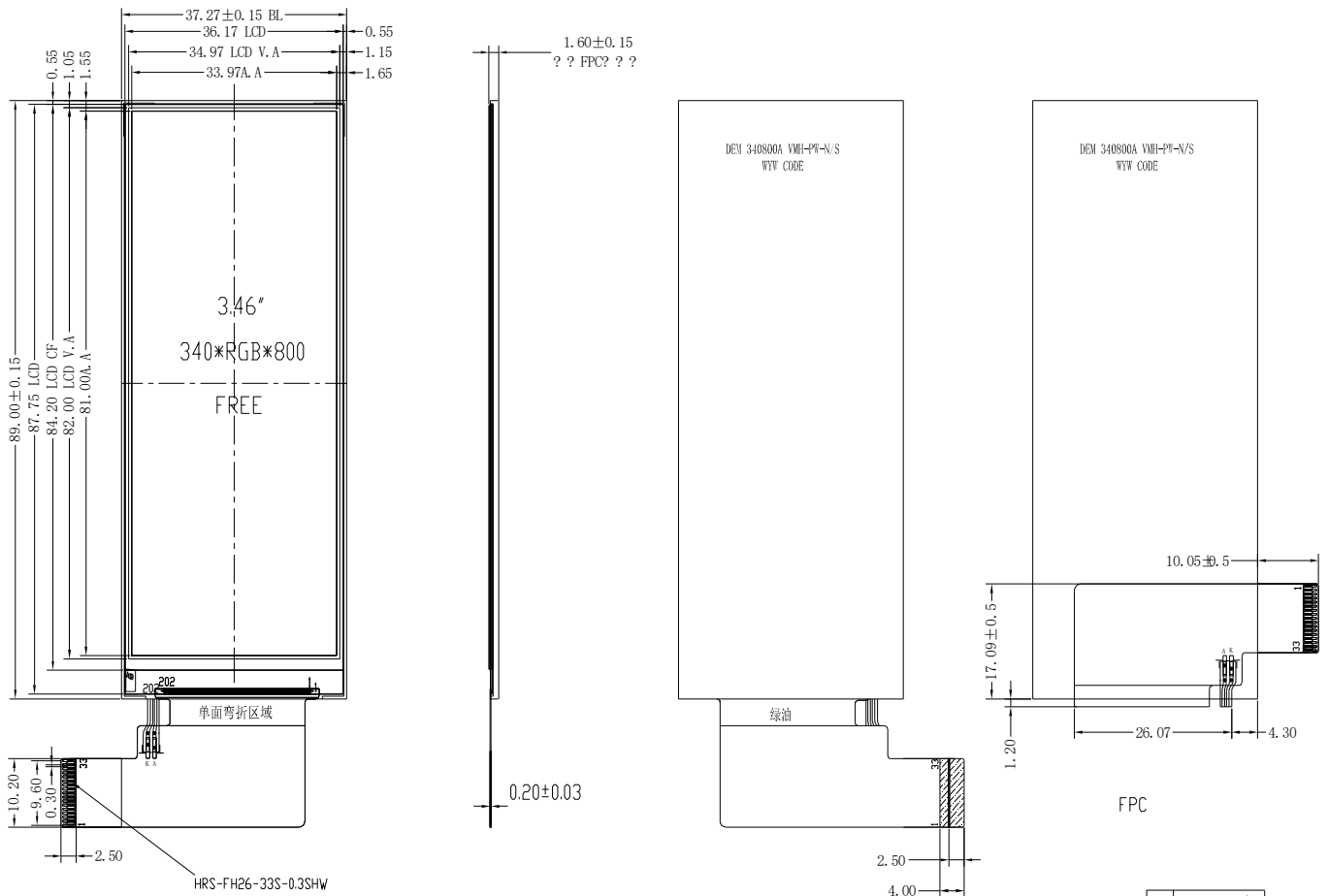
**\* Mechanical Information**

| Item        |               | Min. | Typ.  | Max. | Unit | Note |
|-------------|---------------|------|-------|------|------|------|
| Module Size | Horizontal(H) | -    | 37.27 | -    | mm   | -    |
|             | Vertical(V)   | -    | 89.0  | -    | mm   | -    |
|             | Depth(D)      | -    | 1.6   | -    | mm   | -    |
| Weight      |               | -    | 10    | -    | g    | -    |

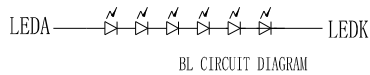
1. Block Diagram



2. Outline Dimension



|                       |   |
|-----------------------|---|
| LCD Type              | 3.46" TFT Transmissive, Normally black, IPS |
| Resolution            | 340(RGB)*800                                |
| View Direction        | All O'CLOCK                                 |
| Driver IC             | ST7701S                                     |
| Color Depth           | 16.7M                                       |
| Interface Types       | TTL(RGB24-bit)                              |
| Operating voltage     | 3.3V  |
| TP/Lens               | Without                                     |
| Backlight LEDs        | 6 LEDs 20mA, 19.2V                          |
| Surface luminance     | 400 cd/m <sup>2</sup>                       |
| Operating temperature | -20°C~70°C                                  |
| Storage Temperature   | -30°C~80°C                                  |
| Storage Humidity      | 60%~90% max                                 |



| Pin | DESCRIPTION |
|-----|-------------|
| 1   | GND         |
| 2   | VCC         |
| 3   | IDVCC       |
| 4   | NCSDD       |
| 5   | SDA         |
| 6   | SCL         |
| 7   | CS          |
| 8   | RESET       |
| 9   | DB15        |
| 10  | DB14        |
| 11  | DB13        |
| 12  | DB12        |
| 13  | DB11        |
| 14  | DB10        |
| 15  | DB9         |
| 16  | DB8         |
| 17  | DB7         |
| 18  | DB6         |
| 19  | DB5         |
| 20  | DB4         |
| 21  | DB3         |
| 22  | DB2         |
| 23  | DB1         |
| 24  | DB0         |
| 25  | DE          |
| 26  | PCLK        |
| 27  | HSYNC       |
| 28  | VSYNC       |
| 29  | LEDA        |
| 30  | LEDK        |
| 31  | NC          |
| 32  | NC          |
| 33  | NC          |

### 3. Input Terminal Pin Assignment

| NO.   | SYMBOL   | DISCRIPTION   | I/O |
|-------|----------|---|-----|
| 1     | GND      | Ground.   | P   |
| 2     | VCC      | Supply voltage (3.3V).  | P   |
| 3     | IOVC     | Supply Voltage (Logic)(1.8~3.3V).   | P   |
| 4     | NC(SDO)  | -   | -   |
| 5     | SDA      | Serial data input/output bidirectional pin for SPI Interface.   | I/O |
| 6     | SCL      | SCL: Serial clock input for SPI interface.  | I   |
| 7     | CS       | A chip select signal<br>Low: the chip is selected and accessible<br>High: the chip is not selected and not accessible                         | I   |
| 8     | RESET    | The external reset input<br>Initializes the chip with a low input. Be sure to execute a power-on reset after supplying power.                 | I   |
| 9-24  | DB15-DB0 | 16-bit parallel data bus for RGB Interface.   | I   |
| 25    | DE       | Data enable signal for RGB interface operation<br>Low: access enabled<br>High: access inhibited<br>Fix to IOVCC or GND level when not in use. | I   |
| 26    | PCLK     | Dot clock signal for RGB interface operation<br>Fix to IOVCC or GND level when not in use.  | I   |
| 27    | HSYNC    | Line synchronizing signal for RGB interface operation<br>Fix to IOVCC or GND level when not in use.   | I   |
| 28    | VSNC     | Frame synchronizing signal for RGB interface operation<br>Fix to IOVCC or GND level when not in use.  | I   |
| 29    | LEDA     | Anode pin of backlight.   | P   |
| 30    | LEDK     | Cathode pin of backlight.   | P   |
| 31-33 | NC       | -   | -   |

4. LCD Optical Characteristics

4.1 Optical Specification

| Item                         | Symbol  | Condition                         | Min.                         | Typ.   | Max.   | Unit.  | Note   |         |
|------------------------------|---------|-----------------------------------|------------------------------|--------|--------|--------|--------|---------|
| Contrast Ratio               | CR      | Θ=0<br>Normal<br>Viewing<br>Angle | --                           | 600    | --     |        | (1)(2) |         |
| Response Time                | Rising  |                                   | T <sub>R+T<sub>F</sub></sub> | --     | 30     | 50     | msec   | (1)(3)  |
|                              | Falling |                                   |                              |        |        |        |        |         |
| Uniformity                   | S(%)    |                                   |                              | --     | 60     | --     | %      | C-light |
| Color Filter<br>Chromaticity | White   |                                   | W <sub>X</sub>               | 0.2184 | 0.2584 | 0.2984 |        | (1)(4)  |
|                              |         |                                   | W <sub>Y</sub>               | 0.2718 | 0.3118 | 0.3518 |        |         |
|                              | Red     |                                   | R <sub>X</sub>               | 0.5864 | 0.6264 | 0.6664 |        |         |
|                              |         |                                   | R <sub>Y</sub>               | 0.3058 | 0.3458 | 0.3858 |        |         |
|                              | Green   |                                   | G <sub>X</sub>               | 0.2857 | 0.3257 | 0.3657 |        |         |
|                              |         |                                   | G <sub>Y</sub>               | 0.5066 | 0.5466 | 0.5866 |        |         |
|                              | Blue    | B <sub>X</sub>                    | 0.1083                       | 0.1483 | 0.1883 |        |        |         |
|                              |         | B <sub>Y</sub>                    | 0.0452                       | 0.0852 | 0.1252 |        |        |         |
| Viewing Angle                | Hor.    | Θ <sub>L</sub>                    | --                           | 80     | --     |        | (1)(4) |         |
|                              |         | Θ <sub>R</sub>                    | --                           | 80     | --     |        |        |         |
|                              | Ver.    | Θ <sub>U</sub>                    | --                           | 80     | --     |        |        |         |
|                              |         | Θ <sub>D</sub>                    | --                           | 80     | --     |        |        |         |
| Option View Direction        | ALL     |                                   |                              |        |        |        | (5)    |         |

\*The data comes from the LCD specification.

**Measuring Condition**

Measuring surrounding: dark room

Ambient temperature: 25°C ± 2°C

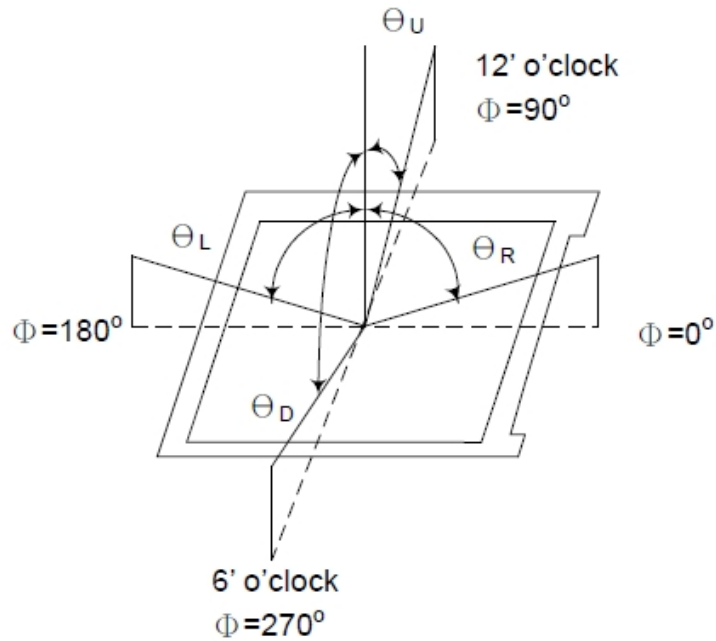
15min. warm-up time.

**Measuring Equipment**

FPM520 of Westar Display technologies, INC., which utilized SR-3 for Chromaticity and BM-5A for other optical characteristics.



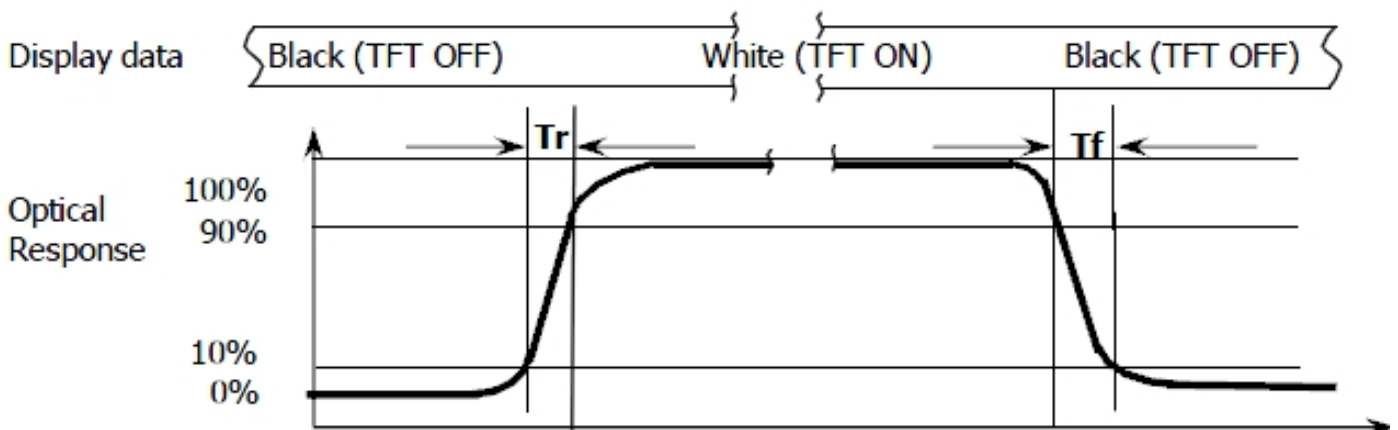
**Note (1):** Definition of Viewing Angle:



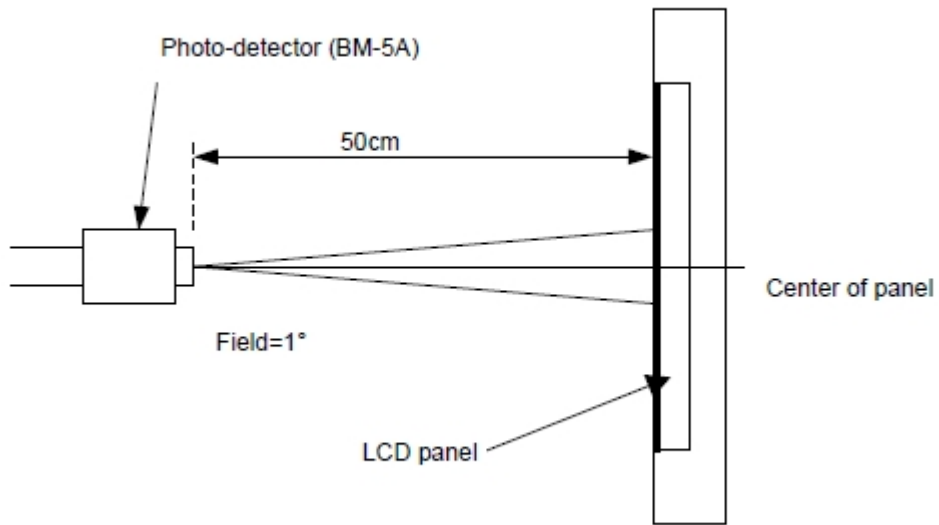
**Note (2):** Definition of Contrast Ratio(CR) :measured at the center point of panel

$$CR = \frac{\text{Luminance with all pixels white}}{\text{Luminance with all pixels black}}$$

**Note (3):** Response Time



**Note (4):** Definition of optical measurement setup



## 5. Electrical Characteristics

### 5.1 Absolute Maximum Rating

| Characteristics                  | Symbol          | Min. | Max. | Unit | Note  |
|----------------------------------|-----------------|------|------|------|-------|
| Digital Supply Voltage           | VCC             | -0.3 | 4.6  | V    | Note1 |
| Digital Interface Supply Voltage | IOVCC           | -0.3 | 4.6  | V    | -     |
| Operating Temperature            | T <sub>OP</sub> | -20  | +70  | °C   | -     |
| Storage Temperature              | T <sub>ST</sub> | -30  | +80  | °C   | -     |

NOTE1: If the absolute maximum rating of even is one of the above parameters is exceeded even momentarily, the quality of the product may be degraded. Absolute maximum ratings, therefore, specify the values exceeding which the product may be physically damaged. Be sure to use the product within the range of the absolute maximum ratings.

### 5.2 DC Electrical Characteristics

| Characteristics                  | Symbol          | Min.      | Typ. | Max.      | Unit | Note |
|----------------------------------|-----------------|-----------|------|-----------|------|------|
| Digital Supply Voltage           | VCC             | 2.5       | 3.3  | 3.6       | V    | -    |
| Digital Interface Supply Voltage | IOVCC           | 1.65      | 1.8  | 3.3       |      | -    |
| Normal Mode Current              | ICC             | --        | 28   | --        | mA   | -    |
| Level Input Voltage              | V <sub>IH</sub> | 0.7*lovcc | --   | lovcc     | V    | -    |
|                                  | V <sub>IL</sub> | GND       | --   | 0.3*lovcc | V    | -    |
| Level Output Voltage             | V <sub>OH</sub> | 0.8*lovcc | --   | lovcc     | V    | -    |
|                                  | V <sub>OL</sub> | GND       | --   | 0.2*lovcc | V    | -    |

**5.3 LED Backlight Characteristics**

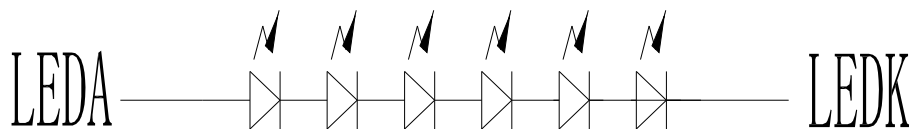
The Backlight system is edge-lighting type with 6 chips LED

| Item                                    | Symbol         | Min. | Typ.  | Max. | Unit  | Note    |
|---|----------------|------|-------|------|-------|---------|
| Forward Current                         | I <sub>F</sub> | 15   | 20    | --   | mA    | -       |
| Forward Voltage                         | V <sub>F</sub> | --   | 19.2  | --   | V     | -       |
| LCM Luminance<br>(I <sub>F</sub> =20mA) | LV             | 350  | 400   | --   | cd/m2 | Note3   |
| LED Lifetime                            | Hr             | --   | 50000 | --   | Hour  | Note1,2 |
| Uniformity                              | Avg            | 80   | --    | --   | %     | Note3   |

Note1: LED life time (Hr) can be defined as the time in which it continues to operate under the condition: Ta=25°C±3°C, typical IL value indicated in the above table until the brightness becomes less than 50%.

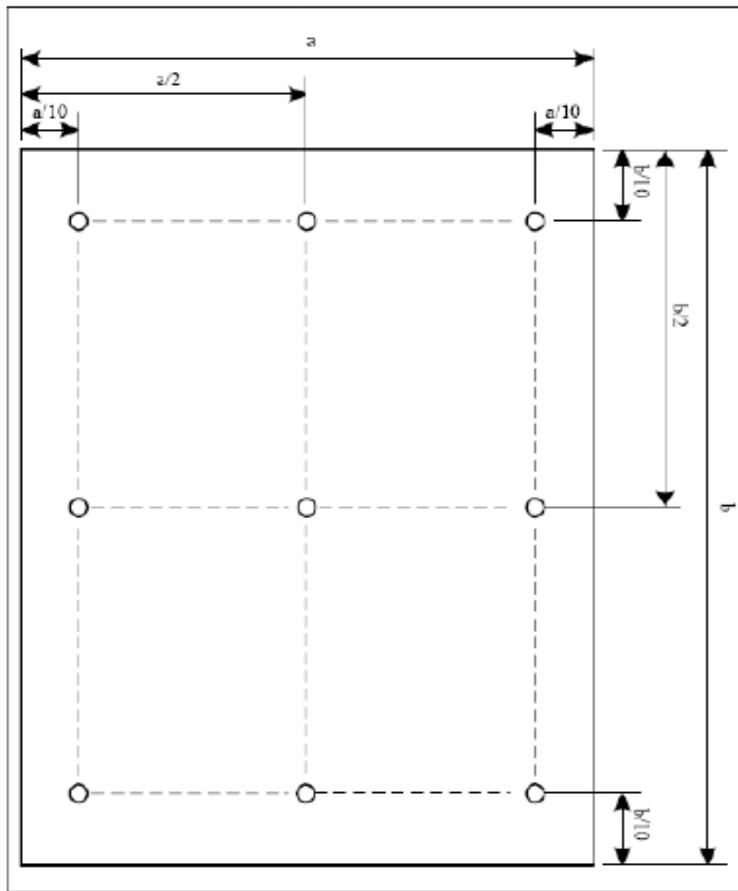
Note 2: The “LED life time” is defined as the module brightness decrease to 50% original brightness at Ta=25°C and IL=20mA. The LED lifetime could be decreased if operating IL is larger than 20mA.

The constant current driving method is suggested.



BL CIRCUIT DIAGRAM

Note (3) Luminance Uniformity of these 9 points is defined as below:



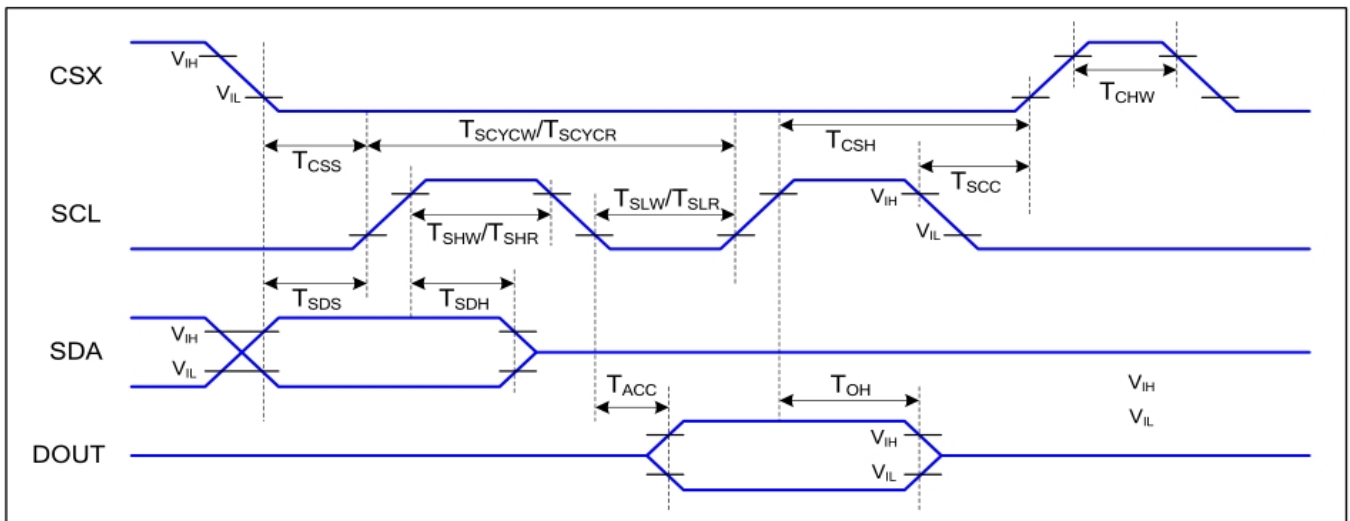
$$\text{Uniformity} = \frac{\text{minimum luminance in 9 points (1-9)}}{\text{maximum luminance in 9 points (1-9)}}$$

$$\text{Luminance} = \frac{\text{Total Luminance of 9 points}}{9}$$

6. AC Characteristics

6.1 Serial Interface Characteristics (3-Line Serial):

$IOVCC=1.8V, VCI=2.8V, Ta=25^{\circ}C$



3-Line Serial Interface Timing Characteristics

| 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   |             |
|              | $T_{SCC}$   | 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   |             |

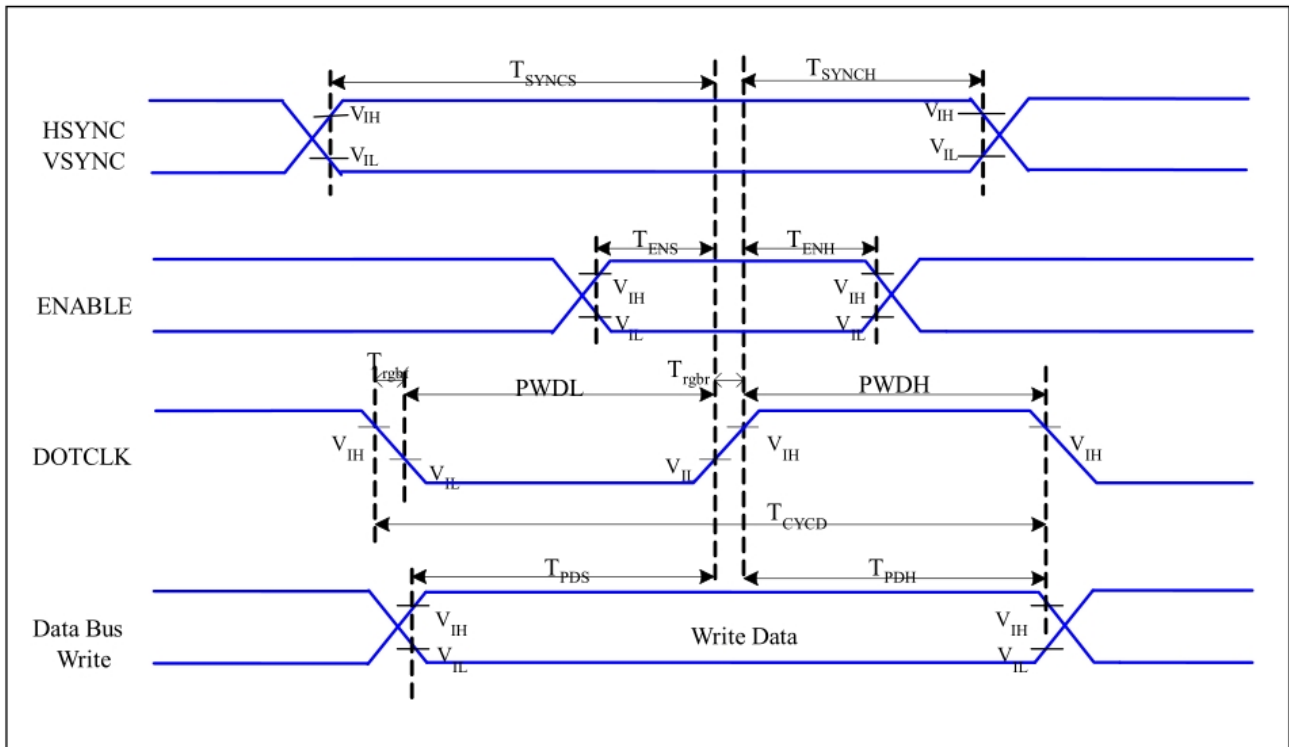
3-Line Serial Interface Characteristics

Note: The rising time and falling time ( $T_r, T_f$ ) of input signal are specified at 15 ns or less.

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

6.2.RGB Interface Characteristics :

IOVCC=1.8V, VCI=2.8V, Ta=25°C

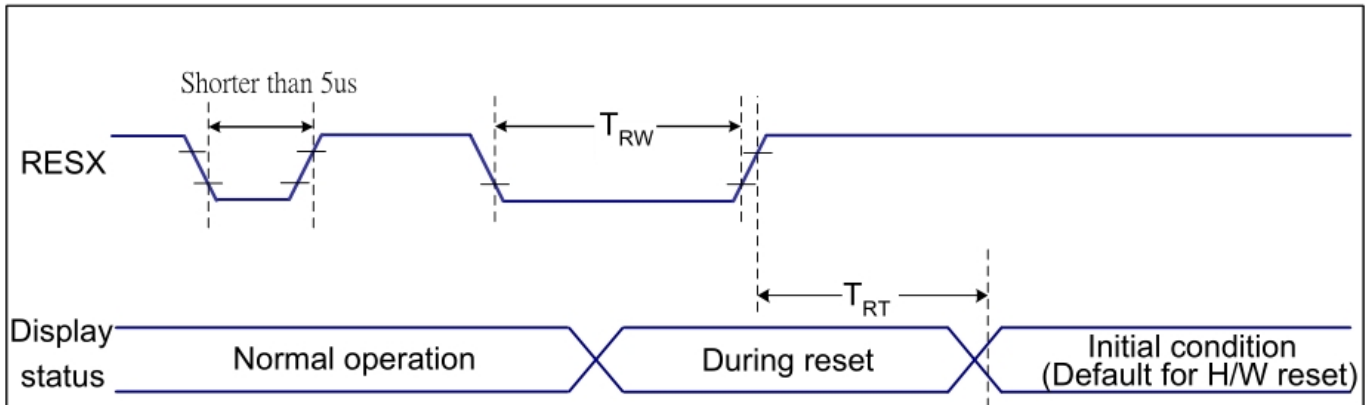


RGB Interface Timing Characteristics

| 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   |             |
|              | $T_{trgh}$ , $T_{trghf}$ | DOTCLK Rise/Fall time         | -   | 15  | ns   |             |
| DB           | $T_{PDS}$                | PD Data Setup Time            | 5   | -   | ns   |             |
|              | $T_{PDH}$                | PD Data Hold Time             | 5   | -   | ns   |             |

18/16 Bits RGB Interface Timing Characteristics

6.3 Reset Input Timing:



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   |

Reset Timing

Notes:

1. The reset cancel includes also required time for loading ID bytes, VCOM setting and other settings from NVM (or similar device) to registers. This loading is done every time when there is HW reset cancel time ( $t_{RT}$ ) within 5 ms after a rising edge of RESX.

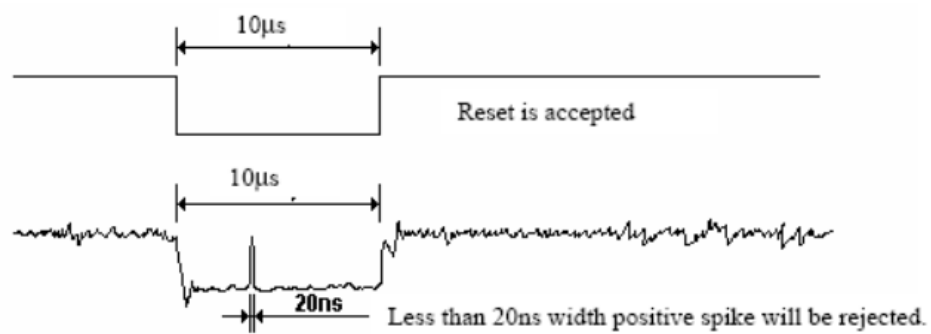
2. Spike due to an electrostatic discharge on RESX line does not cause irregular system reset according to the table below:

| RESX Pulse          | Action         |
|---------------------|----------------|
| Shorter than 5us    | Reset Rejected |
| Longer than 9us     | Reset          |
| Between 5us and 9us | Reset starts   |

3. 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 Sleep Out –mode. The display remains the blank state in Sleep In –mode.) and then return to Default condition for Hardware Reset.

4. Spike Rejection also applies during a valid reset pulse as shown below:





5. When Reset applied during Sleep In Mode.

6. When Reset applied during Sleep Out Mode.

7. It is necessary to wait 5msec after releasing RESX before sending commands. Also Sleep Out command cannot be sent for 120msec.

**7. RGB Interface**

The ST7701 support RGB interface Mode 1 and Mode 2. The interface signals as shown in ST7701S datasheet table 6.3.1. The Mode 1 and Mode 2 function is select by setting in the Command 2, please reference application note. In RGB Mode 1, writing data to line buffer is done by PCLK and Video Data Bus (D[23:0]), when DE is high state. The external clocks (PCLK, VS and HS) are used for internal displaying clock.

So, controller must always transfer PCLK, VS and HS signal to ST7701. In RGB Mode 2, back porch of Vsync is defined by VBP[5:0] of RGBPRCTR command. And back porch of Hsync is defined by HBP[5:0] of RGBPRCTR command.

Front porch of Vsync is defined by VFP[5:0] of RGBPRCTR command. And front porch of Hsync is defined by HFP[5:0] of RGBPRCTR command.

| RGB I/F Mode | PCLK | DE       | VS   | HS   | DB[23:0] | Register for Blanking Porch setting |
|--------------|------|----------|------|------|----------|-------------------------------------|
| RGB Mode 1   | Used | Used     | Used | Used | Used     | Not Used                            |
| RGB Mode 2   | Used | Not Used | Used | Used | Used     | Used                                |

| Symbol   | Name            | Description   |
|----------|-----------------|---|
| PCLK     | Pixel clock     | Pixel clock for capturing pixels at display interface |
| HS       | Horizontal sync | Horizontal synchronization timing signal              |
| VS       | Vertical sync   | Vertical synchronization timing signal                |
| DE       | Data enable     | Data enable signal (assertion indicates valid pixels) |
| DB[23:0] | Pixel data      | Pixel data in 16-bit, 18-bit and 24-bit format        |

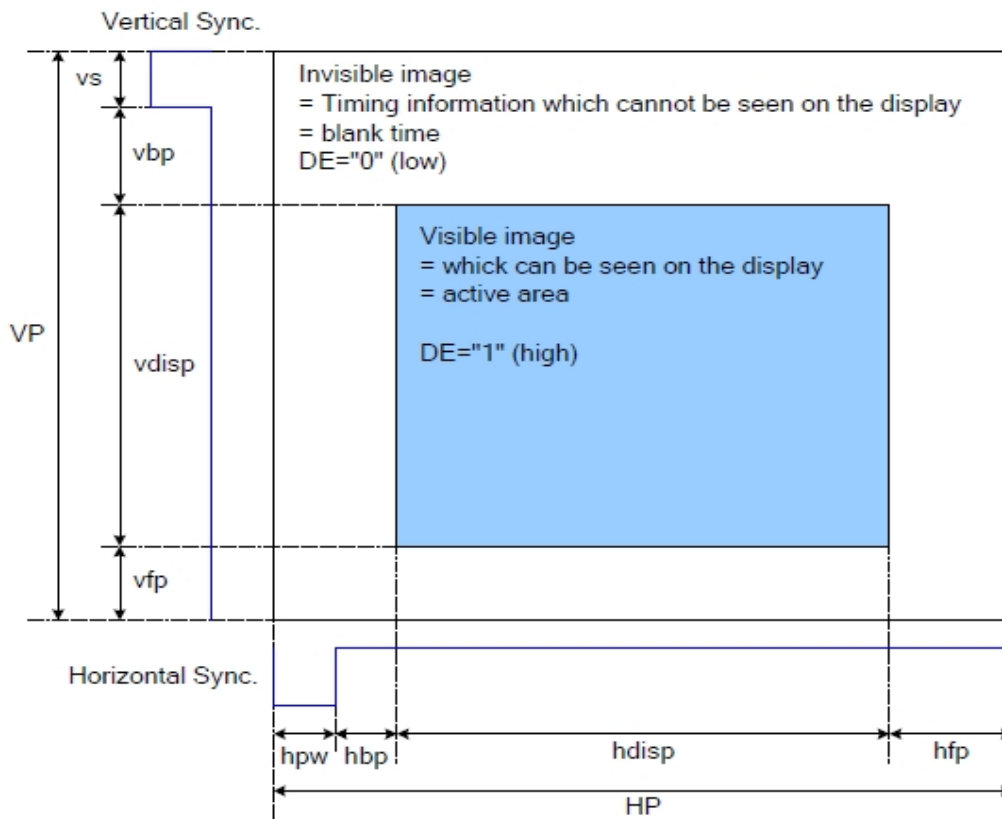
The interface signals of RGB interface

7.1.1 RGB Interface Definition

The display operation via the RGB interface is synchronized with the VSYNC, HSYNC, and DOTCLK signals.

The data can be written only within the specified area with low power consumption by using window address function.

The back porch and front porch are used to set the RGB interface timing.



DRAM Access Area by RGB Interface

Please refer to the following table for the setting limitation of RGB interface signals.

| Parameter                    | Symbol | Min. | Typ. | Max. | Unit  |
|------------------------------|--------|------|------|------|-------|
| DCLK frequency               | FCLK   | --   | (25) | --   | MHz   |
| Horizontal Sync. Width       | hpw    | 1    | (4)  | 255  | Clock |
| Horizontal Sync. Back Porch  | hbp    | 1    | (20) | 255  | Clock |
| Horizontal Sync. Front Porch | hfp    | 1    | (10) | --   | Clock |
| Vertical Sync. Width         | vs     | 1    | (4)  | 254  | Line  |
| Vertical Sync. Back Porch    | vbp    | 1    | (10) | 254  | Line  |
| Vertical Sync. Front Porch   | vfp    | 1    | (8)  | --   | Line  |

Note: 1. Typical value are related to the setting frame rate is 60Hz.

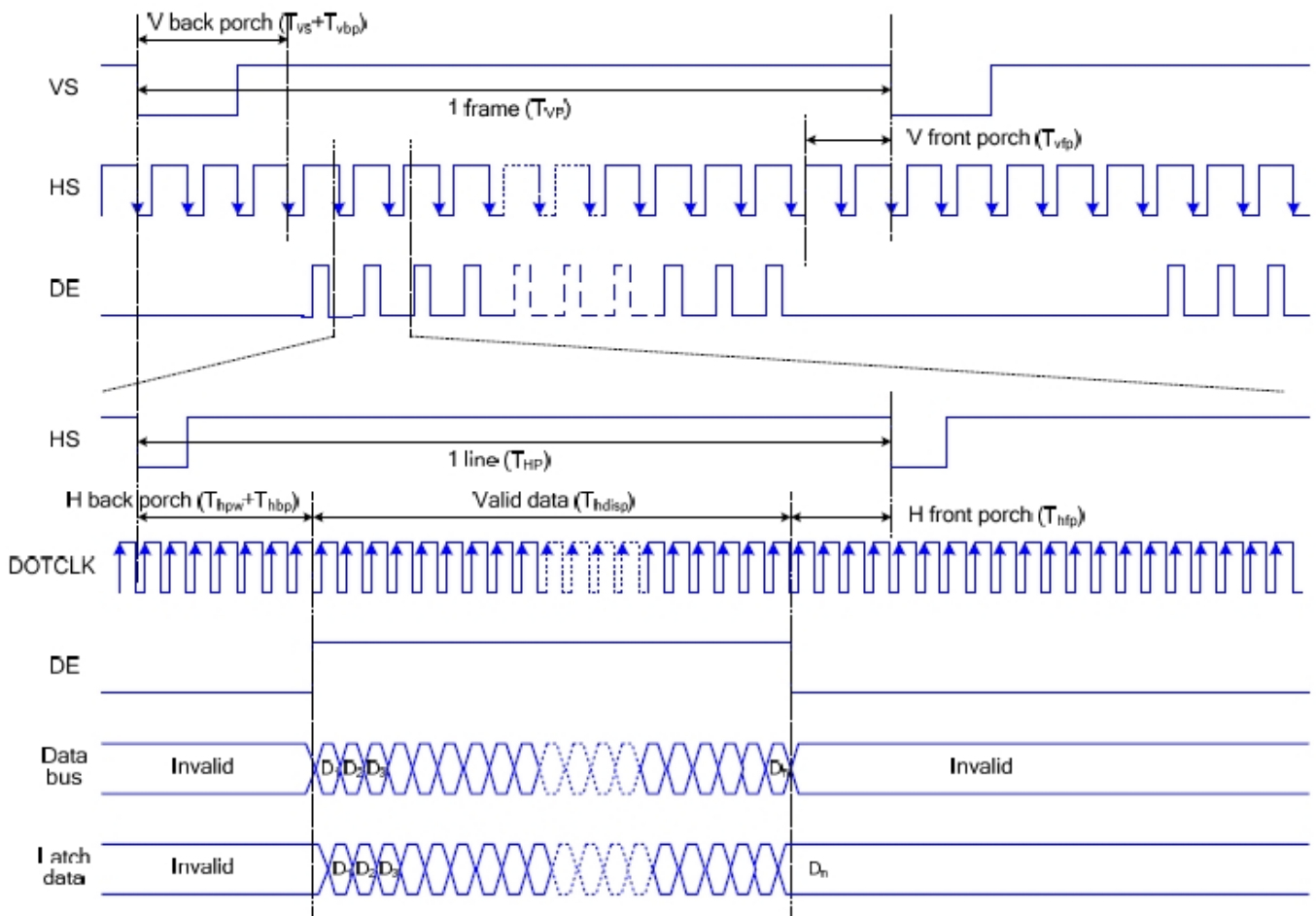
7.1.2 RGB Interface Mode Selection

ST7701S supports two kinds of RGB interface, DE mode and HV mode. The table shown below uses command C3h to select RGB interface mode.

| DE/Sync | RGB Mode |
|---------|----------|
| 0       | DE mode  |
| 1       | HV mode  |

7.1.3 RGB Interface Timing

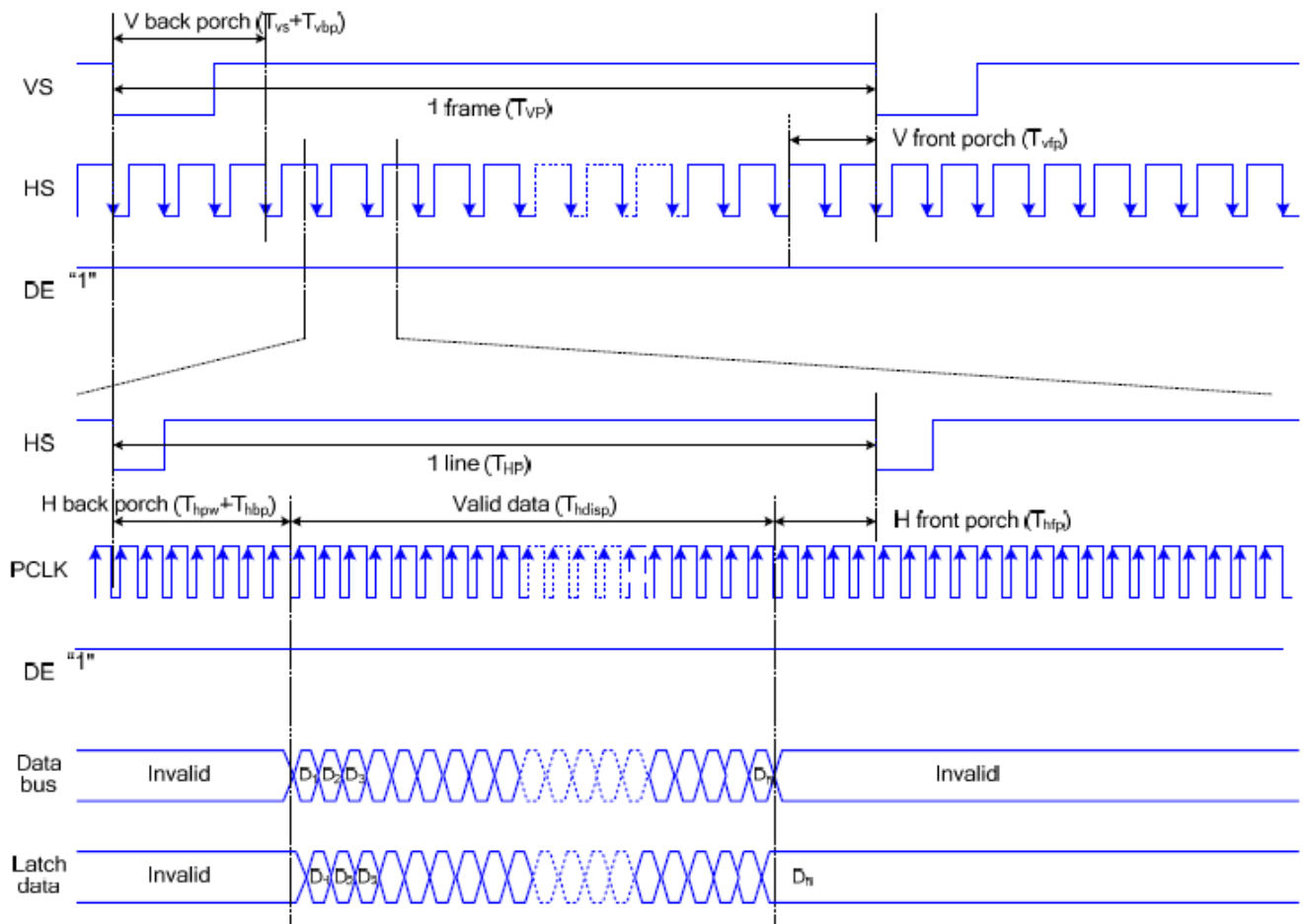
The timing chart of RGB interface DE mode is shown as follows.



Note: The setting of front porch and back porch in host must match that in IC as this mode.

Timing Chart of Signals in RGB Interface DE Mode

The timing chart of RGB interface HV mode is shown as follows.



**Timing chart of RGB interface HV mod**

**8. LCD Module Out-Going Quality Level**

**8.1 VISUAL & FUNCTION INSPECTION STANDARD**

**8.1.1 Inspection conditions**

Inspection performed under the following conditions is recommended.

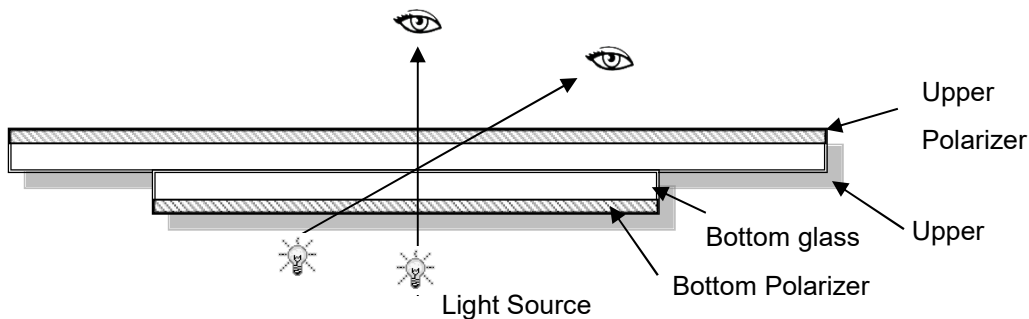
Temperature: 25°C ± 5°C

Humidity: 65%±10%RH

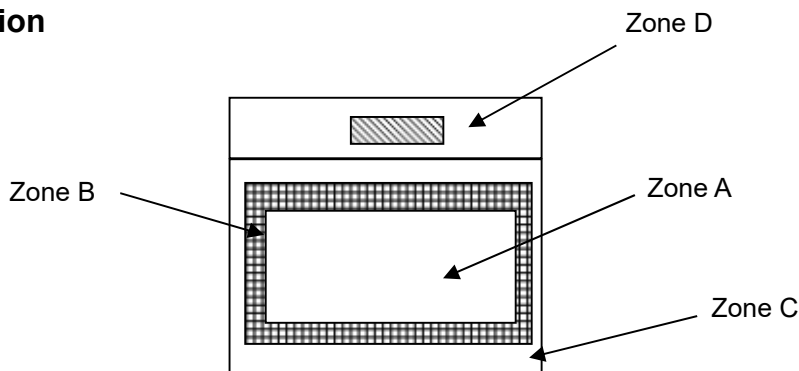
Viewing Angle: Normal viewing Angle.

Illumination: Single fluorescent lamp (300 to 700Lux)

Viewing distance: 30-50cm



**8.1.2 Definition**



Zone A : Effective Viewing Area(Character or Digit can be seen)

Zone B : Viewing Area except Zone A

Zone C : Outside (Zone A+Zone B) which can not be seen after assembly by customer .)

Zone D : IC Bonding Area

Note: As a general rule ,visual defects in Zone C can be ignored when it doesn't effect product Function or appearance after assembly by customer

**8.1.3 Sampling Plan**

According to GB/T 2828-2012, normal inspection, Class II

AQL:

| Major Defect | Minor Defect |
|--------------|--------------|
| 0.65         | 1.5          |

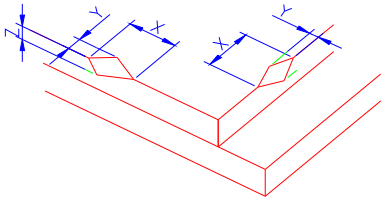
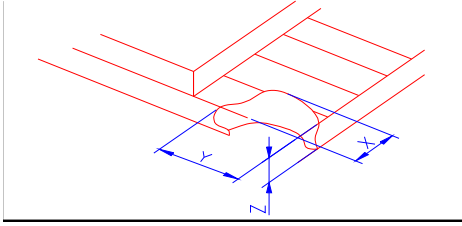
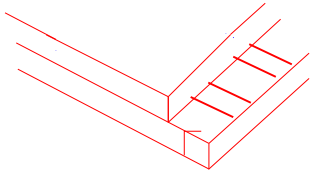
LCD: Liquid Crystal Display, LCM: Liquid Crystal Module, CTP: Capacitive Touch Panel

| No | Items to be inspected | Criteria  | Classification of defects |
|----|-----------------------|---|---------------------------|
| 1  | Functional defects    | 1) No display, Open or miss line<br>2) Display abnormally, Short<br>3) Backlight no lighting, abnormal lighting.<br>etc | Major                     |
| 2  | Missing               | Missing components and etc  |                           |
| 3  | Outline dimension     | Overall outline dimension beyond the drawing is not allowed, deformation and etc  |                           |
| 4  | Color tone            | Color unevenness, refer to limited sample   | Minor                     |
| 5  | Spot/Line defect      | Light dot, Dim spot, (Note 1)<br>Polarizer Air Bubble,<br>Polarizer accidented spot and etc                             |                           |
| 6  | Soldering appearance  | Good soldering , Peeling off is not allowed and etc   |                           |
| 7  | LCD/Polarizer/CTP     | Black/White spot/line, scratch, crack, etc.   |                           |

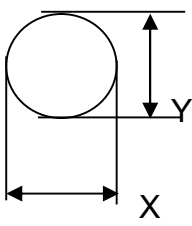
Note1:



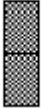
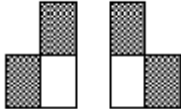
- a) Light dot: Dots appear bright and unchanged in size in which LCD panel is displaying under black pattern.
- b) Dim dot: Dots appear dark and unchanged in size in which LCD panel is displaying under pure red, green, blue picture.


**8.1.4 Criteria (Visual)**

| Number  | Items                          | Criteria(mm)  |   |   |   |        |                                |    |
|---|--------------------------------|---|---|---|---|--------|--------------------------------|----|
| 1.0 LCD<br>Crack/Broken<br>NOTE:<br>X: Length<br>Y: Width<br>Z: Height<br>L: Length of ITO,<br>T: Height of LCD | (1) The edge of LCD broken     |  <table border="1" data-bbox="751 651 1453 801"> <thead> <tr> <th>X</th> <th>Y</th> <th>Z</th> </tr> </thead> <tbody> <tr> <td>≤3.0mm</td> <td>&lt;Inner border line of the seal</td> <td>≤T</td> </tr> </tbody> </table> | X | Y | Z | ≤3.0mm | <Inner border line of the seal | ≤T |
| X   | Y                              | Z   |   |   |   |        |                                |    |
| ≤3.0mm  | <Inner border line of the seal | ≤T  |   |   |   |        |                                |    |
|   | (2)LCD corner broken           |  <table border="1" data-bbox="831 1111 1370 1211"> <thead> <tr> <th>X</th> <th>Y</th> <th>Z</th> </tr> </thead> <tbody> <tr> <td>≤3.0mm</td> <td>≤L</td> <td>≤T</td> </tr> </tbody> </table>                             | X | Y | Z | ≤3.0mm | ≤L                             | ≤T |
| X   | Y                              | Z   |   |   |   |        |                                |    |
| ≤3.0mm  | ≤L                             | ≤T  |   |   |   |        |                                |    |
|   | (3) LCD crack                  |  <p style="text-align: center;">Crack<br/>Not allowed</p>   |   |   |   |        |                                |    |



| 2.0                     | Spot defect  | ① light dot ( black/white spot , pinhole, stain, etc. )  |   |                           |                   |                |  |  |   |   |   |                  |        |  |  |                         |        |  |  |                        |                           |  |              |                           |  |  |              |   |  |  |
|-------------------------|--|--|---|---------------------------|-------------------|----------------|--|--|---|---|---|------------------|--------|--|--|-------------------------|--------|--|--|------------------------|---------------------------|--|--------------|---------------------------|--|--|--------------|---|--|--|
|                         |  <p style="text-align: center;"><math>\Phi=(X+Y)/2</math></p> | <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th rowspan="2" style="text-align: center;">Zone<br/>Size (mm)</th> <th colspan="3" style="text-align: center;">Acceptable Qty</th> </tr> <tr> <th style="text-align: center;">A</th> <th style="text-align: center;">B</th> <th style="text-align: center;">C</th> </tr> </thead> <tbody> <tr> <td style="text-align: center;"><math>\Phi \leq 0.15</math></td> <td colspan="3" style="text-align: center;">Ignore</td> </tr> <tr> <td style="text-align: center;"><math>0.15 &lt; \Phi \leq 0.25</math></td> <td colspan="3" rowspan="2" style="text-align: center;">Ignore</td> </tr> <tr> <td style="text-align: center;"><math>0.25 &lt; \Phi \leq 0.4</math></td> <td colspan="2" style="text-align: center;">3(distance <math>\geq 10</math>mm)</td> </tr> <tr> <td style="text-align: center;"><math>\Phi &gt; 0.4</math></td> <td colspan="3" style="text-align: center;">2(distance <math>\geq 10</math>mm)</td> </tr> <tr> <td style="text-align: center;"><math>\Phi &gt; 0.4</math></td> <td colspan="3" style="text-align: center;">0</td> </tr> </tbody> </table>   |   |                           | Zone<br>Size (mm) | Acceptable Qty |  |  | A | B | C | $\Phi \leq 0.15$ | Ignore |  |  | $0.15 < \Phi \leq 0.25$ | Ignore |  |  | $0.25 < \Phi \leq 0.4$ | 3(distance $\geq 10$ mm)  |  | $\Phi > 0.4$ | 2(distance $\geq 10$ mm)  |  |  | $\Phi > 0.4$ | 0 |  |  |
| Zone<br>Size (mm)       | Acceptable Qty   |  |   |                           |                   |                |  |  |   |   |   |                  |        |  |  |                         |        |  |  |                        |                           |  |              |                           |  |  |              |   |  |  |
|                         | A  | B  | C |                           |                   |                |  |  |   |   |   |                  |        |  |  |                         |        |  |  |                        |                           |  |              |                           |  |  |              |   |  |  |
| $\Phi \leq 0.15$        | Ignore   |  |   |                           |                   |                |  |  |   |   |   |                  |        |  |  |                         |        |  |  |                        |                           |  |              |                           |  |  |              |   |  |  |
| $0.15 < \Phi \leq 0.25$ | Ignore   |  |   |                           |                   |                |  |  |   |   |   |                  |        |  |  |                         |        |  |  |                        |                           |  |              |                           |  |  |              |   |  |  |
| $0.25 < \Phi \leq 0.4$  |  |  |   | 3(distance $\geq 10$ mm)  |                   |                |  |  |   |   |   |                  |        |  |  |                         |        |  |  |                        |                           |  |              |                           |  |  |              |   |  |  |
| $\Phi > 0.4$            | 2(distance $\geq 10$ mm)   |  |   |                           |                   |                |  |  |   |   |   |                  |        |  |  |                         |        |  |  |                        |                           |  |              |                           |  |  |              |   |  |  |
| $\Phi > 0.4$            | 0  |  |   |                           |                   |                |  |  |   |   |   |                  |        |  |  |                         |        |  |  |                        |                           |  |              |                           |  |  |              |   |  |  |
|                         |  | ② Dim spot ( light leakage, dent, dark spot, etc )   |   |                           |                   |                |  |  |   |   |   |                  |        |  |  |                         |        |  |  |                        |                           |  |              |                           |  |  |              |   |  |  |
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| Zone<br>Size (mm)       | Acceptable Qty   |  |   |                           |                   |                |  |  |   |   |   |                  |        |  |  |                         |        |  |  |                        |                           |  |              |                           |  |  |              |   |  |  |
|                         | A  | B  | C |                           |                   |                |  |  |   |   |   |                  |        |  |  |                         |        |  |  |                        |                           |  |              |                           |  |  |              |   |  |  |
| $\Phi \leq 0.15$        | Ignore   |  |   |                           |                   |                |  |  |   |   |   |                  |        |  |  |                         |        |  |  |                        |                           |  |              |                           |  |  |              |   |  |  |
| $0.15 < \Phi \leq 0.25$ | Ignore   |  |   |                           |                   |                |  |  |   |   |   |                  |        |  |  |                         |        |  |  |                        |                           |  |              |                           |  |  |              |   |  |  |
| $0.25 < \Phi \leq 0.4$  |  |  |   | 3( distance $\geq 10$ mm) |                   |                |  |  |   |   |   |                  |        |  |  |                         |        |  |  |                        |                           |  |              |                           |  |  |              |   |  |  |
| $\Phi > 0.4$            | 2( distance $\geq 10$ mm)  |  |   |                           |                   |                |  |  |   |   |   |                  |        |  |  |                         |        |  |  |                        |                           |  |              |                           |  |  |              |   |  |  |
| $\Phi > 0.4$            | 0  |  |   |                           |                   |                |  |  |   |   |   |                  |        |  |  |                         |        |  |  |                        |                           |  |              |                           |  |  |              |   |  |  |
|                         |  | ③ Polarizer accidented spot  |   |                           |                   |                |  |  |   |   |   |                  |        |  |  |                         |        |  |  |                        |                           |  |              |                           |  |  |              |   |  |  |
|                         |  | <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th rowspan="2" style="text-align: center;">Zone<br/>Size (mm)</th> <th colspan="3" style="text-align: center;">Acceptable Qty</th> </tr> <tr> <th style="text-align: center;">A</th> <th style="text-align: center;">B</th> <th style="text-align: center;">C</th> </tr> </thead> <tbody> <tr> <td style="text-align: center;"><math>\Phi \leq 0.2</math></td> <td colspan="3" style="text-align: center;">Ignore</td> </tr> <tr> <td style="text-align: center;"><math>0.2 &lt; \Phi \leq 0.5</math></td> <td colspan="3" rowspan="2" style="text-align: center;">Ignore</td> </tr> <tr> <td style="text-align: center;"><math>\Phi &gt; 0.5</math></td> <td colspan="2" style="text-align: center;">2( distance <math>\geq 10</math>mm)</td> </tr> <tr> <td style="text-align: center;"><math>\Phi &gt; 0.5</math></td> <td colspan="3" style="text-align: center;">0</td> </tr> </tbody> </table>  |   |                           | Zone<br>Size (mm) | Acceptable Qty |  |  | A | B | C | $\Phi \leq 0.2$  | Ignore |  |  | $0.2 < \Phi \leq 0.5$   | Ignore |  |  | $\Phi > 0.5$           | 2( distance $\geq 10$ mm) |  | $\Phi > 0.5$ | 0                         |  |  |              |   |  |  |
| Zone<br>Size (mm)       | Acceptable Qty   |  |   |                           |                   |                |  |  |   |   |   |                  |        |  |  |                         |        |  |  |                        |                           |  |              |                           |  |  |              |   |  |  |
|                         | A  | B  | C |                           |                   |                |  |  |   |   |   |                  |        |  |  |                         |        |  |  |                        |                           |  |              |                           |  |  |              |   |  |  |
| $\Phi \leq 0.2$         | Ignore   |  |   |                           |                   |                |  |  |   |   |   |                  |        |  |  |                         |        |  |  |                        |                           |  |              |                           |  |  |              |   |  |  |
| $0.2 < \Phi \leq 0.5$   | Ignore   |  |   |                           |                   |                |  |  |   |   |   |                  |        |  |  |                         |        |  |  |                        |                           |  |              |                           |  |  |              |   |  |  |
| $\Phi > 0.5$            |  |  |   | 2( distance $\geq 10$ mm) |                   |                |  |  |   |   |   |                  |        |  |  |                         |        |  |  |                        |                           |  |              |                           |  |  |              |   |  |  |
| $\Phi > 0.5$            | 0  |  |   |                           |                   |                |  |  |   |   |   |                  |        |  |  |                         |        |  |  |                        |                           |  |              |                           |  |  |              |   |  |  |
|                         |  | ④ Polarizer Bubble   |   |                           |                   |                |  |  |   |   |   |                  |        |  |  |                         |        |  |  |                        |                           |  |              |                           |  |  |              |   |  |  |
|                         |  | <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th rowspan="2" style="text-align: center;">Zone<br/>Size (mm)</th> <th colspan="3" style="text-align: center;">Acceptable Qty</th> </tr> <tr> <th style="text-align: center;">A</th> <th style="text-align: center;">B</th> <th style="text-align: center;">C</th> </tr> </thead> <tbody> <tr> <td style="text-align: center;"><math>\Phi \leq 0.2</math></td> <td colspan="3" style="text-align: center;">Ignore</td> </tr> <tr> <td style="text-align: center;"><math>0.2 &lt; \Phi \leq 0.4</math></td> <td colspan="3" rowspan="2" style="text-align: center;">Ignore</td> </tr> <tr> <td style="text-align: center;"><math>\Phi &gt; 0.4</math></td> <td colspan="2" style="text-align: center;">2(distance <math>\geq 10</math>mm)</td> </tr> <tr> <td style="text-align: center;"><math>\Phi &gt; 0.4</math></td> <td colspan="3" style="text-align: center;">0</td> </tr> </tbody> </table>   |   |                           | Zone<br>Size (mm) | Acceptable Qty |  |  | A | B | C | $\Phi \leq 0.2$  | Ignore |  |  | $0.2 < \Phi \leq 0.4$   | Ignore |  |  | $\Phi > 0.4$           | 2(distance $\geq 10$ mm)  |  | $\Phi > 0.4$ | 0                         |  |  |              |   |  |  |
| Zone<br>Size (mm)       | Acceptable Qty   |  |   |                           |                   |                |  |  |   |   |   |                  |        |  |  |                         |        |  |  |                        |                           |  |              |                           |  |  |              |   |  |  |
|                         | A  | B  | C |                           |                   |                |  |  |   |   |   |                  |        |  |  |                         |        |  |  |                        |                           |  |              |                           |  |  |              |   |  |  |
| $\Phi \leq 0.2$         | Ignore   |  |   |                           |                   |                |  |  |   |   |   |                  |        |  |  |                         |        |  |  |                        |                           |  |              |                           |  |  |              |   |  |  |
| $0.2 < \Phi \leq 0.4$   | Ignore   |  |   |                           |                   |                |  |  |   |   |   |                  |        |  |  |                         |        |  |  |                        |                           |  |              |                           |  |  |              |   |  |  |
| $\Phi > 0.4$            |  |  |   | 2(distance $\geq 10$ mm)  |                   |                |  |  |   |   |   |                  |        |  |  |                         |        |  |  |                        |                           |  |              |                           |  |  |              |   |  |  |
| $\Phi > 0.4$            | 0  |  |   |                           |                   |                |  |  |   |   |   |                  |        |  |  |                         |        |  |  |                        |                           |  |              |                           |  |  |              |   |  |  |

| 3.0                       | LCD Pixel defect  | <p>Pixel bad points</p> <table border="1"> <thead> <tr> <th data-bbox="534 293 727 344">Item</th> <th data-bbox="727 293 1241 344">Zone A</th> <th data-bbox="1241 293 1492 344">Acceptable Qty</th> </tr> </thead> <tbody> <tr> <td data-bbox="534 344 727 506" rowspan="3">Bright dot</td> <td data-bbox="727 344 1241 403">Random</td> <td data-bbox="1241 344 1492 403">N≤2</td> </tr> <tr> <td data-bbox="727 403 1241 456">2 dots adjacent</td> <td data-bbox="1241 403 1492 456">N≤0</td> </tr> <tr> <td data-bbox="727 456 1241 506">3 dots adjacent</td> <td data-bbox="1241 456 1492 506">N≤0</td> </tr> <tr> <td data-bbox="534 506 727 676" rowspan="3">Dark dot</td> <td data-bbox="727 506 1241 564">Random</td> <td data-bbox="1241 506 1492 564">N≤3</td> </tr> <tr> <td data-bbox="727 564 1241 618">2 dots adjacent</td> <td data-bbox="1241 564 1492 618">N≤0</td> </tr> <tr> <td data-bbox="727 618 1241 676">3 dots adjacent</td> <td data-bbox="1241 618 1492 676">N≤0</td> </tr> <tr> <td data-bbox="534 676 727 983">Distance</td> <td data-bbox="727 676 1241 983">                     1. Minimum Distance Between Bright dots.<br/>                     2. Minimum Distance Between dark dots<br/>                     3. Minimum Distance Between dark and bright dot.                 </td> <td data-bbox="1241 676 1492 983">5mm</td> </tr> <tr> <td colspan="2" data-bbox="534 983 1241 1041">Total bright and dark dot</td> <td data-bbox="1241 983 1492 1041">N≤4</td> </tr> </tbody> </table> <p>Note:</p> <p>A) Bright dot: Dots appear bright and unchanged in size in which LCD panel is displaying under black pattern.</p> <p>B) Dark dot: Dots appear dark and unchanged in size in which LCD panel is displaying under pure red, green, blue picture.</p> <p>C) 2 dot adjacent = 1 pair = 2 dots</p> <p>Picture:</p> <div style="display: flex; justify-content: space-around; align-items: flex-start;"> <div style="text-align: center;">  <p>2 dot adjacent</p> </div> <div style="text-align: center;">  <p>2 dot adjacent</p> </div> </div> <div style="display: flex; justify-content: space-around; align-items: flex-start; margin-top: 20px;"> <div style="text-align: center;">  <p>2 dot adjacent (vertical)</p> </div> <div style="text-align: center;">  <p>2 dot adjacent (slant)</p> </div> </div> | Item | Zone A | Acceptable Qty | Bright dot | Random | N≤2 | 2 dots adjacent | N≤0 | 3 dots adjacent | N≤0 | Dark dot | Random | N≤3 | 2 dots adjacent | N≤0 | 3 dots adjacent | N≤0 | Distance | 1. Minimum Distance Between Bright dots.<br>2. Minimum Distance Between dark dots<br>3. Minimum Distance Between dark and bright dot. | 5mm | Total bright and dark dot |  | N≤4 |
|---------------------------|---|--|------|--------|----------------|------------|--------|-----|-----------------|-----|-----------------|-----|----------|--------|-----|-----------------|-----|-----------------|-----|----------|---|-----|---------------------------|--|-----|
| Item                      | Zone A  | Acceptable Qty   |      |        |                |            |        |     |                 |     |                 |     |          |        |     |                 |     |                 |     |          |   |     |                           |  |     |
| Bright dot                | Random  | N≤2  |      |        |                |            |        |     |                 |     |                 |     |          |        |     |                 |     |                 |     |          |   |     |                           |  |     |
|                           | 2 dots adjacent   | N≤0  |      |        |                |            |        |     |                 |     |                 |     |          |        |     |                 |     |                 |     |          |   |     |                           |  |     |
|                           | 3 dots adjacent   | N≤0  |      |        |                |            |        |     |                 |     |                 |     |          |        |     |                 |     |                 |     |          |   |     |                           |  |     |
| Dark dot                  | Random  | N≤3  |      |        |                |            |        |     |                 |     |                 |     |          |        |     |                 |     |                 |     |          |   |     |                           |  |     |
|                           | 2 dots adjacent   | N≤0  |      |        |                |            |        |     |                 |     |                 |     |          |        |     |                 |     |                 |     |          |   |     |                           |  |     |
|                           | 3 dots adjacent   | N≤0  |      |        |                |            |        |     |                 |     |                 |     |          |        |     |                 |     |                 |     |          |   |     |                           |  |     |
| Distance                  | 1. Minimum Distance Between Bright dots.<br>2. Minimum Distance Between dark dots<br>3. Minimum Distance Between dark and bright dot. | 5mm  |      |        |                |            |        |     |                 |     |                 |     |          |        |     |                 |     |                 |     |          |   |     |                           |  |     |
| Total bright and dark dot |   | N≤4  |      |        |                |            |        |     |                 |     |                 |     |          |        |     |                 |     |                 |     |          |   |     |                           |  |     |

| 4.0                  | Line defect (LCD /Polarizer backlight black/white line, scratch, stain)<br><br>W: width, L : length<br><br>N : Count | <table border="1"> <thead> <tr> <th rowspan="2">Width(mm)</th> <th rowspan="2">Length(m)</th> <th colspan="3">Acceptable Qty</th> </tr> <tr> <th>A</th> <th>B</th> <th>C</th> </tr> </thead> <tbody> <tr> <td><math>\Phi \leq 0.05</math></td> <td>Ignore</td> <td colspan="2">Ignore</td> <td rowspan="3">Ignore</td> </tr> <tr> <td><math>0.05 &lt; W \leq 0.06</math></td> <td><math>L \leq 5.0</math></td> <td colspan="2"><math>N \leq 3</math></td> </tr> <tr> <td><math>0.06 &lt; W \leq 0.08</math></td> <td><math>L \leq 4.0</math></td> <td colspan="2"><math>N \leq 2</math></td> </tr> <tr> <td><math>W &gt; 0.08</math></td> <td colspan="4">Define as spot defect</td> </tr> </tbody> </table> | Width(mm)    | Length(m)  | Acceptable Qty |                |  | A | B | C | $\Phi \leq 0.05$ | Ignore | Ignore |  | Ignore | $0.05 < W \leq 0.06$ | $L \leq 5.0$ | $N \leq 3$ |  | $0.06 < W \leq 0.08$ | $L \leq 4.0$ | $N \leq 2$ |  | $W > 0.08$ | Define as spot defect |  |  |  |
|----------------------|---|--|--------------|------------|----------------|----------------|--|---|---|---|------------------|--------|--------|--|--------|----------------------|--------------|------------|--|----------------------|--------------|------------|--|------------|-----------------------|--|--|--|
|                      |   | Width(mm)  |              |            | Length(m)      | Acceptable Qty |  |   |   |   |                  |        |        |  |        |                      |              |            |  |                      |              |            |  |            |                       |  |  |  |
|                      |   |  | A            | B          |                | C              |  |   |   |   |                  |        |        |  |        |                      |              |            |  |                      |              |            |  |            |                       |  |  |  |
|                      |   | $\Phi \leq 0.05$   | Ignore       | Ignore     |                | Ignore         |  |   |   |   |                  |        |        |  |        |                      |              |            |  |                      |              |            |  |            |                       |  |  |  |
|                      |   | $0.05 < W \leq 0.06$   | $L \leq 5.0$ | $N \leq 3$ |                |                |  |   |   |   |                  |        |        |  |        |                      |              |            |  |                      |              |            |  |            |                       |  |  |  |
| $0.06 < W \leq 0.08$ | $L \leq 4.0$  | $N \leq 2$   |              |            |                |                |  |   |   |   |                  |        |        |  |        |                      |              |            |  |                      |              |            |  |            |                       |  |  |  |
| $W > 0.08$           | Define as spot defect   |  |              |            |                |                |  |   |   |   |                  |        |        |  |        |                      |              |            |  |                      |              |            |  |            |                       |  |  |  |
| 5.0                  | Electronic Components SMT.  | Not allow missing parts, solderless connection, cold solder joint, mismatch, The positive and negative polarity opposite   |              |            |                |                |  |   |   |   |                  |        |        |  |        |                      |              |            |  |                      |              |            |  |            |                       |  |  |  |
| 6.0                  | Display color& Brightness.  | 1. Color: Measuring the color coordinates, The measurement standard according to the datasheet or samples.<br>2. Brightness: Measuring the brightness of White screen, The measurement standard according to the datasheet or Samples.   |              |            |                |                |  |   |   |   |                  |        |        |  |        |                      |              |            |  |                      |              |            |  |            |                       |  |  |  |
| 7.0                  | LCD Mura/Waving/ Hot spot   | Not visible through 5% ND filter in 50% gray or judge by limit sample if necessary.  |              |            |                |                |  |   |   |   |                  |        |        |  |        |                      |              |            |  |                      |              |            |  |            |                       |  |  |  |

Criteria ( functional items)

| Number | Items                 | Criteria (mm) |
|--------|-----------------------|---------------|
| 1      | No display            | Not allowed   |
| 2      | Missing segment       | Not allowed   |
| 3      | Short                 | Not allowed   |
| 4      | Backlight no lighting | Not allowed   |
| 5      | CTP no function       | Not allowed   |

## 9. Reliability Test Result

| Item                                       | Condition  | Inspection after test   |
|--|--|---|
| High Temperature Operating                 | +70°C,96h  | Inspection after 2~4hours storage at room temperature, the sample shall be free of defects:<br>1. Air bubble in the LCD;<br>2. Non-display;<br>3. Missing segments/line;<br>4. Glass crack;<br>5. Current IDD is twice higher than initial value. |
| Low Temperature Operating                  | -20°C, 96h   |   |
| High Temperature Storage                   | +80°C, 96h   |   |
| Low Temperature Storage                    | -30°C, 96h   |   |
| High Temperature & High Humidity Operating | +60°C, 90% RH ,96h   |   |
| Thermal Shock (Non-operation)              | -20°C, 30 min ↔ +70°C, 30 min,<br>Change time: 5min 20CYC.   |   |
| ESD test                                   | C=150pF, R=330,5points/panel<br>Air:±8kV, 5times; Contact:±6kV, 5 times;<br>(Environment: 15°C~35°C, 30%~60%).                               |   |
| Vibration (Non-operation)                  | Frequency range: 10~55Hz, Stroke:1.5mm<br>Sweep:10Hz~55Hz~10Hz 2 hours for each direction of X.Y.Z. (6 hours for total) (Package condition). |   |
| Box Drop Test                              | 1 Corner 3 Edges 6 faces,80cm(MEDIUM BOX)  |   |

Remark:

1. The test samples should be applied to only one test item.
2. Sample size for each test item is 5~10pcs.
3. For Damp Proof Test, Pure water (Resistance > 10MΩ) should be used.
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.
5. Failure Judgment Criterion: Basic Specification, Electrical Characteristic, Mechanical Characteristic, Optical Characteristic.

## **10. Cautions and Handling Precautions**

### **10.1 Handling and Operating the Module**

- (1) When the module is assembled, it should be attached to the system firmly.  
Do not warp or twist the module during assembly work.
- (2) Protect the module from physical shock or any force. In addition to damage, this may cause improper operation or damage to the module and backlight unit.
- (3) Note that polarizer is very fragile and could be easily damaged. Do not press or scratch the surface.
- (4) Do not allow drops of water or chemicals to remain on the display surface.  
If you have the droplets for a long time, staining and discoloration may occur.
- (5) If the surface of the polarizer is dirty, clean it using some absorbent cotton or soft cloth.
- (6) The desirable cleaners are water, IPA (Isopropyl Alcohol) or Hexane.  
Do not use ketene type materials (ex. Acetone), Ethyl alcohol, Toluene, Ethyl acid or Methyl chloride. It might permanent damage to the polarizer due to chemical reaction.
- (7) If the liquid crystal material leaks from the panel, it should be kept away from the eyes or mouth. In case of contact with hands, legs, or clothes, it must be washed away thoroughly with soap.
- (8) Protect the module from static; it may cause damage to the CMOS ICs.
- (9) Use finger-stalls with soft gloves in order to keep display clean during the incoming inspection and assembly process.
- (10) Do not disassemble the module.
- (11) Protection film for polarizer on the module shall be slowly peeled off just before use so that the electrostatic charge can be minimized.
- (12) Pins of I/F connector shall not be touched directly with bare hands.
- (13) Do not connect, disconnect the module in the "Power ON" condition.
- (14) Power supply should always be turned on/off by the item 6.1 Power On Sequence & 6.2 Power Off Sequence

### **10.2 Storage and Transportation.**

- (1) Do not leave the panel in high temperature, and high humidity for a long time.  
It is highly recommended to store the module with temperature from 0°C to 35°C and relative humidity of less than 70%
- (2) Do not store the TFT-LCD module in direct sunlight.
- (3) The module shall be stored in a dark place. When storing the modules for a long time, be sure to adopt effective measures for protecting the modules from strong ultraviolet radiation, sunlight, or fluorescent light.
- (4) It is recommended that the modules should be stored under a condition where no condensation is allowed.  
Formation of dewdrops may cause an abnormal operation or a failure of the module.  
In particular, the greatest possible care should be taken to prevent any module from being operated where condensation has occurred inside.
- (5) This panel has its circuitry FPC on the bottom side and should be handled carefully in order not to be stressed.