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TFT | CHARACTER | UWVD | FSC | SEGMENT | CUSTOM | REPLACEMENT

## TFT Display Module

Part Number

E50RG38048LW2M320-R

### Overview:

- 5.0-inch TFT (120.7x75.8mm)
- 16/18/24-bit RGB Interface
- 800(RGB)x480 pixels
- 3.3V
- White LED back-light
- Transmissive/ Normally Black
- 4-wire Resistive Touch Screen
- 320 NITS
- Controller: ILI5960/ILI6122
- RoHS Compliant

## 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 model is composed of a Transmissive type TFT-LCD Panel, driver circuit and back-light unit. The resolution of a 5.0" TFT-LCD contains 800x480 pixels and can display up to 65K/262K/16.7M colors.

## Features

Low Input Voltage: 3.3V (TYP)

Display Colors of TFT LCD: 65K/262K/16.7M colors

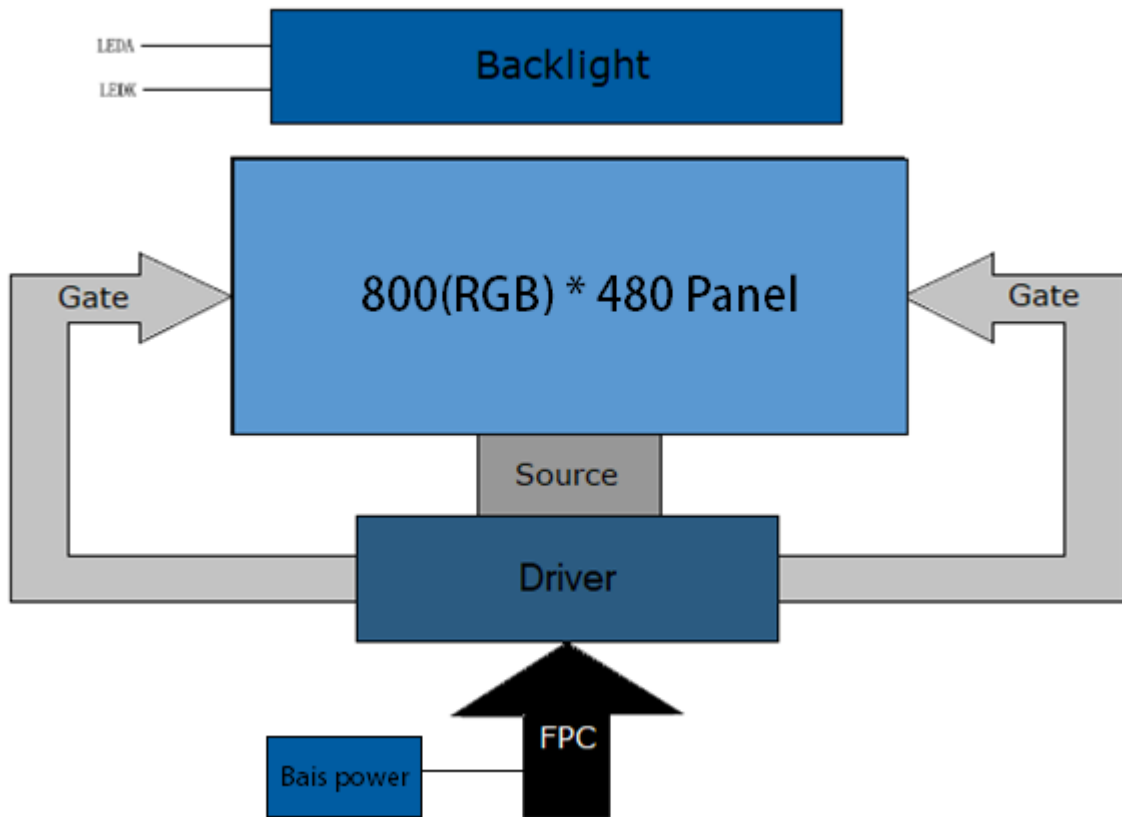
TFT Interface: 16/18/24-bit RGB

| General Information Items | Specification                   | Unit    | Note |
|---------------------------|---------------------------------|---------|------|
|                           | Main Panel                      |         |      |
| TFT Display area (AA)     | 108.00(H) * 64.80(V) (5.0 inch) | mm      | -    |
| Driver element            | TFT active matrix               | -       | -    |
| Display colors            | 65K/262K/16.7M                  | colors  | -    |
| Number of pixels          | 800(RGB)*480                    | dots    | -    |
| TFT Pixel arrangement     | RGB vertical stripe             | -       | -    |
| Pixel pitch               | 0.108 (H) x 0.108 (V)           | mm      | -    |
| Viewing angle             | 12:00                           | o'clock | -    |
| TFT Controller IC         | ILI5960/ILI6122                 | -       | -    |
| Display mode              | Transmissive/ Normally White    | -       | -    |
| Operating temperature     | -20~+70                         | °C      | -    |
| Storage temperature       | -30~+80                         | °C      | -    |

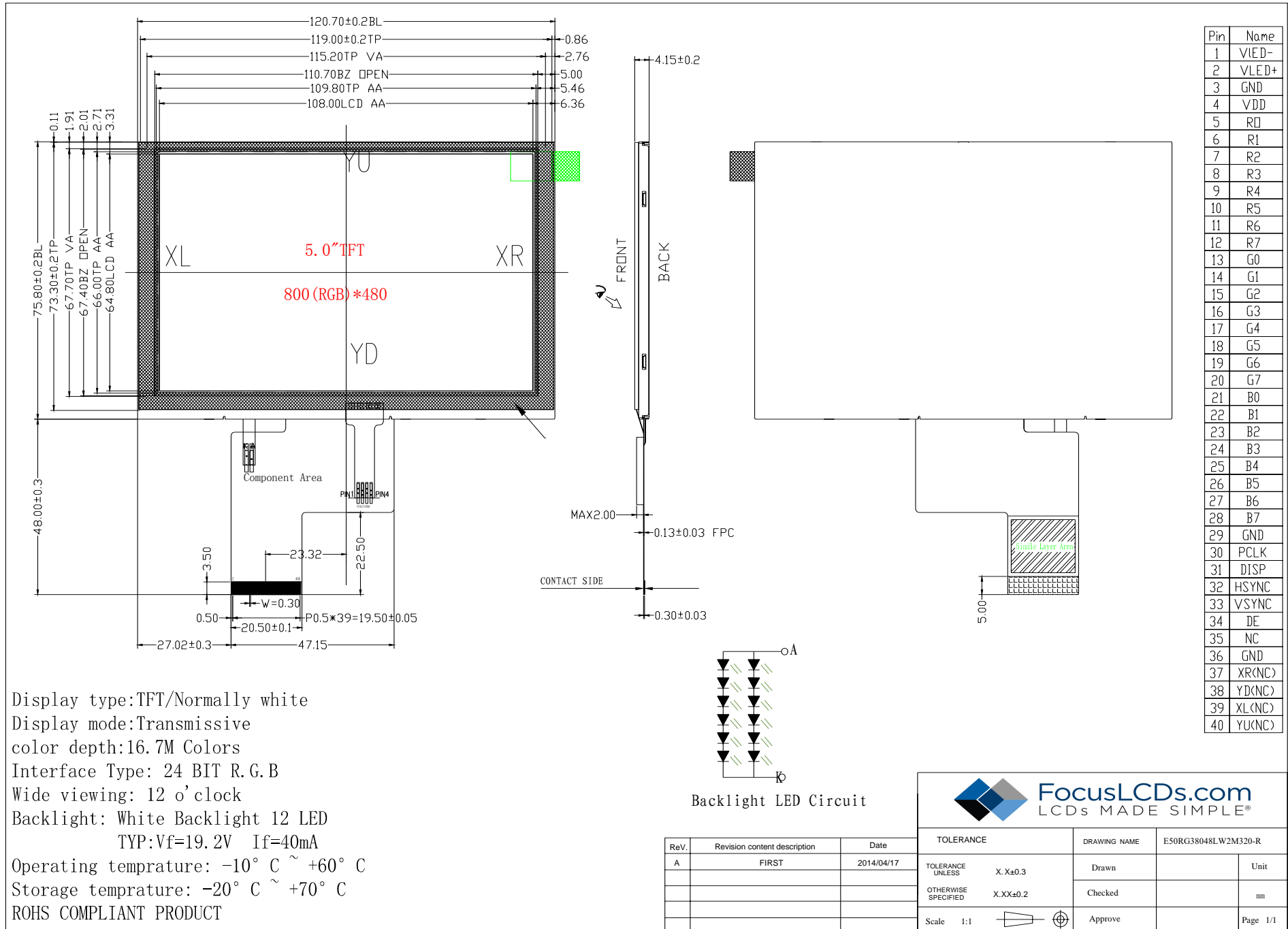
## Mechanical Information

| Item        |               | Min | Typ.   | Max | Unit | Note |
|-------------|---------------|-----|--------|-----|------|------|
| Module size | Horizontal(H) |     | 120.70 |     | mm   | -    |
|             | Vertical(V)   |     | 75.80  |     | mm   | -    |
|             | Depth(D)      |     | 4.15   |     | mm   | -    |
| Weight      |               |     | TBD    |     | g    | -    |


## 1. Block Diagram



## 2. Outline dimensions



| Pin | Name   |
|-----|--------|
| 1   | VLED-  |
| 2   | VLED+  |
| 3   | GND    |
| 4   | VDD    |
| 5   | RD     |
| 6   | R1     |
| 7   | R2     |
| 8   | R3     |
| 9   | R4     |
| 10  | R5     |
| 11  | R6     |
| 12  | R7     |
| 13  | G0     |
| 14  | G1     |
| 15  | G2     |
| 16  | G3     |
| 17  | G4     |
| 18  | G5     |
| 19  | G6     |
| 20  | G7     |
| 21  | B0     |
| 22  | B1     |
| 23  | B2     |
| 24  | B3     |
| 25  | B4     |
| 26  | B5     |
| 27  | B6     |
| 28  | B7     |
| 29  | GND    |
| 30  | PCLK   |
| 31  | DISP   |
| 32  | HSYNC  |
| 33  | VSYNC  |
| 34  | DE     |
| 35  | NC     |
| 36  | GND    |
| 37  | XR(NC) |
| 38  | YD(NC) |
| 39  | XL(NC) |
| 40  | YU(NC) |


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|           |                              |              |                                      |                     |          |
|-----------|------------------------------|--------------|--------------------------------------|---------------------|----------|
| TOLERANCE |                              | DRAWING NAME |                                      | E50RG38048LW2M320-R |          |
| ReV.      | Revision content description | Date         | Tolerance UNLESS OTHERWISE SPECIFIED | Drawn               | Unit     |
| A         | FIRST                        | 2014/04/17   | X.X±0.3                              |                     | mm       |
|           |                              |              | X.XX±0.2                             | Checked             |          |
|           |                              |              | Scale 1:1                            | Approve             | Page 1/1 |

### 3. Input Terminal Pin Assignment

| NO. | Symbol | Description  | I/O |
|-----|--------|--|-----|
| 1   | VLED-  | Cathode pin of backlight   | P   |
| 2   | VLED+  | Anode pin of backlight   | P   |
| 3   | GND    | Ground   | P   |
| 4   | VDD    | Supply voltage (3.3V)  | P   |
| 5   | R0     | Red data input   | I/O |
| 6   | R1     | Red data input   | I/O |
| 7   | R2     | Red data input   | I/O |
| 8   | R3     | Red data input   | I/O |
| 9   | R4     | Red data input   | I/O |
| 10  | R5     | Red data input   | I/O |
| 11  | R6     | Red data input   | I/O |
| 12  | R7     | Red data input   | I/O |
| 13  | G0     | Green data input   | I/O |
| 14  | G1     | Green data input   | I/O |
| 15  | G2     | Green data input   | I/O |
| 16  | G3     | Green data input   | I/O |
| 17  | G4     | Green data input   | I/O |
| 18  | G5     | Green data input   | I/O |
| 19  | G6     | Green data input   | I/O |
| 20  | G7     | Green data input   | I/O |
| 21  | B0     | Blue data input  | I/O |
| 22  | B1     | Blue data input  | I/O |
| 23  | B2     | Blue data input  | I/O |
| 24  | B3     | Blue data input  | I/O |
| 25  | B4     | Blue data input  | I/O |
| 26  | B5     | Blue data input  | I/O |
| 27  | B6     | Blue data input  | I/O |
| 28  | B7     | Blue data input  | I/O |
| 29  | GND    | Ground   | P   |
| 30  | PCLK   | Dot clock signal for RGB interface operation. Fix this pin to VCI or GND when not used.  | I   |
| 31  | DISP   | Standby setting for testing. Should be connected to VDDIO in normal operation mode. If connected to GND the IC is in standby mode. | I   |
| 32  | HSYNC  | Line synchronizing signal for RGB interface operation. Fix to VCI or GND when not in use.  | I   |
| 33  | VSYNC  | Frame synchronizing signal for RGB interface operation. Fix this pin to VCI or GND when not used.                                  | I   |
| 34  | DE     | Data enable signal for RGB interface operation. Fix to VCI or GND when not used.   | I   |
| 35  | NC     | NC   |     |
| 36  | GND    | Ground   | P   |
| 37  | XR(NC) | Touch panel right glass terminal   | A/D |
| 38  | YD(NC) | Touch panel bottom film terminal   | A/D |
| 39  | XL(NC) | Touch panel left glass terminal  | A/D |
| 40  | YU(NC) | Touch panel top film terminal  | A/D |

## 4. LCD Optical Characteristics

### 4.1 Optical Specifications

| Item                                 | Symbol     | Condition                                      | Min   | Typ.  | Max   | Unit   | Note   |     |
|--------------------------------------|------------|--|-------|-------|-------|--------|--------|-----|
| Contrast Ratio                       | CR         | $\theta = \phi = 0$<br>Normal<br>viewing angle | 560   | 700   | --    |        | (2)    |     |
| Response time                        | Rising     |  | TR    | --    | 4     | 8      | msec   | (4) |
|                                      | Falling    |  | TF    | --    | 12    | 24     |        |     |
| Transmittance<br>(with polarizer)    | T(%)       |  | --    | 4.29  | --    | %      | (3)    |     |
| Transmittance<br>(without polarizer) | T(%)       |  | --    | 12.16 | --    | %      | (3)    |     |
| Color Gamut                          | S(%)       |  | --    | 62    | --    | %      | (5)    |     |
| Color Filter<br>Chromaticity         | White      |  | $W_x$ | 0.283 | 0.303 | 0.323  | (5)(6) |     |
|                                      |            |  | $W_y$ | 0.305 | 0.325 | 0.345  |        |     |
|                                      | Red        |  | $R_x$ | 0.606 | 0.626 | 0.646  |        |     |
|                                      |            |  | $R_y$ | 0.314 | 0.334 | 0.354  |        |     |
|                                      | Green      | $G_x$  | 0.257 | 0.277 | 0.297 |        |        |     |
|                                      |            | $G_y$  | 0.529 | 0.549 | 0.569 |        |        |     |
|                                      | Blue       | $B_x$  | 0.122 | 0.142 | 0.162 |        |        |     |
|                                      |            | $B_y$  | 0.102 | 0.122 | 0.142 |        |        |     |
| Viewing angle                        | Hor.       | $\theta_L$                                     | 60    | 70    | --    | (1)(6) |        |     |
|                                      |            | $\theta_R$                                     | 60    | 70    | --    |        |        |     |
|                                      | Ver.       | $\theta_U$                                     | 60    | 70    | --    |        |        |     |
|                                      |            | $\theta_D$                                     | 40    | 60    | --    |        |        |     |
| Option View Direction                | 12 o'clock |  |       |       |       |        | (1)    |     |

### 4.2 Measuring Condition

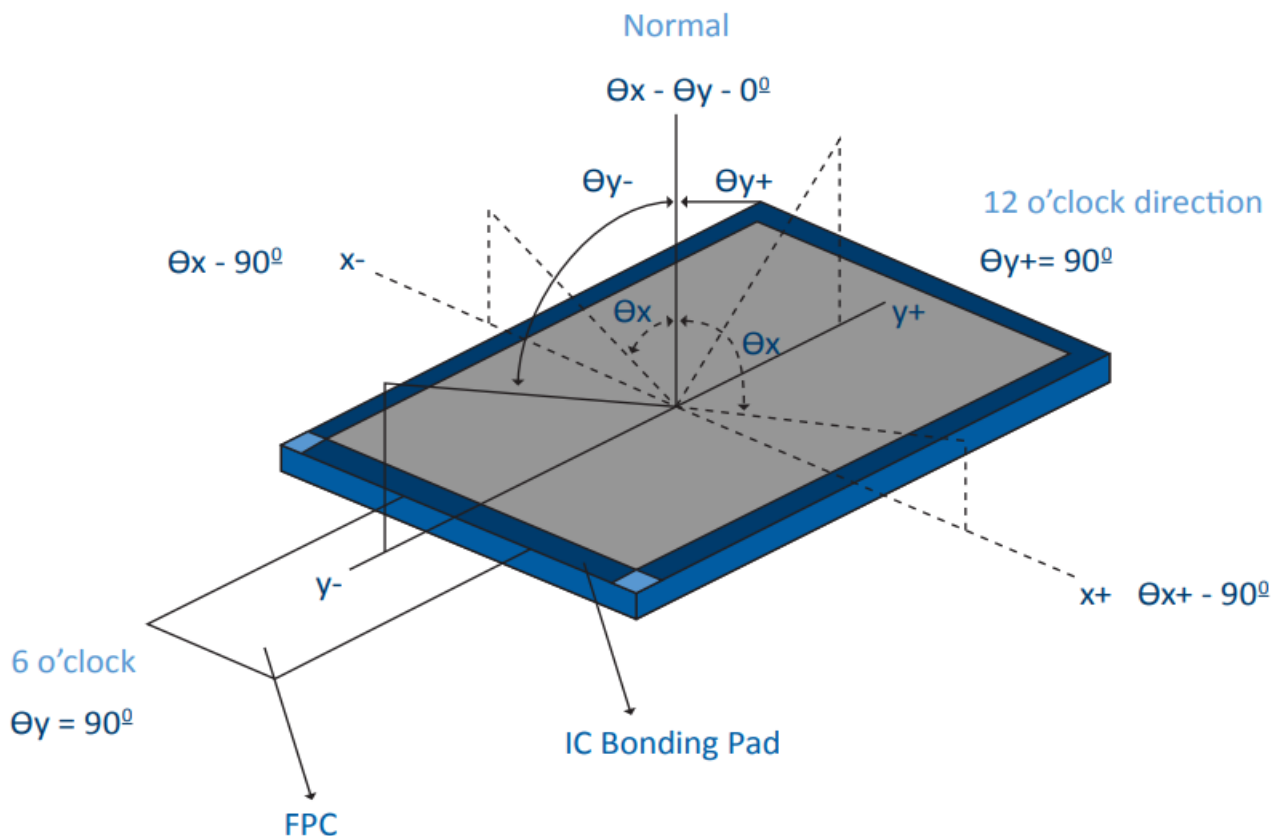
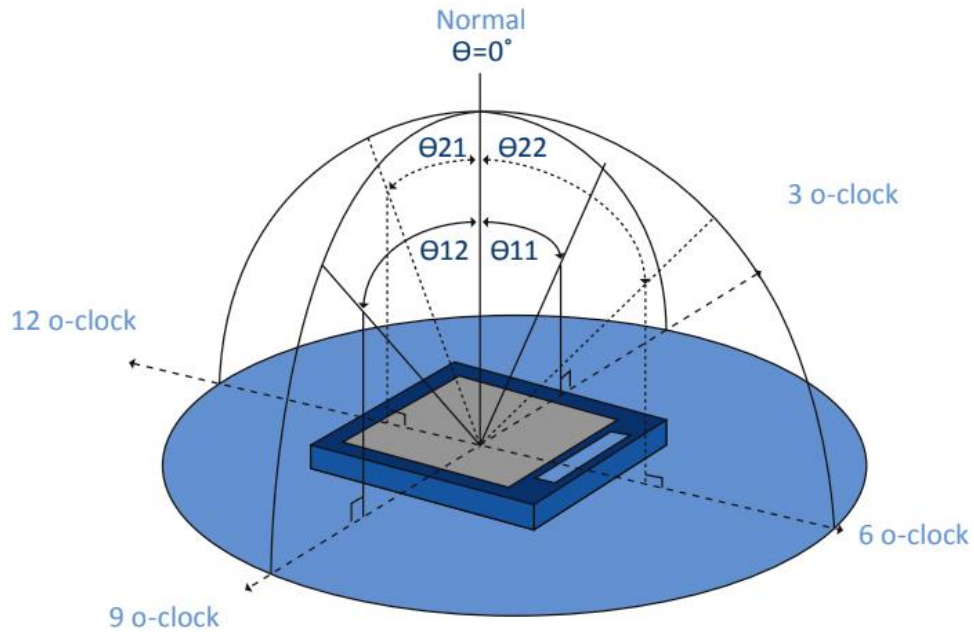
VDD = 3.3V, IL = 20mA (Backlight current)

Ambient temperature:  $25 \pm 2^\circ\text{C}$

15min. warm-up time

**Optical Specification Reference Notes:**

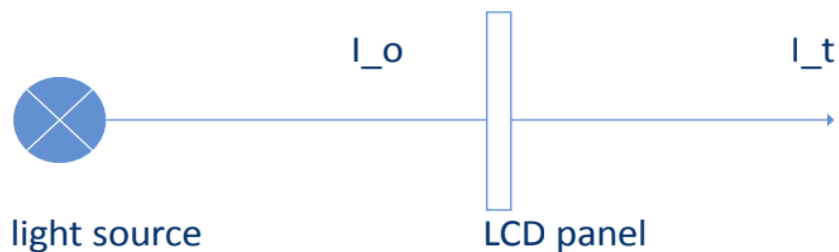
(1) Definition of Viewing Angle: The viewing angle is the angle at which the contrast ratio is greater than 10. The viewing angles are determined for the horizontal or 3,9 o'clock direction and the vertical or 6,12 o'clock direction with respect to the optical axis which is normal to the LCD surface.



(2) Definition of Contrast Ratio (Cr): measured at the center point of panel. The contrast ratio (Cr) measured on a module, is the ratio between the luminance (Lw) in a full white area (R=G=B=1) and the luminance (Ld) in a dark area (R=G=B=0).

$$Cr = \frac{L_w}{L_d}$$

(3) Definition of transmittance (T%): The transmittance of the panel including the polarizers is measured with electrical driving.



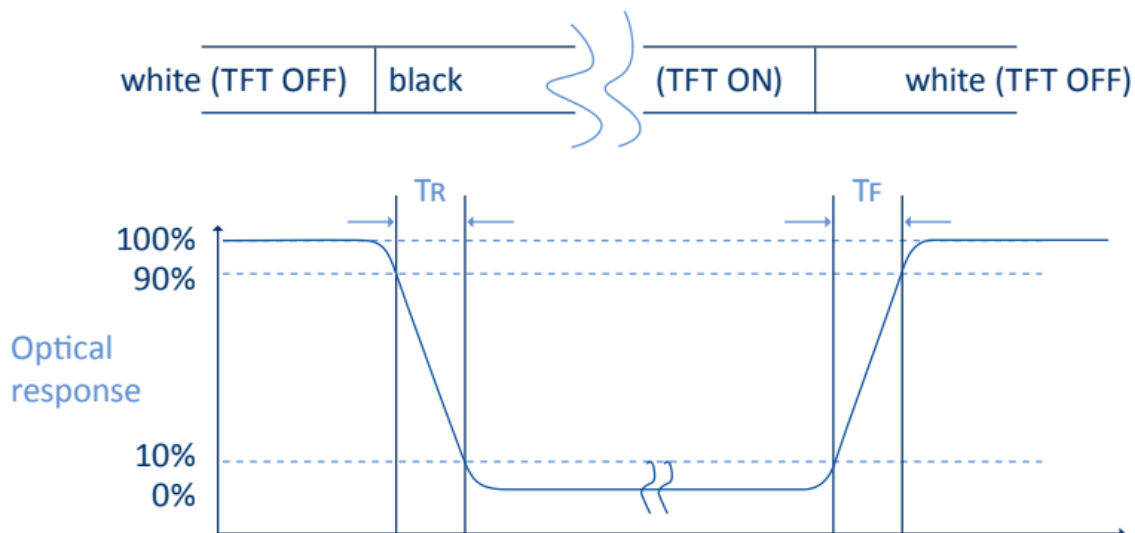
The transmittance is defined as:

$$Tr = \frac{I_t}{I_o} \times 100\%$$

I<sub>o</sub> = the brightness of the light source.

I<sub>t</sub> = the brightness after panel transmission

(4) Definition of Response Time (Tr, Tf): The rise time 'Tr' is defined as the time for luminance to change from 90% to 10% as a result of a change of the electrical condition. The fall time 'Tf' is defined as the time for luminance to change from 10% to 90% as a result of a change of the electrical condition.





(5) Definition of Color Gamut: Measuring machine CFT-01. NTSC's Primaries: R(x,y,Y),G(x,y,Y), B(x,y,Y). FPM520 of Westar Display Technologies, INC., which utilized SR-3 for Chromaticity and BM-5A for other optical characteristics. The color chromaticity shall be calculated from the spectral data measured with all pixels first in red, green, blue and white. Measurements shall be made at the center of the panel.

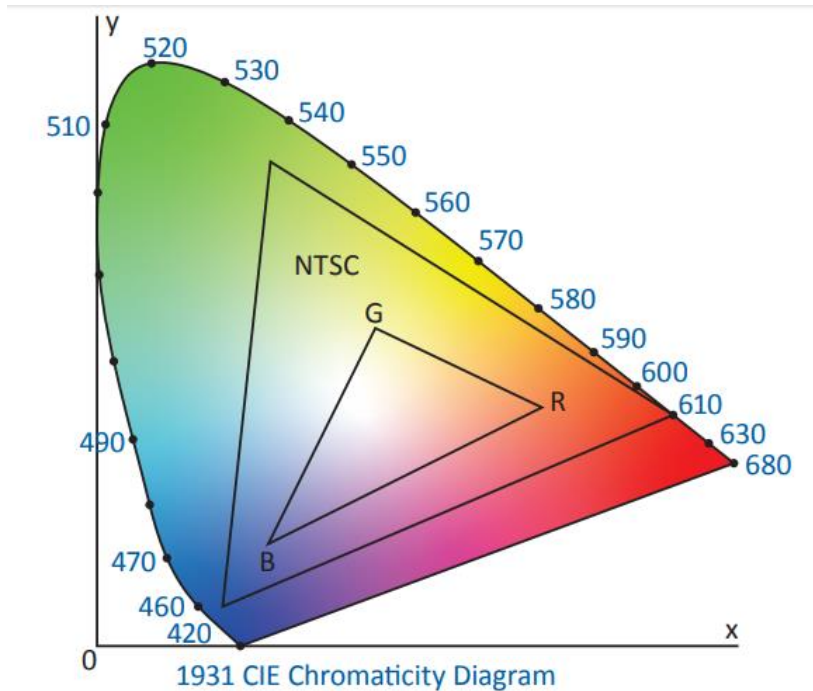
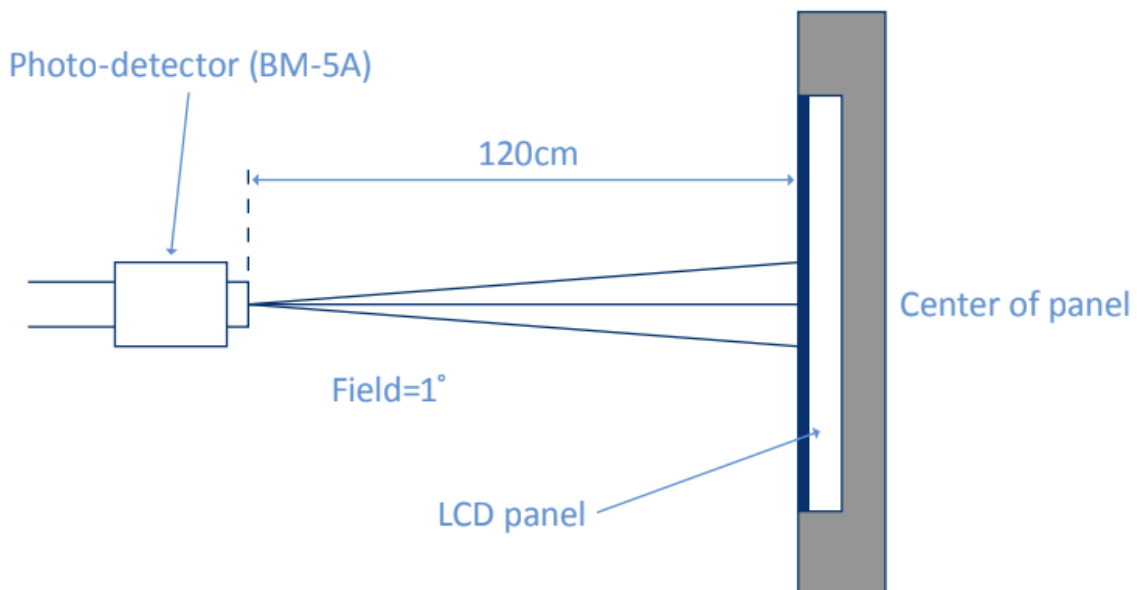


Fig. 1931 CIE chromacity diagram

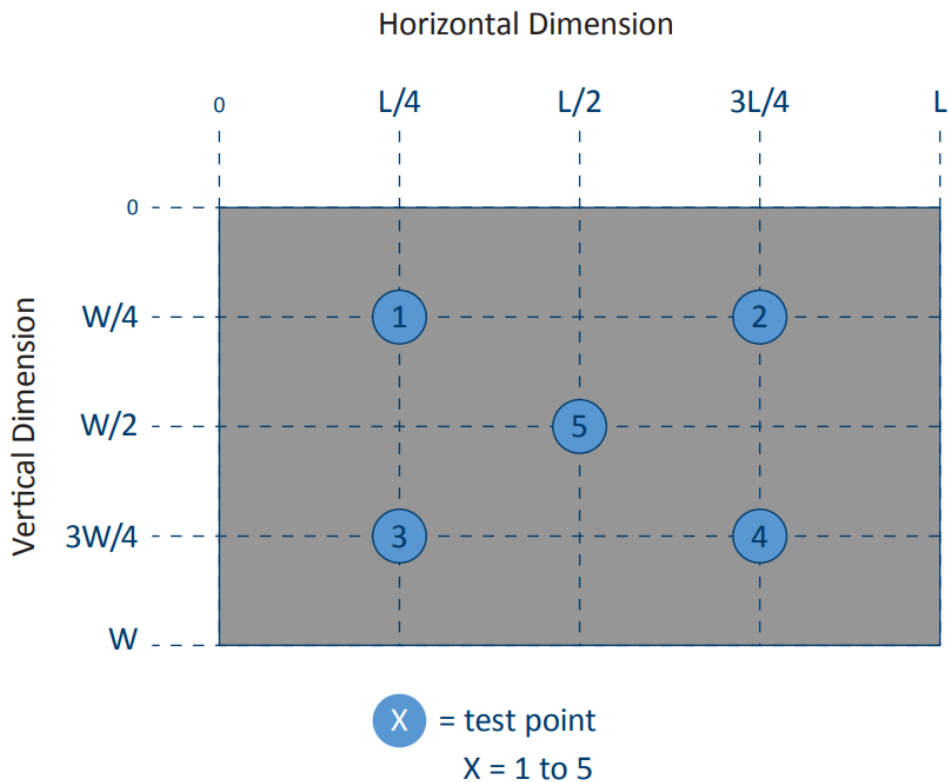
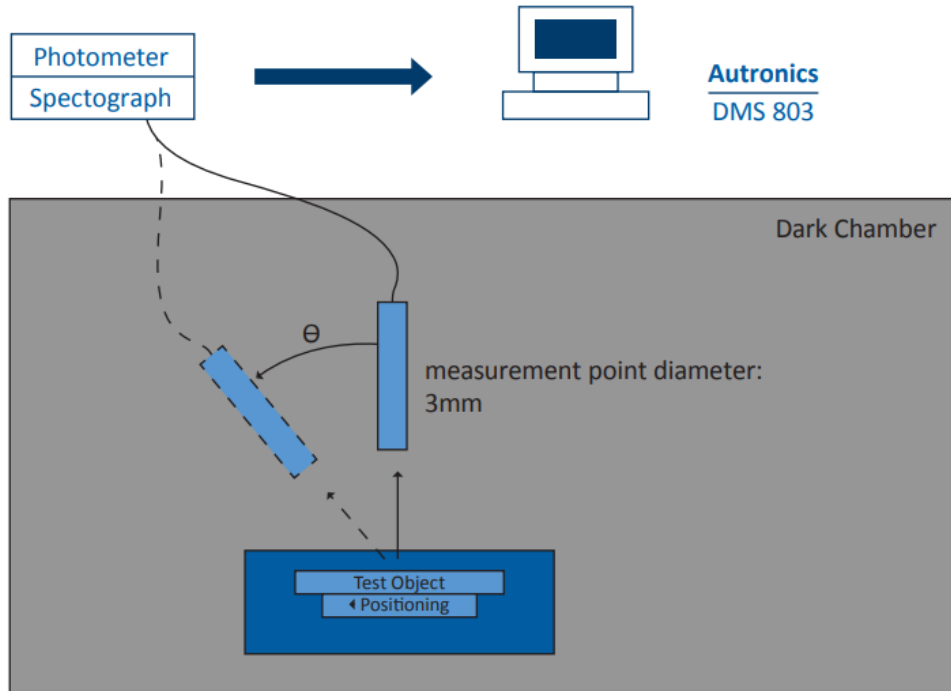
$$\text{Color gamut: } S = \frac{\text{Area of RGB triangle}}{\text{Area of NTSC triangle}} \times 100\%$$

(6) Definition of Optical Measurement Setup:



(6) Optical Measurement Setup Continued:

The LCD module should be stabilized at a given temperature for 20 minutes to avoid abrupt temperature change during measuring. In order to stabilize the luminance, the measurement should be executed after lighting backlight for 20 minutes.



## 5. Electrical Characteristics

### 5.1 Absolute Maximum Rating (Ta=25 VSS=0V)

| Characteristics                  | Symbol          | Min  | Max     | Unit |
|----------------------------------|-----------------|------|---------|------|
| Digital Supply Voltage           | VDD             | -0.5 | 5.0     | V    |
| Digital Interface Supply Voltage | VDDIO           | -0.5 | VDD+0.3 | V    |
| Operating temperature            | T <sub>OP</sub> | -20  | +70     | °C   |
| Storage temperature              | T <sub>ST</sub> | -30  | +80     | °C   |

NOTE: 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           | VDD             | 3.0       | 3.3  | 4.2       | V    |      |
| Digital Interface Supply Voltage | VDDIO           | 3.0       | 3.3  | 4.2       | V    |      |
| Normal Mode Current Consumption  | IDD             | --        | 200  | --        | mA   |      |
| Level input voltage              | V <sub>IH</sub> | 0.7 VDDIO | --   | VDDIO     | V    |      |
|                                  | V <sub>IL</sub> | GND       | --   | 0.3 VDDIO | V    |      |
| Level output voltage             | V <sub>OH</sub> | 0.8 VDDIO | --   | VDDIO     | V    |      |
|                                  | V <sub>OL</sub> | GND       | --   | 0.2 VDDIO | V    |      |

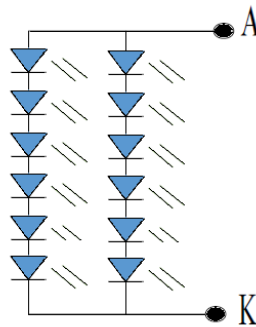
### 5.3 LED Backlight Characteristics

| Item            | Symbol | Min   | Typ. | Max | Unit  | Note      |
|-----------------|--------|-------|------|-----|-------|-----------|
| Forward Current | IF     | 30    | 40   | --  | mA    |           |
| Forward Voltage | VF     | --    | 19.2 | --  | V     |           |
| LCM Luminance   | LV     | 320   | --   | --  | cd/m2 | Note 3    |
| LED lifetime    | Hr     | 50000 | --   | --  | hour  | Note1 & 2 |
| Uniformity      | AVg    | 80    | --   | --  | %     | Note 3    |

The back-light system is edge-lighting type with 12 chips White LED

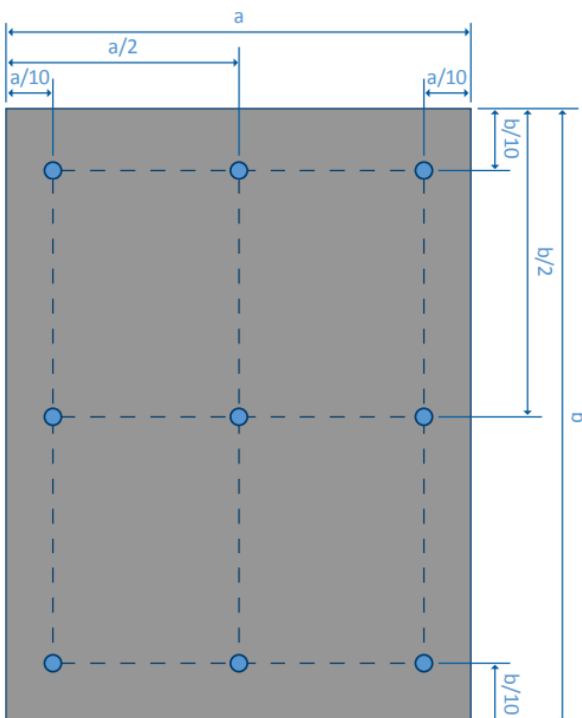
Note 1: LED lifetime (Hr) can be defined as the time in which it continues to operate under the condition: Ta=25±3 °C, typical IL value indicated in the above table until the brightness becomes less than 50%.

Note 2: The “LED lifetime” is defined as the module brightness decrease to 50% original brightness at Ta=25°C and IL=40mA. The LED lifetime could be decreased if operating IL is larger than 40mA. The constant current driving method is suggested.



Backlight LED Circuit

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



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

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

## 6. AC Characteristics

### 6.1 AC Timing Characteristics

| Parameter                      | Symbol     | Min | Typ. | Max | Unit  | Conditions                                  |
|--------------------------------|------------|-----|------|-----|-------|---|
| VDD Power ON slew rate         | $t_{POR}$  | --  | --   | 20  | ms    | 0V-0.9VDD                                   |
| RSTB pulse width               | $t_{RST}$  | 10  | --   | --  | us    | CLKIN=50MHz                                 |
| CLKIN cycle time               | $t_{CPH}$  | 20  | --   | --  | ns    |   |
| CLKIN pulse duty               | $t_{CWH}$  | 40  | 50   | 60  | %     |   |
| VSD setup time                 | $t_{VST}$  | 8   | --   | --  | ns    |   |
| VSD hold time                  | $t_{VHD}$  | 8   | --   | --  | ns    |   |
| HSD setup time                 | $t_{HST}$  | 8   | --   | --  | ns    |   |
| HSD hold time                  | $t_{HHD}$  | 8   | --   | --  | ns    |   |
| Data setup time                | $t_{DST}$  | 8   | --   | --  | ns    | D0[7:0], D1[7:0], D2[7:0] to CLKIN          |
| Data hold time                 | $t_{DHD}$  | 8   | --   | --  | ns    | D0[7:0], D1[7:0], D2[7:0] to CLKIN          |
| DE setup time                  | $t_{EST}$  | 8   | --   | --  | ns    |   |
| DE hold time                   | $t_{EHD}$  | 8   | --   | --  | ns    |   |
| Output stable time             | $t_{SST}$  | --  | --   | 6   | us    | 10% to 90% target voltage, CL=120pF, R=10kΩ |
| CLKIN frequency                | $f_{CLK}$  | --  | 40   | 50  | MHz   | VDD=3.0-3.6V                                |
| CLKIN cycle time               | $t_{CLK}$  | 20  | 25   | --  | ns    |   |
| CLKIN pulse duty               | $t_{CWH}$  | 40  | 50   | 60  | %     | Tclk  |
| Time from HSD to Source output | $t_{HSO}$  | --  | 20   | --  | CLKIN |   |
| Time from HSD to LD            | $t_{HLD}$  | --  | 20   | --  | CLKIN |   |
| Time from HSD to STV           | $t_{HSTV}$ | --  | 2    | --  | CLKIN |   |
| Time from HSD to CKV           | $t_{HCKV}$ | --  | 20   | --  | CLKIN |   |
| Time from HSD to OEV           | $t_{HOEV}$ | --  | 4    | --  | CLKIN |   |
| LD pulse width                 | $t_{WLD}$  | --  | 10   | --  | CLKIN |   |
| CKV pulse width                | $t_{WCKV}$ | --  | 66   | --  | CLKIN |   |
| OEV pulse width                | $t_{WOEV}$ | --  | 74   | --  | CLKIN |   |

Table 6.1: AC Timing Characteristics Table

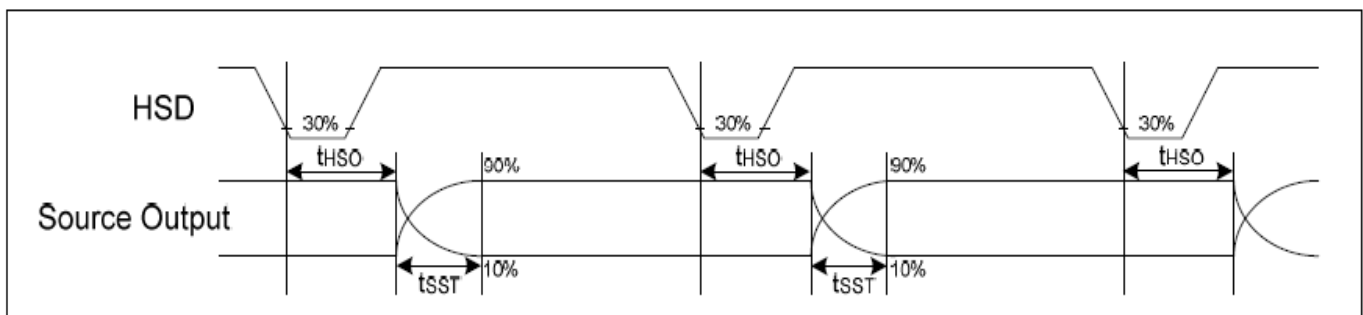


Figure 6.1: Source Output Timing Diagram (Cascade)

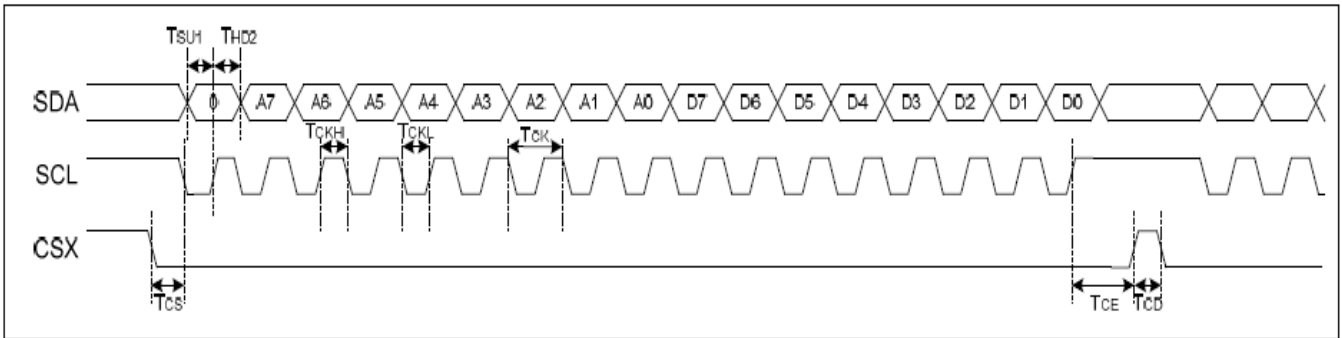


Figure 6. 2: SPI Timing Diagram

| Parameter             | Symbol           | Min | Typ. | Max | Unit | Condition |
|-----------------------|------------------|-----|------|-----|------|-----------|
| SCL period            | T <sub>CLK</sub> | 60  | --   | --  | ns   |           |
| SCL high width        | T <sub>CKH</sub> | 30  | --   | --  | ns   |           |
| SCL low width         | T <sub>CKL</sub> | 30  | --   | --  | ns   |           |
| Data setup time       | T <sub>SU1</sub> | 12  | --   | --  | ns   |           |
| Data hold time        | T <sub>HD1</sub> | 12  | --   | --  | ns   |           |
| CSX to SCL setup time | T <sub>CS</sub>  | 20  | --   | --  | ns   |           |
| CSX to SDA hold time  | T <sub>CE</sub>  | 20  | --   | --  | ns   |           |
| CSX high pulse width  | T <sub>CD</sub>  | 50  | --   | --  | ns   |           |

Table 6.2: SPI AC Timing Characteristics Table

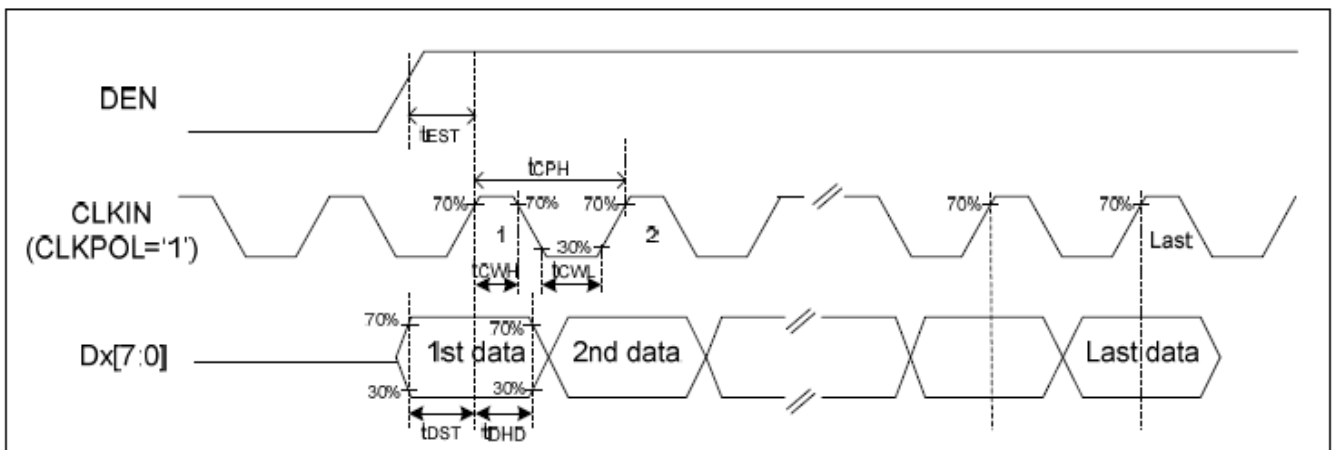


Figure 6.3: DE Mode (Mode='1') Timing Diagram

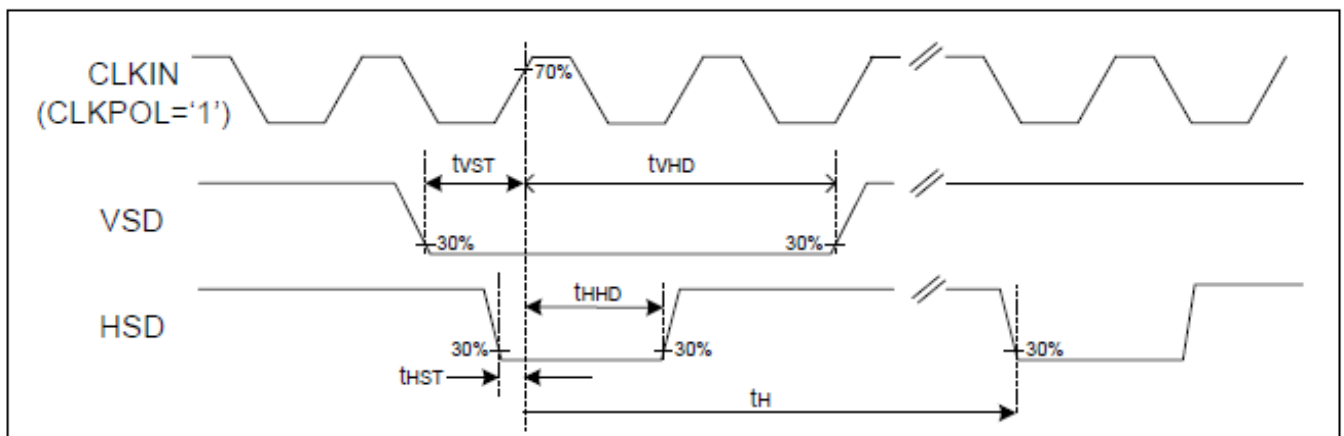


Figure 6.4: SYNC Mode (Mode='0') Timing Diagram

## 6.2 Display Timing Characteristics

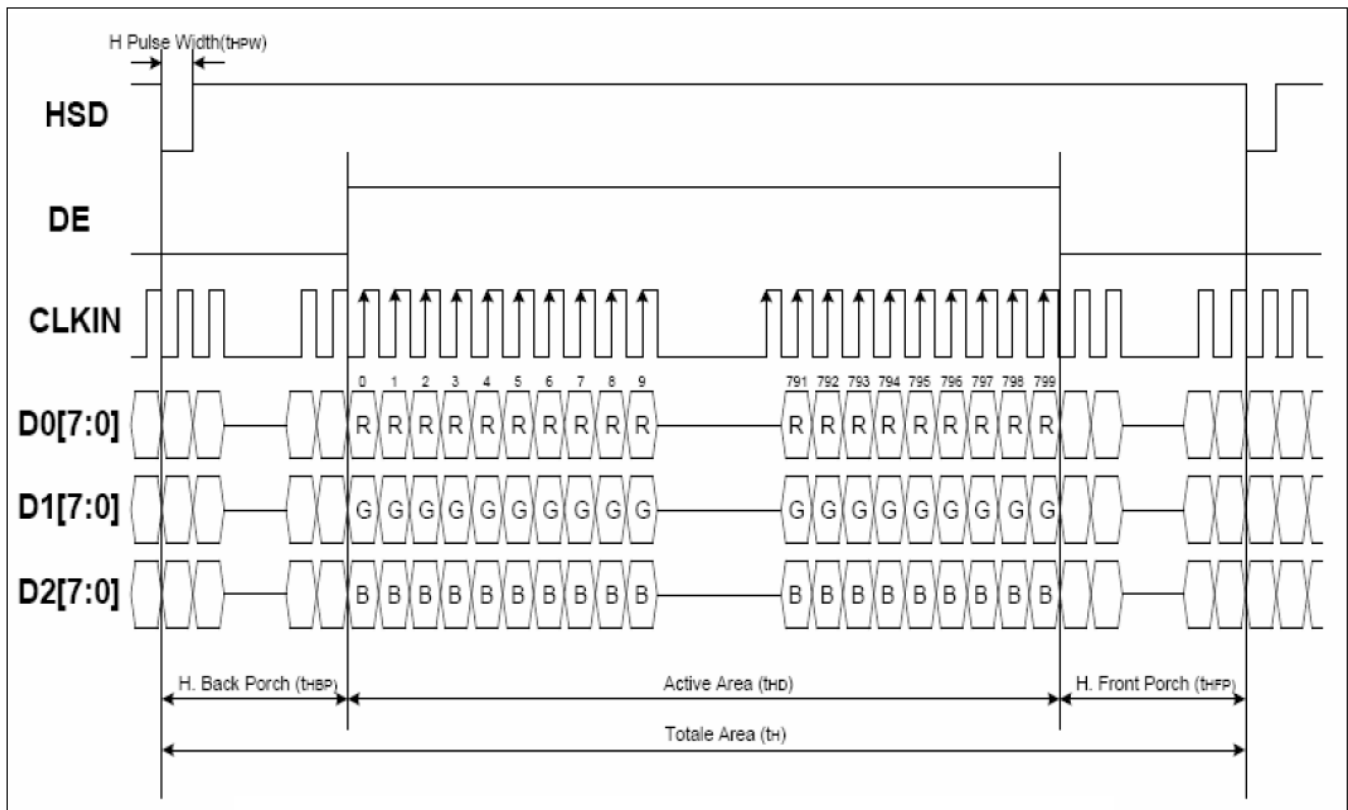


Figure 6.5: Horizontal Input Timing Diagram

### Horizontal Input Timing

| Parameters               | Symbol    | Min       | Typ. | Max  | Unit | Condition |
|--------------------------|-----------|-----------|------|------|------|-----------|
| Horizontal display area  | $t_{HD}$  | --        | 800  | --   | DCLK |           |
| DCLK frequency           | $f_{clk}$ | --        | 33.3 | 50   | MHz  |           |
| 1 Horizontal line period | $t_H$     | 862       | 1056 | 1200 | DCLK |           |
| HSD pulse width          | Min       | --        | 1    | --   | DCLK |           |
|                          | Typ.      | --        | --   | --   | DCLK |           |
|                          | Max       | --        | 40   | --   | DCLK |           |
| HSD back porch           | Sync      | $t_{HBP}$ | 46   | 46   | 46   | DCLK      |
| HSD front porch          | Sync      | $t_{HFP}$ | 16   | 210  | 354  | DCLK      |

Table 6.3: Horizontal Input Timing Characteristics

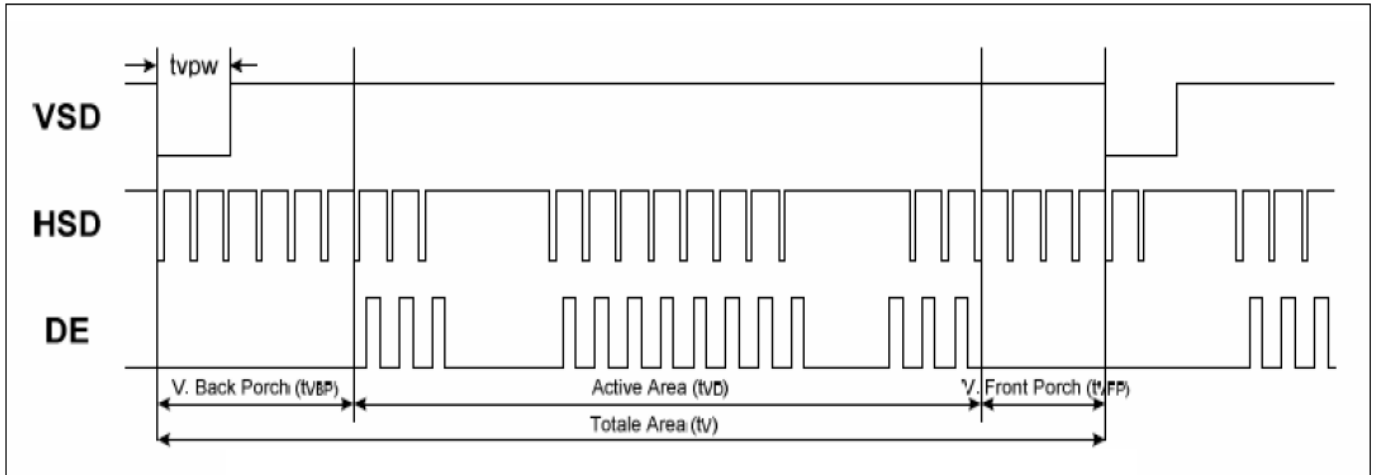


Figure 6.6: Vertical Input Timing Diagram

### Vertical Input Timing

| Parameters            | Symbol           | Min | Typ. | Max | Unit | Condition |
|-----------------------|------------------|-----|------|-----|------|-----------|
| Vertical display area | t <sub>VD</sub>  | --  | 480  | --  | HSD  |           |
| VSD period time       | f <sub>V</sub>   | 510 | 525  | 650 | HSD  |           |
| VSD pulse width       | t <sub>VPW</sub> | 1   | --   | 20  | HSD  |           |
| VSD back porch        | t <sub>VBP</sub> | 23  | 23   | 23  | HSD  |           |
| VSD front porch       | t <sub>VFP</sub> | 7   | 22   | 147 | HSD  |           |

Table 6.4: Vertical Input Timing Characteristics



## 7. Cautions and Handling Precautions

### 7.1 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 back-light 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 fingerstalls 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 Power On Sequence & Power Off Sequence.

### 7.2 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 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.