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

## TFT Display Module

Part Number

E17RG11216LW6M300-R

### Overview:

- 1.8-inch TFT: 128x160 (34.0x47.0)
- 3/4SPI+16/18-bit RGB
- 8/9/16/18-bit MCU
- 4-wire Resistive Touch Screen
- White LED back-light
- Transmissive
- Wide Temp
- 280 NITS
- Controller: ILI9163V
- RoHS Compliant

## Description

This is a color active matrix TFT (Thin Film Transistor) LCD (Liquid / Crystal Display) that uses LTPS (Low Temperature Polysilicon) amorphous silicon TFT as a switching device. This model is composed of a transmissive type TFT-LCD Panel, driver circuit, back-light unit. The resolution of a 1.77" TFT-LCD contains 128x160 pixels and can display up to 65K colors.

## Features

Low Input Voltage: 3.3V (TYP)

Display Colors of TFT LCD: 65K colors

Interface: 8/9/16/18Bit MCU;

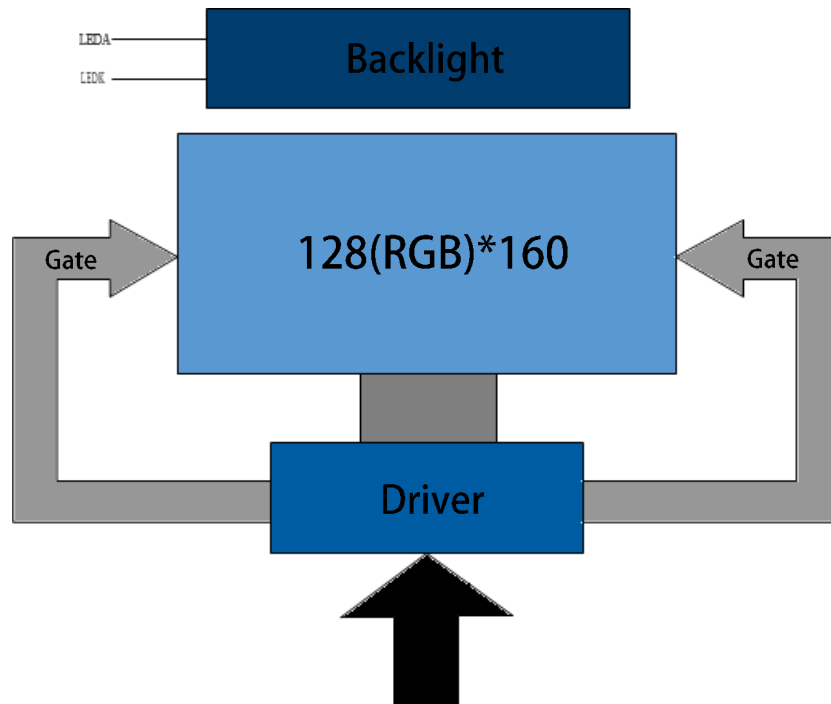
3/4SPI+16/18Bit RGB

| General Information Items | Specification                 | Unit    | Note |
|---------------------------|-------------------------------|---------|------|
|                           | Main Panel                    |         |      |
| Display area (AA)         | 28.02(H) *35.04(V) (1.77inch) | mm      | -    |
| Driver element            | TFT active matrix             | -       | -    |
| Display colors            | 65K                           | colors  | -    |
| Number of pixels          | 128(RGB)*160                  | dots    | -    |
| TFT Pixel arrangement     | RGB vertical stripe           | -       | -    |
| Pixel pitch               | 0.219 (H) x 0.219 (V)         | mm      | -    |
| Viewing angle             | 12:00                         | o'clock | -    |
| TFT Controller IC         | ILI9163V                      | -       | -    |
| Display mode              | Transmissive/Normally White   | -       | -    |
| Operating temperature     | -20~+70                       | °C      | -    |
| Storage temperature       | -30~+80                       | °C      | -    |

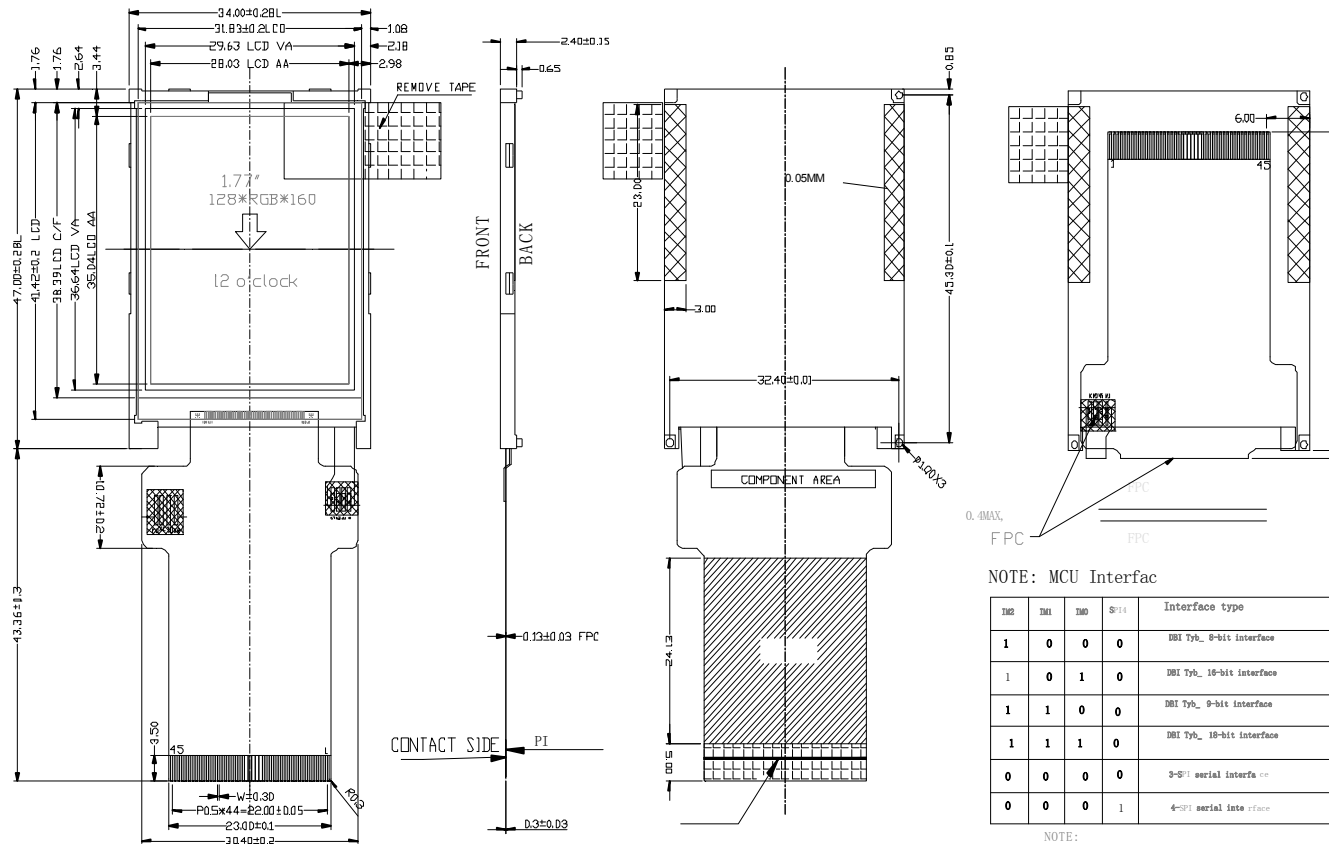
## Mechanical Information

| Item        |               | Min | Typ. | Max | Unit | Note |
|-------------|---------------|-----|------|-----|------|------|
| Module size | Horizontal(H) |     | 34.0 |     | mm   | -    |
|             | Vertical(V)   |     | 47.0 |     | mm   | -    |
|             | Depth(D)      |     | 3.6  |     | mm   | -    |
| Weight      |               |     | TBD  |     | g    | -    |

## 1. Block Diagram



## 2. Outline Dimensions



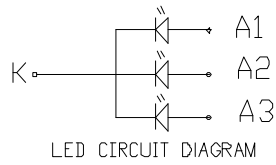
| NO. | Pin Name       |
|-----|----------------|
| 1   | GND            |
| 2   | LEDK           |
| 3   | LEDA1          |
| 4   | LEDA2          |
| 5   | LEDA3          |
| 6   | IM0            |
| 7   | IM1            |
| 8   | IM2            |
| 9   | SPI#           |
| 10  | SPI#W          |
| 11  | VCC            |
| 12  | VCC            |
| 13  | SD1            |
| 14  | RD             |
| 15  | DCX(SPI-SCL)   |
| 16  | WB(SPI-RS)     |
| 17  | CS             |
| 18  | RESET          |
| 19  | DB17(DB5)      |
| 20  | DB16(DB4)      |
| 21  | DB15(DB3)      |
| 22  | DB14(DB2)      |
| 23  | DB13(DB1)      |
| 24  | DB12(DB0)      |
| 25  | DB11(DB5)      |
| 26  | DB10(DB4)      |
| 27  | DB9(DB3)       |
| 28  | DB8(DB2)       |
| 29  | DB7(DB1)       |
| 30  | DB6(DB0)       |
| 31  | DB5(DB5)       |
| 32  | DB4(DB4)       |
| 33  | DB3(DB3)       |
| 34  | DB2(DB2)       |
| 35  | DB1(DB1)       |
| 36  | DB0(DB0/BS/DA) |
| 37  | PCLK           |
| 38  | DE             |
| 39  | HSYNC          |
| 40  | VSYNC          |
| 41  | X(R(X+)        |
| 42  | Y(D(Y+)        |
| 43  | XL(X-)         |
| 44  | YL(Y-)         |
| 45  | GND            |

NOTE: MCU Interfac

| IM2 | IM1 | IM0 | SPI | Interface type                         | DB Pin in use     |
|-----|-----|-----|-----|--|-------------------|
| 1   | 0   | 0   | 0   | DB1 Ty <sub>h</sub> , 8-bit interface  | DB7-DB0           |
| 1   | 0   | 1   | 0   | DB1 Ty <sub>h</sub> , 18-bit interface | DB15-DB0          |
| 1   | 1   | 0   | 0   | DB1 Ty <sub>h</sub> , 9-bit interface  | DB8-DB0           |
| 1   | 1   | 1   | 0   | DB1 Ty <sub>h</sub> , 18-bit interface | DB17-DB0          |
| 0   | 0   | 0   | 0   | 8-SPI serial interface                 | DB0-SBA SCL CS    |
| 0   | 0   | 0   | 1   | 4-SPI serial interface                 | DB0-SBA SCL CS RS |

NOTE:  
1. If not use PIN, fix to the GND, 10VCC or NC.


- NOTES:
1. DISPLAY TYPE: 1.7", TFT-LCD, 65K COLORS
  2. DISPLAY MODE: T/M NORMALLY WHITE
  3. VIEWING DIRECTION: 12:00
  4. DRIVER IC: HX8238D (COG)
  5. INTERFACE: 16BIT/18BIT/24BIT-RGB VCI:
  6. 3.3V(TYP)
  7. OPERATING TEMP: -20°C TO 70°C  
STORAGE TEMP: -30°C TO 80°C
  8. BACK LIGHT: LED WHITE, 6 LED, 20mA, 18.6±0.3V
  9. RoHS COMPLIANT.



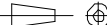
| RCM1 | SET MODE |
|------|----------|
| 1    | RGB MODE |
| 0    | MCU MODE |

NOTE: If used RGB mode must select serial interface!

| Re V. | Revision content description | Date |
|-------|------------------------------|------|
| V0    |                              |      |



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|                                      |   |              |                     |
|--------------------------------------|---|--------------|---------------------|
| TOLERANCE( )                         | <b>±0.2</b>   | DRAWING NAME | E17RG11216LW6M300-R |
| TOLERANCE UNLESS OTHERWISE SPECIFIED | X.X±0.3   | Drawn        | Unit                |
|                                      | X.XX±0.2  | Checked      | mm                  |
| Scale 1:1                            |  | Approve      | Page 1/1            |

### 3. Input Terminal Pin Assignment

Recommended TFT Connector: FH12S-45S-0.5SH(55)

Recommended RTP Connector: FH33-4S-1SH(10)

| NO.   | Symbol         | Description  | I/O |     |     |                    |   |   |                    |   |   |                     |   |   |                    |   |   |                     |
|-------|----------------|--|-----|-----|-----|--------------------|---|---|--------------------|---|---|---------------------|---|---|--------------------|---|---|---------------------|
| 1     | GND            | Ground.  | P   |     |     |                    |   |   |                    |   |   |                     |   |   |                    |   |   |                     |
| 2     | LEDK           | Cathode pin OF backlight.  | P   |     |     |                    |   |   |                    |   |   |                     |   |   |                    |   |   |                     |
| 3     | LEDA1          | Anode pin of backlight.  | P   |     |     |                    |   |   |                    |   |   |                     |   |   |                    |   |   |                     |
| 4     | LEDA2          | Anode pin of backlight.  | P   |     |     |                    |   |   |                    |   |   |                     |   |   |                    |   |   |                     |
| 5     | LEDA3          | Anode pin of backlight.  | P   |     |     |                    |   |   |                    |   |   |                     |   |   |                    |   |   |                     |
| 6     | IM0            | MCU parallel interface type selection  | I   |     |     |                    |   |   |                    |   |   |                     |   |   |                    |   |   |                     |
| 7     | IM1            | <table border="1"> <thead> <tr> <th>IM1</th> <th>IM0</th> <th>Parallel interface</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>0</td> <td>MCU 8-bit Parallel</td> </tr> <tr> <td>0</td> <td>1</td> <td>MCU 16-bit Parallel</td> </tr> <tr> <td>1</td> <td>0</td> <td>MCU 9-bit Parallel</td> </tr> <tr> <td>1</td> <td>1</td> <td>MCU 18-bit Parallel</td> </tr> </tbody> </table> |     | IM1 | IM0 | Parallel interface | 0 | 0 | MCU 8-bit Parallel | 0 | 1 | MCU 16-bit Parallel | 1 | 0 | MCU 9-bit Parallel | 1 | 1 | MCU 18-bit Parallel |
| IM1   | IM0            | Parallel interface   |     |     |     |                    |   |   |                    |   |   |                     |   |   |                    |   |   |                     |
| 0     | 0              | MCU 8-bit Parallel   |     |     |     |                    |   |   |                    |   |   |                     |   |   |                    |   |   |                     |
| 0     | 1              | MCU 16-bit Parallel  |     |     |     |                    |   |   |                    |   |   |                     |   |   |                    |   |   |                     |
| 1     | 0              | MCU 9-bit Parallel   |     |     |     |                    |   |   |                    |   |   |                     |   |   |                    |   |   |                     |
| 1     | 1              | MCU 18-bit Parallel  |     |     |     |                    |   |   |                    |   |   |                     |   |   |                    |   |   |                     |
| 8     | IM2            | MCU Parallel interface bus and Serial interface select IM2='1'; Parallel Interface. IM2='0'; Serial Interface  |     |     |     |                    |   |   |                    |   |   |                     |   |   |                    |   |   |                     |
| 9     | RCM1           | RGB and MCU interface mode selection pin. RCM1=1, RGB interface RCM1=0, MCU interface mode   |     |     |     |                    |   |   |                    |   |   |                     |   |   |                    |   |   |                     |
| 10    | SP14W          | SPI interface selection pin.SPI4W='0': 3 wire SPI. SPI4W='1': 4-wire SPI. This pin is internal pull low.   | I   |     |     |                    |   |   |                    |   |   |                     |   |   |                    |   |   |                     |
| 11    | VCC            | Supply voltage (3.3V).   | P   |     |     |                    |   |   |                    |   |   |                     |   |   |                    |   |   |                     |
| 12    | VCC            | Supply voltage (3.3V).   | P   |     |     |                    |   |   |                    |   |   |                     |   |   |                    |   |   |                     |
| 13    | SDI            | When RCM1, RCM0='1X'(RGB I/F), serial input/ output signal in serial I/F mode. The data is in put on the rising edge of the SCL signal. The data is output on the falling edge of the SCL signal. When RCM1, RCM0='0X'(MCU I/F), this pin is not used, and fix at VDDI or GND level. If not used, please fix this pin at VDDI or GND level.  | I   |     |     |                    |   |   |                    |   |   |                     |   |   |                    |   |   |                     |
| 14    | RD             | Read enable. If not used, please connect this pin to VDD.  | I   |     |     |                    |   |   |                    |   |   |                     |   |   |                    |   |   |                     |
| 15    | DC/SCL         | Displaydata/Commandselection pin in parallel el and SCL in 3- pin SPI interface. D/CX='1': Display data. D/CX='0': Command data. If not used, please connect this pin to GND.  | I   |     |     |                    |   |   |                    |   |   |                     |   |   |                    |   |   |                     |
| 16    | WR/SPI_RS      | Write enable in parallel interface. WRX: for 8080 MCU D/CX: for 4-wire SPI If not used, please connect this pin to VDDI or GND.  | I   |     |     |                    |   |   |                    |   |   |                     |   |   |                    |   |   |                     |
| 17    | CS             | Chip select input pin ("Low" enable). This pin can be permanently fixed "Low" in MCU interface mode only.  | I   |     |     |                    |   |   |                    |   |   |                     |   |   |                    |   |   |                     |
| 18    | RESET          | Reset signal. Must be applied to properly initialize the chip.   | I   |     |     |                    |   |   |                    |   |   |                     |   |   |                    |   |   |                     |
| 19-36 | DB17-DB0(S DA) | When RCM1='0' (MCU I/F), D [17:0] are used to MCU parallel interface data bus, and D0 is also the serial input/ output signal in SPI interface mode. In serial interface, D [17: 1] are not used and should be connected to ground. When RCM1='1' (RGB I/F), D [17:0] are used to RGB interface data bus.  | I/O |     |     |                    |   |   |                    |   |   |                     |   |   |                    |   |   |                     |
| 37    | PCLK           | Pixel clock signal in RGB I/F mode. If it' s not used, fix at GND level  | I   |     |     |                    |   |   |                    |   |   |                     |   |   |                    |   |   |                     |
| 38    | DE             | Data enable signal in RGB I/F mode. If it's not used, fix this pin at GND level.   | I   |     |     |                    |   |   |                    |   |   |                     |   |   |                    |   |   |                     |
| 39    | HSYNC          | Horizontal sync. Signal in RGB I/F mode. Fix to GND when not used.   | I   |     |     |                    |   |   |                    |   |   |                     |   |   |                    |   |   |                     |
| 40    | VSYNC          | Vertical sync. Signal in RGB I/F mode. Fix to GND when not used.   | I   |     |     |                    |   |   |                    |   |   |                     |   |   |                    |   |   |                     |
| 41    | XR(NC)         | Touch panel right glass terminal   |     |     |     |                    |   |   |                    |   |   |                     |   |   |                    |   |   |                     |
| 42    | YD(NC)         | Touch panel bottom film terminal   |     |     |     |                    |   |   |                    |   |   |                     |   |   |                    |   |   |                     |
| 43    | XL(NC)         | Touch panel left glass terminal  |     |     |     |                    |   |   |                    |   |   |                     |   |   |                    |   |   |                     |
| 44    | YU(NC)         | Touch panel top film terminal  |     |     |     |                    |   |   |                    |   |   |                     |   |   |                    |   |   |                     |
| 45    | GND            | Ground   | P   |     |     |                    |   |   |                    |   |   |                     |   |   |                    |   |   |                     |

## 4. LCD Optical Characteristics

### 4.1 Optical specification

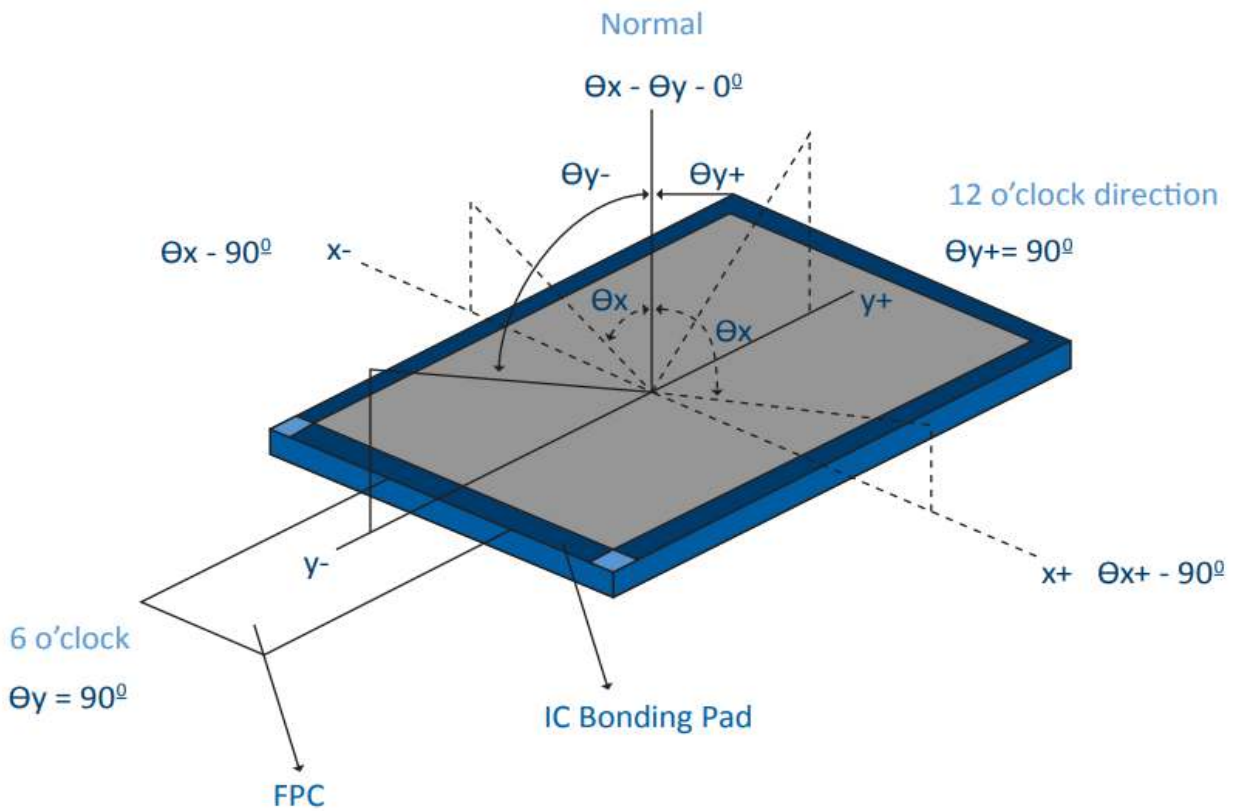
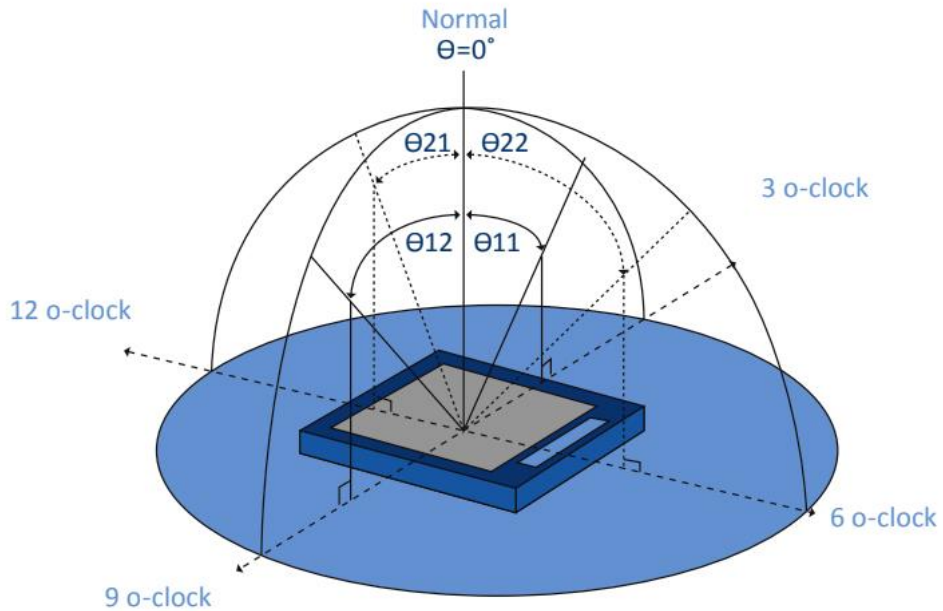
| Item                                 |                    | Symbol                         | Condition                      | Min   | Typ.  | Max   | Unit | Note                  |
|--------------------------------------|--------------------|--------------------------------|--------------------------------|-------|-------|-------|------|-----------------------|
| Transmittance<br>(without Polarizer) |                    | T(%)                           | -                              | -     | 19.1  | -     |      |                       |
| Contrast Ratio                       |                    | CR                             | Θ=0<br>Normal viewing<br>angle | 400   | 500   | --    |      | (1)(2)                |
| Response<br>time                     | Rising+<br>Falling | T <sub>R</sub> +T <sub>F</sub> |                                | --    | 8     | 16    | msec |                       |
| Color gamut                          |                    | S (%)                          |                                | --    | 60    | --    | %    | (1)(3)                |
| Color Filter<br>Chromaticity         | White              | W <sub>x</sub>                 |                                | 0.283 | 0.303 | 0.323 |      | (1)(4)<br>CF<br>Glass |
|                                      |                    | W <sub>y</sub>                 |                                | 0.305 | 0.325 | 0.345 |      |                       |
|                                      | Red                | R <sub>x</sub>                 |                                | 0.606 | 0.626 | 0.646 |      |                       |
|                                      |                    | R <sub>y</sub>                 |                                | 0.314 | 0.334 | 0.354 |      |                       |
|                                      | Green              | G <sub>x</sub>                 |                                | 0.257 | 0.277 | 0.297 |      |                       |
|                                      |                    | G <sub>y</sub>                 |                                | 0.529 | 0.549 | 0.569 |      |                       |
|                                      | Blue               | B <sub>x</sub>                 |                                | 0.122 | 0.142 | 0.162 |      |                       |
|                                      |                    | B <sub>y</sub>                 |                                | 0.102 | 0.122 | 0.142 |      |                       |
| Viewing angle                        | Hor.               | Θ <sub>L</sub>                 | CR>10                          | 35    | 45    | --    |      |                       |
|                                      |                    | Θ <sub>R</sub>                 |                                | 35    | 45    | --    |      |                       |
|                                      | Ver.               | Θ <sub>U</sub>                 |                                | 35    | 45    | --    |      |                       |
|                                      |                    | Θ <sub>D</sub>                 |                                | 10    | 20    | --    |      |                       |
| Option View Direction                |                    | 12 O'clock                     |                                |       |       |       |      | (5)                   |

### 4.2 Measuring Conditions

Measuring surrounding: dark room  
 Ambient temperature: 25±2oC  
 15min. warm-up time.

**Optical Specification Reference Notes:**

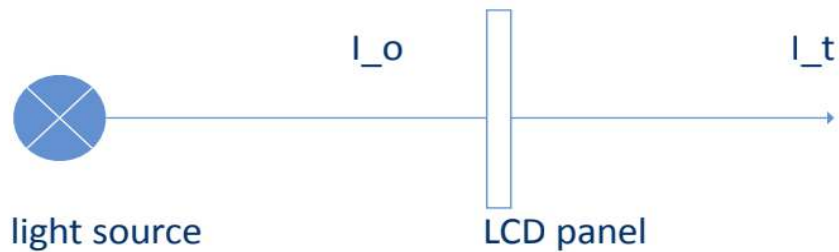
(1) Definition of Viewing Angle: The viewing angle is the angle at which the contrast ratio is greater than 10. The viewing angles are determined for the horizontal or 3,9 o'clock direction and the vertical or 6,12 o'clock direction with respect to the optical axis which is normal to the LCD surface.



(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.



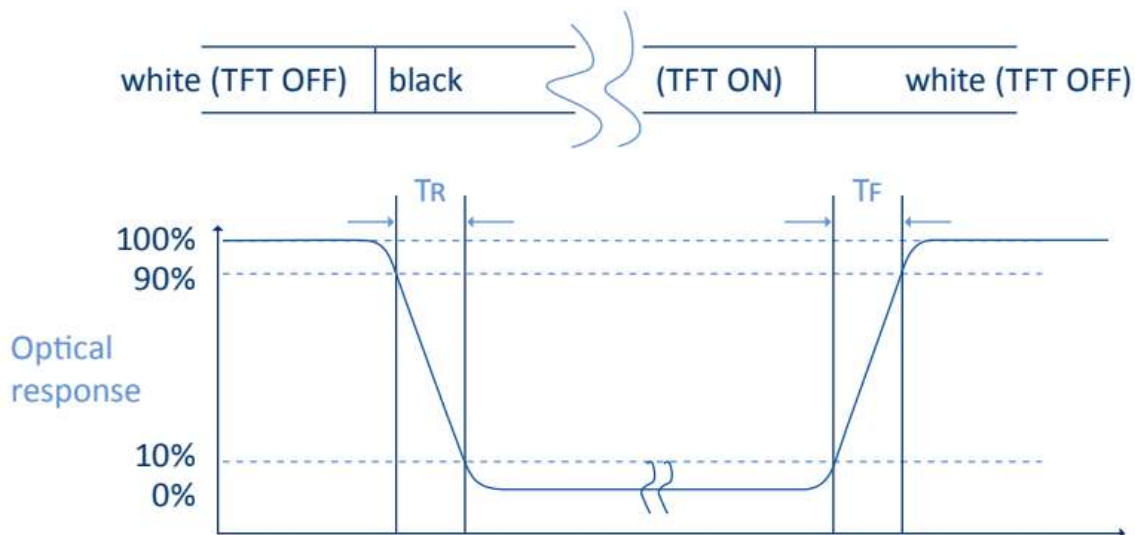
The transmittance is defined as:

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

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.

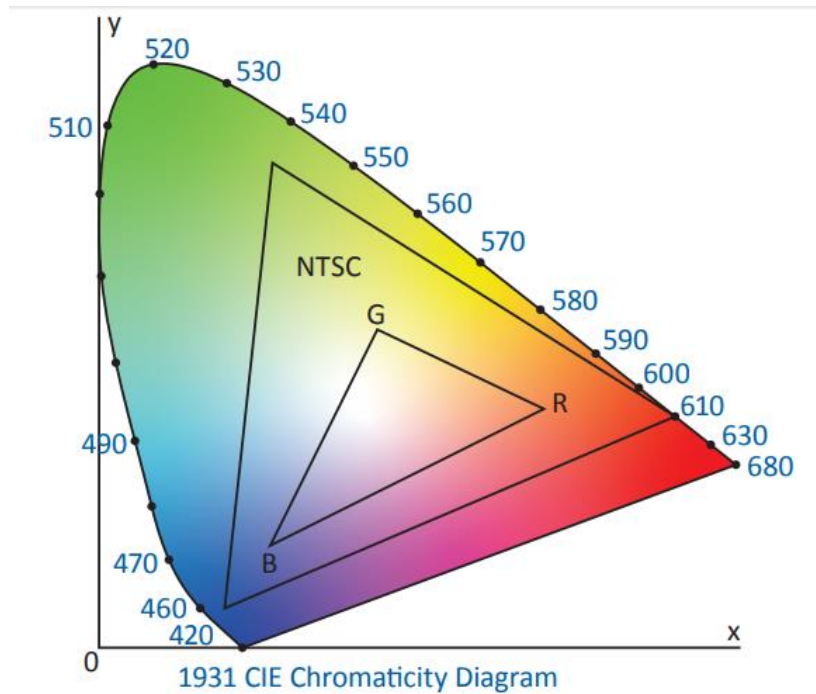
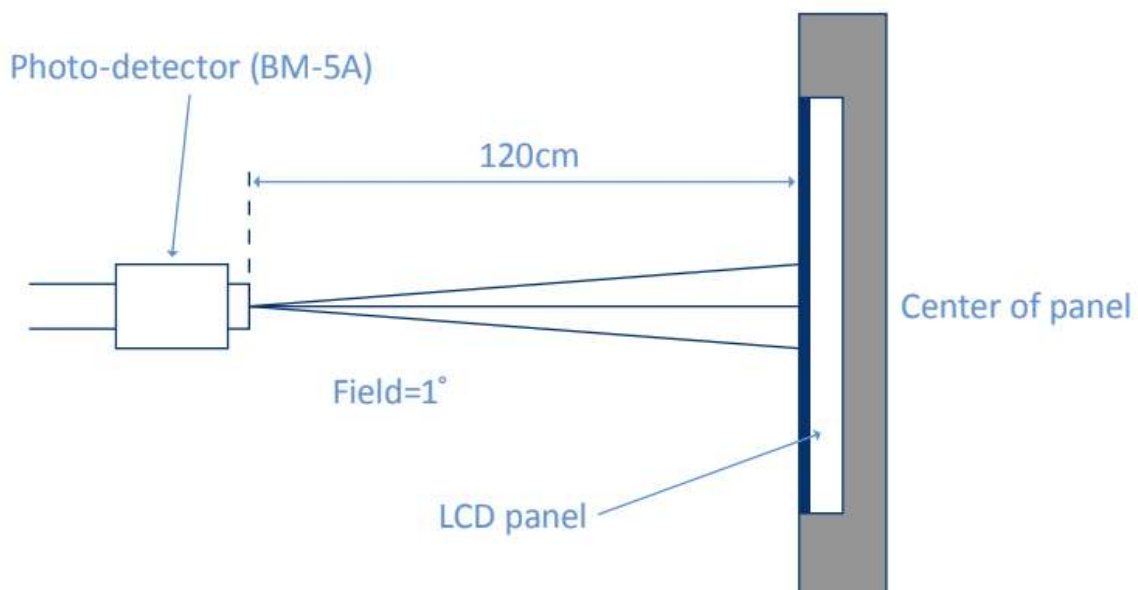


Fig. 1931 CIE chromacity diagram

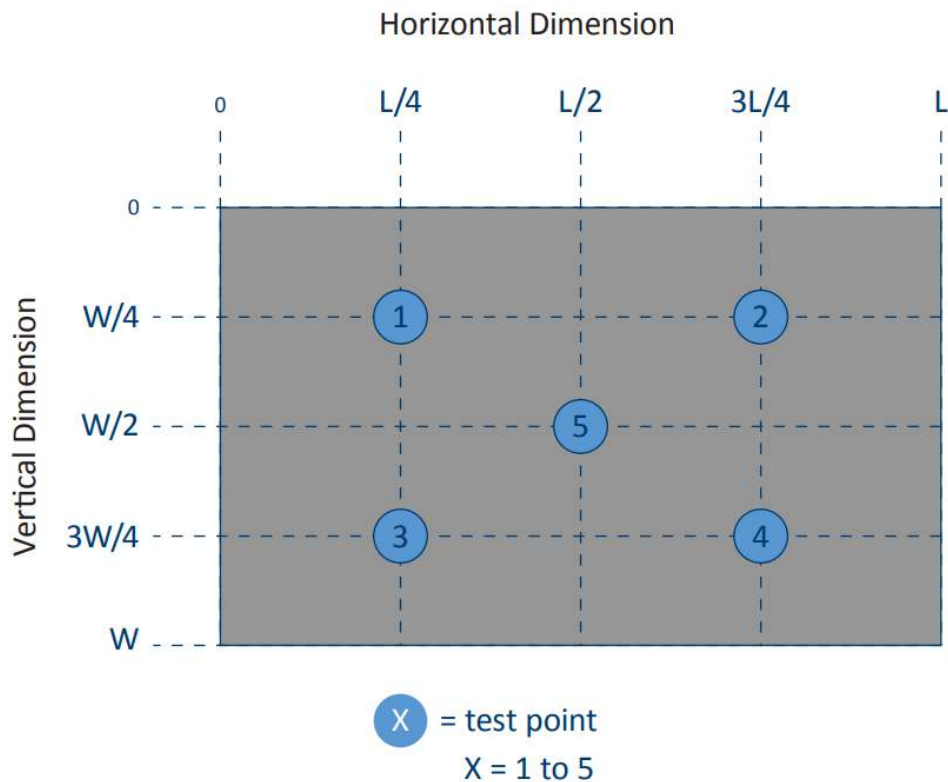
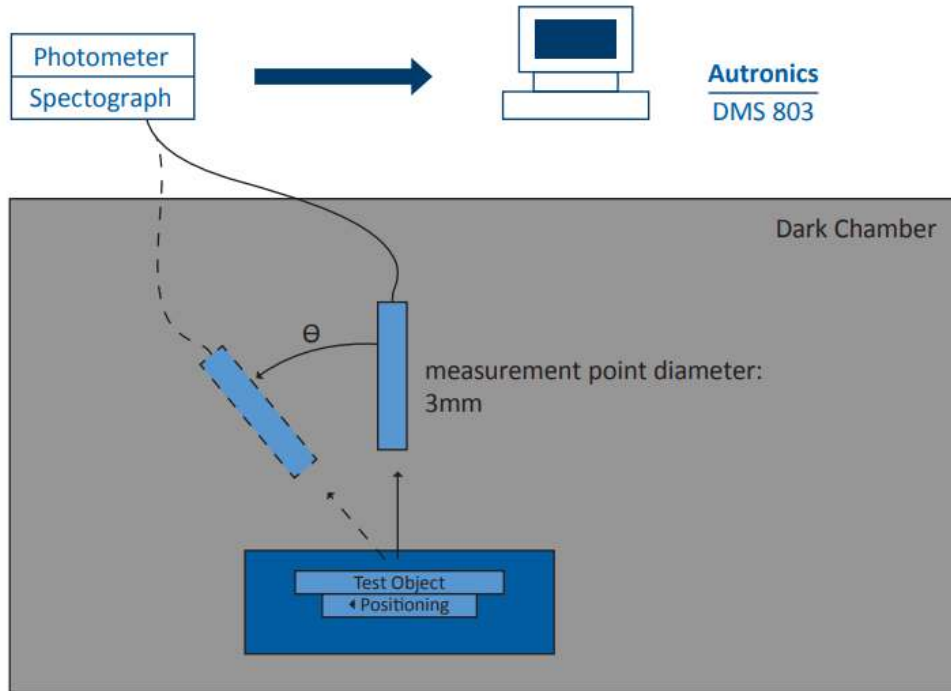
$$\text{Color gamut: } S = \frac{\text{Area of RGB triangle}}{\text{Area of NTSC triangle}} \times 100\%$$

(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    | -0.3 | 4.8 | V    |
| Interface Operation Voltage | VDDIO  | -0.3 | 4.6 | V    |
| Operating temperature       | TOP    | -20  | +70 | °C   |
| Storage temperature         | TST    | -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    | 2.5       | 3.3  | 4.2       | V    |      |
| Interface Operation Voltage     | VDDIO  | 1.65      | 3.3  | 4.2       | V    |      |
| Normal Mode Current Consumption | IDD    | --        | 1.5  | --        | mA   |      |
| Level input voltage             | VIH    | 0.7 VDDIO |      | VDDIO     | V    |      |
|                                 | VIL    | GND       |      | 0.3 VDDIO | V    |      |
| Level output voltage            | VOH    | 0.8 VDDIO |      | IOVCC     | V    |      |
|                                 | VOL    | GND       |      | 0.2 VDDIO | V    |      |

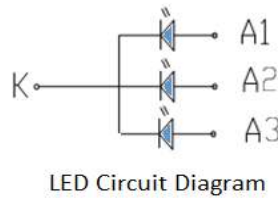
### 5.3 LED Backlight Characteristics

The back-light system is edge-lighting type with 3 chips White LED

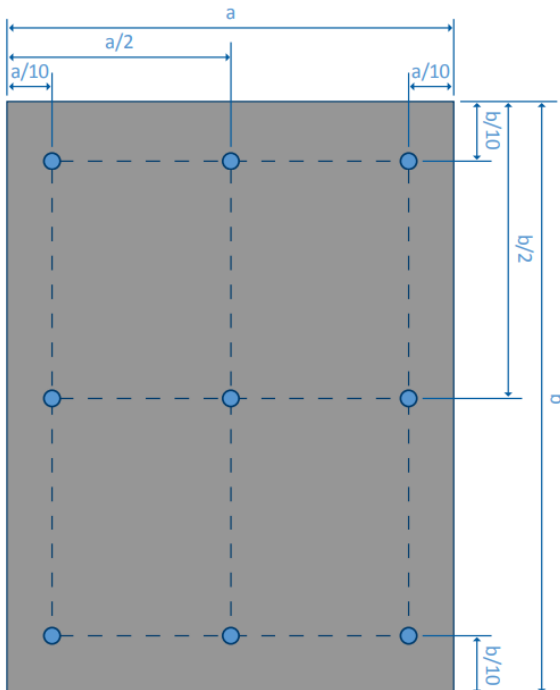
| Item            | Symbol | Min | Typ. | Max | Unit              | Note   |
|-----------------|--------|-----|------|-----|-------------------|--------|
| Forward Current | IF     | 45  | 60   | --  | mA                |        |
| Forward Voltage | VF     | --  | 3.2  | --  | V                 |        |
| LCM Luminance   | LV     | 280 | --   | --  | cd/m <sup>2</sup> | Note 3 |
| Uniformity      | AVg    | 80  | --   | --  | %                 | Note 3 |

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=20mA. The LED lifetime could be decreased if operating IL is larger than 20mA. The constant current driving method is suggested.



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



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

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

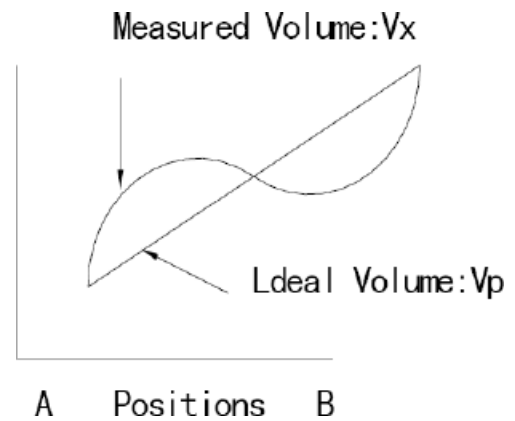
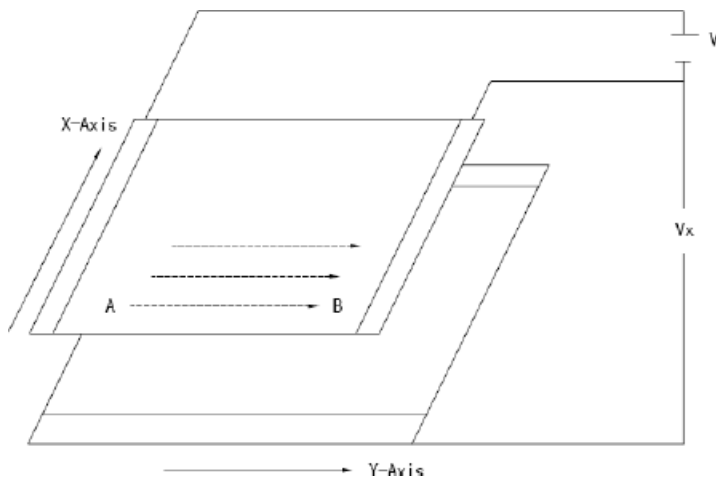
## 6. TP Feature

### 6.1 Conditions of Use and Storage

| Item                             | Condition   | Note                  |
|----------------------------------|---|-----------------------|
| Temperature range upon operation | Humidity: 20%-90% non-dew, condensation<br>-20°C~70°C | In a simple substance |
| Temperature range upon storage   | Humidity: 20%-90% non-dew, condensation<br>-30°C~80°C | In a simple substance |

### 6.2 Electrical Property

| Item                        | Value                                      | Note  |
|-----------------------------|--|---|
| Maximum voltage             | DC5V                                       |   |
| Resistance between terminal | X direction (film side): 200-600 $\Omega$  | Connect X + ~X and Y+ ~Y,<br>apply 25V DC Between X and Y for<br>perform measurements |
|                             | X direction (glass side): 300-900 $\Omega$ |   |
| Insulation resistance       | DC 25V, 20M $\Omega$ or above              |   |
| Chattering                  | 10ms or below                              |   |
| Rating                      | Voltage is 5V DC                           |   |



### 6.3 Mechanical Property

| Item                | Value                              |                  | Note  |
|---------------------|------------------------------------|------------------|---|
| Input method        | Used of an exclusive pen or finger |                  |   |
| Load upon operation | Exclusive pen                      | 60-100g or below | Operation and measurement with a pen must be carried out under the following tip conditions:<br>Stylus pen material: POM (polyacetal)<br>Tip: Diameter 3.0mm, SR 0.8 mm                   |
|                     | Finger                             | 60-100g or below | Operation and measurement with a pen must be carried out under the following tip conditions:<br>Stylus pen material: Silicon rubber (Hardness: 30°Hs)<br>Tip: Diameter 12.0mm, SR 12.5 mm |
| Surface hardness    | Pencil hardness: 3H or above       |                  | It complies with the way of test method JIS K5400   |

### 6.4 Optical Property

| Item                      | Performance                            | Note      |
|---------------------------|--|-----------|
| Total light transmittance | 80% or above                           | JIS K7105 |
| Haze                      | 5% or below                            | JIS K7105 |
| Film specification        | Polished type with hard coated surface |           |

## 7. AC Characteristics

### 7.1 Display Parallel 18/16/9/8-bit Interface Timing Characteristics (8080- system)

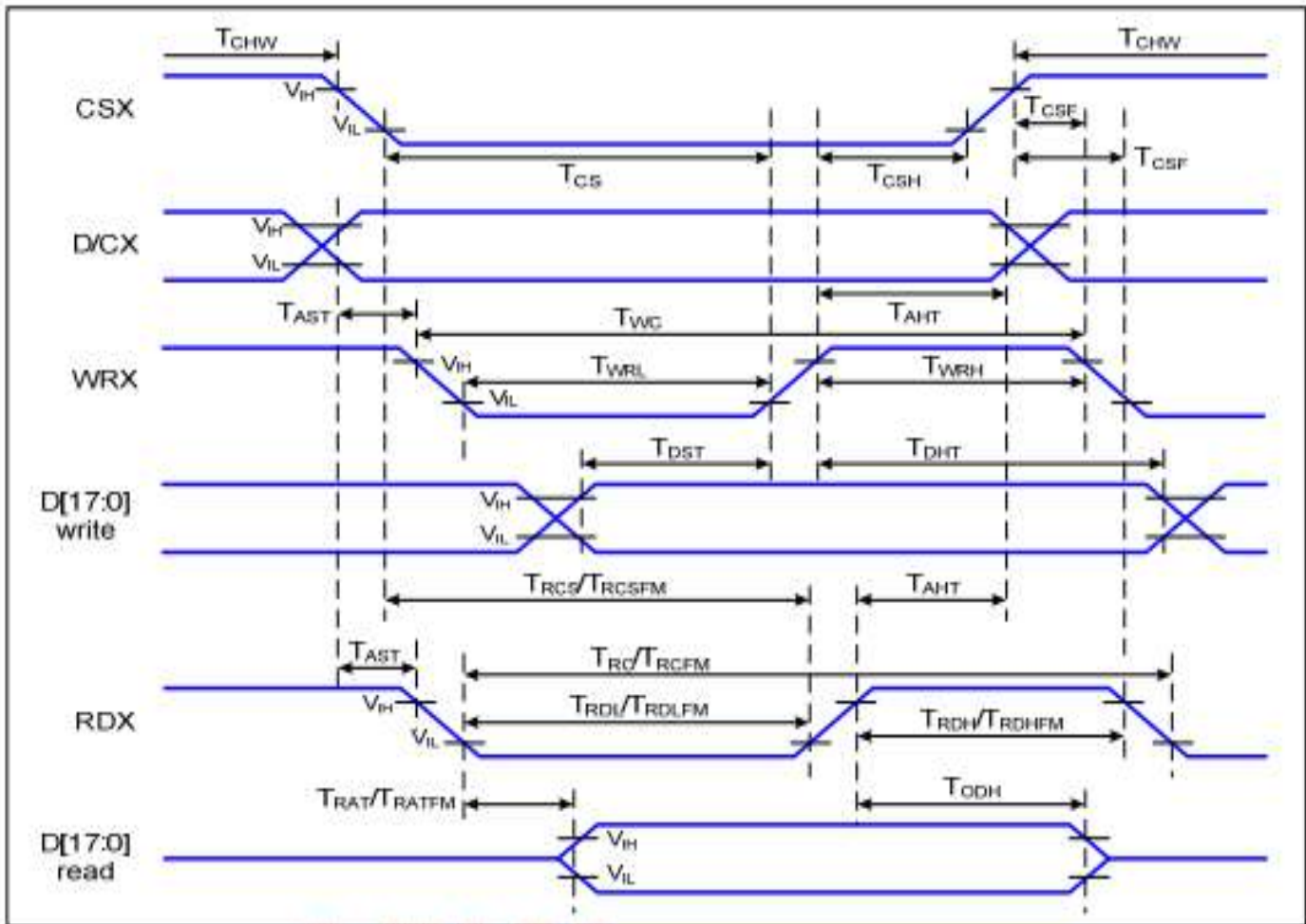
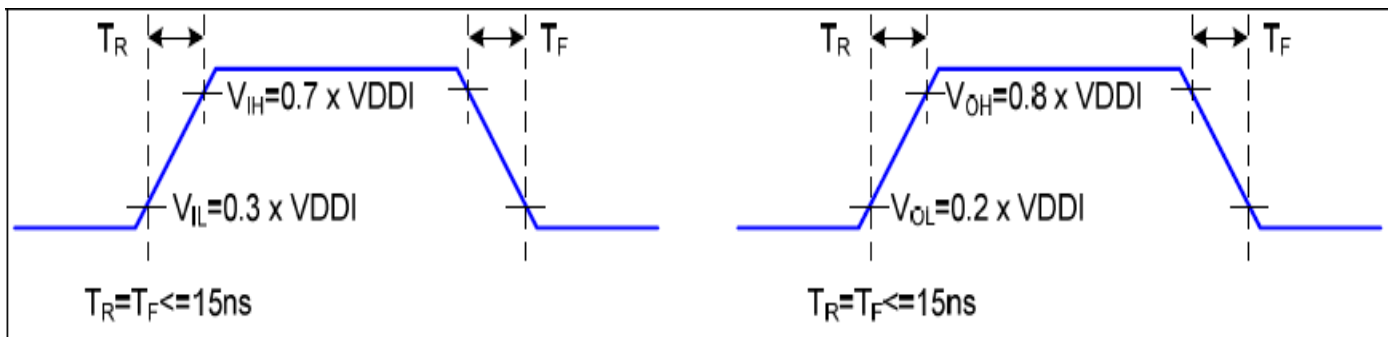


Figure 7.1: Parallel 18/16/9/8-bit Timing Diagram

Note: Logic high and low levels are specified as 30% and 70% of VDDI for input signals.



**7.1 Parallel interface timing characteristics (8080-system) Continued:**

| Signal   | Symbol             | Parameter                          | Min | Max | Unit | Description                 |
|----------|--------------------|------------------------------------|-----|-----|------|-----------------------------|
| D/CX     | T <sub>AST</sub>   | Address setup time                 | 0   |     | ns   | -                           |
|          | T <sub>AHT</sub>   | Address hold time (Write/Read)     | 10  |     | ns   |                             |
| CSX      | T <sub>CHW</sub>   | Chip select "H" pulse width        | 0   |     | ns   | -                           |
|          | T <sub>CS</sub>    | Chip select setup time (Write)     | 10  |     | ns   |                             |
|          | T <sub>RCS</sub>   | Chip select setup time (Read ID)   | 45  |     | ns   |                             |
|          | T <sub>RCSFM</sub> | Chip select setup time (Read FM)   | 355 |     | ns   |                             |
|          | T <sub>CSF</sub>   | Chip select wait time (Write/Read) | 10  |     | ns   |                             |
|          | T <sub>CSH</sub>   | Chip select hold time              | 10  |     | ns   |                             |
| WRX      | T <sub>WC</sub>    | Write cycle                        | 66  |     | ns   |                             |
|          | T <sub>WRH</sub>   | Control pulse "H" duration         | 15  |     | ns   |                             |
|          | T <sub>WRL</sub>   | Control pulse "L" duration         | 15  |     | ns   |                             |
| RDX (ID) | T <sub>RC</sub>    | Read cycle (ID)                    | 160 |     | ns   | When read ID data           |
|          | T <sub>RDH</sub>   | Control pulse "H" duration (ID)    | 90  |     | ns   |                             |
|          | T <sub>RDL</sub>   | Control pulse "L" duration         | 45  |     | ns   |                             |
| RDX (FM) | T <sub>RCFM</sub>  | Read cycle (FM)                    | 450 |     | ns   | When read from frame memory |
|          | T <sub>RDHFM</sub> | Control pulse "H" duration (FM)    | 90  |     | ns   |                             |
|          | T <sub>RDLFM</sub> | Control pulse "L" duration (FM)    | 355 |     | ns   |                             |
| D[17:0]  | T <sub>DST</sub>   | Data setup time                    | 10  |     | ns   | For max<br>CL=30pF,         |
|          | T <sub>DHT</sub>   | Data hold time                     | 10  |     | ns   |                             |
|          | T <sub>RAT</sub>   | Read access time (ID)              |     | 40  | ns   | For min<br>CL=8pF           |
|          | T <sub>RATFM</sub> | Read access time (FM)              |     | 340 | ns   |                             |
|          | T <sub>ODH</sub>   | Output disable time                | 20  | 80  | ns   |                             |

*Table 7.1: Parallel 18/16/9/8-bit Timing Characteristics*

Note 1: VDDI 1.65 to 3.3V, VCI=2.6 to 3.3V, AGND=GND=OV, Ta=-30 to 70 °c (to +85°C no damage).

Note 2: This input signal rise time and fall time (tr, tf) is specified at 1:5 ns or less. Logic high and low levels are specified as 30% and 70% of VDDI for input signals.



## 7.2 Serial Interface Characteristics (3-line serial)

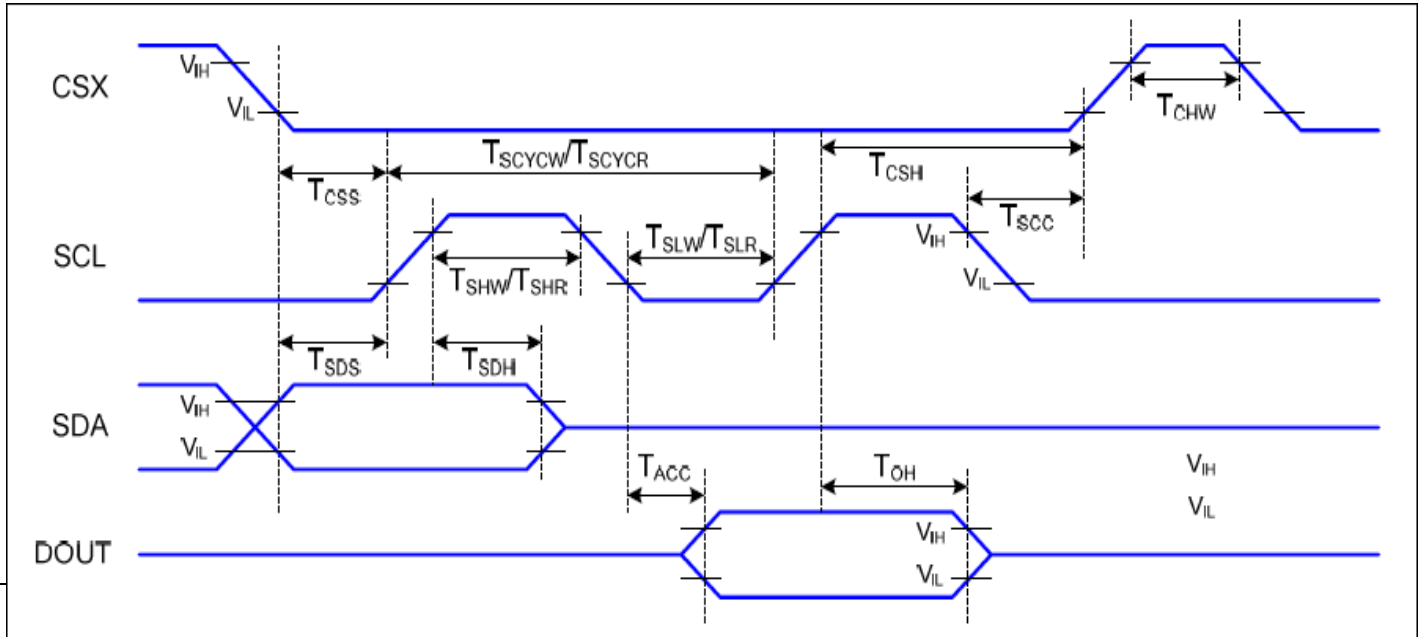


Figure 7.2: 3-line Serial Interface Timing Diagram

| Signal    | Symbol      | Parameter                      | Min | Max | Unit | Description     |
|-----------|-------------|--------------------------------|-----|-----|------|-----------------|
| CSX       | $T_{CSS}$   | Chip select setup time (write) | 10  |     | ns   |                 |
|           | $T_{CSH}$   | Chip select hold time (write)  | 30  |     | ns   |                 |
|           | $T_{CSS}$   | Chip select setup time (read)  | 30  |     | ns   |                 |
| SCL       | $T_{SCYCW}$ | Serial clock cycle (write)     | 66  |     | ns   |                 |
|           | $T_{SHW}$   | SCL "H" pulse width (write)    | 15  |     | ns   |                 |
|           | $T_{SLW}$   | SCL "L" 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 (DIN) | $T_{SDS}$   | Data setup time                | 5   |     | ns   |                 |
|           | $T_{SDH}$   | Data hold time                 | 5   |     | ns   |                 |
| DOUT      | $T_{ACC}$   | Access time                    | 5   | 50  | ns   | For max CL=30pF |
|           | $T_{OH}$    | Output disable time            | 10  |     |      | For min CL=8pF  |

Table 7.2: 3-line Serial Interface Timing Characteristics

### 7.3 Serial Interface Characteristics (4-line serial)

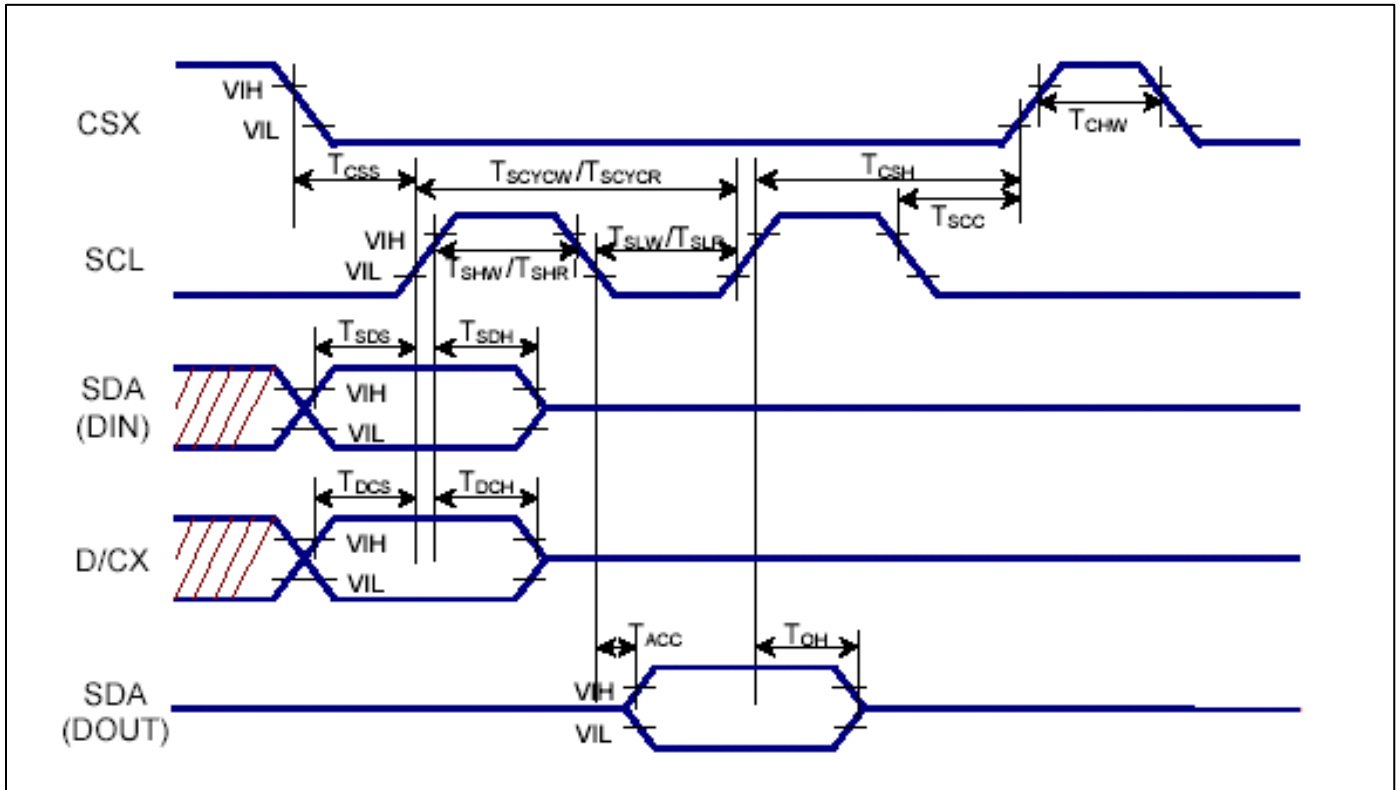


Figure 7.3: 4-line Serial Interface Timing Diagram

| Signal    | Symbol      | Parameter                      | Min | Max | Unit | Description                          |
|-----------|-------------|--------------------------------|-----|-----|------|--------------------------------------|
| CSX       | $T_{CSS}$   | Chip select setup time (write) | 10  |     | ns   | For max<br>CL=30pF<br>For min CL=8pF |
|           | $T_{CSH}$   | Chip select hold time (write)  | 30  |     | ns   |                                      |
|           | $T_{CHW}$   | Chip select setup time (read)  | 30  |     | ns   |                                      |
| SCL       | $T_{SCYCW}$ | Serial clock cycle (write)     | 66  |     | ns   |                                      |
|           | $T_{SHW}$   | SCL "H" pulse width (write)    | 15  |     | ns   |                                      |
|           | $T_{SLW}$   | SCL "L" width (write)          | 15  |     | ns   |                                      |
|           | $T_{SCYCR}$ | Serial clock cycle (read)      | 150 |     | ns   |                                      |
|           | $T_{SHR}$   | SCL "H" pulse width (read)     | 60  |     | ns   |                                      |
| D/CX      | $T_{SLR}$   | SCL "L" pulse width (read)     | 60  |     | ns   |                                      |
|           | $T_{DCS}$   | D/CX setup time                | 5   |     |      |                                      |
| SDA (DIN) | $T_{DCH}$   | D/CX hold time                 | 5   |     |      |                                      |
|           | $T_{SDS}$   | Data setup time                | 5   |     | ns   |                                      |
| DOUT      | $T_{SDH}$   | Data hold time                 | 5   |     |      |                                      |
|           | $T_{ACC}$   | Access time                    | 5   | 50  | ns   |                                      |
|           | $T_{OH}$    | Output disable time            | 10  |     |      |                                      |

Table 7.3: 4-line Serial Interface Timing Characteristics

Note 1: VDDI 1.65 to 3.3V, VCI=2.6 to 3.3V, AGND=GND=0V, Ta=-30 to 70 c (to +85°C no damage).

Note 2: This input signal rise time and fall time (tr, tf) is specified at 1:5 ns or less. Logic high and low levels are specified as 30% and 70% of VDDI for input signals.

## 7.4 Reset Timing

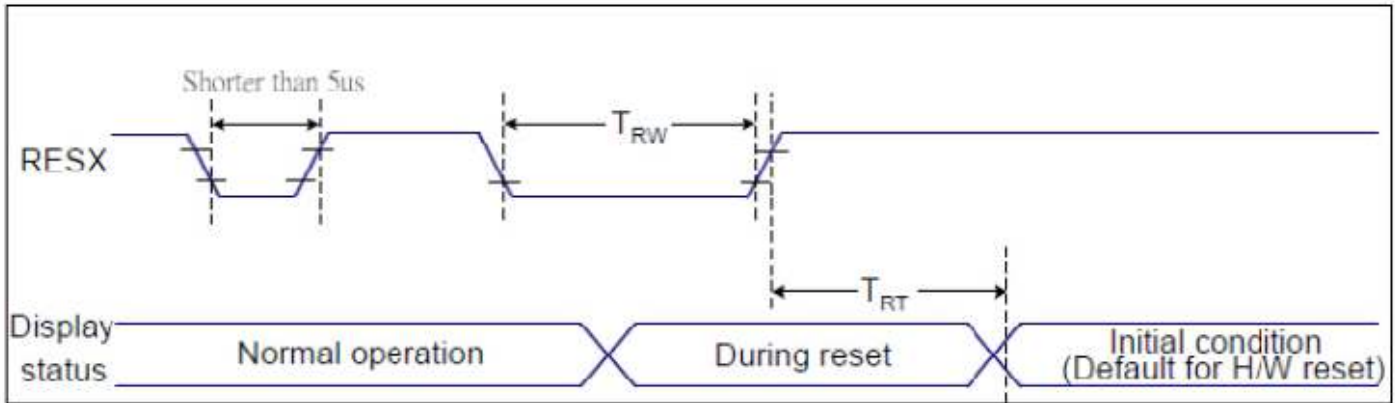


Figure 6.5: Reset Timing

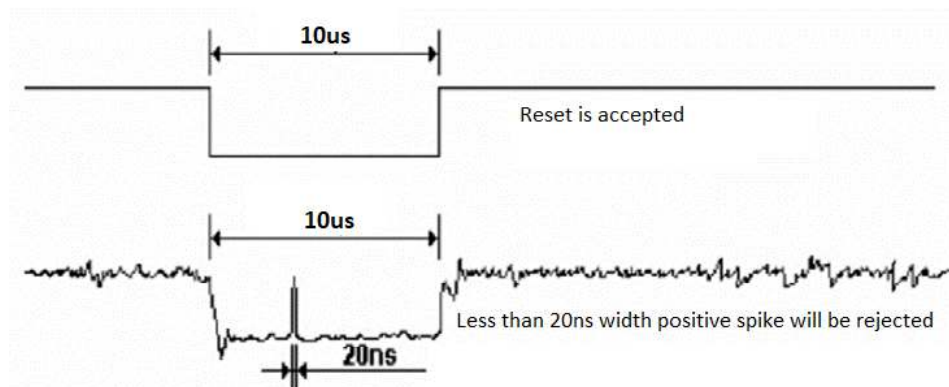
| Related Pins | Symbol | Parameter            | Min | Max                | Unit |
|--------------|--------|----------------------|-----|--------------------|------|
| RESX         | TRW    | Reset pulse duration | 10  | -                  | us   |
|              | TRT    | Reset cancel         | -   | 5 (Note 1,5)       | ms   |
|              |        |                      |     | 120 (Note 1, 6, 7) | ms   |

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 (tRT) within 5ms after a rising edge of RESX.
2. Spike due to an electrostatic discharge on RESX line does not because irregular system reset according to the table below:

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

3. During the resetting period, the display will be blanked (the display is entering blanking sequence, which maximum time is 120ms, 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 5ms after releasing RESX before sending commands. Also Sleep Out command cannot be sent for 120ms.

## 8. Cautions and Handling Precautions

### 8.1 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 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 Power On Sequence & Power Off Sequence

### 8.2 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.