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# SPECIFICATION

[ ] Preliminary Specification  
[√] Final Specification

**Description**                      **6.5” 640xRGBx480 TFT-LCD Module**  
**Part Number**                   **P0650VGF2MB30**

|            |       |                                                                    |           |
|------------|-------|--------------------------------------------------------------------|-----------|
| Customer   |       | Industrial Product Dept, PDBU<br>Tianma Microelectronics Co., Ltd. |           |
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\* This cover page is for your Comments and Signatures back to TIANMA.

## REVISION HISTORY

[illegible]

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## 1. Summary

### 1.1 General Description

This is a 6.5 inch a-Si TFT-LCD module with Normal- Black technology. It is composed of a TFT-LCD panel, a driver circuit, PCB, and a LED backlight unit.

### 1.2 Features

- Ultra-wide viewing angle (Super Fine TFT (SFT) )
- 70Khrs Long LED life time
- Interface: 1 port LVDS
- Without LED driver
- Compliant with the European RoHS Directive (2011/65/EU) and Delegated Directive (2015/863/EU, Amending Annex II of 2011/65/EU)
- Acquisition product for UL62368-1/CSA C22.2 No.62368-1-14 (File number: E333987)

## 2. General Specifications

| Feature                    |                                       | Spec                                | Unit              |
|----------------------------|---------------------------------------|-------------------------------------|-------------------|
| Display Spec               | Size                                  | 6.5 inches                          |                   |
|                            | Resolution                            | 640(RGB)x480                        |                   |
|                            | Pixel Pitch                           | 0.207 (H) x 0.207(V)                | mm                |
|                            | TFT Active Area                       | 132.48 (W) x 99.36 (H)              | mm                |
|                            | Technology Type                       | a-Si                                |                   |
|                            | Pixel Configuration                   | R.G.B Vertical Stripe               |                   |
|                            | Display Mode                          | SFT, Normally black                 |                   |
|                            | Surface Treatment                     | AG                                  |                   |
|                            | Viewing Direction                     | ALL                                 |                   |
|                            | Polarizer pencil-hardness             | 3H                                  |                   |
|                            | Gray Scale Inversion Direction        | NA                                  |                   |
| Mechanical Characteristics | LCM (W x H x D)                       | 153W* 118H * 8.2D(typ)              | mm                |
|                            | Weight                                | 135                                 | g                 |
| Optical Characteristics    | Luminance                             | 650                                 | cd/m <sup>2</sup> |
|                            | Contrast Ratio                        | 800:1                               |                   |
|                            | NTSC                                  | 45                                  | %                 |
|                            | Viewing Angle                         | 88/88/88/88                         | degree            |
|                            | Polarizer absorption axis             | Vertical                            |                   |
| Electrical Characteristics | Interface                             | LVDS                                |                   |
|                            | Color Depth                           | 16.7M/262K                          | color             |
|                            | Power Consumption                     | LCD: 313.5typ<br>Backlight: 1800typ | mW                |
|                            | Recommended LED driver board (Option) | PB065QXGS01                         |                   |

Table 2.1 General TFT Specifications

### 3. Input / Output Terminals

#### 3.1 CN1 Pin assignment (LCD Interface)

| Connector Information |                                    |
|-----------------------|------------------------------------|
| LCD Module connector  | DF19K-20P-1H (HIROSE)              |
| Matching connector    | DF19-20S-1C (HIROSE) or equivalent |

Table 3.1.1 Connector information

| PIN |   | Symbol | I/O | Signal                            | Input data signal:8-bit                        |                   | Input data signal:6-bit | Remark  |
|-----|---|--------|-----|-----------------------------------|------------------------------------------------|-------------------|-------------------------|---------|
|     |   |        |     |                                   | MAP A                                          | MAP B             |                         |         |
| 1   | A | D3+    | I   | Pixel data                        | R0-R1,G0-G1,B0-B1                              | R6-R7,G6-G7,B6-B7 | -                       | Note3,4 |
|     | B | GND    | P   | Ground                            | -                                              | -                 | Ground                  |         |
| 2   | A | D3-    | I   | Pixel data                        | R0-R1,G0-G1,B0-B1                              | R6-R7,G6-G7,B6-B7 | -                       | Note3,4 |
|     | B | GND    | P   | Ground                            | -                                              | -                 | Ground                  |         |
| 3   |   | DPS    | I   | Selection of scan direction       | High: Reverse scan<br>Low or Open: Normal scan |                   |                         | Note5   |
| 4   |   | FRC    | I   | Selection of the number of colors | High                                           |                   | Low or open             |         |
| 5   |   | GND    | P   | Ground                            | Ground                                         |                   |                         |         |
| 6   |   | CLK+   | I   | Pixel clock                       | Pixel clock                                    |                   |                         | Note3   |
| 7   |   | CLK-   | I   |                                   |                                                |                   |                         |         |
| 8   |   | GND    | P   | Ground                            | Ground                                         |                   |                         |         |
| 9   |   | D2+    | I   | Pixel data                        | B4-B7,DE                                       | B2-B5,DE          |                         | Note3   |
| 10  |   | D2-    | I   |                                   |                                                |                   |                         |         |
| 11  |   | GND    | P   | Ground                            | Ground                                         |                   |                         |         |
| 12  |   | D1+    | I   | Pixel data                        | G3-G7,B2-B3                                    | G1-G5,B0-B1       |                         | Note3   |
| 13  |   | D1-    | I   |                                   |                                                |                   |                         |         |
| 14  |   | GND    | P   | Ground                            | Ground                                         |                   |                         |         |
| 15  |   | D0+    | I   | Pixel data                        | R2-R7,G2                                       | R0-R5,G0          |                         | Note3   |
| 16  |   | D0-    | I   |                                   |                                                |                   |                         |         |
| 17  |   | GND    | P   | Ground                            | Ground                                         |                   |                         |         |
| 18  |   | MSL    | I   | Selection of LVDS input map       | Low or Open                                    | High              | Low or Open             |         |
| 19  |   | VCC    | P   | Power supply                      | Power supply                                   |                   |                         |         |
| 20  |   | VCC    |     |                                   |                                                |                   |                         |         |

Table 3.1.2 Pin Assignment for LCD Interface

Note1: I/O definition: I---Input, O---Output, P---Power/Ground, N---No connection

Note2: All of the GND pins should be connected to the system ground.

Note3: See “6.5 Display Colors and Input Data Signals”

Note4: Twist pair wires with 100Ω (Characteristic impedance) should be used between LCD panel signal processing board and LVDS transmitter.

Note5: See “6.7 SCANNING DIRECTIONS”

### 3.2 CN2 Pin assignment (BL Interface)

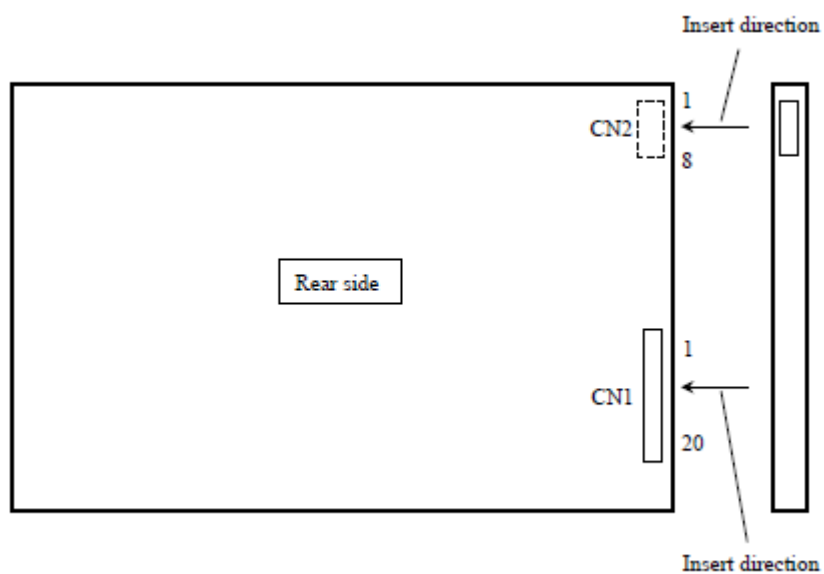
| Connector Information |                                               |
|-----------------------|-----------------------------------------------|
| Connector type        | MS24011P8RA (STM)                             |
| Matching connector    | P24011P8 (STM), SHR-08V-S (JST) or equivalent |

Table 3.2.1 Connector information

| No | Symbol | I/O | Description | Comment |
|----|--------|-----|-------------|---------|
| 1  | A1     | P   | Anode1      |         |
| 2  | K1     | P   | Cathode1    |         |
| 3  | A2     | P   | Anode2      |         |
| 4  | K2     | P   | Cathode2    |         |
| 5  | A3     | P   | Anode3      |         |
| 6  | K3     | P   | Cathode3    |         |
| 7  | NC     | N   | NC          |         |
| 8  | NC     | N   | NC          |         |

Table 3.2.1 Pin Assignment for BL Interface

### 3.3 Positions of socket



#### 4. Absolute Maximum Ratings

| Item                       |                                   | Symbol     | MIN  | MAX       | Unit             | Remark       |
|----------------------------|-----------------------------------|------------|------|-----------|------------------|--------------|
| Power Supply Voltage       | LCD panel signal processing board | VCC        | -0.3 | 5.0       | V                |              |
| Digital Input Voltage      | Display signals                   | VD         | -0.3 | 5.0       | V                | Note1        |
|                            | Function signal                   | VF         | -0.3 | VCC+0.3   | V                | Note2        |
| Storage temperature        | Tst                               | -30 to +80 |      |           | °C               |              |
| Operating temperature      | TopF                              | -30 to +80 |      |           | °C               | Note3        |
|                            | TopR                              | -30 to +80 |      |           | °C               | Note4        |
| Relative Humidity<br>Note5 | RH                                | --         |      | ≤95       | %                | Ta≤40°C      |
|                            |                                   | --         |      | ≤85       | %                | 40°C<Ta≤50°C |
|                            |                                   | --         |      | ≤55       | %                | 50°C<Ta≤60°C |
|                            |                                   | --         |      | ≤36       | %                | 60°C<Ta≤70°C |
|                            |                                   | --         |      | ≤24       | %                | 70°C<Ta≤80°C |
| Absolute Humidity Note5    | AH                                | --         |      | ≤70 Note6 | g/m <sup>3</sup> | Ta>80°C      |

**Table 4.1 Absolute Maximum Ratings**

Note1: D0+/-, D1+/-, D2+/-, D3+/-, CLK+/-

Note2: Digital input voltage includes DPS, FRC, MSL.

Note3: Measured at LCD panel surface (including self-heat)

Note4: Measured at LCD module's rear shield surface (including self-heat)

Note5: No condensation

Note6: Water amount at Ta= 80 °C and RH= 24%

## 5. Electrical Characteristics

### 5.1 DC Characteristics for Panel Driving

| Item                  |            | Symbol              | MIN     | TYP | MAX     | Unit | Remark         |
|-----------------------|------------|---------------------|---------|-----|---------|------|----------------|
| Power supply Voltage  |            | VCC                 | 3.0     | 3.3 | 3.6     | V    | include ripple |
| Power supply current  |            | IVCC                | -       | 95  | 158     | mA   | at VCC=3.3V    |
| Power supply ripple   |            | Vp-p                | -       | -   | 100     | mV   | for VCC        |
| Inrush current        |            | I <sub>Inrush</sub> | -       | -   | 1.5A    | A    |                |
| Digital input voltage | Low Level  | VIL                 | GND     | -   | 0.3*VCC | V    | Note3          |
|                       | High Level | VIH                 | 0.7*VCC | -   | VCC     | V    |                |

Table 5.1.1 DC characteristics

Note1: Checkered flag pattern [by IEC 61747-6]

Note2: Pattern for maximum current

Note3: Digital input voltage includes DPS, FRC, MSL

### 5.2 Fuse

| Parameter | Fuse             |          | Rating | Fusing current | Remarks |
|-----------|------------------|----------|--------|----------------|---------|
|           | Type             | Supplier |        |                |         |
| VCC       | F0603HI2000V032T | AEM      | 2.0A   | 4A             | /       |
|           |                  |          | 32V    |                |         |

### 5.3 DC Characteristics for Backlight Driving

(GND=0V)

| Item                        | Symbol          | Condition          | MIN   | TYP   | MAX   | Unit | Remark                                       |
|-----------------------------|-----------------|--------------------|-------|-------|-------|------|----------------------------------------------|
| Forward Current             | I <sub>F</sub>  | Ta=25℃             | -     | 50    | 55    | mA   | 12 LEDs<br>(4 LED Serial,<br>3 LED Parallel) |
| Forward Current Voltage     | V <sub>F</sub>  | Ta=25℃<br>IF=50mA  | -     | 12.0  | 13.7  | V    |                                              |
|                             |                 | Ta=-10℃<br>IF=55mA | -     | -     | 13.84 |      |                                              |
|                             |                 | Ta=-30℃<br>IF=50mA | -     | -     | 13.80 |      |                                              |
|                             |                 | Ta=-30℃<br>IF=55mA | -     | -     | 13.87 |      |                                              |
|                             |                 | Ta=80℃<br>IF=50mA  | 11.05 | -     | -     |      |                                              |
|                             |                 | Ta=80℃<br>IF=55mA  | 11.12 | -     | -     |      |                                              |
| Backlight Power Consumption | W <sub>BL</sub> | Ta=25℃             | -     | 1800  | -     | mW   |                                              |
| Operating Life Time         | --              | Ta=25℃             | -     | 70000 | -     | hrs  | Note 3                                       |

Table 5.3.1 LED Backlight Characteristics

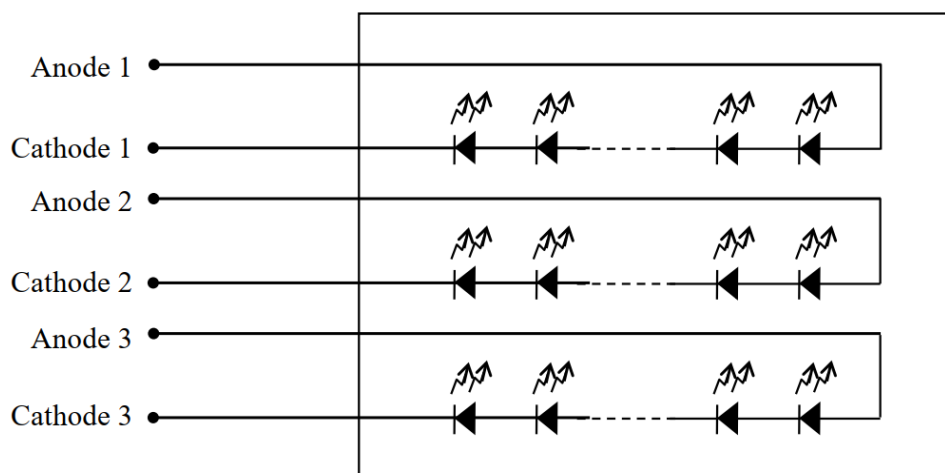
Note1:  $I_F$  is defined for Current value of one LED circuit

Note2: Under LCM operating, the stable forward current should be inputted. And forward voltage is for reference only.

Note3: Optical performance should be evaluated at  $T_a=25^{\circ}\text{C}$  only If LED is driven by high current, high ambient temperature & humidity condition. The life time of LED will be reduced. Operating life means brightness goes down to 50% initial brightness. Typical operating life time is estimated data.

Note4: The LED driving condition is defined for each LED module.

Backlight



## 5.4 Power ON/OFF Sequence

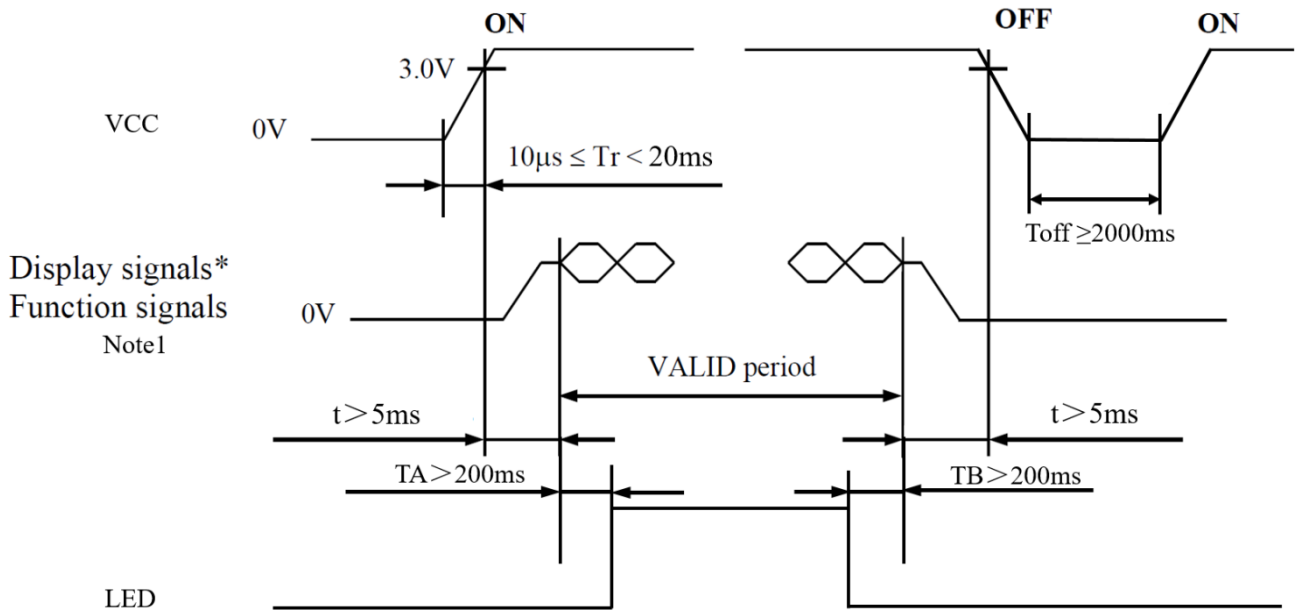


Figure 5.4 Power on/off sequence

Note1: Display signals (D0+/-, D1+/-, D2+/-, D3+/-, CLK+/-) and function signal (DPS, FRC, MSL) must be set to Low or High-impedance, except the VALID period (See above sequence diagram), in order to avoid the circuitry damage.

If some of display and function signals of this product are cut while this product is working, even if the signal input to it once again, it might not work normally. If a customer stops the display and function signals, VCC also must be shut down.

Note2: Keep backlight turned off until the display has stabilized.

## 5.5 LCD Module Block Diagram

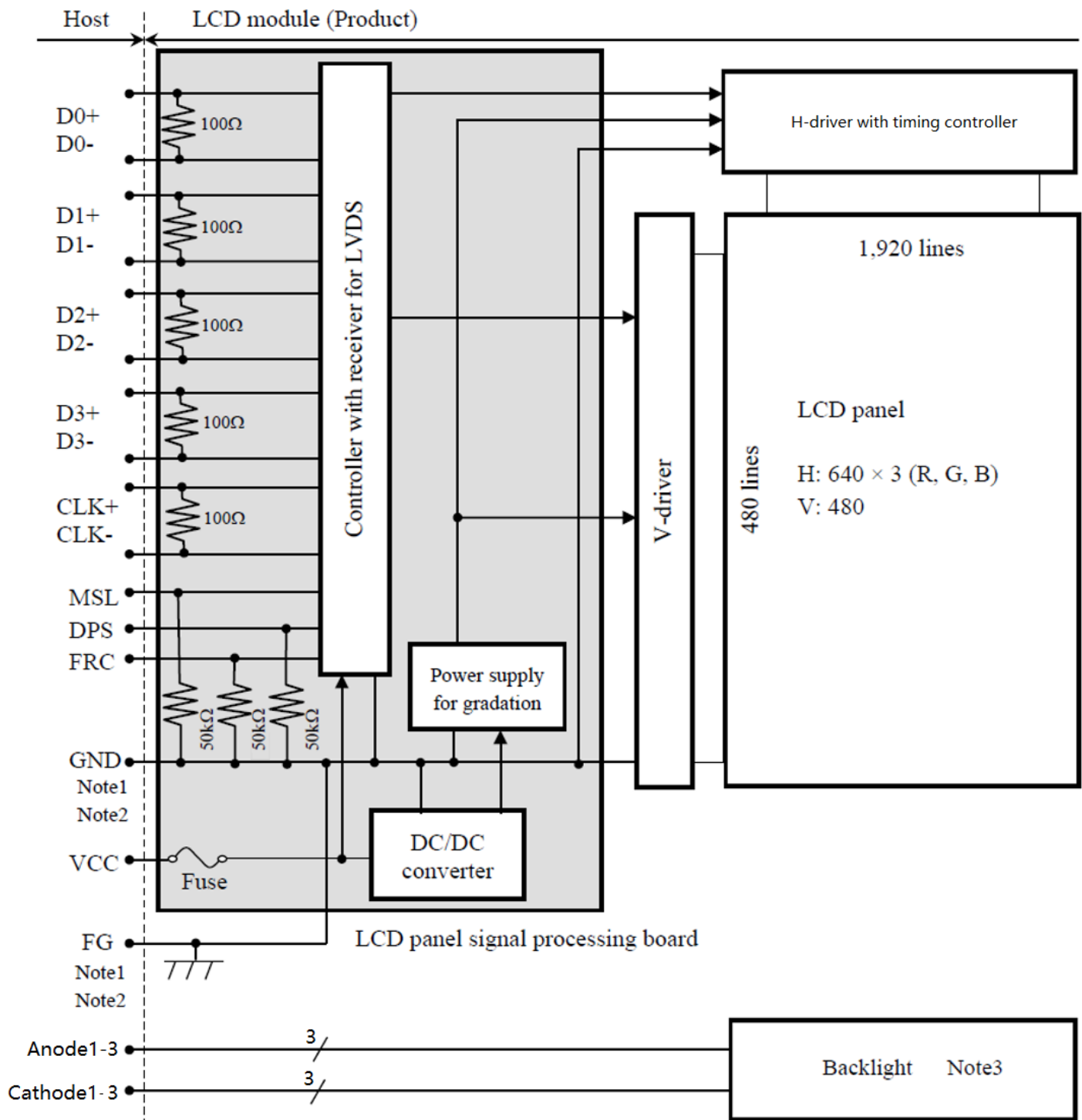


Figure 5.5 LCD Module Block Diagram

Note1: Relations between GND (Signal ground) and FG (Frame ground) in the LCD module are as follows.

|          |           |
|----------|-----------|
| GND - FG | Connected |
|----------|-----------|

Note2: GND and FG must be connected to customer equipment's ground, and it is recommended that these grounds be connected together in customer equipment.

Note3: See 5.3 for details

## 6. Interface Timing Characteristics

### 6.1 Data Input Timing Parameter Setting

TCON (Embedded In Source IC) Input Timing (DCLK, HSYNC, VSYNC, DE)

VCC=3.3V, GND=0V, Ta=25°C

| Parameter |                         |                | Symbol          | Min | Typ  | Max | Unit | Remark |
|-----------|-------------------------|----------------|-----------------|-----|------|-----|------|--------|
| CLK       | Frequency               |                | 1/tc            | 21  | 25.2 | 29  | MHz  |        |
| DE        | Horizontal              | Cycle          | t <sub>h</sub>  | 706 | 800  | 871 | CLK  |        |
|           |                         | Display period | t <sub>hd</sub> | 640 |      |     | CLK  |        |
|           | Vertical<br>(One frame) | Cycle          | t <sub>v</sub>  | 496 | 525  | 555 | H    |        |
|           |                         | Display period | t <sub>vd</sub> | 480 |      |     | H    |        |
| FR        | Frame Rate              |                | FR              | 60  |      |     | Hz   |        |

Table 6.1.1 Data Input Timing Parameters

Note1: Definition of parameters is as follows.

$$t_c = 1\text{CLK}, t_h = 1\text{H}$$

Note2: See the data sheet of LVDS transmitter

Note3: Vertical cycle (t<sub>v</sub>) should be specified in integral multiple of Horizontal cycle (t<sub>h</sub>).

TCON Vertical Input Timing Diagram HV

Horizontal input timing

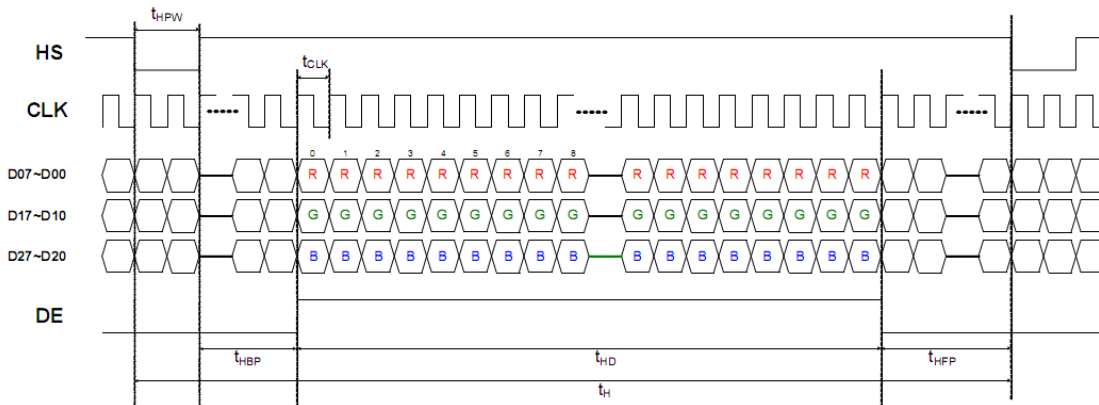


Figure 6.1 Horizontal input timing

Vertical input timing

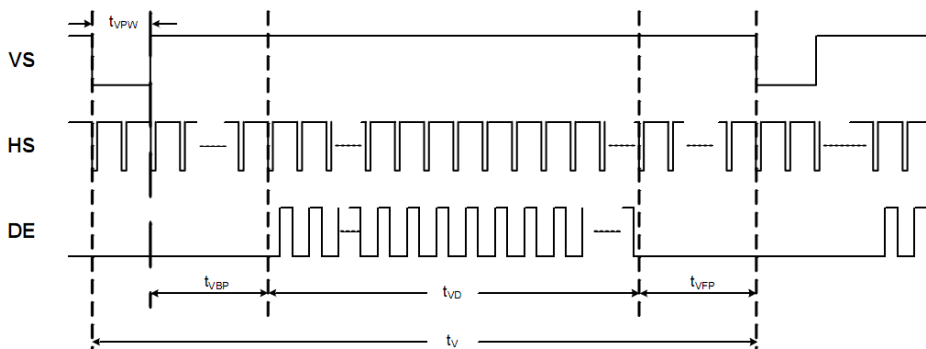


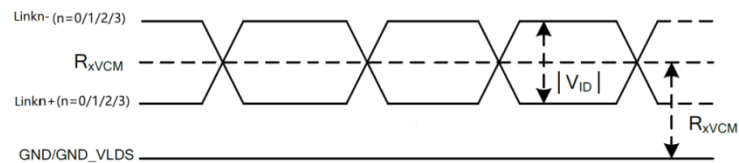
Figure 6.2 Vertical input timing

## 6.2 LVDS DC Electrical Characteristics

| Parameter                                 | Symbol     | Min. | Typ. | Max.             | Unit | Remark          |
|-------------------------------------------|------------|------|------|------------------|------|-----------------|
| Differential input high Threshold voltage | $R_{XVTH}$ | -    | -    | 0.1              | V    | $R_{XVCM}=1.2V$ |
| Differential input Low Threshold voltage  | $R_{XVTL}$ | -0.1 | -    | -                | V    |                 |
| Input voltage range(single-end)           | $R_{XVIN}$ | 0    | -    | VCC-1.0          | V    |                 |
| Differential input common Mode voltage    | $R_{XVCM}$ | 0.6  | 1.2  | $2.4- V_{ID} /2$ | V    |                 |
| Differential input voltage                | $ V_{ID} $ | 0.2  | 0.4  | 0.6              | V    |                 |

Table 6.2.1 LVDS DC Electrical Characteristics

Single end signals



Differential signals

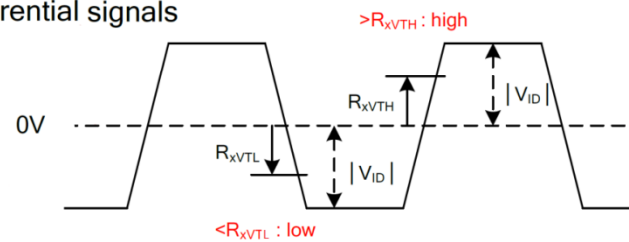


Figure 6.2.1 LVDS DC Electrical Characteristics

### 6.3 AC characteristics

VCC=3.3V, GND=0V, Ta=25°C

| Parameter        | Symbol      | Min.  | Typ. | Max. | Unit        | Conditions |
|------------------|-------------|-------|------|------|-------------|------------|
| Clock Frequency  | $R_{xCLK}$  | 21    | -    | 29   | MHz         |            |
| Clock Period     | $R_{xTCLK}$ | 34.4  | -    | 47.6 | ns          |            |
| 1 data bit time  | UI          | -     | 1/7  | -    | $R_{xTCLK}$ |            |
| Clock high time  | $T_{LVCH}$  |       | 4    |      | UI          |            |
| Clock low time   | $T_{LVCL}$  |       | 3    |      | UI          |            |
| Position 1       | $T_{POS1}$  | -0.25 | 0    | 0.25 | UI          |            |
| Position 2       | $T_{POS2}$  | 0.75  | -    | 1.25 | UI          |            |
| Position 3       | $T_{POS3}$  | 0.75  | 1    | 1.25 | UI          |            |
| Position 4       | $T_{POS4}$  | 1.75  | -    | 2.25 | UI          |            |
| Position 5       | $T_{POS5}$  | 1.75  | 2    | 2.25 | UI          |            |
| Position 6       | $T_{POS6}$  | 2.75  | -    | 3.25 | UI          |            |
| Position 7       | $T_{POS7}$  | 2.75  | 3    | 3.25 | UI          |            |
| Position 8       | $T_{POS8}$  | 3.75  | -    | 4.25 | UI          |            |
| Position 9       | $T_{POS9}$  | 3.75  | 4    | 4.25 | UI          |            |
| Position 10      | $T_{POS10}$ | 4.75  | -    | 5.25 | UI          |            |
| Position 11      | $T_{POS11}$ | 4.75  | 5    | 5.25 | UI          |            |
| Position 12      | $T_{POS12}$ | 5.75  | -    | 6.25 | UI          |            |
| Position 13      | $T_{POS13}$ | 5.75  | 6    | 6.25 | UI          |            |
| Position 14      | $T_{POS14}$ | 6.75  | -    | 7.25 | UI          |            |
| Input eye width  | $T_{EYEW}$  | 0.5   | -    | -    | UI          |            |
| Input eye border | $T_{EX}$    | -     | -    | 0.25 | UI          |            |

**Table 6.3.1 LVDS AC Electrical Characteristics**

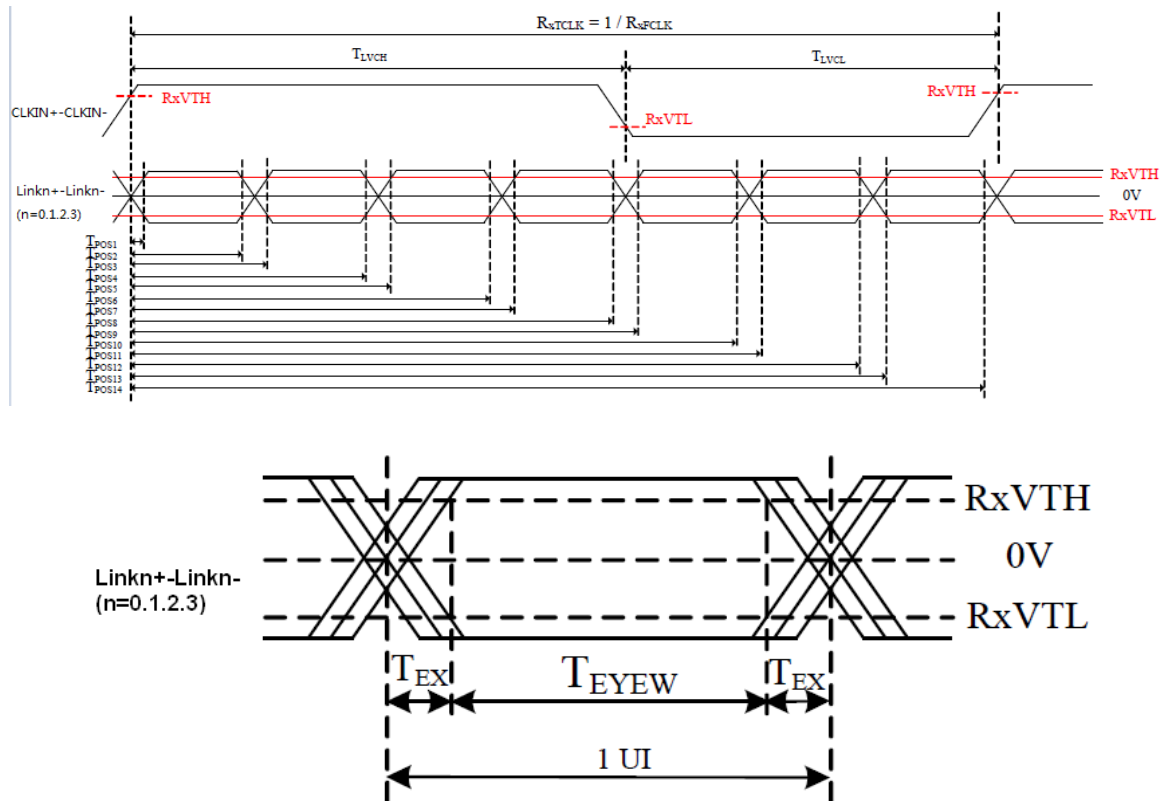
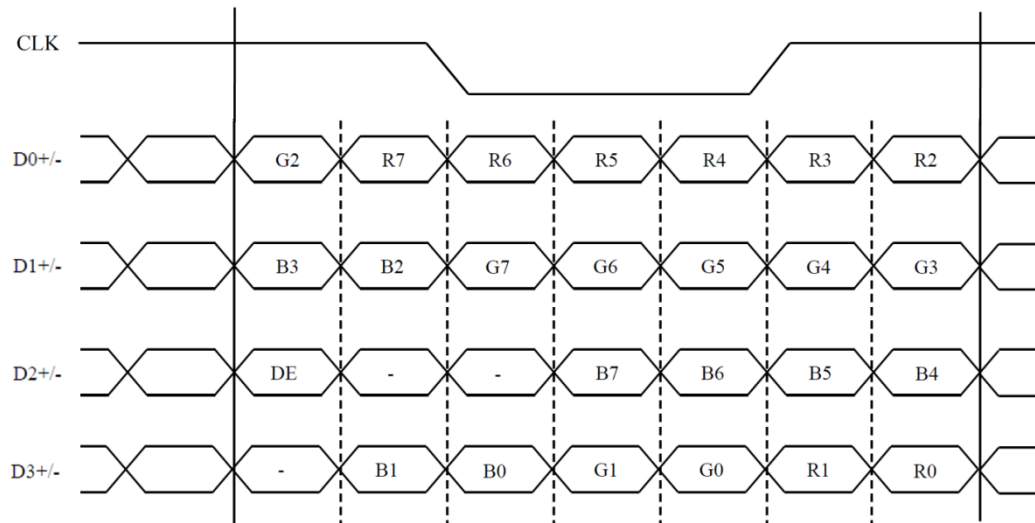


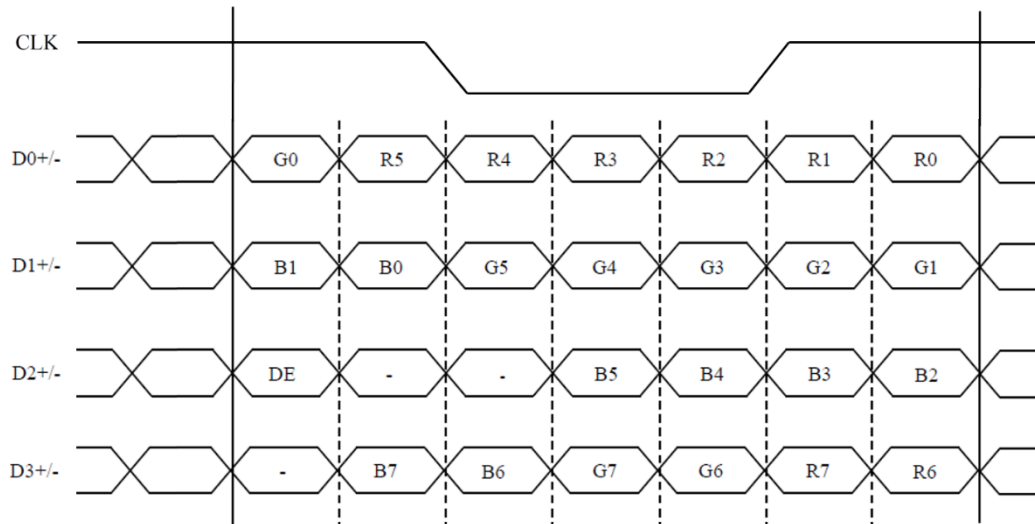
Figure 6.3.2 LVDS AC Electrical Characteristics

## 6.4 LVDS Data Mapping

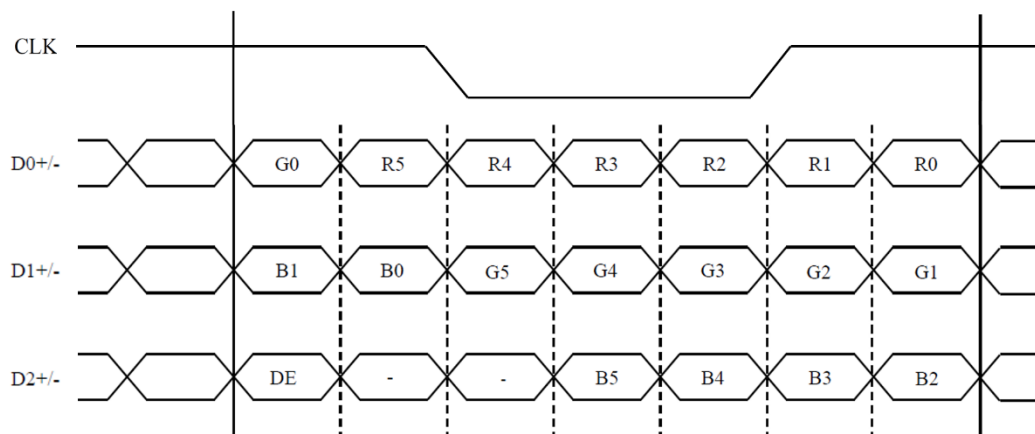
### (1) Input data signal: 8-bit, MAP A



### (2) Input data signal: 8-bit, MAP B



### (3) Input data signal: 6-bit



## 6.5 Display Colors and Input Data Signals

### 6.5.1 Combinations between input data signals, FRC signal and MSL signal

This product can display equivalent of 16,777,216 colors and 262,144 colors by combination between input data signals, FRC signal and MSL signal. See following table.

| Combination | Input data signals | Input data mapping | CN1- Pin No.1 and 2 | FRC terminal | MSL terminal | Display colors | Remarks |
|-------------|--------------------|--------------------|---------------------|--------------|--------------|----------------|---------|
| ①           | 8-bit              | Map A              | D3+/-               | High         | Low or Open  | 16,777,216     | Note1   |
| ②           | 8-bit              | Map B              | D3+/-               | High         | High         | 16,777,216     | Note1   |
| ③           | 6-bit              | -                  | GND                 | Low or Open  | Low or Open  | 262,144        | Note2   |

Note1: See“6.5.2 16,777,216 colors”

Note2: See“6.5.3 262,144 colors”.

### 6.5.2 16,777,216 colors

This product can display equivalent of 16,777,216 colors in 256 gray scales by combination ①and ②.  
(See “6.5.1 Combinations between input data signals, FRC signal and MSL signal”)  
Also the relation between display colors and input data signals is as the following table.

| Display colors   |         | Data signal (0: Low level, 1: High level) |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
|------------------|---------|-------------------------------------------|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|
|                  |         | R7                                        | R6 | R5 | R4 | R3 | R2 | R1 | R0 | G7 | G6 | G5 | G4 | G3 | G2 | G1 | G0 | B7 | B6 | B5 | B4 | B3 | B2 | B1 | B0 |
| Basic Colors     | Black   | 0                                         | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  |
|                  | Blue    | 0                                         | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  |
|                  | Red     | 1                                         | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  |
|                  | Magenta | 1                                         | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  |
|                  | Green   | 0                                         | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  |
|                  | Cyan    | 0                                         | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  |
|                  | Yellow  | 1                                         | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  |
|                  | White   | 1                                         | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  |
| Red gray scale   | Black   | 0                                         | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  |
|                  |         | 0                                         | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  |    |
|                  | dark    | 0                                         | 0  | 0  | 0  | 0  | 0  | 0  | 1  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  |    |
|                  | ↑       |                                           |    |    |    | :  |    |    |    |    |    |    |    | :  |    |    |    |    |    | :  |    |    |    |    |    |
|                  | ↓       |                                           |    |    |    | :  |    |    |    |    |    |    |    | :  |    |    |    |    |    | :  |    |    |    |    |    |
|                  | bright  | 1                                         | 1  | 1  | 1  | 1  | 1  | 0  | 1  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  |
| Green gray scale | Black   | 0                                         | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  |
|                  |         | 0                                         | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 1  | 0  | 0  | 0  | 0  | 0  | 0  | 0  |    |
|                  | dark    | 0                                         | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 1  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  |    |
|                  | ↑       |                                           |    |    |    | :  |    |    |    |    |    |    |    | :  |    |    |    |    |    | :  |    |    |    |    |    |
|                  | ↓       |                                           |    |    |    | :  |    |    |    |    |    |    |    | :  |    |    |    |    |    | :  |    |    |    |    |    |
|                  | bright  | 0                                         | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 1  | 1  | 1  | 1  | 1  | 1  | 0  | 1  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  |
| Blue gray scale  | Black   | 0                                         | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  |
|                  |         | 0                                         | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 1  |    |
|                  | dark    | 0                                         | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 1  | 0  |    |
|                  | ↑       |                                           |    |    |    | :  |    |    |    |    |    |    |    | :  |    |    |    |    |    | :  |    |    |    |    |    |
|                  | ↓       |                                           |    |    |    | :  |    |    |    |    |    |    |    | :  |    |    |    |    |    | :  |    |    |    |    |    |
|                  | bright  | 0                                         | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 1  | 1  | 1  | 1  | 1  | 1  | 0  | 1  |

### 6.5.3 262,144 colors

This product can display equivalent of 262,144 colors in 64 gray scales by combination ③.  
(See “6.5.1 Combinations between input data signals, FRC signal and MSL signal”)  
Also the relation between display colors and input data signals is as the following table.

| Display colors   |         | Data signal (0: Low level, 1: High level) |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
|------------------|---------|-------------------------------------------|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|
|                  |         | R5                                        | R4 | R3 | R2 | R1 | R0 | G5 | G4 | G3 | G2 | G1 | G0 | B5 | B4 | B3 | B2 | B1 | B0 |
| Basic colors     | Black   | 0                                         | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  |
|                  | Blue    | 0                                         | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 1  | 1  | 1  | 1  | 1  | 1  |
|                  | Red     | 1                                         | 1  | 1  | 1  | 1  | 1  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  |
|                  | Magenta | 1                                         | 1  | 1  | 1  | 1  | 1  | 0  | 0  | 0  | 0  | 0  | 0  | 1  | 1  | 1  | 1  | 1  | 1  |
|                  | Green   | 0                                         | 0  | 0  | 0  | 0  | 0  | 1  | 1  | 1  | 1  | 1  | 1  | 0  | 0  | 0  | 0  | 0  | 0  |
|                  | Cyan    | 0                                         | 0  | 0  | 0  | 0  | 0  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  |
|                  | Yellow  | 1                                         | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 0  | 0  | 0  | 0  | 0  | 0  |
|                  | White   | 1                                         | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  |
| Red gray scale   | Black   | 0                                         | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  |
|                  |         | 0                                         | 0  | 0  | 0  | 0  | 1  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  |
|                  | dark    | 0                                         | 0  | 0  | 0  | 1  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  |
|                  | ↑       |                                           |    |    | :  |    |    |    |    | :  |    |    |    |    |    | :  |    |    |    |
|                  | ↓       |                                           |    |    | :  |    |    |    |    | :  |    |    |    |    |    | :  |    |    |    |
|                  | bright  | 1                                         | 1  | 1  | 1  | 0  | 1  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  |
| Green gray scale | Black   | 0                                         | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  |
|                  |         | 0                                         | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 1  | 0  | 0  | 0  | 0  | 0  | 0  | 0  |
|                  | dark    | 0                                         | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 1  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  |
|                  | ↑       |                                           |    |    | :  |    |    |    |    | :  |    |    |    |    |    | :  |    |    |    |
|                  | ↓       |                                           |    |    | :  |    |    |    |    | :  |    |    |    |    |    | :  |    |    |    |
|                  | bright  | 0                                         | 0  | 0  | 0  | 0  | 0  | 1  | 1  | 1  | 1  | 0  | 1  | 0  | 0  | 0  | 0  | 0  | 0  |
| Blue gray scale  | Black   | 0                                         | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  |
|                  |         | 0                                         | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 1  |
|                  | dark    | 0                                         | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 1  | 0  | 0  |
|                  | ↑       |                                           |    |    | :  |    |    |    |    | :  |    |    |    |    |    | :  |    |    |    |
|                  | ↓       |                                           |    |    | :  |    |    |    |    | :  |    |    |    |    |    | :  |    |    |    |
|                  | bright  | 0                                         | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 1  | 1  | 1  | 1  | 0  | 1  |
| Blue             |         | 0                                         | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 1  | 1  | 1  | 1  | 1  | 0  | 0  |
|                  | Blue    | 0                                         | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 1  | 1  | 1  | 1  | 1  | 1  | 1  |

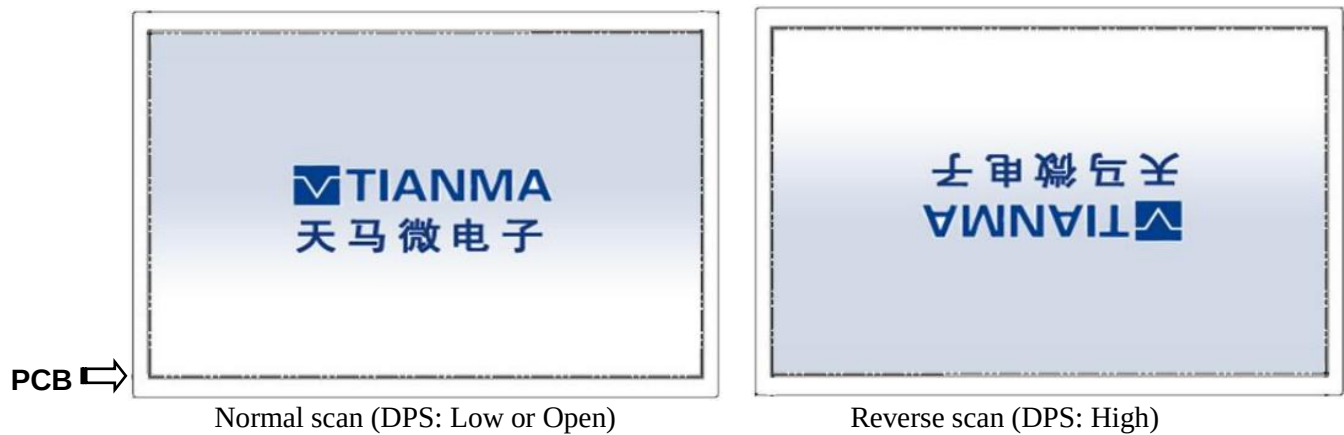
## 6.6 DISPLAY POSITIONS

The following tables is the coordinates per pixel (See"6.7 SCANNING DIRECTIONS".)

|                                                                                   |            |       |            |       |             |             |
|-----------------------------------------------------------------------------------|------------|-------|------------|-------|-------------|-------------|
| C (0, 0)                                                                          |            |       |            |       |             |             |
| R                                                                                 | G          | B     |            |       |             |             |
|  |            |       |            |       |             |             |
| C( 0, 0)                                                                          | C( 1, 0)   | · · · | C( X, 0)   | · · · | C(638, 0)   | C(639, 0)   |
| C( 0, 1)                                                                          | C( 1, 1)   | · · · | C( X, 1)   | · · · | C(638, 1)   | C(639, 1)   |
| ·                                                                                 | ·          | ·     | ·          | ·     | ·           | ·           |
| ·                                                                                 | ·          | · · · | ·          | · · · | ·           | · · ·       |
| ·                                                                                 | ·          | ·     | ·          | ·     | ·           | ·           |
| C( 0, Y)                                                                          | C( 1, Y)   | · · · | C( X, Y)   | · · · | C(638, Y)   | C(639, Y)   |
| ·                                                                                 | ·          | ·     | ·          | ·     | ·           | ·           |
| ·                                                                                 | ·          | · · · | ·          | · · · | ·           | ·           |
| ·                                                                                 | ·          | ·     | ·          | ·     | ·           | ·           |
| C( 0, 478)                                                                        | C( 1, 478) | · · · | C( X, 478) | · · · | C(638, 478) | C(639, 478) |
| C( 0, 479)                                                                        | C( 1, 479) | · · · | C( X, 479) | · · · | C(638, 479) | C(639, 479) |

## 6.7 SCANNING DIRECTIONS

The following figures are figures are seen from a front view. Also the arrow show the direction of scan.



## 7. Optical Characteristics

| Item           |       | Symbol           | Condition       | Min   | Typ   | Max   | Unit              | Remark   |
|----------------|-------|------------------|-----------------|-------|-------|-------|-------------------|----------|
| View Angles    |       | θU               | CR≧10           | 70    | 88    | -     | degree            | Note2,3  |
|                |       | θD               |                 | 70    | 88    | -     |                   |          |
|                |       | θL               |                 | 70    | 88    | -     |                   |          |
|                |       | θR               |                 | 70    | 88    | -     |                   |          |
| Contrast Ratio |       | CR               | θ=0°            | 500   | 800   | -     |                   | Note 3   |
| Response Time  |       | T <sub>ON</sub>  | 25℃             | -     | 25    | 35    | ms                | Note 4   |
|                |       | T <sub>OFF</sub> |                 |       |       |       |                   |          |
| Chromaticity   | White | x                | Backlight is on | 0.254 | 0.304 | 0.354 |                   | Note 1,5 |
|                |       | y                |                 | 0.287 | 0.337 | 0.387 |                   |          |
|                | Red   | x                |                 | 0.541 | 0.591 | 0.641 |                   | Note 1,5 |
|                |       | y                |                 | 0.308 | 0.358 | 0.408 |                   |          |
|                | Green | x                |                 | 0.242 | 0.292 | 0.342 |                   | Note 1,5 |
|                |       | y                |                 | 0.501 | 0.551 | 0.601 |                   |          |
|                | Blue  | x                |                 | 0.111 | 0.161 | 0.211 |                   | Note 1,5 |
|                |       | y                |                 | 0.100 | 0.150 | 0.200 |                   |          |
| Uniformity     |       | U                |                 | 72    | 80    |       | %                 | Note 6   |
| NTSC           |       | -                |                 | 40    | 45    |       | %                 | Note 5   |
| Luminance      |       | L                |                 | 570   | 650   |       | cd/m <sup>2</sup> | Note 7   |

Table 7.1 Optical Parameters

Test Conditions:

1.  $I_F = 50$  mA and the ambient temperature is 25°C.
2. The test systems refer to Note1 ~ Note7.

Note1: Definition of optical measurement system.

The optical characteristics should be measured in dark room. After 5 Minutes operation, the optical characteristics are measured at the center point of the LCD screen.

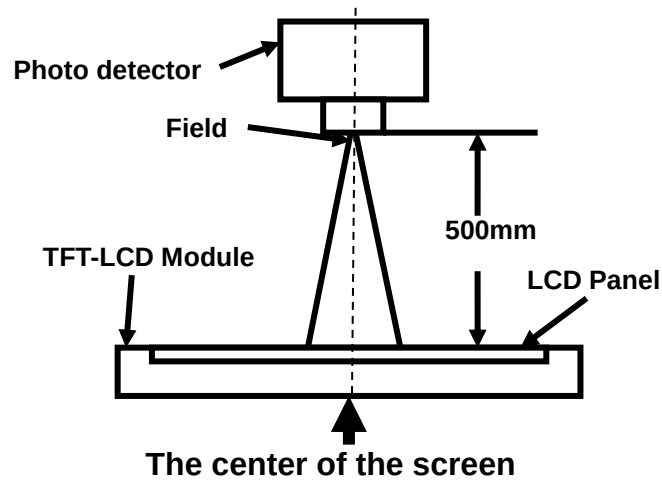


Fig1.Measurement Set Up

Note2: Definition of viewing angle range and measurement system. Viewing angle is measured at the center point of the LCD .

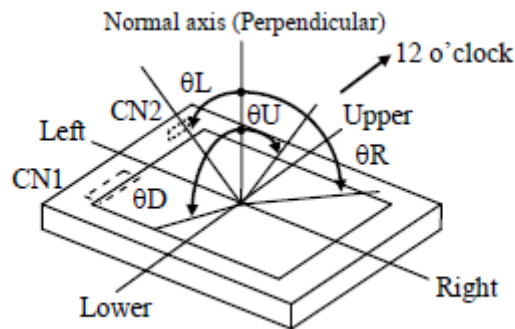


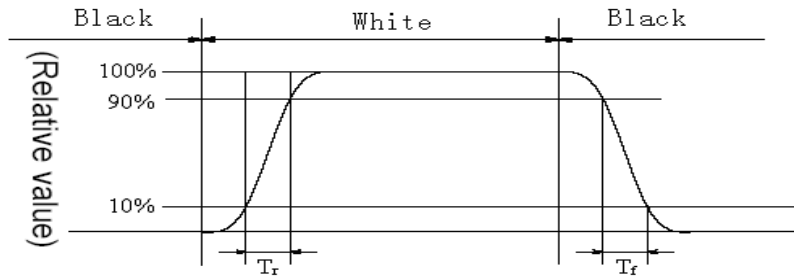
Fig2. Measurement viewing angle

Note3: Definition of contrast ratio

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

Note4: Definition of Response time

For SFT LCM, the response time is defined as the LCD optical switching time interval between “White” state and “Black” state. Rise time ( $T_r$ ) is the time between photo detector output intensity changed from 10% to 90%. And fall time ( $T_f$ ) is the time between photo detector output intensity changed from 90% to 10%.



**Fig4.Response Time Testing(SFT)**

Note5: Definition of color chromaticity (CIE1931)

Color coordinates measured at center point of LCD.

Note6: Definition of Luminance Uniformity

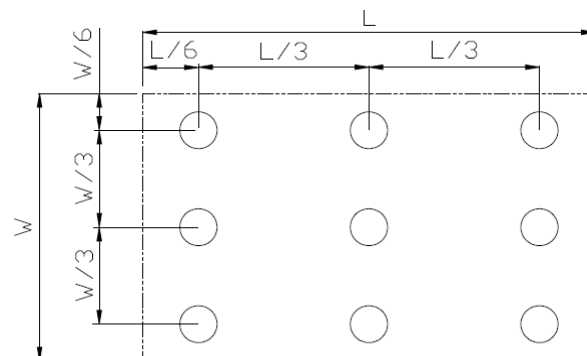
Active area is divided into 9 measuring areas (Refer Fig.5). Every measuring point is placed at the center of each measuring area.

Luminance Uniformity (U) =  $L_{min} / L_{max}$

$L_{max}$ : The measured Maximum luminance of all measurement position.

$L_{min}$ : The measured Minimum luminance of all measurement position.

L-----Active area length; W----- Active area width



**Fig5. Luminance Uniformity Measurement Locations(9 points)**

Note7: Definition of Luminance:

Measure the luminance of white state at center point.

## 8. Reliability Test

| No | Test Item                               | Condition                                                                                            | Remarks                                                                                   |
|----|-----------------------------------------|------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------|
| 1  | High Temperature Operation              | Ta = +80°C, 240 hours                                                                                | IEC60068-2-2:2007<br>GB2423.2-2008                                                        |
| 2  | Low Temperature Operation               | Ta = -30°C, 240 hours                                                                                | IEC60068-2-1:2007<br>GB2423.1-2008                                                        |
| 3  | High Temperature Storage                | Ta = +80°C, 240hours                                                                                 | IEC60068-2-2:2007<br>GB2423.2-2008                                                        |
| 4  | Low Temperature Storage                 | Ta = -30°C, 240 hours                                                                                | IEC60068-2-1:2007<br>GB2423.1-2008                                                        |
| 5  | High Temperature and Humidity Operation | Ta = +60°C, 90% RH max,240hours                                                                      | IEC60068-2-78 :2012<br>GB/T2423.3—2016                                                    |
| 6  | Thermal Shock (non-operation)           | -30°C 30 min~+80°C 30 min, Change time:5min, 100 Cycle                                               | Start with cold temperature, End with high temperature, IEC60068-2-14:2009,GB2423.22-2012 |
| 7  | ESD                                     | C=150pF,R=150Ω,9point/panel Contact: ±10Kv,10times;                                                  | IEC61000-4-2:2008<br>GB/T17626.2-2018                                                     |
| 8  | Vibration Test (non-operation)          | 5~100HZ , 19.60m/s <sup>2</sup> 1min/cycle 120times Per X\Y\Z                                        | IEC60068-2-6:2007<br>GB/T2423.10—2019                                                     |
| 9  | Shock Test (non-operation)              | 539m/s <sup>2</sup> , 11ms 5times ±X、 ±Y、 ±Z                                                         | GB/T 2423.5-1995                                                                          |
| 10 | Package Drop Test                       | Height:60cm, 1corner,3edges,6surfaces                                                                | GB/T 4857.5-1995                                                                          |
| 11 | Package Vibration                       | Frequency : 5-20-200HZ , PSD : 0.01-0.01-0.001 Total:0.781g <sup>2</sup> /HZ, x/y/z axis per 30min ) | GB/T 4857.23-2021                                                                         |

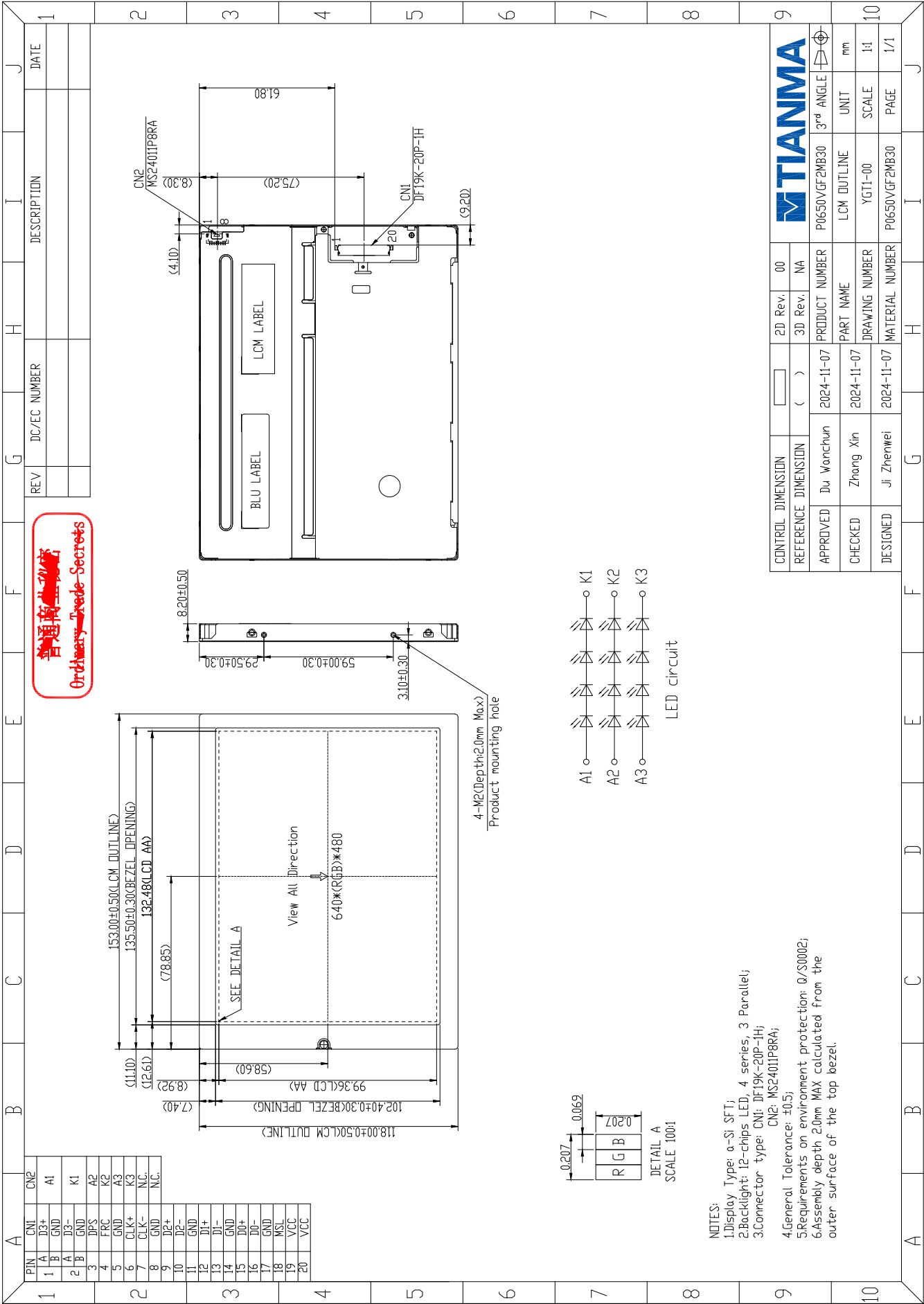
**Table 8.1 RA test condition**

Note1: Temperature is the ambient temperature of sample

Note2: Before cosmetic and function test, the product must have enough recovery time, at least 24 hours at room temperature.

Note3: In the standard condition, there shall be no practical problem that may affect the display function. After the reliability test, the product's function only be guaranteed, but not for all of the cosmetic specification.

9. Mechanical Drawing



NOTES:

1.Display Type: a-Si SFT;

2.Backlight: 12-chips LED, 4 series, 3 Parallel;

3.Connector type: CN1: DF19K-20P-1H; CN2: MS2401P8RA;

4.General Tolerance: ±0.5;

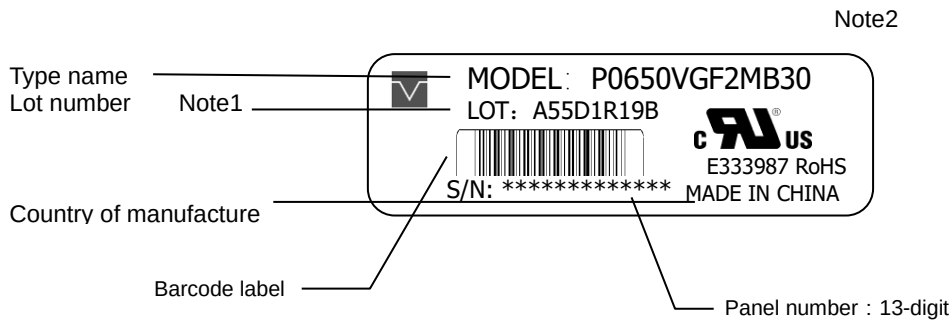
5.Requirements on environment protection: 0/S0002;

6.Assembly depth 2.0mm MAX calculated from the outer surface of the top bezel.

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## 10. Markings

The nameplate label marking is attached to this product



Note1: The meaning of lot number

- Example: A55D1R19B

| A                                         | 5                                                                                         | 5                                                                                                                      | D1R19B                                   |
|-------------------------------------------|-------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------|------------------------------------------|
| <b>Revision</b><br>1 letter<br>(Alphabet) | <b>Manufacturing year</b><br>1 figure of the A.D. end<br>numbers<br>(e.g.: A.D 2025 is 5) | <b>Manufacturing month</b><br>1 letter<br>Jan. to Sep.: Number of<br>month<br>October: A<br>November: B<br>December: C | <b>Production number</b><br>Multi-letter |

Note2: Do not attach anything like another label on the name plate label! In case of replacing the product, Tianma needs the contents of nameplate such as the lot number, inspection date and so on, to identify the warranty period with individual product. If Tianma cannot decipher the contents of nameplate, replacing shall be charged. Tianma also may give a new lot number to replaced products.

## 11. Packing Instruction

| No | Item           | Model (Material) | Dimensions(mm)  | Unit Weight(Kg) | Quantity | Remark |
|----|----------------|------------------|-----------------|-----------------|----------|--------|
| 1  | LCM            | P0650VGF2MB30    | 153.0×118.0×8.2 | 0.135           | 24       |        |
| 2  | Tray           | PET              | 356×256×19.7    | 0.125           | 15       |        |
| 3  | Dust-proof Bag | PE               | 680×520         | 0.042           | 1        |        |
| 4  | EPE 1          | EPE              | 336×246×6       | 0.01            | 6        |        |
| 5  | EPE 2          | EPE              | 375×275×10      | 0.014           | 4        |        |
| 6  | EPE3           | EPE              | 250×280×12      | 0.015           | 2        |        |
| 7  | Carton         | CORRUGATED PAPER | 398×290×315     | 0.58            | 1        |        |
| 8  | Lable          | tagboard         | 100×52          | 0.002           | 1        |        |
| 9  | Total weight   | 5.885 Kg         |                 |                 |          |        |

### Packaging Specification and Quantity

|                                                                                   |
|-----------------------------------------------------------------------------------|
| (1) LCM quantity per tray:2                                                       |
| (2) Total LCM quantity per group:8(4 trays+1 tray)                                |
| (3) Total LCM quantity in Carton: Number of PET trays 12× quantity per tray 2= 24 |

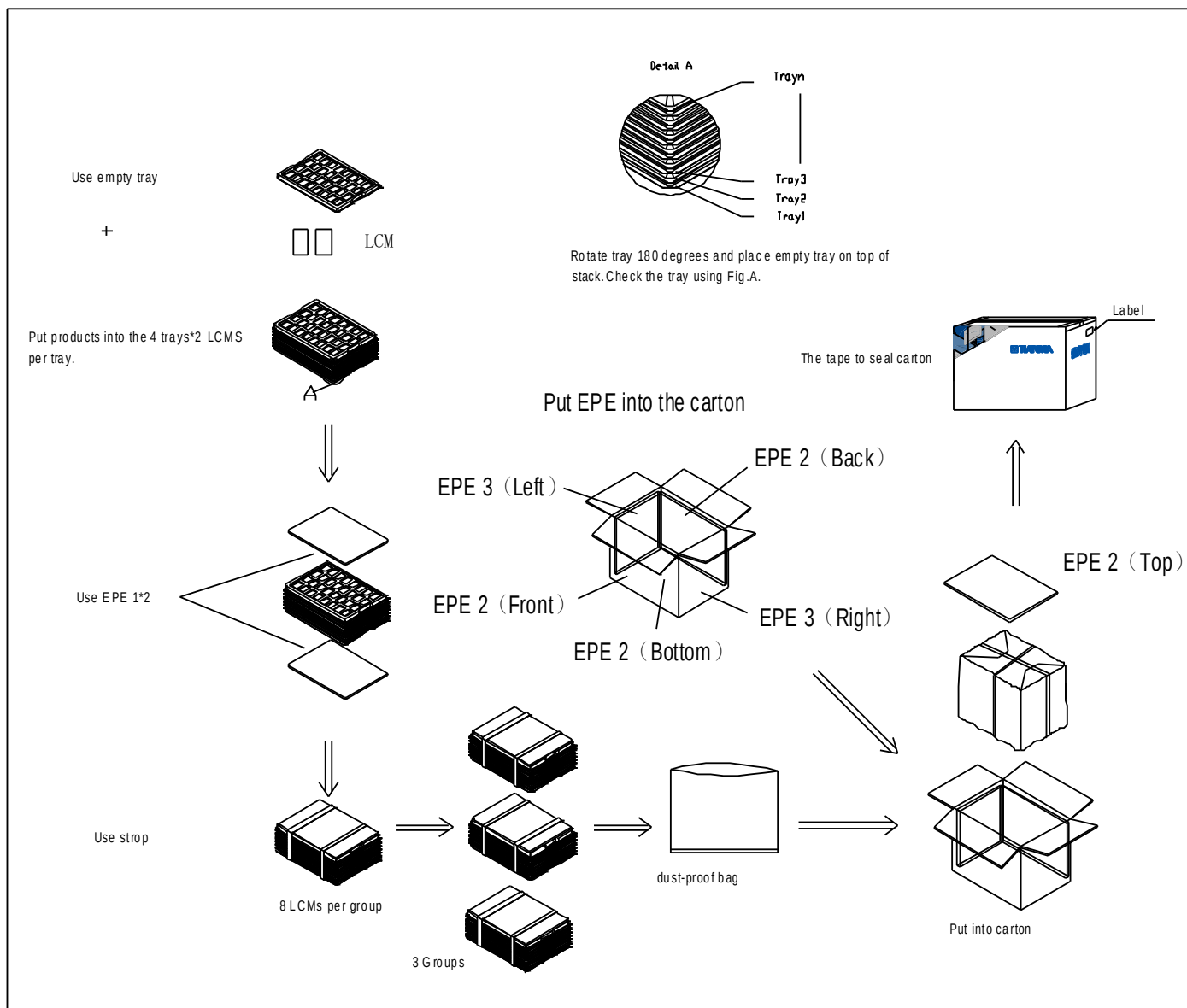
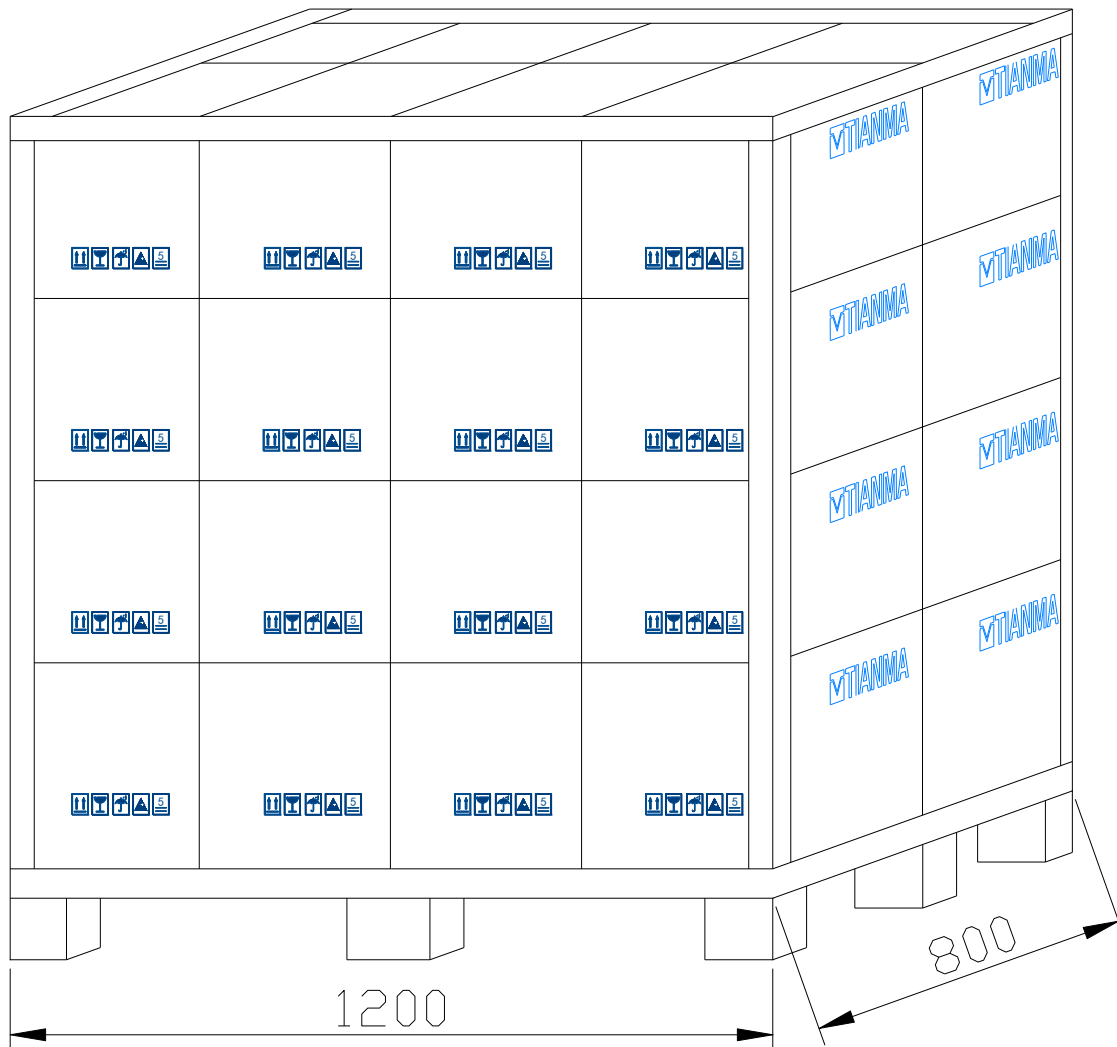


Figure 10.1 Packing Instruction

## Stack placement

The number of cartons stacked is 2 x 4/ each layer x 4 layers in total

Below dimensions unit: mm



## 12. Precautions for Use of LCD Modules

### 12.1 Handling Precautions

- (1) The display panel is made of glass. Do not subject it to mechanical shock by dropping it, etc.
- (2) If the display panel is damaged and the liquid crystal fluid inside it leaks out be sure not to get any in your mouth. If the fluid comes into contact with your skin or clothes promptly wash it off using soap and water.
- (3) Do not apply excessive force to the display surface or the bezel since this may cause the color tone to vary.
- (4) The polarizer covering the display surface of the LCD module is soft and easily scratched. Handle the polarizer carefully.
- (5) If the display surface is contaminated, breathe on the surface and gently wipe it with a soft dry cloth. If it is still not completely clear use a moist cloth with one of the following solvents:
  - Isopropyl alcohol
  - Ethyl alcoholSolvents other than those mentioned above may damage the polarizer. Specifically, do not use the following:
  - Water
  - Ketone
  - Aromatic solvents
- (6) Do not disassemble the LCD Module.
- (7) If powered off, do not apply the input signals.
- (8) To prevent destruction of the module by static electricity, be careful to maintain an optimum work environment.
- (9) Be sure to ground your body when handling the LCD Modules.
- (10) Tools used for assembly, must be properly grounded.
- (11) To reduce the amount of static electricity generated, do not conduct assembly or other work under very low humidity conditions.
- (12) The LCD Module is covered with a film to protect the display surface, remove film slowly under the ionizer.

### 12.2 Storage precautions

- (1) When storing the LCD modules avoid exposure to direct sunlight or to the light of fluorescent lamps.
- (2) The LCD modules should be stored within the rated storage temperature range. The recommend condition is: Temperature: 0 ~ 35 °C at normal humidity.
- (3) The LCD modules should be stored in a room without acid, alkali or other harmful gas.

### 12.3 Transportation Precautions

The LCD modules should not be dropped or subject to violent mechanical shock during transportation. Also they should avoid excessive pressure, water, high humidity and direct sunlight.

### 12.4 Screen saver Precautions

Not display the fixed pattern for a long time. Use a screen saver, if the fixed pattern is displayed on the screen

### 12.5 Safety Precautions

- (1) When you waste damaged or unnecessary LCDs, it is recommended to crush LCDs into pieces and wash them off with solvents such as acetone and ethanol, which should later be burned
- (2) Be sure to turn off the power supply when inserting or disconnecting the LED backlight cable.
- (3) LED driver should be designed carefully to limit or stop its function when over current is detected on the LED.