

# TFT Module Specification

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## MODEL: 13-090XIEBCAA1-S

< ◇ > PRELIMINARY SPECIFICATION

< ◆ > APPROVAL SPECIFICATION

| CUSTOMER    |
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|             |
| APPROVED BY |
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| DATE:       |

| DESIGNED                                           | CHECKED                                            | APPROVED                                          |
|----------------------------------------------------|----------------------------------------------------|---------------------------------------------------|
| <div>RD</div> <div>2022.08.31</div> <div>趙長慶</div> | <div>PM</div> <div>2022.08.31</div> <div>呂家祥</div> | <div>批准</div> <div>2022.08.31</div> <div>PM</div> |

DigiWise International Corporation

3F., No.10, Ln 83, Sec 1, Guang Fu Rd., Sanchong Dist., 24158,  
New Taipei City, Taiwan (ROC)

TEL : +886-2-29992866

FAX : +886-2-29990900



## RECORD OF REVISION

| Version | Revised Date | Page | Content      |
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|         |              |      |              |
|         |              |      |              |



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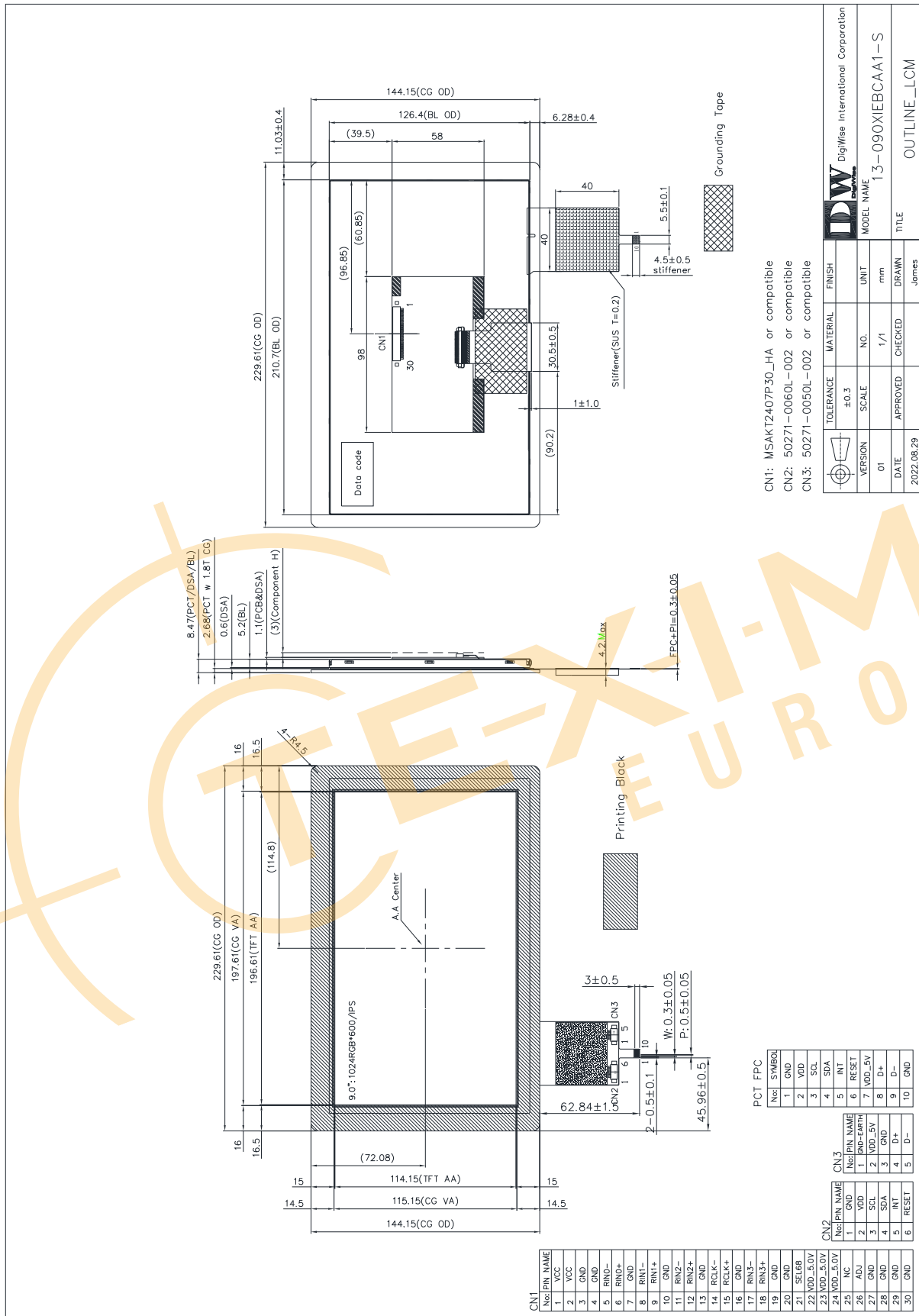
**1. GENERAL DESCRIPTION****1.1 Description**

The specification is model 13-090XIEBCAA1-S is a color active matrix thin film transistor (TFT) liquid crystal display (LCD) that uses amorphous silicon TFT as a switching device. This model is composed of a TFT LCD panel, a driving circuit, a backlight system, a projected capacitive touch panel. This TFT LCD has a 9.0 (16:9) inch diagonally measured active display area with WSGA (1024 horizontal by 600 vertical pixels) resolution.

**1.2 Features:**

| No. | Item                           | Specification                       | Unit   |
|-----|--------------------------------|-------------------------------------|--------|
| 1   | Panel Size                     | 9.0"                                | Inch   |
| 2   | Number of Pixels               | 1024 (W) x RGB x 600 (H)            | Pixels |
| 3   | Active Area                    | 196.61 (W) × 114.15 (H)             | mm     |
| 4   | Pixel Pitch                    | 0.192 (W) x 0.19025 (H)             | mm     |
| 5   | Outline Dimension              | 229.61 (W) × 144.15 (H) × 8.47 (T)  | mm     |
| 6   | Number of Colors               | 16.2M / 262K                        | - -    |
| 7   | Display Mode                   | IPS / Normally Black / Transmissive | - -    |
| 8   | Viewing Direction              | Free direction                      | - -    |
| 9   | Display Format                 | RGB vertical stripe                 | - -    |
| 10  | Surface Treatment              | Clear (7H)                          | - -    |
| 11  | Contrast Ratio                 | 600 (Typ.)                          | - -    |
| 12  | Luminance (cd/m <sup>2</sup> ) | 800 (Typ.)                          | cd/m2  |
| 13  | Interface                      | LVDS 8 / 6 bit Interface            | - -    |
| 14  | Backlight                      | White LED                           | - -    |
| 15  | Operation Temperature          | -20 ~ 70                            | °C     |
| 16  | Storage Temperature            | -30 ~ 80                            | °C     |
| 17  | Weight                         | TBD                                 | g      |

## 2. MECHANICAL SPECIFICATION



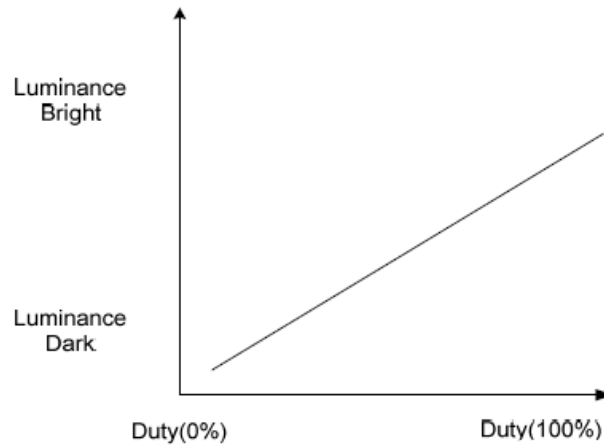
3. **PIN DESCRIPTION** (Connector Part No: MSAKT2407P30\_HA or equivalent)

| Pin No. | Symbol | I/O | Function                               | Note  |
|---------|--------|-----|----------------------------------------|-------|
| 1       | VCC    | P   | Power Supply Logic voltage +3.3V       |       |
| 2       | VCC    | P   | Power Supply Logic voltage +3.3V       |       |
| 3       | GND    | P   | Ground                                 |       |
| 4       | GND    | P   | Ground                                 |       |
| 5       | RIN0-  | I   | Negative LVDS differential data input  |       |
| 6       | RIN0+  | I   | Positive LVDS differential data input  |       |
| 7       | GND    | P   | Ground                                 |       |
| 8       | RIN1-  | I   | Negative LVDS differential data input  |       |
| 9       | RIN1+  | I   | Positive LVDS differential data input  |       |
| 10      | GND    | P   | Ground                                 |       |
| 11      | RIN2-  | I   | Negative LVDS differential data input  |       |
| 12      | RIN2+  | I   | Positive LVDS differential data input  |       |
| 13      | GND    | P   | Ground                                 |       |
| 14      | RCLK-  | I   | Negative LVDS differential clock input |       |
| 15      | RCLK+  | I   | Positive LVDS differential clock input |       |
| 16      | GND    | P   | Ground                                 |       |
| 17      | RIN3-  | I   | Negative LVDS differential data input  |       |
| 18      | RIN3+  | I   | Positive LVDS differential data input  |       |
| 19      | GND    | P   | Ground                                 |       |
| 20      | GND    | P   | Ground                                 |       |
| 21      | SEL68  | I   | 6bit/8bit mode select                  | Note1 |
| 22      | VDD_5V | P   | Power Supply LED voltage +5V           |       |
| 23      | VDD_5V | P   | Power Supply LED voltage +5V           |       |
| 24      | VDD_5V | P   | Power Supply LED voltage +5V           |       |
| 25      | NC     | -   | No connection                          |       |
| 26      | ADJ    | I   | Back-light Dimming control             |       |
| 27      | GND    | P   | Ground                                 |       |
| 28      | GND    | P   | Ground                                 |       |
| 29      | GND    | P   | Ground                                 |       |
| 30      | GND    | P   | Ground                                 |       |

Notes:

- 1) If LVDS input data is 6 bits, SELB must be set to High;  
If LVDS input data is 8 bits, SELB must be set to Low.
- 2) ADJ is brightness control Pin. The larger of the pulse duty is, the higher of the brightness.

3) ADJ signal is 0~3.3V. Operation frequency range is 20KHz



**4. ABSOLUTE MAXIMUM RATINGS****4.1 Electrical Absolute Rating****4.1.1 TFT LCD Module**

| Item                 | Symbol | Values |      | Unit | Note |
|----------------------|--------|--------|------|------|------|
|                      |        | Min    | Max. |      |      |
| Power supply voltage | VCC    | -0.3   | 4.0  | V    |      |
| Power supply voltage | VDD_5V | 0      | 6.0  | V    |      |

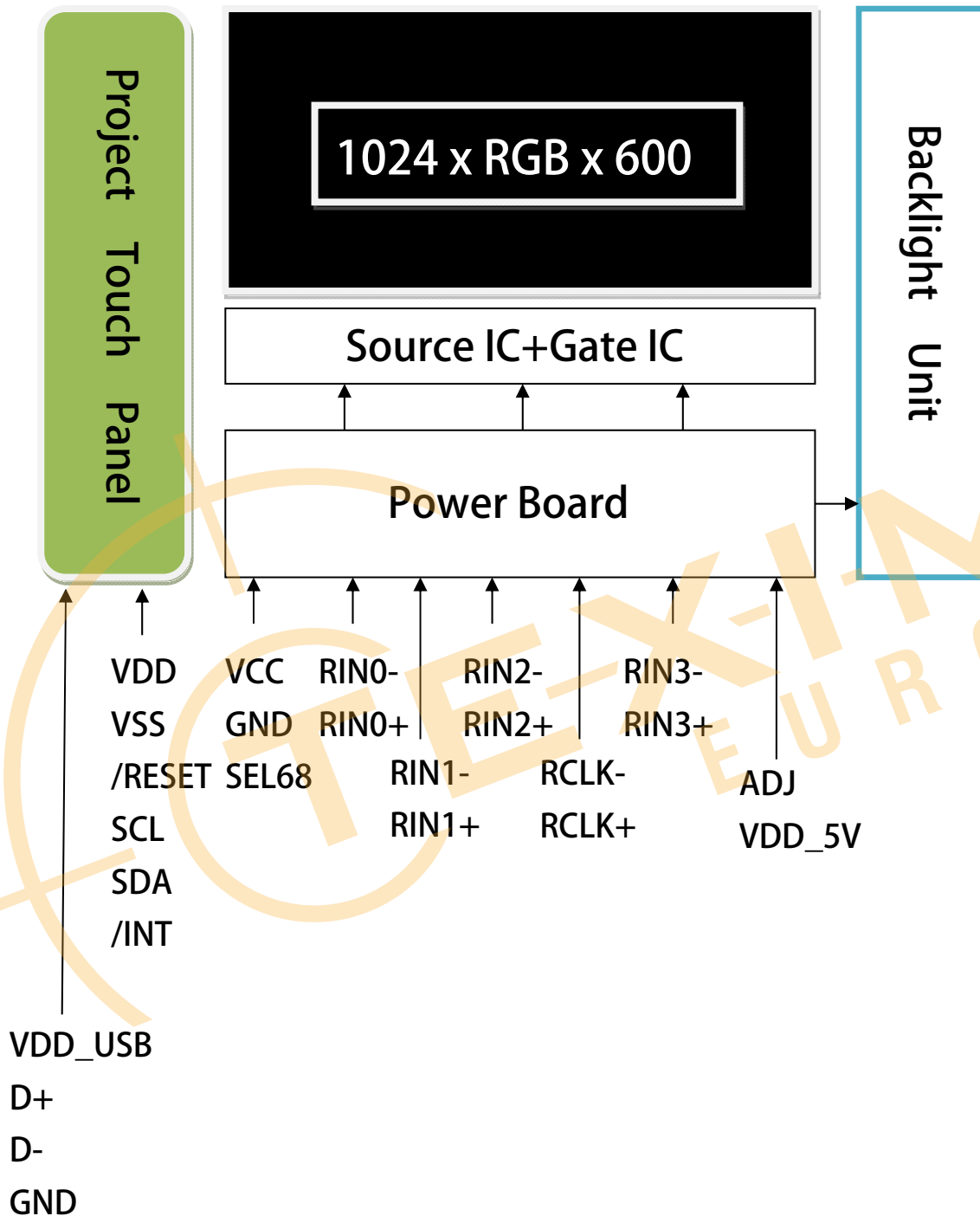
**4.1.2 Environment Absolute Rating**

| Item                  | Symbol | Values |     |      | Unit | Note                |
|-----------------------|--------|--------|-----|------|------|---------------------|
|                       |        | Min    | Typ | Max. |      |                     |
| Operating Temperature | Topa   | -20    |     | 70   | °C   | Ambient temperature |
| Storage Temperature   | Tstg   | -30    |     | 80   | °C   |                     |



## 5. BLOCK DIAGRAM

### 5.1 TFT LCD Module



## 6. Relationship Between Displayed Color and Input

### 6.1 6 bit

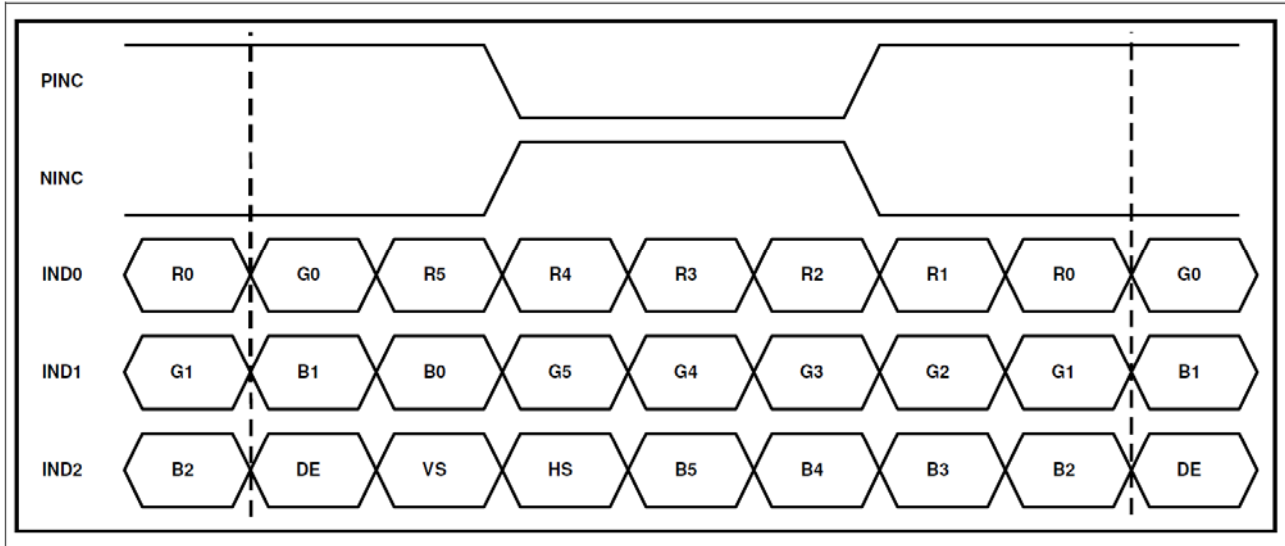
|             | Color & Gray Scale | Data Signal |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
|-------------|--------------------|-------------|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|
|             |                    | R5          | R4 | R3 | R2 | R1 | R0 | G5 | G4 | G3 | G2 | G1 | G0 | B5 | B4 | B3 | B2 | B1 | B0 |
| Basic Color | Black              | 0           | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  |
|             | Red                | 1           | 1  | 1  | 1  | 1  | 1  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  |
|             | Green              | 0           | 0  | 0  | 0  | 0  | 0  | 1  | 1  | 1  | 1  | 1  | 1  | 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  |
|             | Cyan               | 0           | 0  | 0  | 0  | 0  | 0  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  |
|             | Magenta            | 1           | 1  | 1  | 1  | 1  | 1  | 0  | 0  | 0  | 0  | 0  | 0  | 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         | Black              | 0           | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  |
|             | Red(1)             | 0           | 0  | 0  | 0  | 0  | 1  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  |
|             | Red(2)             | 0           | 0  | 0  | 0  | 1  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  |
|             | :                  | :           | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  |
|             | Red(31)            | 0           | 1  | 1  | 1  | 1  | 1  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  |
|             | :                  | :           | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  |
|             | Red(62)            | 1           | 1  | 1  | 1  | 1  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  |
|             | Red(63)            | 1           | 1  | 1  | 1  | 1  | 1  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  |
| Green       | Black              | 0           | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  |
|             | Green(1)           | 0           | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 1  | 0  | 0  | 0  | 0  | 0  | 0  |
|             | Green(2)           | 0           | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 1  | 0  | 0  | 0  | 0  | 0  | 0  | 0  |
|             | :                  | :           | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  |
|             | Green(31)          | 0           | 0  | 0  | 0  | 0  | 0  | 0  | 1  | 1  | 1  | 1  | 0  | 0  | 0  | 0  | 0  | 0  | 0  |
|             | :                  | :           | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  |
|             | Green(62)          | 0           | 0  | 0  | 0  | 0  | 0  | 1  | 1  | 1  | 1  | 1  | 0  | 0  | 0  | 0  | 0  | 0  | 0  |
|             | Green(63)          | 0           | 0  | 0  | 0  | 0  | 0  | 1  | 1  | 1  | 1  | 1  | 1  | 0  | 0  | 0  | 0  | 0  | 0  |
| Blue        | Black              | 0           | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  |
|             | Blue(1)            | 0           | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 1  |
|             | Blue(2)            | 0           | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 1  | 0  |
|             | :                  | :           | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  |
|             | Blue(31)           | 0           | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 1  | 1  | 1  | 1  | 1  |
|             | :                  | :           | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  |
|             | Blue(62)           | 0           | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 1  | 1  | 1  | 1  | 1  | 0  |
|             | Blue(63)           | 0           | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 1  | 1  | 1  | 1  | 1  | 1  |

**6.2 8 bit**

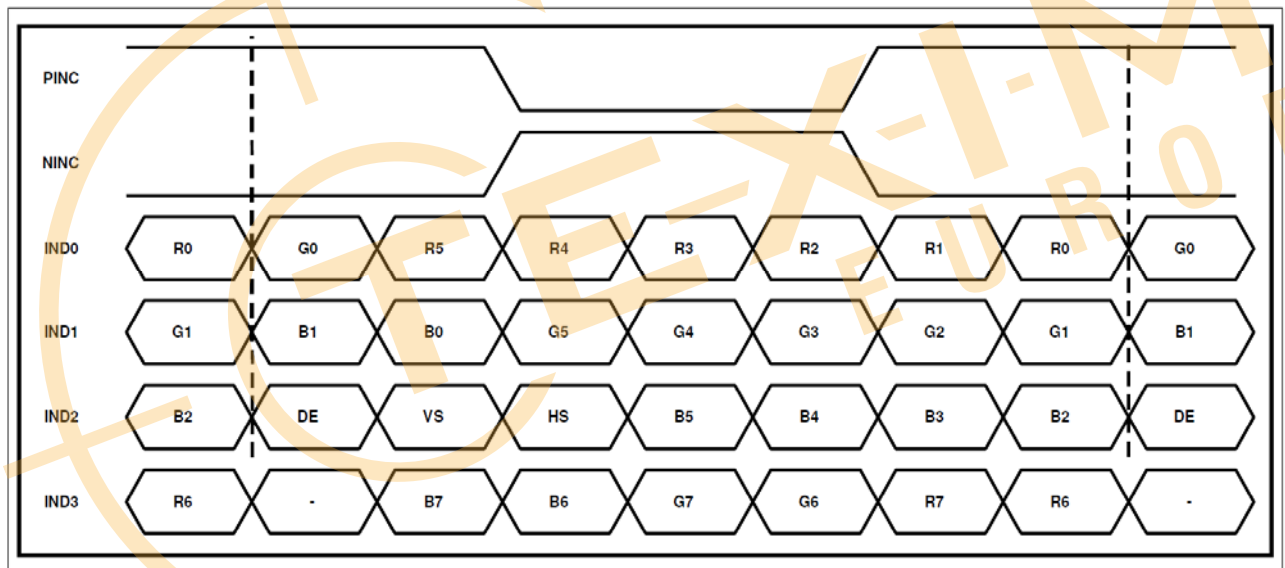
|             |                                                                                     | Color & Gray Scale | Data Signal |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
|-------------|-------------------------------------------------------------------------------------|--------------------|-------------|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|
|             |                                                                                     |                    | 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 Color |    | 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  |
|             |    | 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  |
|             |    | 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  |
|             |    | 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  |
|             |    | 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  |
|             |    | 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  |
|             |    | 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         |    | Black              | 0           | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  |    |
|             |    | Red(1)             | 0           | 0  | 0  | 0  | 0  | 0  | 0  | 1  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  |    |
|             |    | Red(2)             | 0           | 0  | 0  | 0  | 0  | 0  | 1  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  |    |
|             |    | :                  | :           | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  |    |
|             |    | Red(127)           | 0           | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  |    |
|             |    | :                  | :           | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  |    |
|             |   | Red(254)           | 1           | 1  | 1  | 1  | 1  | 1  | 1  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  |    |
|             |  | Red(255)           | 1           | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  |    |
| Green       |  | Black              | 0           | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  |    |
|             |  | Green(1)           | 0           | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 1  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  |    |
|             |  | Green(2)           | 0           | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 1  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  |    |
|             |  | :                  | :           | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  |    |
|             |  | Green(127)         | 0           | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 0  | 0  | 0  | 0  | 0  | 0  | 0  |    |
|             |  | :                  | :           | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  |    |
|             |  | Green(254)         | 0           | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  |    |
|             |  | Green(255)         | 0           | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 0  | 0  | 0  | 0  | 0  | 0  | 0  |    |
| Blue        |  | Black              | 0           | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  |    |
|             |  | Blue(1)            | 0           | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 1  |    |
|             |  | Blue(2)            | 0           | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 1  | 0  |    |
|             |  | :                  | :           | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  |    |
|             |  | Blue(127)          | 0           | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 1  | 1  | 1  | 1  | 1  | 1  | 1  |    |
|             |  | :                  | :           | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  |    |
|             |  | Blue(254)          | 0           | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 1  | 1  | 1  | 1  | 1  | 1  | 0  |    |
|             |  | Blue(255)          | 0           | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 1  | 1  | 1  | 1  | 1  | 1  | 1  |    |

### 6.3 Data Mapping

#### 6bit LVDS input



#### 8-bit LVDS input



**7. ELECTRICAL CHARACTERISTICS****7.1 TFT LCD Module**

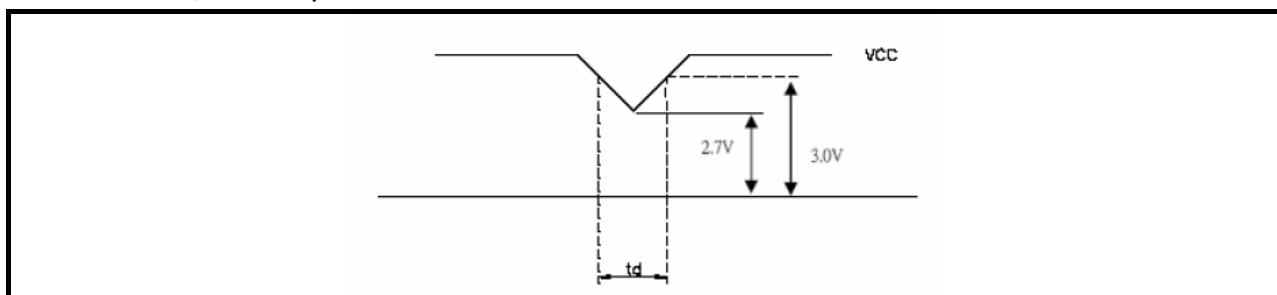
| Item                                 | Symbol          | Values |       |      | Unit   | Remark         |
|--------------------------------------|-----------------|--------|-------|------|--------|----------------|
|                                      |                 | Min.   | Typ.  | Max. |        |                |
| Supply Voltage                       | VCC             | 3.0    | 3.3   | 3.6  | V      |                |
|                                      | VDD_5V          | 4.5    | 5.0   | 5.5  | V      |                |
|                                      | VRF             | -      | -     | 100  | mV p-p | Ripple voltage |
| Differential Input High Threshold    | VTH             | -      | -     | +100 | mV     | Vcm=+1.2V      |
| Differential Input Low Threshold     | VTL             | -100   | -     | -    | mV     | Vcm=+1.2V      |
| Magnitude differential Input Voltage | VID             | 100    | -     | 600  | mV     |                |
| Common Mode Voltage                  | Vcm             | 0.7    | 1.2   | 1.6  | V      |                |
| Common Mode Voltage Offset           | $\Delta V_{cm}$ | -      | -     | 50   | mV     | Vcm=+1.2V      |
| Supply Current                       | ICC             | -      | 200   | 250  | mA     | VCC=3.3V       |
|                                      | IDD             | -      | 670   | 750  | mA     | VDD_5V=5V      |
| ADJ frequency                        |                 | 19K    | 20K   | 50K  | Hz     |                |
| ADJ input voltage                    | VIH             | 3.0    | -     | 3.3  | V      |                |
|                                      | VIL             | 0      | -     | 0.3  | V      |                |
| LED life time                        |                 | -      | 40000 | -    | Hr     | Note1          |

Note (1): The “LED life time” is defined as the module brightness decrease to 50% original brightness that the ambient temperature is 25°C 60% RH.

Note (2): VCC-dip condition

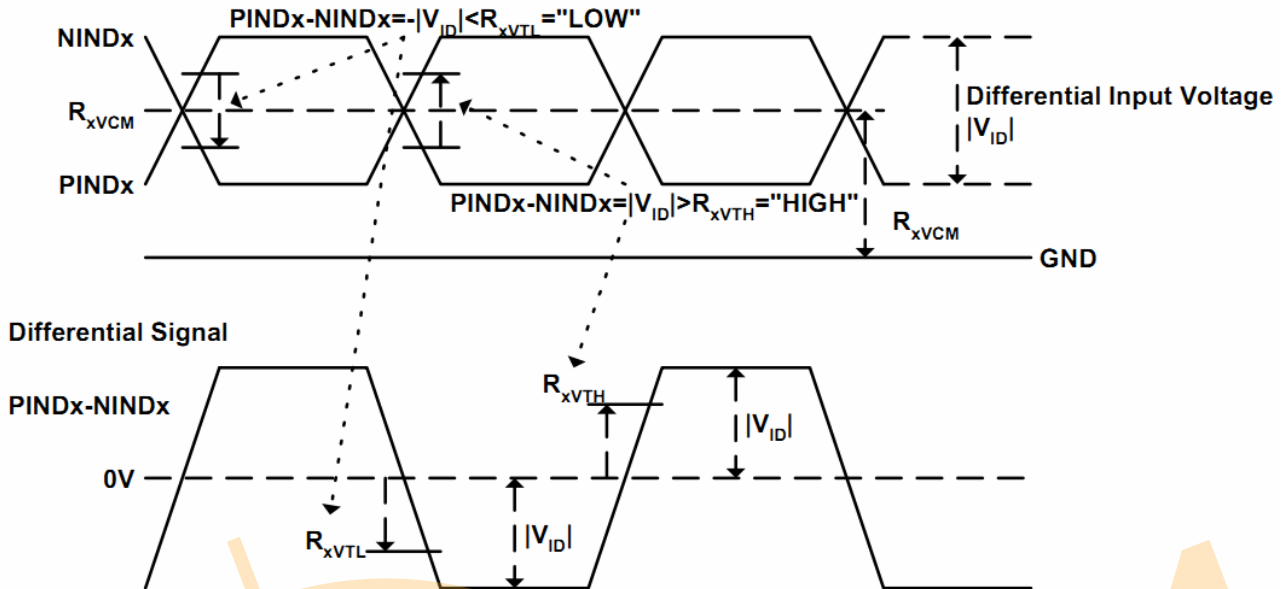
a.  $2.7\text{ V} \leq VCC < 3.0\text{V}$ ,  $t_d \leq 10\text{ ms}$

b.  $VCC > 3.0\text{V}$ , VCC-dip condition should be the same with VCC-turn-on condition °



Note (3): The built-in LVDS receiver is compatible with (ANSI/TIA/TIA-644 ) standard.

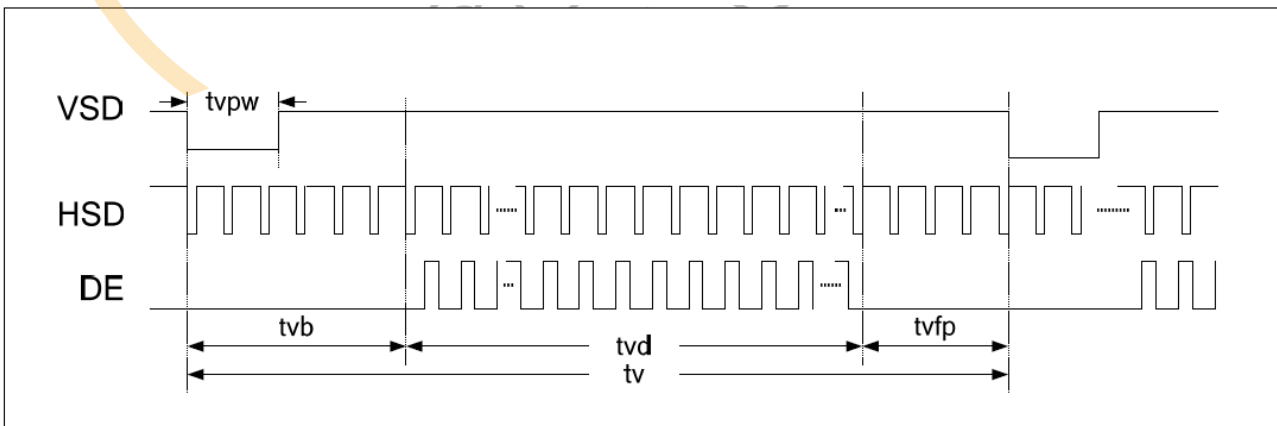
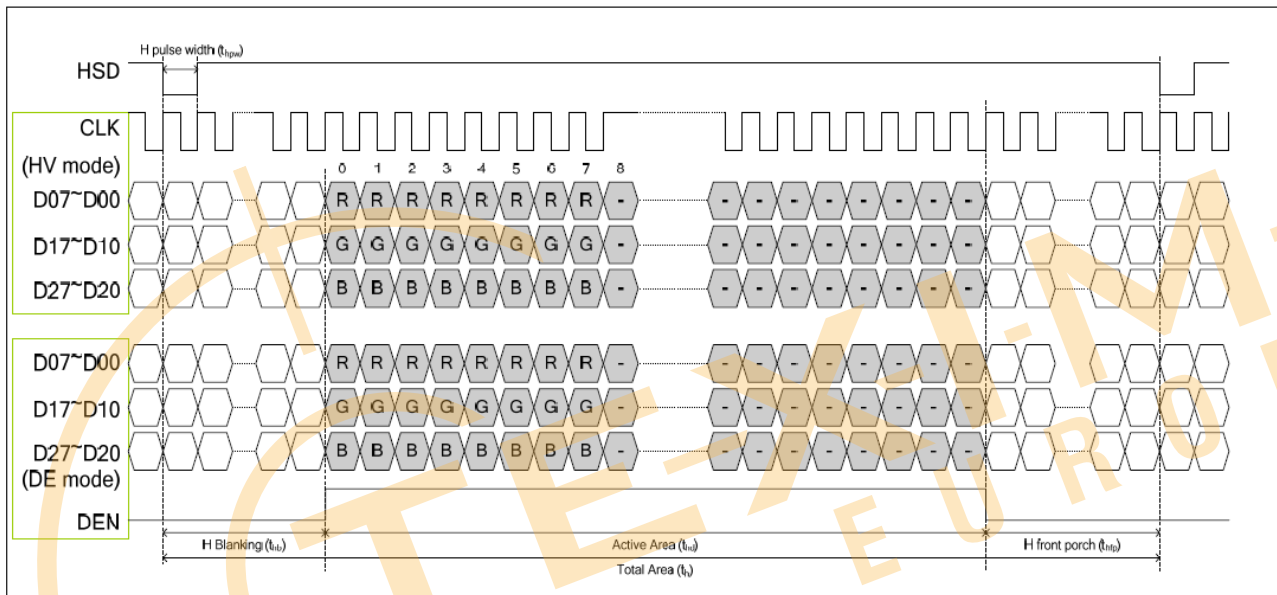
#### Single-end Signals



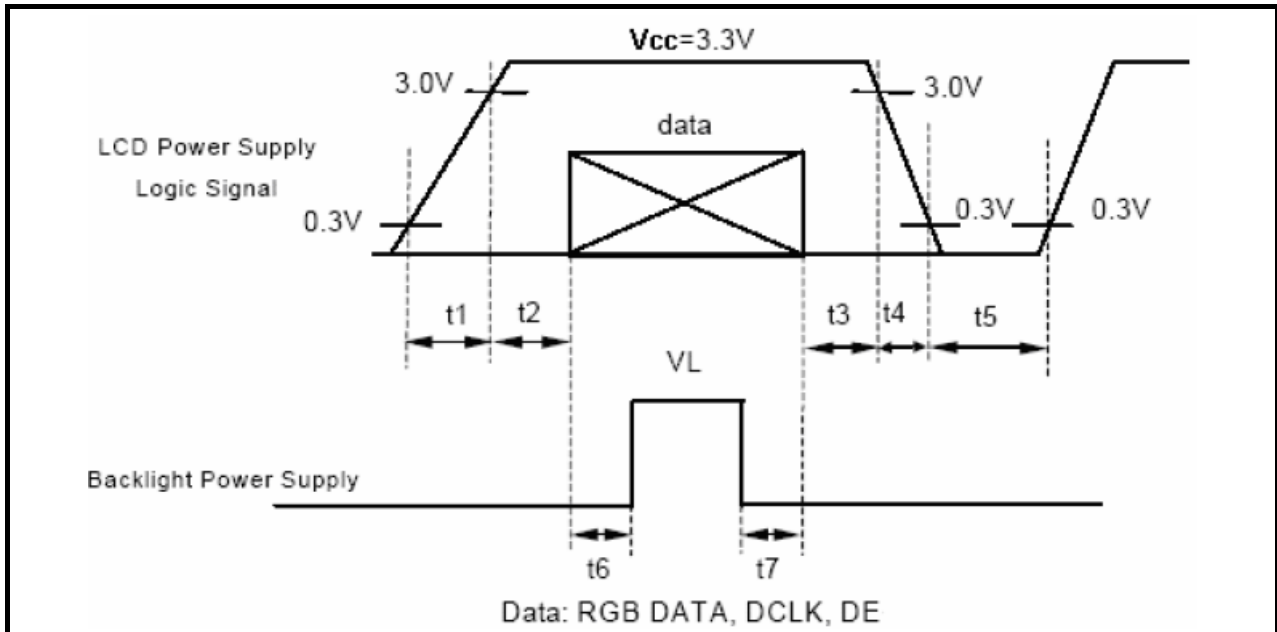
## 7.2 INTERFACE SPECIFICATIONS

### 7.2.1 DE mode Input signal characteristics

| Signal     | Parameter               | Symbol   | Min. | Typ. | Max. | Unit. | Note |
|------------|-------------------------|----------|------|------|------|-------|------|
| DCLK       | DCLK Frequency          | fclk     | 40.8 | 51.2 | 67.2 | MHz   |      |
| Horizontal | Horizontal display area | thd      | -    | 1024 | -    | DCLK  |      |
|            | HSD period time         | th       | 1114 | 1344 | 1400 | DCLK  |      |
|            | HSD Blanking            | thb+thfb | 90   | 320  | 376  | DCLK  |      |
| Vertical   | Vertical display area   | tvd      | -    | 600  | -    | th    |      |
|            | VSD period time         | tv       | 610  | 635  | 800  | th    |      |
|            | VSD pulse width         | tvb+tvfb | 10   | 35   | 200  | th    |      |



### 7.3 Power On / Off Sequence



$$t_1 \leq 10\text{ms} : 1 \text{ sec} \leq t_5$$

$$50\text{ms} \leq t_2 : 200\text{ms} \leq t_6$$

$$0 < t_3 \leq 50\text{ms} : 200\text{ms} \leq t_7$$

$$0 < t_4 \leq 10\text{ms}$$



**8. PROJECTED CAPACITIVE TOUCH PANEL SPECIFICATION****8.1 Main Feature**

| Item                        | Specification                                     | Unit     |
|-----------------------------|---------------------------------------------------|----------|
| Screen Size                 | 9.0 inches                                        | Diagonal |
| Type                        | Transparent Type Projected Capacitive Touch Panel |          |
| Input Mode                  | Human's Finger                                    |          |
| Interface                   | I2C or USB                                        |          |
| Touch number                | 5 points                                          |          |
| Cover glass pencil-hardness | 7H                                                |          |
| Response time               | ≤25ms                                             | ms       |
| IC solution                 | ILI2511                                           |          |

**8.2 Pin Assignments and Definitions**

| Item | Name    | I/O | Unit                                                                            |
|------|---------|-----|---------------------------------------------------------------------------------|
| 1    | GND     | P   | Ground                                                                          |
| 2    | VDD     | P   | Power supply for I2C                                                            |
| 3    | SCL     | I   | I2C clock                                                                       |
| 4    | SDA     | I/O | I2C data                                                                        |
| 5    | INT     | O   | Interrupt signal to inform the host processor that touch data is ready for read |
| 6    | RESET   | I   | External low signal reset the chip.                                             |
| 7    | VDD_USB | P   | Power supply for USB I/F                                                        |
| 8    | D+      | I/O | USB interface                                                                   |
| 9    | D-      | I/O | USB interface                                                                   |
| 10   | GND     | P   | Ground                                                                          |

**(CN2)**

| Item | Name  | I/O | Unit                                                                            |
|------|-------|-----|---------------------------------------------------------------------------------|
| 1    | GND   | P   | Ground                                                                          |
| 2    | VDD   | P   | Power supply for I2C                                                            |
| 3    | SCL   | I   | I2C clock                                                                       |
| 4    | SDA   | I/O | I2C data                                                                        |
| 5    | INT   | O   | Interrupt signal to inform the host processor that touch data is ready for read |
| 6    | RESET | I   | External low signal reset the chip.                                             |



**(CN3)**

| Item | Name      | I/O | Unit                 |
|------|-----------|-----|----------------------|
| 1    | GND_EARTH | P   | Ground               |
| 2    | VDD_USB   | P   | Power supply for USB |
| 3    | GND       | P   | Ground               |
| 4    | D+        | I/O | USB interface        |
| 5    | D-        | I/O | USB interface        |

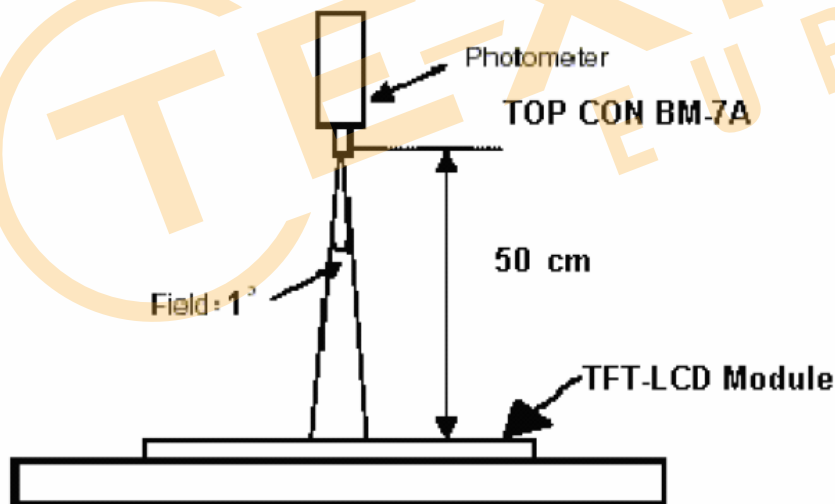


**9. OPTICAL CHARACTERISTICS**

| Item               | Symbol     | Condition                                                                  | Min.  | Typ.  | Max.  | Unit              |
|--------------------|------------|----------------------------------------------------------------------------|-------|-------|-------|-------------------|
| Brightness         | --         | Note1,<br>Note 3,<br>( $\theta = 0^\circ$ ;<br>Normal<br>Viewing<br>Angle) | 640   | 800   | --    | cd/m <sup>2</sup> |
| Uniformity         | B-uni      |                                                                            | 70    | 75    | -     | %                 |
| Contrast Ratio     | CR         |                                                                            | 400   | 600   | --    | --                |
| Response Time      | Tr         |                                                                            | --    | 17    | 24    | ms                |
|                    | Tf         |                                                                            | --    | 18    | 26    | ms                |
| Color Chromaticity | White      | Wx                                                                         | 0.260 | 0.310 | 0.360 | --                |
|                    |            | Wy                                                                         | 0.280 | 0.330 | 0.380 | --                |
| View angle         | Horizontal | $\theta x+$                                                                | 80    | 85    | --    |                   |
|                    |            | $\theta x-$                                                                | 80    | 85    | --    |                   |
|                    | Vertical   | $\theta y+$                                                                | 80    | 85    | --    |                   |
|                    |            | $\theta y-$                                                                | 80    | 85    | --    |                   |

Note : The following optical specifications shall be measured in a darkroom or equivalent state (ambient luminance  $\leq 1$  lux, and at room temperature). The operation temperature is  $25^\circ\text{C} \pm 2^\circ\text{C}$ . The measurement method is shown in Note1.

Note1: The method of optical measurement:

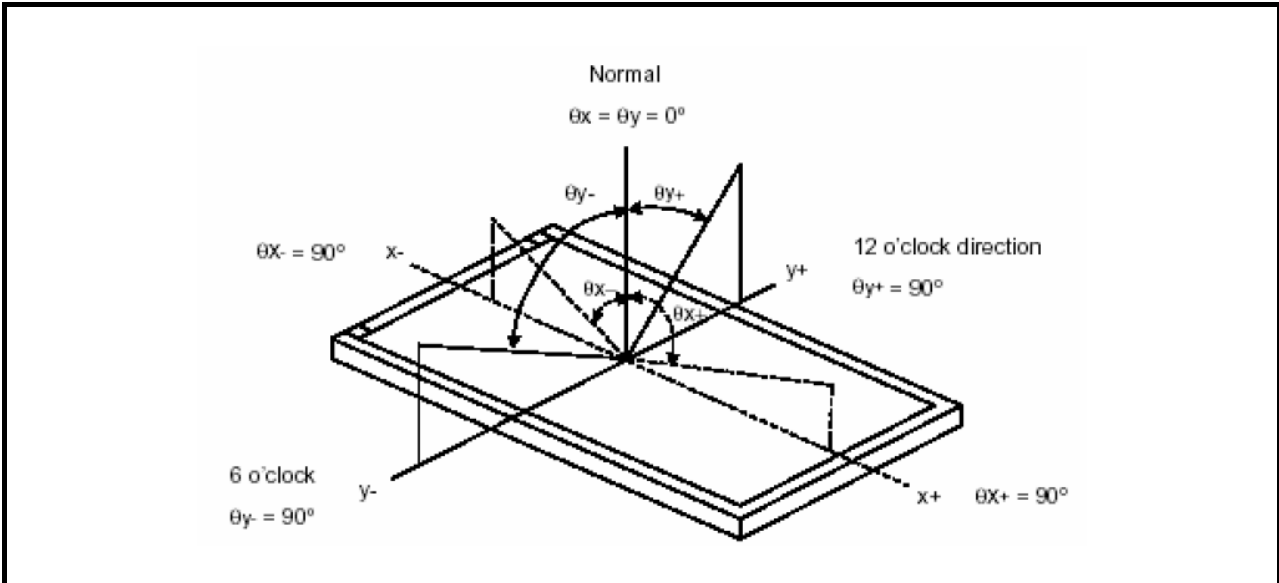


Note2: Measured at the center area of the panel and at the viewing angle of the  $\theta x = \theta y = 0^\circ$

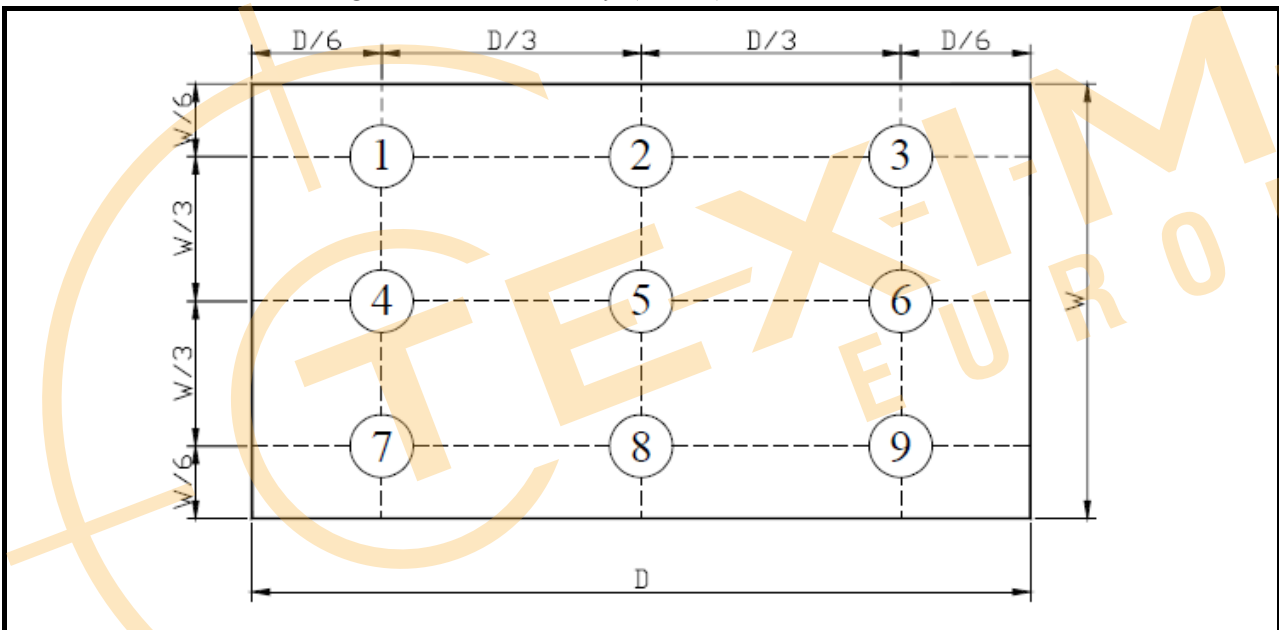
Note3: Definition of Contrast Ratio (CR):

CR = Luminance with all pixels in white state  $\div$  Luminance with all pixels in Black state

**Note 4: Definition of Viewing Angle:**



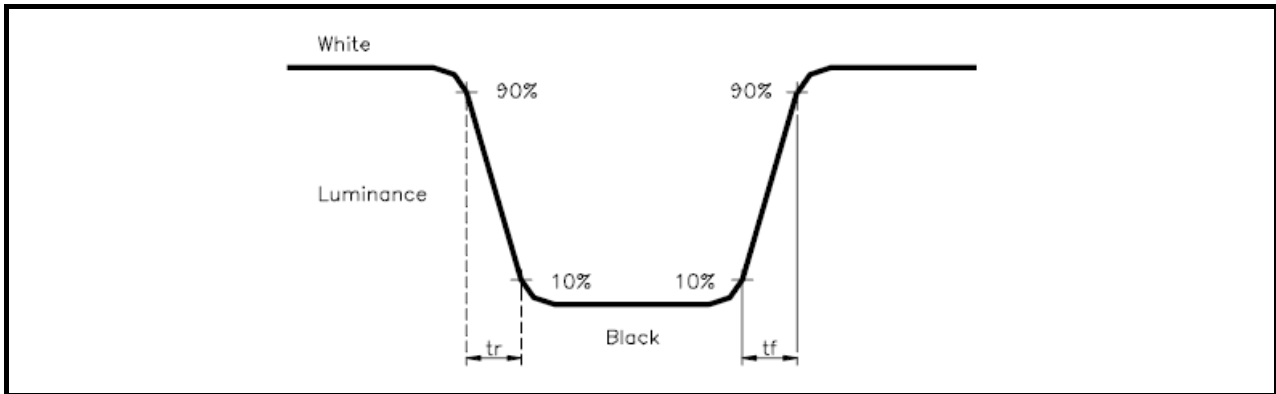
**Note 5: Definition of Brightness Uniformity (B-uni):**



$$B\text{-uni} = (\text{Minimum luminance of 9 points} \div \text{Maximum luminance of 9 points}) \times 100\%$$

**Note 6: Definition of Response Time:**

The Response Time is set initially by defining the “Rising Time ( $T_r$ )” and the “Falling Time ( $T_f$ )” respectively.  $T_r$  and  $T_f$  are defined as following figure



**Note 7: Definition of Chromaticity:**

The color coordinates ( $W_x, W_y$ ), ( $R_x, R_y$ ), ( $G_x, G_y$ ), and ( $B_x, B_y$ ) are obtained with all pixels in the viewing field at white, red, green, and blue states, respectively.

**10. RELIABILITY****10.1 Test Condition****10.1.1** Temperature and Humidity(Ambient Temperature)Temperature :  $25 \pm 5^{\circ}\text{C}$ Humidity :  $65 \pm 5\%$ **10.1.2** Operation

Unless specified otherwise, test will be conducted under function state.

**10.1.3** Container

Unless specified otherwise, vibration test will be conducted to the product itself without putting it in a container.

**10.1.4** Test Frequency

In case of related to deterioration such as shock test. It will be conducted only once.

**10.2 TESTS**

| No. | ITEM                                    | CONDITION CRITERION                                                                                          |
|-----|-----------------------------------------|--------------------------------------------------------------------------------------------------------------|
| 1   | High Temperature Storage                | 80°C, 120 hrs                                                                                                |
| 2   | Low Temperature Storage                 | -30°C, 120 hrs                                                                                               |
| 3   | High Temperature Operating              | 70°C, 120 hrs                                                                                                |
| 4   | Low Temperature Operating               | -20°C, 120 hrs                                                                                               |
| 5   | High Temperature/Humidity Non-Operating | 50°C, 90%RH, 120 hrs                                                                                         |
| 6   | Temperature Shock Non-Operating         | -30°C $\longleftrightarrow$ 70°C<br>(0.5hr each), 25 cycles                                                  |
| 7   | Vibration Test Non-Operating            | Frequency:0 ~ 55 Hz Amplitude:1.5 mm<br>Sweep Time:11min<br>Test Period:6 Cycles for each Direction of X,Y,Z |
| 9   | Electro-static Discharge Non-Operating  | 150pF,330Ω<br>Air:± 8KV;Contact: ±4KV<br>10 times/point;4 points/panel face                                  |

Note1: The test sample have recovery time for 24 hours at room temperature before the function check. In the standard conditions, there is no any touch panel function NG issue occurred.

### 10.3 JUDGMENT STANDARD

The judgment of the above test should be made as follow:

Pass: Normal display image with no obvious non-uniformity and no line defect. Partial transformation of the module parts should be ignored.

Fail: No display image, obvious non-uniformity, or line defects.



#### 10.4 INCOMING INSPECTION STANDARDS

| No.                                                                                                                                                                                                                                                                                                                                                                                                                                    | Parameter                           | Criteria                                                                                                                                                                                                                                                                                                           |                        |                   |                     |             |                |     |                                        |      |                              |   |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------|-------------------|---------------------|-------------|----------------|-----|----------------------------------------|------|------------------------------|---|
| 1                                                                                                                                                                                                                                                                                                                                                                                                                                      | Operating                           | Display function: No Display malfunction (Major)                                                                                                                                                                                                                                                                   |                        |                   |                     |             |                |     |                                        |      |                              |   |
|                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                     | Contrast ratio (Black, White):<br>Does not meet specified range in the spec. (Major) (Note:3)                                                                                                                                                                                                                      |                        |                   |                     |             |                |     |                                        |      |                              |   |
|                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                     | Line Defect: No obvious Vertical and Horizontal line defect in bright, dark and colored. (Major) (Note:1)                                                                                                                                                                                                          |                        |                   |                     |             |                |     |                                        |      |                              |   |
|                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                     | Point Defect : Active area $\leq 5$ dots (Minor) (Note:1)                                                                                                                                                                                                                                                          |                        |                   |                     |             |                |     |                                        |      |                              |   |
|                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                     | <table><tr><th rowspan="2">Item</th><th>Acceptable number</th><th rowspan="2">Total</th></tr><tr><th>Active Area</th></tr><tr><td>Bright</td><td>2</td><td rowspan="2">5</td></tr><tr><td>Dark</td><td>4</td></tr></table>                                                                                         | Item                   | Acceptable number | Total               | Active Area | Bright         | 2   | 5                                      | Dark | 4                            |   |
|                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                     | Item                                                                                                                                                                                                                                                                                                               |                        | Acceptable number |                     | Total       |                |     |                                        |      |                              |   |
|                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                     |                                                                                                                                                                                                                                                                                                                    | Active Area            |                   |                     |             |                |     |                                        |      |                              |   |
|                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                     | Bright                                                                                                                                                                                                                                                                                                             | 2                      | 5                 |                     |             |                |     |                                        |      |                              |   |
|                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                     | Dark                                                                                                                                                                                                                                                                                                               | 4                      |                   |                     |             |                |     |                                        |      |                              |   |
|                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                     | Non-uniformity: Visible through 5%ND filter. (Minor)                                                                                                                                                                                                                                                               |                        |                   |                     |             |                |     |                                        |      |                              |   |
| Foreign material in Black or White spots shape ( $W>1/4L$ )                                                                                                                                                                                                                                                                                                                                                                            |                                     |                                                                                                                                                                                                                                                                                                                    |                        |                   |                     |             |                |     |                                        |      |                              |   |
| <table><tr><th>Zone<br/>Dimension</th><th>Acceptable number</th><th>Class Of Defects</th><th>AQL Level</th></tr><tr><td><math>D&gt;0.5</math></td><td>0</td><td rowspan="3">Minor</td><td rowspan="3">1.5</td></tr><tr><td><math>0.3 &lt; D \leq 0.5</math></td><td>5</td></tr><tr><td><math>D \leq 0.3</math></td><td>*</td></tr></table>                                                                                             | Zone<br>Dimension                   | Acceptable number                                                                                                                                                                                                                                                                                                  | Class Of Defects       | AQL Level         | $D>0.5$             | 0           | Minor          | 1.5 | $0.3 < D \leq 0.5$                     | 5    | $D \leq 0.3$                 | * |
| Zone<br>Dimension                                                                                                                                                                                                                                                                                                                                                                                                                      | Acceptable number                   | Class Of Defects                                                                                                                                                                                                                                                                                                   | AQL Level              |                   |                     |             |                |     |                                        |      |                              |   |
| $D>0.5$                                                                                                                                                                                                                                                                                                                                                                                                                                | 0                                   | Minor                                                                                                                                                                                                                                                                                                              | 1.5                    |                   |                     |             |                |     |                                        |      |                              |   |
| $0.3 < D \leq 0.5$                                                                                                                                                                                                                                                                                                                                                                                                                     | 5                                   |                                                                                                                                                                                                                                                                                                                    |                        |                   |                     |             |                |     |                                        |      |                              |   |
| $D \leq 0.3$                                                                                                                                                                                                                                                                                                                                                                                                                           | *                                   |                                                                                                                                                                                                                                                                                                                    |                        |                   |                     |             |                |     |                                        |      |                              |   |
| $D = (\text{Long} + \text{Short}) / 2$ * : Disregard                                                                                                                                                                                                                                                                                                                                                                                   |                                     |                                                                                                                                                                                                                                                                                                                    |                        |                   |                     |             |                |     |                                        |      |                              |   |
| Foreign Material in Line or spiral shape ( $W \leq 1/4L$ ) (Note: 4)                                                                                                                                                                                                                                                                                                                                                                   |                                     |                                                                                                                                                                                                                                                                                                                    |                        |                   |                     |             |                |     |                                        |      |                              |   |
| <table><tr><th>Zone<br/>L (mm) \ W(mm)</th><th>Acceptable number</th><th>Class Of Defects</th><th>AQL Level</th></tr><tr><td><math>L &gt; 5</math> \ <math>W &gt; 0.1</math></td><td>0</td><td rowspan="3">Minor</td><td rowspan="3">1.5</td></tr><tr><td><math>0.5 &lt; L \leq 5</math> \ <math>0.03 &lt; W \leq 0.1</math></td><td>5</td></tr><tr><td><math>L \leq 0.5</math> \ <math>W \leq 0.03</math></td><td>*</td></tr></table> | Zone<br>L (mm) \ W(mm)              | Acceptable number                                                                                                                                                                                                                                                                                                  | Class Of Defects       | AQL Level         | $L > 5$ \ $W > 0.1$ | 0           | Minor          | 1.5 | $0.5 < L \leq 5$ \ $0.03 < W \leq 0.1$ | 5    | $L \leq 0.5$ \ $W \leq 0.03$ | * |
| Zone<br>L (mm) \ W(mm)                                                                                                                                                                                                                                                                                                                                                                                                                 | Acceptable number                   | Class Of Defects                                                                                                                                                                                                                                                                                                   | AQL Level              |                   |                     |             |                |     |                                        |      |                              |   |
| $L > 5$ \ $W > 0.1$                                                                                                                                                                                                                                                                                                                                                                                                                    | 0                                   | Minor                                                                                                                                                                                                                                                                                                              | 1.5                    |                   |                     |             |                |     |                                        |      |                              |   |
| $0.5 < L \leq 5$ \ $0.03 < W \leq 0.1$                                                                                                                                                                                                                                                                                                                                                                                                 | 5                                   |                                                                                                                                                                                                                                                                                                                    |                        |                   |                     |             |                |     |                                        |      |                              |   |
| $L \leq 0.5$ \ $W \leq 0.03$                                                                                                                                                                                                                                                                                                                                                                                                           | *                                   |                                                                                                                                                                                                                                                                                                                    |                        |                   |                     |             |                |     |                                        |      |                              |   |
| $L$ : Length $W$ : Width    * : Disregard                                                                                                                                                                                                                                                                                                                                                                                              |                                     |                                                                                                                                                                                                                                                                                                                    |                        |                   |                     |             |                |     |                                        |      |                              |   |
| 2                                                                                                                                                                                                                                                                                                                                                                                                                                      | External Inspection (non-operating) | Dimension: Outline (Major)                                                                                                                                                                                                                                                                                         |                        |                   |                     |             |                |     |                                        |      |                              |   |
|                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                     | Bezel appearance: uneven (Minor)                                                                                                                                                                                                                                                                                   |                        |                   |                     |             |                |     |                                        |      |                              |   |
|                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                     | Scratch on the polarize: (Note:2)                                                                                                                                                                                                                                                                                  |                        |                   |                     |             |                |     |                                        |      |                              |   |
|                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                     | <table><tr><th>Zone<br/>L (mm) \ W(mm)</th><th>Acceptable number</th><th>Class Of Defects</th><th>AQL Level</th></tr><tr><td>-- \ <math>W &gt; 0.1</math></td><td>0</td><td rowspan="2">Minor</td><td rowspan="2">1.5</td></tr><tr><td><math>L \leq 3</math> \ <math>W \leq 0.1</math></td><td>3</td></tr></table> | Zone<br>L (mm) \ W(mm) | Acceptable number | Class Of Defects    | AQL Level   | -- \ $W > 0.1$ | 0   | Minor                                  | 1.5  | $L \leq 3$ \ $W \leq 0.1$    | 3 |
|                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                     | Zone<br>L (mm) \ W(mm)                                                                                                                                                                                                                                                                                             | Acceptable number      | Class Of Defects  | AQL Level           |             |                |     |                                        |      |                              |   |
|                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                     | -- \ $W > 0.1$                                                                                                                                                                                                                                                                                                     | 0                      | Minor             | 1.5                 |             |                |     |                                        |      |                              |   |
|                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                     | $L \leq 3$ \ $W \leq 0.1$                                                                                                                                                                                                                                                                                          | 3                      |                   |                     |             |                |     |                                        |      |                              |   |
|                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                     | $L$ : Length $W$ : Width    * : Disregard                                                                                                                                                                                                                                                                          |                        |                   |                     |             |                |     |                                        |      |                              |   |
|                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                     | Dent or bubble on the polarize (Note:2)                                                                                                                                                                                                                                                                            |                        |                   |                     |             |                |     |                                        |      |                              |   |
|                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                     | <table><tr><th>Zone<br/>Dimension</th><th>Acceptable number</th><th>Class Of Defects</th><th>AQL Level</th></tr><tr><td><math>D \leq 0.3</math></td><td>*</td><td rowspan="2">Minor</td><td rowspan="2">1.5</td></tr><tr><td><math>D \leq 0.5</math></td><td>3</td></tr></table>                                   | Zone<br>Dimension      | Acceptable number | Class Of Defects    | AQL Level   | $D \leq 0.3$   | *   | Minor                                  | 1.5  | $D \leq 0.5$                 | 3 |
| Zone<br>Dimension                                                                                                                                                                                                                                                                                                                                                                                                                      | Acceptable number                   | Class Of Defects                                                                                                                                                                                                                                                                                                   | AQL Level              |                   |                     |             |                |     |                                        |      |                              |   |
| $D \leq 0.3$                                                                                                                                                                                                                                                                                                                                                                                                                           | *                                   | Minor                                                                                                                                                                                                                                                                                                              | 1.5                    |                   |                     |             |                |     |                                        |      |                              |   |
| $D \leq 0.5$                                                                                                                                                                                                                                                                                                                                                                                                                           | 3                                   |                                                                                                                                                                                                                                                                                                                    |                        |                   |                     |             |                |     |                                        |      |                              |   |
| $D = (\text{Long} + \text{Short}) / 2$ * : Disregard                                                                                                                                                                                                                                                                                                                                                                                   |                                     |                                                                                                                                                                                                                                                                                                                    |                        |                   |                     |             |                |     |                                        |      |                              |   |



| Class of defects | Major | AQL 0.65% | Definition                                                                                                                         |
|------------------|-------|-----------|------------------------------------------------------------------------------------------------------------------------------------|
|                  | Minor | AQL 1.5%  | Definition                                                                                                                         |
|                  |       |           | It is a defect that is likely to result in failure or to reduce materially the usability of the product for the intended function. |
|                  |       |           | It is a defect that will not result in functioning problem with deviation classified.                                              |

**Note1:**

(a) Bright point defect is defined as point defect of R,G,B with area  $>1/2$  pixel respectively

(b) Dark point defect is defined as visible in full white pattern.

(c) Definition of distribution of point defect is as follows:

- minimum separation between dark point defects should be larger than 5mm.
- minimum separation between bright point defects should be larger than 5mm.

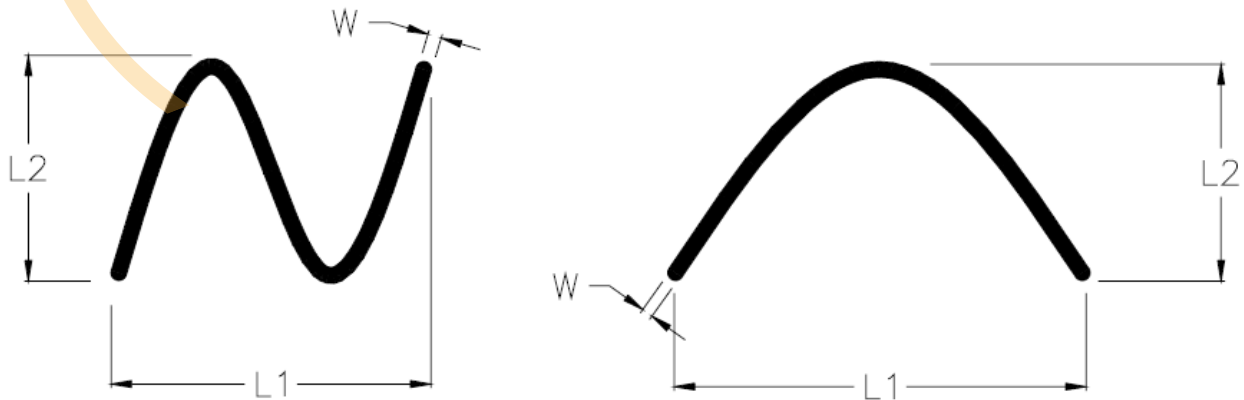
(d) Definition of joined bright point defect and joined dark point defect are as follows:

- Two or more joined bright point defects must be nil.
- Three joined dark point defects must be nil.
- Coupling of one dark and one bright point in junction is counted as one dark and bright spot with 1 pair maximum.
- Two Joined dark point is counted as two dark points with 2 pair maximum.

Note2: The external inspection should be conducted at the distance  $30 \pm 5$  cm between the eyes of inspector and the panel.

Note3: Luminance measurement for contrast ratio is at the distance  $50 \pm 5$  cm between the detective head and the panel with ambient luminance less than 1 lux. Contrast ratio is obtained at optimum view angle.

Note4: W-Width in mm , L-length of Max.(L1,L2) in mm.



### 10.5 Sampling Condition

Unless otherwise agree in written, the sampling inspection shall be applied to the incoming inspection of customer.

Lot size: Quantity of shipment lot per model.

Sampling type: normal inspection, single sampling

Sampling table: MIL-STD-105E

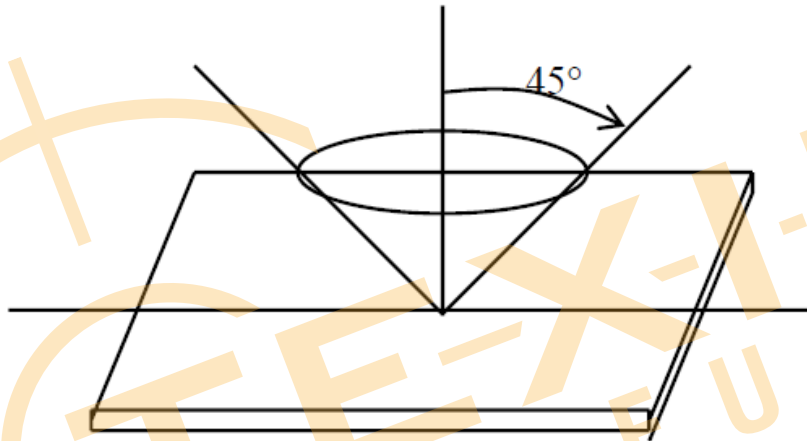
Inspection level: Level II

### 10.6 Inspection conditions

The LCD shall be inspected under 40W white fluorescent light.

$\theta \leq 45^\circ$  inspection under non-operating condition.

$\theta \leq 5^\circ$  inspection under operating condition



## **11. PRECAUTION RELATING PRODUCT HANDLING**

### **11.1 SAFETY**

**11.1.1** If the LCD panel breaks , be careful not to get the liquid crystal to touch your skin.

**11.1.2** If the liquid crystal touches your skin or clothes , please wash it off immediately by using soap and water.

### **11.2 HANDLING**

**11.2.1** Avoid any strong mechanical shock which can break the glass.

**11.2.2** Avoid static electricity which can damage the CMOS LSI—When working with the module, be sure to ground your body and any electrical equipment you may be using.

**11.2.3** Do not remove the panel or frame from the module.

**11.2.4** The polarizing plate of the display is very fragile. So , please handle it very carefully, Do not touch, push or rub the exposed polarizing with anything harder than an HB pencil lead (glass , tweezers , etc.)

**11.2.5** Do not wipe the polarizing plate with a dry cloth, as it may easily scratch the surface of plate.

**11.2.6** Do not touch the display area with bare hands , this will stain the display area.

**11.2.7** Do not use ketonics solvent & aromatic solvent. Use with a soft cloth soaked with a cleaning naphtha solvent.

**11.2.8** To control temperature and time of soldering is  $280 \pm 10^{\circ}\text{C}$  and 3-5 sec.

**11.2.9** To avoid liquid (include organic solvent) stained on LCM.

### **11.3 STORAGE**

**11.3.1** Store the panel or module in a dark place where the temperature is  $25^{\circ}\text{C} \pm 5^{\circ}\text{C}$  and the humidity is below 65% RH.

**11.3.2** Do not place the module near organics solvents or corrosive gases.

**11.3.3** Do not crush, shake, or jolt the module.