



## SPECIFICATION FOR LCD MODULE

**MODULE NO: AFD1280800B0L-10.1INTM-CU**  
**VERSION NO.: V1.0**

Customer's Approval:

|  |
|--|
|  |
|--|

|             | SIGNATURE | DATE |
|-------------|-----------|------|
| PREPARED BY |           |      |
| CHECKED BY  |           |      |
| APPROVED BY |           |      |

## RECORD OF REVISION

| Version | Revised Date | Page | Content      |
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| V1.0    | 2014/11/03   | --   | First Issued |
|         |              |      |              |
|         |              |      |              |
|         |              |      |              |
|         |              |      |              |

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## 1. GENERAL DESCRIPTION

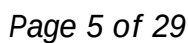
### 1.1 Description

The specifications is model AFD1280800B0L-10.1INTM-CU 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 back light system and a projected capacitive touch panel. This TFT LCD has a 10.1 (16:10) inch diagonally measured active display area with WXGA (1280 horizontal by 800 vertical pixels) resolution.

### 1.2 Features:

| No. | Item                           | Specification                     | Unit   |
|-----|--------------------------------|-----------------------------------|--------|
| 1   | Panel Size                     | 10.1"                             | Inch   |
| 2   | Number of Pixels               | 1280 (W) x RGB x 800 (H)          | Pixels |
| 3   | Active Area                    | 216.96 (W) × 135.6 (H)            | mm     |
| 4   | Pixel Pitch                    | 0.1695 (W) x 0.1695 (H)           | mm     |
| 5   | Outline Dimension              | 283 (W) × 202 (H) × 7.15 (T)      | mm     |
| 6   | Number of Colors               | 262K                              | - -    |
| 7   | Display Mode                   | IPS/Normally Black / Transmissive | - -    |
| 8   | View Direction                 | Free of direction                 | - -    |
| 9   | Display Format                 | RGB vertical stripe               | - -    |
| 10  | Surface Treatment              | Clear (7H)                        | - -    |
| 11  | Contrast Ratio                 | 800 (Typ.)                        | - -    |
| 12  | Luminance (cd/m <sup>2</sup> ) | 250 (Typ.)                        | cd/m2  |
| 13  | Interface                      | LVDS 6 bit Interface              | - -    |
| 14  | Backlight                      | White LED                         | - -    |
| 15  | Driver IC                      | --                                | - -    |
| 16  | Operation Temperature          | 0 ~ 50                            | °C     |
| 17  | Storage Temperature            | -20 ~ 60                          | °C     |
| 18  | Weight                         | (TBD)                             | g      |

11/3/2014



### 3. PIN DESCRIPTION

#### 3.1 TFT LCD Module

| Pin | Symbol   | I/O | Function                               | Remark         |
|-----|----------|-----|----------------------------------------|----------------|
| 1   | NC       | -   | NO Connect                             |                |
| 2   | VDD      | P   | Power Supply                           |                |
| 3   | VDD      | P   | Power Supply                           |                |
| 4   | NC       | -   | NO Connect                             |                |
| 5   | NC       | -   | NO Connect                             |                |
| 6   | NC       | -   | NO Connect                             |                |
| 7   | NC       | -   | NO Connect                             |                |
| 8   | RXIN0-   | I   | Negative LVDS differential data input  | R0~R5,G0       |
| 9   | RXIN0+   | I   | Positive LVDS differential data input  |                |
| 10  | GND      | P   | Ground                                 |                |
| 11  | RXIN1-   | I   | Negative LVDS differential data input  | G1~G5,B0,B1    |
| 12  | RXIN1+   | I   | Positive LVDS differential data input  |                |
| 13  | GND      | P   | Ground                                 |                |
| 14  | RXIN2-   | I   | Negative LVDS differential data input  | B2~B5,HS,VS,DE |
| 15  | RXIN2+   | I   | Positive LVDS differential data input  |                |
| 16  | GND      | P   | Ground                                 |                |
| 17  | RXCLK-   | I   | Negative LVDS differential clock input | LVDS CLK       |
| 18  | RXCLK+   | I   | Positive LVDS differential clock input |                |
| 19  | NC       | -   | NO Connect                             |                |
| 20  | NC       | -   | NO Connect                             |                |
| 21  | NC       | -   | NO Connect                             |                |
| 22  | GND      | P   | Ground                                 |                |
| 23  | NC       | -   | NO Connect                             |                |
| 24  | NC       | -   | NO Connect                             |                |
| 25  | GND      | P   | Ground                                 |                |
| 26  | NC       | -   | NO Connect                             |                |
| 27  | NC       | -   | NO Connect                             |                |
| 28  | GND      | P   | Ground                                 |                |
| 29  | NC       | -   | NO Connect                             |                |
| 30  | NC       | -   | NO Connect                             |                |
| 31  | VLED_GND | P   | LED Ground                             |                |

|    |          |   |                                    |  |
|----|----------|---|------------------------------------|--|
| 32 | VLED_GND | P | LED Ground                         |  |
| 33 | VLED_GND | P | LED Ground                         |  |
| 34 | NC       | - | NO Connect                         |  |
| 35 | PWM      | - | PWM Signal for LED dimming control |  |
| 36 | NC       | - | NO Connect                         |  |
| 37 | NC       | - | NO Connect                         |  |
| 38 | VLED     | P | LED Power Supply(4.5~5.5V)         |  |
| 39 | VLED     | P | LED Power Supply(4.5~5.5V)         |  |
| 40 | VLED     | P | LED Power Supply(4.5~5.5V)         |  |

NOTE: The Brightness of LCD Panel could be changed by adjusting PWM

#### 4. ABSOLUTE MAXIMUM RATINGS

##### 4.1 Electrical Absolute Rating

###### 4.1.1 TFT LCD Module

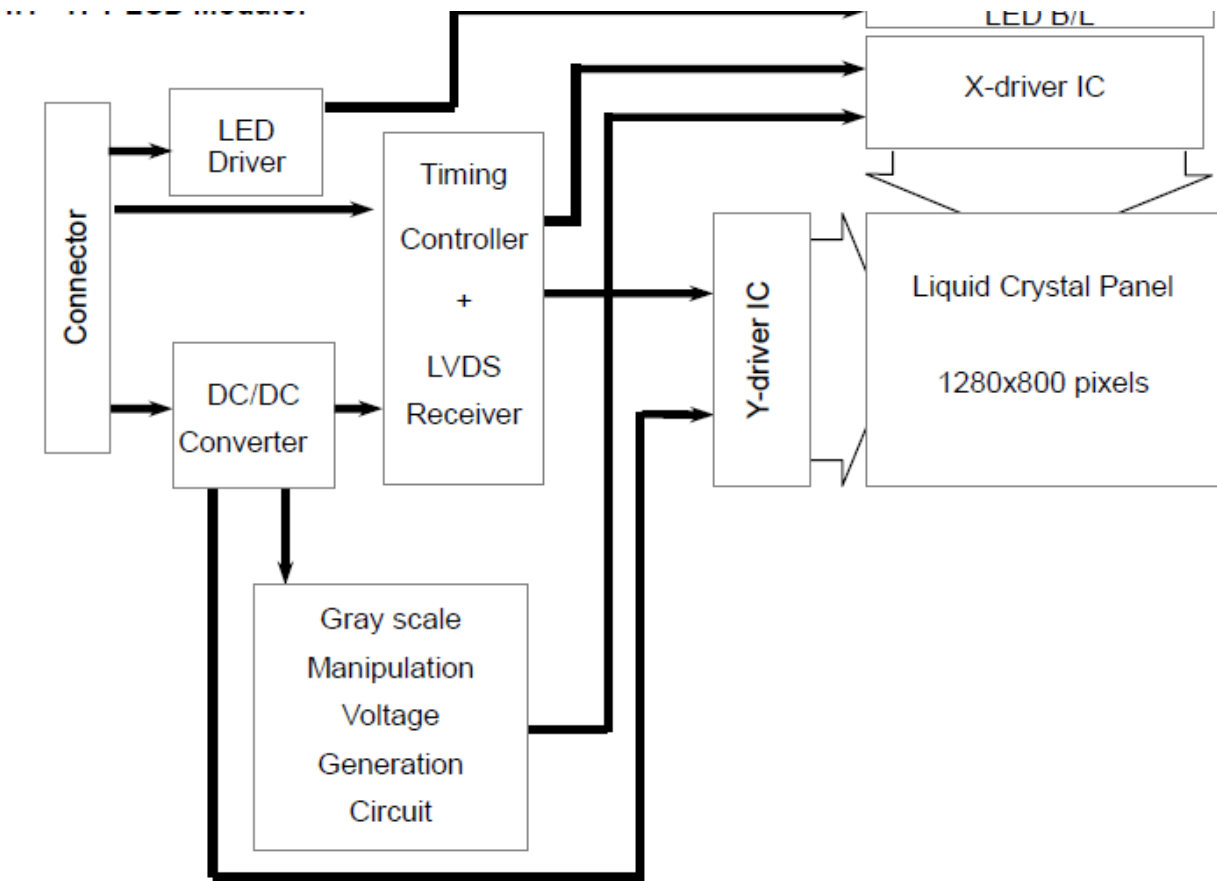
| Item                 | Symbol | Values |      | Unit | Note |
|----------------------|--------|--------|------|------|------|
|                      |        | Min    | Max. |      |      |
| Power supply voltage | VDD    | -0.3   | 4.0  | V    |      |

###### 4.1.2 Environment Absolute Rating

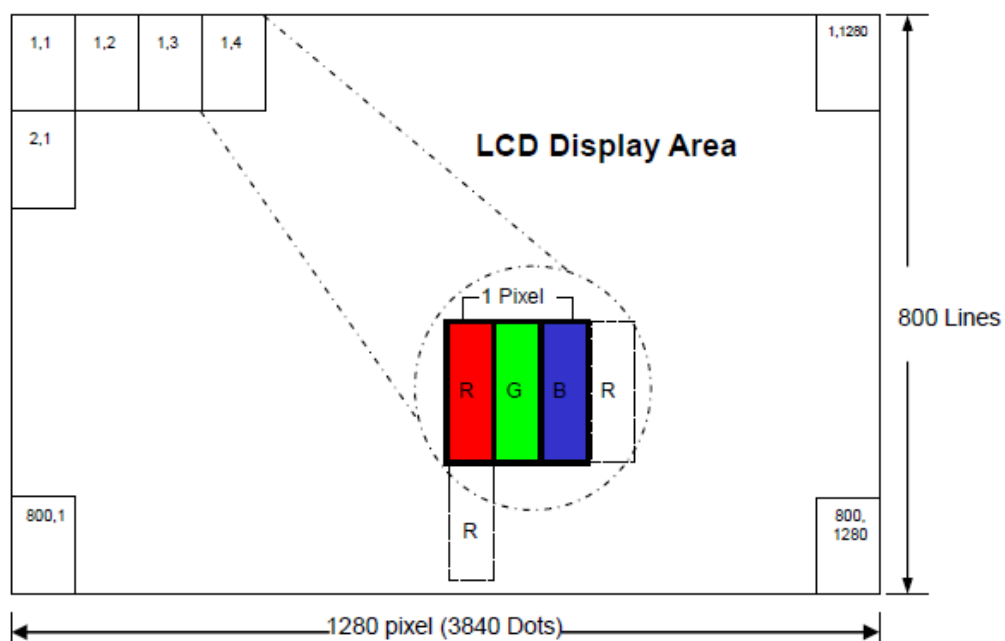
| Item                  | Symbol | Values |     |      | Unit | Note                   |
|-----------------------|--------|--------|-----|------|------|------------------------|
|                       |        | Min    | Typ | Max. |      |                        |
| Operating Temperature | Topa   | 0      |     | 50   | °C   | Ambient<br>temperature |
| Storage Temperature   | Tstg   | -20    |     | 60   | °C   |                        |

## 5. BLOCK DIAGRAM

### 5.1 TFT LCD Module



#### Pixel Format



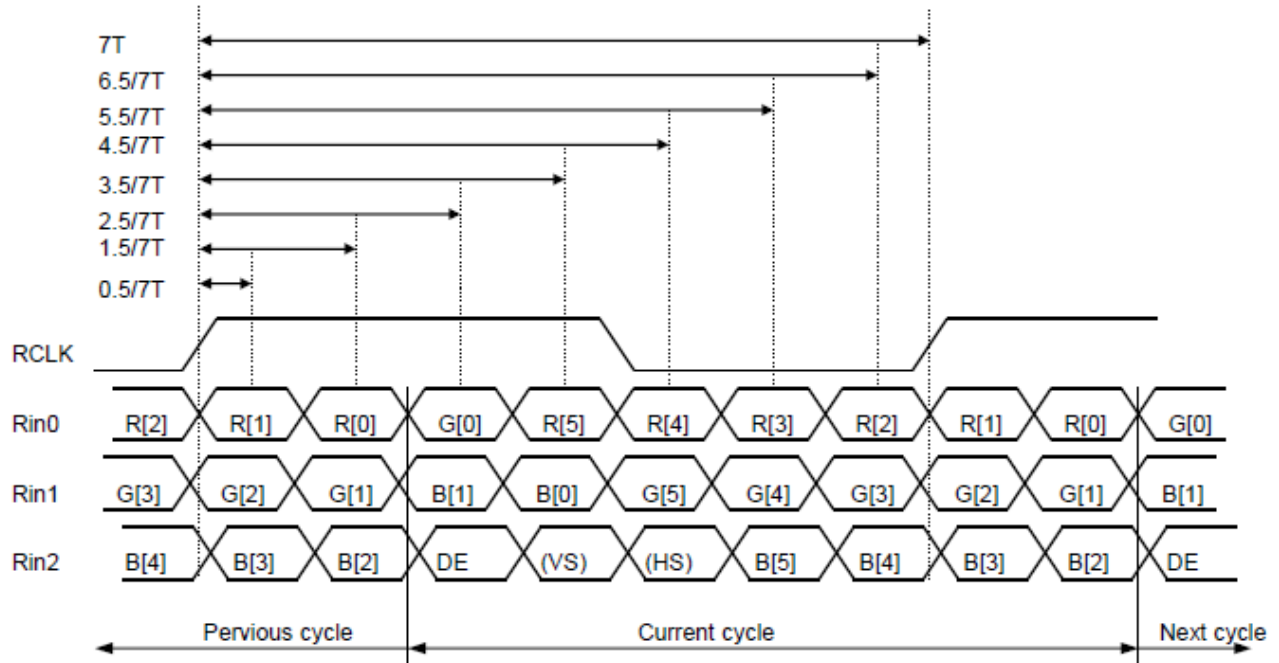
## 6. Relationship Between Displayed Color and Input

### 6.1 6 bit

|                         |                             | MSB   |    |    |    |    |    | LSB |    |    |    |    |    | MSB |    |    |    |    |    | LSB       |     |  |  |  |  | Gray scale level |
|-------------------------|-----------------------------|-------|----|----|----|----|----|-----|----|----|----|----|----|-----|----|----|----|----|----|-----------|-----|--|--|--|--|------------------|
|                         | Display                     | R5    | R4 | R3 | R2 | R1 | R0 | G5  | G4 | G3 | G2 | G1 | G0 | B5  | B4 | B3 | B2 | B1 | B0 |           |     |  |  |  |  |                  |
| Basic color             | Black                       | L     | L  | L  | L  | L  | L  | L   | L  | L  | L  | L  | L  | L   | L  | L  | L  | L  | L  | -         |     |  |  |  |  |                  |
|                         | Blue                        | L     | L  | L  | L  | L  | L  | L   | L  | L  | L  | L  | L  | H   | H  | H  | H  | H  | H  | -         |     |  |  |  |  |                  |
|                         | Green                       | L     | L  | L  | L  | L  | L  | H   | H  | H  | H  | H  | H  | L   | L  | L  | L  | L  | L  | -         |     |  |  |  |  |                  |
|                         | Light Blue                  | L     | L  | L  | L  | L  | L  | H   | H  | H  | H  | H  | H  | H   | H  | H  | H  | H  | H  | -         |     |  |  |  |  |                  |
|                         | Red                         | H     | H  | H  | H  | H  | H  | L   | L  | L  | L  | L  | L  | L   | L  | L  | L  | L  | L  | -         |     |  |  |  |  |                  |
|                         | Purple                      | H     | H  | H  | H  | H  | H  | L   | L  | L  | L  | L  | L  | H   | H  | H  | H  | H  | H  | -         |     |  |  |  |  |                  |
|                         | Yellow                      | H     | H  | H  | H  | H  | H  | H   | H  | H  | H  | H  | H  | L   | L  | L  | L  | L  | L  | -         |     |  |  |  |  |                  |
|                         | White                       | H     | H  | H  | H  | H  | H  | H   | H  | H  | H  | H  | H  | H   | H  | H  | H  | H  | H  | -         |     |  |  |  |  |                  |
| Gray scale of Red       | Black                       | L     | L  | L  | L  | L  | L  | L   | L  | L  | L  | L  | L  | L   | L  | L  | L  | L  | L  | L0        |     |  |  |  |  |                  |
|                         | Dark<br>↑<br>↓<br>Light     | L     | L  | L  | L  | L  | H  | L   | L  | L  | L  | L  | L  | L   | L  | L  | L  | L  | L  | L1        |     |  |  |  |  |                  |
|                         |                             | L     | L  | L  | L  | H  | L  | L   | L  | L  | L  | L  | L  | L   | L  | L  | L  | L  | L  | L2        |     |  |  |  |  |                  |
|                         |                             | ⋮     |    |    |    |    |    | ⋮   |    |    |    |    |    | ⋮   |    |    |    |    |    | L3...L60  |     |  |  |  |  |                  |
|                         |                             | H     | H  | H  | H  | L  | H  | L   | L  | L  | L  | L  | L  | L   | L  | L  | L  | L  | L  | L61       |     |  |  |  |  |                  |
|                         |                             | H     | H  | H  | H  | H  | L  | L   | L  | L  | L  | L  | L  | L   | L  | L  | L  | L  | L  | L         | L62 |  |  |  |  |                  |
|                         | Red                         | H     | H  | H  | H  | H  | H  | L   | L  | L  | L  | L  | L  | L   | L  | L  | L  | L  | L  | Red L63   |     |  |  |  |  |                  |
|                         | Gray scale of Green         | Black | L  | L  | L  | L  | L  | L   | L  | L  | L  | L  | L  | L   | L  | L  | L  | L  | L  | L         | L0  |  |  |  |  |                  |
| Dark<br>↑<br>↓<br>Light |                             | L     | L  | L  | L  | L  | L  | L   | L  | L  | L  | L  | H  | L   | L  | L  | L  | L  | L  | L1        |     |  |  |  |  |                  |
|                         |                             | L     | L  | L  | L  | L  | L  | L   | L  | L  | L  | H  | L  | L   | L  | L  | L  | L  | L  | L2        |     |  |  |  |  |                  |
|                         |                             | ⋮     |    |    |    |    |    | ⋮   |    |    |    |    |    | ⋮   |    |    |    |    |    | L3...L60  |     |  |  |  |  |                  |
|                         |                             | L     | L  | L  | L  | L  | L  | H   | H  | H  | H  | L  | H  | L   | L  | L  | L  | L  | L  | L61       |     |  |  |  |  |                  |
|                         |                             | L     | L  | L  | L  | L  | L  | H   | H  | H  | H  | H  | L  | L   | L  | L  | L  | L  | L  | L         | L62 |  |  |  |  |                  |
| Green                   |                             | L     | L  | L  | L  | L  | L  | H   | H  | H  | H  | H  | H  | L   | L  | L  | L  | L  | L  | Green L63 |     |  |  |  |  |                  |
| Gray scale of Blue      |                             | Black | L  | L  | L  | L  | L  | L   | L  | L  | L  | L  | L  | L   | L  | L  | L  | L  | L  | L         | L0  |  |  |  |  |                  |
|                         | Dark<br>↑<br>↓<br>Light     | L     | L  | L  | L  | L  | L  | L   | L  | L  | L  | L  | L  | L   | L  | L  | L  | L  | H  | L1        |     |  |  |  |  |                  |
|                         |                             | L     | L  | L  | L  | L  | L  | L   | L  | L  | L  | L  | L  | L   | L  | L  | L  | H  | L  | L2        |     |  |  |  |  |                  |
|                         |                             | ⋮     |    |    |    |    |    | ⋮   |    |    |    |    |    | ⋮   |    |    |    |    |    | L3...L60  |     |  |  |  |  |                  |
|                         |                             | L     | L  | L  | L  | L  | L  | L   | L  | L  | L  | L  | L  | H   | H  | H  | H  | L  | H  | L61       |     |  |  |  |  |                  |
|                         |                             | L     | L  | L  | L  | L  | L  | L   | L  | L  | L  | L  | L  | H   | H  | H  | H  | H  | L  | L         | L62 |  |  |  |  |                  |
|                         | Blue                        | L     | L  | L  | L  | L  | L  | L   | L  | L  | L  | L  | L  | H   | H  | H  | H  | H  | H  | Blue L63  |     |  |  |  |  |                  |
|                         | Gray scale of White & Black | Black | L  | L  | L  | L  | L  | L   | L  | L  | L  | L  | L  | L   | L  | L  | L  | L  | L  | L         | L0  |  |  |  |  |                  |
| Dark<br>↑<br>↓<br>Light |                             | L     | L  | L  | L  | L  | H  | L   | L  | L  | L  | L  | H  | L   | L  | L  | L  | L  | H  | L1        |     |  |  |  |  |                  |
|                         |                             | L     | L  | L  | L  | H  | L  | L   | L  | L  | L  | H  | L  | L   | L  | L  | L  | H  | L  | L2        |     |  |  |  |  |                  |
|                         |                             | ⋮     |    |    |    |    |    | ⋮   |    |    |    |    |    | ⋮   |    |    |    |    |    | L3...L60  |     |  |  |  |  |                  |
|                         |                             | H     | H  | H  | H  | L  | H  | H   | H  | H  | L  | H  | H  | H   | H  | H  | L  | H  | L  | L61       |     |  |  |  |  |                  |
|                         |                             | H     | H  | H  | H  | H  | L  | H   | H  | H  | H  | H  | L  | H   | H  | H  | H  | H  | L  | L         | L62 |  |  |  |  |                  |
| White                   |                             | H     | H  | H  | H  | H  | H  | H   | H  | H  | H  | H  | H  | H   | H  | H  | H  | H  | H  | White L63 |     |  |  |  |  |                  |

## 6.2 Data Mapping

### Bit Mapping & Interface Definition



LVDS Receiver Input Timing Definition  
for 6bits LVDS input

## 7. ELECTRICAL CHARACTERISTICS

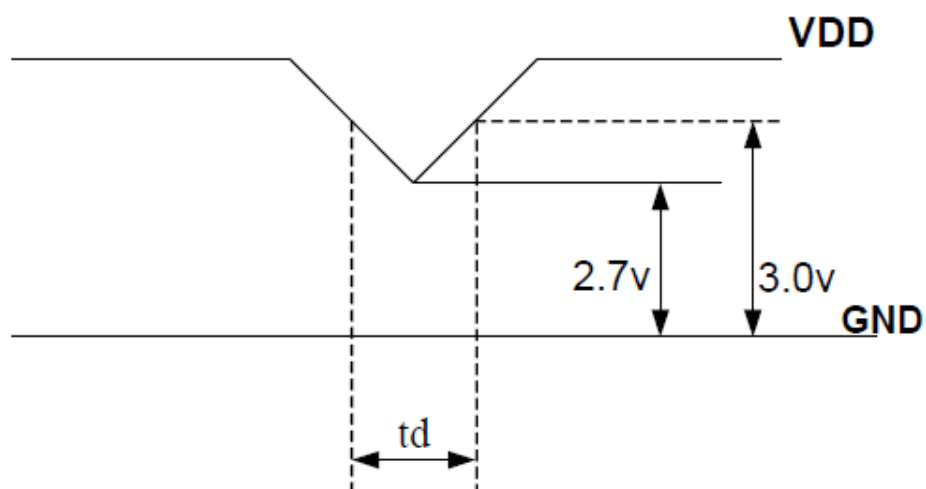
### 7.1 TFT LCD Module

| Item                    | Symbol     | Min. | Typ. | Max. | Unit | Note                               |
|-------------------------|------------|------|------|------|------|------------------------------------|
| Supply Voltage          | $V_{DD}$   | 3.0  | 3.3  | 3.6  | V    | Note (2)                           |
| Current of power supply | $I_{DD}$   | -    | 0.27 | -    | A    | $V_{DD}=3.3V$ 、White pattern (L63) |
| VDD Power               | PDD        | -    | -    | 1.0  | W    | $V_{DD}=3.3V$ 、White pattern (L63) |
| Inrush current          | $I_{RUSH}$ | -    | -    | 1.50 | A    | Note (2)                           |

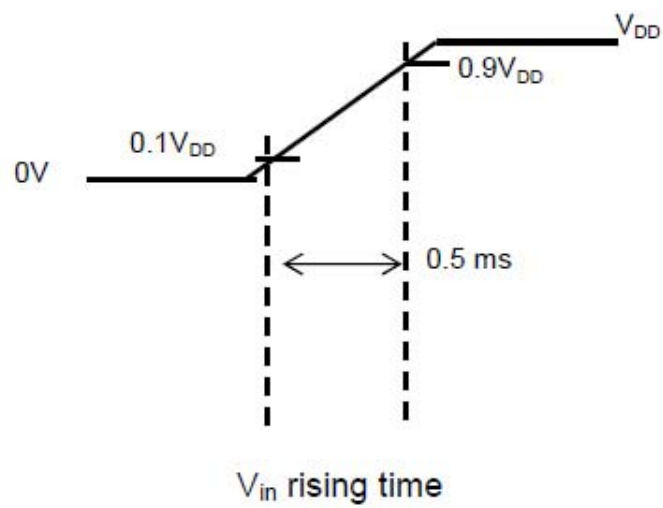
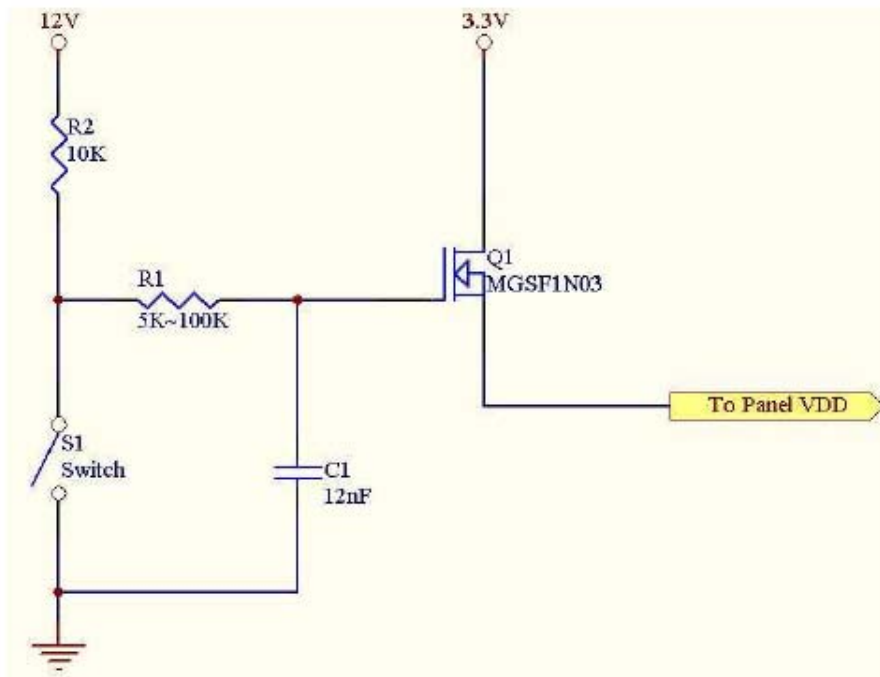
**Note (1):**  $V_{DD}$ -dip condition:

When VDD operating within  $2.7V \leq VDD < 3.0V$  ,  $t_d \leq 10ms$  , the display may momentarily become abnormal.

$VDD < 2.7V$  , VDD dip condition should also follow the Power On/Off conditions for supply voltage.



**Note : (2) Power on Inrush current test circuit**

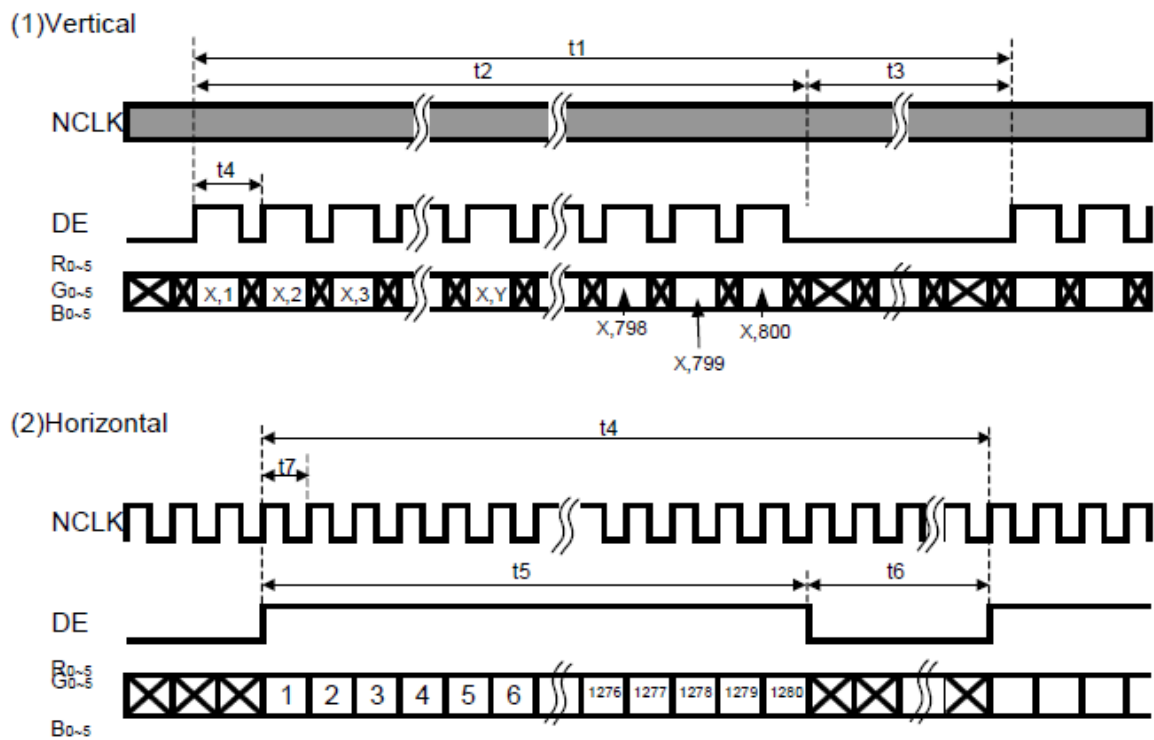


## 7.2 INTERFACE SPECIFICATIONS

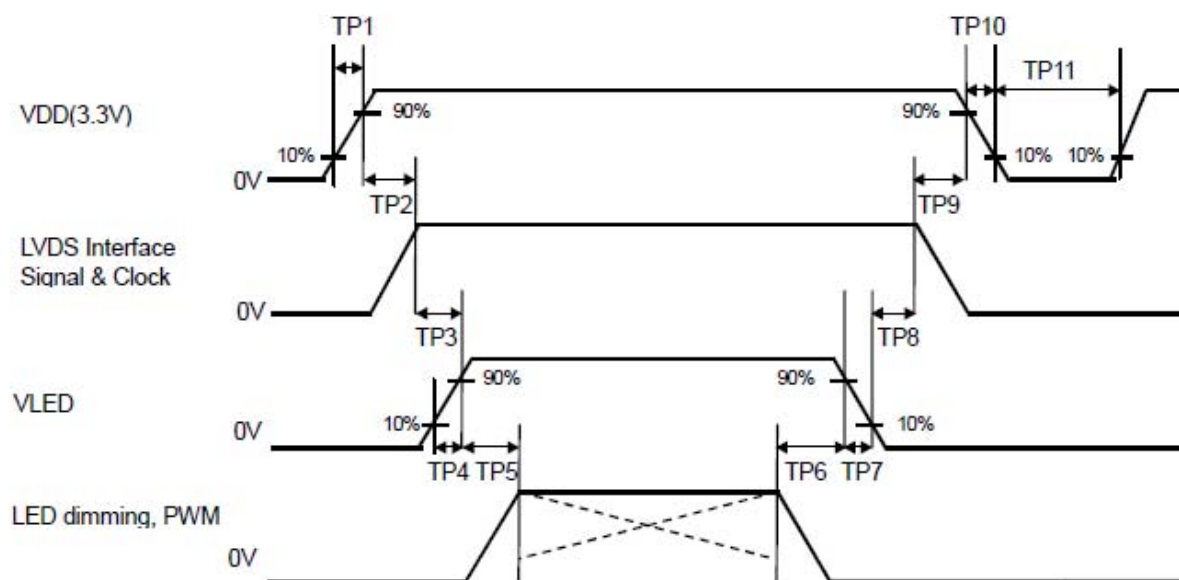
### 7.2.1 Timing

| Item                     | Symbol | Min. | Typ. | Max. | Unit  |
|--------------------------|--------|------|------|------|-------|
| Frame Rate               | --     | 55   | 60   | 65   | Hz    |
| Frame Period             | t1     | 803  | 823  | 1023 | line  |
| Vertical Display Time    | t2     | 800  | 800  | 800  | line  |
| Vertical Blanking Time   | t3     | 3    | 23   | 223  | line  |
| 1 Line Scanning Time     | t4     | 1334 | 1440 | 1961 | clock |
| Horizontal Display Time  | t5     | 1280 | 1280 | 1280 | clock |
| Horizontal Blanking Time | t6     | 54   | 160  | 681  | clock |
| Clock Rate               | t7     | 64.3 | 71.1 | 85   | MHz   |

Timing Diagram of Interface Signal (DE mode)



### 7.3 Power On / Off Sequence



| Item | Min. | Typ. | Max. | Unit | Remark |
|------|------|------|------|------|--------|
| TP1  | 0.5  | --   | 10   | msec |        |
| TP2  | 0    | --   | 50   | msec |        |
| TP3  | 200  | --   | --   | msec |        |
| TP4  | 0.5  | --   | 10   | msec |        |
| TP5  | 10   | --   | --   | msec |        |
| TP6  | 10   | --   | --   | msec |        |
| TP7  | 0    | --   | 10   | msec |        |
| TP8  | 200  | --   | --   | msec |        |
| TP9  | 0    | --   | 50   | msec |        |
| TP10 | 1    | --   | 10   | msec |        |
| TP11 | 1000 | --   | --   | msec |        |

- Note :** (1) The supply voltage of the external system for the module input should be the same as the definition of  $V_{DD}$ .
- (2) Apply the lamp voltage within the LCD operation range. When the back-light turns on before the LCD operation or the LCD turns off before the back-light turns off, the display may momentarily become white.
- (3) In case of  $V_{DD}$  = off level, please keep the level of input signal on the low or keep a high impedance.
- (4) TP13 should be measured after the module has been fully discharged between power off and on period.
- (5) Interface signal shall not be kept at high impedance when the power is on.
- (6) The duty of LED dimming signal should be more than 20% in TP6 and TP14
- (7) PWM can adjust brightness to control Pin. Pulse duty the bigger the brighter

#### 7.4 Backlight Unit

| Parameter                                                      | Symbol    | Min    | Typ | Max  | Units | Condition                                                    |
|----------------------------------------------------------------|-----------|--------|-----|------|-------|--------------------------------------------------------------|
| Backlight Power consumption<br>(Include LED driver efficiency) | $P_{LED}$ | --     | --  | 2.91 | Watt  | Ta=25°C<br>V <sub>LED</sub> =5V<br>PWM duty 100%<br>Note (1) |
| LED Life-Time                                                  | N/A       | 10,000 | --  | --   | Hour  | Ta=25°C<br>I <sub>F</sub> =23mA<br>Note (2)                  |

**Note (1):** The LED lifetime defines as the estimated time to 50% degradation of final luminous.

## 7.5 LED Dr

### 7.5.1 Absolute Maximum Ratings

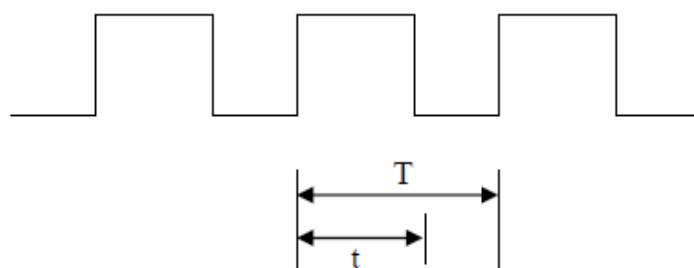
| Item                     | Symbol    | Min. | Max.      | Unit | Note |
|--------------------------|-----------|------|-----------|------|------|
| LED Power Supply voltage | $V_{LED}$ | -0.3 | 5.5       | Volt |      |
| LED_EN, PWM pin Voltage  | $V_{PWM}$ | --   | $V_{LED}$ | Volt |      |

### 7.5.2 DC Electrical Characteristics

| Parameter                | Symbol     | Min | Typ | Max       | Units | Remark  |
|--------------------------|------------|-----|-----|-----------|-------|---------|
| LED Power Supply Voltage | $V_{LED}$  | 4.5 | --  | 5.5       | Volt  |         |
| PWM High Threshold       | $V_{PWMH}$ | 2.0 | --  | $V_{LED}$ | Volt  |         |
| PWM Low Threshold        | $V_{PWML}$ | --  | --  | 0.8       | Volt  |         |
| PWM Frequency            | $F_{PWM}$  | 225 | --  | 1k        | Hz    |         |
| PWM Frequency            | $F_{PWM}$  | 14K |     | 20k       | Hz    | Note(1) |
| PWM Duty Cycle           | $T_D$      | 20  | --  | 100       | %     | Note(2) |

**Note (1):** PWM Frequency have noise problems during 1K~13K Hz.

**Note (2):** PWM Duty Cycle



$$\text{Duty Cycle} = (t / T) * 100\%$$

## 8. PROJECTED CAPACITIVE TOUCH PANEL SPECIFICATIONS

### 8.1 Main Feature

| Item                        | Specification                                                              | Unit       |
|-----------------------------|----------------------------------------------------------------------------|------------|
| Screen Size                 | 10.1 inches                                                                | Diagonal   |
| Type                        | Transparent Type Projected Capacitive Touch Panel                          | --         |
| Input Mode                  | Human's Finger                                                             | --         |
| View Area                   | 217.96(H)(typ.) X 136.6 (V)(typ.)                                          | mm         |
| Module Outline              | 283 (H)(typ.) X 202 (V)(typ.)                                              | mm         |
| Resolution                  | 2048(H) X 2048(V)                                                          | --         |
| Interface                   | USB                                                                        | --         |
| Operating system OS         | WIN7/Android                                                               |            |
| Touch number                | Two points                                                                 |            |
| Cover glass pencil-hardness | 7H(min) by JIS K-5600-5-4                                                  | --         |
| Response time               | 35                                                                         | ms         |
| Report Rate                 | 75                                                                         | Points/sec |
| Digital Power Supply        | 2.7V(min)~3.3V DC (typ.)                                                   | V          |
| Power Consumption           | EXC7200 Active: Max.50mA<br>EXC7200 idle : 8 mA<br>EX5404 Active: Max.10mA | mA         |
| IC solution                 | IC : EETI_ EX5404 MCU : EETI_ EXC7200                                      |            |

### 8.2 Pin Assignments and Definitions

| Item | Name | I/O | Unit         |
|------|------|-----|--------------|
| 1    | GND  | P   | Ground       |
| 2    | D-   | I/O | D-           |
| 3    | D+   | I/O | D+           |
| 4    | VDD  | P   | Power supply |
| 5    | NC   | -   | NO connect   |
| 6    | RST  | I   | Reset signal |

## 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) | 200   | 250   | --    | cd/m <sup>2</sup> |
| Uniformity            |            | B-uni         |                                                                            | 70    | 75    | -     | %                 |
| Contrast Ratio        |            | CR            |                                                                            | 600   | 800   | --    | --                |
| Response Time         |            | Tr+Tf         |                                                                            | --    | 25    | 35    | ms                |
| Color<br>Chromaticity | White      | Wx            |                                                                            | 0.283 | 0.313 | 0.343 | --                |
|                       |            | Wy            |                                                                            | 0.299 | 0.329 | 0.359 | --                |
| View angle            | Horizontal | $\theta_{x+}$ | Center<br>CR $\geq$ 10                                                     | 80    | 89    | --    |                   |
|                       |            | $\theta_{x-}$ |                                                                            | 80    | 89    | --    |                   |
|                       | Vertical   | $\theta_{Y+}$ |                                                                            | 80    | 89    | --    |                   |
|                       |            | $\theta_{Y-}$ |                                                                            | 80    | 89    | --    |                   |

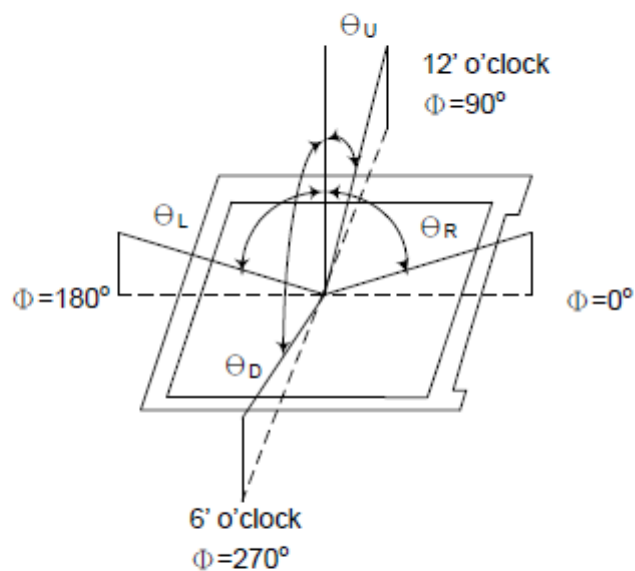
### Measuring Condition

- Measuring surrounding : dark room
- Ambient temperature : 25 $\pm$ 2°C
- 15min. warm-up time.

### Measuring Equipment

- FPM520 of Westar Display technologies, INC., which utilized SR-3 for Chromaticity and BM-5A for other optical characteristics.
- Measuring spot size : 20 ~ 21 mm

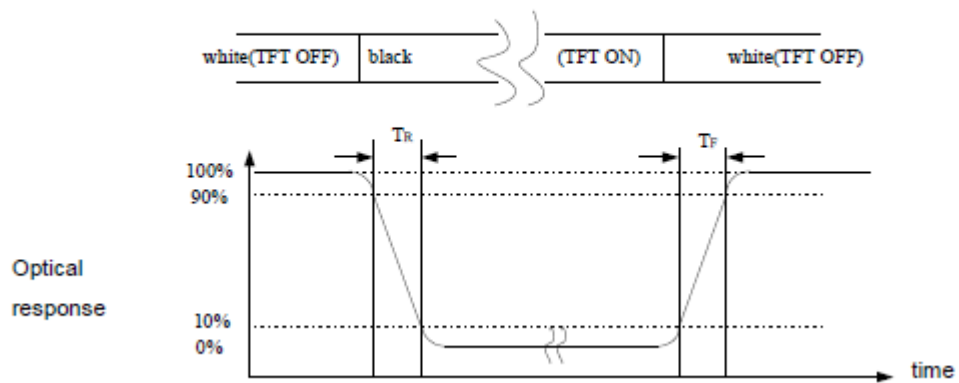
Note (1) Definition of Viewing Angle:



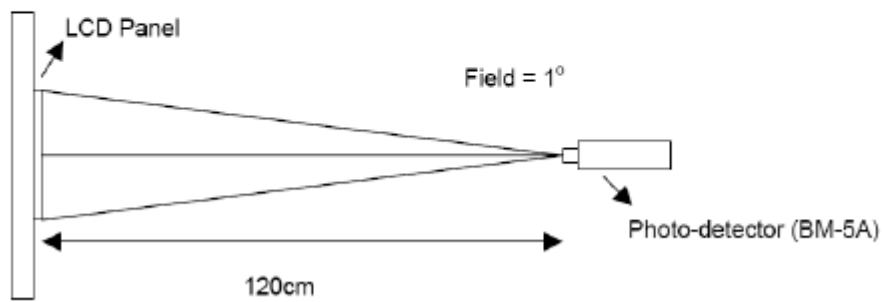
Note (2) Definition of Contrast Ratio (CR) :  
measured at the center point of panel

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

Note (3) Definition of Response Time : Sum of  $T_R$  and  $T_F$

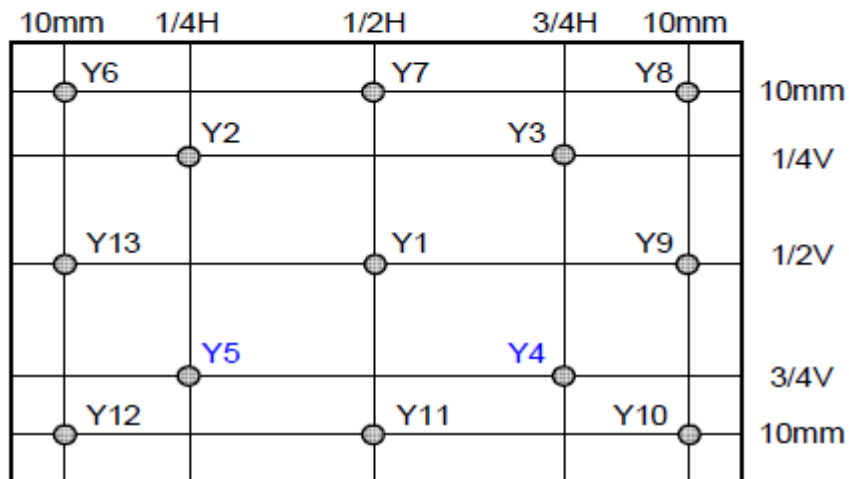


Note (4) Definition of optical measurement setup



**Note (5) Definition of Average Luminance Uniformity of White (5 Point)**

$$\text{Average Luminance Uniformity} = \frac{Y_1 + Y_2 + Y_3 + Y_4 + Y_5}{5}$$



**Note (6) Definition of brightness uniformity**

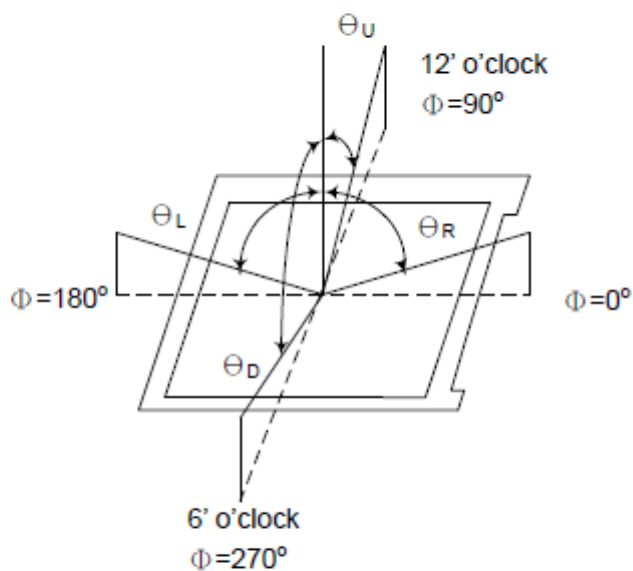
$$\text{Luminance uniformity(5 points)} = \frac{(\text{Max Luminance of 5 points})}{(\text{Min Luminance of 5 points})}$$

$$\text{Luminance uniformity(13points)} = \frac{(\text{Max Luminance of 13 points})}{(\text{Min Luminance of 13 points})}$$

### Measuring Equipment

- FPM520 of Westar Display technologies, INC., which utilized SR-3 for Chromaticity and BM-5A for other optical characteristics.
- Measuring spot size : 20 ~ 21 mm

Note (1) Definition of Viewing Angle:



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

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

## 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                | 60°C, 240 hrs                                                                                                |
| 2   | Low Temperature Storage                 | -20°C, 240 hrs                                                                                               |
| 3   | High Temperature Operating              | 50°C, 240 hrs                                                                                                |
| 4   | Low Temperature Operating               | 0°C, 240 hrs                                                                                                 |
| 5   | High Temperature/Humidity Non-Operating | 60°C, 90%RH, 240 hrs                                                                                         |
| 6   | Temperature Shock Non-Operating         | -20°C $\longleftrightarrow$ 60°C<br>(0.5hr each), 100 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 |

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 rowspan="4">Class Of Defects<br/>Minor</th><th rowspan="4">AQL Level<br/>1.5</th></tr><tr><td><math>D&gt;0.5</math></td><td>0</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<br>Minor | AQL Level<br>1.5          | $D>0.5$                   | 0                         | $0.3 < D \leq 0.5$ | 5                | $D \leq 0.3$     | *                   |            |              |               |   |
| Zone<br>Dimension                                                                                                                                                                                                                                                                                                                                                                                                                                      | Acceptable number                   | Class Of Defects<br>Minor                                                                                                                                                                                                                                                                                                    |                           |                           | AQL Level<br>1.5          |                           |                    |                  |                  |                     |            |              |               |   |
| $D>0.5$                                                                                                                                                                                                                                                                                                                                                                                                                                                | 0                                   |                                                                                                                                                                                                                                                                                                                              |                           |                           |                           |                           |                    |                  |                  |                     |            |              |               |   |
| $0.3 < D \leq 0.5$                                                                                                                                                                                                                                                                                                                                                                                                                                     | 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>L (mm)</th><th>Zone<br/>W(mm)</th><th>Acceptable number</th><th rowspan="4">Class Of Defects<br/>Minor</th><th rowspan="4">AQL Level<br/>1.5</th></tr><tr><td><math>L &gt; 5</math></td><td><math>W &gt; 0.1</math></td><td>0</td></tr><tr><td><math>0.5 &lt; L \leq 5</math></td><td><math>0.03 &lt; W \leq 0.1</math></td><td>5</td></tr><tr><td><math>L \leq 0.5</math></td><td><math>W \leq 0.03</math></td><td>*</td></tr></table> | L (mm)                              | Zone<br>W(mm)                                                                                                                                                                                                                                                                                                                | Acceptable number         | Class Of Defects<br>Minor | AQL Level<br>1.5          | $L > 5$                   | $W > 0.1$          | 0                | $0.5 < L \leq 5$ | $0.03 < W \leq 0.1$ | 5          | $L \leq 0.5$ | $W \leq 0.03$ | * |
| L (mm)                                                                                                                                                                                                                                                                                                                                                                                                                                                 | Zone<br>W(mm)                       | Acceptable number                                                                                                                                                                                                                                                                                                            | Class Of Defects<br>Minor |                           |                           | AQL Level<br>1.5          |                    |                  |                  |                     |            |              |               |   |
| $L > 5$                                                                                                                                                                                                                                                                                                                                                                                                                                                | $W > 0.1$                           | 0                                                                                                                                                                                                                                                                                                                            |                           |                           |                           |                           |                    |                  |                  |                     |            |              |               |   |
| $0.5 < L \leq 5$                                                                                                                                                                                                                                                                                                                                                                                                                                       | $0.03 < W \leq 0.1$                 | 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>L (mm)</th><th>Zone<br/>W(mm)</th><th>Acceptable number</th><th rowspan="3">Class Of Defects<br/>Minor</th><th rowspan="3">AQL Level<br/>1.5</th></tr><tr><td>--</td><td><math>W &gt; 0.1</math></td><td>0</td></tr><tr><td><math>L \leq 3</math></td><td><math>W \leq 0.1</math></td><td>3</td></tr></table> | L (mm)                    | Zone<br>W(mm)             | Acceptable number         | Class Of Defects<br>Minor | AQL Level<br>1.5   | --               | $W > 0.1$        | 0                   | $L \leq 3$ | $W \leq 0.1$ | 3             |   |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                     | L (mm)                                                                                                                                                                                                                                                                                                                       | Zone<br>W(mm)             | Acceptable number         | Class Of Defects<br>Minor |                           |                    | AQL Level<br>1.5 |                  |                     |            |              |               |   |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                     | --                                                                                                                                                                                                                                                                                                                           | $W > 0.1$                 | 0                         |                           |                           |                    |                  |                  |                     |            |              |               |   |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                     | $L \leq 3$                                                                                                                                                                                                                                                                                                                   | $W \leq 0.1$              | 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 rowspan="3">Class Of Defects<br/>Minor</th><th rowspan="3">AQL Level<br/>1.5</th></tr><tr><td><math>D \leq 0.3</math></td><td>*</td></tr><tr><td><math>D \leq 0.5</math></td><td>3</td></tr></table>                                                     | Zone<br>Dimension         | Acceptable number         | Class Of Defects<br>Minor | AQL Level<br>1.5          | $D \leq 0.3$       | *                | $D \leq 0.5$     | 3                   |            |              |               |   |
| Zone<br>Dimension                                                                                                                                                                                                                                                                                                                                                                                                                                      | Acceptable number                   | Class Of Defects<br>Minor                                                                                                                                                                                                                                                                                                    | AQL Level<br>1.5          |                           |                           |                           |                    |                  |                  |                     |            |              |               |   |
| $D \leq 0.3$                                                                                                                                                                                                                                                                                                                                                                                                                                           | *                                   |                                                                                                                                                                                                                                                                                                                              |                           |                           |                           |                           |                    |                  |                  |                     |            |              |               |   |
| $D \leq 0.5$                                                                                                                                                                                                                                                                                                                                                                                                                                           | 3                                   |                                                                                                                                                                                                                                                                                                                              |                           |                           |                           |                           |                    |                  |                  |                     |            |              |               |   |
| $D = (\text{Long} + \text{Short}) / 2$ * : Disregard                                                                                                                                                                                                                                                                                                                                                                                                   |                                     |                                                                                                                                                                                                                                                                                                                              |                           |                           |                           |                           |                    |                  |                  |                     |            |              |               |   |

| Class of defects | Major | AQL 0.65% | Definition                                                                            |
|------------------|-------|-----------|---------------------------------------------------------------------------------------|
|                  | Minor | AQL 1.5%  | 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.

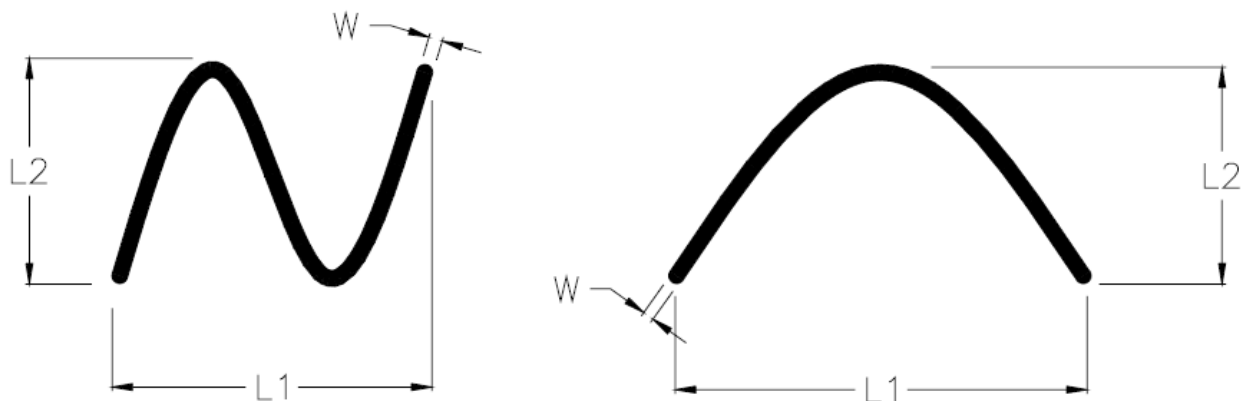
(d) Definition of joined bright point defect and joined dark point defect are as follows:

- 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

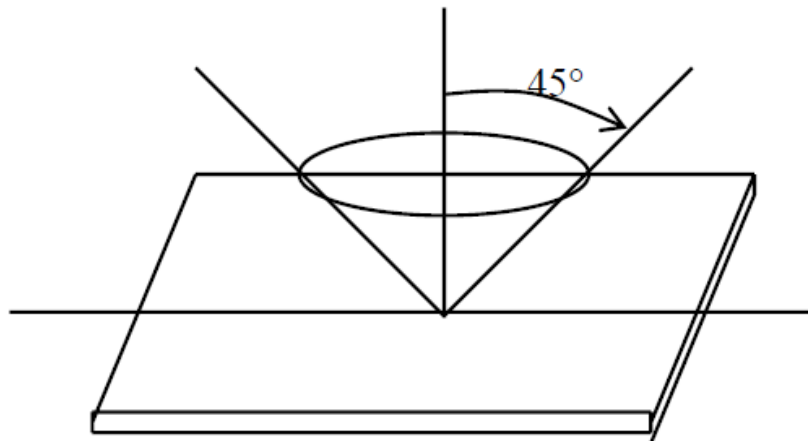
Inspection level: Level II

### 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.**