



# **SPECIFICATION FOR LCD MODULE**

**MODULE NO: AFD640480A0T-5.7N12WTM-R**  
**VERSION NO.: V1.0**

Customer's Approval:

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

| Version | Revised Date | Page | Content      |
|---------|--------------|------|--------------|
| V1.0    | 2013/11/29   | --   | First Issued |
|         |              |      |              |
|         |              |      |              |
|         |              |      |              |
|         |              |      |              |

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## 1. GENERAL DESCRIPTION

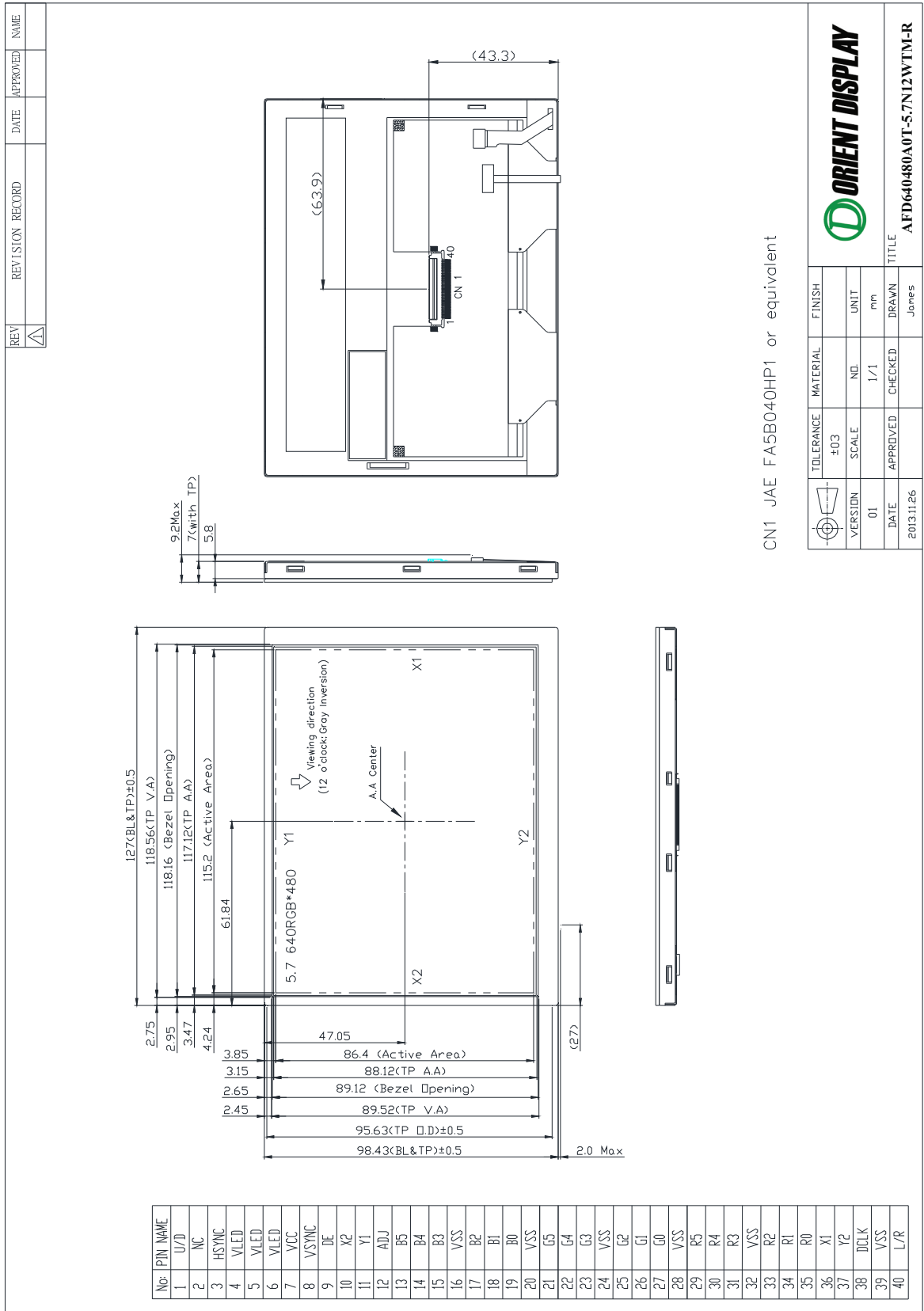
### 1.1 Description

The specifications is model AFD640480A0T-5.7N12WTM-R 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 touch panel. This TFT LCD has a 5.7 inch diagonally measured active display area with WVGA (640 horizontal by 480 vertical pixels) resolution.

### 1.2 Features:

| No. | Item                           | Specification                      | Unit   |
|-----|--------------------------------|------------------------------------|--------|
| 1   | Panel Size                     | 5.7"                               | Inch   |
| 2   | Number of Pixels               | 640 (W) x RGB x 480 (H)            | Pixels |
| 3   | Active Area                    | 115.2 (W) × 86.4 (H)               | mm     |
| 4   | Pixel Pitch                    | 0.18 (W) x 0.18 (H)                | mm     |
| 5   | Outline Dimension              | 127 (W) × 98.43 (H) × 9.2 (T)      | mm     |
| 6   | Number of Colors               | 262K                               | - -    |
| 7   | Display Mode                   | TN / Normally White / Transmissive | - -    |
| 8   | View Direction                 | 12 o'clock(Gray Inversion)         |        |
| 9   | Display Format                 | RGB vertical stripe                | - -    |
| 10  | Surface Treatment              | Anti-glare                         | - -    |
| 11  | Contrast Ratio                 | 300 (Typ.)                         | - -    |
| 12  | Luminance (cd/m <sup>2</sup> ) | 320 (Typ.)                         | cd/m2  |
| 13  | Interface                      | RGB 18bit Interface                | - -    |
| 14  | Backlight                      | White LED                          | - -    |
| 15  | Operation Temperature          | -20 ~ 70                           | °C     |
| 16  | Storage Temperature            | -30 ~ 80                           | °C     |
| 17  | Weight                         | 128                                | g      |

## 2. MECHANICAL SPECIFICATION



### 3. PIN DESCRIPTION

#### 3.1 TFT LCD Module

| Pin No. | Symbol | I/O | Function                       | Remark |
|---------|--------|-----|--------------------------------|--------|
| 1       | U/D    | I   | Up or Down Display Control     |        |
| 2       | NC     | -   | No connection                  |        |
| 3       | HSYNC  | I   | Horizontal SYNC Signal         |        |
| 4       | VLED   | P   | Power Supply for LED Driver    |        |
| 5       | VLED   | P   | Power Supply for LED Driver    |        |
| 6       | VLED   | P   | Power Supply for LED Driver    |        |
| 7       | VCC    | P   | Power Supply for system        |        |
| 8       | VSYNC  | I   | Vertical SYNC Signal           |        |
| 9       | DE     | I   | Data Enable Signal             |        |
| 10      | X2     | O   | Touch Panel control (Left)     |        |
| 11      | Y1     | O   | Touch Panel control (Up)       |        |
| 12      | ADJ    | I   | Brightness control for LED B/L |        |
| 13      | B5     | I   | Blue data signal (MSB)         |        |
| 14      | B4     | I   | Blue data signal               |        |
| 15      | B3     | I   | Blue data signal               |        |
| 16      | VSS    | P   | Ground                         |        |
| 17      | B2     | I   | Blue data signal               |        |
| 18      | B1     | I   | Blue data signal               |        |
| 19      | B0     | I   | Blue data signal (LSB)         |        |
| 20      | VSS    | P   | Ground                         |        |
| 21      | G5     | I   | Green data signal (MSB)        |        |
| 22      | G4     | I   | Green data signal              |        |
| 23      | G3     | I   | Green data signal              |        |
| 24      | VSS    | P   | Ground                         |        |
| 25      | G2     | I   | Green data signal              |        |
| 26      | G1     | I   | Green data signal              |        |
| 27      | G0     | I   | Green data signal (LSB)        |        |
| 28      | VSS    | P   | Ground                         |        |
| 29      | R5     | I   | Red data signal (MSB)          |        |
| 30      | R4     | I   | Red data signal                |        |
| 31      | R3     | I   | Red data signal                |        |
| 32      | VSS    | P   | Ground                         |        |
| 33      | R2     | I   | Red data signal                |        |
| 34      | R1     | I   | Red data signal                |        |
| 35      | R0     | I   | Red data signal (LSB)          |        |

|    |      |   |                                                |  |
|----|------|---|------------------------------------------------|--|
| 36 | X1   | O | Touch Panel control (Right)                    |  |
| 37 | Y2   | O | Touch Panel control (Down)                     |  |
| 38 | DCLK | I | Clock Signals ; Latch Data at the Falling Edge |  |
| 39 | VSS  | P | Ground                                         |  |
| 40 | L/R  | I | Left or Right Display Control                  |  |

Note:

(1) VSS PIN must be grounding, cannot be floating.

(2) U/D and L/R control Function

| L/R | U/D | Function                                       |
|-----|-----|------------------------------------------------|
| 1   | 0   | Normally display                               |
| 0   | 0   | Left and Right opposite                        |
| 1   | 1   | Up and Down opposite                           |
| 0   | 1   | Left and Right opposite , Up and Down opposite |

(3) If DE signal is fixed low, SYNC mode is used. Otherwise, DE mode is used.

#### 4. ABSOLUTE MAXIMUM RATINGS

##### 4.1 Electrical Absolute Rating

###### 4.1.1 TFT LCD Module

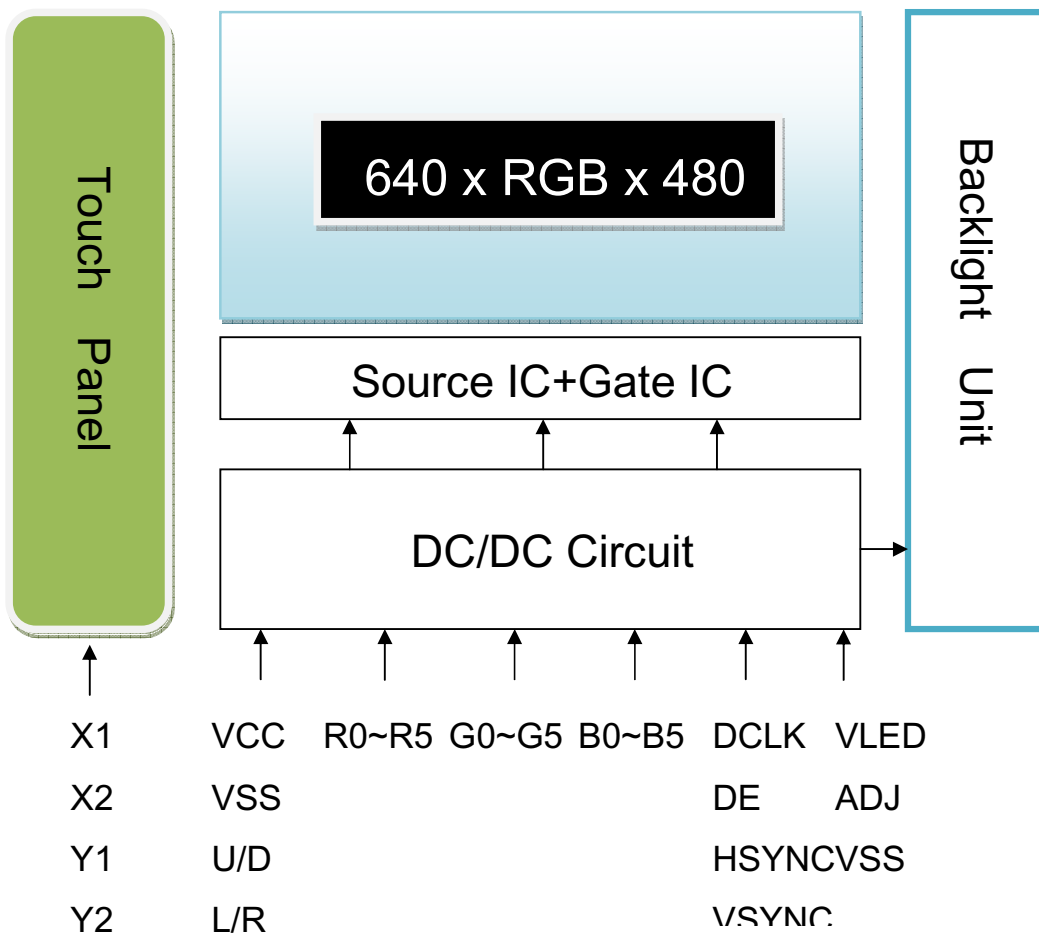
| Item                 | Symbol | Values |      | Unit | Note |
|----------------------|--------|--------|------|------|------|
|                      |        | Min    | Max. |      |      |
| Power supply voltage | VCC    | -0.3   | 5.0  | V    |      |
|                      | VLED   | 0      | 5.5  | V    |      |

###### 4.1.2 Environment Absolute Rating

| Item                  | Symbol | Values |     |      | Unit | Note                   |
|-----------------------|--------|--------|-----|------|------|------------------------|
|                       |        | Min    | Typ | Max. |      |                        |
| Operating Temperature | Topa   | -20    |     | 70   | °C   | Ambient<br>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  |

0 : Low level voltage, 1 :High level voltage

Each basic color can be displayed in 64 gray scales from 6 bit data signals. With the combination of total 18 bit data signals, the 262K-color display can be achieved on the screen.

## 7. ELECTRICAL CHARACTERISTICS

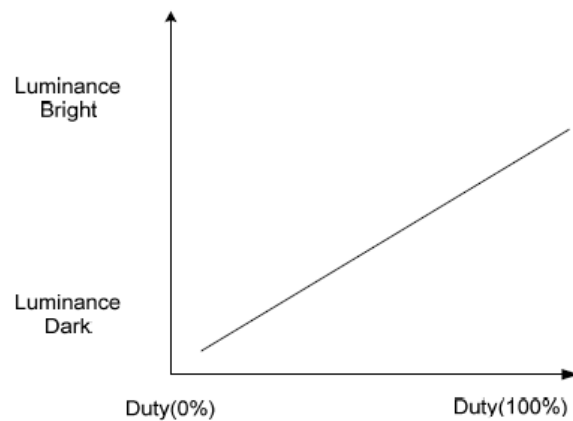
### 7.1 TFT LCD Module

| Item                    |         | Symbol | Value   |      |         | Unit | Note    |
|-------------------------|---------|--------|---------|------|---------|------|---------|
|                         |         |        | Min.    | Typ. | Max.    |      |         |
| Power supply voltage    |         | VCC    | 3.0     | 3.3  | 3.6     | V    |         |
|                         |         | VLED   | 4.5     | 5    | 5.5     | V    |         |
| Input Voltage for logic | H Level | VIH    | 0.7xVCC | -    | VCC     | V    |         |
|                         | L Level | VIL    | 0       | -    | 0.3xVCC | V    |         |
| PWM frequency           |         | ADJ    | 19K     | 20K  | 21K     | Hz   | Note2   |
| Digital Current         |         | ICC    | -       | 111  | 140     | mA   | Note1   |
|                         |         | ILED   | -       | 333  | 400     | mA   | VLED=5V |
| LED Life Time (25°C)    |         | -      | (50000) | -    | -       | hr   | Note3   |

Note 1: frame =60Hz , Ta=25°C , Display pattern : Black pattern



Note 2: ADJ signal is 0~3.3V.Operation frequency is 20KHz



Note 3: The “LED life time” is defined as the module brightness decrease to 50% original brightness that the ambient temperature is 25°C 60% RH.

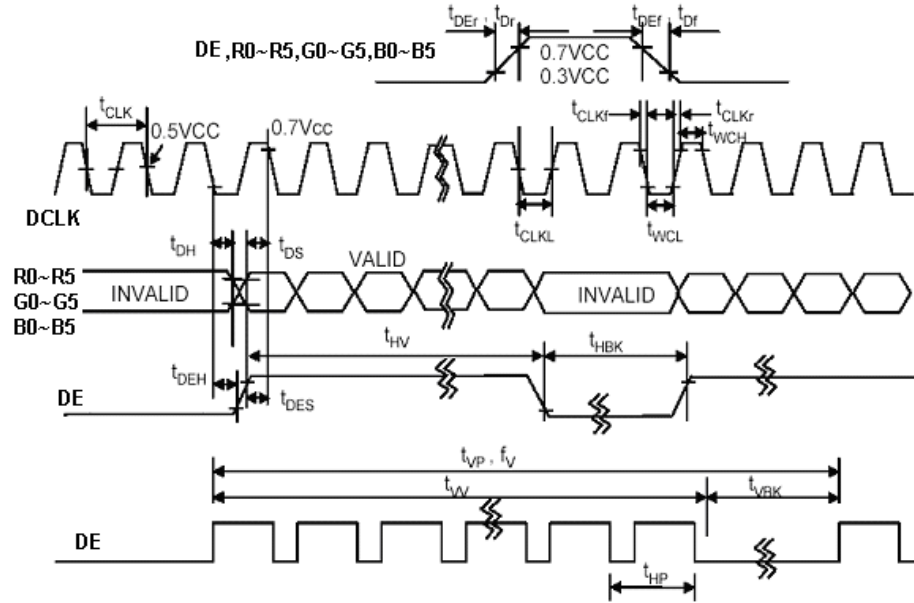
## 7.2 INTERFACE SPECIFICATIONS

### 7.2.1 DE Mode Input Timing Table

| Signal        | Parameter        | Symbol      | Min. | Typ. | Max. | Unit. | Note |
|---------------|------------------|-------------|------|------|------|-------|------|
| DCLK          | CLK frequency    | fCLK        | 23   | 25   | 30   | MHz   |      |
|               | CLK period       | tCLK        | 33   | 40   | 43   | ns    |      |
|               | CLK pulse duty   | -           | 45   | 50   | 55   | %     |      |
|               | Low Level Width  | tWCL        | 6    | -    | -    | ns    |      |
|               | High Level Width | tWCH        | 6    | -    | -    | ns    |      |
|               | Rise, Fall Time  | tCLKr,tCLKf | -    | -    | 3    | ns    |      |
| DE            | Setup Time       | tDES        | 5    | -    | -    | ns    |      |
|               | Hold Time        | tDEH        | 10   | -    | -    | ns    |      |
|               | Rise, Fall Time  | tDEr,tDEf   | -    | -    | 16   | ns    |      |
|               | Horizontal Line  | tHP         | 750  | 800  | 900  | tCLK  |      |
|               | HS Display Area  | tHV         | 640  | 640  | 640  | tCLK  |      |
|               | HS Blank         | tHBK        | 110  | 160  | 260  | tCLK  |      |
|               | VS Display Area  | tVP         | 515  | 525  | 560  | tHP   |      |
|               | VS Period Time   | tVV         | 480  | 480  | 480  | tHP   |      |
|               | VS Blank         | tVBK        | 35   | 45   | 80   | tHP   |      |
|               | VS Frequency     | fV          | 55   | 60   | 65   | Hz    |      |
| Data<br>R,G,B | Setup Time       | tDS         | 5    | -    | -    | ns    |      |
|               | Hold Time        | tDH         | 10   | -    | -    | ns    |      |
|               | Rise, Fall Time  | tDr,tDf     | -    | -    | 3    | ns    |      |

Note: (1) tCLKL / tCLK.

## 7.2.2 DE mode timing waveform



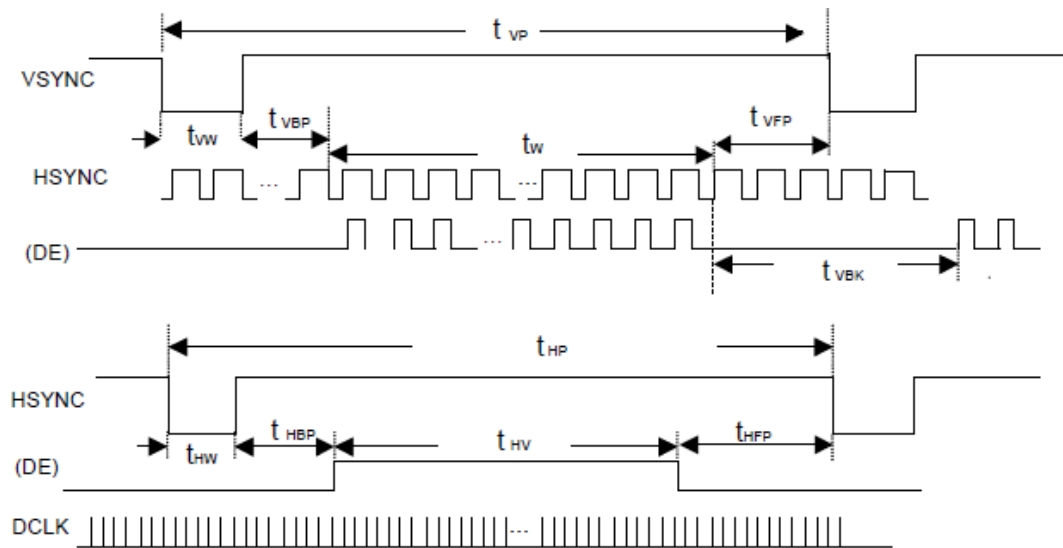
## 7.2.3 SYNC mode Input signal characteristics

| Signal | Parameter            | Symbol       | Min. | Typ. | Max. | Unit. | Note |
|--------|----------------------|--------------|------|------|------|-------|------|
| DCLK   | CLK frequency        | fCLK         | 23   | 25   | 30   | MHz   |      |
|        | CLK period           | tCLK         | 33   | 40   | 43   | ns    |      |
|        | Low Level Width      | tWCL         | 6    | -    | -    | ns    |      |
|        | High Level Width     | tWCH         | 6    | -    | -    | ns    |      |
|        | Rise, Fall Time      | tCLKr, tCLKf | -    | -    | 3    | ns    |      |
| HSYNC  | Horizontal Line      | tHP          | 750  | 800  | 900  | tCLK  |      |
|        | HS Display Area      | tHv          | 640  | 640  | 640  | tCLK  |      |
|        | HS Pulse Width       | tHW          | 5    | 30   | -    | tCLK  |      |
|        | HS Back Porch        | tHBP         | 1    | 114  | 139  | tCLK  |      |
|        | HS Front Porch       | tHFP         | 1    | 16   | 116  | tCLK  |      |
|        | HS Blanking          | tHBK         | 1    | 160  | 260  | tCLK  |      |
|        | HS Width+ Back Porch | tHW+tHBP     | 144  | 144  | 144  | tCLK  |      |
| VSYNC  | VS Period Time       | tVP          | 515  | 525  | 560  | tHP   |      |
|        | VS Display Area      | tVV          | 480  | 480  | 480  | tHP   |      |
|        | VS Pulse Width       | tVW          | 1    | 3    | 5    | tHP   |      |
|        | VS Back Porch        | tVBP         | 30   | 32   | 34   | tHP   |      |
|        | VS Front Porch       | tVFP         | 1    | 10   | 45   | tHP   |      |
|        | VS Width+ Back Porch | tVW+tVBP     | 35   | 35   | 35   | tHP   |      |
|        | VS Blanking          | tVBK         | 35   | 45   | 80   | tHP   |      |
| DATA   | Setup Time           | tDS          | 5    | -    | -    | ns    |      |
|        | Hold Time            | tDH          | 10   | -    | -    | ns    |      |

Note: (1) tHBK = tHFP + tHW + tHBP.

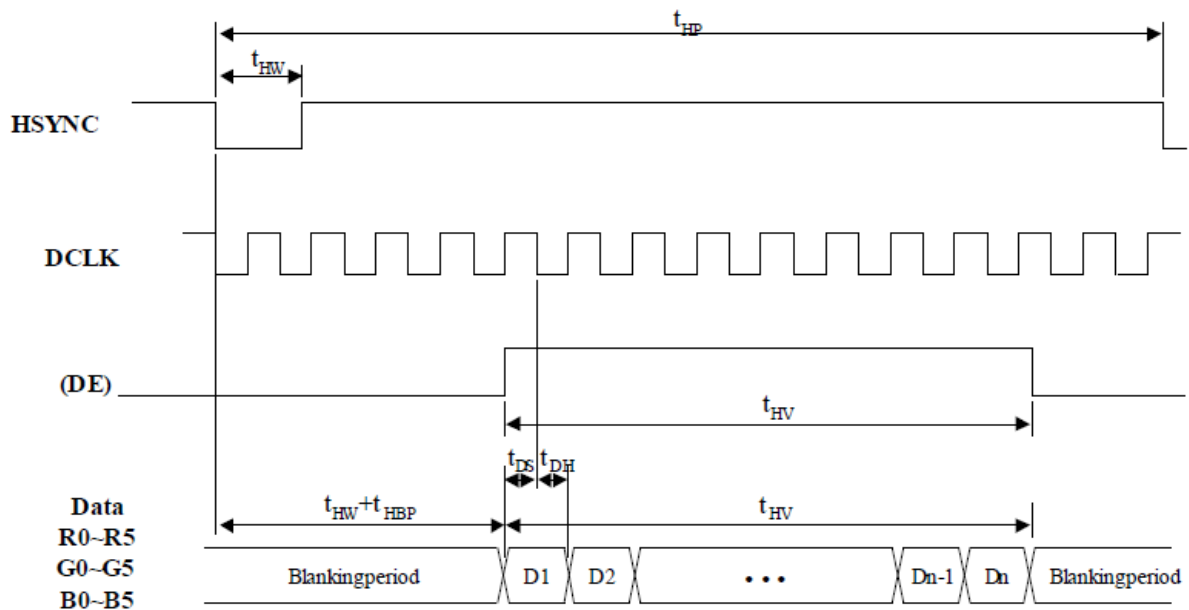
## 7.2.4 SYNC mode timing waveform

### Input vertical timing:



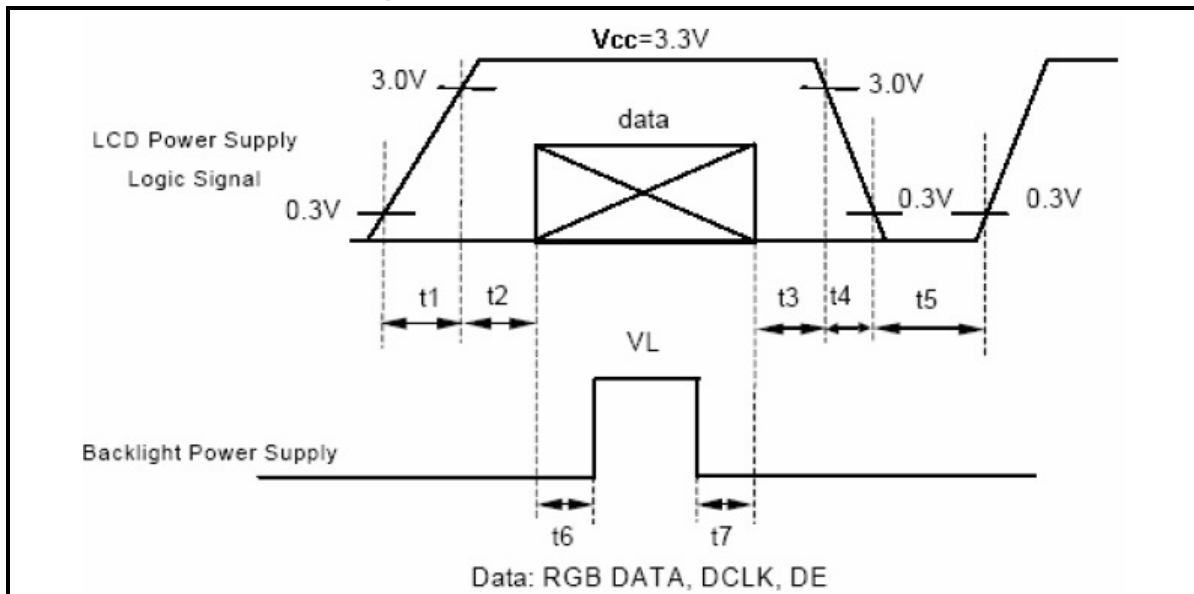
Note: If SYNC mode is used, please fix DE signal to low, DE timing waveform is for reference only.

### Input horizontal timing:



Note: If SYNC mode is used, please fix DE signal to low, DE timing waveform is for reference only

### 7.3 Power On / Off Sequence



$t1 \leq 10ms : 1 \text{ sec} \leq t5$

$50ms \leq t2 : 200ms \leq t6$

$0 < t3 \leq 50ms : 200ms \leq t7$

$0 < t4 \leq 10ms$

## 8. Touch Screen Panel Specifications

### 8.1 Main Feature

| Item                  | Min.    | Typ. | Max. | Unit       | Note                                                           |
|-----------------------|---------|------|------|------------|----------------------------------------------------------------|
| Linearity             | -1.5    | -    | +1.5 | %          | Initial data                                                   |
| Terminal resistance   | 300     | -    | 1000 | $\Omega$   | X1~X2                                                          |
|                       | 100     | -    | 800  | $\Omega$   | Y1~Y2                                                          |
| Insulation resistance | 10      | -    | -    | M $\Omega$ | DC 25V                                                         |
| Voltage               | -       | -    | 7    | V          | DC                                                             |
| Response time         | -       | -    | 20   | ms         |                                                                |
| Haze                  | -       | 5    | -    | %          | JIS K-7105                                                     |
| FPC peeling strength  | 5       | -    | -    | N          | Peeling upward by 90°                                          |
| Minimum Input force   | -       | -    | 50   | gf         | Test Area is 3mm inside of active area, but not on Dot-Spacer. |
| Notes life            | 100000  | -    | -    | words      |                                                                |
| Input life            | 1000000 | -    | -    | times      |                                                                |

#### Note1:

##### Durability test:

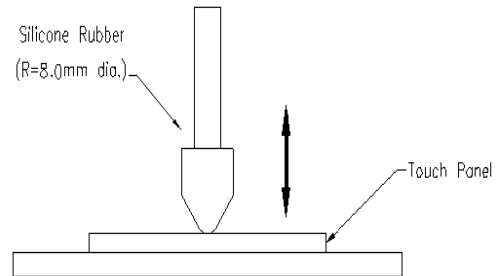
Touch panel is hit 1 million times with a silicone rubber of R8 finger, hitting rate is by 200g. the measurement must satisfy the following:

Circuit close resistance: x 300  $\Omega$ ~1000  $\Omega$  ;  
y 100  $\Omega$ ~800  $\Omega$

Circuit open resistance:  $\geq 10\text{M}\Omega$  at DC25V

Contact bounce:  $\leq 20\text{ms}$

Linearity test:  $\leq 3\%$



#### Note2:

##### Stylus writing:

Touch panel is drawn by R0.8 Delrin stylus pen, at 250g forces, repeat one inch by 100k times.

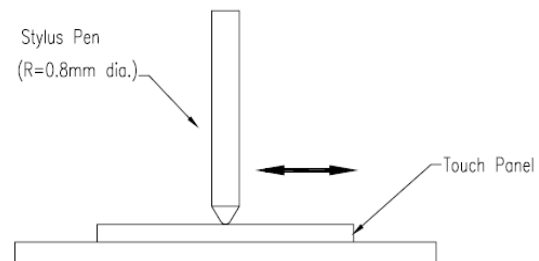
Writing speed: 60 mm / sec. The measurement must satisfy the following:

Circuit close resistance: x 300  $\Omega$ ~1000  $\Omega$  ;  
y 100  $\Omega$ ~800  $\Omega$

Circuit open resistance:  $\geq 10\text{M}\Omega$  at DC25V

Contact bounce:  $\leq 20\text{ms}$

Linearity test:  $\leq 3\%$

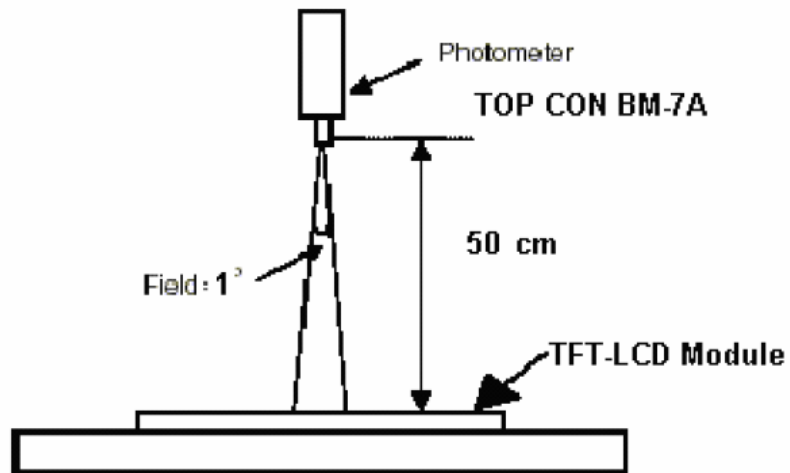


## 9. OPTICAL CHARACTERISTICS

| Item                  |            | Symbol      | Condition                                                                    | Min.  | Typ.  | Max.  | Unit  |
|-----------------------|------------|-------------|------------------------------------------------------------------------------|-------|-------|-------|-------|
| Brightness            |            | --          | Note1,<br>Note 3,<br>( $\theta = 0^{\circ}$ ;<br>Normal<br>Viewing<br>Angle) | 250   | 320   | --    | cd/m2 |
| Uniformity            |            | B-uni       |                                                                              | 70    | 80    | -     | %     |
| Contrast Ratio        |            | CR          |                                                                              | 200   | 300   | --    | --    |
| Response Time         |            | Tr          |                                                                              | --    | 15    | --    | ms    |
|                       |            | Tf          |                                                                              | --    | 35    | --    | ms    |
| Color<br>Chromaticity | White      | Wx          |                                                                              | 0.265 | 0.315 | 0.365 | --    |
|                       |            | Wy          | 0.281                                                                        | 0.331 | 0.381 | --    |       |
| View angle            | Horizontal | $\theta$ x+ | Center<br>CR≥10                                                              | 60    | 70    | --    |       |
|                       |            | $\theta$ x- |                                                                              | 60    | 70    | --    |       |
|                       | Vertical   | $\theta$ Y+ |                                                                              | 50    | 60    | --    |       |
|                       |            | $\theta$ Y- |                                                                              | 30    | 40    | --    |       |
| Image sticking        |            | tis         | 2 hours                                                                      | --    | --    | 2     | Sec   |

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:

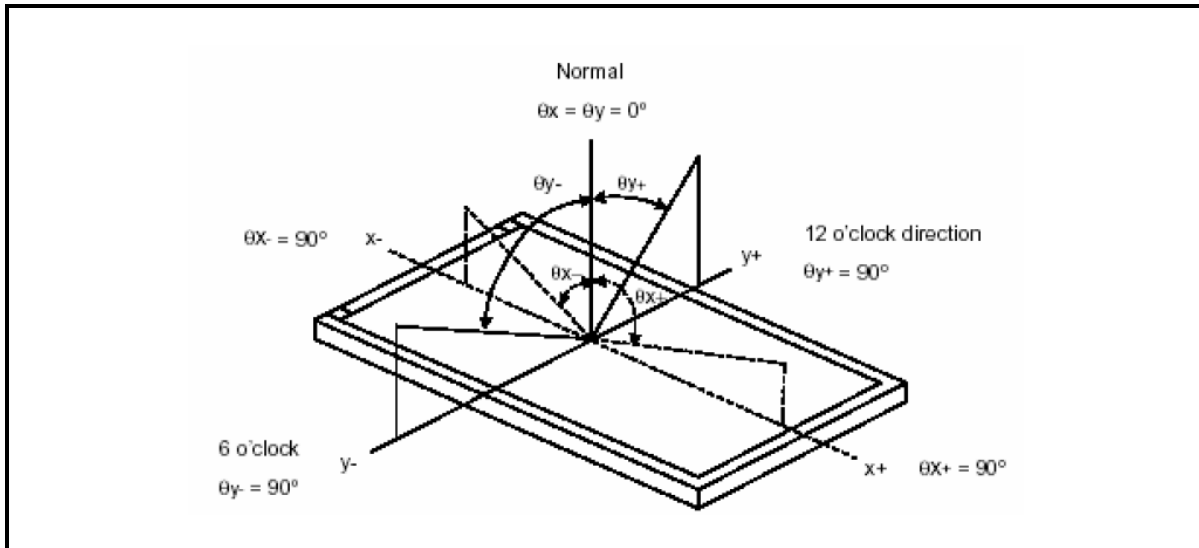


Note2: Measured at the center area of the panel and at the viewing angle of the  $\theta x = \theta y = 0^\circ$

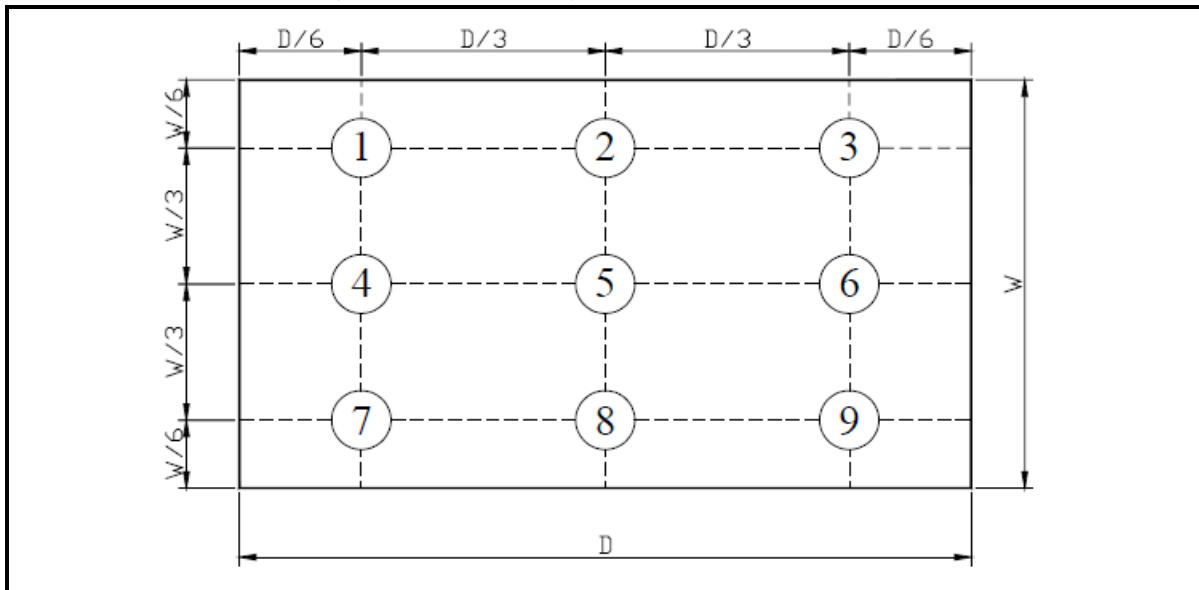
Note3: Definition of Contrast Ratio (CR):

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

Note4: Definition of Viewing Angle:



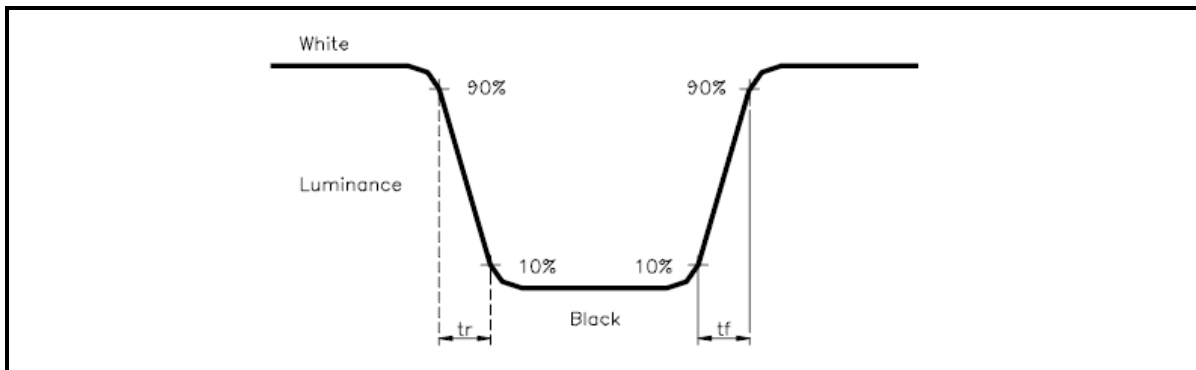
Note 5: Definition of Brightness Uniformity (B-uni):



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

**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



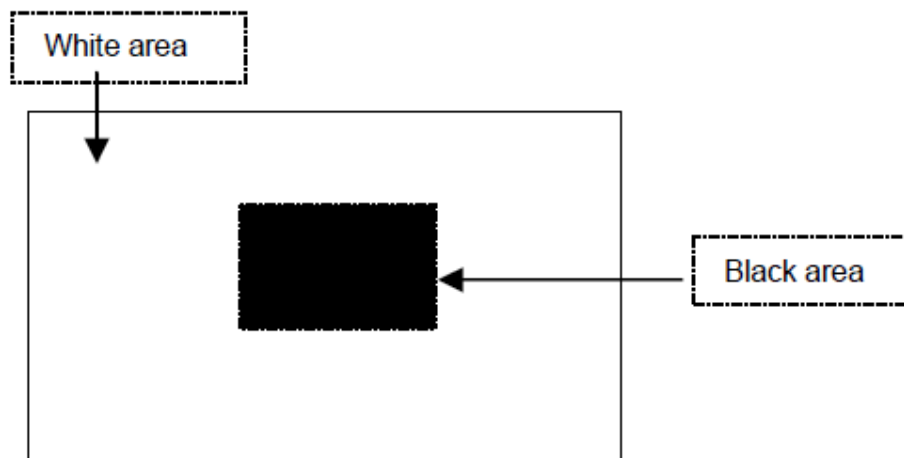
**Note 7: Definition of Chromaticity:**

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.

**Note 8: Definition of Image sticking ( $t_{is}$ ):**

Continuously display the test pattern shown in the figure below for 2 hours. Then display a completely white screen. The previous image shall not persist more than 2 sec at 25 °C

**Image sticking pattern**



## 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, 240 hrs                                                                                                   |
| 2   | Low Temperature Storage                    | -30°C, 240 hrs                                                                                                  |
| 3   | High Temperature Operating                 | 70°C, 240 hrs                                                                                                   |
| 4   | Low Temperature Operating                  | -20°C, 240 hrs                                                                                                  |
| 5   | High Temperature/Humidity<br>Non-Operating | 60°C, 90%RH, 240 hrs                                                                                            |
| 6   | Temperature Shock Non-Operating            | -30°C $\leftarrow$ +25°C $\rightarrow$ 80°C<br>(0.5hr each), 200 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<br>X,Y,Z |
| 8   | Electro-static Discharge<br>Non-Operating  | 150pF, 330Ω<br>Air:± 12KV;Contact: ±6KV<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>L (mm)</th><th>Zone<br/>W(mm)</th><th>Acceptable number</th><th>Class Of Defects</th><th>AQL Level</th></tr><tr><td><math>L &gt; 5</math></td><td><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></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  | 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 (mm)                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Zone<br>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<br>(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>Class Of Defects</th><th>AQL Level</th></tr><tr><td>--</td><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></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 | AQL Level    | --  | $W > 0.1$          | 0    | Minor            | 1.5                 | $L \leq 3$ | $W \leq 0.1$ | 3             |   |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                        | L (mm)                                                                                                                                                                                                                                                                                                                               | Zone<br>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%  | 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.

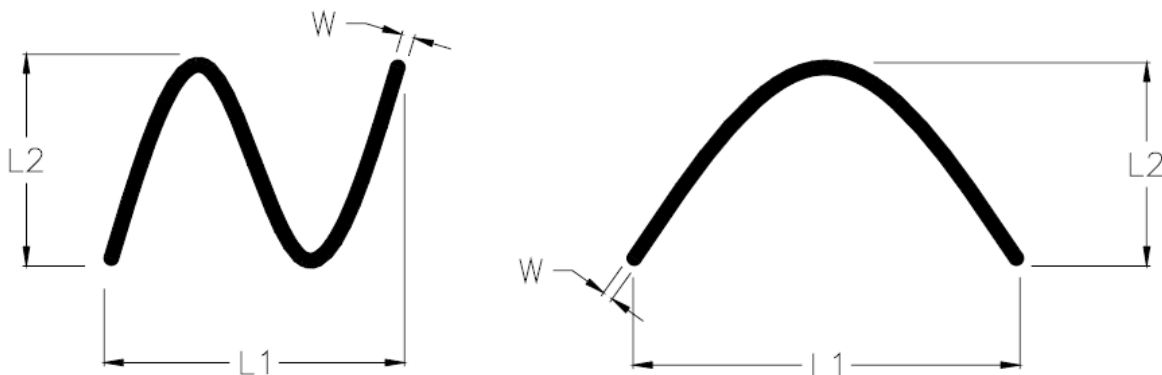
(d) Definition of joined bright point defect and joined dark point defect are as follows:

- 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

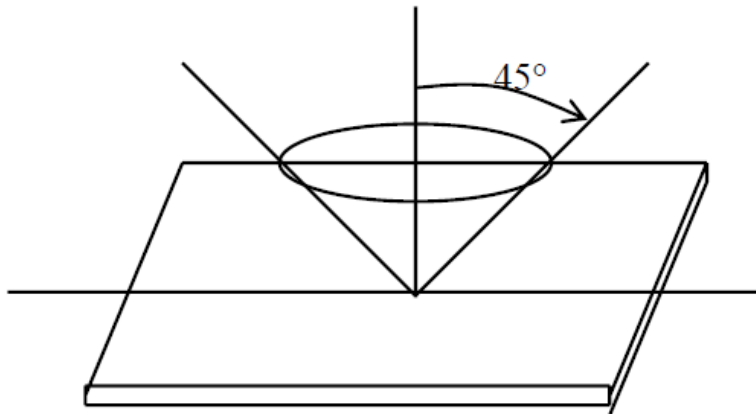
Inspection level: Level II

### 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.