

# DMT070WSNHCMU-1E

## PRODUCT SPECIFICATION

Version 0.1  
Feb 22, 2023

TBD

| <i>Customer's Approval</i> |                    |
|----------------------------|--------------------|
| <u><i>Signature</i></u>    | <u><i>Date</i></u> |

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Approved by *Kenny Lin*

## Revision History

| VERSION | DATE         | DESCRIPTION | AUTHOR      |
|---------|--------------|-------------|-------------|
| 0.1     | Feb 22, 2023 | Preliminary | Victoria Ho |
|         |              |             |             |
|         |              |             |             |
|         |              |             |             |
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|         |              |             |             |

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## Table of Contents

|  |           |
|--|-----------|
| <b>1. GENERAL DESCRIPTION .....</b>            | <b>4</b>  |
| 1.1 Introduction .....                         | 4         |
| 1.2 Main Features .....                        | 4         |
| <b>2. MECHANICAL SPECIFICATION .....</b>       | <b>5</b>  |
| 2.1 Mechanical Characteristics .....           | 5         |
| 2.2 Mechanical Drawing.....                    | 6         |
| <b>3. ELECTRICAL SPECIFICATION .....</b>       | <b>7</b>  |
| 3.1 Absolute Maximum Ratings .....             | 7         |
| 3.2 DC Electrical Characteristics .....        | 7         |
| 3.3 Interface Pin Assignment .....             | 8         |
| 3.4 Block Diagram .....                        | 10        |
| 3.5 Timing Characteristics .....               | 11        |
| <b>4. ELECTRICAL SPECIFICATION TOUCH .....</b> | <b>14</b> |
| 4.1 Electrical Characteristics .....           | 14        |
| <b>5. OPTICAL SPECIFICATION .....</b>          | <b>17</b> |
| <b>6. PACKAGING .....</b>                      | <b>19</b> |
| <b>7. QUALITY ASSURANCE SPECIFICATION.....</b> | <b>20</b> |
| 7.1 Conformity .....                           | 20        |
| 7.2 Environment Required .....                 | 20        |
| 7.3 Delivery Assurance .....                   | 20        |
| 7.4 Dealing with Customer Complaints.....      | 28        |
| <b>8. RELIABILITY SPECIFICATION .....</b>      | <b>29</b> |
| <b>9. HANDLING PRECAUTIONS.....</b>            | <b>30</b> |
| 9.1 Handling Precautions .....                 | 30        |
| 9.2 Storage Precautions .....                  | 31        |
| 9.3 Designing Precautions.....                 | 31        |
| 9.4 Operation Precautions .....                | 32        |
| 9.5 Other Precautions .....                    | 32        |

# 1. General Description

## 1.1 Introduction

This is a 7.0" size colour active matrix TFT LCD module that uses amorphous silicon TFT as a switching device. The display is normally black mode, transmissive, and featuring high contrast and excellent colour saturation. The resolution of the TFT-LCD is 1024x 600 and can display up to 16.7M colours. The display module supports HDMI interface and tape bonding touch panel.

## 1.2 Main Features

| Item                  | Contents                              |
|-----------------------|---------------------------------------|
| Display Type          | TFT LCD                               |
| Screen Size           | 7.0" Diagonal                         |
| Display Format        | 1024 x RGB x 600 Dots                 |
| No. of Colour         | 262K/16.7M                            |
| Overall Dimensions    | 182.07 (W) x 117.6 (H) x 10.73 (D) mm |
| Active Area           | 154.21 (W) x 85.92 (H) mm             |
| Mode                  | Normally Black / Transmissive / IPS   |
| Surface Treatment     | Glare (6H)                            |
| Viewing Direction     | All round                             |
| Interface             | HDMI                                  |
| Driver IC             | EK73215+EK79001                       |
| Touch Panel           | CTP                                   |
| Touch Interface       | USB                                   |
| Touch Driver IC       | FT5826QSM                             |
| Bonding Type          | Tape Bonding                          |
| Operating Temperature | -20°C ~ +70°C                         |
| Storage Temperature   | -30°C ~ +80°C                         |
| ROHS                  | Compliant to RoHS 2.0                 |

## 2. Mechanical Specification

### 2.1 Mechanical Characteristics

| Item                 | Characteristic                     | Unit |
|----------------------|------------------------------------|------|
| Display Format       | 1024 x RGB x 600                   | Dots |
| Overall Dimensions   | 182.07 (W) x 117.6 (H) x 10.73 (D) | mm   |
| Active Area          | 154.21 (W) x 85.92 (H)             | mm   |
| Dot Pitch            | 0.1506 (W) x 0.1432 (H)            | mm   |
| Weight               | TBD                                | g    |
| IC Controller/Driver | EK73215+EK79001                    |      |

| NO. | Pin Name | Pin Name |          |
|-----|----------|----------|----------|
| 1   | RA_02+   | 1        | VBUS_SV  |
| 2   | GND      | 2        | RA_02+   |
| 3   | RA_02+   | 3        | RA_02+   |
| 4   | RA_02+   | 4        | RA_02+   |
| 5   | GND      | 5        | GND      |
| 6   | RA_02+   | 6        | RA_02+   |
| 7   | RA_02+   | 7        | RA_02+   |
| 8   | GND      | 8        | GND      |
| 9   | RA_02+   | 9        | RA_02+   |
| 10  | RA_02+   | 10       | RA_02+   |
| 11  | GND      | 11       | GND      |
| 12  | RA_02+   | 12       | RA_02+   |
| 13  | NC       | 13       | NC       |
| 14  | NC       | 14       | NC       |
| 15  | HDMI_SCL | 15       | HDMI_SCL |
| 16  | HDMI_SDA | 16       | HDMI_SDA |
| 17  | GND      | 17       | GND      |
| 18  | VBUS_SV  | 18       | VBUS_SV  |
| 19  | HPD      | 19       | HPD      |

## 3. Electrical Specification

### 3.1 Absolute Maximum Ratings

| Item                  | Symbol          | Min  | Max  | Unit | Note    |
|-----------------------|-----------------|------|------|------|---------|
| LCM Supply Voltage    | VBUS1           | -0.3 | +5.5 | V    | Micro 1 |
| CTP Supply Voltage    | VBUS2           | -0.3 | +5.5 | V    | Micro 2 |
| Operating Temperature | T <sub>OP</sub> | -20  | +70  | °C   | -       |
| Storage Temperature   | T <sub>ST</sub> | -30  | +80  | °C   | -       |

**Note 1:** When this module is used beyond the above absolute maximum ratings, permanent breakage of the module may occur. For normal operations, it is desirable to use this module under the conditions according to Section 3.2 “Electrical Characteristics”, to avoid malfunctioning.

**Note 2:** Background colour changes slightly depending on ambient temperature. This phenomenon is reversible.

**Note 3:** Please refer to item of RELIABILITY.

### 3.2 DC Electrical Characteristics

| Item                    | Symbol | Condition | Min | Typ. | Max | Unit | Note    |
|-------------------------|--------|-----------|-----|------|-----|------|---------|
| LCM Supply Voltage      | VBUS1  | -         | 4.8 | 5.0  | 5.2 | V    | Micro 1 |
| CTP Supply Voltage      | VBUS2  | -         | 4.8 | 5.0  | 5.2 | V    | Micro 2 |
| LCM Normal mode Current | IDD1   | -         | -   | 850  | -   | mA   | -       |
| CTP Normal mode Current | IDD1   | -         | -   | 20   | -   | mA   | -       |

### 3.3 Interface Pin Assignment

#### 3.3.1 HDMI PIN Define

| No. | Symbol   | I/O | Function                                       |
|-----|----------|-----|--|
| 1   | RX_D2+   | I   | HDMI Receiver channel 2 positive analog input. |
| 2   | GND      | P   | Ground.  |
| 3   | RX_D2-   | I   | HDMI Receiver channel 2 negative analog input. |
| 4   | RX_D1+   | I   | HDMI Receiver channel 1 positive analog input. |
| 5   | GND      | P   | Ground.  |
| 6   | RX_D1-   | I   | HDMI Receiver channel 1 negative analog input. |
| 7   | RX_D0+   | I   | HDMI Receiver channel 0 positive analog input. |
| 8   | GND      | P   | Ground.  |
| 9   | RX_D0-   | I   | HDMI Receiver channel 0 negative analog input. |
| 10  | RX_CLK+  | I   | HDMI Receiver clock positive analog input.     |
| 11  | GND      | P   | Ground.  |
| 12  | RX_CLK-  | I   | HDMI Receiver clock negative analog input.     |
| 13  | NC       | -   | No connection                                  |
| 14  | NC       | -   | No connection                                  |
| 15  | HDMI_SCL | I   | HDMI Receiver DDC data channel.                |
| 16  | HDMI_SDA | I/O | HDMI Receiver DDC clock channel.               |
| 17  | GND      | P   | Ground.  |
| 18  | VBUS_5V  | P   | HDMI Supply voltage (5.0V).                    |
| 19  | HPD      | O   | HDMI Receiver hot plug detect output           |



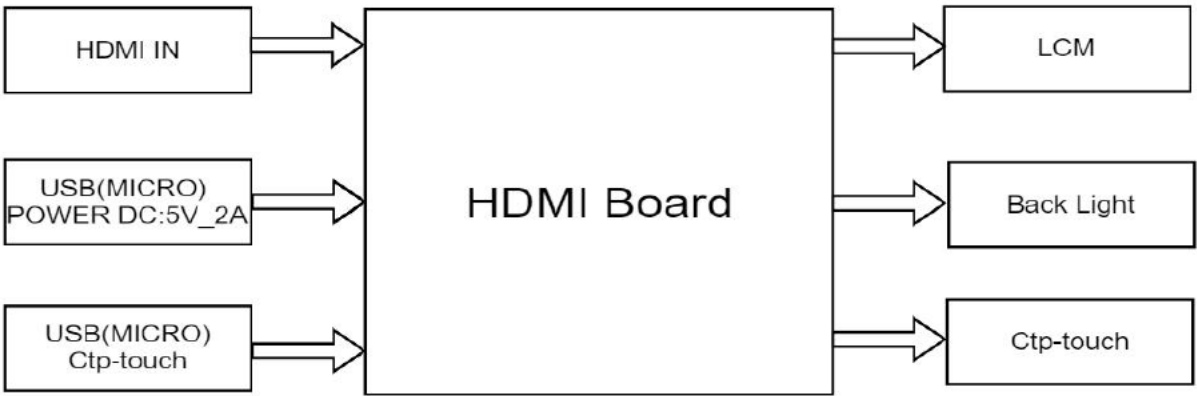
### 3.3.2 Micro1 USB Power PIN Define

| No. | Symbol  | I/O | Function                      |
|-----|---------|-----|-------------------------------|
| 1   | VBUS_5V | P   | LCM Supply voltage (5.0V,2A). |
| 2   | NC      | -   | No Connection.                |
| 3   | NC      | -   | No Connection.                |
| 4   | NC      | -   | No Connection.                |
| 5   | GND     | P   | Ground                        |

### 3.3.3 Micro2 USB CTP PIN Define

| No. | Symbol         | I/O | Function                        |
|-----|----------------|-----|---------------------------------|
| 1   | VBUS_5V        | P   | CTP Supply voltage (5.0V).      |
| 2   | USB_CTP_DN(D-) | I/O | USB data positive analog input. |
| 3   | USB_CTP_DP(D+) | I/O | USB data negative analog input. |
| 4   | NC             | -   | No Connection.                  |
| 5   | GND            | P   | Ground.                         |

3.4 Block Diagram

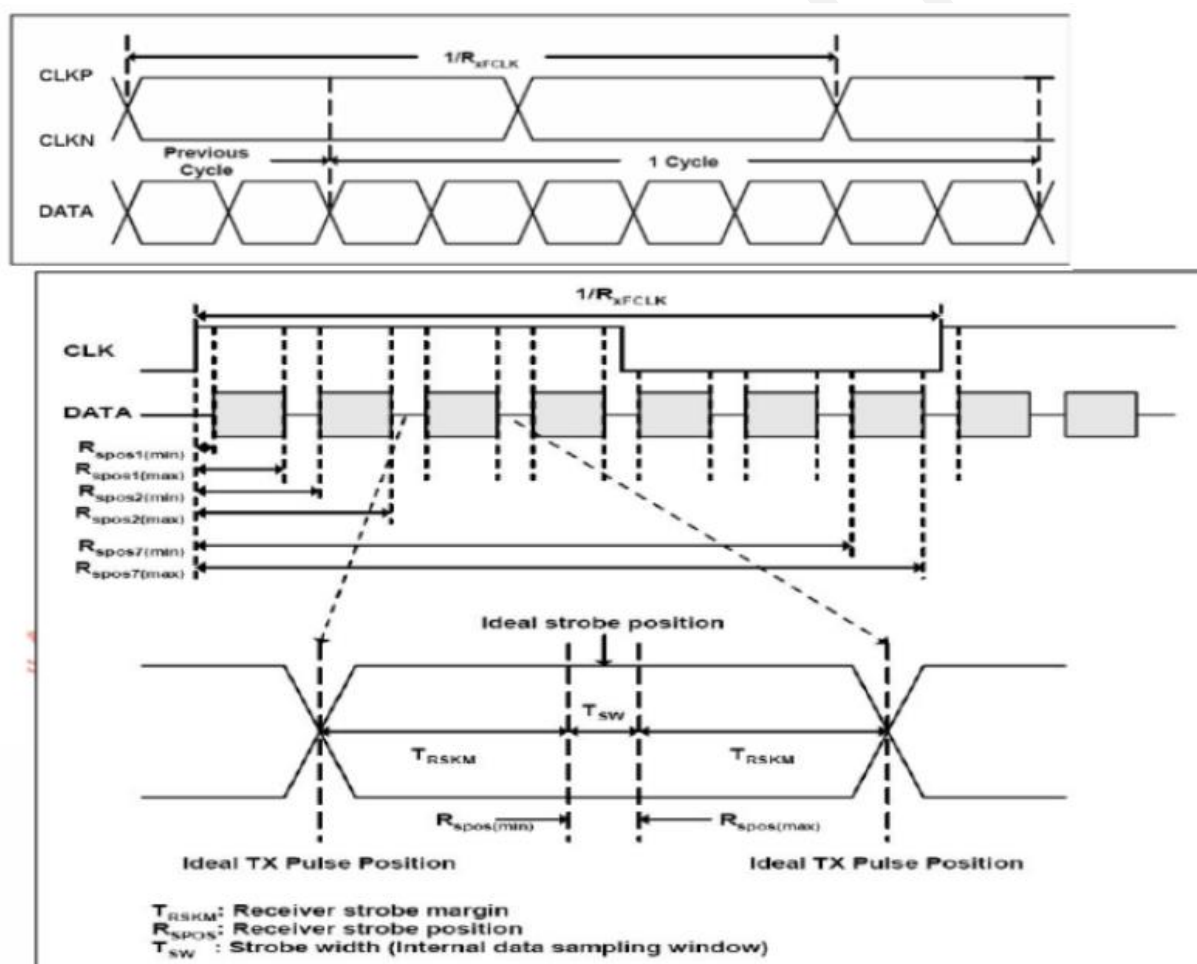


## 3.5 Timing Characteristics

### 3.5.1 AC Electrical Characteristics

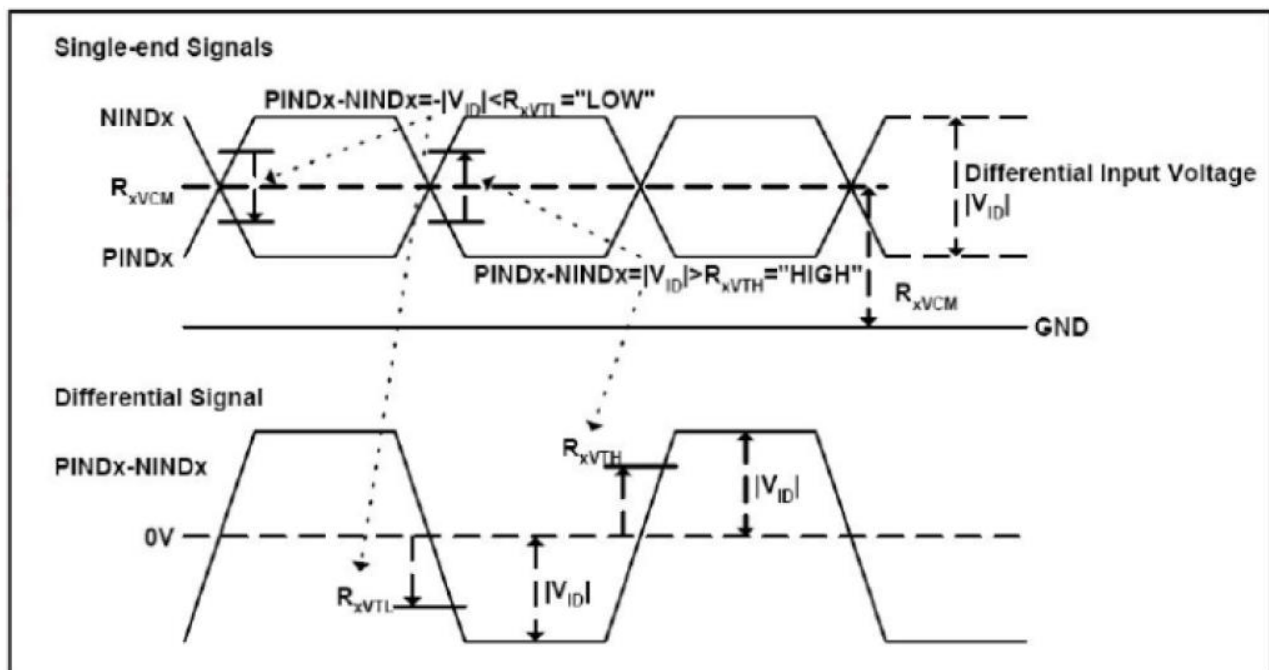
| Item                   | Symbol      | Min  | Typ.                   | Max  | Unit. |
|------------------------|-------------|------|------------------------|------|-------|
| Clock frequency        | $R_{XFCLK}$ | 40.8 | 51.2                   | 67.2 | MHz   |
| Input data skew margin | $T_{RSKM}$  | 500  | -                      | -    | ps    |
| Clock high time        | $T_{LVCH}$  | -    | $*4 / (7 * R_{XFCLK})$ | -    | ns    |
| Clock low time         | $T_{LVCL}$  | -    | $*3 / (7 * R_{XFCLK})$ | -    | ns    |

### 3.5.2 Input Clock and Data Timing Diagram



### 3.5.3 DC Electrical Characteristics

| Item                                      | Symbol      | Min          | Typ. | Max                | Unit.   | Note            |
|---|-------------|--------------|------|--------------------|---------|-----------------|
| Differential input high Threshold voltage | $R_{xVTH}$  | -            | -    | +0.1               | V       | $R_{xVCM}=1.2V$ |
| Differential input low Threshold voltage  | $R_{xVTL}$  | -0.1         | -    | -                  | V       |                 |
| Input voltage range (single-end)          | $R_{xVIN}$  | 0            | -    | 2.4                | V       |                 |
| Differential input common mode voltage    | $R_{xVCM}$  | $ V_{ID} /2$ | -    | $2.4 -  V_{ID} /2$ | V       |                 |
| Differential voltage                      | $ V_{ID} $  | 0.2          | -    | 0.6                | V       |                 |
| Differential input leakage current        | $R_{VxIIZ}$ | -10          | -    | +10                | $\mu A$ |                 |



3.5.4 Timing

| Item                    | Symbol | Min  | Typ. | Max  | Unit. | Note            |
|-------------------------|--------|------|------|------|-------|-----------------|
| Clock Frequency         | fclk   | 40.8 | 51.2 | 67.2 | MHz   | Frame rate=60Hz |
| Horizontal display area | thd    | 1024 |      |      | DCLK  |                 |
| HS period time          | th     | 1114 | 1344 | 1400 | DCLK  |                 |
| HS Blanking             | thb    | 90   | 320  | 376  | DCLK  |                 |
| Vertical display area   | tvd    | 600  |      |      | H     |                 |
| VS period time          | tv     | 610  | 635  | 800  | H     |                 |
| VS Blanking             | thb    | 10   | 35   | 200  | H     |                 |

## 4. Electrical Specification Touch

### 4.1 Electrical Characteristics

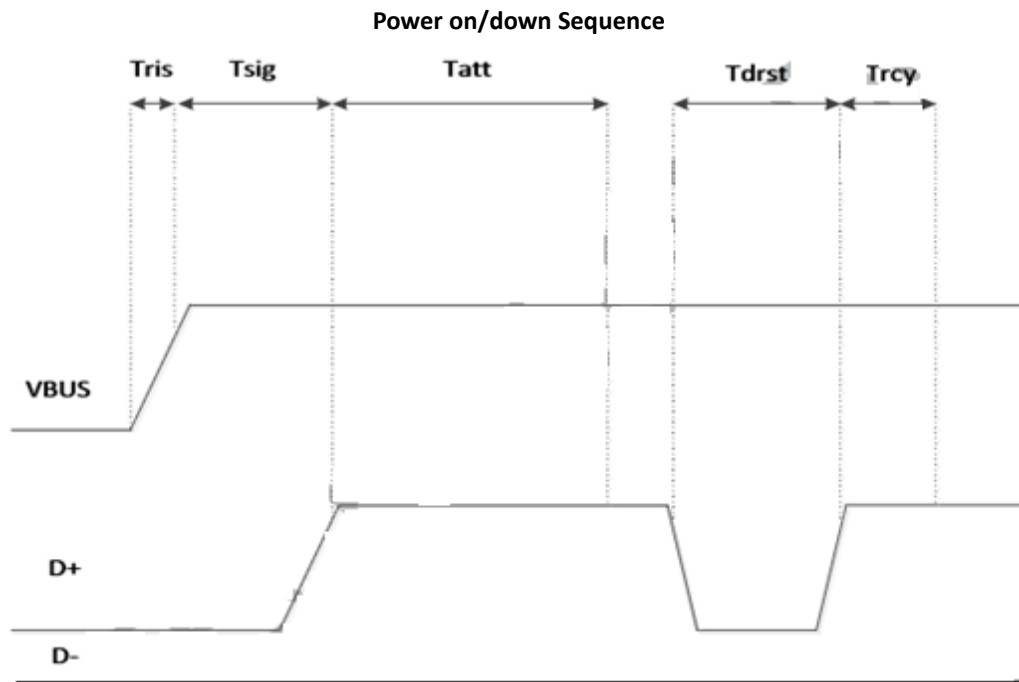
#### 4.1.1 Absolute Maximum Rating

| Item                  | Symbol  | Min. | Typ. | Max. | Unit | Note |
|-----------------------|---------|------|------|------|------|------|
| Power Supply Voltage  | VBUS_5V | -0.3 | -    | 5.5  | V    | 1, 2 |
| Operating Temperature | Top     | -20  | -    | +70  | °C   | 1    |
| Storage Temperature   | Tst     | -30  | -    | +80  | °C   | 1    |

#### 4.1.2 Power Consumption

| IC     | Interface | Active (mA) | Monitor (mA) | Sleep (uA) |
|--------|-----------|-------------|--------------|------------|
| FT5C26 | I2C       | 19.16       | 9.88         | 35.4       |
|        | I2C-HID   | 19.02       | 9.66         | 188.5      |
|        | USB-HID   | 20.73       | 10.27        | 187.5      |
| FT5B26 | I2C       | 17.20       | 8.63         | 35.4       |
|        | I2C-HID   | 17.21       | 8.67         | 188.5      |
|        | USB-HID   | 18.77       | 9.48         | 187.5      |
| FT5926 | I2C       | 15.12       | 7.77         | 35.4       |
|        | I2C-HID   | 15.01       | 7.58         | 188.5      |
|        | USB-HID   | 16.68       | 8.56         | 187.5      |
| FT5826 | I2C       | 12.97       | 6.85         | 35.4       |
|        | I2C-HID   | 12.91       | 6.78         | 188.5      |
|        | USB-HID   | 14.55       | 7.44         | 187.5      |

### 4.1.3 Power On/Reset Sequence



## USB Power on/Reset Sequence Items

| Item  | Description   | Min | Max | Unit |
|-------|---|-----|-----|------|
| Tris  | Rise time from 0.1VDD to 0.9VDD   | -   | 5   | ms   |
| Tsig  | Time required for the device internal power rail to stabilize and for D+ or D- to reach VIH (min)                           | 100 | -   | ms   |
| Tatt  | Time ensures that the electrical and mechanical connection is stable before software attempts to reset the attached device. | 100 | -   | ms   |
| Tdrst | Time hubs drive reset to a device   | 10  | -   | ms   |
| Trcy  | The USB System Software guarantees a minimum of 10ms for reset recovery   | 10  | -   | ms   |

#### 4.1.4 USB

USB is configured in device mode, and a Full speed USB function is supported. The USB function controller is as follows.

- USB 2.01-compliant composite device, full speed (12Mbps)
- Require external crystal (12MHz)
- Support USB LPM L1
- Integrated transceiver.
- Support USB-HID protocol for Win8.
- Vendor ID: 0x2808

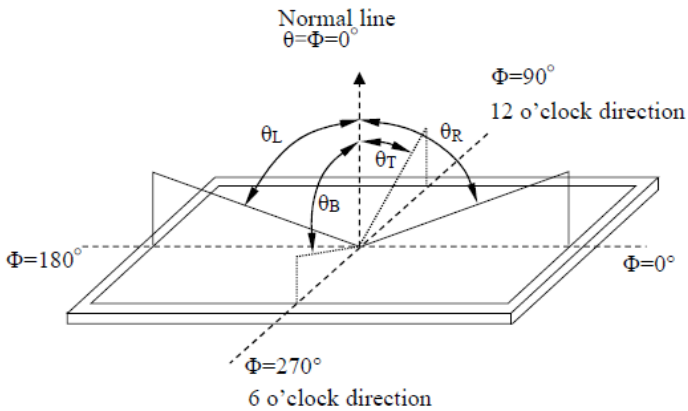
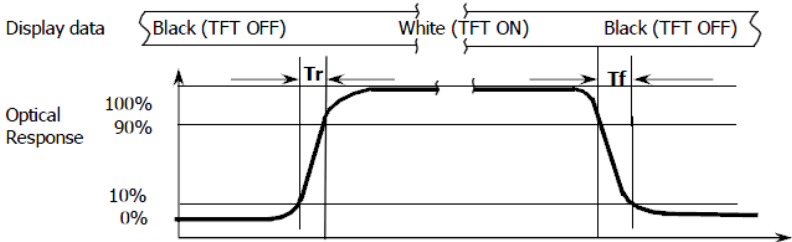
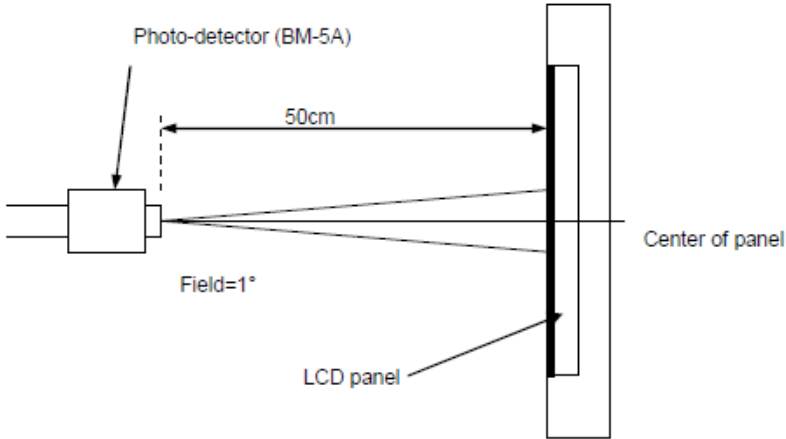


## 5. Optical Specification

### 5.1 Optical Characteristics

| Characteristics     |       | Symbol        | Conditions                                      | Min    | Typ.   | Max    | Unit              | Note |
|---------------------|-------|---------------|---|--------|--------|--------|-------------------|------|
| Contrast Ratio      |       | CR            | $\theta = 0^{\circ}$<br>Normal<br>viewing angle | 600    | 800    | -      | -                 | 1    |
| Response time       |       | Rising        |   | -      | 25     | 40     | msec              | 2    |
|                     |       | Falling       |   |        |        |        |                   |      |
| Color Gamut         |       | S (%)         |   | 45     | 50     | -      | %                 | -    |
| Viewing Angle       | Left  | $\theta_{x-}$ | CR > 10   | -      | 85     | -      | -                 | -    |
|                     | Right | $\theta_{x+}$ |   | -      | 85     | -      |                   |      |
|                     | Up    | $\theta_{y+}$ |   | -      | 85     | -      |                   |      |
|                     | Down  | $\theta_{y-}$ |   | -      | 85     | -      |                   |      |
| Colour Chromaticity | Red   | Rx            | $\theta = 0^{\circ}$<br>Normal<br>viewing angle | 0.5668 | 0.5868 | 0.6068 | -                 | -    |
|                     |       | Ry            |   | 0.3305 | 0.3505 | 0.3705 |                   |      |
|                     | Green | Gx            |   | 0.2880 | 0.3080 | 0.3280 |                   |      |
|                     |       | Gy            |   | 0.5230 | 0.5430 | 0.5630 |                   |      |
|                     | Blue  | Bx            |   | 0.1338 | 0.1538 | 0.1738 |                   |      |
|                     |       | By            |   | 0.0738 | 0.0938 | 0.1138 |                   |      |
|                     | White | Wx            |   | 0.2477 | 0.2877 | 0.3277 |                   |      |
|                     |       | Wy            |   | 0.2672 | 0.3072 | 0.3472 |                   |      |
| Luminance           |       | Lv            | -   | 550    | 600    | -      | cd/m <sup>2</sup> | -    |
| Uniformity          |       | Avg           | -   | TBD    | -      | -      | %                 | -    |

Measuring Condition: in dark room, at ambient temperature = 25±2°C, 15 min. warm-up time

| Note | Item  | Test method   |
|------|---|---|
| 1    | Definition of Viewing Angle                   |   |
| 2    | Definition of Contrast Ratio (CR)             | Measured at the center point of panel<br><br>$\text{Contrast ratio (CR)} = \frac{\text{Luminance measured when LCD is at "white state"}}{\text{Luminance measured when LCD is at "black state"}}$ |
| 3    | Definition of Response Time ( $T_R$ , $T_F$ ) |    |
| 4    | Definition of Optical Measurement Setup       |   |

## 6. Packaging

TBD

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## 7. Quality Assurance Specification

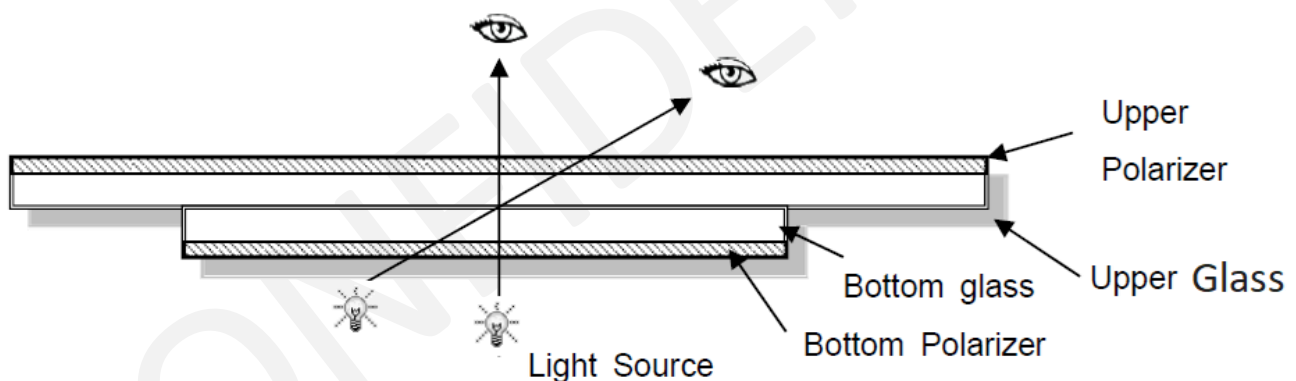
### 7.1 Conformity

The performance, function and reliability of the shipped products conform to the Product Specification.

### 7.2 Environment Required

Customer's test & measurement are required to be conducted under the following conditions:

|   |  |
|---|--|
| Temperature:  | $25 \pm 5^{\circ}\text{C}$               |
| Humidity:   | $65\% \pm 10\% \text{ RH}$               |
| Viewing Angle:  | Normal Viewing Angle                     |
| Illumination:   | Single fluorescent lamp (300 to 700 Lux) |
| Viewing distance:   | 30 - 50cm                                |
| Finger glove (or finger cover) must be worn by the inspector. |  |
| Inspection table or jig must be anti-electrostatic.           |  |

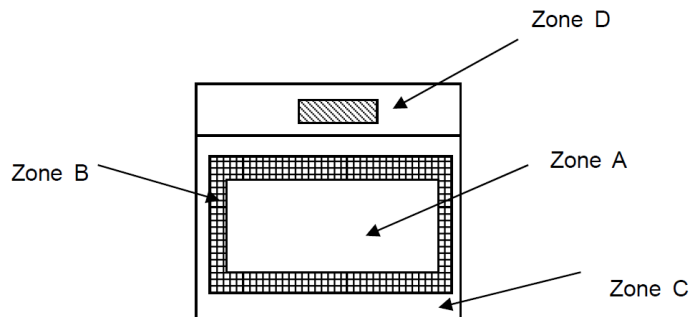


### 7.3 Delivery Assurance

#### 7.3.1 Delivery Inspection Standards

Class II, Normal Inspection, MIL-STD-105E

### 7.3.2 Zone Definition



Zone A: Effective Viewing Area (Character or Digit can be seen)

Zone B: Viewing Area except Zone A

Zone C: Outside (Zone A + Zone B) Area which cannot be seen after assembly by customer.

Zone D: IC Bonding Area

**Note:** Generally, visual defects in Zone C can be ignored when it doesn't affect product function or appearance after assembly by customer

### 7.3.3 Criteria & Acceptable Quality Level

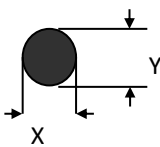
| Partition | AQL  | Definition                              |
|-----------|------|---|
| Major     | 0.65 | Defects in Pattern Check (Display On)   |
| Minor     | 1.5  | Defects in Cosmetic Check (Display Off) |




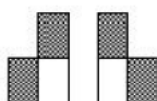
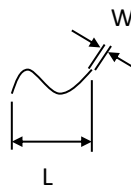
LCD: Liquid Crystal Display, TP: Touch Panel, LCM: Liquid Crystal Module

| No. | Items                | Criteria   | Classification of defects |
|-----|----------------------|--|---------------------------|
| 1   | Functional defects   | 1) No display, open or miss line<br>2) Display abnormally<br>3) Backlight no lighting, abnormal lighting.<br>4) TP no function | Major                     |
| 2   | Missing              | Missing component  |                           |
| 3   | Outline dimension    | Overall outline dimension beyond the drawing is not allowed  |                           |
| 4   | Color tone           | Color unevenness, refer to limited sample  | Minor                     |
| 5   | Spot Line Defect     | Light dot, Dim spot, Polarizer Bubble;<br>Polarizer accidented spot.   |                           |
| 6   | Soldering Appearance | Good soldering, peeling off is not allowed.  |                           |
| 7   | LCD/Polarizer/CTP    | Black/White spot/line, scratch, crack, etc.  |                           |

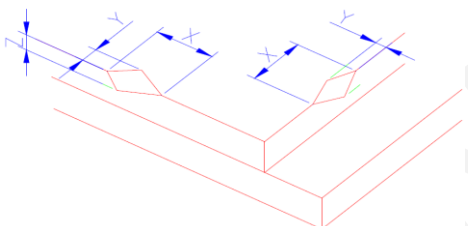
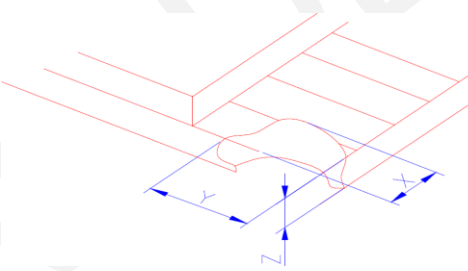
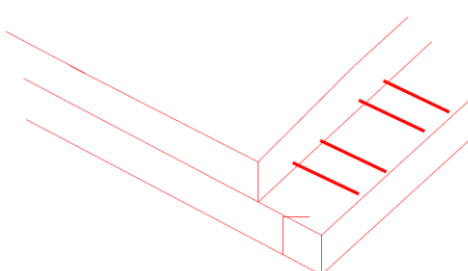
## 7.3.4 Criteria &amp; Classification

Units: mm

| Class      | Item            | Criteria   |                                  |                     |               |            |        |            |                 |                         |                 |            |          |                                |                                  |  |  |                               |                                  |  |  |                     |   |  |  |
|------------|-----------------|--|----------------------------------|---------------------|---------------|------------|--------|------------|-----------------|-------------------------|-----------------|------------|----------|--------------------------------|----------------------------------|--|--|-------------------------------|----------------------------------|--|--|---------------------|---|--|--|
| Minor      | Spot Defect     | Round type: as per following drawing, $\varnothing = (X+Y)/2$ <div></div>   |                                  |                     |               |            |        |            |                 |                         |                 |            |          |                                |                                  |  |  |                               |                                  |  |  |                     |   |  |  |
|            |                 | 1) Light Dot (LCD/TP/Polarizer black/white spot, pinhole, stain, etc.)   |                                  |                     |               |            |        |            |                 |                         |                 |            |          |                                |                                  |  |  |                               |                                  |  |  |                     |   |  |  |
|            |                 | <table><tr><th rowspan="2">Size\Zone</th><th colspan="3">Acceptable Quantity</th></tr><tr><th>A</th><th>B</th><th>C</th></tr><tr><td><math>\varnothing \leq 0.10</math></td><td colspan="3">Ignore</td></tr><tr><td><math>0.10 &lt; \varnothing \leq 0.25</math></td><td colspan="3">3 (distance <math>\geq 10\text{mm}</math>)</td></tr><tr><td><math>0.25 &lt; \varnothing \leq 0.4</math></td><td colspan="3">2 (distance <math>\geq 10\text{mm}</math>)</td></tr><tr><td><math>0.4 &lt; \varnothing</math></td><td colspan="3">0</td></tr></table> | Size\Zone                        | Acceptable Quantity |               |            | A      | B          | C               | $\varnothing \leq 0.10$ | Ignore          |            |          | $0.10 < \varnothing \leq 0.25$ | 3 (distance $\geq 10\text{mm}$ ) |  |  | $0.25 < \varnothing \leq 0.4$ | 2 (distance $\geq 10\text{mm}$ ) |  |  | $0.4 < \varnothing$ | 0 |  |  |
|            |                 | Size\Zone  |                                  | Acceptable Quantity |               |            |        |            |                 |                         |                 |            |          |                                |                                  |  |  |                               |                                  |  |  |                     |   |  |  |
|            |                 |  | A                                | B                   | C             |            |        |            |                 |                         |                 |            |          |                                |                                  |  |  |                               |                                  |  |  |                     |   |  |  |
|            |                 | $\varnothing \leq 0.10$  | Ignore                           |                     |               |            |        |            |                 |                         |                 |            |          |                                |                                  |  |  |                               |                                  |  |  |                     |   |  |  |
|            |                 | $0.10 < \varnothing \leq 0.25$   | 3 (distance $\geq 10\text{mm}$ ) |                     |               |            |        |            |                 |                         |                 |            |          |                                |                                  |  |  |                               |                                  |  |  |                     |   |  |  |
|            |                 | $0.25 < \varnothing \leq 0.4$  | 2 (distance $\geq 10\text{mm}$ ) |                     |               |            |        |            |                 |                         |                 |            |          |                                |                                  |  |  |                               |                                  |  |  |                     |   |  |  |
|            |                 | $0.4 < \varnothing$  | 0                                |                     |               |            |        |            |                 |                         |                 |            |          |                                |                                  |  |  |                               |                                  |  |  |                     |   |  |  |
|            |                 | 2) Dim Spot (LCD/TP/Polarizer dim dot, light leakage, dark spot, etc.)   |                                  |                     |               |            |        |            |                 |                         |                 |            |          |                                |                                  |  |  |                               |                                  |  |  |                     |   |  |  |
|            |                 | <table><tr><th rowspan="2">Size\Zone</th><th colspan="3">Acceptable Quantity</th></tr><tr><th>A</th><th>B</th><th>C</th></tr><tr><td><math>\varnothing \leq 0.15</math></td><td colspan="3">Ignore</td></tr><tr><td><math>0.15 &lt; \varnothing \leq 0.25</math></td><td colspan="3">3 (distance <math>\geq 10\text{mm}</math>)</td></tr><tr><td><math>0.25 &lt; \varnothing \leq 0.4</math></td><td colspan="3">2 (distance <math>\geq 10\text{mm}</math>)</td></tr><tr><td><math>0.4 &lt; \varnothing</math></td><td colspan="3">0</td></tr></table> | Size\Zone                        | Acceptable Quantity |               |            | A      | B          | C               | $\varnothing \leq 0.15$ | Ignore          |            |          | $0.15 < \varnothing \leq 0.25$ | 3 (distance $\geq 10\text{mm}$ ) |  |  | $0.25 < \varnothing \leq 0.4$ | 2 (distance $\geq 10\text{mm}$ ) |  |  | $0.4 < \varnothing$ | 0 |  |  |
|            |                 | Size\Zone  |                                  | Acceptable Quantity |               |            |        |            |                 |                         |                 |            |          |                                |                                  |  |  |                               |                                  |  |  |                     |   |  |  |
|            |                 |  | A                                | B                   | C             |            |        |            |                 |                         |                 |            |          |                                |                                  |  |  |                               |                                  |  |  |                     |   |  |  |
|            |                 | $\varnothing \leq 0.15$  | Ignore                           |                     |               |            |        |            |                 |                         |                 |            |          |                                |                                  |  |  |                               |                                  |  |  |                     |   |  |  |
|            |                 | $0.15 < \varnothing \leq 0.25$   | 3 (distance $\geq 10\text{mm}$ ) |                     |               |            |        |            |                 |                         |                 |            |          |                                |                                  |  |  |                               |                                  |  |  |                     |   |  |  |
|            |                 | $0.25 < \varnothing \leq 0.4$  | 2 (distance $\geq 10\text{mm}$ ) |                     |               |            |        |            |                 |                         |                 |            |          |                                |                                  |  |  |                               |                                  |  |  |                     |   |  |  |
|            |                 | $0.4 < \varnothing$  | 0                                |                     |               |            |        |            |                 |                         |                 |            |          |                                |                                  |  |  |                               |                                  |  |  |                     |   |  |  |
|            |                 | 3) Polarizer Accidented Spot   |                                  |                     |               |            |        |            |                 |                         |                 |            |          |                                |                                  |  |  |                               |                                  |  |  |                     |   |  |  |
|            |                 | <table><tr><th rowspan="2">Size\Zone</th><th colspan="3">Acceptable Quantity</th></tr><tr><th>A</th><th>B</th><th>C</th></tr><tr><td><math>\varnothing \leq 0.2</math></td><td colspan="3">Ignore</td></tr><tr><td><math>0.2 &lt; \varnothing \leq 0.5</math></td><td colspan="3">2 (distance <math>\geq 10\text{mm}</math>)</td></tr><tr><td><math>0.5 &lt; \varnothing</math></td><td colspan="3">0</td></tr></table>  | Size\Zone                        | Acceptable Quantity |               |            | A      | B          | C               | $\varnothing \leq 0.2$  | Ignore          |            |          | $0.2 < \varnothing \leq 0.5$   | 2 (distance $\geq 10\text{mm}$ ) |  |  | $0.5 < \varnothing$           | 0                                |  |  |                     |   |  |  |
|            |                 | Size\Zone  |                                  | Acceptable Quantity |               |            |        |            |                 |                         |                 |            |          |                                |                                  |  |  |                               |                                  |  |  |                     |   |  |  |
|            |                 |  | A                                | B                   | C             |            |        |            |                 |                         |                 |            |          |                                |                                  |  |  |                               |                                  |  |  |                     |   |  |  |
|            |                 | $\varnothing \leq 0.2$   | Ignore                           |                     |               |            |        |            |                 |                         |                 |            |          |                                |                                  |  |  |                               |                                  |  |  |                     |   |  |  |
|            |                 | $0.2 < \varnothing \leq 0.5$   | 2 (distance $\geq 10\text{mm}$ ) |                     |               |            |        |            |                 |                         |                 |            |          |                                |                                  |  |  |                               |                                  |  |  |                     |   |  |  |
|            |                 | $0.5 < \varnothing$  | 0                                |                     |               |            |        |            |                 |                         |                 |            |          |                                |                                  |  |  |                               |                                  |  |  |                     |   |  |  |
|            |                 | 4) Pixel Bad Points (light dot, Dim dot, color dot)  |                                  |                     |               |            |        |            |                 |                         |                 |            |          |                                |                                  |  |  |                               |                                  |  |  |                     |   |  |  |
|            |                 | <table><tr><th>Item</th><th>Zone A</th><th>Acceptable Qt</th></tr><tr><td rowspan="3">Bright dot</td><td>Random</td><td><math>N \leq 2</math></td></tr><tr><td>2 dots adjacent</td><td><math>N \leq 0</math></td></tr><tr><td>3 dots adjacent</td><td><math>N \leq 0</math></td></tr><tr><td>Dark dot</td><td>Random</td><td><math>N \leq 3</math></td></tr></table>   | Item                             | Zone A              | Acceptable Qt | Bright dot | Random | $N \leq 2$ | 2 dots adjacent | $N \leq 0$              | 3 dots adjacent | $N \leq 0$ | Dark dot | Random                         | $N \leq 3$                       |  |  |                               |                                  |  |  |                     |   |  |  |
|            |                 | Item   | Zone A                           | Acceptable Qt       |               |            |        |            |                 |                         |                 |            |          |                                |                                  |  |  |                               |                                  |  |  |                     |   |  |  |
| Bright dot | Random          | $N \leq 2$   |                                  |                     |               |            |        |            |                 |                         |                 |            |          |                                |                                  |  |  |                               |                                  |  |  |                     |   |  |  |
|            | 2 dots adjacent | $N \leq 0$   |                                  |                     |               |            |        |            |                 |                         |                 |            |          |                                |                                  |  |  |                               |                                  |  |  |                     |   |  |  |
|            | 3 dots adjacent | $N \leq 0$   |                                  |                     |               |            |        |            |                 |                         |                 |            |          |                                |                                  |  |  |                               |                                  |  |  |                     |   |  |  |
| Dark dot   | Random          | $N \leq 3$   |                                  |                     |               |            |        |            |                 |                         |                 |            |          |                                |                                  |  |  |                               |                                  |  |  |                     |   |  |  |

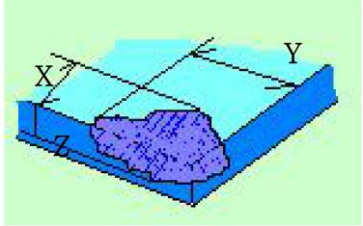
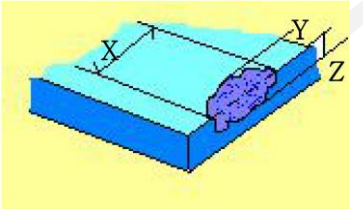
| Class     | Item  | Criteria   |  |     |   |
|-----------|---|--|--|-----|---|
|           |   |  | 2 dots adjacent  | N≤0 |   |
|           |   |  | 3 dots adjacent  | N≤0 |   |
|           |   | Distance   | 1. Minimum Distance<br>Between Bright dots.<br>2. Minimum Distance<br>Between dark dots<br>3. Minimum Distance<br>Between dark and bright dot. | 5mm |   |
|           |   | Total bright and dark dot  |  | N≤4 |   |
|           |   | Note:<br>A) Bright dot : Dots appear bright and unchanged in size in which LCD panel is displaying under black pattern.<br>B) Dark dot: Dots appear dark and unchanged in size in which LCD panel is displaying under pure red, green, blue picture.<br>C) 2 dot adjacent = 1 pair = 2 dots<br>Picture:  |  |     |   |
|           |   | <div><div></div><div></div></div> <div><div>2 dot adjacent</div><div>2 dot adjacent</div></div> <div><div></div><div></div></div> <div><div>2 dot adjacent (vertical)</div><div>2 dot adjacent (slant)</div></div> |  |     |   |
|           |   | 5) Polarizer Bubble  |  |     |   |
|           |   | Size\Zone  | Acceptable Quantity  |     |   |
|           |   |  | A  | B   | C |
|           |   | Ø≤0.2  | Ignore   |     |   |
| 0.2<Ø≤0.4 | 2 (distance ≥ 10mm)                               |  |  |     |   |
| 0.4<Ø     | 0   |  |  |     |   |
| Minor     | Line Defect<br>(LCD/TP/<br>Polarizer<br>backlight | Line type: as per following drawing<br>  |  |     |   |



| Class      | Item                              | Criteria  |              |                     |   |        |
|------------|-----------------------------------|---|--------------|---------------------|---|--------|
|            | black/white line, scratch, stain) | Width   | Length       | Acceptable quantity |   |        |
|            |                                   |   |              | A                   | B | C      |
|            |                                   | $W \leq 0.05$   | Ignore       | Ignore              |   | Ignore |
|            |                                   | $0.05 < W \leq 0.06$  | $L \leq 5.0$ | $N \leq 3$          |   |        |
|            |                                   | $0.06 < W \leq 0.08$  | $L \leq 4.0$ | $N \leq 2$          |   |        |
| $0.08 < W$ | Define as spot defect             |   |              |                     |   |        |
| Minor      | LCD Crack/Broken                  | <p>Symbols:<br/>X: Length, Y: Width, Z: Height, L: Length of ITO, T: Height of LCD</p> <p>1) The edge of LCD broken: <math>X \leq 3.0\text{mm}</math>; <math>Y &lt; \text{Inner border line of the seal}</math>; <math>Z \leq T</math></p>  <p>2) LCD corner broken: <math>X \leq 3.0\text{mm}</math>; <math>Y \leq L</math>; <math>Z \leq T</math></p>  |              |                     |   |        |
| Major      | LCD Crack                         | <p>The LCD with extensive crack is not acceptable.</p>   |              |                     |   |        |
| Major      | Electronic Components SMT         | Not allow missing parts, solderless connection, cold solder joint, mismatch, The positive and negative polarity opposite  |              |                     |   |        |

| Class | Item                        | Criteria   |
|-------|-----------------------------|--|
| Minor | Display colour & Brightness | 1) Colour: Measuring the colour coordinates in accordance with the datasheet or samples.<br>2) Brightness: Measuring the brightness of white screen in accordance with the datasheet or samples. |
|       | LCD Mura                    | By 5% ND filter invisible.   |

| Class | Item        | Criteria   |
|-------|-------------|--|
| Minor | CTP Related | 1) CTP Cover Sensor Accidented Black/White Spot                  |
|       |             | Size\Zone  |
|       |             | Acceptable Qty   |
|       |             | A B C  |
|       |             | $\varnothing \leq 0.15$ Ignore                                   |
|       |             | $0.15 < \varnothing \leq 0.25$ 4 ( distance $\geq 10\text{mm}$ ) |
|       |             | $0.25 < \varnothing \leq 0.35$ 3 ( distance $\geq 10\text{mm}$ ) |
|       |             | $0.35 < \varnothing$ 1   |
|       |             | 2) CTP Cover Scratch   |
|       |             | Width Length   |
|       |             | Acceptable Qty   |
|       |             | A B C  |
|       |             | $\varnothing \leq 0.05$ Ignore                                   |
|       |             | $0.05 < W \leq 0.06$ $L \leq 4.0$ $N \leq 3$                     |
|       |             | $0.06 < W \leq 0.08$ $L \leq 3.0$ $N \leq 2$                     |
|       |             | $0.08 < W$ Define as spot defect                                 |
|       |             | 3) CTP Cover Pinhole / Lack of Ink                               |
|       |             | Size\Zone  |
|       |             | Acceptable Qty   |
|       |             | C  |
|       |             | $\varnothing \leq 0.2$ Ignore                                    |
|       |             | $0.2 < \varnothing \leq 0.3$ 4 ( distance $\geq 10\text{mm}$ )   |
|       |             | $0.3 < \varnothing \leq 0.4$ 2 ( distance $\geq 10\text{mm}$ )   |
|       |             | $0.4 < \varnothing$ 0  |
|       |             | 4) CTP Bonding Bubble / Accidented Spot                          |
|       |             | Size\Zone  |
|       |             | Acceptable Qty   |
|       |             | A B  |
|       |             | $\varnothing \leq 0.1$ Ignore                                    |
|       |             | $0.1 < \varnothing \leq 0.2$ 3 ( distance $\geq 10\text{mm}$ )   |

| Class | Item        | Criteria  |   |
|-------|-------------|---|---|
|       |             | $0.2 < \varnothing \leq 0.3$  | 2 (distance $\geq 10\text{mm}$ )  |
|       |             | $0.3 < \varnothing$   | 0   |
|       |             | Assembly Deflection: beyond the edge of backlight $\leq 0.2\text{mm}$   |   |
| Minor | CTP Related | TP cover broken X: length, Y: width, Z: height<br>$X \leq 0.5\text{mm}$ ; $Y \leq 0.5\text{mm}$ ; $Z < \text{Cover thickness}$<br>*Circuitry broken is not allowed. |  |
|       |             | TP cover broken X: length, Y: width, Z: height<br>$X \leq 0.3\text{mm}$ ; $Y \leq 0.3\text{mm}$ ; $Z < \text{LCD thickness}$<br>*Circuitry broken is not allowed.   |  |

Criteria (functional items)

| No. | Item                  | Criteria    |
|-----|-----------------------|-------------|
| 1   | No display            | Not allowed |
| 2   | Missing segment       |             |
| 3   | Short circuit         |             |
| 4   | Backlight no lighting |             |
| 5   | CTP no function       |             |

## 7.4 Dealing with Customer Complaints

### 7.4.1 Non-conforming Analysis

Purchaser should supply Densitron with detailed data of non-conforming sample.

### 7.4.2 Handling of Non-conforming Displays

If any non-conforming displays are found during customer acceptance inspection which Densitron is clearly responsible for, return them to Densitron.

Both Densitron and customer should analyse the reason and discuss the handling of non-conforming displays when the reason is not clear.

Equally, both sides should discuss and come to agreement for issues pertaining to modification of Densitron quality assurance standard.

## 8. Reliability Specification

### 8.1 Reliability Tests

| Test Item                     | Test Condition  | Inspection after Test   |
|-------------------------------|---|---|
| High Temperature Operating    | 70°C, 96H   | Inspection after<br>2~4hours<br>storage at room<br>temperature, the<br>sample shall be free<br>from defects:<br>1.Air bubble in the LCD;<br>2.Non-display;<br>3.Missing<br>segments/line;<br>4.Glass crack;<br>5.Current IDD is twice<br>higher than initial value. |
| Low Temperature Operating     | -20°C, 96HR   |   |
| High Temperature Storage      | 80°C, 96HR  |   |
| Low Temperature Storage       | -30°C, 96HR   |   |
| Thermal Shock (Non-operation) | -10°C, 30 min ↔ +60°C, 30 min,<br>Change time: 5min 20CYC.  |   |
| ESD Test                      | C=150pF, R=330, 5points/panel<br>Air: ±8KV, 5times; Contact: ±6KV, 5 times;<br>(Environment: 15°C~35°C, 30%~60%).                                 |   |
| Vibration (Non-operation)     | Frequency range: 10~55Hz, Stroke: 1.5mm<br>Sweep: 10Hz~55Hz~10Hz 2 hours for each direction of<br>X.Y.Z. (6 hours for total) (Package condition). |   |
| Box Drop Test                 | 1 Corner 3 Edges 6 faces, 80 cm (MEDIUM BOX)  |   |

**Note 1:** The test samples should be applied to only one test item.

**Note 2:** Sample size for each test item is 5~10pcs.

**Note 3:** For Damp Proof Test, Pure water (Resistance > 10MΩ) should be used.

**Note 4:** In case of malfunction defect caused by ESD damage, if it would be recovered to normal state after resetting, it would be judged as a good part.

**Note 5:** Failure Judgment Criterion: Basic Specification, Electrical Characteristic, Mechanical Characteristic, Optical Characteristic.

**Note 6:** The color fading mura of polarizing filter should not care.

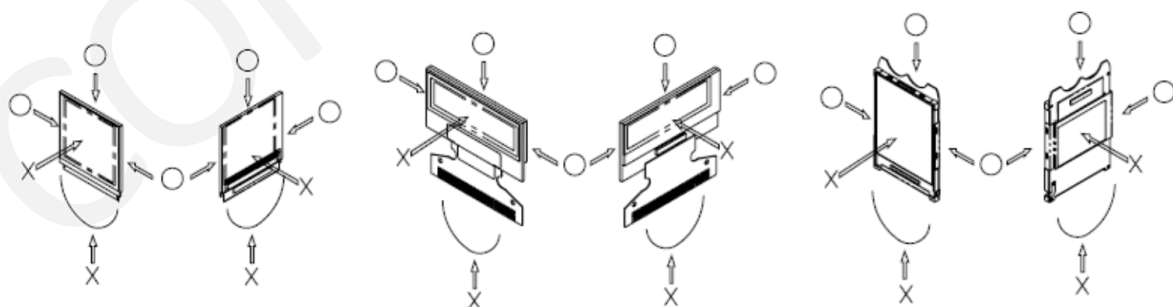
#### 8.1.1 Inspection Check Standard

After the completion of the described reliability test, the samples are to be left at room temperature for 4 hrs prior to conducting the inspection check at 25±5 °C, 65±10% RH.

## 9. Handling Precautions

### 9.1 Handling Precautions

- 1) Since the display panel is being made of glass, do not apply mechanical impacts such as dropping from a high position.
- 2) If the display panel is broken by some accident and the internal organic substance leaks out, be careful not to inhale nor lick the organic substance.
- 3) If the liquid crystal touches your skin or clothes, wash it off immediately using soap and plenty of water
- 4) If pressure is applied to the display surface or its neighbourhood of the display module, the cell structure may be damaged and be careful not to apply pressure to these sections.
- 5) The polarizer covering the surface of the display module is soft and easily scratched. Please be careful when handling the display module.
- 6) When the surface of the polarizer of the display module has soil, clean the surface. It takes advantage of by using following adhesion tape.
  - a. Scotch Mending Tape No. 810 or an equivalent
  - b. Never try to breathe upon the soiled surface nor wipe the surface using cloth containing solvent such as ethyl alcohol, since the surface of the polarizer will become cloudy.
  - c. Also, pay attention that the following liquid and solvent may spoil the polarizer:
    - Water
    - Ketone
    - Aromatic Solvents
- 7) Hold the display module very carefully when placing it into the system housing. Do not apply excessive stress or pressure to display module. And, do not over bend the film with electrode pattern layouts. These stresses will



influence the display performance. Also, secure sufficient rigidity for the outer cases.

- 8) Do not apply stress to the LSI chips and the surrounding molded sections.
- 9) Do not disassemble nor modify the display module.
- 10) Do not apply input signals while the logic power is off.
- 11) Pay sufficient attention to the working environments when handing display modules to prevent occurrence of element breakage accidents by static electricity.

- a. Be sure to make human body grounding when handling display modules.
  - b. Be sure to ground tools to use or assembly such as soldering irons.
  - c. To suppress generation of static electricity, avoid carrying out assembly work under dry environments.
  - d. Protective film is being applied to the surface of the display panel of the display module. Be careful since static electricity may be generated when exfoliating the protective film.
- 12) Protection film is being applied to the surface of the display panel and removes the protection film before assembling it. If the display module has been stored for a long period of time, residue adhesive material of the protection film may remain on the surface of the display panel after removed of the film. In such case, remove the residue material by the method introduced in the above Section 5).
- 13) If electric current is applied when the display module is being dewed or when it is placed under high humidity environments, the electrodes may be corroded and be careful to avoid the above.

## 9.2 Storage Precautions

- 1) When storing display modules, put them in static electricity preventive bags avoiding exposure to direct sun light nor to lights of fluorescent lamps, etc. and, also, avoiding high temperature and high humidity environments or low temperature (less than 0°C) environments. (We recommend you store these modules in the packaged state when they were shipped from Densitron) At that time, be careful not to let water drops adhere to the packages or bags nor let dewing occur with them.
- 2) If electric current is applied when water drops are adhering to the surface of the display module, when the display module is being dewed or when it is placed under high humidity environments, the electrodes may be corroded and be careful about the above.

## 9.3 Designing Precautions

- 1) The absolute maximum ratings are the ratings which cannot be exceeded for display module, and if these values are exceeded, panel damage may be happen.
- 2) To prevent occurrence of malfunctioning by noise, pay attention to satisfy the VIL and VIH specifications and, at the same time, to make the signal line cable as short as possible.
- 3) We recommend you install excess current preventive unit (fuses, etc.) to the power circuit (VDD). (Recommend value: 0.5A)
- 4) Pay sufficient attention to avoid occurrence of mutual noise interference with the neighbouring devices.
- 5) As for EMI, take necessary measures on the equipment side basically.
- 6) When fastening the display module, fasten the external plastic housing section.
- 7) If power supply to the display module is forcibly shut down by such errors as taking out the main battery while the display panel is in operation, we cannot guarantee the quality of this display module.

## 9.4 Operation Precautions

- 1) It is indispensable to drive the display within the specified voltage limit since excessive voltage shortens its life.
- 2) Direct current causes an electrochemical reaction with remarkable deterioration of the display quality. Give careful consideration to prevent direct current during ON/OFF timing and during operation.
- 3) Response time is extremely delayed at temperatures lower than the operating temperature range while, at high temperatures, displays become dark. However, this phenomenon is reversible and does not mean a malfunction or a display that has been permanently damaged.
- 4) To protect display modules from performance drops by static electricity rapture, etc., do not touch the following sections whenever possible while handling the display modules.
  - a. Pins and electrodes
  - b. Pattern layouts such as the FPC
- 5) When the driver is being exposed (COG), semiconductor elements change their characteristics when light is radiated according to the principle of the solar battery. Consequently, if the driver is exposed to light, malfunctioning may occur.
  - a. Design the product and installation method so that the driver may be shielded from light in actual usage.
  - b. Design the product and installation method so that the driver may be shielded from light during the inspection processes.
- 6) Although the display module stores the operation state data by the commands and the indication data, when excessive external noise, etc. enters into the module, the internal status may be changed. It therefore is necessary to take appropriate measures to suppress noise generation or to protect from influences of noise on the system design.
- 7) We recommend you construct its software to make periodical refreshment of the operation statuses (re-setting of the commands and re-transference of the display data) to cope with catastrophic noise.

## 9.5 Other Precautions

- 1) Request the qualified companies to handle industrial wastes when disposing of the display modules. Or, when burning them, be sure to observe the environmental and hygienic laws and regulations.