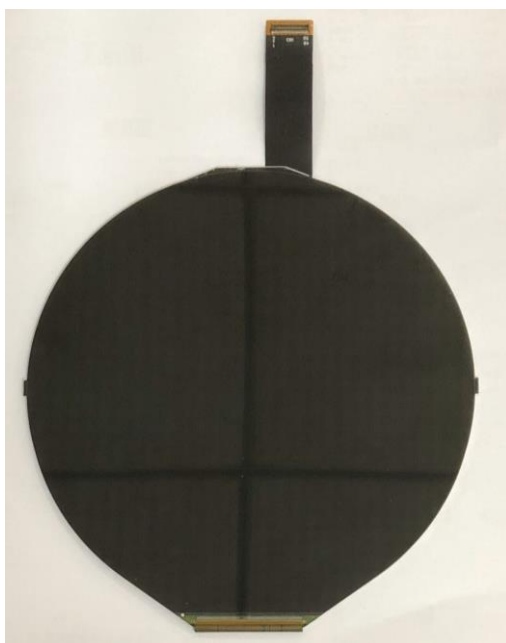


DMT050H7NMNT0-1A

PRODUCT SPECIFICATION

Version 1.0
Jun 29, 2020



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

Prepared by *Joyce Huang*
Approved by *Odin Hung* and *Eric Wan*

Revision History

| VERSION | DATE | DESCRIPTION | AUTHOR |
|---------|--------------|-----------------|-------------|
| 1.0 | Jun 29, 2020 | Initial Release | Joyce Huang |
| | | | |
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1. General Description

1.1 Introduction

This is a 5" 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 1080 x 1080 and can display up to 16.7M colours. The display module supports 4 Lane MIPI interface.

1.2 Main Features

| Item | Contents |
|-----------------------|---------------------------------------|
| Display Type | TFT LCD |
| Screen Size | 5" Diagonal |
| Display Format | 1080 x RGB x 1080 Dots |
| No. of Colour | 16.7M |
| Overall Dimensions | 132.21 (W) x 136.53 (H) x 1.98 (D) mm |
| Active Area | 127.01 (W) x 127.01 (H) mm |
| Mode | Normally Black / Transmissive |
| Surface Treatment | Anti-Glare (3H) |
| Viewing Direction | All round |
| Interface | 4 Lane MIPI |
| Driver IC | HX8399C |
| Backlight Type | LED, White, 12 chips |
| Operating Temperature | -20°C ~ +60°C |
| Storage Temperature | -30°C ~ +70°C |
| ROHS | Compliant to RoHS 2.0 |

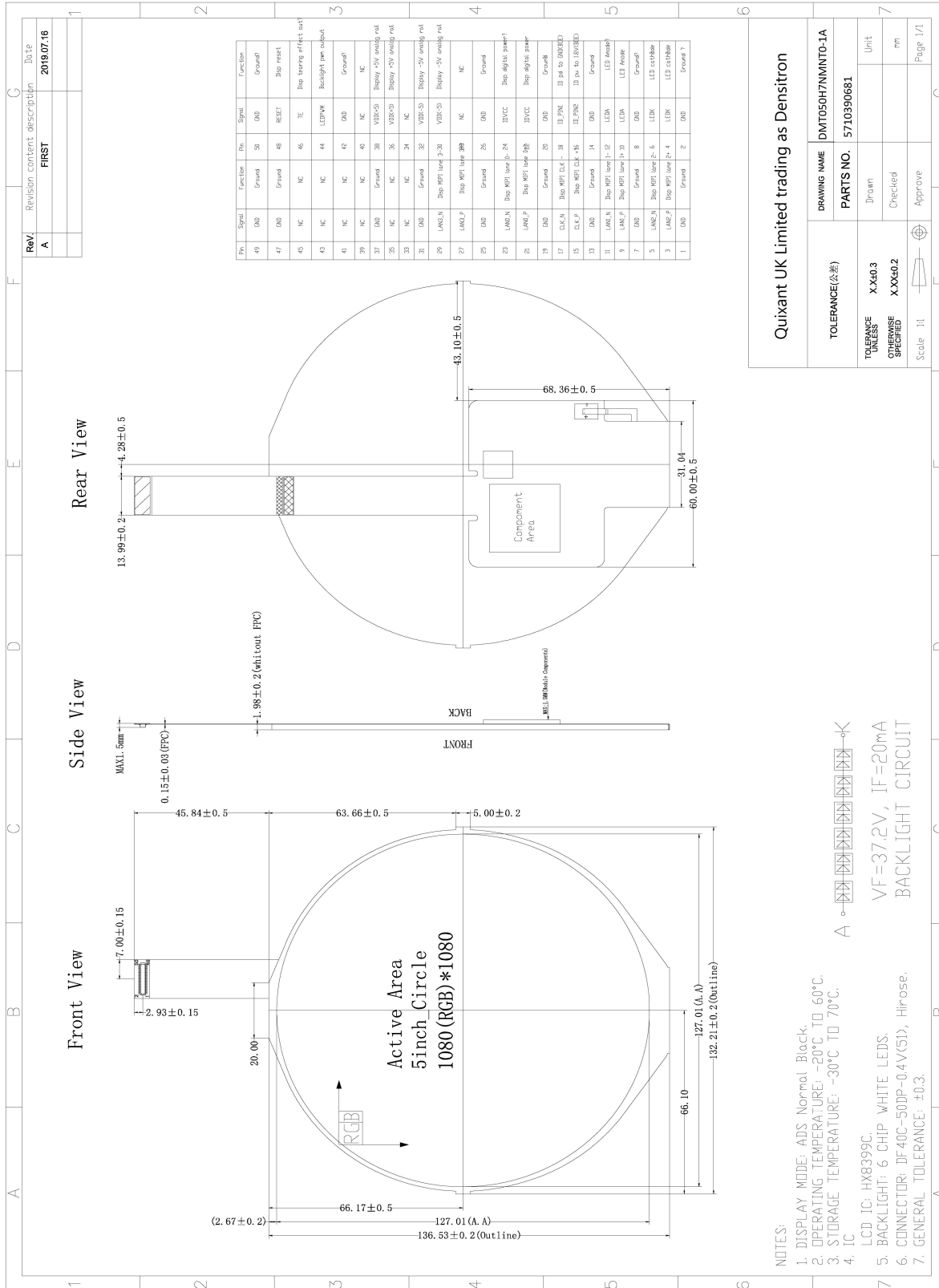
2. Mechanical Specification

2.1 Mechanical Characteristics

| Item | Characteristic | Unit |
|----------------------|------------------------------------|------|
| Display Format | 1080 x RGB x 1080 | Dots |
| Overall Dimensions | 132.21 (W) x 136.53 (H) x 1.98 (D) | mm |
| Active Area | 127.01 (W) x 127.01 (H) | mm |
| Dot Pitch | 0.1176(H)*0.1176(V) | mm |
| Weight | 70 | g |
| IC Controller/Driver | HX8399 | |

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2.2 Mechanical Drawing



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| | |
|--------------------------------------|------------------|
| DRAWING NAME | DMT050H7NMNT0-1A |
| PARTS NO. | 5710390681 |
| TOLERANCE (公差) | Unit |
| TOLERANCE UNLESS OTHERWISE SPECIFIED | Checked |
| Scale | 1:1 |
| Page | 1/1 |

3. Electrical Specification

3.1 Absolute Maximum Ratings

| Item | Symbol | Min | Max | Unit | Note |
|------------------------------|-----------------|------|------|------|------|
| Logic Power Supply Voltage | IOVCC | -0.3 | 3.6 | V | 1 |
| Analog Positive Power Supply | VDD+/VSP | -0.3 | +6.6 | V | - |
| Analog Negative Power Supply | VDD-/VSN | 0 | -6.6 | V | - |
| Operating Temperature | T _{OP} | -20 | +60 | °C | - |
| Storage Temperature | T _{ST} | -30 | +70 | °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 Electrical Characteristics

| Item | Symbol | Condition | Min | Typ. | Max | Unit | Note |
|------------------------------|----------|-----------|-----------|------|-----------|------|------|
| Power Supply Input Voltage | IOVCC | - | 1.65 | 1.8 | 3.3 | V | - |
| Analog Positive Power Supply | VDD+/VSP | - | 4.8 | 5.0 | 6.0 | V | - |
| Analog Negative Power Supply | VDD-/VSP | - | -6.0 | -5.0 | -4.8 | V | - |
| Normal Mode Current | IOIDD | - | - | 17 | 34 | mA | - |
| Low Level Input Voltage | VIL | - | 0 | - | 0.3*IOVCC | V | - |
| High Level Input voltage | VIH | - | 0.7*IOVCC | - | IOVCC | V | - |

3.3 Interface Pin Assignment

| No. | Symbol | I/O | Function |
|-----|----------|-----|--------------------------------------|
| 1 | GND | P | Ground |
| 2 | GND | P | Ground |
| 3 | LAN2_P | I | Disp MIPI lane2+. |
| 4 | LEDK | P | LED cathode. |
| 5 | LAN2_N | I | Disp MIPI lane2-. |
| 6 | LEDK | P | LED cathode. |
| 7 | GND | P | Ground |
| 8 | GND | P | Ground |
| 9 | LAN1_P | I | Disp MIPI Blane 1+. |
| 10 | LEDA | P | LED Anode. |
| 11 | LAN1_N | I | Disp MIPI lane 1-. |
| 12 | LEDA | P | LED Anode. |
| 13 | GND | P | Ground |
| 14 | GND | P | Ground |
| 15 | CLK_P | I | Disp MIPICLK+. |
| 16 | ID_PIN2 | P | ID pu to1.8V(LCM). If not used open. |
| 17 | CLK_N | I | Disp MIPICLK-. |
| 18 | ID_PIN1 | P | ID pd to GND(LCM). If not used open. |
| 19 | GND | P | Ground |
| 20 | GND | P | Ground |
| 21 | LAN0_P | I | Disp MIPI lane 0+. |
| 22 | IOVCC | P | Disp digital power (1.8V). |
| 23 | LAN0_N | I | Disp MIPI lane0-. |
| 24 | IOVCC | P | Disp digital power (1.8V). |
| 25 | GND | P | Ground |
| 26 | GND | P | Ground |
| 27 | LAN3_P | I | Disp MIPI lane 3+. |
| 28 | NC | - | NC |
| 29 | LAN3_N | I | Disp MIPI lane 3-. |
| 30 | VSN/VDD- | P | Display -5V analog rail. |
| 31 | GND | P | Ground |
| 32 | VSN/VDD- | P | Display -5V analog rail. |
| 33 | NC | - | NC |
| 34 | NC | - | NC |
| 35 | NC | - | NC |

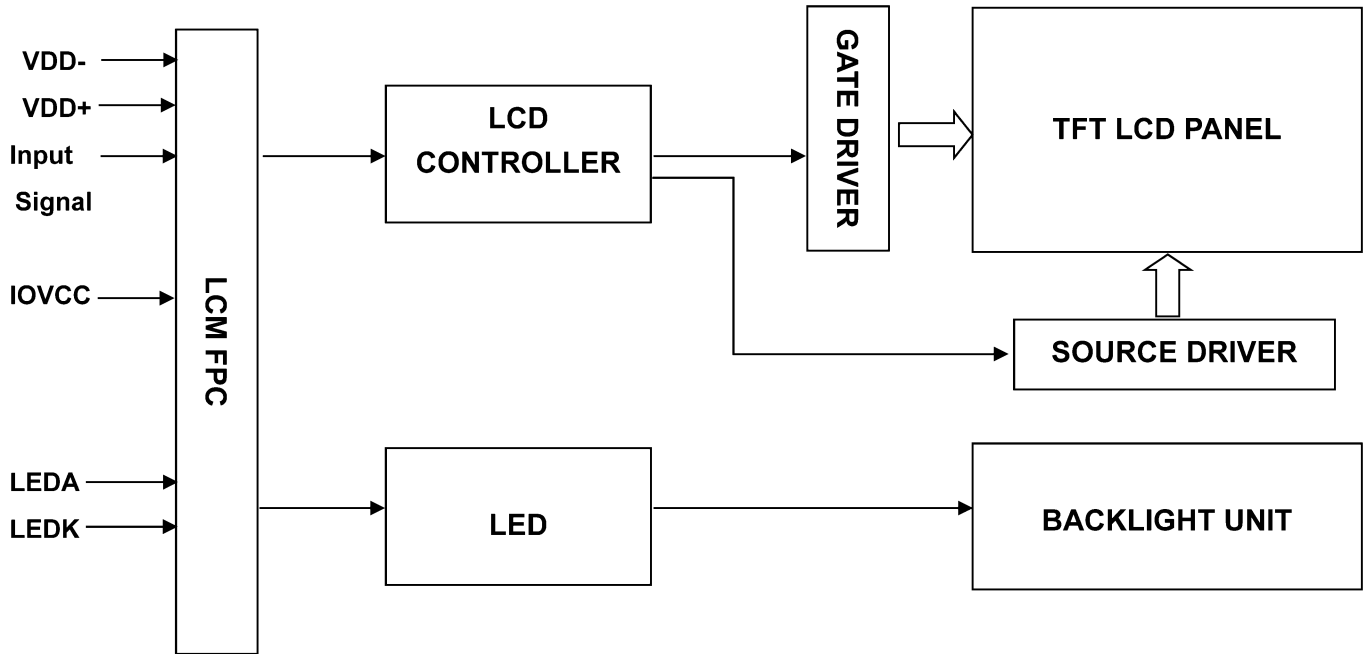
| | | | |
|----|----------|---|--|
| 36 | VSP/VDD+ | P | Disp +5V analog rail. |
| 37 | GND | P | Ground |
| 38 | VSP/VDD+ | P | Disp +5V analog rail . |
| 39 | NC | - | NC |
| 40 | NC | - | NC |
| 41 | NC | - | NC |
| 42 | GND | P | Ground |
| 43 | NC | - | NC |
| 44 | LEDPWM | O | Backlight pwm output, If not used open. |
| 45 | NC | - | NC |
| 46 | TE | O | Disp tearing effect out, If not used open. |
| 47 | GND | P | Ground |
| 48 | RESET | I | Disp reset |
| 49 | GND | P | Ground |
| 50 | GND | P | Ground |

Note 1: Connector Model Number: DF40C-50DP-0.4V

Note 2: Manufacturer: Hirose

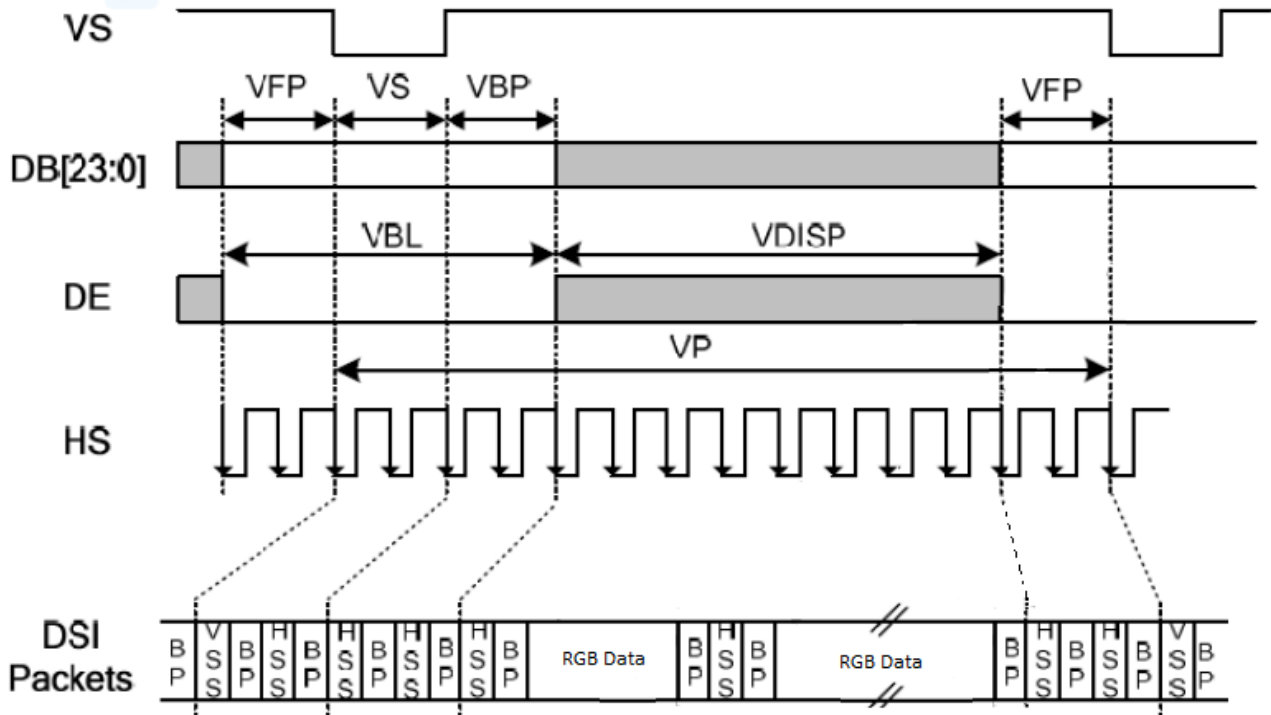
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3.4 Block Diagram



3.5 Timing Characteristics

3.5.1 Vertical Timing

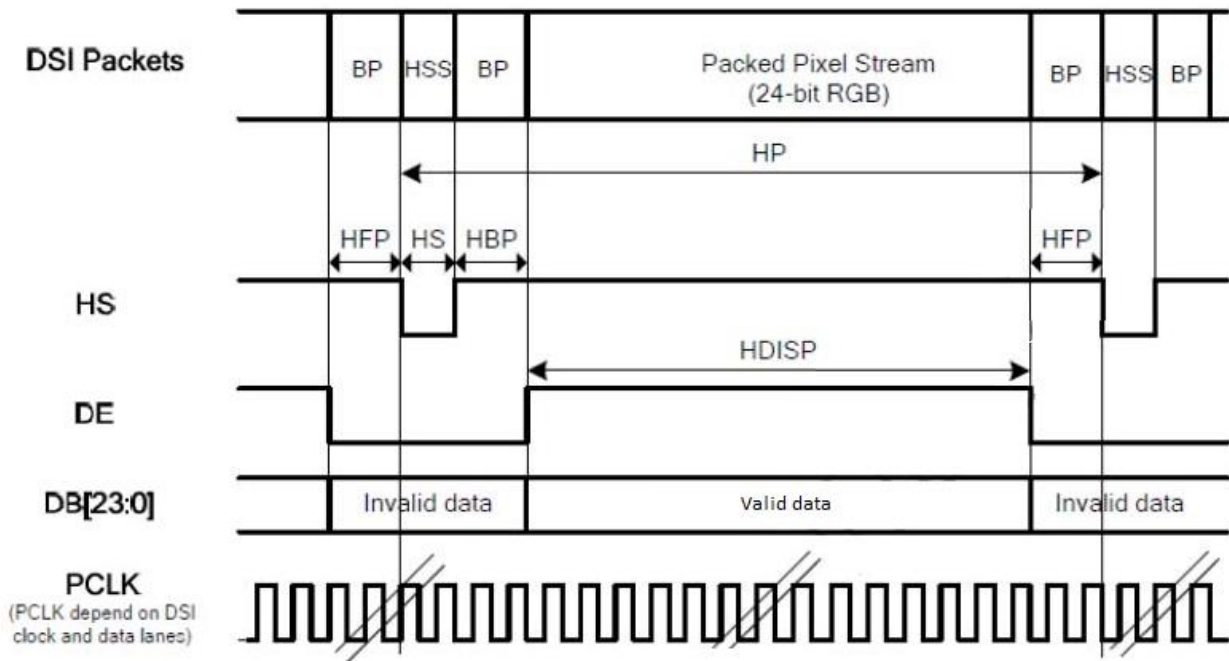


Vertical Resolution=528+8xNL (VSSA=0V, VDD1=1.8V, VDD3=2.8V, TA=25C)

| Item | Symbol | Condition | Min | Typ. | Max | Unit | Note |
|---------------------------|--------|------------|----------|----------|-----|------|------|
| Vertical cycle | VP | - | 534+8xNL | - | - | Line | - |
| Vertical low pulse width | VS | - | 2 | - | - | Line | 1 |
| Vertical front porch | VFP | - | 2 | - | - | Line | - |
| Vertical back porch | VBP | - | 2 | - | - | Line | 1 |
| Vertical data start point | - | VS+VBP | 4 | - | - | Line | 1 |
| Vertical blanking period | VBL | VS+VBP+VFP | 6 | - | - | Line | - |
| Vertical active area | - | VDISP | - | 528+8xNL | - | Line | - |
| Vertical refresh rate | VRR | - | - | 60 | - | Line | - |

Note 1: The VS and VBP pulse width are related to GSP and GCK timing. The GSP and GCK must be set at corresponding positions for LCD normal display.

3.5.2 Horizontal Timing



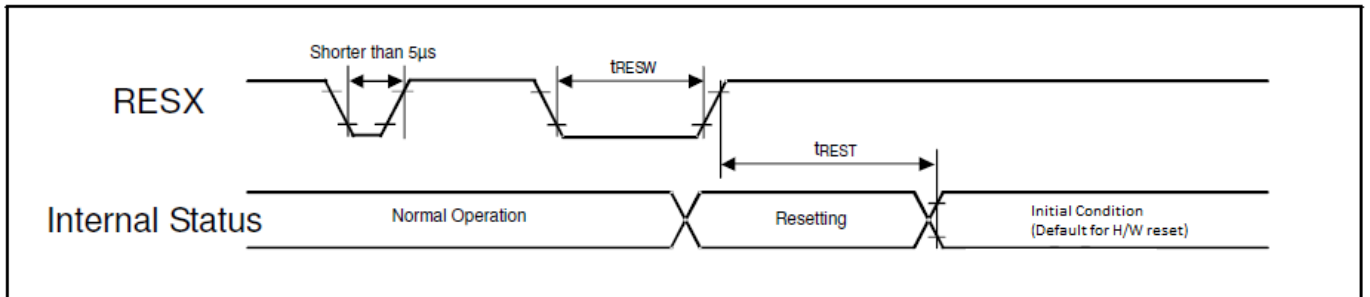
Horizontal Resolution=H_RES(1080/1024/960/800/720) (VSSA=0V, VDD1=1.8V, VDD3=HS_VCC=2.8V, TA=25C)

| Item | Symbol | Condition | Min | Typ. | Max | Unit | Note |
|-----------------------------|--------|------------|----------|-------|-----|------|------|
| HS Cycle | HP | - | H_RES+66 | - | - | DCK | - |
| HS low pulse width | HS | - | 25 | - | - | DCK | - |
| Horizontal back porch | HBP | - | 25 | - | - | DCK | - |
| Horizontal front porch | HFP | - | 16 | - | - | DCK | - |
| Horizontal data start point | - | HS+HBP | 50 | - | - | DCK | 1 |
| Horizontal blanking period | HBLK | HS+HBP+HFP | 66 | - | - | DCK | - |
| Horizontal active area | HDISP | - | - | H_RES | - | DCK | - |

Note 1: HS+HBP must larger than 50 PCLK.

3.5.3 Reset Timing

Figure: Reset Input Timing



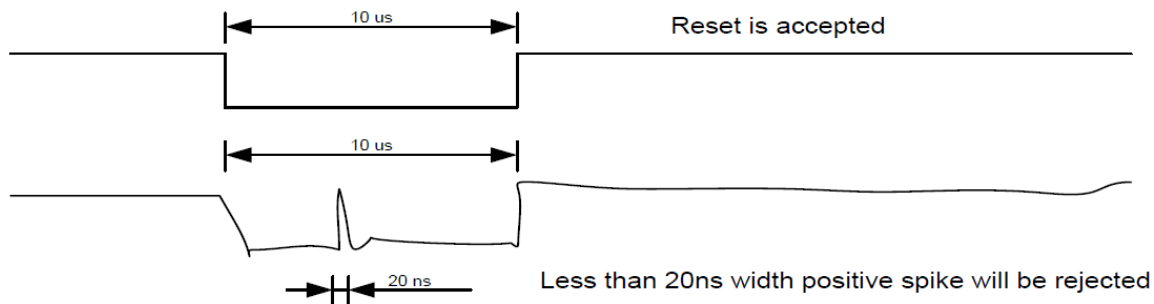
| Symbol | Item | Related Pins | Min | Typ. | Max | Unit | Note |
|------------|-----------------------|--------------|-----|------|-----|------|------|
| t_{RESW} | Reset Low Pulse Width | RESX | 10 | - | - | is | - |
| t_{REST} | Reset Complete Time | - | - | - | 50 | ms | - |

Note 1: Spike due to an electrostatic discharge on RESX line does not because irregular system reset according to the table below:

| RESX Pulse | Action |
|----------------------|----------------|
| Shorter than 5us | Reset Rejected |
| Longer than 10us | Reset |
| Between 5us and 10us | Reset Start |

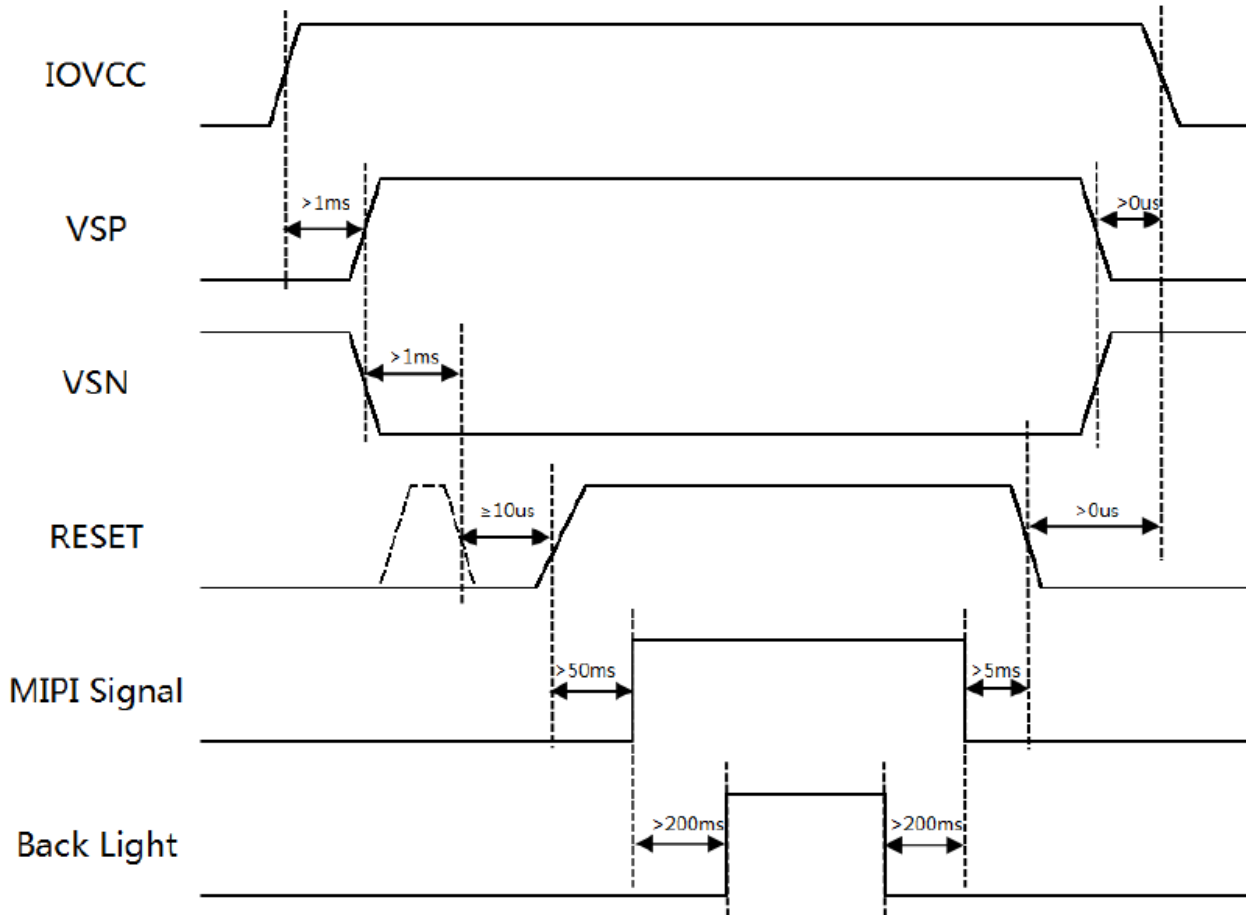
Note 2: During Reset Complete Time, OTP will be latched to internal register during this period. This loading is done every time when there is H/W reset complete time (t_{REST}) within 5ms after a rising edge of RESX.

Note 3: Spike Rejection also applies during a valid reset pulse as shown below:



3.6 Power On/Off Sequence

Power on/off Sequence



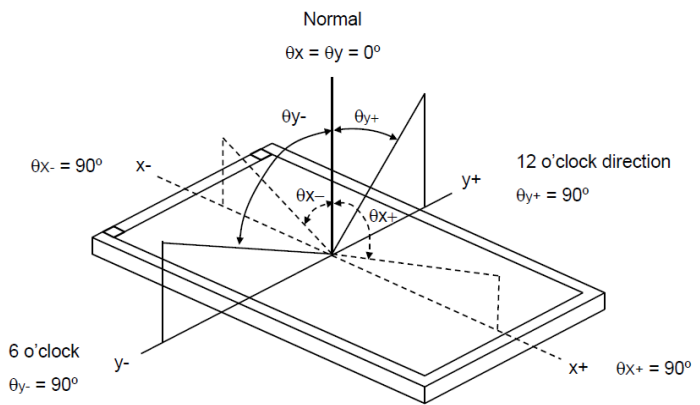
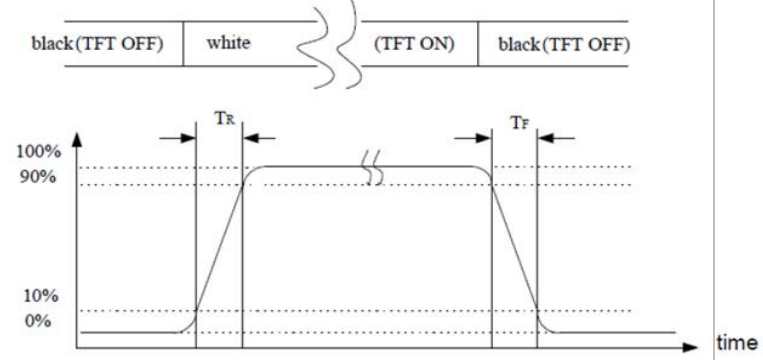
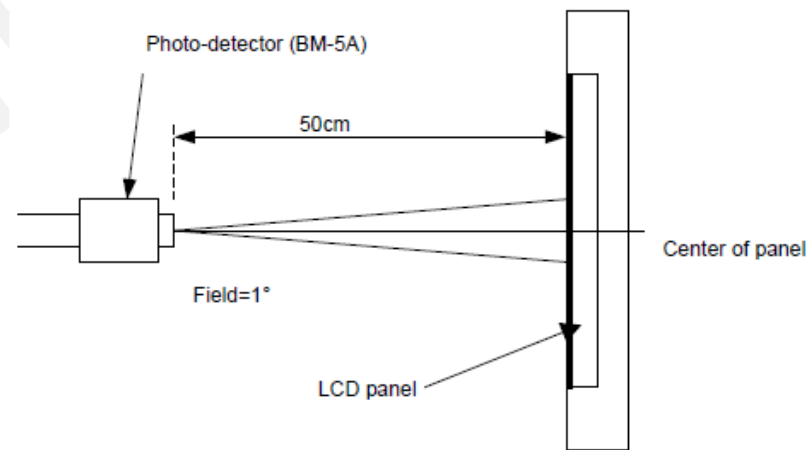
4. Optical Specification

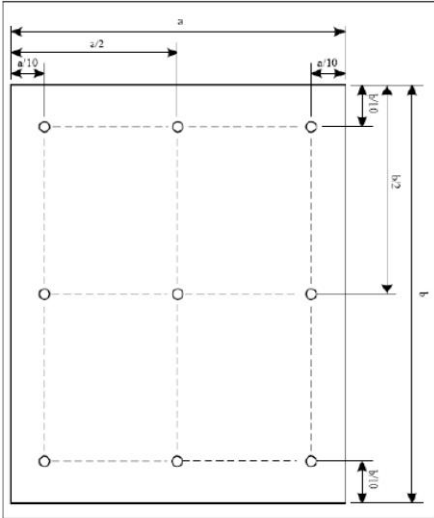
4.1 Optical Characteristics

| Characteristics | | Symbol | Conditions | Min | Typ. | Max | Unit | Note |
|---------------------|---------|---------------|--|--------|--------|--------|-------------------|----------------|
| Contrast Ratio | | CR | $\theta = 0^\circ$ | 800 | 1200 | - | - | 2 |
| Response Time | Rising | TR + TF | Normal viewing angle | - | - | 40 | msec | 3 |
| | Falling | | | | | | | |
| Color Gamut | | S(%) | - | 60 | 65 | - | % | 1 |
| Viewing Angle | Left | θ_{x-} | CR > 10 | 70 | 80 | - | - | 4 |
| | Right | θ_{x+} | | 70 | 80 | - | | |
| | Up | θ_{y+} | | 70 | 80 | - | | |
| | Down | θ_{y-} | | 70 | 80 | - | | |
| Colour Chromaticity | Red | Rx | $\theta = 0^\circ$ Normal viewing angle | 0.5938 | 0.6338 | 0.6738 | - | CA310 (Module) |
| | | Ry | | 0.3075 | 0.3475 | 0.3875 | | |
| | Green | Gx | | 0.2641 | 0.3041 | 0.3441 | | |
| | | Gy | | 0.5093 | 0.5493 | 0.5893 | | |
| | Blue | Bx | | 0.1064 | 0.1464 | 0.1864 | | |
| | | By | | 0.0126 | 0.0526 | 0.0926 | | |
| | White | Wx | | 0.2422 | 0.2822 | 0.3222 | | |
| | | Wy | | 0.2597 | 0.2957 | 0.3357 | | |
| Luminance | | Lv | $I_F = 20 \text{ mA}$ | 250 | 300 | - | cd/m ² | 5 |
| Uniformity | | Avg | - | 70 | - | - | % | 5 |

The data comes from the LCD specification.

Note: Measuring Condition = in dark room, at ambient temperature $25 \pm 2^\circ\text{C}$, for 15 min, warm-up time.

| Note | Item | Test method |
|------|--|--|
| 1 | Definition of Viewing Angle (θ_x, θ_y) |  <p>Normal $\theta_x = \theta_y = 0^\circ$</p> <p>$\theta_{x-} = 90^\circ$ $\theta_{x+} = 90^\circ$ $\theta_{y-} = 90^\circ$ $\theta_{y+} = 90^\circ$</p> <p>6 o'clock $\theta_{y-} = 90^\circ$ 12 o'clock direction $\theta_{y+} = 90^\circ$</p> |
| 2 | Definition of Contrast Ratio (CR) | <p>Measured at the center point of panel</p> $\text{Contrast ratio (CR)} = \frac{\text{Luminance measured when LCD is at "white state"}}{\text{Luminance measured when LCD is at "black state"}}$ |
| 3 | Definition of Response Time (T_R, T_F) |  <p>black(TFT OFF) white (TFT ON) black(TFT OFF)</p> <p>Optical response</p> <p>100% 90% 10% 0%</p> <p>time</p> <p>T_R T_F</p> |
| 4 | Definition of Optical Measurement Setup |  <p>Photo-detector (BM-5A)</p> <p>50cm</p> <p>Field=1°</p> <p>LCD panel</p> <p>Center of panel</p> |
| 5 | Definition of Luminance Uniformity | <p>Luminance Uniformity of these 9 points is defined as below:</p> |

| Note | Item | Test method |
|------|------|---|
| | |  <p> $\text{Uniformity} = \frac{\text{minimum luminance in 9 points (1-9)}}{\text{maximum luminance in 9 points (1-9)}}$ $\text{Luminance} = \frac{\text{Total Luminance of 9 points}}{9}$ </p> |

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5. LED Backlight Specification

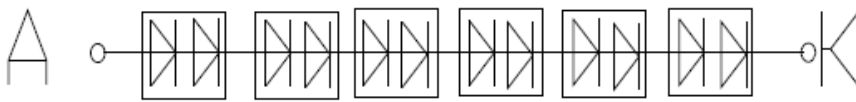
5.1 LED Backlight Characteristics

| Item | Symbol | Condition | Min | Typ. | Max | Unit | Note |
|-----------------|--------|-----------|-----|-------|------|------|------|
| Forward Current | I_F | - | 15 | 20 | - | mA | - |
| Forward Voltage | V_F | - | - | 37.2 | 38.4 | V | - |
| LED Life Time | Hr | - | - | 30000 | - | Hour | 1, 2 |

Note 1: LED life time (Hr) can be defined as the time in which it continues to operate under the condition:
 $T_a=25\pm 3^\circ\text{C}$, typical IL (I_F) value indicated in the above table until the brightness becomes less than 50%.

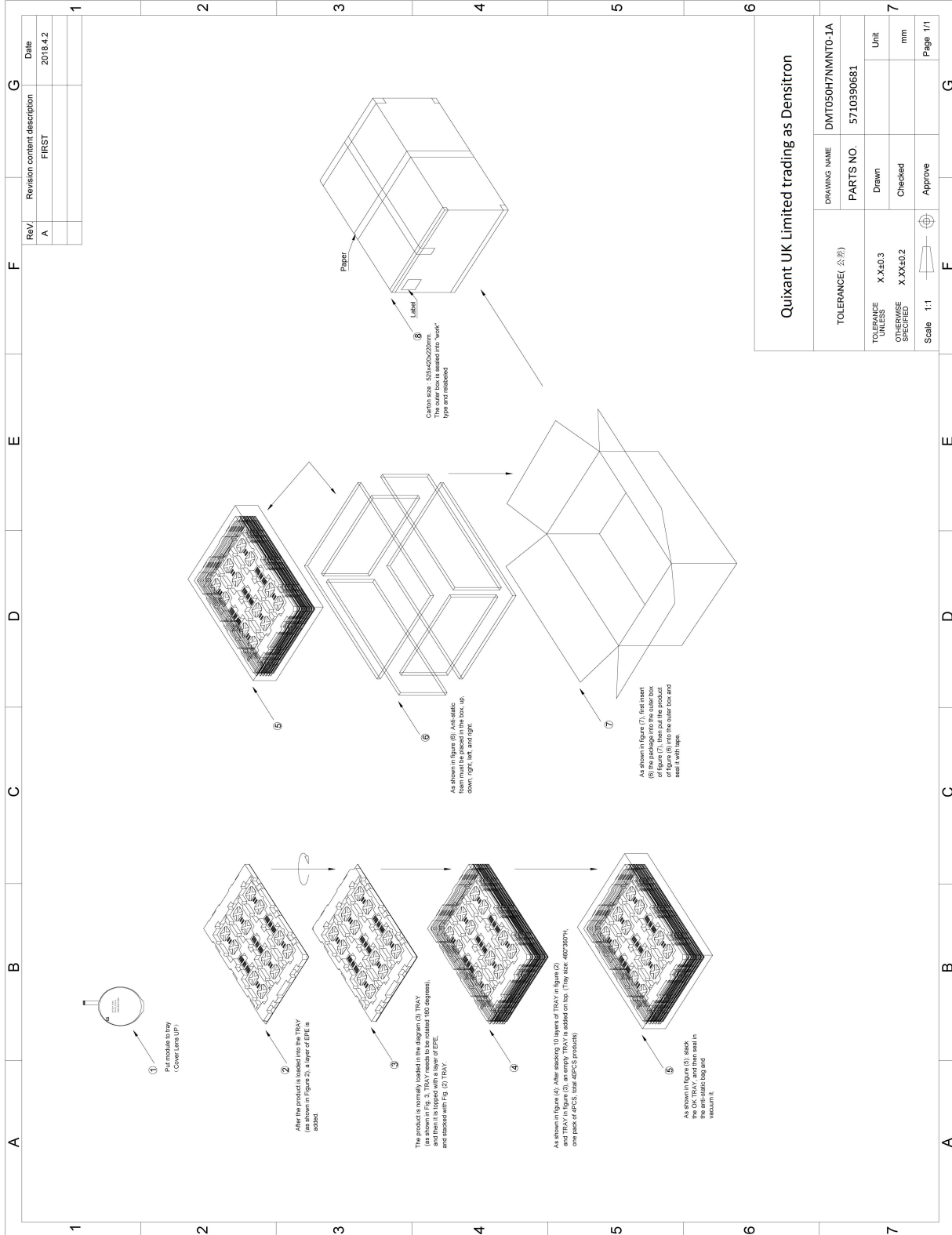
Note 2: The "LED life time" is defined as the module brightness decreases to 50% original brightness
 at $T_a=25^\circ\text{C}$ and $I_L=20\text{mA}$. The LED lifetime could be decreased if operating I_L is larger than 20mA. The constant current driving method is suggested.

5.2 INTERNAL CIRCUIT DIAGRAM



BACKLIGHT CIRCUIT

6. Packaging



7. Quality Assurance Specification

7.1 Conformity

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

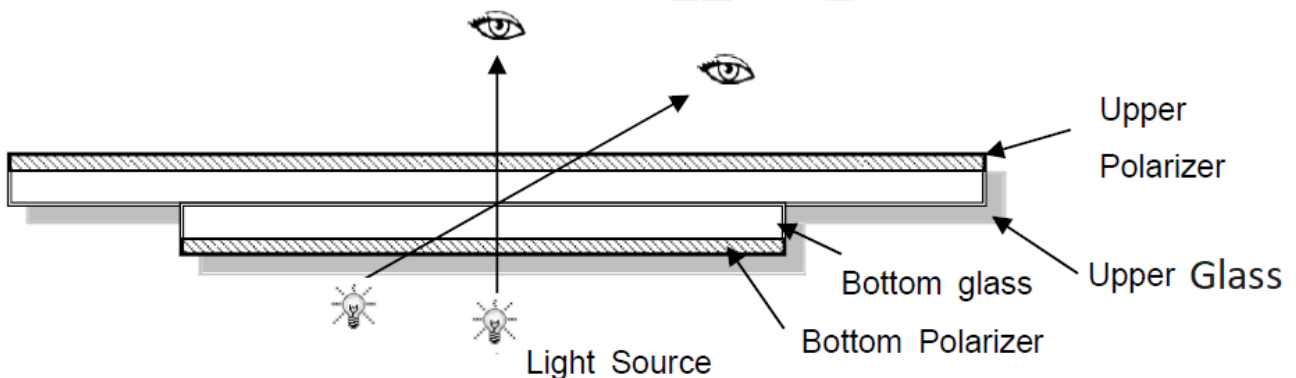
7.2 Environment Required

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

| | |
|-------------------|--|
| Temperature: | 25 ± 5°C |
| Humidity: | 65% ± 10% 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.

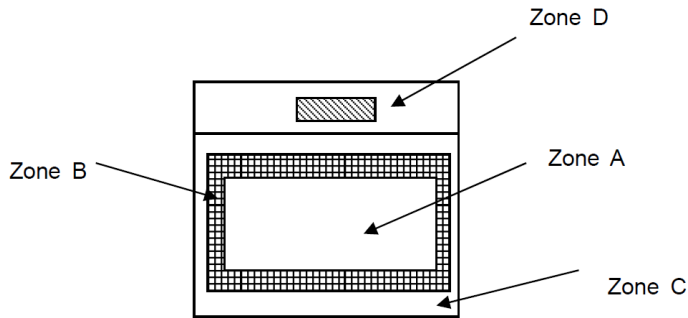


7.3 Delivery Assurance

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

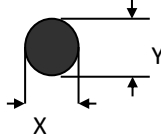
| Partition | AQL | Definition |
|-----------|------|---|
| Major | 0.65 | Defects in Pattern Check (Display On) |
| Minor | 1.5 | Defects in Cosmetic Check (Display Off) |

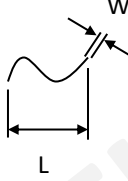
LCD: Liquid Crystal Display, TP: Touch Panel, LCM: Liquid Crystal Module

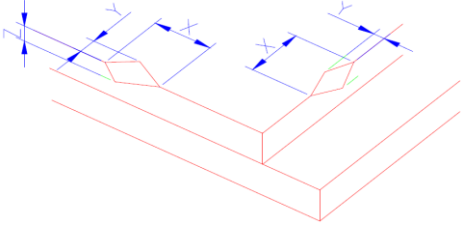
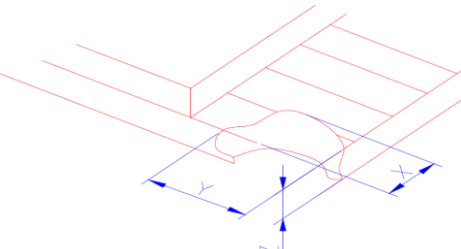
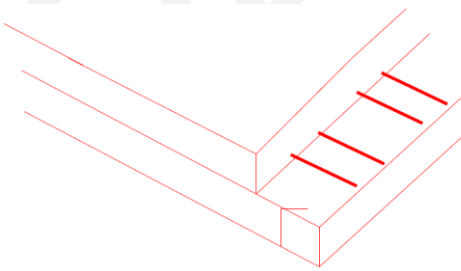
| No. | Items | Criteria | Classification of defects |
|-----|----------------------|--|---------------------------|
| 1 | Functional defects | 1) No display, open or miss line 2) Display abnormally 3) Backlight no lighting, abnormal lighting. 4) TP no function | Major |
| 2 | Missing | Missing component | |
| 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; Polarizer accidented spot. | |
| 6 | Soldering Appearance | Good soldering, Peeling off is not allowed. | |
| 7 | LCD/Polarizer/TP | Black/White spot/line, scratch, crack, etc. | |

7.3.4 Criteria & Classification

Units: mm

| Class | Item | Criteria | | | | | | | | | | | | | | | | | | | | | | | |
|---|----------------------------------|--|----------------------------------|---------------------|---|---|---|-----------------|--------|-------------------------|--------|-------------------------|----------------------------------|--------------------------------|----------------------------------|--------------|---|--------------------------------|---|--|--|----------------------|---|--|--|
| Minor | Spot Defect | Round type: as per following drawing, $\varnothing = (X+Y)/2$  | | | | | | | | | | | | | | | | | | | | | | | |
| | | 1) Light Dot (LCD/TP/Polarizer black/white spot, light dot, pinhole, dent, stain) | | | | | | | | | | | | | | | | | | | | | | | |
| | | <table border="1"> <thead> <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> </thead> <tbody> <tr> <td>$\varnothing \leq 0.10$</td> <td colspan="3">Ignore</td> </tr> <tr> <td>$0.10 < \varnothing \leq 0.25$</td> <td colspan="3">3 (distance $\geq 10\text{mm}$)</td> </tr> <tr> <td>$0.25 < \varnothing \leq 0.30$</td> <td colspan="3">2</td> </tr> <tr> <td>$0.35 < \varnothing$</td> <td colspan="3">0</td> </tr> </tbody> </table> | Size\Zone | Acceptable Quantity | | | A | B | C | $\varnothing \leq 0.10$ | Ignore | | | $0.10 < \varnothing \leq 0.25$ | 3 (distance $\geq 10\text{mm}$) | | | $0.25 < \varnothing \leq 0.30$ | 2 | | | $0.35 < \varnothing$ | 0 | | |
| | | Size\Zone | | Acceptable Quantity | | | | | | | | | | | | | | | | | | | | | |
| | | | A | B | C | | | | | | | | | | | | | | | | | | | | |
| | | $\varnothing \leq 0.10$ | Ignore | | | | | | | | | | | | | | | | | | | | | | |
| | | $0.10 < \varnothing \leq 0.25$ | 3 (distance $\geq 10\text{mm}$) | | | | | | | | | | | | | | | | | | | | | | |
| | | $0.25 < \varnothing \leq 0.30$ | 2 | | | | | | | | | | | | | | | | | | | | | | |
| | | $0.35 < \varnothing$ | 0 | | | | | | | | | | | | | | | | | | | | | | |
| | | 2) Dim Spot (LCD/TP/Polarizer dim dot, light leakage, dark spot) | | | | | | | | | | | | | | | | | | | | | | | |
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| | | | A | B | C | | | | | | | | | | | | | | | | | | | | |
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| | | $0.10 < \varnothing \leq 0.25$ | 3 (distance $\geq 10\text{mm}$) | | | | | | | | | | | | | | | | | | | | | | |
| | | $0.25 < \varnothing \leq 0.30$ | 2 | | | | | | | | | | | | | | | | | | | | | | |
| | | $0.35 < \varnothing$ | 0 | | | | | | | | | | | | | | | | | | | | | | |
| | | 3) Polarizer Accidented Spot | | | | | | | | | | | | | | | | | | | | | | | |
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| | | Size\Zone | | Acceptable Quantity | | | | | | | | | | | | | | | | | | | | | |
| A | B | | C | | | | | | | | | | | | | | | | | | | | | | |
| $\varnothing \leq 0.2$ | Ignore | | | | | | | | | | | | | | | | | | | | | | | | |
| $0.3 < \varnothing \leq 0.5$ | 2 (distance $\geq 10\text{mm}$) | | | | | | | | | | | | | | | | | | | | | | | | |
| $0.5 < \varnothing$ | 0 | | | | | | | | | | | | | | | | | | | | | | | | |
| 4) Pixel Bad Points (Light Dot, Dim Dot, Color Dot) | | | | | | | | | | | | | | | | | | | | | | | | | |
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| Size\Zone | | Acceptable Quantity | | | | | | | | | | | | | | | | | | | | | | | |
| | A | B | C | | | | | | | | | | | | | | | | | | | | | | |
| $\Phi \leq 0.1$ | Ignore | | | | | | | | | | | | | | | | | | | | | | | | |
| $0.15 < \Phi \leq 0.25$ | 2 (distance $\geq 10\text{mm}$) | | | | | | | | | | | | | | | | | | | | | | | | |
| $\Phi > 0.3$ | 0 | | | | | | | | | | | | | | | | | | | | | | | | |
| 5) Polarizer Bubble | | | | | | | | | | | | | | | | | | | | | | | | | |

| Class | Item | Criteria | | | | |
|----------------------|---|--|----------------------------------|---------------------|---|--------|
| | | Size\Zone | Acceptable Quantity | | | |
| | | | A | B | C | |
| | | $\varnothing \leq 0.20$ | Ignore | | | |
| | | $0.3 < \varnothing \leq 0.4$ | 3 (distance $\geq 10\text{mm}$) | | | |
| | | $0.4 < \varnothing \leq 0.5$ | 2 | | | |
| | | $0.5 < \varnothing$ | 0 | | | |
| Minor | Line Defect (LCD/TP/ Polarizer backlight black/white line, scratch, stain) | Line type: as per following drawing | | | | |
| | |  | | | | |
| | | Width | Length | Acceptable quantity | | |
| | | | | A | B | C |
| | | $W \leq 0.05$ | Ignore | Ignore | | Ignore |
| | | $0.05 < W \leq 0.06$ | $L \leq 3.0$ | $N \leq 2$ | | |
| $0.07 < W \leq 0.08$ | $L \leq 2.0$ | $N \leq 1$ | | | | |
| | $0.08 < W$ | Define as spot defect | | | | |
| Minor | Electronic Components SMT | Not allow missing parts, solderless connection, cold solder joint, mismatch. The positive and negative polarity opposite. | | | | |
| Minor | Display color & Brightness | 1. Color: Measuring the color coordinates. The measurement standard according to the datasheet or samples. 2. Brightness: Measuring the brightness of White screen. The measurement standard according to the datasheet or Samples. | | | | |
| Minor | LCD Mura | By 5% ND filter invisible. | | | | |

| Class | Item | Criteria |
|-------|------------------|--|
| Minor | LCD Crack/Broken | <p>Symbols: X: Length, Y: Width, Z: Height, L: Length of ITO, T: Height of LCD</p> <p>1) The edge of LCD broken: $X \leq 3.0\text{mm}$; $Y < \text{Inner border line of the seal}$; $Z \leq T$</p>  <p>2) LCD corner broken: $X \leq 3.0\text{mm}$; $Y \leq L$; $Z \leq T$</p>  |
| Major | LCD Crack | <p>The LCD with extensive crack is not acceptable.</p>  |

Criteria (functional items)

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

CONFIDENTIAL

7.4 Dealing with Customer Complaints

7.4.1 Non-conforming Analysis

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

After accepting it, Densitron should complete the analysis in two weeks from receiving the sample.

If the analysis cannot be completed on time, Densitron must inform the purchaser.

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 Operation | 60°C, 96 hrs | Inspection after 2~4hours storage at room temperature, the sample shall be free from defects: 1.Air bubble in the LCD; 2.Non-display; 3.Missing segments/line; 4.Glass crack; 5.Current IDD is twice higher than initial value. |
| Low Temperature Operation | -20°C, 96 hrs | |
| High Temperature Storage | 75°C, 96 hrs | |
| Low Temperature Storage | -30°C, 96 hrs | |
| High Temperature & High Humidity Operating | +60°C, 90%RH, 96HR | |
| Thermal Shock (Non-operation) | -10°C,30 min ↔ 60°C,30 min, Change time:5min 20CYC. | |
| ESD test | C=150pF, R=330,5points/panel Air: ±8KV, 5times; Contact: ±6KV, 5 times; (Environment: 15°C~35°C, 30%~60%). | |
| Vibration (Non-operation) | Frequency range:10~55Hz, Stroke:1.5mm Sweep:10Hz~55Hz~10Hz 2 hours for each direction of X.Y.Z. (6 hours for total) (Package condition). | |
| Box Drop Test | 1 Corner 3 Edges 6 faces,80cm (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.

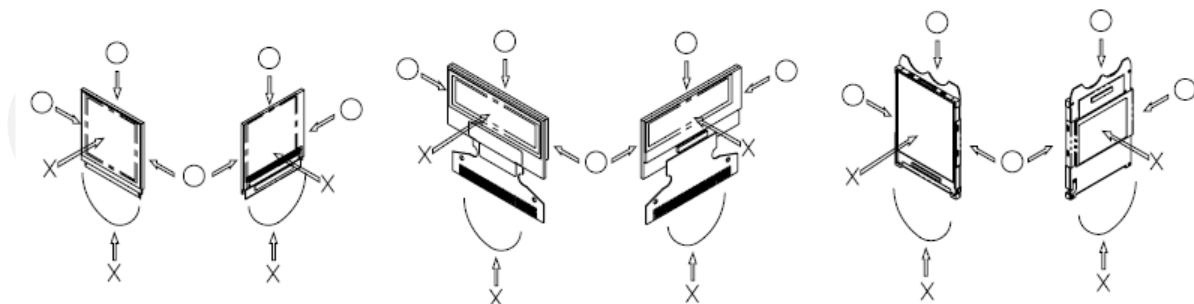
8.1.1 Inspection Check Standard

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 handling 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 to 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 to 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 to 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.