LIQUID CRYSTAL DISPLAY MODULE

Product Specification

<table>
<thead>
<tr>
<th>CUSTOMER</th>
<th>Standard</th>
</tr>
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<td>CUSTOMER PART NUMBER</td>
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<tr>
<td>PRODUCT NUMBER</td>
<td>DMT043WVNXCMI-1A</td>
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<table>
<thead>
<tr>
<th>Authorised By</th>
<th>Created By</th>
</tr>
</thead>
<tbody>
<tr>
<td>Luo Luo</td>
<td>David Hardman</td>
</tr>
</tbody>
</table>

Date: 03-Aug-17           Date: 03-Aug-17
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## REVISION RECORD

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<th>Date</th>
<th>Page</th>
<th>Chapt.</th>
<th>Comment</th>
<th>ECN no.</th>
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<td>1.0</td>
<td>03-Aug-17</td>
<td></td>
<td></td>
<td>Initial Release</td>
<td>ECN8020</td>
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# MAIN FEATURES

<table>
<thead>
<tr>
<th>ITEM</th>
<th>CONTENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Screen Size</td>
<td>4.3” Diagonal</td>
</tr>
<tr>
<td>Display Format</td>
<td>480 x RGB x 800 Dots</td>
</tr>
<tr>
<td>N° of Colour</td>
<td>65K/262K/16.7M</td>
</tr>
<tr>
<td>TFT Active Area</td>
<td>56.16 mm (H) x 93.6 mm (V)</td>
</tr>
<tr>
<td>PCT View Area</td>
<td>57.16 mm (H) x 94.6 mm (V)</td>
</tr>
<tr>
<td>LCD Type</td>
<td>TFT</td>
</tr>
<tr>
<td>Mode</td>
<td>IPS Transmissive / Normally Black</td>
</tr>
<tr>
<td>Viewing Direction</td>
<td>Full view</td>
</tr>
<tr>
<td>TFT Interface</td>
<td>3-line SPI + 16/18/24-bit RGB interface</td>
</tr>
<tr>
<td>PCT Interface</td>
<td>I2C</td>
</tr>
<tr>
<td>TFT Driver IC</td>
<td>ILI9806E or equivalent</td>
</tr>
<tr>
<td>PCT Driver IC</td>
<td>GT970</td>
</tr>
<tr>
<td>Simultaneous Touch Points</td>
<td>5</td>
</tr>
<tr>
<td>Backlight Type</td>
<td>LED</td>
</tr>
<tr>
<td>Operating Temperature</td>
<td>-20°C ~ +70°C</td>
</tr>
<tr>
<td>Storage Temperature</td>
<td>-30°C ~ +80°C</td>
</tr>
<tr>
<td>RoHS compliant</td>
<td>Yes</td>
</tr>
</tbody>
</table>
## 2 MECHANICAL SPECIFICATION

### 2.1 MECHANICAL CHARACTERISTICS

<table>
<thead>
<tr>
<th>ITEM</th>
<th>CHARACTERISTIC</th>
<th>UNIT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Display Format</td>
<td>480 x RGB x 800 Dots</td>
<td>Dots</td>
</tr>
<tr>
<td>Overall Dimensions</td>
<td>69.16 mm (H) x 120.05 mm (V) x 4.13 mm (D)</td>
<td>mm</td>
</tr>
<tr>
<td>Active Area</td>
<td>56.16 mm (H) x 93.6 mm (V)</td>
<td>mm</td>
</tr>
<tr>
<td>pixel Pitch</td>
<td>0.117 (H) x 0.117 (V)</td>
<td>mm</td>
</tr>
<tr>
<td>Weight</td>
<td>45</td>
<td>g</td>
</tr>
</tbody>
</table>
3 ELECTRICAL SPECIFICATION

3.1 ABSOLUTE MAXIMUM RATINGS

3.1.1 TFT

<table>
<thead>
<tr>
<th>Item</th>
<th>Symbol</th>
<th>Condition</th>
<th>Min</th>
<th>Max</th>
<th>Unit</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power Supply Voltage</td>
<td>VCI</td>
<td></td>
<td>-0.3</td>
<td>4.6</td>
<td>V</td>
<td></td>
</tr>
<tr>
<td>Digital Interface Supply Voltage</td>
<td>IOVCC</td>
<td></td>
<td>-0.3</td>
<td>4.6</td>
<td>V</td>
<td></td>
</tr>
<tr>
<td>Operating Temperature</td>
<td>TOP</td>
<td></td>
<td>-20</td>
<td>70</td>
<td>°C</td>
<td>1</td>
</tr>
<tr>
<td>Storage Temperature</td>
<td>TST</td>
<td></td>
<td>-30</td>
<td>80</td>
<td>°C</td>
<td>1,2,3</td>
</tr>
</tbody>
</table>

Note 1. 90 % RH Max for Ta<50 °C, and 60% RH for Ta≥50°C.
Note 2. In case of below 0°C, the response time of liquid crystal (LC) becomes slower and the colour of panel becomes darker than normal one. Level of retardation depends on temperature, because of LC's characteristic.
Note 3. Only operation is guaranteed at operating temperature. Contrast, response time, another display quality are evaluated at +25°C.

3.1.2 PCT

<table>
<thead>
<tr>
<th>Item</th>
<th>Symbol</th>
<th>Condition</th>
<th>Min</th>
<th>Max</th>
<th>Unit</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power Supply Voltage</td>
<td>VDD</td>
<td></td>
<td>2.66</td>
<td>3.47</td>
<td>V</td>
<td>4</td>
</tr>
<tr>
<td>Operating Temperature</td>
<td>TOP</td>
<td></td>
<td>-20</td>
<td>70</td>
<td>°C</td>
<td>-</td>
</tr>
<tr>
<td>Storage Temperature</td>
<td>TST</td>
<td></td>
<td>-30</td>
<td>80</td>
<td>°C</td>
<td>-</td>
</tr>
</tbody>
</table>

Note 4. If used beyond the absolute maximum ratings, GT970 may be permanently damaged. It is strongly recommended that the device be used within the electrical characteristics in normal operations. If exposed to the condition not within the electrical characteristics, it may affect the reliability of the device.
### 3.2 DC ELECTRICAL CHARACTERISTICS

#### 3.2.1 TFT

<table>
<thead>
<tr>
<th>Item</th>
<th>Symbol</th>
<th>Condition</th>
<th>Min</th>
<th>Typ</th>
<th>Max</th>
<th>Unit</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supply Voltage</td>
<td>VCI</td>
<td>Ta=25˚C</td>
<td>2.5</td>
<td>3.3</td>
<td>3.6</td>
<td>V</td>
<td></td>
</tr>
<tr>
<td>Digital Interface Supply Voltage</td>
<td>IOVCC</td>
<td>Ta=25˚C</td>
<td>1.65</td>
<td>1.8</td>
<td>3.6</td>
<td>V</td>
<td></td>
</tr>
<tr>
<td>Input Voltage for Logic</td>
<td>VIH</td>
<td>-0.3 IOVCC</td>
<td>-</td>
<td>-</td>
<td>0.3 IOVCC</td>
<td>V</td>
<td></td>
</tr>
<tr>
<td>Output Voltage for Logic</td>
<td>VOH</td>
<td>0.8 IOVCC</td>
<td>-</td>
<td>-</td>
<td>IOVCC</td>
<td>V</td>
<td></td>
</tr>
<tr>
<td>Current Consumption</td>
<td>ICC</td>
<td>-</td>
<td>30</td>
<td>-</td>
<td>-</td>
<td>mA</td>
<td>1</td>
</tr>
</tbody>
</table>

Note 1: The specified power consumption is under the conditions of VCI=3.3V, FV=60Hz.

#### 3.2.2 PCT

<table>
<thead>
<tr>
<th>Item</th>
<th>Symbol</th>
<th>Condition</th>
<th>Min</th>
<th>Typ</th>
<th>Max</th>
<th>Unit</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supply Voltage</td>
<td>VDD</td>
<td>Ta=25˚C</td>
<td>2.8</td>
<td>-</td>
<td>3.3</td>
<td>V</td>
<td></td>
</tr>
<tr>
<td>Input Voltage for Logic</td>
<td>VIH</td>
<td>0.75VDD</td>
<td>-</td>
<td>VDD+</td>
<td>0.3</td>
<td>V</td>
<td></td>
</tr>
<tr>
<td>Output Voltage for Logic</td>
<td>VOH</td>
<td>0.85VDDIO</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>V</td>
<td></td>
</tr>
<tr>
<td>Normal operation mode</td>
<td>IOPR</td>
<td>-</td>
<td>8</td>
<td>14.5</td>
<td>mA</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Current Consumption</td>
<td>IMON</td>
<td>-</td>
<td>3.3</td>
<td>-</td>
<td>mA</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Green mode</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Current Consumption</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sleep mode</td>
<td>ISLP</td>
<td>70</td>
<td>-</td>
<td>120</td>
<td>uA</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Current Consumption</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### 3.3 INTERFACE PIN ASSIGNMENT

#### 3.3.1 TFT PIN ASSIGNMENT

Recommended connector: Omron XF2M-5015-1A

<table>
<thead>
<tr>
<th>Pin NO.</th>
<th>Symbol</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>LEDK</td>
<td>Power supply for Backlight</td>
</tr>
<tr>
<td>2</td>
<td>LEDA</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>NC</td>
<td>Not Connected</td>
</tr>
<tr>
<td>4</td>
<td>GND</td>
<td>Ground</td>
</tr>
<tr>
<td>5</td>
<td>GND</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>VCI</td>
<td>Supply voltage (3.3V)</td>
</tr>
<tr>
<td>7</td>
<td>IOVCC</td>
<td>I/O power supply voltage</td>
</tr>
<tr>
<td>8</td>
<td>NC</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>NC</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>NC</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>NC</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>RESX</td>
<td>Reset pin, active low</td>
</tr>
</tbody>
</table>

| 13-36   | DB23-DB16 (R7-R0) | 24-bit bi-directional data bus. |
|         | DB15-DB8 (G7-G0)  | 24-bit bus: use DB23-DB0 |
|         | DB7-DB0 (B7-B0)   | 16-bit bus: use DB20-DB16, DB13-DB8, DB4-DB0 |
|         |                   | 18-bit bus: use DB21-D16, DB13-DB8, DB5-DB0 |
|         |                   | Please connect unused pins to GND. |

<p>| 37      | NC     | Not Connected |
| 38      | NC     | Not Connected |
| 39      | SCL    | Serial Clock Input |
| 40      | CSX    | Chip select signal. |
|         |        | Low: chip can be accessed; |
|         |        | High: chip cannot be accessed. |
|         |        | If not used, please connect to GND. |
| 41      | SDI (SDA) | Serial data input pin used for the SPI Interface. |
|         |        | SDI : Serial data input pin |
|         |        | SDA : Serial data input/output bidirectional pin |
| 42      | SDO    | Serial data output pin in serial bus system interface. |
|         |        | If not used, please leave this pin open. |
| 43      | VS     | Frame synchronizing signal for RGB (DPI) I/F mode. |
| 44      | HS     | Line synchronizing signal for RGB (DPI) I/F mode. |</p>
<table>
<thead>
<tr>
<th>Pin NO.</th>
<th>Symbol</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>45</td>
<td>DE</td>
<td>Data Enable signal for RGB (DPI) I/F mode. Low: access enabled</td>
</tr>
<tr>
<td>46</td>
<td>PCLK</td>
<td>Pixel clock signal for RGB (DPI) I/F mode.</td>
</tr>
<tr>
<td>47</td>
<td>XR</td>
<td>Not Connected</td>
</tr>
<tr>
<td>48</td>
<td>YD</td>
<td>Not Connected</td>
</tr>
<tr>
<td>49</td>
<td>XL</td>
<td>Not Connected</td>
</tr>
<tr>
<td>50</td>
<td>YU</td>
<td>Not Connected</td>
</tr>
</tbody>
</table>

### 3.3.2 PCT PIN ASSIGNMENT

<table>
<thead>
<tr>
<th>Pin NO.</th>
<th>Symbol</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>GND</td>
<td>Ground</td>
</tr>
<tr>
<td>2</td>
<td>NC</td>
<td>Not Connected</td>
</tr>
<tr>
<td>3</td>
<td>VDD</td>
<td>Supply voltage</td>
</tr>
<tr>
<td>4</td>
<td>SCL</td>
<td>I2C clock input</td>
</tr>
<tr>
<td>5</td>
<td>SDA</td>
<td>I2C data input and output</td>
</tr>
<tr>
<td>6</td>
<td>INT</td>
<td>External interrupt to the host</td>
</tr>
<tr>
<td>7</td>
<td>RST</td>
<td>External Reset, Low is active</td>
</tr>
<tr>
<td>8</td>
<td>GND</td>
<td>Ground</td>
</tr>
</tbody>
</table>
3.4 **TIMING CHARACTERISTICS**

Please refer to IC ILI9806E datasheet for more information

### 3.4.1 Display RGB (DPI) Interface Timing

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbols</th>
<th>Min.</th>
<th>Typ.</th>
<th>Max.</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frame Rate</td>
<td>FR</td>
<td>54</td>
<td>66</td>
<td>-</td>
<td>fps</td>
</tr>
<tr>
<td>Horizontal Low Pulse width</td>
<td>HLW</td>
<td>1</td>
<td>-</td>
<td>-</td>
<td>DOTCLK</td>
</tr>
<tr>
<td>Horizontal Back Porch</td>
<td>HBP</td>
<td>2</td>
<td>126</td>
<td>DOTCLK</td>
<td></td>
</tr>
<tr>
<td>Horizontal Address</td>
<td>HACT</td>
<td>480</td>
<td>840</td>
<td>DOTCLK</td>
<td></td>
</tr>
<tr>
<td>Horizontal Front Porch</td>
<td>HFP</td>
<td>2</td>
<td>-</td>
<td>DOTCLK</td>
<td></td>
</tr>
<tr>
<td>Vertical Low Pulse width</td>
<td>VLW</td>
<td>1</td>
<td>126</td>
<td>Line</td>
<td></td>
</tr>
<tr>
<td>Vertical Back Porch</td>
<td>VBP</td>
<td>1</td>
<td>126</td>
<td>Line</td>
<td></td>
</tr>
<tr>
<td>Vertical Address</td>
<td>VACT</td>
<td>864</td>
<td>1024</td>
<td>Line</td>
<td></td>
</tr>
<tr>
<td>Vertical Front Porch</td>
<td>VFP</td>
<td>1</td>
<td>255</td>
<td>Line</td>
<td></td>
</tr>
<tr>
<td>Data Clock</td>
<td>DCLK</td>
<td>16.6</td>
<td>41.7</td>
<td>MHz</td>
<td></td>
</tr>
</tbody>
</table>

VLW : VSYNC Low pulse Width
HLW : HSYNC Low pulse Width
DTST : Data Transfer Startup Time
Pn : pixel 1, pixel 2…, pixel n.
### 3.4.2 Display Parallel RGB (24/18/16 bit) DPI Interface Timing

<table>
<thead>
<tr>
<th>Signal</th>
<th>Symbol</th>
<th>Parameter</th>
<th>min</th>
<th>max</th>
<th>Unit</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>VS/ HS</td>
<td>tSYNCS</td>
<td>VS/HS setup time</td>
<td>5</td>
<td>-</td>
<td>ns</td>
<td>24/18/16-bit bus RGB interface mode</td>
</tr>
<tr>
<td>DE</td>
<td>tENS</td>
<td>DE setup time</td>
<td>5</td>
<td>-</td>
<td>ns</td>
<td></td>
</tr>
<tr>
<td>DE</td>
<td>tENH</td>
<td>DE hold time</td>
<td>5</td>
<td>-</td>
<td>ns</td>
<td></td>
</tr>
<tr>
<td>DB[23:0]</td>
<td>tPOS</td>
<td>Data setup time</td>
<td>5</td>
<td>-</td>
<td>ns</td>
<td></td>
</tr>
<tr>
<td></td>
<td>tPDH</td>
<td>Data hold time</td>
<td>5</td>
<td>-</td>
<td>ns</td>
<td></td>
</tr>
<tr>
<td>PCLK</td>
<td>PWDH</td>
<td>PCLK high-level period</td>
<td>13</td>
<td>-</td>
<td>ns</td>
<td></td>
</tr>
<tr>
<td>PCLK</td>
<td>PWDL</td>
<td>PCLK low-level period</td>
<td>13</td>
<td>-</td>
<td>ns</td>
<td></td>
</tr>
<tr>
<td></td>
<td>tCYCD</td>
<td>PCLK cycle time</td>
<td>28</td>
<td>-</td>
<td>ns</td>
<td></td>
</tr>
<tr>
<td></td>
<td>trgbr, trgbf</td>
<td>PCLK, HS, VS rise/fall time</td>
<td>-</td>
<td>15</td>
<td>ns</td>
<td></td>
</tr>
</tbody>
</table>

**Note:** Ta = -30 to 70°C, IOVCC = 1.65V to 3.6V, VCI = 2.5V to 3.6V, GND = 0V
3.4.3 Display Serial Interface Timing characteristics (3-line SPI System)

<table>
<thead>
<tr>
<th>Signal</th>
<th>Symbol</th>
<th>Description</th>
<th>Parameter</th>
<th>min</th>
<th>max</th>
<th>Unit</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>CSX</td>
<td>tcss</td>
<td>Chip select time (Write)</td>
<td></td>
<td>15</td>
<td>-</td>
<td>ns</td>
<td></td>
</tr>
<tr>
<td></td>
<td>tcsh</td>
<td>Chip select hold time (Read)</td>
<td></td>
<td>15</td>
<td>-</td>
<td>ns</td>
<td></td>
</tr>
<tr>
<td></td>
<td>tcw</td>
<td>CS “H” pulse width</td>
<td></td>
<td>40</td>
<td>-</td>
<td>ns</td>
<td></td>
</tr>
<tr>
<td>SCL</td>
<td>twc</td>
<td>Serial clock cycle (Write)</td>
<td></td>
<td>30</td>
<td>-</td>
<td>ns</td>
<td></td>
</tr>
<tr>
<td></td>
<td>twlh</td>
<td>SCL “H” pulse width (Write)</td>
<td></td>
<td>10</td>
<td>-</td>
<td>ns</td>
<td></td>
</tr>
<tr>
<td></td>
<td>twrl</td>
<td>SCL “L” pulse width (Write)</td>
<td></td>
<td>10</td>
<td>-</td>
<td>ns</td>
<td></td>
</tr>
<tr>
<td></td>
<td>trc</td>
<td>Serial clock cycle (Read)</td>
<td></td>
<td>150</td>
<td>-</td>
<td>ns</td>
<td></td>
</tr>
<tr>
<td></td>
<td>trdh</td>
<td>SCL “H” pulse width (Read)</td>
<td></td>
<td>60</td>
<td>-</td>
<td>ns</td>
<td></td>
</tr>
<tr>
<td></td>
<td>trdl</td>
<td>SCL “L” pulse width (Read)</td>
<td></td>
<td>60</td>
<td>-</td>
<td>ns</td>
<td></td>
</tr>
<tr>
<td>SDA/SDO (Output)</td>
<td>tacc</td>
<td>Access time (Read)</td>
<td></td>
<td>10</td>
<td>100</td>
<td>ns</td>
<td>For maximum CL=30pF</td>
</tr>
<tr>
<td></td>
<td>toh</td>
<td>Output disable time (Read)</td>
<td></td>
<td>15</td>
<td>100</td>
<td>ns</td>
<td>For minimum CL=8pF</td>
</tr>
<tr>
<td>SDA/SDI (Input)</td>
<td>tds</td>
<td>Data setup time (Write)</td>
<td></td>
<td>10</td>
<td>-</td>
<td>ns</td>
<td></td>
</tr>
<tr>
<td></td>
<td>tdh</td>
<td>Data hold time (Write)</td>
<td></td>
<td>10</td>
<td>-</td>
<td>ns</td>
<td></td>
</tr>
</tbody>
</table>
3.4.4 PCT I2C Interface Timing

GT970 provides a standard I2C communication interface for SCL and SDA to communicate with the host. GT970 always serves as slave device in the system with all communication being initialized by the host. It is strongly recommended that transmission rate be kept at or below 400Kbps. The I2C timing is shown below:

Test condition 1: 1.8V host interface voltage, 400Kbps transmission rate, 2K pull-up resistor

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Min.</th>
<th>Max.</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>SCL low period</td>
<td>t_{lo}</td>
<td>1.3</td>
<td>-</td>
<td>us</td>
</tr>
<tr>
<td>SCL high period</td>
<td>t_{hi}</td>
<td>0.6</td>
<td>-</td>
<td>us</td>
</tr>
<tr>
<td>SCL setup time for START condition</td>
<td>t_{st1}</td>
<td>0.6</td>
<td>-</td>
<td>us</td>
</tr>
<tr>
<td>SCL setup time for STOP condition</td>
<td>t_{st3}</td>
<td>0.6</td>
<td>-</td>
<td>us</td>
</tr>
<tr>
<td>SCL hold time for START condition</td>
<td>t_{hd1}</td>
<td>0.6</td>
<td>-</td>
<td>us</td>
</tr>
<tr>
<td>SDA setup time</td>
<td>t_{sd2}</td>
<td>0.1</td>
<td>-</td>
<td>us</td>
</tr>
<tr>
<td>SDA hold time</td>
<td>t_{hd2}</td>
<td>0</td>
<td>-</td>
<td>us</td>
</tr>
</tbody>
</table>

Test condition 2: 3.3V host interface voltage, 400Kbps transmission rate, 2K pull-up resistor

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Min.</th>
<th>Max.</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>SCL low period</td>
<td>t_{lo}</td>
<td>1.3</td>
<td>-</td>
<td>us</td>
</tr>
<tr>
<td>SCL high period</td>
<td>t_{hi}</td>
<td>0.6</td>
<td>-</td>
<td>us</td>
</tr>
<tr>
<td>SCL setup time for START condition</td>
<td>t_{st1}</td>
<td>0.6</td>
<td>-</td>
<td>us</td>
</tr>
<tr>
<td>SCL setup time for STOP condition</td>
<td>t_{st3}</td>
<td>0.6</td>
<td>-</td>
<td>us</td>
</tr>
<tr>
<td>SCL hold time for START condition</td>
<td>t_{hd1}</td>
<td>0.6</td>
<td>-</td>
<td>us</td>
</tr>
<tr>
<td>SDA setup time</td>
<td>t_{sd2}</td>
<td>0.1</td>
<td>-</td>
<td>us</td>
</tr>
<tr>
<td>SDA hold time</td>
<td>t_{hd2}</td>
<td>0</td>
<td>-</td>
<td>us</td>
</tr>
</tbody>
</table>
GT970 supports two I2C slave addresses: 0XBA/0XBB and 0x28/0x29. The host can select the address by changing the status of Reset and INT pins during the power-on initialization phase. See the diagram below for configuration methods and timings:

Power-On Timing:

Timing for host resetting GT970:

Timing for setting slave address to 0x28/0x29:
Timing for setting slave address to 0XBA/0XBB:

A) Data Transmission
(For example: device address is 0xBA/0xBB)
Communication is always initiated by the host. Valid Start condition is signalled by pulling SDA line from “high” to “low” when SCL line is “high”. Data flow or address is transmitted after the Start condition.

All slave devices connected to I2C bus should detect the 8-bit address issued after Start condition and send the correct ACK. After receiving matching address, GT970 acknowledges by configuring SDA line as output port and pulling SDA line low during the ninth SCL cycle. When receiving unmatched address, namely, not 0XBA or 0XBB, GT970 will stay in an idle state.

For data bytes on SDA, each of 9 serial bits will be sent on nine SCL cycles. Each data byte consists of 8 valid data bits and one ACK or NACK bit sent by the recipient. The data transmission is valid when SCL line is “high”.

When communication is completed, the host will issue the STOP condition. Stop condition implies the transition of SDA line from “low” to “high” when SCL line is “high”.

B) Writing Data to GT970
(For example: device address is 0xBA/0xBB)

The diagram above displays the timing sequence of the host writing data onto GT970. First, the host issues a Start condition. Then, the host sends 0XBA (address bits and R/W bit; R/W bit as 0 indicates Write operation) to the slave device.
After receiving ACK, the host sends the 16-bit register address (where writing starts) and the 8-bit data bytes (to be written onto the register).

The location of the register address pointer will automatically add 1 after every Write Operation. Therefore, when the host needs to perform Write Operations on a group of registers of continuous addresses, it is able to write continuously. The Write Operation is terminated when the host issues the Stop condition.

C) Reading Data from GT970
(For example: device address is 0xBA/0xBB)

The diagram above is the timing sequence of the host reading data from GT970. First, the host issues a Start condition and sends 0XBA (address bits and R/W bit; R/W bit as 0 indicates Write operation) to the slave device.

After receiving ACK, the host sends the 16-bit register address (where reading starts) to the slave device. Then the host sets register addresses which need to be read. After receiving ACK, the host issues the Start condition once again and sends 0XBB (Read Operation). After receiving ACK, the host starts to read data.

GT970 also supports continuous Read Operation and, by default, reads data continuously. Whenever receiving a byte of data, the host sends an ACK signal indicating successful reception. After receiving the last byte of data, the host sends a NACK signal followed by a STOP condition which terminates communication.
3.5 POWER SEQUENCE

3.5.1 RESET Input Timing

![Diagram of RESET Input Timing]

**Figure 102 Reset Timing**

<table>
<thead>
<tr>
<th>Signal</th>
<th>Symbol</th>
<th>Parameter</th>
<th>Min</th>
<th>Max</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>RESX</td>
<td>tRW</td>
<td>Reset pulse duration</td>
<td>10</td>
<td>5(note 1.5)</td>
<td>us</td>
</tr>
<tr>
<td></td>
<td>tRT</td>
<td>Reset cancel</td>
<td>120 (note 1,6,7)</td>
<td>ms</td>
<td></td>
</tr>
</tbody>
</table>

Note:
1. The reset cancel includes also required time for loading 1D bytes, VCOM setting and other settings from OTP to registers. This loading is done every time when there is H/W reset cancel time (tRT) within 5 ms after a rising edge of RESX.
2. Spike due to an electrostatic discharge on RESX line does not cause irregular system reset according to the Table 43.

**Table 42 Reset Descript**

<table>
<thead>
<tr>
<th>RESX Pulse</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shorter than 5us</td>
<td>Reset Rejected</td>
</tr>
<tr>
<td>Longer than 9us</td>
<td>Reset</td>
</tr>
<tr>
<td>Between 5us and 9us</td>
<td>Reset starts</td>
</tr>
</tbody>
</table>

3. During the Resetting period, the display will be blanked (The display is entering blanking sequence, which maximum time is 120 ms, when Reset Starts in Sleep Out mode. The display remains the blank state in Sleep In mode.) and then return to Default condition for Hardware Reset.
4. Spike Rejection also applies during a valid reset pulse as shown below:

![Diagram of Positive Noise Pulse during Reset Low]

**Figure 103 Positive Noise Pulse during Reset Low**

5. When Reset applied during Sleep In Mode.
6. When Reset applied during Sleep Out Mode.
7. It is necessary to wait 5msec after releasing RESX before sending commands. Also Sleep Out command cannot be sent for 120msec.

3.5.2 Power on/off Sequence

Please refer to IC ILI9806E datasheet.
## 4 OPTICAL SPECIFICATION

### 4.1 OPTICAL CHARACTERISTICS

Driving condition: \( V_{CI} = 3.3V, V_{SS} = 0V \)

Backlight: \( I_{F} = 20mA \)

Measured temperature: \( T_a = 25^\circ C \)

<table>
<thead>
<tr>
<th>Item</th>
<th>Symbol</th>
<th>Condition</th>
<th>MIN</th>
<th>TYP</th>
<th>MAX</th>
<th>Unit</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>Response Time</td>
<td>TR+TF</td>
<td>( \theta = \phi = 0^\circ ) Normal Viewing Angle</td>
<td>-</td>
<td>30</td>
<td>45</td>
<td>ms</td>
<td>2</td>
</tr>
<tr>
<td>Contrast Ratio</td>
<td>CR</td>
<td></td>
<td>-</td>
<td>800</td>
<td>-</td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>Viewing Angle</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Left</td>
<td>( \theta_L )</td>
<td>CR ( \geq 10 )</td>
<td>-</td>
<td>80</td>
<td>-</td>
<td>deg</td>
<td>4</td>
</tr>
<tr>
<td>Right</td>
<td>( \theta_R )</td>
<td>CR ( \geq 10 )</td>
<td>-</td>
<td>80</td>
<td>-</td>
<td>deg</td>
<td></td>
</tr>
<tr>
<td>Up</td>
<td>( \phi_U )</td>
<td>CR ( \geq 10 )</td>
<td>-</td>
<td>80</td>
<td>-</td>
<td>deg</td>
<td></td>
</tr>
<tr>
<td>Down</td>
<td>( \phi_D )</td>
<td></td>
<td>-</td>
<td>80</td>
<td>-</td>
<td>deg</td>
<td></td>
</tr>
<tr>
<td>Colour Chromaticity</td>
<td></td>
<td>CR ( \geq 10 )</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Red</td>
<td>Rx</td>
<td>0.616 0.317</td>
<td>0.656 0.357</td>
<td>-</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Ry</td>
<td>0.636 0.337</td>
<td>0.667 0.375</td>
<td>-</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Green</td>
<td>Gx</td>
<td>0.300 0.587</td>
<td>0.340 0.627</td>
<td>-</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Gy</td>
<td>0.320 0.607</td>
<td>0.340 0.627</td>
<td>-</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Blue</td>
<td>Bx</td>
<td>0.127 0.033</td>
<td>0.167 0.073</td>
<td>-</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>By</td>
<td>0.147 0.053</td>
<td>0.167 0.073</td>
<td>-</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>White</td>
<td>Wx</td>
<td>0.285 0.033</td>
<td>0.325 0.073</td>
<td>-</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Wy</td>
<td>0.326 0.325</td>
<td>0.366 0.386</td>
<td>-</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Centre Brightness</td>
<td></td>
<td>I_{F} = 20mA</td>
<td>400</td>
<td>450</td>
<td>-</td>
<td>cd/m²</td>
<td>6</td>
</tr>
<tr>
<td>Brightness Distribution</td>
<td></td>
<td></td>
<td>80</td>
<td>-</td>
<td>-</td>
<td>%</td>
<td>7</td>
</tr>
</tbody>
</table>
### 4.1.1 Test Method

<table>
<thead>
<tr>
<th>Note</th>
<th>Item</th>
<th>Test method</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Setup</td>
<td>The display should be stabilised at a given temperature for 30 minutes to avoid abrupt temperature change during measuring. In order to stabilise the luminance, measurements should be executed after lighting the backlight for 30 minutes in a windless room.</td>
</tr>
<tr>
<td>2</td>
<td>Response time</td>
<td>Measure output signal waveform by the luminance meter when raster of window pattern is changed from white to black and from black to white.</td>
</tr>
<tr>
<td>3</td>
<td>Contrast ratio</td>
<td>Measure maximum brightness and minimum brightness at the centre of the screen by displaying raster or window pattern. Then calculate the contrast ratio between these values.</td>
</tr>
</tbody>
</table>
|      |                  | **Contrast Ratio (CR) =** \[
\frac{\text{Brightness of unselected position (white)}}{\text{Brightness of selected position (black)}}\] |
| 4    | Viewing angle | Move the luminance meter from right to left and up and down and determinate the angles where contrast ratio is 10 |
|      | Horizontal \( \theta \) | |
|      | Vertical \( \phi \) | |
| 5    | Colour chromaticity | Measure chromaticity coordinates \( x \) and \( y \) of CIE1931 colorimetric system |
| 6    | Centre brightness | Measure the brightness at the centre of the screen |
| 7    | Brightness distribution | (Brightness distribution) = 100 \times \frac{B}{A} \% |
|      |                  | A: max. brightness of the 9 points |
|      |                  | B: min. brightness of the 9 points |
5 BACKLIGHT SPECIFICATION

5.1 LED DRIVING CONDITIONS

The backlight system is edge-lighting type with 8 chips White LED

| Item             | Symbol | Condition   | Min | Typ | Max | Unit
|------------------|--------|-------------|-----|-----|-----|------
| Forward Current  | IF     | Ta=25 °C,  | 15  | 20  | -   | mA   |
| Forward Voltage  | VF     | Ta= 25°C,  |     |     | 25.6| V    |
| LED life time    | Hr     | Ta= 25°C,  | -   |     | 50000| Hour |

Note:
- The lifetime of the LED is defined as a period till the brightness of the LED decreases to the half of its initial value.
- This figure is given as a reference purpose only, and not a guarantee.
- This figure is estimated for an LED operating alone.
  The performance of an LED may differ when assembled as a monitor together with a TFT panel due to different environmental temperature.
- Estimated lifetime could vary on a different temperature and usually higher temperature could reduce the life significantly.

5.2 LED CIRCUIT

![LED Circuit Diagram]
6 QUALITY ASSURANCE SPECIFICATION

6.1 DELIVERY INSPECTION STANDARDS

6.1.1 Inspection Conditions
Inspection distance: 30 cm ± 2 cm
Viewing angle: ±45°

6.1.2 Environmental Conditions
Ambient temperature: 25°C ±5°C
Ambient humidity: 65±10% RH
Ambient illumination: 300~700 lux

6.1.3 Sampling Conditions
1. Lot size: quantity of shipment lot per model
2. Sampling method:

<table>
<thead>
<tr>
<th>Sampling Plan</th>
<th>GB/T 2828-2003</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Normal inspection, Single Sampling, Class II</td>
</tr>
<tr>
<td>AQL</td>
<td></td>
</tr>
<tr>
<td>Major Defect</td>
<td>0.65%</td>
</tr>
<tr>
<td>Minor Defect</td>
<td>1.5%</td>
</tr>
</tbody>
</table>

6.1.4 Definition of Area
A zone: active area
B zone: viewing area

6.1.5 Basic Principle
A set of sample to indicate the limit of acceptable quality level shall be discussed should a dispute occur.
### 6.1.6 Inspection Criteria

<table>
<thead>
<tr>
<th>Number</th>
<th>Items</th>
<th>Criteria (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.0</td>
<td>LCD Crack/Broken</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(1) The edge of LCD broken</td>
<td><img src="image1.png" alt="Diagram" /></td>
</tr>
<tr>
<td></td>
<td>$X \leq 3.0 \text{mm}$</td>
<td><img src="image2.png" alt="Diagram" /></td>
</tr>
<tr>
<td></td>
<td>$Y &lt; \text{Inner border line of the seal}$</td>
<td></td>
</tr>
<tr>
<td></td>
<td>$Z \leq T$</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(2) LCD corner broken</td>
<td></td>
</tr>
<tr>
<td></td>
<td>$X \leq 3.0 \text{mm}$</td>
<td></td>
</tr>
<tr>
<td></td>
<td>$Y \leq L$</td>
<td></td>
</tr>
<tr>
<td></td>
<td>$Z \leq T$</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(3) LCD crack</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Crack Not allowed</td>
<td></td>
</tr>
<tr>
<td>Number</td>
<td>Items</td>
<td>Criteria (mm)</td>
</tr>
<tr>
<td>--------</td>
<td>----------------------------------------------------------------------</td>
<td>---------------</td>
</tr>
<tr>
<td>2.0</td>
<td>Spot defect</td>
<td></td>
</tr>
<tr>
<td></td>
<td>① light dot (LCD/TP/Polarizer black/white spot, light dot, pinhole, dent, stain)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Zone</td>
<td>Acceptable Qty</td>
</tr>
<tr>
<td></td>
<td>Size (mm)</td>
<td>A</td>
</tr>
<tr>
<td></td>
<td>$\phi \leq 0.10$</td>
<td>Ignore</td>
</tr>
<tr>
<td></td>
<td>$0.10 &lt; \phi \leq 0.20$</td>
<td>3 (distance $\geq 10$mm)</td>
</tr>
<tr>
<td></td>
<td>$0.20 &lt; \phi \leq 0.25$</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>$\phi &gt; 0.25$</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>$\phi = (X + Y)/2$</td>
<td>Ignore</td>
</tr>
<tr>
<td></td>
<td>② Dim spot (LCD/TP/Polarizer dim dot, light leakage, dark spot)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Zone</td>
<td>Acceptable Qty</td>
</tr>
<tr>
<td></td>
<td>Size (mm)</td>
<td>A</td>
</tr>
<tr>
<td></td>
<td>$\phi \leq 0.1$</td>
<td>Ignore</td>
</tr>
<tr>
<td></td>
<td>$0.10 &lt; \phi \leq 0.20$</td>
<td>3 (distance $\geq 10$mm)</td>
</tr>
<tr>
<td></td>
<td>$0.20 &lt; \phi \leq 0.30$</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>$\phi &gt; 0.30$</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>③ Polarizer accidented spot</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Zone</td>
<td>Acceptable Qty</td>
</tr>
<tr>
<td></td>
<td>Size (mm)</td>
<td>A</td>
</tr>
<tr>
<td></td>
<td>$\phi \leq 0.2$</td>
<td>Ignore</td>
</tr>
<tr>
<td></td>
<td>$0.3 &lt; \phi \leq 0.5$</td>
<td>2 (distance $\geq 10$mm)</td>
</tr>
<tr>
<td></td>
<td>$\phi &gt; 0.5$</td>
<td>Ignore</td>
</tr>
</tbody>
</table>

|                     | Line defect (LCD/TP/Polarizer black/white line, scratch, stain)      |               |   |
|                     | Width (mm)                                                           | Length (mm)   |   |
|                     | $\phi \leq 0.03$                                                    | Ignore       |   |
|                     | $0.03 < W \leq 0.05$                                                | $L \leq 3.0$ | $N \leq 2$ |
|                     | $0.05 < W \leq 0.08$                                                | $L \leq 2.0$ | $N \leq 2$ |
|                     | $0.08 < W$                                                          | Define as spot defect |   |

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### Polarizer Bubble

<table>
<thead>
<tr>
<th>Zone</th>
<th>Acceptable Qty</th>
</tr>
</thead>
<tbody>
<tr>
<td>Size (mm)</td>
<td>A</td>
</tr>
<tr>
<td>$\Phi &lt; 0.2$</td>
<td>Ignore</td>
</tr>
<tr>
<td>$0.2 &lt; \Phi \leq 0.4$</td>
<td>3 (distance $\geq 10$ m)</td>
</tr>
<tr>
<td>$0.4 &lt; \Phi \leq 0.6$</td>
<td>2</td>
</tr>
<tr>
<td>$0.6 &lt; \Phi$</td>
<td>0</td>
</tr>
</tbody>
</table>

### SMT

According to IPC-A-610C class II standard. Function defect and missing part are major defect, the others are minor defect.

<table>
<thead>
<tr>
<th>TP bubble/accidented spot</th>
<th>Acceptable Qty</th>
</tr>
</thead>
<tbody>
<tr>
<td>Size $\Phi$(mm)</td>
<td>A</td>
</tr>
<tr>
<td>$\Phi &lt; 0.1$</td>
<td>Ignore</td>
</tr>
<tr>
<td>$0.1 &lt; \Phi \leq 0.25$</td>
<td>Ignore</td>
</tr>
<tr>
<td>$0.25 &lt; \Phi \leq 0.3$</td>
<td>2</td>
</tr>
<tr>
<td>$0.3 &lt; \Phi$</td>
<td>0</td>
</tr>
</tbody>
</table>

Assembly deflection beyond the edge of backlight $\leq 0.15$ mm
5.0 TP Related

Newton Ring

Newton Ring area > 1/3 TP area NG
Newton Ring area ≤ 1/3 TP area OK

<table>
<thead>
<tr>
<th>TP corner broken</th>
<th>X</th>
<th>Y</th>
<th>Z</th>
</tr>
</thead>
<tbody>
<tr>
<td>X: length</td>
<td>X ≤ 3.0 mm</td>
<td>Y ≤ 3.0 mm</td>
<td>Z &lt; LCD thickness</td>
</tr>
<tr>
<td>Y: width</td>
<td>* Circuitry broken is not allowed.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Z: height</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>TP edge broken</th>
<th>X</th>
<th>Y</th>
<th>Z</th>
</tr>
</thead>
<tbody>
<tr>
<td>X: length</td>
<td>X ≤ 6.0 mm</td>
<td>Y ≤ 2.0 mm</td>
<td>Z &lt; LCD thickness</td>
</tr>
<tr>
<td>Y: width</td>
<td>* Circuitry broken is not allowed.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Z: height</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Number</th>
<th>Items</th>
<th>Criteria (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>No display</td>
<td>Not allowed</td>
</tr>
<tr>
<td>2</td>
<td>Missing segment</td>
<td>Not allowed</td>
</tr>
<tr>
<td>3</td>
<td>Short</td>
<td>Not allowed</td>
</tr>
<tr>
<td>4</td>
<td>Backlight no lighting</td>
<td>Not allowed</td>
</tr>
<tr>
<td>5</td>
<td>TP no function</td>
<td>Not allowed</td>
</tr>
</tbody>
</table>
6.2 DEALING WITH CUSTOMER COMPLAINTS

6.2.1 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.

6.2.2 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.
# 7 RELIABILITY SPECIFICATION

## 7.1 RELIABILITY TESTS

<table>
<thead>
<tr>
<th>Test Item</th>
<th>Test Condition</th>
<th>Sample Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>Durability Test</td>
<td></td>
<td></td>
</tr>
<tr>
<td>High Temperature Operation</td>
<td>Ta= 70°C, 96h</td>
<td>3pcs</td>
</tr>
<tr>
<td>Low Temperature Operation</td>
<td>Ta=-20°C, 96h</td>
<td>3pcs</td>
</tr>
<tr>
<td>Temperature Cycle Operation</td>
<td>-20°C ↔ 70°C ON/OFF, 20 cycles. ON time over 10 seconds, OFF time over 10 seconds</td>
<td>3pcs</td>
</tr>
<tr>
<td>High Temperature Storage</td>
<td>Tp= 80°C, 96h</td>
<td>3pcs</td>
</tr>
<tr>
<td>Low Temperature Storage</td>
<td>Tp=-30°C, 96h</td>
<td>3pcs</td>
</tr>
<tr>
<td>ESD Test</td>
<td>150pF, 330Ω, ±6KV (Contact)/±8KV (Air), 5 Points/panel, 10 times/point</td>
<td>3pcs</td>
</tr>
<tr>
<td>Thermal Shock Resistance</td>
<td>The sample should be allowed to stand the following 5 cycles of operation: LTS for 30 minutes -&gt; normal temperature for 5 minutes -&gt; HTS for 30 minutes -&gt; normal temperature for 5 minutes, as one cycle, then taking it out and drying it at normal temperature, and allowing it stand for 24 hours</td>
<td>3pcs</td>
</tr>
<tr>
<td>Box Drop Test</td>
<td>1 Corner 3 Edges 6 faces, 66 cm (Medium Box)</td>
<td>1 box</td>
</tr>
</tbody>
</table>

Note: Ta=ambient temperature Tp= Panel temperature

Notes:
1. No dew condensation to be observed.
2. The function test shall be conducted after 4 hours storage at the normal temperature and humidity after removed from the test chamber.
3. No cosmetic or functional defects should be allowed.
4. Total current consumption should be less than twice the initial value.
8 HANDLING PRECAUTIONS

Safety
If the LCD panel breaks, be careful not to get the liquid crystal fluid in your mouth or in your eyes. If the liquid crystal touches your skin or clothes, wash it off immediately using soap and plenty of water.

Mounting and Design
Place a transparent plate (e.g. acrylic, polycarbonate or glass) on the display surface to protect the display from external pressure. Leave a small gap between the transparent plate and the display surface.
When assembling with a zebra connector, clean the surface of the pads with alcohol and keep the surrounding air very clean.
Design the system so that no input signal is given unless the power supply voltage is applied.

Caution during LCD cleaning
Lightly wipe the display surface with a soft cloth soaked with Isopropyl alcohol, Ethyl alcohol or Trichlorotrifluoroethane.
Do not wipe the display surface with dry or hard materials that will damage the polariser surface.
Do not use aromatic solvents (toluene and xylene), or ketonic solvents (ketone and acetone).

Caution against static charge
As the display uses C-MOS LSI drivers, connect any unused input terminal to VDD or VSS. Do not input any signals before power is turned on. Also, ground your body, work/assembly table and assembly equipment to protect against static electricity.

Packaging
Displays use LCD elements, and must be treated as such. Avoid strong shock and drop from a height.
To prevent displays from degradation, do not operate or store them exposed directly to sunshine or high temperature/humidity.

Caution during operation
It is indispensable to drive the display within the specified voltage limit since excessive voltage shortens its life. 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. 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. If the display area is pushed on hard during operation, some graphics will be abnormally displayed but returns to a normal condition after turning off the display once. Even a small amount of condensation on the contact pads (terminals) can cause an electro-chemical reaction which causes missing rows and columns. Give careful attention to avoid condensation.

Storage
Store the display in a dark place where the temperature is 25°C ± 10°C and the humidity below 50%RH. Store the display in a clean environment, free from dust, organic solvents and corrosive gases.
Do not crash, shake or jolt the display (including accessories).