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Customer __________________________

Date ______________________________

By ________________________________

☐ PVI’s Confirmation

Confirmed By _______________________

Prepared By _______________________
## Revision History

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<th>Issued Date</th>
<th>Revised Date</th>
<th>Contents</th>
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<td>1.0</td>
<td>Jan. 7.2008</td>
<td>New</td>
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<tr>
<td>2.0</td>
<td>March 24.2008</td>
<td>Add Page 23 11. Handling Cautions 11-1 item d)</td>
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<tr>
<td>3.0</td>
<td>Oct. 31.2008</td>
<td>Page 5 4. Mechanical Drawing of TFT-LCD Module Add UL Label on outline drawing</td>
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## TECHNICAL SPECIFICATION

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<td>27</td>
</tr>
<tr>
<td>14</td>
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<td>28</td>
</tr>
</tbody>
</table>
1. Application
This technical specification applies to 5” color TFT-LCD module, PA050XSH. The applications of the panel are portable DVD, GPS, multimedia applications and others AV system.

2. Features

. Compatible with NTSC & PAL system

. Amorphous silicon TFT LCD panel with LED back-light unit

. Pixel in stripe configuration

. Slim and compact

. Image Reversal: Up/Down and Left/Right

3. Mechanical Specifications

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Specifications</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Screen Size</td>
<td>5 (diagonal)</td>
<td>inch</td>
</tr>
<tr>
<td>Display Format</td>
<td>320x(RGB)x234</td>
<td>dot</td>
</tr>
<tr>
<td>Active Area</td>
<td>102.72(H) × 74.529(V)</td>
<td>mm</td>
</tr>
<tr>
<td>Pixel Pitch</td>
<td>0.321 (H) × 0.3185 (V)</td>
<td>mm</td>
</tr>
<tr>
<td>Pixel Configuration</td>
<td>Stripe</td>
<td></td>
</tr>
<tr>
<td>Back-light</td>
<td>15-LED</td>
<td></td>
</tr>
<tr>
<td>Outline Dimension</td>
<td>119.30(W)× 91.40(H)× 7.50(D)(typ.)</td>
<td>mm</td>
</tr>
<tr>
<td>Surface Treatment</td>
<td>Anti – Glare+EWV</td>
<td></td>
</tr>
<tr>
<td>Weight</td>
<td>116±5</td>
<td>g</td>
</tr>
<tr>
<td>Display mode</td>
<td>Normally white</td>
<td></td>
</tr>
<tr>
<td>Gray scale inversion direction</td>
<td>6 o’clock</td>
<td></td>
</tr>
</tbody>
</table>

[ ref to Note 10-1 ]
4. Mechanical Drawing of TFT-LCD Module
### 5. Input / Output Terminals

TFT-LCD Module Connector  
FPC Down Connect, 30Pins, Pitch: 0.5 mm

<table>
<thead>
<tr>
<th>Pin No</th>
<th>Symbol</th>
<th>I/O</th>
<th>Description</th>
<th>Remark</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>DIO1</td>
<td>I/O</td>
<td>Vertical start pulse</td>
<td>Note 5 – 4</td>
</tr>
<tr>
<td>2</td>
<td>CPV</td>
<td>I</td>
<td>Shift clock for gate driver</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>VGL</td>
<td>I</td>
<td>Power for gate driver (AC voltage)</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>NC</td>
<td>-</td>
<td>No connection</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>NC</td>
<td>-</td>
<td>No connection</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>NC</td>
<td>-</td>
<td>No connection</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>XOE</td>
<td>I</td>
<td>Output enable for gate driver</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>VSS</td>
<td>-</td>
<td>Ground for digital circuit</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>VCC</td>
<td>I</td>
<td>Supply voltage for logic control circuit for gate driver</td>
<td>Note 5 – 2</td>
</tr>
<tr>
<td>10</td>
<td>NC</td>
<td>-</td>
<td>No connection</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>VGH</td>
<td>I</td>
<td>Positive power for gate driver</td>
<td>Note 5 – 3</td>
</tr>
<tr>
<td>12</td>
<td>NC</td>
<td>-</td>
<td>No connection</td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>U/D</td>
<td>I</td>
<td>Up/Down control for gate driver</td>
<td>Note 5 – 4</td>
</tr>
<tr>
<td>14</td>
<td>DIO2</td>
<td>I/O</td>
<td>Vertical start pulse</td>
<td>Note 5 – 4</td>
</tr>
<tr>
<td>15</td>
<td>VCOM</td>
<td>I</td>
<td>Common electrode voltage</td>
<td>Note 5 – 1</td>
</tr>
<tr>
<td>16</td>
<td>STH1</td>
<td>I/O</td>
<td>Start pulse for source driver</td>
<td>Note 5 – 4</td>
</tr>
<tr>
<td>17</td>
<td>VDD1</td>
<td>I</td>
<td>Supply power for digital circuit</td>
<td>Note 5 – 2</td>
</tr>
<tr>
<td>18</td>
<td>VSS1</td>
<td>-</td>
<td>Ground for digital circuit</td>
<td></td>
</tr>
<tr>
<td>19</td>
<td>VDD2</td>
<td>I</td>
<td>Supply power for analog circuit</td>
<td>Note 5 – 2</td>
</tr>
<tr>
<td>20</td>
<td>VSS2</td>
<td>-</td>
<td>Ground for analog circuit</td>
<td></td>
</tr>
<tr>
<td>21</td>
<td>R/L</td>
<td>I</td>
<td>Left/Right control for source driver</td>
<td>Note 5 – 4</td>
</tr>
<tr>
<td>22</td>
<td>VR</td>
<td>I</td>
<td>Video input R</td>
<td>Note 5 – 1</td>
</tr>
<tr>
<td>23</td>
<td>VG</td>
<td>I</td>
<td>Video input G</td>
<td></td>
</tr>
<tr>
<td>24</td>
<td>VB</td>
<td>I</td>
<td>Video input B</td>
<td></td>
</tr>
<tr>
<td>25</td>
<td>CPH1</td>
<td>I</td>
<td>Sampling and shift clock for source driver</td>
<td>Note 5 – 5</td>
</tr>
<tr>
<td>26</td>
<td>CPH2</td>
<td>I</td>
<td>Sampling and shift clock for source driver</td>
<td></td>
</tr>
<tr>
<td>27</td>
<td>CPH3</td>
<td>I</td>
<td>Sampling and shift clock for source driver</td>
<td></td>
</tr>
<tr>
<td>28</td>
<td>STH2</td>
<td>I/O</td>
<td>Start pulse for source driver</td>
<td>Note 5 – 4</td>
</tr>
<tr>
<td>29</td>
<td>OEH</td>
<td>I</td>
<td>Output enable for source driver</td>
<td></td>
</tr>
<tr>
<td>30</td>
<td>NC</td>
<td>-</td>
<td>No connection</td>
<td></td>
</tr>
</tbody>
</table>
Note 5 – 1: $V_{COM} = 6V_{PP}$.  
Phase of the video signal input and $V_{COM}$  
The relation between these values could refer to 8-1 Operating condition.

Liquid crystal transmission of the video signal input, $V_{COM}$ and timing

<table>
<thead>
<tr>
<th></th>
<th>( V_{COM} )</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>H Level</td>
</tr>
<tr>
<td>Video Signal Input Maximum</td>
<td>Black</td>
</tr>
<tr>
<td>Video Signal Input Minimum</td>
<td>White</td>
</tr>
</tbody>
</table>

White: maximum transmission / Black: minimum transmission

Note 5 – 2: \( V_{DD1}, V_{CC} = +3.3V, V_{DD2} = +5V \) (Typ.)

Note 5 – 3: \( V_{GH} = +17V \) (Typ.).
Note 5 – 4: STH1, STH2 and R/L mode

<table>
<thead>
<tr>
<th>R/L</th>
<th>STH1</th>
<th>STH2</th>
<th>Remark</th>
</tr>
</thead>
<tbody>
<tr>
<td>High(VDD)</td>
<td>Input</td>
<td>Output</td>
<td>Left to Right</td>
</tr>
<tr>
<td>Low(0 Volt.)</td>
<td>Output</td>
<td>Input</td>
<td>Right to Left</td>
</tr>
</tbody>
</table>

U/D (PIN 13) = High, R/L (PIN 21) = High

U/D (PIN 13) = Low, R/L (PIN 21) = Low

DIO1, DIO2, and U/D mode

<table>
<thead>
<tr>
<th>U/D</th>
<th>DIO1</th>
<th>DIO2</th>
<th>Remark</th>
</tr>
</thead>
<tbody>
<tr>
<td>High(VDD)</td>
<td>Input</td>
<td>Output</td>
<td>Up to Down</td>
</tr>
<tr>
<td>Low(0 Volt.)</td>
<td>Output</td>
<td>Input</td>
<td>Down to Up</td>
</tr>
</tbody>
</table>

Note 5 – 5: The CPH1 reference Fig.8-1 Sampling clock timing CPH2 and CPH3 connect GND.

6. Pixel Arrangement and input connector pin NO.
7. Absolute Maximum Ratings:
7-1) The followings are maximum values, which if exceeded, may cause faulty operation or damage to the unit.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>MIN.</th>
<th>MAX.</th>
<th>Unit</th>
<th>Remark</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supply Voltage For Source Driver</td>
<td>( V_{DD2} )</td>
<td>-0.3</td>
<td>+5.8</td>
<td>V</td>
<td></td>
</tr>
<tr>
<td></td>
<td>( V_{DD1} )</td>
<td>-0.3</td>
<td>+7.0</td>
<td>V</td>
<td></td>
</tr>
<tr>
<td>Supply Voltage For Gate Driver</td>
<td>( V_{CC} )</td>
<td>-0.3</td>
<td>+6.0</td>
<td>V</td>
<td></td>
</tr>
<tr>
<td></td>
<td>( V_{GH} )</td>
<td>-0.3</td>
<td>+25.0</td>
<td>V</td>
<td></td>
</tr>
<tr>
<td></td>
<td>( V_{EE} )</td>
<td>-16</td>
<td>+0.3</td>
<td>V</td>
<td></td>
</tr>
<tr>
<td>LED Forward Current</td>
<td>( I_f )</td>
<td>-</td>
<td>25</td>
<td>mA</td>
<td>Each LED At 25°C</td>
</tr>
</tbody>
</table>

8. Electrical Characteristics
8-1) Operating Condition

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>MIN.</th>
<th>Typ.</th>
<th>MAX.</th>
<th>Unit</th>
<th>Remark</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supply Voltage For Source Driver</td>
<td>Analog</td>
<td>( V_{DD2} )</td>
<td>+4.5</td>
<td>+5.0</td>
<td>+5.5</td>
<td>V</td>
</tr>
<tr>
<td></td>
<td>Logic</td>
<td>( V_{DD1} )</td>
<td>+3.0</td>
<td>+3.3</td>
<td>+3.6</td>
<td>V</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>+4.5</td>
<td>+5.0</td>
<td>+5.5</td>
<td>V</td>
</tr>
<tr>
<td>Supply Voltage For Gate Driver</td>
<td>( V_{GH} )</td>
<td>+15</td>
<td>+17</td>
<td>+19</td>
<td>V</td>
<td></td>
</tr>
<tr>
<td></td>
<td>( V_{GL,DC} )</td>
<td>-13</td>
<td>-12</td>
<td>-11</td>
<td>V</td>
<td>DC Component of ( V_{GL} )</td>
</tr>
<tr>
<td></td>
<td>( V_{GL,AC} )</td>
<td>-</td>
<td>+6.0</td>
<td>-</td>
<td>V</td>
<td>AC Component of ( V_{GL} )</td>
</tr>
<tr>
<td>Analog Signal input Level</td>
<td>( V_{IAC} )</td>
<td>-</td>
<td>+3.6</td>
<td>+4.0</td>
<td>V</td>
<td>Note 8-1</td>
</tr>
<tr>
<td>(( V_R ), ( V_G ), ( V_B ))</td>
<td>( V_{IDC} )</td>
<td>-</td>
<td>+2.5</td>
<td>-</td>
<td>V</td>
<td></td>
</tr>
<tr>
<td>Digital input voltage</td>
<td>H level</td>
<td>( V_{IH} )</td>
<td>0.7 ( V_{DD1} )</td>
<td>-</td>
<td>( V_{DD1} )</td>
<td>V</td>
</tr>
<tr>
<td></td>
<td>L level</td>
<td>( V_{IL} )</td>
<td>-0.3</td>
<td>-</td>
<td>0.3 ( V_{DD1} )</td>
<td>V</td>
</tr>
<tr>
<td>Digital output voltage</td>
<td>H level</td>
<td>( V_{OH} )</td>
<td>0.7 ( V_{DD1} )</td>
<td>-</td>
<td>( V_{DD1} )</td>
<td>V</td>
</tr>
<tr>
<td></td>
<td>L level</td>
<td>( V_{OL} )</td>
<td>-0.3</td>
<td>-</td>
<td>0.3 ( V_{DD1} )</td>
<td>V</td>
</tr>
<tr>
<td>( V_{COM} )</td>
<td>( V_{COM,AC} )</td>
<td>-</td>
<td>+6.0</td>
<td>-</td>
<td>V</td>
<td>AC Component of ( V_{COM} )</td>
</tr>
<tr>
<td></td>
<td>( V_{COM,DC} )</td>
<td>-</td>
<td>2.1</td>
<td>-</td>
<td>V</td>
<td>DC Component of ( V_{COM} ) Note 8-2</td>
</tr>
</tbody>
</table>

Note 8-1: Both NTSC and PAL system Video Signal input waveform is based on 8 steps gray scale.

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Note 8-2: PVI strongly suggests that the $V_{\text{COM, DC}}$ level shall be adjustable, and the adjustable level range is $2.1V \pm 1V$, every module's $V_{\text{COM, DC}}$ level shall be carefully adjusted to show a best image performance.

8-2) Current Consumption (GND=0V)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Condition</th>
<th>Min.</th>
<th>Typ.</th>
<th>Max.</th>
<th>Unit</th>
<th>Remark</th>
</tr>
</thead>
<tbody>
<tr>
<td>Current for Driver</td>
<td>$I_{\text{GH}}$</td>
<td>$V_{\text{GH}} = +17V$</td>
<td>-</td>
<td>0.1</td>
<td>0.3</td>
<td>mA</td>
<td>$V_{\text{GH}}$, center voltage</td>
</tr>
<tr>
<td></td>
<td>$I_{\text{GL}}$</td>
<td>$V_{\text{GL}} = -12V$</td>
<td>-</td>
<td>0.1</td>
<td>0.3</td>
<td>mA</td>
<td></td>
</tr>
<tr>
<td></td>
<td>$I_{\text{CC}}$</td>
<td>$V_{\text{CC}} = +3.3V$</td>
<td>-</td>
<td>0.1</td>
<td>0.3</td>
<td>mA</td>
<td></td>
</tr>
<tr>
<td></td>
<td>$I_{\text{DD1}}$</td>
<td>$V_{\text{DD1}} = +3.3V$</td>
<td>-</td>
<td>0.6</td>
<td>1.2</td>
<td>mA</td>
<td></td>
</tr>
<tr>
<td></td>
<td>$I_{\text{DD2}}$</td>
<td>$V_{\text{DD2}} = 5V$</td>
<td>-</td>
<td>3.7</td>
<td>7.4</td>
<td>mA</td>
<td></td>
</tr>
</tbody>
</table>

8-3) Backlight driving & Power Consumption

<table>
<thead>
<tr>
<th>Pin No</th>
<th>Symbol</th>
<th>Description</th>
<th>Remark</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>+</td>
<td>Input terminal (Anode)</td>
<td>Red</td>
</tr>
<tr>
<td>2</td>
<td>-</td>
<td>Input terminal (Cathode)</td>
<td>Black</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Min</th>
<th>TYP</th>
<th>MAX</th>
<th>Unit</th>
<th>Remark</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supply voltage of LED backlight</td>
<td>$V_{\text{LED}}$</td>
<td>-</td>
<td>-</td>
<td>11</td>
<td>V</td>
<td>Note 8-3</td>
</tr>
<tr>
<td>Supply current of LED backlight</td>
<td>$I_{\text{LED}}$</td>
<td>18</td>
<td>20</td>
<td>22</td>
<td>mA</td>
<td>Note 8-4</td>
</tr>
<tr>
<td>Backlight Power Consumption</td>
<td>$P_{\text{LED}}$</td>
<td>-</td>
<td>-</td>
<td>1.1</td>
<td>W</td>
<td>Note 8-3, 8-5</td>
</tr>
</tbody>
</table>

Note 8-3: $I_{\text{LED}} = 20mA$, constant current
Note 8-4: The LED driving condition is defined for each LED module. (3 LED Serial)
Input current = $20mA \times 5 = 100mA$
Note 8-5: $P_{\text{LED}} = V_{\text{LED,1}} \times I_{\text{LED,1}} + V_{\text{LED,2}} \times I_{\text{LED,2}} + \ldots + V_{\text{LED,4}} \times I_{\text{LED,4}} + V_{\text{LED,5}} \times I_{\text{LED,5}}$
Note 8-5: The power consumption for backlight is not included.

Note 8-6: LED backlight power consumption is calculated by $I_L \times V_L$.

8-4) Input / Output Connector

1. Backlight Connector
   JST BHSR-02VS-1,
   Pin No.: 2
   Pitch: 3.5 mm

8-5) Timing Characteristics of Input Signals

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Symbol</th>
<th>Min.</th>
<th>Typ.</th>
<th>Max.</th>
<th>Unit</th>
<th>Remark</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rising time</td>
<td>$t_r$</td>
<td>-</td>
<td>-</td>
<td>10</td>
<td>ns</td>
<td></td>
</tr>
<tr>
<td>Falling time</td>
<td>$t_f$</td>
<td>-</td>
<td>-</td>
<td>10</td>
<td>ns</td>
<td></td>
</tr>
<tr>
<td>High and low level pulse width</td>
<td>$t_{\text{CPH}}$</td>
<td>147</td>
<td>156</td>
<td>166</td>
<td>ns</td>
<td>CPH1</td>
</tr>
<tr>
<td>CPH pulse duty</td>
<td>$t_{\text{CWH}}$</td>
<td>30</td>
<td>50</td>
<td>70</td>
<td>%</td>
<td>CPH1</td>
</tr>
<tr>
<td>STH setup time</td>
<td>$t_{\text{SUH}}$</td>
<td>20</td>
<td>-</td>
<td>-</td>
<td>ns</td>
<td>STH1,STH2</td>
</tr>
<tr>
<td>STH hold time</td>
<td>$t_{\text{HDH}}$</td>
<td>20</td>
<td>-</td>
<td>-</td>
<td>ns</td>
<td>STH1,STH2</td>
</tr>
<tr>
<td>STH pulse width</td>
<td>$t_{\text{STH}}$</td>
<td>-</td>
<td>1</td>
<td>-</td>
<td>$t_{\text{CPH}}$</td>
<td>STH1,STH2</td>
</tr>
<tr>
<td>STH period</td>
<td>$t_{\text{H}}$</td>
<td>61.5</td>
<td>63.5</td>
<td>65.5</td>
<td>µs</td>
<td>STH1,STH2</td>
</tr>
<tr>
<td>OEH pulse width</td>
<td>$t_{\text{OEH}}$</td>
<td>-</td>
<td>1.6</td>
<td>-</td>
<td>µs</td>
<td>OEH</td>
</tr>
<tr>
<td>Sample and hold disable time</td>
<td>$t_{\text{DIS1}}$</td>
<td>-</td>
<td>4.4</td>
<td>-</td>
<td>µs</td>
<td></td>
</tr>
<tr>
<td>OEV pulse width</td>
<td>$t_{\text{OEV}}$</td>
<td>-</td>
<td>12</td>
<td>-</td>
<td>µs</td>
<td>XOE</td>
</tr>
<tr>
<td>CKV pulse width</td>
<td>$t_{\text{CKV}}$</td>
<td>-</td>
<td>32</td>
<td>-</td>
<td>µs</td>
<td>CPV</td>
</tr>
<tr>
<td>Clean enable time</td>
<td>$t_{\text{DIS2}}$</td>
<td>-</td>
<td>6</td>
<td>-</td>
<td>µs</td>
<td></td>
</tr>
<tr>
<td>Horizontal display timing range</td>
<td>$t_{\text{DHI}}$</td>
<td>-</td>
<td>960</td>
<td>-</td>
<td>$t_{\text{CPH}}/3$</td>
<td></td>
</tr>
<tr>
<td>STV setup time</td>
<td>$t_{\text{SLV}}$</td>
<td>400</td>
<td>-</td>
<td>-</td>
<td>ns</td>
<td>DIO1,DIO2</td>
</tr>
<tr>
<td>STV hold time</td>
<td>$t_{\text{HIV}}$</td>
<td>400</td>
<td>-</td>
<td>-</td>
<td>ns</td>
<td>DIO1,DIO2</td>
</tr>
<tr>
<td>STV pulse width</td>
<td>$t_{\text{STV}}$</td>
<td>-</td>
<td>-</td>
<td>1</td>
<td>$t_{\text{H}}$</td>
<td>DIO1,DIO2</td>
</tr>
<tr>
<td>Horizontal lines per field</td>
<td>$t_{v}$</td>
<td>256</td>
<td>262</td>
<td>268</td>
<td>$t_{\text{H}}$</td>
<td></td>
</tr>
<tr>
<td>Vertical display start</td>
<td>$t_{sv}$</td>
<td>3</td>
<td>-</td>
<td>$t_{\text{H}}$</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vertical display timing range</td>
<td>$t_{\text{DV}}$</td>
<td>234</td>
<td>-</td>
<td>-</td>
<td>$t_{\text{H}}$</td>
<td></td>
</tr>
<tr>
<td>VCOM rising time</td>
<td>$t_{\text{COM}}$</td>
<td>-</td>
<td>5</td>
<td>-</td>
<td>µs</td>
<td></td>
</tr>
<tr>
<td>VCOM falling time</td>
<td>$t_{\text{COM}}$</td>
<td>-</td>
<td>5</td>
<td>-</td>
<td>µs</td>
<td></td>
</tr>
<tr>
<td>VCOM delay time</td>
<td>$t_{\text{DCOM}}$</td>
<td>-</td>
<td>3</td>
<td>-</td>
<td>µs</td>
<td></td>
</tr>
<tr>
<td>RGB delay time</td>
<td>$t_{\text{DRGB}}$</td>
<td>-</td>
<td>1</td>
<td>-</td>
<td>µs</td>
<td></td>
</tr>
</tbody>
</table>
8 -6 ) Signal Timing Waveforms

Fig. 8.1 Sampling clock timing
Fig. 8.2 Horizontal display timing range.

Input (STH1/STH2)  | Output (TH2/STH1)  | CPH1
Vertical timing (From up to down)

![Diagram of vertical timing]

Fig. 8-5 (a) Vertical timing (From Up to Down)

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Vertical timing (From down to up)

Fig. 8-5 (b) Vertical timing (From Down to Up)
9. Power On Sequence

![Power On Sequence Diagram]

1) \(10\text{ms} \leq T1 < T2\)
2) \(0\text{ms} < T3 \leq T4 \leq 10\text{ms}\)

10. Optical Characteristics

10-1) Specification:

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Condition</th>
<th>MIN.</th>
<th>TYP.</th>
<th>MAX.</th>
<th>Unit</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Viewing Angle</td>
<td>(\theta_{21}, \theta_{22})</td>
<td>Horizontal</td>
<td>(\theta_{11})</td>
<td>CR (\geq 10)</td>
<td>65</td>
<td>70</td>
<td>--- deg</td>
</tr>
<tr>
<td></td>
<td>(\theta_{12})</td>
<td>Vertical</td>
<td></td>
<td></td>
<td>55</td>
<td>60</td>
<td>--- deg</td>
</tr>
<tr>
<td></td>
<td>CR</td>
<td></td>
<td></td>
<td></td>
<td>35</td>
<td>40</td>
<td>--- deg</td>
</tr>
<tr>
<td>Contrast Ratio</td>
<td>CR</td>
<td></td>
<td></td>
<td></td>
<td>200</td>
<td>400</td>
<td>---</td>
</tr>
<tr>
<td>Response time</td>
<td>(T_r)</td>
<td>(\theta = 0^\circ)</td>
<td>---</td>
<td>15</td>
<td>30</td>
<td>ms</td>
<td>Note 10-4</td>
</tr>
<tr>
<td></td>
<td>(T_f)</td>
<td></td>
<td>---</td>
<td>30</td>
<td>50</td>
<td>ms</td>
<td></td>
</tr>
<tr>
<td>Uniformity</td>
<td>U</td>
<td></td>
<td>75</td>
<td>80</td>
<td>---</td>
<td>%</td>
<td>Note 10-5</td>
</tr>
<tr>
<td>Brightness</td>
<td>L</td>
<td></td>
<td>200</td>
<td>250</td>
<td>---</td>
<td>cd/m²</td>
<td>Note 10-3</td>
</tr>
<tr>
<td>White</td>
<td>x</td>
<td>(\theta = 0^\circ)</td>
<td>0.27</td>
<td>0.31</td>
<td>0.35</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chromaticity</td>
<td>y</td>
<td>(\theta = 0^\circ)</td>
<td>0.30</td>
<td>0.34</td>
<td>0.38</td>
<td></td>
<td></td>
</tr>
<tr>
<td>LED Life Time</td>
<td></td>
<td>(+25^\circ C)</td>
<td>20000</td>
<td>30000</td>
<td>---</td>
<td>Hr</td>
<td>Note 10-6</td>
</tr>
</tbody>
</table>
Note 10-1: The definitions of viewing angles

Note 10-2: CR = \( \frac{\text{Luminance when Testing point is White}}{\text{Luminance when Testing point is Black}} \)
(Testing configuration see 10-2)
Contrast Ratio is measured in optimum common electrode voltage.

Note 10-3: Topcon BM-7(fast) luminance meter 1° field of view is used in the testing
(after 20~30 minutes operation). LED Current 100mA

Note 10-4: The definition of response time:

White \[ \rightarrow \] Black \[ \rightarrow \] White

<table>
<thead>
<tr>
<th>Brightness</th>
<th>100%</th>
<th>90%</th>
<th>10%</th>
<th>0%</th>
</tr>
</thead>
<tbody>
<tr>
<td>White</td>
<td>( \rightarrow )</td>
<td>( \rightarrow )</td>
<td>( \rightarrow )</td>
<td></td>
</tr>
<tr>
<td>Black</td>
<td>( \rightarrow )</td>
<td>( \rightarrow )</td>
<td>( \rightarrow )</td>
<td></td>
</tr>
<tr>
<td>White</td>
<td>( \rightarrow )</td>
<td>( \rightarrow )</td>
<td>( \rightarrow )</td>
<td></td>
</tr>
</tbody>
</table>

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Note 10-5: The uniformity of LCD is defined as

\[ U = \frac{\text{The Minimum Brightness of the 9 testing Points}}{\text{The Maximum Brightness of the 9 testing Points}} \]

Luminance meter: BM-5A or BM-7 fast (TOPCON)
Measurement distance: 500 mm +/- 50 mm
Ambient illumination: < 1 Lux
Measuring direction: Perpendicular to the surface of module

The test pattern is white (Gray Level 63).

Note 10-6: The “LED Life time “ is defined as the module brightness decrease to 50% original Brightness that the ambient temperature is 25°C and \( I_{LED} = 100mA(20mA \times 5) \).
10-2) Testing configuration

- LCD Display

Caution: 1. Environmental illumination \( \leq 1 \) lux
2. Before test CR, Vcom voltage must be adjusted carefully to get the best CR.

- R, G, B Waveform of Pattern A at Testing Point

- R, G, B Waveform of Pattern B at Testing Point
11. Handling Cautions

11-1) Mounting of module
   a) Please power off the module when you connect the input/output connector.
   b) Polarizer which is made of soft material and susceptible to flaw must be handled carefully.
   c) Protective film (Laminator) is applied on surface to protect it against scratches and dirt.
   d) Please following the tear off direction as figure 11-1 to remove the protective film as slowly as possible, so that electrostatic charge can be minimized.

11-2) Precautions in mounting
   a) When metal part of the TFT-LCD module (shielding lid and rear case) is soiled, wipe it with soft dry cloth.
   b) Wipe off water drops or finger grease immediately. Long contact with water may cause discoloration or spots.
   c) TFT-LCD module uses glass which breaks or cracks easily if dropped or bumped on hard surface. Please handle with care.
   d) Since CMOS LSI is used in the module. So take care of static electricity and earth yourself when handling.

11-3) Adjusting module
   a) Adjusting volumes on the rear face of the module have been set optimally before shipment.
   b) Therefore, do not change any adjusted values. If adjusted values are changed, the specifications described may not be satisfied.

11-4) Others
   a) Do not expose the module to direct sunlight or intensive ultraviolet rays for many hours.
   b) Store the module at a room temperature place.
   c) The voltage of beginning electric discharge may over the normal voltage because of leakage current from approach conductor by to draw lump read lead line around.
   d) If LCD panel breaks, it is possibly that the liquid crystal escapes from the panel.
       Avoid putting it into eyes or mouth. When liquid crystal sticks on hands, clothes or feet. Wash it out immediately with soap.
   e) Observe all other precautionary requirements in handling general electronic components.
   f) Please adjust the voltage of common electrode as material of attachment by 1 module.
Figure 11-1 the way to peel off protective film
12. Reliability Test

<table>
<thead>
<tr>
<th>No</th>
<th>Test Item</th>
<th>Test Condition</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>High Temperature Storage Test</td>
<td>Ta = +80°C, 240 hrs</td>
</tr>
<tr>
<td>2</td>
<td>Low Temperature Storage Test</td>
<td>Ta = -30°C, 240 hrs</td>
</tr>
<tr>
<td>3</td>
<td>High Temperature Operation Test</td>
<td>Ta = +70°C, 240 hrs</td>
</tr>
<tr>
<td>4</td>
<td>Low Temperature Operation Test</td>
<td>Ta = -20°C, 240 hrs</td>
</tr>
<tr>
<td>5</td>
<td>High Temperature &amp; High Humidity Operation Test</td>
<td>Ta = +60°C, 90%RH, 240 hrs</td>
</tr>
<tr>
<td>6</td>
<td>Thermal Cycling Test</td>
<td>-25°C → +70°C, 200 Cycles</td>
</tr>
<tr>
<td></td>
<td>(non-operating)</td>
<td>30 min 30 min</td>
</tr>
<tr>
<td>7</td>
<td>Vibration Test</td>
<td>Frequency : 10 ~ 55 Hz</td>
</tr>
<tr>
<td></td>
<td>(non-operating)</td>
<td>Amplitude : 1.5 mm</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Sweep time: 11 mins</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Test Period : 6 Cycles for each direction of X, Y, Z</td>
</tr>
<tr>
<td>8</td>
<td>Shock Test</td>
<td>100G, 6ms</td>
</tr>
<tr>
<td></td>
<td>(non-operating)</td>
<td>Direction : ±X, ±Y, ±Z</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Cycle : 3 times</td>
</tr>
<tr>
<td>9</td>
<td>Electrostatic Discharge Test</td>
<td>200pF, 0Ω</td>
</tr>
<tr>
<td></td>
<td>(non-operating)</td>
<td>±200V</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1 time / each terminal</td>
</tr>
</tbody>
</table>

Ta: ambient temperature

[Criteria]
In the standard conditions, there is not display function NG issue occurred. (including : line defect, no image) All the cosmetic specification is judged before the reliability stress.
13. Block Diagram

- LCD Panel
- V Driver (Gate)
- H Driver (Source)
- Input
- LED driving Board
- Back-light
14. Packing

NOTE:
1. 10 Trays: 40 pcs panel/carton
2. Dimension: 630*295*230mm
3. Weight: 8 Kg

Prime View International Co., Ltd.