Product Specification
3.5" COLOR TFT-LCD MODULE

MODEL NAME: A035QN02 V0

< ◆ >Preliminary Specification
<   >Final Specification

Note: The content of this specification is subject to change.

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# Record of Revision

<table>
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<th>Revise Date</th>
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<td>Add description of gray level inversion</td>
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<td>Update mechanical drawing</td>
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<td>6, 7</td>
<td>Pin assignment revised from 61 pins to 67 pins</td>
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<td>10, 11</td>
<td>Update power On/Off sequence</td>
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<td>Add panel FPC bending test, touch panel FPC peeling test &amp; touch panel impact resistance criteria</td>
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<td>Update the cushion area illustration</td>
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<td>Correct the pin description, Pin 8 DGND2 → AGND1</td>
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<td>FPC thickness</td>
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<td>Module Left edge to suggested bezel open area left edge</td>
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<tr>
<td></td>
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<td></td>
<td>Module left edge to TP A/A left edge</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>Module left edge to LCD A/A left edge</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Module upper edge to suggested bezel open area upper edge</td>
</tr>
<tr>
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<td>Module upper edge to TP A/A upper edge</td>
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<td>Update drawing, add label location, size and thickness</td>
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<td>0.7</td>
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<td>Update module dimension (Thickness 4mm → 4.32mm)</td>
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<td>Update drawing, modify thickness</td>
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<td>2007/03/20</td>
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A. General Description

A035QN02 V0 is an amorphous transmissive type Thin Film Transistor Liquid crystal Display (TFT-LCD). This model is composed of a TFT-LCD, a driver, an FPC (flexible printed circuit), a backlight unit and a touch panel.

B. Features

- 3.5-inch display with touch panel
- QVGA resolution in RGB stripe dot arrangement
- DC/DC integrated
- High brightness
- 3-wire register setting
- Interfaces: parallel RGB 18-bit
- Wide viewing angle
- Integrated touch screen panel (resistive type)
- 3-in-1 FPC for LCD signals, backlight LED power and touch panel
- Green design
## C. Physical Specifications

<table>
<thead>
<tr>
<th>NO.</th>
<th>Item</th>
<th>Unit</th>
<th>Specification</th>
<th>Remark</th>
</tr>
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<tbody>
<tr>
<td>1</td>
<td>Display Resolution</td>
<td>dot</td>
<td>320 RGB (H)×240(V)</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Active Area</td>
<td>mm</td>
<td>70.08(H)×52.56(V)</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Screen Size</td>
<td>inch</td>
<td>3.5(Diagonal)</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Dot Pitch</td>
<td>mm</td>
<td>0.073(H)×0.219(V)</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Color Configuration</td>
<td>--</td>
<td>R. G. B. Stripe</td>
<td>Note 1</td>
</tr>
<tr>
<td>6</td>
<td>Color Depth</td>
<td>--</td>
<td>262K Colors</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Overall Dimension</td>
<td>mm</td>
<td>76.9(H) × 63.9(V) × 4.32(T)</td>
<td>Note 2</td>
</tr>
<tr>
<td>8</td>
<td>Weight</td>
<td>g</td>
<td>40</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Panel surface treatment</td>
<td>--</td>
<td>Hard coating 3H</td>
<td></td>
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<tr>
<td>10</td>
<td>Display Mode</td>
<td>--</td>
<td>Normally White</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>Gray Level Inversion Direction</td>
<td></td>
<td>6 O'clock</td>
<td></td>
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</tbody>
</table>

Note 1: Below figure shows dot stripe arrangement.

Note 2: Not including FPC. Refer to the drawing next page for further information.
D. Outline Dimension

[Diagram of outline dimensions with various measurements and annotations]

1. 
2. 
3. 
4. 
5. 

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### E. Electrical Specifications

#### 1. Pin Assignment

Connector type: FH26G 67pin 0.3mm pitch connector

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<th>Remarks</th>
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<td>1</td>
<td>LED_C</td>
<td>PI</td>
<td>Cathode for LED back-light</td>
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<tr>
<td>2</td>
<td>LED_A</td>
<td>PI</td>
<td>Anode for LED back-light</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>DGND1</td>
<td>G</td>
<td>Grounding for digital circuit</td>
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</tr>
<tr>
<td>4</td>
<td>X1</td>
<td>O</td>
<td>Touch Panel Right Electrode</td>
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<td>5</td>
<td>Y2</td>
<td>O</td>
<td>Touch Panel Bottom Electrode</td>
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<td>6</td>
<td>X2</td>
<td>O</td>
<td>Touch Panel Left Electrode</td>
<td></td>
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<tr>
<td>7</td>
<td>Y1</td>
<td>O</td>
<td>Touch Panel Top Electrode</td>
<td></td>
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<tr>
<td>8</td>
<td>AGND1</td>
<td>G</td>
<td>Grounding for digital circuit</td>
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<td>27</td>
<td>CM</td>
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<td>Input pinto select 262k- or 8-color mode</td>
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<td>28</td>
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<td>29</td>
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<td>42</td>
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<td>HSYNC</td>
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<td>Line synchronization signal</td>
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<td>59</td>
<td>DOTCLK</td>
<td>I</td>
<td>Dot-clock and oscillator source</td>
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<tr>
<td>60</td>
<td>CDMUO</td>
<td>C</td>
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<tr>
<td>61</td>
<td>DGND4</td>
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<td>Grounding for digital circuit</td>
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<td>62</td>
<td>VLCD63</td>
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<td>Stabilizing capacitor</td>
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<tr>
<td>63</td>
<td>VCOMH</td>
<td>C</td>
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<td>64</td>
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<td>65</td>
<td>DGND5</td>
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<td>67</td>
<td>CSVCMN</td>
<td>C</td>
<td>Stabilizing capacitor</td>
<td></td>
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</tbody>
</table>

I: Digital signal input, O: Digital signal output, G: GND, PI: Power input, C: Capacitor
2. Absolute Maximum Ratings

<table>
<thead>
<tr>
<th>Items</th>
<th>Symbol</th>
<th>Values</th>
<th>Unit</th>
<th>Condition</th>
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<td></td>
<td><strong>Min.</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Power Voltage</td>
<td>VDDIO</td>
<td>1.8</td>
<td>3.6</td>
<td>V</td>
</tr>
<tr>
<td></td>
<td>VCI</td>
<td>2.5</td>
<td>3.6</td>
<td>V</td>
</tr>
<tr>
<td>Input Signal Voltage</td>
<td>Vi</td>
<td>0</td>
<td>0.2 x VDDIO</td>
<td>V</td>
</tr>
<tr>
<td></td>
<td>VI</td>
<td>0.8 x VDDIO</td>
<td>VDDIO</td>
<td>V</td>
</tr>
<tr>
<td>LED Reverse Voltage</td>
<td>Vr</td>
<td>2</td>
<td></td>
<td>One LED</td>
</tr>
<tr>
<td>LED Forward Current</td>
<td>If</td>
<td>30</td>
<td>mA</td>
<td>One LED, Note 2</td>
</tr>
<tr>
<td>Operating Temperature</td>
<td>T.OP</td>
<td>-20</td>
<td>70</td>
<td>°C</td>
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<td>Storage Temperature</td>
<td>T.ST</td>
<td>-30</td>
<td>85</td>
<td>°C</td>
</tr>
</tbody>
</table>

Note 1. If the operating condition exceeds the absolute maximum ratings, the TFT-LCD module may be damaged permanently. Also, if the module operated with the absolute maximum ratings for a long time, its reliability may drop.

Note 2. If LED current exceeds the limit curve, the lifetime will drop dramatically.

Note 3. 90% RH maximum humidity when temp. ≤60°C.

If temp. >60°C, the absolute humidity maximum shall be less than 90% RH.
3. Electrical Characteristics

The following items are measured under stable condition and suggested application circuit.

a. TFT-LCD Panel (GND=0V)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Min</th>
<th>Typ</th>
<th>Max</th>
<th>Unit</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Digital Power Supply</td>
<td>VDDIO</td>
<td>1.8</td>
<td>3.3</td>
<td>3.6</td>
<td>V</td>
<td></td>
</tr>
<tr>
<td>Analog Power Supply</td>
<td>VCI</td>
<td>2.5</td>
<td>3.3</td>
<td>3.6</td>
<td>V</td>
<td></td>
</tr>
<tr>
<td>Frame Frequency</td>
<td>fFrame</td>
<td>60</td>
<td></td>
<td></td>
<td>Hz</td>
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</tr>
<tr>
<td>Dot Data Clock</td>
<td>DCLK</td>
<td>5</td>
<td></td>
<td></td>
<td>MHz</td>
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</tr>
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Note 1. Panel surface temperature should be kept less than content of section 3.2. "Absolute maximum ratings"

b. Backlight Driving Conditions

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Min</th>
<th>Typ.</th>
<th>Max.</th>
<th>Unit</th>
<th>Remark</th>
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</thead>
<tbody>
<tr>
<td>LED Supply Current</td>
<td>I_L</td>
<td>20</td>
<td></td>
<td></td>
<td>mA</td>
<td>single serial</td>
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<tr>
<td>LED Supply Voltage</td>
<td>V_L</td>
<td>19.2</td>
<td></td>
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<td>V</td>
<td>single serial</td>
</tr>
<tr>
<td>LED Life Time</td>
<td>L_L</td>
<td>10,000</td>
<td>---</td>
<td>---</td>
<td>Hr</td>
<td>Note 2, 3</td>
</tr>
</tbody>
</table>

Note 1: LED backlight is six LEDs serial type.

Note 2: The "LED Supply Voltage" is defined by the number of LED at Ta=25℃, I_L=20mA. In the case of 6 pcs LED, V_L=3.2*6=19.2V

Note 3: The "LED life time" is defined as the time for the module brightness to decrease to 50% of the initial value at Ta=25℃, I_L=20mA

Note 4: The LED lifetime could be decreased if operating I_L is larger than 25mA
4. AC Timing

a. Power on/off sequence

**Power On**

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Symbol</th>
<th>Min</th>
<th>Typ</th>
<th>Max</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>VDDIO on to falling edge of SHUT</td>
<td>tp-shut</td>
<td>1</td>
<td></td>
<td></td>
<td>uSec</td>
</tr>
<tr>
<td>DOTCLK</td>
<td>tclk-shut</td>
<td>1</td>
<td></td>
<td></td>
<td>clk</td>
</tr>
<tr>
<td>Falling edge of SHUT to display on</td>
<td>tshut-on</td>
<td>164</td>
<td>10</td>
<td></td>
<td>mSec</td>
</tr>
<tr>
<td>-- 1 line: 336 clk</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-- 1 frame: 244 line</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-- DOTCLK = 5.0 MHz</td>
<td></td>
<td></td>
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</tr>
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</table>

*Note1:* It is necessary to input DOTCLK before the falling edge of SHUT.

*Note2:* Display starts at 10th falling edge of VSYNC after the falling edge of SHUT.
### Power Off

<table>
<thead>
<tr>
<th>Characteristics</th>
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<th>Unit</th>
</tr>
</thead>
<tbody>
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<td></td>
<td>frame</td>
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<td>-- 1 line: 336 clk</td>
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<td></td>
<td></td>
</tr>
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<td>-- 1frame: 244 line</td>
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<td></td>
<td></td>
<td>32.8</td>
<td>mSec</td>
</tr>
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<tr>
<td>Input-signal-off to VDDIO / VDD</td>
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<td></td>
<td></td>
<td>uSec</td>
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</tbody>
</table>

**Note1:** DOTCLK must be maintained at least 2 frames after the rising edge of SHUT.

**Note2:** Display become off at the 2nd falling edge of VSTNC after the falling edge of SHUT.

**Note3:** If RESET signal is necessary for power down, provide it after the 2-frames-cycle of the SHUT period.

### Timing Condition

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<td></td>
<td>nSec</td>
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<tr>
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<td></td>
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### Hsync Hold Time

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### Phase Difference of Sync Signal Falling Edge

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### DOTCLK Low Period

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### DOTCLK High Period

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### Data Setup Time

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### Data Hold Time

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### Reset Pulse Width

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### Rise / Fall Time

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### c. Timing Diagram

[Caption of the timing diagram with labels for VSYNC, HSYNC, DOTCLK, and Pixel, showing the various timing intervals such as t_{vsys}, t_{vsyn}, t_{hsyn}, t_{vsys}, t_{hv}, t_{hsys}, t_{hsyn}, t_{DOTCLK}, t_{r}, t_{r}, t_{ckl}, t_{ckh}, t_{ds}, t_{dh}, and t_{r/t_{l}}.]
NOTE: The falling edge of HSYNC belongs to blanking period is always behind or equal to the one of VSYNC.

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## 5. Command Register Map

### a. Serial setting map

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<th>IB09</th>
<th>IB08</th>
<th>IB07</th>
<th>IB06</th>
<th>IB05</th>
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<td>PKP11</td>
<td>PKP12</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>PKP02</td>
<td>PKP01</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0000h)</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>R31h</td>
<td>γ control (1)</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>PKP32</td>
<td>PKP31</td>
<td>PKP32</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>PKP22</td>
<td>PKP21</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0200h)</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>R32h</td>
<td>γ control (1)</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>PKP52</td>
<td>PKP51</td>
<td>PKP52</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>PKP42</td>
<td>PKP41</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0001h)</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>R33h</td>
<td>γ control (1)</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>PRP12</td>
<td>PRP11</td>
<td>PRP12</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>PRP02</td>
<td>PRP01</td>
</tr>
</tbody>
</table>
### b. Description of serial control data

<table>
<thead>
<tr>
<th>REV</th>
<th>RGB data</th>
<th>Source Output level</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>VCOM = &quot;H&quot;</td>
</tr>
<tr>
<td>1</td>
<td>000000B</td>
<td>V63</td>
</tr>
<tr>
<td>111111B</td>
<td>V0</td>
<td>V63</td>
</tr>
<tr>
<td>0</td>
<td>000000B</td>
<td>V63</td>
</tr>
<tr>
<td>111111B</td>
<td>V63</td>
<td>V0</td>
</tr>
</tbody>
</table>

**REV**: Displays all character and graphic display sections with reversal when REV = "1".

Since the grayscale level can be reversed, display of the same data is enabled on normally white and normally black panels.

Source output level is indicated below.

#### CAD: Set up based on retention capacitor configuration of the TFT panel.

<table>
<thead>
<tr>
<th>CAD</th>
<th>Retention capacitor configuration</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Cs on Common</td>
</tr>
<tr>
<td>1</td>
<td>Cs on Gate</td>
</tr>
</tbody>
</table>

**BGR**: Selects the <R><G><B> arrangement.

When BGR = "0" <R><G><B> color is assigned from S0. When BGR = "1" <B><G><R> color is assigned from S0.

**SM**: Change the division of gate driver.
When SM = "0", odd/even division (interlace mode) is selected. When SM = "1", upper/lower division is selected. Select the division mode according to the mounting method.

**TB**: Selects the output shift direction of the gate driver.

When TB = "1", G0 shifts to G239. When TB = "0", G239 shifts to G0.

**RL**: Selects the output shift direction of the source driver.

When RL = "1", S0 shifts to S959 and <R><G><B> color is assigned from S1.

When RL = "0", S959 shifts to S0 and <R><G><B> color is assigned from S959.

Set RL bit and BGR bit when changing the dot order of R, G and B.

**Note**: The default setting of register bits REV, CAD, BGR, TB and RL are defined by the logic stage of corresponding hardware pins. These bits will override the hardware setting once software command was sent to set the bits.

<table>
<thead>
<tr>
<th>LCD drive AC control</th>
<th>0</th>
<th>1</th>
<th>0</th>
<th>0</th>
<th>0</th>
<th>0</th>
<th>0</th>
<th>B/C</th>
<th>ERO</th>
<th>0</th>
<th>NW6</th>
<th>NW5</th>
<th>NW4</th>
<th>NW3</th>
<th>NW2</th>
<th>NW1</th>
<th>NW0</th>
</tr>
</thead>
<tbody>
<tr>
<td>R02h</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
</tbody>
</table>

**B/C**: Select the liquid crystal drive waveform VCOM.

When B/C = 0, frame inversion of the LCD driving signal is enabled.

When B/C = 1, a N-line inversion waveform is generated and alternates in a N-line equals to NW[7:0]+1.

**EOR**: When B/C = 1 and EOR = 1, the odd/even frame-select signals and the N-line inversion signals are EORed for alternating drive.

EOR is used when the LCD is not alternated by combining the set values of the lines of the LCD driven and the N-lines.

**NW6-0**: Specify the number of lines that will alternate at the N-line inversion setting (B/C = 1). NW6-0 alternate for every set value + 1 lines.

<table>
<thead>
<tr>
<th>Power control (1)</th>
<th>0</th>
<th>1</th>
<th>DCT3</th>
<th>DCT2</th>
<th>DCT1</th>
<th>DCT0</th>
<th>BT2</th>
<th>BT1</th>
<th>BT0</th>
<th>0</th>
<th>DC3</th>
<th>DC2</th>
<th>DC1</th>
<th>DC0</th>
<th>AP2</th>
<th>AP1</th>
<th>AP0</th>
<th>0</th>
</tr>
</thead>
<tbody>
<tr>
<td>R03h</td>
<td></td>
<td></td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
</tr>
</tbody>
</table>

**DCT3-0**: Set the step-up cycle of the step-up circuit for 8-color mode (CM = VDDIO).

When the cycle is accelerated, the driving ability of the step-up circuit increases, but its current consumption increases too.

Adjust the cycle taking into account the display quality and power consumption.

<table>
<thead>
<tr>
<th>DCT3</th>
<th>DCT2</th>
<th>DCT1</th>
<th>DCT0</th>
<th>Step-up cycle</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>Fline x 14</td>
</tr>
<tr>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>Fline x 12</td>
</tr>
<tr>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>Fline x 8</td>
</tr>
<tr>
<td>0</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>Fline x 7</td>
</tr>
<tr>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>Fline x 6</td>
</tr>
<tr>
<td>0</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>Fline x 5</td>
</tr>
<tr>
<td>0</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>Fline x 4</td>
</tr>
<tr>
<td>0</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>Fline x 3</td>
</tr>
<tr>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>Fline x 2</td>
</tr>
</tbody>
</table>
**BT2-0**: Control the step-up factor of the step-up circuit. Adjust the step-up factor according to the power-supply voltage to be used.

<table>
<thead>
<tr>
<th>BT2</th>
<th>BT1</th>
<th>BT0</th>
<th>V_GH output</th>
<th>V_GL output</th>
<th>V_GH booster ratio</th>
<th>V_GL booster ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>0</td>
<td>V_Cox x3</td>
<td>-(V_Cox x3) + VCI</td>
<td>6</td>
<td>-5</td>
</tr>
<tr>
<td>0</td>
<td>0</td>
<td>1</td>
<td>V_Cox x3</td>
<td>-(V_Cox x2)</td>
<td>6</td>
<td>-4</td>
</tr>
<tr>
<td>0</td>
<td>1</td>
<td>0</td>
<td>V_Cox x3</td>
<td>-(V_Cox x3)</td>
<td>6</td>
<td>-6</td>
</tr>
<tr>
<td>0</td>
<td>1</td>
<td>1</td>
<td>V_Cox x2 + VCI</td>
<td>-(V_Cox x3) + VCI</td>
<td>5</td>
<td>-5</td>
</tr>
<tr>
<td>1</td>
<td>0</td>
<td>0</td>
<td>V_Cox x2 + VCI</td>
<td>-(V_Cox x2)</td>
<td>5</td>
<td>-4</td>
</tr>
<tr>
<td>1</td>
<td>0</td>
<td>1</td>
<td>V_Cox x2 + VCI</td>
<td>-(V_Cox x2) + VCI</td>
<td>5</td>
<td>-3</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
<td>0</td>
<td>V_Cox x2</td>
<td>-(V_Cox x2)</td>
<td>4</td>
<td>-4</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
<td>1</td>
<td>V_Cox x2</td>
<td>-(V_Cox x2) + VCI</td>
<td>4</td>
<td>-3</td>
</tr>
</tbody>
</table>

**DC3-0**: Set the step-up cycle of the step-up circuit for 262k-color mode (CM = VSS).

When the cycle is accelerated, the driving ability of the step-up circuit increases, but its current consumption increases too.

Adjust the cycle taking into account the display quality and power consumption.

<table>
<thead>
<tr>
<th>DC3</th>
<th>DC2</th>
<th>DC1</th>
<th>DC0</th>
<th>Step-up cycle</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>Fline x 14</td>
</tr>
<tr>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>Fline x 12</td>
</tr>
<tr>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>Fline x 8</td>
</tr>
<tr>
<td>0</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>Fline x 7</td>
</tr>
<tr>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>Fline x 6</td>
</tr>
<tr>
<td>0</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>Fline x 5</td>
</tr>
<tr>
<td>0</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>Fline x 4</td>
</tr>
<tr>
<td>0</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>Fline x 3</td>
</tr>
<tr>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>Fline x 2</td>
</tr>
<tr>
<td>1</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>Fline x 1</td>
</tr>
<tr>
<td>1</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>fosc / 64</td>
</tr>
<tr>
<td>1</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>fosc / 80</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>fosc / 96</td>
</tr>
</tbody>
</table>

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**AP2-0**: Adjust the amount of current from the stable-current source in the internal operational amplifier circuit.

When the amount of current becomes large, the driving ability of the operational-amplifier circuits increase.

Adjust the current taking into account the power consumption.

During times when there is no display, such as when the system is in a sleep mode.

<table>
<thead>
<tr>
<th>AP2</th>
<th>AP1</th>
<th>AP0</th>
<th>Op-amp power</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>0</td>
<td>Least</td>
</tr>
<tr>
<td>0</td>
<td>0</td>
<td>1</td>
<td>Small</td>
</tr>
<tr>
<td>0</td>
<td>1</td>
<td>0</td>
<td>Small to medium</td>
</tr>
<tr>
<td>0</td>
<td>1</td>
<td>1</td>
<td>Medium</td>
</tr>
<tr>
<td>1</td>
<td>0</td>
<td>0</td>
<td>Medium to large</td>
</tr>
<tr>
<td>1</td>
<td>0</td>
<td>1</td>
<td>Large</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
<td>0</td>
<td>Large to Maximum</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
<td>1</td>
<td>Maximum</td>
</tr>
</tbody>
</table>

**NO1-0**: Sets amount of non-overlap of the gate output.

**SDT1-0**: Set delay amount from the gate output signal falling edge of the source outputs.

**EQ1-0**: Sets the equalizing period on source

| R0Ch | Power control (2) | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | VRC2 | VRC1 | VRC0 |
|      | (0002h)           |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |

**VRC[2:0]**: Adjust VCIX2 output voltage. The adjusted level is indicated in the chart below VRC2-0 setting.

<table>
<thead>
<tr>
<th>VRC2</th>
<th>VRC1</th>
<th>VRC0</th>
<th>( V_{CIX2} ) voltage</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>0</td>
<td>5.1V</td>
</tr>
<tr>
<td>0</td>
<td>0</td>
<td>1</td>
<td>5.3V</td>
</tr>
<tr>
<td>0</td>
<td>1</td>
<td>0</td>
<td>5.5V</td>
</tr>
<tr>
<td>0</td>
<td>1</td>
<td>1</td>
<td>5.7V</td>
</tr>
<tr>
<td>1</td>
<td>0</td>
<td>0</td>
<td>5.9V</td>
</tr>
<tr>
<td>1</td>
<td>0</td>
<td>1</td>
<td>6.1V</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
<td>0</td>
<td>Reserved</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
<td>1</td>
<td>Reserved</td>
</tr>
</tbody>
</table>
VRH3-0: Set amplitude magnification of VLCD63. These bits amplify the VLCD63 voltage 1.78 to 3.00 times the Vref voltage set by VRH3-0.

<table>
<thead>
<tr>
<th>VRH3</th>
<th>VRH2</th>
<th>VRH1</th>
<th>VRH0</th>
<th>Vلزم</th>
<th>Voltage</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>Vref x 2.815</td>
</tr>
<tr>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>Vref x 2.905</td>
</tr>
<tr>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>Vref x 3.000</td>
</tr>
<tr>
<td>0</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>Vref x 1.780</td>
</tr>
<tr>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>Vref x 1.850</td>
</tr>
<tr>
<td>0</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>Vref x 1.930</td>
</tr>
<tr>
<td>0</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>Vref x 2.020</td>
</tr>
<tr>
<td>0</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>Vref x 2.090</td>
</tr>
<tr>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>Vref x 2.165</td>
</tr>
<tr>
<td>1</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>Vref x 2.245</td>
</tr>
<tr>
<td>1</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>Vref x 2.335</td>
</tr>
<tr>
<td>1</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>Vref x 2.400</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>Vref x 2.500</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>Vref x 2.570</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>Vref x 2.645</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>Vref x 2.725</td>
</tr>
</tbody>
</table>

VCOMG: When VCOMG = “1”, it is possible to set output voltage of VCOML to any level, and the instruction (VDV4-0) becomes available.

When VCOMG = “0”, VCOML output is fixed to Hi-z level, VCI2 output for VCOML power supply stops, and the instruction (VDV4-0) becomes unavailable.

Set VCOMG according to the sequence of power supply setting flow as it relates with power supply operating sequence.

VDV4-0: Set the alternating amplitudes of VCOM at the VCOM alternating drive.

These bits amplify VCOM amplitude 0.6 to 1.23 times the VLCD63 voltage.

When VCOMG = “0”, the settings become invalid.
VCOMAS: Set the equation of VCOML.

\[ V_{COML} = \alpha \times V_{COMH} - V_{COMA} \]

<table>
<thead>
<tr>
<th>VCOMAS</th>
<th>( \alpha )</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0.94</td>
</tr>
<tr>
<td>1</td>
<td>0.5</td>
</tr>
</tbody>
</table>

SCN7-0: Set the scanning starting position of the gate driver.

XL7-0: Set the number of valid pixel per line.
**HBP5-0**: Set the delay period from falling edge of HSYNC signal to first valid data.

The pixel data exceed the range set by XL8-0 and before the first valid data will be treated as dummy data.

<table>
<thead>
<tr>
<th>HBP5</th>
<th>HBP4</th>
<th>HBP3</th>
<th>HBP2</th>
<th>HBP1</th>
<th>HBP0</th>
<th># of clock cycle of DOTCLK</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**VBP7-0**: Set the delay period from falling edge of VSYNC to first valid line.

The line data within this delay period will be treated as dummy line.

<table>
<thead>
<tr>
<th>VBP7</th>
<th>VBP6</th>
<th>VBP5</th>
<th>VBP4</th>
<th>VBP3</th>
<th>VBP2</th>
<th>VBP1</th>
<th>VBP0</th>
<th>VBP7</th>
<th>VBP6</th>
<th>VBP5</th>
<th>VBP4</th>
<th>VBP3</th>
<th>VBP2</th>
<th>VBP1</th>
<th>VBP0</th>
<th># of pixels per line</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>3</td>
<td>3</td>
</tr>
</tbody>
</table>
### Table 1: Power control (5)

<table>
<thead>
<tr>
<th>Address</th>
<th>bits 1 0 1 0 1 0 0 0 0 0 0 0 0 0 0</th>
<th>nOTP</th>
<th>VCM5</th>
<th>VCM4</th>
<th>VCM3</th>
<th>VCM2</th>
<th>VCM1</th>
<th>VCM0</th>
</tr>
</thead>
<tbody>
<tr>
<td>(002Dh)</td>
<td>0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

**nOTP:** nOTP equals to “0” after power on reset and VCOMH voltage equals to programmed OTP value.

When nOTP set to “1", setting of VCM5-0 becomes valid and voltage of VCOMH can be adjusted.

**VCM5-0:** Set the VCOMH voltage if nOTP = “1”. These bits amplify the VCOMH voltage 0.36 to 0.99 times the VLCD63 voltage.

### Table 2: 3 Gamma

<table>
<thead>
<tr>
<th>Address</th>
<th>bits 1 1 1 1 1 1 0 0 1 0 0 0 0 0 0</th>
<th>OLO</th>
</tr>
</thead>
<tbody>
<tr>
<td>(B945h)</td>
<td>1 0 1 1 1 1 1 0 1 0 0 0 0 0 1 0</td>
<td>0</td>
</tr>
</tbody>
</table>

**OLO:** When OLO = “1”, all R,G and B gamma registers are set by one set of gamma control, R30h to R3Bh.

When OLO = “0", R, G and B gamma registers are set separately by registers R30h to R3Bh, R40h to R4Bh and R50h to R5Bh.

### Gamma control (1)

<table>
<thead>
<tr>
<th>Address</th>
<th>bits 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0</th>
<th>PKP12</th>
<th>PKP11</th>
<th>PKP12</th>
<th>PKP02</th>
<th>PKP01</th>
<th>PKP00</th>
</tr>
</thead>
<tbody>
<tr>
<td>(0000h)</td>
<td>0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

**PRP00:**

<table>
<thead>
<tr>
<th>Address</th>
<th>bits 1 1 1 1 1 0 0 0 0 0 0 0 0 0 0 0</th>
<th>PKP12</th>
<th>PKP11</th>
<th>PKP12</th>
<th>PRP02</th>
<th>PRP01</th>
<th>PRP00</th>
</tr>
</thead>
<tbody>
<tr>
<td>(0700h)</td>
<td>0 0 0 0 0 1 1 1 1 0 0 0 0 0 0 0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>
When OLO = “0”, R30h-R3Bh are registers to adjust the gamma register values on the output of source S(3n), where n = 0 to 319. S(3n) are the red color source output when BGR = “0”.

When OLO = “1”, R30h-R3Bh are registers to adjust the gamma register values on the output of all source S0 to S959.

**PKP52-00**: Gamma micro adjustment register for the positive polarity output.

**PRP12-00**: Gradient adjustment register for the positive polarity output.

**PKN52-00**: Gamma micro adjustment register for the negative polarity output.

**PRN12-00**: Gradient adjustment register for the negative polarity output.

**VRP14-00**: Adjustment register for amplification adjustment of the positive polarity output.

**VRN14-00**: Adjustment register for the amplification adjustment of the negative polarity output.
### F. Optical specifications (Note 1, 2)

<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>Remark</th>
</tr>
</thead>
<tbody>
<tr>
<td>Response Time</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rise</td>
<td>Tr</td>
<td>$\vartheta = 0^\circ$</td>
<td>-</td>
<td>10</td>
<td>20</td>
<td>ms</td>
<td>Note 3</td>
</tr>
<tr>
<td>Fall</td>
<td>Tf</td>
<td></td>
<td>-</td>
<td>15</td>
<td>25</td>
<td>ms</td>
<td></td>
</tr>
<tr>
<td>Contrast ratio</td>
<td>CR</td>
<td>At optimized viewing angle</td>
<td>150</td>
<td>300</td>
<td>-</td>
<td></td>
<td>Note 5, 6</td>
</tr>
<tr>
<td>Viewing Angle</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Top</td>
<td></td>
<td>CR $\geq 10$</td>
<td>35</td>
<td>50</td>
<td>-</td>
<td>deg.</td>
<td>Note 7, 8</td>
</tr>
<tr>
<td>Bottom</td>
<td></td>
<td></td>
<td>40</td>
<td>55</td>
<td>-</td>
<td>deg.</td>
<td></td>
</tr>
<tr>
<td>Left</td>
<td></td>
<td></td>
<td>45</td>
<td>60</td>
<td>-</td>
<td>deg.</td>
<td></td>
</tr>
<tr>
<td>Right</td>
<td></td>
<td></td>
<td>45</td>
<td>60</td>
<td>-</td>
<td>deg.</td>
<td></td>
</tr>
<tr>
<td>Brightness</td>
<td>$Y_L$</td>
<td>$\vartheta = 0^\circ$</td>
<td>280</td>
<td>330</td>
<td>-</td>
<td>cd/m$^2$</td>
<td>Note 9</td>
</tr>
<tr>
<td>NTSC</td>
<td></td>
<td></td>
<td>50</td>
<td>60</td>
<td>-</td>
<td>%</td>
<td></td>
</tr>
<tr>
<td>White Chromaticity</td>
<td>$X$</td>
<td>$\vartheta = 0^\circ$</td>
<td>0.26</td>
<td>0.31</td>
<td>0.36</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>$y$</td>
<td>$\vartheta = 0^\circ$</td>
<td>0.28</td>
<td>0.33</td>
<td>0.38</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Luminance Uniformity</td>
<td></td>
<td></td>
<td>75</td>
<td>80</td>
<td>-</td>
<td>%</td>
<td>Note 9</td>
</tr>
</tbody>
</table>

**Note 1:** Measurement should be performed in the dark room, optical ambient temperature $=25^\circ$C, and backlight current $I_L=20$ mA.

**Note 2:** To be measured on the center area of panel with a field angle of 1° by Topcon luminance meter BM-7, after 10 minutes operation.

**Note 3:** Definition of response time:

The output signals of photo detector are measured when the input signals are changed from “black” to “white” (falling time) and from “white” to “black” (rising time), respectively.

**Note 4:** From liquid crystal characteristics, response time will become slower and the color of panel will become darker when ambient temperature is below 25°C.

**Note 5:** Contrast ratio is calculated with the following formula.
Contrast ratio = \[ \frac{\text{Photo detector output when LCD is at "White" state}}{\text{Photo detector output when LCD is at "Black" state}} \]

Note 6. White \( V_i = V_i50 \mu 1.5V \)
Black \( V_i = V_i50 \pm 2.0V \)

“μ” means that the analog input signal swings in phase with COM signal.
“μ” means that the analog input signal swings out of phase with COM signal.

\( V_i50 \) : The analog input voltage when transmission is 50%
The 100% transmission is defined as the transmission of LCD panel when all the input terminals of module are electrically opened.

Note 7. Definition of viewing angle: refer to figure as below.

Note 8. The viewing angles are measured at the center area of the panel when all the input terminals of LCD panel are electrically opened.

Note 9. Definition of brightness and luminance uniformity:
Brightness = average brightness of nine points illustrated below

Luminance Uniformity = \[ \frac{\text{Min. Brightness of nine points}}{\text{Max. Brightness of nine points}} \]
### G. Reliability Test Items

<table>
<thead>
<tr>
<th>No.</th>
<th>Test Items</th>
<th>Conditions</th>
<th>Remark</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>High Temperature Storage</td>
<td>Ta= 85°C 40 Hrs</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Low Temperature Storage</td>
<td>Ta= -30°C 40 Hrs</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>High Temperature Operation</td>
<td>Ta= 70°C 40 Hrs</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Low Temperature Operation</td>
<td>Ta= -20°C 40 Hrs</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>High Temperature &amp; High Humidity</td>
<td>Ta= 60°C, 90% RH 240Hrs Operation</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Heat Shock</td>
<td>-25°C to 70°C, 50 cycle, 2Hrs/cycle</td>
<td>Non-operation</td>
</tr>
<tr>
<td>7</td>
<td>Electrostatic Discharge</td>
<td>Contact 64kV, Air +/-12kV</td>
<td>Non-operation</td>
</tr>
<tr>
<td>8</td>
<td>Vibration (With Carton)</td>
<td>Random vibration: 0.015G²/Hz from 5<del>200Hz -6dB/Octave from 200</del>500Hz</td>
<td>IEC 68-34</td>
</tr>
<tr>
<td>9</td>
<td>Drop (With Carton)</td>
<td>Height: 60cm, 1 corner, 3 edges, 6 surfaces</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>FPC Bending Test</td>
<td>Curved radius: 2mm, Pulling force: 250g, Bending angle: 180°→270°→90°→180° 50 cycles (Note 10)</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>Touch Panel FPC Peeling Test</td>
<td>5N Min, Peeling upward by 90°</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>Touch Panel Impact Resistance</td>
<td>Φ11mm(5g) steel ball, Distance: 70cm, Measured at the center of touch panel (Touch panel is supported around its four edges with 10mm thick and 10 mm wide PVC board)</td>
<td></td>
</tr>
</tbody>
</table>

Note 1: In the standard conditions, there is not display function NG issue occurred. All the cosmetic specification is judged before the reliability stress.

Note 2: Ta: Ambient temperature.

Note 3: Bending test condition:
H. Touch Screen Panel Specifications

1. FPC Pin Assignment

<table>
<thead>
<tr>
<th>Pin No.</th>
<th>Symbol</th>
<th>I/O</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>R</td>
<td>O</td>
</tr>
<tr>
<td>5</td>
<td>B</td>
<td>O</td>
</tr>
<tr>
<td>6</td>
<td>L</td>
<td>O</td>
</tr>
<tr>
<td>7</td>
<td>U</td>
<td>O</td>
</tr>
</tbody>
</table>

2. Electrical Characteristics

<table>
<thead>
<tr>
<th>Item</th>
<th>Min.</th>
<th>Max.</th>
<th>Unit</th>
<th>Remark</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rate DC Voltage</td>
<td>7</td>
<td></td>
<td>V</td>
<td></td>
</tr>
<tr>
<td>Resistance X (Film)</td>
<td>350</td>
<td>950</td>
<td>Ω</td>
<td>At connector</td>
</tr>
<tr>
<td>Resistance Y (Glass)</td>
<td>150</td>
<td>800</td>
<td>Ω</td>
<td>DC 25V</td>
</tr>
<tr>
<td>Linearity</td>
<td>-1.5%</td>
<td>1.5%</td>
<td>--</td>
<td>Note 1, test by 250 gf</td>
</tr>
<tr>
<td>Chattering</td>
<td>10</td>
<td>ms</td>
<td></td>
<td>At connector pin</td>
</tr>
</tbody>
</table>

Note 1: Measurement condition of Linearity: difference between actual voltage & theoretical voltage is an error at any points. Linearity is the value max. error voltage divided by voltage difference on active area.

3. Mechanical Characteristics

<table>
<thead>
<tr>
<th>Item</th>
<th>Min.</th>
<th>Max.</th>
<th>Unit</th>
<th>Remark</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hardness of Surface</td>
<td>3</td>
<td>--</td>
<td>H</td>
<td>JIS K-5400</td>
</tr>
<tr>
<td>Operation Force (Pen or Finger)</td>
<td>--</td>
<td>50</td>
<td>gf</td>
<td>Note 1</td>
</tr>
</tbody>
</table>

Note 1: Within “guaranteed active area”, but not on the edge and dot-spacer.
4. Life test Condition

<table>
<thead>
<tr>
<th>Item</th>
<th>Min.</th>
<th>Max.</th>
<th>Unit</th>
<th>Remark</th>
</tr>
</thead>
<tbody>
<tr>
<td>Notes Life</td>
<td>$10^5$</td>
<td>--</td>
<td>words</td>
<td>Note 1, 2</td>
</tr>
<tr>
<td>Input Life</td>
<td>$10^6$</td>
<td>--</td>
<td>times</td>
<td>Note 1, 3</td>
</tr>
</tbody>
</table>

Note 1: Measurement condition of Operation Force: Within "guaranteed active area". Resistance, Insulation resistance, and operation force should be under 5.2 & 5.3 condition. When user pushes down on the film, resistance between X & Y axis must be equal or lower than 2kΩ. Below is test figure.

Note 2: Notes Life test condition (by pen): Notes area for pen notes life test is 10×9 mm. Size of word is 7.5×6.75mm. Word is any A,B,C….. letter. Writing speed is 60mm/s. Center of each word is changed at random in notes area.

Note 3: Input Life test condition( by finger): By silicone rubber tapping at same point. Tapping Load is 200g, and tapping frequency is 5Hz.

5. Attention

Please pay attention for below matters at mounting design of touch panel of LCD module.

1. Do not design enclosure pressing the view area to prevent from miss input.
2. Enclosure support must not touch with view area.
3. Use elastic or non-conductive material to enclosure touch panel.
4. Do not bond film of touch panel with enclosure.
5. The touch panel edge is conductive. Do not touch it with any conductive part after mounting.
6. If user wants to cleaning touch panel by air gun, pressure 2kg/cm² below is suggested. Not to blow glass from FPC site to prevent FPC peeled off.
7. Do not put a heavy shock or stress on touch panel and film surface. Ex. Don’t lift the panel by film face with vacuum.
8. Do not lift LCD module by FPC.
9. Please use dry cloth or soft cloth with neutral detergent (after wring dry) or one with ethanol at cleaning. Do not use any organic solvent, acid or alkali liquor.
10. Do not pile touch panel. Do not put heavy goods on touch panel.

Recommendation of the cushion area:

![Diagram of cushion area]
I. Packing Form

MAX. CAPACITY: 160 MODULES
MAX. WEIGHT: 12Kg
MEAS. 520mm*540mm*250mm
1. Application circuit

The following drawing is the application circuit recommended.
The BOM list is as follows.

<table>
<thead>
<tr>
<th>Name</th>
<th>Component</th>
<th>Value</th>
<th>Description</th>
<th>Remark</th>
</tr>
</thead>
<tbody>
<tr>
<td>J1A</td>
<td>61 pins connector</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C1</td>
<td>Capacitor</td>
<td>2.2uF</td>
<td>6.3V / X5R</td>
<td></td>
</tr>
<tr>
<td>C2</td>
<td>Capacitor</td>
<td>2.2uF</td>
<td>6.3V / X5R</td>
<td></td>
</tr>
<tr>
<td>C3</td>
<td>Capacitor</td>
<td>2.2uF</td>
<td>16V / X5R</td>
<td></td>
</tr>
<tr>
<td>C4</td>
<td>Capacitor</td>
<td>0.22uF</td>
<td>16V / X5R</td>
<td></td>
</tr>
<tr>
<td>C5</td>
<td>Capacitor</td>
<td>0.22uF</td>
<td>6.3V / X5R</td>
<td></td>
</tr>
<tr>
<td>C6</td>
<td>Capacitor</td>
<td>2.2uF</td>
<td>16V / X5R</td>
<td></td>
</tr>
<tr>
<td>C7</td>
<td>Capacitor</td>
<td>0.22uF</td>
<td>16V / X5R</td>
<td></td>
</tr>
<tr>
<td>C8</td>
<td>Capacitor</td>
<td>2.2uF</td>
<td>6.3V / X5R</td>
<td></td>
</tr>
<tr>
<td>C9</td>
<td>Capacitor</td>
<td>0.22uF</td>
<td>6.3V / X5R</td>
<td></td>
</tr>
<tr>
<td>C10</td>
<td>Capacitor</td>
<td>2.2uF</td>
<td>6.3V / X5R</td>
<td></td>
</tr>
<tr>
<td>C11</td>
<td>Capacitor</td>
<td>0.22uF</td>
<td>6.3V / X5R</td>
<td></td>
</tr>
<tr>
<td>C12</td>
<td>Capacitor</td>
<td>2.2uF</td>
<td>6.3V / X5R</td>
<td></td>
</tr>
<tr>
<td>C13</td>
<td>Capacitor</td>
<td>2.2uF</td>
<td>6.3V / X5R</td>
<td></td>
</tr>
<tr>
<td>C14</td>
<td>Capacitor</td>
<td>2.2uF</td>
<td>6.3V / X5R</td>
<td></td>
</tr>
<tr>
<td>C15</td>
<td>Capacitor</td>
<td>2.2uF</td>
<td>6.3V / X5R</td>
<td></td>
</tr>
<tr>
<td>C16</td>
<td>Capacitor</td>
<td>2.2uF</td>
<td>6.3V / X5R</td>
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