TO : 

SAMSUNG TFT-LCD
MODEL NO. : LTN154AT12-401

NOTE :
- Extension code [ -4 ] ; LTN154AT12-401
- Surface type [ Anti-Glare ]

Any Modification of Specification is not allowed without SEC’s Permission.
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<tr>
<td>Oct. 31. 2008</td>
<td>P00</td>
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<td>Nov. 17. 2008</td>
<td>P01</td>
<td>All</td>
<td>LTN154AT12-401 Model name fixed.</td>
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<td>Dec. 26. 2008</td>
<td>P02</td>
<td>20</td>
<td>FPC Connector pin map was updated.</td>
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<tr>
<td>Jan. 7. 2009</td>
<td>P03</td>
<td>12</td>
<td>LED forward current was updated.</td>
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<td>24</td>
<td>Outline drawing was updated.</td>
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<td></td>
<td></td>
<td>26</td>
<td>Product Markings and Others (Error-typo correction)</td>
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<td>Jan. 9. 2009</td>
<td>P04</td>
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<td>Back-light Unit was updated.</td>
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<td>24</td>
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GENERAL DESCRIPTION

DESCRIPTION

LTN154AT12 is a color active matrix TFT (Thin Film Transistor) liquid crystal display (LCD) that uses amorphous silicon TFT as a switching devices. This model is composed of a TFT LCD panel, a driver circuit and a backlight unit. The resolution of a 15.4" contains 1,280 x 800 pixels and can display up to 262,144 colors. 6 O'clock direction is the Optimum viewing angle.

FEATURES

- High contrast ratio, high aperture structure
- 1280 x 800 pixels resolution
- Low power consumption
- Fast Response
- DE(Data enable) only mode
- 3.3V LVDS Interface
- Onboard EEDID chip
- LED BLU
- Color gamut 45%

APPLICATIONS

- Notebook PC
- If the usage of this product is not for PC application, but for others, please contact SEC.

GENERAL INFORMATION

<table>
<thead>
<tr>
<th>Item</th>
<th>Specification</th>
<th>Unit</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>Display area</td>
<td>331.2(H) x 207.0(V) (15.4&quot; diagonal )</td>
<td>mm</td>
<td></td>
</tr>
<tr>
<td>Driver element</td>
<td>a-Si TFT active matrix</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Display colors</td>
<td>262,144</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of pixel</td>
<td>1280 x RGB(3) x 800</td>
<td>pixel</td>
<td>16 : 10</td>
</tr>
<tr>
<td>Pixel arrangement</td>
<td>RGB vertical stripe</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pixel pitch</td>
<td>0.2588(H) x 0.2588(V) (TYP.)</td>
<td>mm</td>
<td></td>
</tr>
<tr>
<td>Display Mode</td>
<td>Normally white</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Surface treatment</td>
<td>HAZE 25, HARD-COATING 3H, AG</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Mechanical Information

<table>
<thead>
<tr>
<th>Item</th>
<th>Min.</th>
<th>Typ.</th>
<th>Max.</th>
<th>Unit</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>Horizontal (H)</td>
<td>343.5</td>
<td>344.0</td>
<td>344.5</td>
<td>mm</td>
<td></td>
</tr>
<tr>
<td>Vertical (V)</td>
<td>221.5</td>
<td>222.0</td>
<td>222.6</td>
<td>mm</td>
<td></td>
</tr>
<tr>
<td>Depth (D)</td>
<td>-</td>
<td>-</td>
<td>6.5</td>
<td>mm</td>
<td>(1)</td>
</tr>
<tr>
<td>Weight</td>
<td>-</td>
<td>560</td>
<td>(575)</td>
<td>g</td>
<td></td>
</tr>
</tbody>
</table>

Note (1) Measurement condition of outline dimension
- Equipment: Vernier Calipers
- Push Force: 500g + f (minimum)

1. ABSOLUTE MAXIMUM RATINGS

1.1 ENVIRONMENTAL ABSOLUTE RATINGS

<table>
<thead>
<tr>
<th>Item</th>
<th>Symbol</th>
<th>Min.</th>
<th>Max.</th>
<th>Unit</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>Storage temperate</td>
<td>T&lt;sub&gt;STG&lt;/sub&gt;</td>
<td>-20</td>
<td>60</td>
<td>°C</td>
<td>(1)</td>
</tr>
<tr>
<td>Operating temperate (Temperature of glass surface)</td>
<td>T&lt;sub&gt;OPR&lt;/sub&gt;</td>
<td>0</td>
<td>50</td>
<td>°C</td>
<td>(1)</td>
</tr>
<tr>
<td>Shock (non-operating)</td>
<td>Snop</td>
<td>-</td>
<td>210</td>
<td>G</td>
<td>(2),(5)</td>
</tr>
<tr>
<td>Vibration (non-operating)</td>
<td>Vnop</td>
<td>-</td>
<td>2.41</td>
<td>G</td>
<td>(4),(5)</td>
</tr>
</tbody>
</table>

Note (1) Temperature and relative humidity range are shown in the figure below.
- 95 % RH Max. (40 °C ≥ Ta)
- Maximum wet-bulb temperature at 39 °C or less. (Ta > 40 °C) No condensation.
- (2) 3ms, half sine wave, one time for ±X, ±Y, ±Z.
- (3) 18ms, Trapezoidal wave, one time for ±X, ±Y, ±Z.
- (4) 5~500 Hz, Random vibration, 30 min for X, Y, Z.
- (5) At testing Vibration and Shock, the fixture in holding the Module to be tested have to be hard and rigid enough so that the Module would not be twisted or bent by the fixture.
### 1.2 ELECTRICAL ABSOLUTE RATINGS

#### (1) TFT LCD MODULE

$V_{DD} = 3.3V$, $V_{SS} = GND = 0V$

<table>
<thead>
<tr>
<th>Item</th>
<th>Symbol</th>
<th>Min.</th>
<th>Max.</th>
<th>Unit</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power Supply Voltage</td>
<td>$V_{DD}$</td>
<td>$V_{DD} - 0.3$</td>
<td>$V_{DD} + 0.3$</td>
<td>V</td>
<td>(1)</td>
</tr>
<tr>
<td>Logic Input Voltage</td>
<td>$V_{DD}$</td>
<td>$V_{DD} - 0.3$</td>
<td>$V_{DD} + 0.3$</td>
<td>V</td>
<td>(1)</td>
</tr>
</tbody>
</table>

Note (1) Within $Ta (25 \pm 2 ^\circ C)$
2. OPTICAL CHARACTERISTICS

The following items are measured under stable conditions. The optical characteristics should be measured in a dark room or equivalent state with the methods shown in Note (5). Measuring equipment: TOPCON BM-5A and PR-650

\[ Ta = 25 \pm 2 \, ^\circ C, \quad V_{DD}=3.3V, \quad f_v = 60Hz, \quad f_{DCLK} = 72.2 \, MHz \]

<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>Contrast Ratio (5 Points)</td>
<td>CR</td>
<td></td>
<td>-</td>
<td>300</td>
<td>-</td>
<td>-</td>
<td>AG (1), (2), (5)</td>
</tr>
<tr>
<td>Response Time at Ta (Rising + Falling)</td>
<td>T_{RT,B/W}</td>
<td></td>
<td>-</td>
<td>16</td>
<td>25</td>
<td>msec</td>
<td>(1), (3)</td>
</tr>
<tr>
<td>Average Luminance of White (5 Points)</td>
<td>Y_{ave}</td>
<td></td>
<td>190</td>
<td>220</td>
<td>-</td>
<td>cd/m²</td>
<td>(1), (4)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Color Chromaticity (CIE)</th>
<th>Normal Viewing Angle $\phi = 0$, $\theta = 0$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Red</td>
<td>$R_x$</td>
</tr>
<tr>
<td></td>
<td>$R_y$</td>
</tr>
<tr>
<td>Green</td>
<td>$G_x$</td>
</tr>
<tr>
<td></td>
<td>$G_y$</td>
</tr>
<tr>
<td>Blue</td>
<td>$B_x$</td>
</tr>
<tr>
<td></td>
<td>$B_y$</td>
</tr>
<tr>
<td>White</td>
<td>$W_x$</td>
</tr>
<tr>
<td></td>
<td>$W_y$</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Viewing Angle</th>
<th>CR $\geq$ 10</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hor.</td>
<td>$\theta_L$</td>
</tr>
<tr>
<td></td>
<td>$\theta_H$</td>
</tr>
<tr>
<td>Ver.</td>
<td>$\phi_L$</td>
</tr>
<tr>
<td></td>
<td>$\phi_H$</td>
</tr>
</tbody>
</table>

| Color gamut | 45% | % |

| 13 Points White Variation | $\delta_L$ | 60% | - | (1.7) | - | (6) |

| 5 Points White Variation | $\delta_L$ | 80% | - | - | % | (6) |
Note 1) Definition of Viewing Angle: Viewing angle range (10° ≤ C/R, 100° ≤ C/R)

Normal Line
\[ \phi = 0°, \theta = 0° \]

\[ \theta_L = 90° \]

12 O’clock direction
\[ \phi_H = 90° \]

6 O’clock direction
\[ \phi_L = 90° \]

\[ \theta_R = 90° \]

Note 2) Definition of Contrast Ratio (CR): Ratio of gray max (Gmax), gray min (Gmin) at 5 points (4, 5, 7, 9, 10)

\[ \text{CR} = \frac{\text{CR}(4) + \text{CR}(5) + \text{CR}(7) + \text{CR}(9) + \text{CR}(10)}{5} \]

Points: 4, 5, 7, 9, 10 at the figure of Note (6).

Note 3) Definition of Response time:

Display data

<table>
<thead>
<tr>
<th>Gray 32 (TFT OFF)</th>
<th>Gray 48 (TFT ON)</th>
<th>Gray 32 (TFT OFF)</th>
</tr>
</thead>
<tbody>
<tr>
<td>White (TFT OFF)</td>
<td>White (TFT OFF)</td>
<td>White (TFT OFF)</td>
</tr>
<tr>
<td>Black (TFT ON)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Optical Response

Average Luminance of White (Y_{LAVE})

\[ Y_{LAVE} = \frac{Y_L4 + Y_L5 + Y_L7 + Y_L9 + Y_L10}{5} \]

VIEW AREA

(320) (640) (960)

(200) (400) (600) (lines)

O: test point

Note 4) Definition of Average Luminance of White: measure the luminance of white at 5 points.
Note 5) After stabilizing and leaving the panel alone at a given temperature for 30 min, the measurement should be executed. Measurement should be executed in a stable, windless, and dark room. 30 min after lighting the backlight. This should be measured in the center of screen.

Environment condition: $T_a = 25 \pm 2 \degree C$

![Optical characteristics measurement setup diagram]

Note 6) Definition of 13 points white variation ($\delta L$), CR variation ($C_{VER}$) [1 ~ 13]

$$\delta L = \frac{\text{Maximum luminance of 13 points}}{\text{Minimum luminance of 13 points}}$$
3. ELECTRICAL CHARACTERISTICS

3.1 TFT LCD MODULE

Ta= 25 ± 2°C

<table>
<thead>
<tr>
<th>Item</th>
<th>Symbol</th>
<th>Min.</th>
<th>Typ.</th>
<th>Max.</th>
<th>Unit</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>Voltage of Power Supply</td>
<td>$V_{DD}$</td>
<td>3.0</td>
<td>3.3</td>
<td>3.6</td>
<td>V</td>
<td></td>
</tr>
<tr>
<td>Differential Input Voltage for LVDS Receiver Threshold</td>
<td>$V_{IH}$</td>
<td>-</td>
<td>-</td>
<td>+100</td>
<td>mV</td>
<td>$V_{CM} = +1.2V$</td>
</tr>
<tr>
<td>Low</td>
<td>$V_{IL}$</td>
<td>-100</td>
<td>-</td>
<td>-</td>
<td>mV</td>
<td></td>
</tr>
<tr>
<td>Vsync Frequency</td>
<td>$f_v$</td>
<td>-</td>
<td>(60)</td>
<td>-</td>
<td>Hz</td>
<td></td>
</tr>
<tr>
<td>Hsync Frequency</td>
<td>$f_h$</td>
<td>-</td>
<td>(50.04)</td>
<td>-</td>
<td>KHz</td>
<td></td>
</tr>
<tr>
<td>Main Frequency</td>
<td>$f_{DCLK}$</td>
<td>-</td>
<td>(72.2)</td>
<td>(85)</td>
<td>MHz</td>
<td></td>
</tr>
<tr>
<td>Rush Current</td>
<td>$I_{RUSH}$</td>
<td>-</td>
<td>-</td>
<td>(1.5)</td>
<td>A</td>
<td>(4)</td>
</tr>
</tbody>
</table>

| Current of Power Supply             |        |      |      |      |      |                        |
| White                               | $I_{DD}$ | -    | (300) | -    | mA   | (2),(3)*a             |
| Mosaic                              | -    | -    | (350) | -    | mA   | (2),(3)*b             |
| V. stripe                           | -    | -    | (450) | (520) | mA   | (2),(3)*c             |

Note
(1) Display data pins and timing signal pins should be connected. (GND = 0V)
(2) $f_v = 60$Hz, $f_{DCLK} = 72.2$MHz, $V_{DD} = 3.3$V, DC Current.
(3) Power dissipation pattern

*a) White Pattern

![White Pattern Diagram]

*b) Mosaic Pattern

![Mosaic Pattern Diagram]
4) Rush current measurement condition

**c) 1dot Vertical stripe pattern**

![Diagram of the rush current measurement condition](image)

- **VDD** (LCD INPUT)
- **CONTROL SIGNAL** (HIGH to LOW)
- **R1 47K**
- **R2 1K**
- **R3 47K**
- **C1 1uF**
- **C2 10000uF**
- **M1 2SK1059**
- **M2 2SK1399**

**Vdd rising time is 470us**

- **0.9VDD**
- **0.1VDD**
- **3.3V**
- **470us**

**Samsung Secret**
### 3.2 BACK-LIGHT UNIT

<table>
<thead>
<tr>
<th>Item</th>
<th>Symbol</th>
<th>Min.</th>
<th>Typ.</th>
<th>Max.</th>
<th>Unit</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>LED Forward Current</td>
<td>IF</td>
<td>(18)</td>
<td>(20)</td>
<td>(22)</td>
<td>mA</td>
<td></td>
</tr>
<tr>
<td>LED Forward Voltage</td>
<td>VF</td>
<td>(3.0)</td>
<td>(3.2)</td>
<td>(3.4)</td>
<td>V</td>
<td></td>
</tr>
<tr>
<td>LED Array Voltage</td>
<td>VP</td>
<td>(24.0)</td>
<td>(25.6)</td>
<td>(27.2)</td>
<td>V</td>
<td>VF X 8 LEDs</td>
</tr>
<tr>
<td>Power Consumption</td>
<td>P</td>
<td>(2.6)</td>
<td>(3.1)</td>
<td>(3.6)</td>
<td>W</td>
<td>IF X VF X 48 LEDs (w/o Converter)</td>
</tr>
<tr>
<td>Operating Life Time</td>
<td>Hr</td>
<td>10,000</td>
<td>-</td>
<td>-</td>
<td>Hour</td>
<td></td>
</tr>
</tbody>
</table>

Ta= 25 ± 2 °C
4. BLOCK DIAGRAM

4.1 TFT LCD Module

---

- **LVDS Input/RSDS Output Timing Controller**
- **Source Driver IC**
- **15.4" WXGA TFT-LCD Panel**
- **SOURCE PCB**

**I2C bus**

**Input Connector**

**LVDS Input/RSDS Output Timing Controller**

**DC-DC Converter**

**Gamma Generator**

**VCOM Generator**

**Gate Pulse Generator**

---

**Video Signal**

**Control Signal**

**VCOM**

**Gamma**

**DVDD**

**AVDD**

**Von/Voff**
### 5. INPUT TERMINAL PIN ASSIGNMENT

5.1. Input Signal & Power  (LVDS, Connector : JAE FI-XB30SRL-HF11 or compatible )

<table>
<thead>
<tr>
<th>No.</th>
<th>Symbol</th>
<th>Function</th>
<th>Polarity</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>VSS</td>
<td>Ground</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>VDD</td>
<td>POWER SUPPLY +3.3V</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>VDD</td>
<td>POWER SUPPLY +3.3V</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>VEEDID</td>
<td>DDC 3.3V Power</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>BIST</td>
<td>Panel BIST enable</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>CLKEDID</td>
<td>DDC Clock</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>DATAEDID</td>
<td>DDC data</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>RxIN0-</td>
<td>LVDS Differential Data INPUT (R0-R5,G0)</td>
<td>Negative</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>RxIN0+</td>
<td>LVDS Differential Data INPUT (R0-R5,G0)</td>
<td>Positive</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>GND</td>
<td>Ground</td>
<td></td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>RxIN1-</td>
<td>LVDS Differential Data INPUT (G1-G5,B0-B1)</td>
<td>Negative</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>RxIN1+</td>
<td>LVDS Differential Data INPUT (G1-G5,B0-B1)</td>
<td>Positive</td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>GND</td>
<td>Ground</td>
<td></td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>RxIN2-</td>
<td>LVDS Differential Data INPUT (B2-B5,Sync,DE)</td>
<td>Negative</td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>RxIN2+</td>
<td>LVDS Differential Data INPUT (B2-B5,Sync,DE)</td>
<td>Positive</td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>VSS</td>
<td>Ground</td>
<td></td>
<td></td>
</tr>
<tr>
<td>17</td>
<td>ClkIN-</td>
<td>LVDS Differential Clock INPUT</td>
<td>Negative</td>
<td></td>
</tr>
<tr>
<td>18</td>
<td>ClkIN+</td>
<td>LVDS Differential Clock INPUT</td>
<td>Positive</td>
<td></td>
</tr>
<tr>
<td>19</td>
<td>VSS</td>
<td>Ground</td>
<td></td>
<td></td>
</tr>
<tr>
<td>20</td>
<td>NC</td>
<td>No connect</td>
<td></td>
<td></td>
</tr>
<tr>
<td>21</td>
<td>NC</td>
<td>No connect</td>
<td></td>
<td></td>
</tr>
<tr>
<td>22</td>
<td>NC</td>
<td>No connect</td>
<td></td>
<td></td>
</tr>
<tr>
<td>23</td>
<td>NC</td>
<td>No connect</td>
<td></td>
<td></td>
</tr>
<tr>
<td>24</td>
<td>NC</td>
<td>No connect</td>
<td></td>
<td></td>
</tr>
<tr>
<td>25</td>
<td>NC</td>
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<td></td>
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*Samsung Secret*
5.2 LVDS Interface: Transmitter DS90CF363 or Compatible

**LVDS**

<table>
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<th>Pin No.</th>
<th>Name</th>
<th>RGB Signal</th>
<th>Pin No.</th>
<th>Name</th>
<th>RGB Signal</th>
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<td>TxIN12</td>
<td>BO0</td>
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<td>TxIN2</td>
<td>RO2</td>
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<td>TxIN14</td>
<td>BO2</td>
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<td>26</td>
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<td>Clock</td>
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</table>
Note: The LCD Module uses a 100 ohm resistor between positive and negative lines of each receiver input.
5.3 Timing Diagrams of LVDS For Transmission

LVDS Receiver : Integrated T-CON

T

TxCLK OUT
RxCLK IN

Rx IN2
RxOUT20  RxOUT19  RxOUT18  RxOUT17  RxOUT16  RxOUT15  RxOUT14
DE  Vsync  Hsync  B5  B4  B3  B2

Rx IN1
RxOUT13  RxOUT12  RxOUT11  RxOUT10  RxOUT9  RxOUT8  RxOUT7
B1  B0  G5  G4  G3  G2  G1

RxIN0
RxOUT6  RxOUT5  RxOUT4  RxOUT3  RxOUT2  RxOUT1  RxOUT0
G0  R5  R4  R3  R2  R1  R0
## 5.4 Input Signals, Basic Display Colors and Gray Scale of Each Color

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<thead>
<tr>
<th>Color</th>
<th>Display</th>
<th>Gray Scale Level</th>
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<td><strong>Red</strong></td>
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<td></td>
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<tr>
<td>Data Signal</td>
<td></td>
<td></td>
</tr>
<tr>
<td>R0 R1 R2 R3 R4 R5</td>
<td>0 0 0 0 0 0</td>
<td>0 1 1 1 1 1</td>
</tr>
<tr>
<td><strong>Green</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Data Signal</td>
<td></td>
<td></td>
</tr>
<tr>
<td>R0 R1 R2 R3 R4 R5</td>
<td>0 0 0 0 0 0</td>
<td>1 1 1 1 1 1</td>
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<tr>
<td><strong>Blue</strong></td>
<td></td>
<td></td>
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<tr>
<td>Data Signal</td>
<td></td>
<td></td>
</tr>
<tr>
<td>R0 R1 R2 R3 R4 R5</td>
<td>0 0 0 0 0 0</td>
<td>1 1 1 1 1 1</td>
</tr>
</tbody>
</table>

### Note

1) Definition of gray:
- Rn: Red gray, Gn: Green gray, Bn: Blue gray (n=gray level)
2) Input signal: 0 = Low level voltage, 1 = High level voltage

---

**Samsung Secret**

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5.5 Pixel Format in the display

LTN154AT12-401 Panel

Line 1

1
RGB RGB RGB

1280
RGB RGB RGB

Line 800

RGB RGB RGB

RGB RGB RGB
5.6 LED FPC Connector & Pin Assignment

LED FPC Connector: FH33-12S-0.5SH(05)) or Compatible

<table>
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<th>Function</th>
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<tr>
<td>2</td>
<td>LCD channel 2 cathode</td>
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<tr>
<td>3</td>
<td>LCD channel 3 cathode</td>
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<td>4</td>
<td>LCD channel 4 cathode</td>
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<td>5</td>
<td>LCD channel 5 cathode</td>
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<td>6</td>
<td>LCD channel 6 cathode</td>
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<td>9</td>
<td>NC</td>
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<td>10</td>
<td>LED power bus (LED Anode)</td>
</tr>
<tr>
<td>11</td>
<td>LED power bus (LED Anode)</td>
</tr>
<tr>
<td>12</td>
<td>LED power bus (LED Anode)</td>
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</tbody>
</table>
6. INTERFACE TIMING

6.1 Timing Parameters

<table>
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<tr>
<th>Signal</th>
<th>Item</th>
<th>Symbol</th>
<th>Min.</th>
<th>Typ.</th>
<th>Max.</th>
<th>Unit</th>
<th>Note</th>
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<td>Cycle</td>
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<td>816</td>
<td>1000</td>
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<td>Display Period</td>
<td>TVD</td>
<td>-</td>
<td>800</td>
<td>-</td>
<td>Lines</td>
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<td>Cycle</td>
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<td>1350</td>
<td>1400</td>
<td>1550</td>
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</tr>
<tr>
<td>Horizontal Active Display Term</td>
<td>Display Period</td>
<td>THD</td>
<td>-</td>
<td>1280</td>
<td>-</td>
<td>Clocks</td>
<td></td>
</tr>
</tbody>
</table>

6.2 Timing diagrams of interface signal

![Timing Diagram]

Valid display data (1280 clocks)
6.3 Power ON/OFF Sequence

To prevent a latch-up or DC operation of the LCD module, the power on/off sequence should be as the diagram below.

NOTE.

1. The supply voltage of the external system for the module input should be the same as the definition of $V_{DD}$.

2. Apply the lamp voltage within the LCD operation range. When the back-light turns on before the LCD operation or the LCD turns off before the back-light turns off, the display may momentarily become white.

3. In case of $V_{DD} = \text{off level}$, please keep the level of input signals on the low or keep a high impedance.

4. T4 should be measured after the module has been fully discharged between power off and on period.

5. Interface signal shall not be kept at high impedance when the power is on.

$\text{T1 : } V_{dd} \text{ rising time from 10\% to 90\%}$

$\text{T2 : The time from } V_{dd} \text{ to valid data at power ON.}$

$\text{T3 : The time from valid data off to } V_{dd} \text{ off at power Off.}$

$\text{T4 : } V_{dd} \text{ off time for Windows restart}$

$\text{T5 : The time from valid data to B/L enable at power ON.}$

$\text{T6 : The time from valid data off to B/L disable at power Off.}$
7. Mechanical Outline Dimension

It will be attached with PDF file.
7. Mechanical Outline Dimension

It will be attached with PDF file
8. PACKING

1. CARTON (Internal Package)

(1) Packing Form
Corrugated Cardboard box and Corrupad form as shock absorber

(2) Packing Method

Note
1) Total Weight: Approximately 10 kg
2) Acceptance number of piling: 10 sets
3) Carton size: 408(W) X 325(D) X 295(H)
9. Product Markings and Others

A nameplate bearing followed by is affixed to a shipped product at the specified location on each product.

(1) Parts number: LTN156AT12-401
(2) Revision: Three letter
(3) Control code: One letter
(4) Lot number: X X X X X X X X X

Panel No.  
Cell ID  
Lot ID  
Year  
Product Code  
Line

NOTE 1). This code indicating year is omitted in the products of SESL site.

(5) Product Label Definition

![Product Label Diagram]

TFT-LCD Product name: LTN154AT12
Lot number: XXXXXXXXXX
Revision Code: 401
Inspected work week: 0818 (2008 Year, 18th week)
P/N: Lenovo Part Number (42T0588)
EC NO: Engineering Change Number (Blank)
FRU: Field Replaceable Unit Part Number (42T0589)
Header Code: 1ZFL1 (one Z F L one)
Lenovo Barcode: XXXXXXXXXX1ZF0P XXXXXX XXX

[Diagram of Lenovo Barcode]

YMM  
Serial No (6 digits)  
Lenovo H/C (5 digits)  
Lenovo P/N (7 digits)
(5) High voltage caution label

This HIGH VOLTAGE CAUTION is carved in mold frame

---

(6) Packing small box attach

---

(7) Packing box Marking : Samsung TFT-LCD Brand Name
10. GENERAL PRECAUTIONS

1. Handling

(a) When the module is assembled, it should be attached to the system firmly using every mounting holes. Be careful not to twist and bend the modules.

(b) Refrain from strong mechanical shock and/or any force to the module. In addition to damage, this may cause improper operation or damage to the module and CCFT back-light.

(c) Note that polarizers are very fragile and could be easily damaged. Do not press or scratch the surface harder than a HB pencil lead.

(d) Wipe off water droplets or oil immediately. If you leave the droplets for a long time, staining and discoloration may occur.

(e) If the surface of the polarizer is dirty, clean it using some absorbent cotton or soft cloth.

(f) The desirable cleaners are water, IPA (Isopropyl Alcohol) or Hexane. Do not use Ketone type materials (ex. Acetone), Ethyl alcohol, Toluene, Ethyl acid or Methyl chloride. It might permanent damage to the polarizer due to chemical reaction.

(g) If the liquid crystal material leaks from the panel, it should be kept away from the eyes or mouth. In case of contact with hands, legs or clothes, it must be washed away thoroughly with soap.

(h) Protect the module from static, it may cause damage to the C-MOS Gate Array IC.

(i) Use fingerstalls with soft gloves in order to keep display clean during the incoming inspection and assembly process.

(j) Do not disassemble the module.

(k) Do not pull or fold the lamp wire.

(l) Do not adjust the variable resistor which is located on the back side.

(m) Protection film for polarizer on the module shall be slowly peeled off just before use so that the electrostatic charge can be minimized.

(n) Pins of I/F connector shall not be touched directly with bare hands.
2. STORAGE

(a) Do not leave the module in high temperature, and high humidity for a long time. It is highly recommended to store the module with temperature from 0 to 35 °C and relative humidity of less than 70%.

(b) Do not store the TFT-LCD module in direct sunlight.

(c) The module shall be stored in a dark place. It is prohibited to apply sunlight or fluorescent light during the store.

3. OPERATION

(a) Do not connect, disconnect the module in the “Power On” condition.

(b) Power supply should always be turned on/off by following item 6.3 “Power on/off sequence”.

(c) Module has high frequency circuits. Sufficient suppression to the electromagnetic interference shall be done by system manufacturers. Grounding and shielding methods may be important to minimize the interference.

(d) The cable between the back-light connector and its inverter power supply shall be a minimized length and be connected directly. The longer cable between the back-light and the inverter may cause lower luminance of lamp(CCFT) and may require higher startup voltage (Vs).

(e) The standard limited warranty is only applicable when the module is used for general notbook applications. If used for purposes other than as specified, SEC is not to be held reliable for the defective operations. It is strongly recommended to contact SEC to find out fitness for a particular purpose.

4. OTHERS

(a) Ultra-violet ray filter is necessary for outdoor operation.

(b) Avoid condensation of water. It may result in improper operation or disconnection of electrode.

(c) Do not exceed the absolute maximum rating value. (the supply voltage variation, input voltage variation, variation in part contents and environmental temperature, so on) Otherwise the module may be damaged.

(d) If the module displays the same pattern continuously for a long period of time, it can be the situation when the image “sticks” to the screen.

(e) This module has its circuitry PCB’s on the rear side and should be handled carefully in order not to be stressed.
### 11. EDID

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<th>ASCIl or Data</th>
<th>Notes</th>
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**Manufacturer Specified (Timing)**

- Horizontal active pixel (8)-31
- Image Aspect Ratio (16:10)
- Low Refresh Rate #1 (50Hz)
- Low Refresh Rate #1 (40Hz)
- Brightness (1/10nit)
- Feature flag (TN/LED mode)

**supplier ID "SEC"**

**Product code "AT"**

**Monitor Name Tag (ASCII)**

**Detailed timing/monitor descriptor #4**

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| 73    | 4E      | 01001110 | 78 [N]  |
| 74    | 31      | 00110001 | 49 [1]  |
| 75    | 35      | 00110101 | 53 [5]  |
| 76    | 34      | 00110100 | 52 [4]  |
| 77    | 41      | 01000001 | 65 [A]  |
| 78    | 54      | 01010100 | 84 [T]  |
| 79    | 31      | 00110001 | 49 [1]  |
| 7A    | 32      | 00110100 | 50 [2]  |
| 7B    | 34      | 00110100 | 52 [4]  |
| 7C    | 30      | 00110000 | 48 [0]  |
| 7D    | 31      | 00110001 | 49 [1]  |
| 7E    | 00      | 00000000 | 0       |
| 7F    | A0      | 10100110 | 100     |

**Extension Flag**

**Checksum**