LS010B7DH01 Memory LCD Module

Product Specification
December 2010

Normally White, transflective 128 × 128 Module features Octagonal Shape, Individual Pixel Memory, Very Low Power use, Serial Interface, FPC connection, extended temperature operation; contrast of 14:1, 0.25% transmissivity, and 17% reflectivity.
# SPECIFICATION

## DEVICE SPECIFICATION for TFT LCD Module

**Model No.**

**LS010B7DH01**

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**CUSTOMER'S APPROVAL**

**PRESENTED BY**

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DEPARTMENT GENERAL MANAGER
ENGINEERING DEPARTMENT I
LCD DIVISION II
LCD GROUP
SHARP CORPORATION

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**DATE**

__________________________

**BY**

__________________________
# RECORDS OF REVISION

**MODEL No:** LS010B7DH01

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<td>30 Sep. 2010</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>1st Issue</td>
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<td>3 Dec. 2010</td>
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<td>changed</td>
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<td>changed</td>
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<td>Delivery form 11-1 4)</td>
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<td>Packaging</td>
<td>changed</td>
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</tr>
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<td>Outline dimensions</td>
<td>changed</td>
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1. Applicable scope
This specification is applicable to TFT-LCD Module “LS010B7DH01” only.

2. General description
This module is a monochrome transflective and active matrix LCD module incorporating CG-Silicon TFT (Continuous Grain-Silicon Thin Film Transistor). It is composed of a monochrome TFT-LCD panel with 1 bit memory and FPC.
Graphics and texts can be displayed on a 128×128 dots panel by super low power consumptions.

3. Mechanical (physical) specifications

<table>
<thead>
<tr>
<th>Item</th>
<th>Specifications</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Screen size</td>
<td>Ø25.024 (0.99” type) diameter</td>
<td>mm</td>
</tr>
<tr>
<td>Active area</td>
<td>Ø25.024 diameter</td>
<td>mm</td>
</tr>
<tr>
<td>Pixel format</td>
<td>128(H)×128(V)</td>
<td>dots</td>
</tr>
<tr>
<td>Pixel pitch</td>
<td>0.1955(H) × 0.1955(V)</td>
<td>mm</td>
</tr>
<tr>
<td>Pixel configuration</td>
<td>Stripe</td>
<td></td>
</tr>
<tr>
<td>Display mode</td>
<td>Normally white</td>
<td></td>
</tr>
<tr>
<td>Unit outline dimensions</td>
<td>33.0(W)×33.4(H)×1.64(D)</td>
<td>mm</td>
</tr>
<tr>
<td>Mass</td>
<td>Approx 3.7</td>
<td>g</td>
</tr>
<tr>
<td>Surface hardness</td>
<td>3H</td>
<td></td>
</tr>
<tr>
<td>Surface treatment</td>
<td>AG</td>
<td></td>
</tr>
</tbody>
</table>

[Note 3-1] The above-mentioned table indicates module sizes without some projections and FPC.
For detailed measurements and tolerances, please refer to Figure 23.
4. Input terminal names and functions

4-1. LCD-FPC

Table 2

<table>
<thead>
<tr>
<th>#</th>
<th>symbol</th>
<th>I/O</th>
<th>Function</th>
<th>Remark</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>SCLK</td>
<td>I</td>
<td>Serial clock signal</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>SI</td>
<td>I</td>
<td>Serial data input signal</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>SCS</td>
<td>I</td>
<td>Chip select signal</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>EXTCOMIN</td>
<td>I</td>
<td>External COM inversion signal input (H: enable)</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>DISP</td>
<td>I</td>
<td>Display on/off signal</td>
<td>Note 4-1</td>
</tr>
<tr>
<td>6</td>
<td>VDDA</td>
<td>-</td>
<td>Power supply (Analog)</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>VDD</td>
<td>-</td>
<td>Power supply (Digital)</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>EXTMODE</td>
<td>I</td>
<td>COM inversion select terminal</td>
<td>Note 4-2</td>
</tr>
<tr>
<td>9</td>
<td>VSS</td>
<td>-</td>
<td>GND (Digital)</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>VSSA</td>
<td>-</td>
<td>GND (Analog)</td>
<td></td>
</tr>
</tbody>
</table>

[Note 4-1] The display on/off signal is only for display. Data memory will be saved also at the time of on/off.

    "H": data memory will be displayed.
    "L": white color will be displayed and data memory will be saved.

[Note 4-2] "H": enable EXTCOMIN signal, connect to VDD.
    "L": enable serial input flag, connect to VSS.

4-2. Recommended circuit

**COM signal serial input**

EXTMODE="L"

```
SCLK
SI
SCS
EXTCOMIN
DISP
VDDA
VDD
EXTMODE
VSS
VSSA
```

**COM signal serial input**

EXTMODE="H"

```
SCLK
SI
SCS
EXTCOMIN
DISP
VDDA
VDD
EXTMODE
VSS
VSSA
```

Figure 1

4-3. External circuit example

```
1  SCLK
2  SI
3  SCS
4  EXTCOMIN
5  DISP
6  VDDA
7  VDD
8  EXTMODE
9  VSS
10 VSSA
```

C1, C2: 0.1μF/B/10V
C3: 1μF/B/10V

Figure 2
5. Absolute maximum ratings

Table 3

<table>
<thead>
<tr>
<th>Item</th>
<th>Symbol</th>
<th>Condition</th>
<th>Rated value</th>
<th>Unit</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Logic I/O power supply voltage</td>
<td>VDD</td>
<td>Ta = 25°C</td>
<td>-0.3 to +5.8</td>
<td>V</td>
<td>Note 5-1</td>
</tr>
<tr>
<td>Analog power supply voltage</td>
<td>VDDA</td>
<td>Ta = 25°C</td>
<td>-0.3 to +5.8</td>
<td>V</td>
<td></td>
</tr>
<tr>
<td>Input voltage</td>
<td>VI</td>
<td>Ta = 25°C</td>
<td>-0.3 to VDD</td>
<td>V</td>
<td>Note 5-2</td>
</tr>
<tr>
<td>Temperature for storage</td>
<td>Tstg</td>
<td>-</td>
<td>-30 to +85</td>
<td>deg.</td>
<td>Note 5-3</td>
</tr>
<tr>
<td>Temperature for operation</td>
<td>Topr</td>
<td>-</td>
<td>-20 to +70</td>
<td>deg.</td>
<td></td>
</tr>
</tbody>
</table>

[Note 5-1] Also applicable to EXTMODE
[Note 5-2] Applicable to SCLK, SI, SCS, DISP and EXTCOMIN
[Note 5-3] Humidity: 80%RH Max. (Ta≤40°C)

Maximum bulb temperature under 39°C (Ta>40°C) See to it that no dew will be condensed.

Figure 3 Humidity guarantee range
6. Electrical characteristics

6-1. TFT LCD panel driving

Table 4-1 (SCS SCLK, Si, DISP, EXTCOMIN=3V, VDD=5V, VDDA=5V)

<table>
<thead>
<tr>
<th>Power consumption</th>
<th>MIN</th>
<th>TYP</th>
<th>MAX</th>
<th>Unit</th>
<th>Remark</th>
</tr>
</thead>
<tbody>
<tr>
<td>Still picture model</td>
<td>-</td>
<td>10</td>
<td>55</td>
<td>uW</td>
<td>no display data update</td>
</tr>
<tr>
<td>Data update mode</td>
<td>-</td>
<td>45</td>
<td>100</td>
<td>uW</td>
<td>display data update:</td>
</tr>
<tr>
<td>(SCLK=1MHz)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1frame/sec</td>
</tr>
</tbody>
</table>

*Power consumption Display pattern : Black display

*LC inversion frequency : 1Hz (LC inversion frequency 1Hz is COM frequency 0.5Hz)

Table 4-2 Recommended operating Condition

<table>
<thead>
<tr>
<th>Item</th>
<th>symbol</th>
<th>MIN</th>
<th>TYP</th>
<th>MAX</th>
<th>Unit</th>
<th>Remark</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power supply</td>
<td>Analog</td>
<td>VDDA</td>
<td>+4.8</td>
<td>+5.0</td>
<td>+5.5</td>
<td>V</td>
</tr>
<tr>
<td></td>
<td>Logic</td>
<td>VDD</td>
<td>+4.8</td>
<td>+5.0</td>
<td>+5.5</td>
<td>V</td>
</tr>
<tr>
<td>Input signal voltage</td>
<td>Hi</td>
<td>VIH</td>
<td>+2.70</td>
<td>+3.00</td>
<td>V</td>
<td>*VDD</td>
</tr>
<tr>
<td></td>
<td>Lo</td>
<td>VIL</td>
<td>VSS</td>
<td>VSS</td>
<td>VSS+0.15</td>
<td>V</td>
</tr>
</tbody>
</table>

*It can be operated below VDD voltage, however, operation around 3V is recommended.

[Note 6-2] Applies to EXTMODE="H"
[Note 6-3] Applies to SCLK, Si, SCS, DISP, EXTCOMIN.
6-2. Power supply sequence

![Diagram](image)

**Figure 4**

**[ON Sequence]**
1. 5V rise time (depends on IC)
2. Pixel memory initialization T2: 1V or more Initialize with M2 (all clear flag) or write all screen white
3. Release time for initialization of TCOM latch T3: 30μs or more
   Time required to release COM related latch circuit initialization which is initializing using DISP signals
4. TCOM polarity initialization time T4: 30μs or more
   Time required initializing TCOM polarity accordingly to EXTCOMIN input

**[Normal Operation]**
Duration of normal driving

**[Off Sequence]**
5. Pixel memory initialization time T5: It is the same content as T2
6. VA, VB and VCOM initialization time T6: 30μs or more
7. 5V falling time (Depends on IC)

*Refer to timing chart and AC timing characteristics for detail

*1 T3 and T4 may be opposite (however, TCOM polarity inversion will not occur even with EXTCOMIN between DISP="L"). Also, when DISP and EXTCOMIN are simultaneously started up, allow 100μs or more before SCS starts up (It may be less than 200μs).

*2 Setting value for pixel memory initialization

  SCS=Driving accordingly to clear pixel internal memory method (use all clear flag or write all screen white)
  S1=M2 (all clear flag) = "H" or write white
  SCLK: Normal Driving

**[Remark] Cautions when powering on**
1. VDD and VDDA should rise simultaneously or VDD should rise first.
2. VDD and VDDA should fall simultaneously or VDD should fall first
### Table 5

<table>
<thead>
<tr>
<th>Item</th>
<th>Symbol</th>
<th>MIN</th>
<th>TYP</th>
<th>MAX</th>
<th>Unit</th>
<th>Remark</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frame frequency</td>
<td>fSCS</td>
<td>0.95</td>
<td>-</td>
<td>60</td>
<td>Hz</td>
<td></td>
</tr>
<tr>
<td>Clock frequency</td>
<td>fSCLK</td>
<td>-</td>
<td>1</td>
<td>2</td>
<td>MHz</td>
<td></td>
</tr>
<tr>
<td>Vertical Interval</td>
<td>tV</td>
<td>16.67</td>
<td>-</td>
<td>1000</td>
<td>msec</td>
<td></td>
</tr>
<tr>
<td>COM Frequency</td>
<td>fCOM</td>
<td>0.5</td>
<td>-</td>
<td>30</td>
<td>Hz</td>
<td></td>
</tr>
<tr>
<td>SCS rising time</td>
<td>trSCS</td>
<td>-</td>
<td>-</td>
<td>50</td>
<td>nsec</td>
<td>Data update mode</td>
</tr>
<tr>
<td>SCS falling time</td>
<td>tfSCS</td>
<td>-</td>
<td>-</td>
<td>50</td>
<td>nsec</td>
<td>Display mode</td>
</tr>
<tr>
<td>SCS High width</td>
<td>twSCSH</td>
<td>84</td>
<td>-</td>
<td>-</td>
<td>µsec</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>12</td>
<td>-</td>
<td>-</td>
<td>µsec</td>
<td></td>
</tr>
<tr>
<td>SCS Low width</td>
<td>twSCSL</td>
<td>1</td>
<td>-</td>
<td>-</td>
<td>µsec</td>
<td></td>
</tr>
<tr>
<td>SCS setup time</td>
<td>tsSCS</td>
<td>3</td>
<td>-</td>
<td>-</td>
<td>µsec</td>
<td></td>
</tr>
<tr>
<td>SCS hold time</td>
<td>thSCS</td>
<td>1</td>
<td>-</td>
<td>-</td>
<td>µsec</td>
<td></td>
</tr>
<tr>
<td>SI rising time</td>
<td>trSI</td>
<td>-</td>
<td>-</td>
<td>50</td>
<td>nsec</td>
<td></td>
</tr>
<tr>
<td>SI falling time</td>
<td>tfSI</td>
<td>-</td>
<td>-</td>
<td>50</td>
<td>nsec</td>
<td></td>
</tr>
<tr>
<td>SI set up time</td>
<td>tsSI</td>
<td>120</td>
<td>-</td>
<td>-</td>
<td>nsec</td>
<td></td>
</tr>
<tr>
<td>SI hold time</td>
<td>thSI</td>
<td>190</td>
<td>-</td>
<td>-</td>
<td>nsec</td>
<td></td>
</tr>
<tr>
<td>SCLK rising time</td>
<td>trSCLK</td>
<td>-</td>
<td>-</td>
<td>50</td>
<td>nsec</td>
<td></td>
</tr>
<tr>
<td>SCLK falling time</td>
<td>tfSCLK</td>
<td>-</td>
<td>-</td>
<td>50</td>
<td>nsec</td>
<td></td>
</tr>
<tr>
<td>SCLK High width</td>
<td>twSCLKH</td>
<td>200</td>
<td>450</td>
<td>-</td>
<td>nsec</td>
<td></td>
</tr>
<tr>
<td>SCLK Low width</td>
<td>twSCLKL</td>
<td>200</td>
<td>450</td>
<td>-</td>
<td>nsec</td>
<td></td>
</tr>
<tr>
<td>EXTCOMIN signal frequency</td>
<td>fEXTCOMIN</td>
<td>1</td>
<td>-</td>
<td>60</td>
<td>Hz</td>
<td>Note 6-4</td>
</tr>
<tr>
<td>EXTCOMIN signal rising time</td>
<td>fEXTCOMIN</td>
<td>-</td>
<td>-</td>
<td>50</td>
<td>nsec</td>
<td></td>
</tr>
<tr>
<td>EXTCOMIN signal falling time</td>
<td>tfEXTCOMIN</td>
<td>-</td>
<td>-</td>
<td>50</td>
<td>nsec</td>
<td></td>
</tr>
<tr>
<td>EXTCOMIN signal High width</td>
<td>twEXTCOMIN</td>
<td>1</td>
<td>-</td>
<td>-</td>
<td>µsec</td>
<td></td>
</tr>
<tr>
<td>DISP rising time</td>
<td>trDISP</td>
<td>-</td>
<td>-</td>
<td>50</td>
<td>nsec</td>
<td></td>
</tr>
<tr>
<td>DISP falling time</td>
<td>tfDISP</td>
<td>-</td>
<td>-</td>
<td>50</td>
<td>nsec</td>
<td></td>
</tr>
</tbody>
</table>

[Note 6-4] EXTCOMIN frequency should be made lower than frame frequency
SCS, SI, SCLK signal

EXTCOMIN signal

DISP signal

Figure 5
6-4. Input signal timing chart

Table 6

<table>
<thead>
<tr>
<th>M0</th>
<th>M2</th>
<th>Mode</th>
</tr>
</thead>
<tbody>
<tr>
<td>H</td>
<td>L</td>
<td>1) Data update mode (1 line)</td>
</tr>
<tr>
<td>L</td>
<td>L</td>
<td>2) Data Update Mode (Multiple lines)</td>
</tr>
<tr>
<td>L</td>
<td>H</td>
<td>3) Display Mode</td>
</tr>
<tr>
<td>H</td>
<td>H</td>
<td>4) All Clear Mode</td>
</tr>
</tbody>
</table>

1) Data update mode (1 line)

Updates data of only one specified line (M0="H", M2="L")

M0: Mode flag. Set for "H". Data update mode (Memory internal data update)

When "L", display mode (maintain memory internal data).

M1: Frame inversion flag

When "H", outputs VCOM="H", and when "L", outputs VCOM="L".

When EXTMODE="H", it can be "H" or "L".

M2: All clear flag

Refer to 6-5-4) All Clear Mode to execute clear.

DUMMY DATA: Dummy data. It can be "H" or "L" ("L" is recommended.)

*Data write period
Data is being stored in 1st latch block of binary driver on panel.

*Data transfer period
Data written in 1st latch is being transferred (written) to pixel internal memory circuit.

*For gate line address setting, refer to 6-6) Input Signal and Display.

*M1: Frame inversion flag is enabled when EXTMODE="L".

*When SCS becomes “L”, M0 and M2 are cleared.
2) Data update mode (multiple lines)

Updates arbitrary multiple lines data (M0="H", M2="L")

M0: Mode flag. Set for "H". Data update mode (Memory internal data update)
When "L", display mode (maintain memory internal data).

M1: Frame inversion flag
When "H", outputs VCOM="H", and when "L", outputs VCOM="L".
When EXTMODE="H", it can be "H" or "L".

M2: All clear flag
Refer to 6-4-4) All Clear Mode to execute clear.

DUMMY DATA: Dummy data. It can be "H" or "L" ("L" is recommended.)

*Data write period
Data is being stored in 1st latch block of binary driver on panel.

*Data transfer period
For example, during GL2nd line data transfer period, GL 2nd line address is latched and
GL1st line data is transferred from 1st latch to pixel internal memory circuit at the same time.

*For gate line address setting, refer to 6-6) Input Signal and Display.

*Input data continuously.

*M1: Frame inversion flag is enabled when EXTMODE="L".

*When SCS becomes "L", M0 and M2 are cleared.
3) Display mode

Maintains memory internal data (maintains current display). (M0="L", M2="L")

Figure 8

M0: Mode flag. Set for "H". Data update mode (Memory internal data update)
   When "L", display mode (maintain memory internal data).

M1: Frame inversion flag
   When "H", outputs VCOM="H", and when "L", outputs VCOM="L".
   When EXTMODE="H", it can be "H" or "L".

M2: All clear flag
   Refer to 6-5-4) All Clear Mode to execute clear.

DUMMY DATA: Dummy data. It can be "H" or "L" ("L" is recommended).

*M1: Frame inversion flag is enabled when EXTMODE="L"
*When SCS becomes "L", M0 and M2 are cleared.
4) **All clear mode**

Clears memory internal data and writes white \((M0=\\text{"L"}, M2=\\text{"H"})\)

**Figure 9**

- **M0**: Mode flag
  - Set it “L”.
- **M1**: Frame inversion flag
  - When EXTMODE=“H”, it can be “H” or “L”.
- **M2**: All clear flag
  - Set it “H”

* **DUMMY DATA**: Dummy data. It can be “H” or “L” (“L” is recommended).

* **M1**: Frame inversion flag is enabled when EXTMODE=“L”.
  * When SCS becomes “L”, M0 and M2 are cleared.
6-5. COM inversion

There are two types of inputs, COM signal serial input (EXTMODE="L") and external COM signal input (EXTMODE="H").

1) EXTMODE="L"

   Figure 10

   M1: LC polarity inversion flag: If M1 is “H” then VCOM="H" is output. If M1 is "L" then VCOM="L" is output.

   *1: LC inversion has been changed by M1 flag statement.
   *2: The periods of plus polarity and minus polarity should be same length as much as possible.

2) EXTMODE="H" (COM inversion timing has two conditions)
   a) EXTCOMIN input when the SCS signal is “H”

   Figure 11

   *3: LC inversion polarity has been set by the rising timing of EXTCOMIN in internal circuit block as COMZ signal.
   *4: The period of EXTCOMIN should be constant.

   b) EXTCOMIN input when the SCS signal is “L”

   Figure 12

   *5: LC inversion polarity has been set by the rising edge of EXTCOMIN.
   *6: The period of EXTCOMIN should be constant.
6-6. Input signal and display, gate address (line) setting

Data position in display [H, V]

Figure 13

Figure 14
Figure 16

No display area
Table 7

<table>
<thead>
<tr>
<th>LINE</th>
<th>AG0</th>
<th>AG1</th>
<th>AG2</th>
<th>AG3</th>
<th>AG4</th>
<th>AG5</th>
<th>AG6</th>
<th>AG7</th>
</tr>
</thead>
<tbody>
<tr>
<td>V1</td>
<td>H</td>
<td>L</td>
<td>L</td>
<td>L</td>
<td>L</td>
<td>L</td>
<td>L</td>
<td>L</td>
</tr>
<tr>
<td>V2</td>
<td>L</td>
<td>H</td>
<td>L</td>
<td>L</td>
<td>L</td>
<td>L</td>
<td>L</td>
<td>L</td>
</tr>
<tr>
<td>V3</td>
<td>H</td>
<td>H</td>
<td>L</td>
<td>L</td>
<td>L</td>
<td>L</td>
<td>L</td>
<td>L</td>
</tr>
<tr>
<td>V127</td>
<td>H</td>
<td>H</td>
<td>H</td>
<td>H</td>
<td>H</td>
<td>L</td>
<td>H</td>
<td></td>
</tr>
<tr>
<td>V128</td>
<td>L</td>
<td>L</td>
<td>L</td>
<td>L</td>
<td>L</td>
<td>L</td>
<td>L</td>
<td>H</td>
</tr>
</tbody>
</table>

Gate line address setup

Figure 17

No display area
7. Optical characteristics

Table 8

<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>Viewing angle range</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>deg.</td>
<td></td>
</tr>
<tr>
<td>Horizontal</td>
<td>$\theta_{21}$</td>
<td>CR&gt;3</td>
<td>40</td>
<td>-</td>
<td>-</td>
<td>deg.</td>
<td></td>
</tr>
<tr>
<td>Horizontal</td>
<td>$\theta_{22}$</td>
<td>CR&gt;3</td>
<td>40</td>
<td>-</td>
<td>-</td>
<td>deg.</td>
<td></td>
</tr>
<tr>
<td>Vertical</td>
<td>$\theta_{11}$</td>
<td>CR&gt;3</td>
<td>60</td>
<td>-</td>
<td>-</td>
<td>deg.</td>
<td></td>
</tr>
<tr>
<td>Vertical</td>
<td>$\theta_{12}$</td>
<td>CR&gt;3</td>
<td>60</td>
<td>-</td>
<td>-</td>
<td>deg.</td>
<td></td>
</tr>
<tr>
<td>Contrast ratio</td>
<td>CR</td>
<td></td>
<td>-</td>
<td>14</td>
<td>-</td>
<td></td>
<td>Note 7-1</td>
</tr>
<tr>
<td>Reflection ratio</td>
<td>R</td>
<td></td>
<td>-</td>
<td>17</td>
<td>-</td>
<td>%</td>
<td>Note 7-3</td>
</tr>
<tr>
<td>Transmission ratio</td>
<td>T</td>
<td>$\theta=0^\circ$</td>
<td>-</td>
<td>0.25</td>
<td>-</td>
<td>%</td>
<td>Note 7-1</td>
</tr>
<tr>
<td>Response time</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>msec.</td>
<td></td>
</tr>
<tr>
<td>Rise</td>
<td>$\tau_r$</td>
<td></td>
<td>-</td>
<td>10</td>
<td>-</td>
<td>msec.</td>
<td>Note 7-1</td>
</tr>
<tr>
<td>Decay</td>
<td>$\tau_d$</td>
<td></td>
<td>-</td>
<td>20</td>
<td>-</td>
<td>msec.</td>
<td>Note 7-4</td>
</tr>
<tr>
<td>Chromaticity of White</td>
<td>x</td>
<td></td>
<td>-</td>
<td>0.30</td>
<td>-</td>
<td></td>
<td>Note 7-1</td>
</tr>
<tr>
<td></td>
<td>y</td>
<td></td>
<td>-</td>
<td>0.33</td>
<td>-</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

[Note 7-1] This shall be measured at center of the screen.

Figure 18 Measurement of contrast, reflective ratio and panel surface chromaticity
[Note 7-2] Definition of viewing angle range

Figure 19

[Note 7-3] Definition of contrast ratio

The contrast ratio is defined as the following:

\[
\text{Contrast ratio (CR)} = \frac{\text{Reflection intensity on all pixels white}}{\text{Reflection intensity on all pixels black}}
\]

[Note 7-4] Definition of response time

The response time is defined as the following figure and shall be measured by switching the input signal for “black” and “white”

Figure 20
8. Handling of module

8-1. About handling of FPC

1) The bending radius of the FPC should be more than 0.7mm, and it should be bent evenly.
2) Do not dangle the LCD module by holding the FPC, or do not give any stress to it.

Do not bend the FPC toward the display surface of LCD module, because it will cause FPC disconnection.

![Figure 21](image)

8-2. Mounting of the module

1) The module should be held on to the plain surface. Do not give any warping or twisting stress to the module.
2) Please consider that GND can ground a modular metal portion etc. so that static electricity is not charged to a module.

8-3. Cautions in assembly / Handling precautions

1) As the polarizer can be easily scratched, be most careful in handling it.
2) To avoid circuit failure, do not touch panel connective area.
3) Do not use chloroprene rubber as it generates chlorine gas and affects reliability in LCD panel connective area.
4) To avoid picture uniformity failure, do not put a seal or an adhesive material on the panel surface.
5) Work environments in assembly.

Working under the following environments is desirable:

a) Implement more than 1MΩ conductive treatment (by placing a conductive mat or applying conductive paint) on the floor or tiles.

b) No dusts come in to the working room. Place an adhesive, anti-dust mat at the entrance of the room.

c) Humidity of 50 to 70% and temperature of 15 to 27°C are desirable.

d) All workers wear conductive shoes, conductive clothes, conductive fingerstalls and grounding belts without fail.

e) Use a blower for electrostatic removal. Set it in a direction slightly tilt downward so that each Module can be well subjected to its wind. Set the blower at an optimum distance between the blower and the module.

6) How to remove dust on the polarizer

a) When you use LCD module, peel off the protection laminate film attached on the display surface of LCD module.

b) Blow out dust by the use of an N² blower with antistatic measures taken. Use of an ionized air gun is recommendable.
c) When the panel surface is soiled, wipe it with soft cloth.

7) In the case of the module’s metal part (shield case) is stained, wipe it with a piece of dry, soft cloth. If rather difficult, give a breath on the metal part to clean better.

8) If water drops, etc. are left on the polarizer for a long time, they are apt to cause stains or make the polarizer get discolored. Wipe it off immediately.

9) As a glass substrate is used for the TFT-LCD panel, if it is dropped on the floor or hit by something hard, it may be broken or chipped off.

10) Since CMOS LSI is used in this module, take care of static electricity and take the human earth into consideration when handling.

11) LCD module does not have the function to limit current. In order to prevent latch up, please design your product to limit current.

12) Protective film is attached to both of surface polarizer films (front polarizer and rear polarizer) on LCD panel to prevent scratches or other damages. Remove these protective films before use. In addition, do not attach the protective films which are removed from LCD module again. When the LCD panel which has the reattached protective film is needed to storage for a long time, the polarizer film might have a damage with picture quality failure.

13) When handling LCD module and assembling them into cabinets, be noted that storage in the environment of oxidization or deoxidization gas and the use of such materials as reagent, solvent, adhesive, resin, and etc. which generate these gasses, may cause corrosion and discoloration of LCD modules.

8-4. Others

1) Do not store LCD modules in any place where it will be subjected to direct sunlight.

   You are requested to store under the following conditions:
   (Environmental conditions of temperature/humidity for storage)
   a) Temperature: 0 to 40°C
   b) Relative humidity: 90% or less
     • As average values of environments (temperature and humidity) for storing, use the following control guidelines:
       Summer season: 20 to 35°C, 85% or less  Winter season: 5 to 15°C, 85% or less
     • If stored under the conditions of 40°C and 90% RH, cumulative time of storage must be less than 240 hours.

2) If stored at temperatures below the rated values, the inner liquid crystal may freeze, causing cell destruction. At temperatures exceeding the rated values for storage, the liquid crystal may become isotropic liquid, making it no longer possible to come back to its original state in some cases.

3) If the LCD module is broken, do not drink liquid crystal or put it in the mouth.

4) If a water drop or dust adheres to the polarizer, it is apt to cause deterioration. Wipe it immediately.

5) Be sure to observe other caution items for ordinary electronic parts and components.

6) If local pressure is put on the display surface of LCD module for a long time, it will cause Newton ring.

7) Epoxy resin (amine series curing agent), silicone adhesive material (dealcoholization series and oxime series), tray forming agent (azo compound) etc, in the cabinet or the packing materials may induce abnormal display with polarizer film deterioration regardless of contact or noncontact to polarizer film. Be sure to confirm the component of them.
9. Reliability test items

Table 9

<table>
<thead>
<tr>
<th>No.</th>
<th>Test item</th>
<th>Condition</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>High temperature storage test</td>
<td>( Ta = 85°C ) 240h</td>
</tr>
<tr>
<td>2</td>
<td>Low temperature storage test</td>
<td>( Ta = -30°C ) 240h</td>
</tr>
<tr>
<td>3</td>
<td>High temperature &amp; high humidity operation test</td>
<td>( Ta = 40°C / 90%RH ) (No condensation) 240h</td>
</tr>
<tr>
<td>4</td>
<td>High temperature operation test</td>
<td>( Ta = 70°C ) 240h</td>
</tr>
<tr>
<td>5</td>
<td>Low temperature operation test</td>
<td>( Ta = -20°C ) 240h</td>
</tr>
<tr>
<td>6</td>
<td>Thermal shock test (non-operating)</td>
<td>( Ta = -20°C ) to 70°C (30 min.) 10 cycles</td>
</tr>
<tr>
<td>7</td>
<td>Electro static discharge test</td>
<td>±200V/200pF(0Ω) to Terminals (Contact) (1 time for each terminals)</td>
</tr>
</tbody>
</table>

[Note 9-1] \( Ta = \) Ambient temperature, \( Tp = \) Panel temperature

[Note 9-2] A still image should be displayed less than two hours, if it is necessary to display still image longer than two hour, display image data must be refreshed in order to avoid sticking image on LCD panel. In refreshing, display can be written white image by addressing white data as normal driving for this panel or DISP signal would be set as "Low".

[Check items]

In the standard condition, there shall be no practical problems that may affect the display function.

10. Display grade

The standard regarding the grade of monochrome LCD displaying modules should be based on the delivery inspection standard.
11. Delivery form

11-1. Carton storage conditions

- Carton piling-up: Max11 rows

2) Environments

   Temperature: 0 to 40°C
   Humidity: 65% RH or less (at 40°C)

   There should be no dew condensation even at a low temperature and high humidity.

3) Packing form: As shown in figure 22.

   *Cartons are weak against damp, and they are apt to be smashed easily due to the compressive pressure applied when piled up. The above environmental conditions of temperature and humidity are set in consideration of reasonable pile-up for storage.

4) Period: about 3 months

11-2. Packing composition

**Table 10**

<table>
<thead>
<tr>
<th>Name</th>
<th>quantity</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carton size</td>
<td>1</td>
<td>578mm × 382mm × 153mm</td>
</tr>
<tr>
<td>Tray (The number of Module)</td>
<td>10</td>
<td>Material: Electrification prevention polypropylene</td>
</tr>
<tr>
<td>Electrification prevention bag</td>
<td>1</td>
<td>Material: Electrification prevention polyethylene</td>
</tr>
</tbody>
</table>

Carton weight (1000 modules): Approx. 7.5 kg

11-3. Lot no. marking

The lot No. will be indicated on individual ink jet printing. The location is as shown
11-4. Packaging

1) Disassembling the module can cause permanent damage and you should be strictly avoided.

2) Please be careful that you don’t keep the screen displayed fixed pattern image for a long time, since retention may occur.

3) If you pressed down a liquid crystal display screen with your finger and so on, the alignment disorder of liquid crystal will occur. And then it will become display fault. Therefore, be careful not to touch the screen directly, and to consider not stressing to it.

4) If any problem arises regarding the items mentioned in this specification sheet or otherwise, it should be discussed and settled mutually in a good faith for remedy and/or improvement.

Figure 22 Packing form
Any foreign materials, scratches, bubbles and contamination outside the Active area are to be treated as "no-count" at our inspections. General tolerance is ±0.9.

LCD FPC bend larger than 0.8 in radius. Please design carefully to hide the polarizer edge which are outside of the guaranteed area. Light may be leaked from the gap of outside of viewing area, please pay attention to such leakage during the set design.
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Fax: (1) 360-834-8903
www.sharpsma.com

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