Technical Literature
For
TFT-LCD Module

Model No. LS012B7DD01

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Display Device Business Division
SHARP CORPORATION
<table>
<thead>
<tr>
<th>DATE</th>
<th>REF. PAGE PARAGRAPH</th>
<th>REVISED No.</th>
<th>SUMMARY</th>
</tr>
</thead>
<tbody>
<tr>
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</tr>
</tbody>
</table>
NOTICE

<<Precautions>>

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[For handling and system design]

(1) Handle with care as glass is used in this LCD panel. Dropping or contact against hard object may cause cracks or chips.

(2) Be careful to handle this LCD panel in order to avoid injury yourself by panel’s edge as this panel is made of glass and might be a sharp edge.

(3) Do not scratch the surface of the polarizer as it is easily damaged.

(4) Water droplets on the polarizer must be wiped off immediately as they may cause color changes, or other defects if remained for a long time.

(5) Do not leave the LCD panel in direct sun or under ultraviolet ray.

(6) To clean LCD panel surface, wipe clean with absorbent cotton or soft cloth. If further cleaning is needed, use IPA (isopropyl alcohol) and wipe clean lightly on surface only. Do not use organic solvents as it may damage the LCD panel terminal area which uses organic material. Also, do not directly touch with finger. When the terminals cleaning are needed, those should be wiped by a soft cloth or a cotton swab without directly touching by hand.

(7) Do not expose gate driver, etc. on the panel (circuit area outside panel display area) to light as it may not operate properly. Design that shields gate driver, etc. from light is required when mounting the LCD module.

(8) To avoid circuit failure, do not touch panel terminal area.

(9) Support for the LCD panel should be carefully designed to avoid stress that exceeds specification on glass surface.

(10) When handling LCD module and assembling them into cabinets, be noted that storage in the environment of oxidation 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.

(11) To avoid picture uniformity failure, do not put a seal or an adhesive material on the panel surface.

(12) Do not use chloroprene rubber as it generates chlorine gas and affects reliability in LCD panel connective area.

(13) Protective film is attached to the surface of polarizer on LCD panel to prevent scratches or other damages. Remove this protective film before use. In addition, do not attach the protective film which is 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 might have a damage with picture quality failure.

(14) Panel is susceptible to mechanical stress and such stress may affect the display. Place the panel on flat surface to avoid stress caused by twist, bend, etc.

(15) When transporting LCD panels, secure them in LCD panel tray to avoid mechanical stress. The tray should be conductive to protect LCD panels from static charge.

Material used in set or epoxy resin (amine type hardening agent) from packaging, and silicon adhesive (dealcoholized or oxime) all release gas which may affect quality of polarizer. Do confirm compatibility with user materials.
(16) As this LCD module is composed electronic circuits, it is sensitive to electrostatic discharge of 200V or more. Handle with care using cautions for the followings:

- Operators
  Operators must wear anti-static wears to prevent electrostatic charge up to and discharge from human body.

- Equipment and containers
  Process equipment such as conveyer, soldering iron, working bench and containers may possibly generate electrostatic charge up and discharge. Equipment must be grounded through 100Mohms resistance. Use ion blower.

- Floor
  Floor plays an important role in leaking static electricity generated in human body or equipment. If the floor is made of insulated material (such as polymer or rubber material), such static electricity may charge. Proper measure should be taken to avoid static electricity charge (electrostatic earth: 100Mohms). There is a possibility that the static electricity is charged to them without leakage in case of insulating floor, so the electrostatic earth: $1 \times 10^8 \Omega$ should be made.

- Humidity
  Humidity in work area relates to surface resistance of the persons or objects that generate electrostatics, and it can be manipulated to prevent electrostatic charge. Humidity of 40% or lower increases electrostatic earth resistance and promotes electrostatic charging. Therefore, the humidity in the work area should be kept above 40%. Specifically for film peeling process or processes that require human hands, humidity should be kept above 50% and use electricity removal blower.

- Transportation/Storage
  Containers and styroform used in transporation and storage may charge electrostatic (from friction and peeling) or electrostatic charge from human body, etc. may cause containers and styroform to have induced charge. Proper electrostatic measure should be taken for containers and storage material.
[For operating LCD module]

(1) Do not operate the LCD panel under outside of electrical specification. Otherwise LCD panel may be damaged.
(2) Do not use the LCD panel under outside of specified driving timing chart. Otherwise LCD panel may not have proper picture quality.
(3) 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.
(4) If LCD module takes a static electricity, as the display image which is written into pixel memory might not be displayed, Data update should be executed frequently.
(5) It is neither a breakdown nor a defective indication though very slight change in black level might be periodically seen in a black part on the black display image according to the source of light (angle of the luminance and the source of light).

[Precautions for Storage]

(1) After opening the package, do not leave the LCD panel in direct sun or under strong ultraviolet ray. Store in dark place.
(2) In temperature lower than specified rating, liquid crystal material will coagulate. In temperature higher than specified rating, it isotropically liquifies. In either condition, the liquid crystal may not recover its original condition. Store the LCD panel in at or around room temperature as much as possible.
   Also, storing the LCD panel in high humidity will damage the polarizer. Store in normal room temperature as much as possible.
(3) Keeping Method
   a. Don't keeping under the direct sunlight.  
   b. Keeping in the tray under the dark place.
[Other Notice]

(1) Operation outside specified environmental conditions cannot be guaranteed.

(2) As power supply (VDD-GND) impedance is lowered during use, bus controller should be inserted near LCD module as much as possible.

(3) Polarizer is applied over LCD panel surface. Liquid crystal inside LCD panel deteriorates with ultraviolet ray. The panel should not be left in direct sun or under strong ultraviolet ray for prolonged period of time even with the polarizer.

(4) Disassembling the LCD module will cause permanent damage to the module. Do not disassemble the module.

(5) If LCD panel is broken, do not ingest the liquid crystal from the broken panel. If hand, leg, or clothes come in contact with liquid crystal, wash off immediately with soap.

(6) ODS (specific chlorofluorocarbon, specific halon, 1-1-1 trichloroethane, carbon tetrachloride) are not used or contained in material or all production processes of this product.

(7) Observe all other precautionary requirements in handling general electronic components.

Discarding liquid crystal modules

LCD Panel : Dispose of as glass waste. This LCD module contains no harmful substances.

The liquid crystal panel contains no dangerous or harmful substances.

This liquid crystal panel contains only an extremely small amount of liquid crystal (approximately 100mg) and therefore it will not leak even if the panel should break.

Its median lethal dose (LD50) is greater than 2,000 mg/kg and a mutagenetic (Aims test: negative) material is used.
1. Scope of application .................................................................................................................................7
2. Outline .......................................................................................................................................................7
3. Features .....................................................................................................................................................7
4. Mechanical specification ............................................................................................................................7
5. Structure ....................................................................................................................................................8
   5-1 Makeup ...............................................................................................................................................8
   5-2 LCD-FPC performance ..........................................................................................................................8
6. Input pin specification .................................................................................................................................9
7. Absolute maximum ratings ..........................................................................................................................9
8. Electrical specification .................................................................................................................................10
   8-1 Recommended operation range ..............................................................................................................10
   8-2 DC electrical characteristics ................................................................................................................10
   8-3 Operation characteristics ....................................................................................................................11
   8-4 Input signal characteristics ..................................................................................................................11
9. Recommended sequence .............................................................................................................................13
   9-1 Power source sequence .........................................................................................................................13
   9-2 Timing chart .......................................................................................................................................14
10. Example of external circuit .......................................................................................................................18
11. Optical specification .................................................................................................................................19
   11-1 Optical characteristics ........................................................................................................................19
   11-2 Measurement method ........................................................................................................................19
12. Display quality ..........................................................................................................................................20
13. Shipping ....................................................................................................................................................21
   13-1 Lot number display ............................................................................................................................21
   13-2 Carton storage conditions ..................................................................................................................22
   13-3 Packing ..............................................................................................................................................22
14. Reliability test conditions ..........................................................................................................................23
   14-1 Reliability test items ...........................................................................................................................23
15. TFT-LCD module handling .......................................................................................................................24
   15-1 Inserting the FPC in the connector and removing ..............................................................................24
   15-2 FPC handling ....................................................................................................................................24
   15-3 Module handling ................................................................................................................................24
16. Other .........................................................................................................................................................24
Outline dimention ........................................................................................................................................25
1. **Scope of application**
   
   This specification applies to TFT-LCD module LS012B7DD01

2. **Outline**
   
   This TFT-LCD module is an active matrix LC display (LCD: liquid crystal display) module with CG silicon (CG-Si: Continuous Grain-Silicon) and thin film transistors (TFT: Thin Film Transistor). This TFT-LCD module is such that black and white 2 value display is possible in a 184x38 dot panel.

3. **Features**
   
   • Active matrix drive system
   • Transflective type, black and white display with 1.17” screen. (184x38 dot structure)
   • Low power consumption using pixel memory panel (normally white).
   • The interface system uses serial interface (3 wire system).
   • Lightweight, thin and compact.
   • High reflectance (with slight transmissivity)

4. **Mechanical specification**

   Table 4-1 Module mechanical specification table

<table>
<thead>
<tr>
<th>Item</th>
<th>Specification</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Screen size(diagonal)</td>
<td>2.9686[1.17&quot;]</td>
<td>cm</td>
</tr>
<tr>
<td>Active display area</td>
<td>29.072(H)×6.004(V)</td>
<td>mm</td>
</tr>
<tr>
<td>Dot structure</td>
<td>184(H)×38(V)</td>
<td>Dot</td>
</tr>
<tr>
<td>Dot pitch</td>
<td>0.158(H)×0.158(V)</td>
<td>mm</td>
</tr>
<tr>
<td>Pixel array</td>
<td>Square</td>
<td>–</td>
</tr>
<tr>
<td>Module outline dimensions</td>
<td>35.1W)×11.0(H)×0.741(D) (NB)</td>
<td>mm</td>
</tr>
<tr>
<td>Mass</td>
<td>0.6 (TYP)</td>
<td>g</td>
</tr>
<tr>
<td>Surface hardness</td>
<td>At least 3H (initial)</td>
<td>Pencil hardness</td>
</tr>
</tbody>
</table>

NB) Please refer to Figure 5-1 (Page.25) for the detailed dimensions, tolerance.
5. Structure

5-1 Makeup
This LCD module is made up of an LCD panel, polarizer (Front, Rear), LCD-FPC.
The outline dimensions are shown in Figure 5-1 (Page.25).

5-2 LCD-FPC performance
① Suitable connector
   F.C.I. 59453-08111F 8 pin (0.5mm pitch)
② FPC flex resistance
   Flexure tests are carried out with a flexure radius=R0.6mm, flexure angle =90° and there should be no breakage after less than 10 times.
③ LCD-FPC circuit diagram
   The LCD-FPC circuit diagram is shown in Figure 5-2.

Figure 5-2 LCD-FPC circuit diagram
6. Input pin specification

Table 6-1 Input pin names

<table>
<thead>
<tr>
<th>No.</th>
<th>Code</th>
<th>I/O</th>
<th>Voltage</th>
<th>Signal name</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>SCLK</td>
<td>I</td>
<td>0/3.0 (V)</td>
<td>Serial clock signal</td>
</tr>
<tr>
<td>2</td>
<td>SI</td>
<td>I</td>
<td>0/3.0 (V)</td>
<td>Serial input signal</td>
</tr>
<tr>
<td>3</td>
<td>SCS</td>
<td>I</td>
<td>0/3.0 (V)</td>
<td>Chip select signal</td>
</tr>
<tr>
<td>4</td>
<td>EXTCOMIN</td>
<td>I</td>
<td>0/3.0 (V)</td>
<td>COM inversion polarity input pin</td>
</tr>
<tr>
<td>5</td>
<td>DISP</td>
<td>I</td>
<td>0/3.0 (V)</td>
<td>Display ON/OFF switching signal</td>
</tr>
<tr>
<td>6</td>
<td>VDD</td>
<td>I</td>
<td>3(V)</td>
<td>Power source (logic, analog)</td>
</tr>
<tr>
<td>7</td>
<td>NC</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>8</td>
<td>VSS</td>
<td>—</td>
<td>0(V)</td>
<td>GND</td>
</tr>
</tbody>
</table>

7. Absolute maximum ratings

Table 7-1 Module input absolute maximum ratings

<table>
<thead>
<tr>
<th>Item</th>
<th>Code</th>
<th>Rating</th>
<th>Unit</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supply voltage for logic</td>
<td>VDD</td>
<td>-0.3~+3.6</td>
<td>V</td>
<td></td>
</tr>
<tr>
<td>Input signal voltage</td>
<td>VIN</td>
<td>-0.3~VDD</td>
<td>V</td>
<td>(*2)</td>
</tr>
<tr>
<td>Operation</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>temperature (panel temperature)</td>
<td>Topr</td>
<td>-10~+70</td>
<td>°C</td>
<td>(*1)</td>
</tr>
<tr>
<td>Storage temperature</td>
<td>Tstg</td>
<td>-20~+80</td>
<td>°C</td>
<td>(*1)</td>
</tr>
</tbody>
</table>

(NB) VSS pin = 0V unless otherwise indicated.

(*1) Do not allow condensation.

(*2) Applies to SCS, SCLK, SI, DISP and EXTCOMIN signals.
8. Electrical specification

8-1 Recommended operation range

Table 8-1 Recommended operation range

<table>
<thead>
<tr>
<th>Item</th>
<th>Code</th>
<th>Conditions</th>
<th>Min</th>
<th>Typ</th>
<th>Max</th>
<th>Unit</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power supply voltage for driver</td>
<td>VDD</td>
<td></td>
<td>2.7</td>
<td>3.0</td>
<td>3.3</td>
<td>V</td>
<td></td>
</tr>
<tr>
<td>Input signal voltage (High)</td>
<td>VINHI</td>
<td>VDD-0.1</td>
<td></td>
<td></td>
<td>V</td>
<td>V</td>
<td>(1)</td>
</tr>
<tr>
<td>Input signal voltage (Low)</td>
<td>VINLO</td>
<td>VSS</td>
<td></td>
<td></td>
<td>VSS+0.1</td>
<td>V</td>
<td>(1)</td>
</tr>
</tbody>
</table>

(1) Applies to SCS, SCLK, SI, DISP and EXTCOMIN signals.

8-2 DC electrical characteristics

Table 8-2-1 DC electrical characteristics

<table>
<thead>
<tr>
<th>Item</th>
<th>Code</th>
<th>Drive</th>
<th>Min.</th>
<th>Typ</th>
<th>Max.</th>
<th>Unit</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Current consumption 1</td>
<td>PVDD1</td>
<td>(*)</td>
<td>1</td>
<td></td>
<td>15</td>
<td>μA</td>
<td></td>
</tr>
<tr>
<td>Current consumption 2</td>
<td>PVDD2</td>
<td>(*)</td>
<td>2</td>
<td></td>
<td>150</td>
<td>μA</td>
<td></td>
</tr>
</tbody>
</table>

(1) The display pattern is such that there is no image update with the all black display.
SCS=SCLK=SI=L, EXTCOMIN=60Hz

(2) The display pattern is such that there is continuous image data update with the vertical stripe (1 dot interval) display. Data update mode
SCLK=1MHz, EXTCOMIN=60Hz

![Frame frequency](image)
### 8-3 Operation characteristics

**Table 8-3 Operation signals**

(Ta=25°C, SCS, SCLK, SI, DISP, EXTCOMIN=3.0V, VDD=3.0V, VSS pin=0V)

<table>
<thead>
<tr>
<th>Pin name</th>
<th>Item Code</th>
<th>Min</th>
<th>Typ.</th>
<th>Max</th>
<th>Unit</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>SCS</td>
<td>fSCS</td>
<td>56</td>
<td>60</td>
<td>63</td>
<td>Hz</td>
<td></td>
</tr>
<tr>
<td>SCLK</td>
<td>fSCLK</td>
<td>-</td>
<td>0.5</td>
<td>1</td>
<td>MHz</td>
<td></td>
</tr>
<tr>
<td></td>
<td>tV</td>
<td>15.87</td>
<td>16.67</td>
<td>17.86</td>
<td>msec</td>
<td></td>
</tr>
<tr>
<td></td>
<td>fCOM</td>
<td>28</td>
<td>30</td>
<td>31.5</td>
<td>Hz</td>
<td></td>
</tr>
</tbody>
</table>

### 8-4 Input signal characteristics

**Table 8-4 Input signals**

(Ta=25°C, SCS, SCLK, SI, DISP, EXTCOMIN=3.0V, VDD=3.0V, VSS pin=0V)

<table>
<thead>
<tr>
<th>Pin name</th>
<th>Item Code</th>
<th>Min</th>
<th>Typ.</th>
<th>Max</th>
<th>Unit</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>SCS</td>
<td>trSCS</td>
<td>70</td>
<td>nsec</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SCS</td>
<td>tfSCS</td>
<td>70</td>
<td>nsec</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>twSCSH</td>
<td>232</td>
<td>μsec</td>
<td></td>
<td></td>
<td>Data update mode</td>
</tr>
<tr>
<td></td>
<td>twSCSL</td>
<td>2</td>
<td>μsec</td>
<td></td>
<td></td>
<td>Display mode</td>
</tr>
<tr>
<td></td>
<td>tsSCS</td>
<td>6</td>
<td>μsec</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>thSCS</td>
<td>2</td>
<td>μsec</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SI</td>
<td>trSI</td>
<td>50</td>
<td>nsec</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SI</td>
<td>trSI</td>
<td>50</td>
<td>nsec</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>tsSCS</td>
<td>250</td>
<td>nsec</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>thSI</td>
<td>525</td>
<td>nsec</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SCLK</td>
<td>trSCLK</td>
<td>50</td>
<td>nsec</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SCLK</td>
<td>tfSCLK</td>
<td>50</td>
<td>nsec</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>twSCLKH</td>
<td>450</td>
<td>nsec</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>twSCLKL</td>
<td>450</td>
<td>nsec</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>EXTCOMIN</td>
<td>fEXTCOMIN</td>
<td>60</td>
<td>63</td>
<td>Hz</td>
<td></td>
<td>(*1)</td>
</tr>
<tr>
<td>EXTCOMIN</td>
<td>trEXTCOMIN</td>
<td>70</td>
<td>nsec</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>EXTCOMIN</td>
<td>tfEXTCOMIN</td>
<td>70</td>
<td>nsec</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>EXTCOMIN</td>
<td>twEXTCOMIN</td>
<td>2</td>
<td>μsec</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DISP</td>
<td>trDISP</td>
<td>70</td>
<td>nsec</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DISP</td>
<td>tfDISP</td>
<td>70</td>
<td>nsec</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(*1) Please make the EXTCOMIN frequency less than the frame rate frequency.
<table>
<thead>
<tr>
<th>Pin Name</th>
<th>Item</th>
<th>Symbol</th>
<th>Waveform</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>SCS</td>
<td>SCS rise time</td>
<td>trSCS</td>
<td><img src="image" alt="SCS rise time waveform" /></td>
<td></td>
</tr>
<tr>
<td>SCS</td>
<td>SCS fall time</td>
<td>tfSCS</td>
<td><img src="image" alt="SCS fall time waveform" /></td>
<td></td>
</tr>
<tr>
<td>SCS</td>
<td>High width</td>
<td>twSCSH</td>
<td><img src="image" alt="SCS high width waveform" /></td>
<td></td>
</tr>
<tr>
<td>SCS</td>
<td>Low width</td>
<td>twSCSL</td>
<td><img src="image" alt="SCS low width waveform" /></td>
<td></td>
</tr>
<tr>
<td>SCS</td>
<td>Set-up time</td>
<td>tsSCS</td>
<td><img src="image" alt="SCS set-up time waveform" /></td>
<td></td>
</tr>
<tr>
<td>SCS</td>
<td>Hold time</td>
<td>thSCS</td>
<td><img src="image" alt="SCS hold time waveform" /></td>
<td></td>
</tr>
<tr>
<td>SI</td>
<td>Rise time</td>
<td>trSI</td>
<td><img src="image" alt="SI rise time waveform" /></td>
<td></td>
</tr>
<tr>
<td>SI</td>
<td>Fall time</td>
<td>tfSI</td>
<td><img src="image" alt="SI fall time waveform" /></td>
<td></td>
</tr>
<tr>
<td>SI</td>
<td>Set-up time</td>
<td>tsSI</td>
<td><img src="image" alt="SI set-up time waveform" /></td>
<td></td>
</tr>
<tr>
<td>SI</td>
<td>Hold time</td>
<td>thSI</td>
<td><img src="image" alt="SI hold time waveform" /></td>
<td></td>
</tr>
<tr>
<td>SCLK</td>
<td>Rise time</td>
<td>trSCLK</td>
<td><img src="image" alt="SCLK rise time waveform" /></td>
<td></td>
</tr>
<tr>
<td>SCLK</td>
<td>Fall time</td>
<td>tfSCLK</td>
<td><img src="image" alt="SCLK fall time waveform" /></td>
<td></td>
</tr>
<tr>
<td>SCLK</td>
<td>High width</td>
<td>twSCLKH</td>
<td><img src="image" alt="SCLK high width waveform" /></td>
<td></td>
</tr>
<tr>
<td>SCLK</td>
<td>Low width</td>
<td>twSCLKL</td>
<td><img src="image" alt="SCLK low width waveform" /></td>
<td></td>
</tr>
<tr>
<td>EXTCOMIN</td>
<td>Rise time</td>
<td>trEXTCOMIN</td>
<td><img src="image" alt="EXTCOMIN rise time waveform" /></td>
<td></td>
</tr>
<tr>
<td>EXTCOMIN</td>
<td>Fall time</td>
<td>tfEXTCOMIN</td>
<td><img src="image" alt="EXTCOMIN fall time waveform" /></td>
<td></td>
</tr>
<tr>
<td>EXTCOMIN</td>
<td>High width</td>
<td>twEXTCOMIN</td>
<td><img src="image" alt="EXTCOMIN high width waveform" /></td>
<td></td>
</tr>
<tr>
<td>DISP</td>
<td>Rise time</td>
<td>trDISP</td>
<td><img src="image" alt="DISP rise time waveform" /></td>
<td></td>
</tr>
<tr>
<td>DISP</td>
<td>Fall time</td>
<td>tfDISP</td>
<td><img src="image" alt="DISP fall time waveform" /></td>
<td></td>
</tr>
</tbody>
</table>

Figure 8-4  Input signal timing characteristics diagram
9. Recommended sequence

9-1 Power source sequence

Refer to timing chart and AC timing characteristics for detail

1. (3) and (4) 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 30us or more before SCS starts up (it may be less than 60us).

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

[ON Sequence]
(1) 3V rise time (depends on IC)
(2) Pixel memory initialisation.
   T2: at least 1 frame.
   Use M2 (all clear flag) to initialise (at least once). Or write whole screen white.
(3) Release time for initialisation of TCOM latch T3: 30us or more
   Time required to release COM latch circuit which is initialized using DISP signals
(4) TCOM polarity initialisation time T4: 30us or more
   Time required initialising TCOM polarity accordingly to EXTCOMIN input

[Normal Operation]
Duration of normal driving

[Off Sequence]
(5) Pixel memory initialisation time T5: at least 1 frame
(6) VCOM initialisation time T6: 30us or more
(7) 3V falling time (Depends on IC)

NB: Please contact Sharp before changing this sequence.
9-2 Timing chart

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

M1: It can be "H" or "L".

M2: All clear flag.

All Clear Mode, set to "L". Refer to 'All clear timing chart'


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

Example:

- 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.

Gate line address selection table

<table>
<thead>
<tr>
<th>GL</th>
<th>AG0</th>
<th>AG1</th>
<th>AG2</th>
<th>AG3</th>
<th>AG4</th>
<th>AG5</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
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<td>2</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>3</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
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<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>5</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
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<td>6</td>
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<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
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<td>1</td>
<td>1</td>
<td>0</td>
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<td>0</td>
</tr>
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<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
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<td>...</td>
<td>...</td>
<td>...</td>
<td>...</td>
<td>...</td>
<td>...</td>
</tr>
<tr>
<td>31</td>
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<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>0</td>
</tr>
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<td>32</td>
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<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>33</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>34</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>35</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
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<td>36</td>
<td>0</td>
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<tr>
<td>38</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
</tbody>
</table>
**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**: It can be "H" or "L".
- **M2**: All clear flag.
  - All Clear Mode, set to "L". Refer to 'All clear timing chart'
- **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 GL2 line data transfer period, GL 2nd line address is latched and GL 1st line data is transferred from 1st latch to pixel internal memory circuit at the same time.

- **Mode selection period**
  - (3ck+5ckDMY)
- **Gate line address period**
  - (6ck+2ckDMY)
- **Data writing period**
  - (184ck)
- **Data transfer period**
  - (8ck(Dummy)+6ck(Address)+2ck(Dummy)=16ck)

- **Data writing period**
  - (184ck)
- **Data transfer period**
  - (16ck)
Display Mode
Maintains memory internal data (maintains current display). (M0="L", M2="L")

```
M0: Mode flag.
   When "L", display mode (maintain memory internal data).
   Set for "H". Data update mode (Memory internal data update)
M1: It can be "H" or "L".
M2: All clear flag.
   All Clear Mode, set to "L". Refer to 'All clear timing chart'
DUMMY DATA: Dummy data. It can be "H" or "L" (*L* is recommended.)
```

All Clear Mode
Clears memory internal data and writes white. (M0="L", M2="H")

```
M0: Mode flag.
   Set it "L".
M1: 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.)
```
**COM Inversion**

**EXTCOMIN has 2 timing conditions:**

(1): The EXTCOMIN input during high period of the SCS signal

- LC inversion polarity has been set by the falling edge of SCS signal.
- The period of EXTCOMIN should be constant.

(2): The EXTCOMIN input during low period of the SCS signal

- LC inversion polarity has been set by the rising edge of EXTCOMIN.
- The period of EXTCOMIN should be constant.
10. Example of external circuit

*Above circuit and parts are only recommendation
For actual use, please evaluate their conformity with your system and design.
(Capacitor pressure resistance can be larger than resistance indicated above.)

Figure 10-1 External circuit diagram (recommended)
11. Optical specification

11-1 Optical characteristics

(a) Reflection characteristics

<table>
<thead>
<tr>
<th>Item</th>
<th>Code</th>
<th>Conditions</th>
<th>Min</th>
<th>Typ</th>
<th>Max</th>
<th>Unit</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reflectance</td>
<td></td>
<td>θ=0°</td>
<td>12</td>
<td>15</td>
<td></td>
<td>%</td>
<td>11-2(b),(e)</td>
</tr>
<tr>
<td>Contrast ratio</td>
<td>CR</td>
<td>θ=0°</td>
<td>18</td>
<td>22</td>
<td></td>
<td></td>
<td>11-2(c),(e)</td>
</tr>
<tr>
<td>Viewing angle</td>
<td></td>
<td>Co≥2</td>
<td>50</td>
<td>60</td>
<td></td>
<td>degrees</td>
<td>11-2(a),(d)</td>
</tr>
<tr>
<td></td>
<td>011</td>
<td></td>
<td>50</td>
<td>60</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>012</td>
<td></td>
<td>50</td>
<td>60</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>021</td>
<td></td>
<td>50</td>
<td>60</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>022</td>
<td></td>
<td>50</td>
<td>60</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chromaticity</td>
<td>White</td>
<td>θ=0°</td>
<td></td>
<td>0.31</td>
<td></td>
<td></td>
<td>11-2(e)</td>
</tr>
<tr>
<td></td>
<td>Wx</td>
<td></td>
<td></td>
<td>0.31</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Wy</td>
<td></td>
<td></td>
<td>0.33</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Transmissivity</td>
<td></td>
<td>θ=0°</td>
<td></td>
<td>(0.25)</td>
<td></td>
<td>%</td>
<td></td>
</tr>
</tbody>
</table>

11-2 Measurement method

(a) The viewing angle direction is defined as shown below.

Figure 11-1 Definition of viewing angle direction
(b) Reflectance is defined as shown below.

\[
\text{Reflectance} = \frac{\text{Reflected luminance of white display}}{\text{Reflected luminance of calibrated diffuse white standard}}
\]

(c) The reflection contrast ratio is defined with the following equation.

\[
\text{Reflection contrast ratio} = \frac{\text{Reflected luminance of white display}}{\text{Reflected luminance of black display}}
\]

(d) Reflection Viewing angle

(e) Reflectance/contrast/ chromaticity
- Based on light source (D65).

12. Display quality
The standard for LCD module display quality is based on the shipping inspection standards.
13. Shipping

13-1 Lot number display

  Displayed by printing. The display position is shown in Figure 13-1 outline dimension diagram.

  Incjet print contests: TBD

Figure 13-1 Lot number printing position
13-2 Carton storage conditions

(1) Max number stacked: TBD
Max number stored: TBD pcs/carton

(2) Environment
  • Temperature: 0~40°C
  • Humidity: Less than 60%RH (at 40°C)
    There should be no condensation at low temperatures even with high humidity.
  • Atmosphere: No toxic gases that significantly corrode the electronic parts and wiring material such as acid and alkali should be detected.
  • Period: Around 3 months
  • Unpacking: In order to prevent electrostatic damage to TFT modules, room humidity should be made over 50% RH and take effective measure such as use of earth when opening the package.

13-3 Packing
The packing method is shown in Figure 13-2.
The packaging is designed such that the module does not break during transit.

Packageing size: TBD

Figure 13-2: packing condition
14. Reliability test conditions

14-1 Reliability test items

Table 14-1 Reliability test items

<table>
<thead>
<tr>
<th>Test items</th>
<th>Test contents</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. High temperature storage</td>
<td>Ta=80°C</td>
<td>240h</td>
</tr>
<tr>
<td>2. Low temp. storage</td>
<td>Ta=-20°C</td>
<td>240h</td>
</tr>
<tr>
<td>3. High temp. high humidity</td>
<td>Tp=40°C /95%RH</td>
<td>240h</td>
</tr>
<tr>
<td>4. High temp. operation</td>
<td>Tp=70°C</td>
<td>240h</td>
</tr>
<tr>
<td>5. Low temp. operation</td>
<td>Tp=-10°C</td>
<td>240h</td>
</tr>
<tr>
<td>6. Thermal shock</td>
<td>Ta=-20°C (1h)</td>
<td>5cycles</td>
</tr>
<tr>
<td></td>
<td>+70°C (1h)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>cycle=</td>
<td></td>
</tr>
<tr>
<td>7. Electrostatic resistance</td>
<td>±200V,200pF(0Ω)</td>
<td></td>
</tr>
</tbody>
</table>

【NB】Ta=ambient temperature, Tp=panel temperature

(Evaluation method)

In the standard condition, there shall be no practical problems that may affect the display function.
15. TFT-LCD module handling

15-1 Inserting the FPC in the connector and removing

When inserting the FPC in the connector and then when removing, be sure to turn the set side power OFF.

15-2 FPC handling

(1) The fold of the FPC (R) should be at least 0.6mm and R should be uniform.

Please do not fold the FPC towards the front polarizer side in the connection part with the LCD panel.

(2) Please do not hold the FPC and swing the LCD module or apply too much strength to the FPC.

15-3 Module handling

(1) When adhering the module to a device, contact with the driver or conductive part of the substrate can cause electrical ln leakage.

(2) When attaching, please fix such that it is on the same level and make sure there is no stress such as warping or twisting on the module. When pressing the LCD surface after embedding, please take care that excess mechanical stress is not applied to the LC module.

(3) In a set design that has no protective sheet in the panel front part for reducing surface reflection, when static electricity is applied to the panel peripheral part, there is the risk of electrostatic damage of the module so please design such that it is surrounded by the set cabinet up to the peripheral part of the polarizer and such that a conductive sheet or the like grounded to the rear side thereof is adhered to absorb static electricity. (Refer to Figure 15-1)

![Electric conduction sheet](image)

Figure 15-1 Design example

16. Other

If any problems occur with the Sharp specification items or any other items, efforts will be made to improve in cooperation. When making any changes that are likely to have a significant effect on the quality and reliability, advance contact will be made to gain approval.
Outline dimension

Figure 5-1 Outline dimensions diagram