LCD Component Data Sheet

Model Number:  04101

4 Characters (7 Segment) w/ Overflow Bar
Numeric LCD Assembly
With Embedded Controller and Backlight Diffuser

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1. GENERAL INFORMATION

1.1 Product Overview
- 4 Characters (7 Segment) w/ overflow bar COG LCD Assy
- LCD Controller: COG PCF8576 segment controller
- Multiplexing driving: 1/1 duty (static), 1/2 bias
- Operating Mode: Film Compensated Super Twisted Nematic (FSTN) technology
- COG LCD Assy Service Life: 100,000 hours minimum

1.2 Part Options & Numbering System

| 04101 | -FC | -F | -ST | -D | -6 |

- Custom Option Designator
  - (Can be left blank)

- Operating Mode
  - (-FC) Black & White FSTN Technology

- Rear Polarizer Options:
  - (-F) Transflective

- Operating Temperature
  - (-ST) Extended (0 to +50 °C)

- Backlight Options:
  - (-D) Diffuser for customer mounted LED

- Viewing Angle
  - (-6) 6 o’clock
1.3 Absolute Maximum Ratings

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Min</th>
<th>Max</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supply voltage for logic</td>
<td>V_{DD}</td>
<td>-0.3</td>
<td>8.0</td>
<td>V</td>
</tr>
<tr>
<td>Supply voltage for LCD</td>
<td>V_{LCD}</td>
<td>V_{DD}-8.0</td>
<td>V_{DD}</td>
<td>V</td>
</tr>
<tr>
<td>Input voltage</td>
<td>V_{I}</td>
<td>V_{SS}-0.5</td>
<td>V_{DD}+0.5</td>
<td>V</td>
</tr>
<tr>
<td>Standard Operating temperature</td>
<td>TOP (-ST)</td>
<td>0</td>
<td>50</td>
<td>ºC</td>
</tr>
<tr>
<td>Standard Storage temperature</td>
<td>TST (-ST)</td>
<td>-10</td>
<td>60</td>
<td>ºC</td>
</tr>
<tr>
<td>Soldering Temp</td>
<td>Tsolder</td>
<td>260</td>
<td></td>
<td>ºC</td>
</tr>
</tbody>
</table>

1.4 Circuit Block Diagram

```
CONTROLLER IC
PCF8576

Seg29

SCL SCA
VSS V_{DD} V_{O}

Com1

LCD PANEL
4 CHARACTERS x 1 LINE
```

1.5 Mechanical Characteristics

<table>
<thead>
<tr>
<th>Item</th>
<th>Contents</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Module size (W×H×T)</td>
<td>12.5 x 13.5 x 2.1 (excluding solder pins and diffuser) 12.5 x 13.5 x 5.1 (excluding solder pins)</td>
<td>mm</td>
</tr>
<tr>
<td>Viewing area (W×H)</td>
<td>10.0 x 5.0</td>
<td>mm</td>
</tr>
<tr>
<td>Active Area (W×H)</td>
<td>9.0 x 4.0</td>
<td>mm</td>
</tr>
<tr>
<td>Character size (W×H)</td>
<td>1.5 x 3.0</td>
<td>mm</td>
</tr>
<tr>
<td>Overflow Bar Size (W×H)</td>
<td>7.0 x 0.2</td>
<td>mm</td>
</tr>
</tbody>
</table>
1.6 Input Signal Function
(Typical: $V_{DD} = +3V \pm 5\%$, $V_{SS} = 0V$, $Ta = 25^\circ C$)

<table>
<thead>
<tr>
<th>Pin #</th>
<th>Symbol</th>
<th>Level</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>$V_{LCD}$</td>
<td>0.2V (Typ)</td>
<td>Input voltage for LCD</td>
</tr>
<tr>
<td>2</td>
<td>$V_{SS}$</td>
<td>0V</td>
<td>Ground</td>
</tr>
<tr>
<td>3</td>
<td>$V_{DD}$</td>
<td>3.0V (Typ)</td>
<td>Supply voltage for logic</td>
</tr>
<tr>
<td>4</td>
<td>$S_{CL}$</td>
<td>H/L</td>
<td>I2C Serial Clock</td>
</tr>
<tr>
<td>5</td>
<td>$S_{DA}$</td>
<td>H/L</td>
<td>I2C Serial Data</td>
</tr>
</tbody>
</table>

1.7 LCM Contrast Control and Bias

![LCM Contrast Control and Bias Diagram]

$V_{DD} - V_{LCD}$: LCD Driving Voltage
$V_{R}$: 10K - 20K

1.8 LCM Dimensions

![LCM Dimensions Diagram]

NOTES:
1. OPERATING TEMPERATURE: -0°C TO 50°C
2. STORAGE TEMPERATURE: -10°C TO 60°C
3. DRIVE IC: PCF8574A/DU/2/F2
4. PIN NO: 500070
5. PIN LDG

TOLERANCE OF SEGMENTS TO EDGE OF GLASS: ±0.2MM
1.9 LCM Segment Interconnections

1.10 LCM Chip Interconnections
1.11 LCM Dimensions with LED Diffuser

![Diagram of LCM Dimensions with LED Diffuser]

1.12 LED Diffuser and LED Mounting Information

![Diagram of LED Diffuser and LED Mounting Information]

**Notes:**
1. Suggested Backlight LED: Stanley 1113F Series LED
2. LED conductive mounting pads to be inset into diffuser 0.5mm min.
2. ELECTRICAL / OPTICAL CHARACTERISTICS

2.1 DC Electrical Characteristics  (Typical: \( V_{DD} = +3V \pm 5\% \), \( V_{SS} = 0V \), Ta = 25°C)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Condition</th>
<th>Min</th>
<th>Typ</th>
<th>Max</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supply voltage for logic</td>
<td>( V_{DD} )</td>
<td>---</td>
<td>2.0</td>
<td>3.0 or 5.0</td>
<td>6.0</td>
<td>V</td>
</tr>
<tr>
<td>Supply current for logic</td>
<td>( I_{DD} )</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>120</td>
<td>( \mu A )</td>
</tr>
<tr>
<td>Operating voltage for LCD*</td>
<td>( V_{DD} - V_{LCD} )</td>
<td>0°C</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>V</td>
</tr>
<tr>
<td></td>
<td></td>
<td>25°C</td>
<td>---</td>
<td>2.8V</td>
<td>---</td>
<td>V</td>
</tr>
<tr>
<td></td>
<td></td>
<td>50°C</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>V</td>
</tr>
<tr>
<td>Input voltage 'H' level</td>
<td>( V_{IH} )</td>
<td>---</td>
<td>0.7 x ( V_{DD} )</td>
<td>---</td>
<td>( V_{DD} )</td>
<td>V</td>
</tr>
<tr>
<td>Input voltage 'L' level</td>
<td>( V_{IL} )</td>
<td>---</td>
<td>( V_{SS} )</td>
<td>---</td>
<td>0.3 x ( V_{DD} )</td>
<td>V</td>
</tr>
</tbody>
</table>

*Note: -This voltage will change approximately -10mv/°C.

2.2 AC Electrical Characteristics

Please refer to the Phillips PCF8576 Data Sheet.
2.3 Optical Characteristics \((V_{\text{OP}} = 3.0\, \text{V}, \, T_a = 25^\circ\, \text{C})\)

<table>
<thead>
<tr>
<th>Item</th>
<th>Symbol</th>
<th>Condition</th>
<th>Min</th>
<th>Typ</th>
<th>Max</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Response time</td>
<td>(T_r)</td>
<td>---</td>
<td>---</td>
<td>100</td>
<td>200</td>
<td>ms</td>
</tr>
<tr>
<td></td>
<td>(T_f)</td>
<td>---</td>
<td>---</td>
<td>210</td>
<td>340</td>
<td>ms</td>
</tr>
<tr>
<td>Frame Frequency</td>
<td>(f_{\text{FRM}})</td>
<td>---</td>
<td>---</td>
<td>64</td>
<td>---</td>
<td>Hz</td>
</tr>
<tr>
<td>Contrast ratio (FSTN)</td>
<td>(C_r)</td>
<td>---</td>
<td>9</td>
<td>---</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>Viewing angle range</td>
<td>(\theta_1)</td>
<td>25(^\circ)</td>
<td>40</td>
<td>--</td>
<td>140</td>
<td>Deg</td>
</tr>
<tr>
<td></td>
<td>(\theta_2)</td>
<td>25(^\circ)</td>
<td>-40</td>
<td>--</td>
<td>40</td>
<td>Deg</td>
</tr>
</tbody>
</table>

* Definition of angles \(\phi\) and \(\theta\)

![Diagram showing optical characteristics](image)

*Definition of contrast \(C\)

\[
C = \frac{B_1}{B_2} = \frac{\text{Brightness of selected portion}}{\text{Brightness of unselected portion}}
\]

![Graph showing brightness vs. operation voltage](image)

PACIFIC DISPLAY DEVICES

02.24.2007
3. OPERATING PRINCIPALS AND METHODES

Please refer to the Phillips PCF8576 Data Sheet.
## 4. RELIABILITY

### Environmental Test

<table>
<thead>
<tr>
<th>No.</th>
<th>Test Item</th>
<th>Content of Test</th>
<th>Test Condition</th>
<th>Applicable Standard</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>High temperature storage</td>
<td>Endurance test applying the high storage temperature for a long time.</td>
<td>80 °C 200 hrs</td>
<td>---</td>
</tr>
<tr>
<td>2</td>
<td>Low temperature storage</td>
<td>Endurance test applying the low storage temperature for a long time.</td>
<td>-30 °C 200 hrs</td>
<td>---</td>
</tr>
<tr>
<td>3</td>
<td>High temperature operation</td>
<td>Endurance test applying the electric stress (Voltage &amp; Current) and the thermal stress to the element for a long time.</td>
<td>70 °C 200 hrs</td>
<td>---</td>
</tr>
<tr>
<td>4</td>
<td>Low temperature operation</td>
<td>Endurance test applying the electric stress under low temperature for a long time.</td>
<td>-20 °C 200 hrs</td>
<td>---</td>
</tr>
<tr>
<td>5</td>
<td>High temperature / Humidity storage</td>
<td>Endurance test applying the high temperature and high humidity storage for a long time.</td>
<td>80 °C, 90 %RH 96 hrs</td>
<td>MIL-202E-103B JIS-C5023</td>
</tr>
<tr>
<td>6</td>
<td>High temperature / Humidity operation</td>
<td>Endurance test applying the electric stress (Voltage &amp; Current) and temperature / humidity stress to the element for a long time.</td>
<td>70 °C, 90 %RH 96 hrs</td>
<td>MIL-202E-103B JIS-C5023</td>
</tr>
<tr>
<td>7</td>
<td>Temperature cycle</td>
<td>Endurance test applying the low and high temperature cycle.</td>
<td>-20°C / 70°C 10 cycles</td>
<td>---</td>
</tr>
</tbody>
</table>

### Mechanical Test

<table>
<thead>
<tr>
<th>No.</th>
<th>Test Item</th>
<th>Content of Test</th>
<th>Test Condition</th>
<th>Applicable Standard</th>
</tr>
</thead>
<tbody>
<tr>
<td>8</td>
<td>Vibration test</td>
<td>Endurance test applying the vibration during transportation and using.</td>
<td>10<del>22Hz → 1.5mmp-p 22</del>500Hz → 1.5G Total 0.5hrs</td>
<td>MIL-202E-201A JIS-C5025 JIS-C7022-A-10</td>
</tr>
<tr>
<td>9</td>
<td>Shock test</td>
<td>Constructional and mechanical endurance test applying the shock during transportation.</td>
<td>50G Half sign wave 11 msend 3 times of each direction</td>
<td>MIL-202E-213B</td>
</tr>
<tr>
<td>10</td>
<td>Atmospheric pressure test</td>
<td>Endurance test applying the atmospheric pressure during transportation by air.</td>
<td>115 mbar 40 hrs</td>
<td>MIL-202E-105C</td>
</tr>
<tr>
<td>11</td>
<td>Static electricity test</td>
<td>Endurance test applying the electric stress to the terminal.</td>
<td>VS=800V , RS=1.5 kΩ CS=100 pF 1 time</td>
<td>MIL-883B-3015.1</td>
</tr>
</tbody>
</table>

*** Supply voltage for logic system = VDD. Supply voltage for LCD system = Operating voltage at 25°C

### LCD Panel Service Life

**Definition of panel service life**

- 100,000 hours minimum at 25°C ±10%
- Contrast becomes 30% of initial value
- Current consumption becomes three times higher than initial value
- Remarkable alignment deterioration occurs in LCD cell layer
- Unusual operation occurs in display functions
5. PRECAUTIONS FOR USING LCD MODULES

Installing LCD Modules
The hole in the printed circuit board is used to fix LCM as shown in the picture below. Attend to the following items when installing the LCM.

1) Cover the surface with a transparent protective plate to protect the polarizer and LC cell.

2) When assembling the LCM into other equipment, the spacer to the bit between the LCM and the fitting plate should have enough height to avoid causing stress to the module surface, refer to the individual specifications for measurements. The measurement tolerance should be ±0.1mm.

Precaution for Handing LCD Modules
Since LCM has been assembled and adjusted with a high degree of precision, avoid applying excessive shocks to the module or making any alterations or modifications to it.

1) Cover the surface with a transparent protective plate to protect the polarizer and LC cell.
2) Do not alter, modify or change the shape of the tab on the metal frame.
3) Do not make extra holes on the printed circuit board, modify its shape or change the positions of components to be attached.
4) Do not damage or modify the pattern writing on the printed circuit board.
5) Absolutely do not modify the zebra rubber strip (conductive rubber) or heat seal connector.
6) Except for soldering the interface, do not make any alterations or modifications with a soldering iron.
7) Do not drop, bend or twist LCM.

Electro-Static Discharge Control
Since this module uses a CMOS LSI, the same careful attention should be paid to electrostatic discharge as for an ordinary CMOS IC.

1) Make certain that you are grounded when handing LCM.
2) Before remove LCM from its packing case or incorporating it into a set, be sure the module and your body have the same electric potential.
3) When soldering the terminal of LCM, make certain the AC power source for the soldering iron does not leak.
4) When using an electric screwdriver to attach LCM, the screwdriver should be of ground potentiality to minimize as much as possible any transmission of electromagnetic waves produced sparks coming from the commutator of the motor.
5) As far as possible make the electric potential of your work clothes and that of the work bench the ground potential.
6) To reduce the generation of static electricity be careful that the air in the work is not too dried. A relative humidity of 50%-60% is recommended.

Precaution for soldering to the LCM
1) Observe the following when soldering lead wire, connector cable and etc. to the LCM.
   a) Soldering iron temperature : 280°C ±10°C.
   b) Soldering time : 3-4 sec.
2) Solder : eutectic solder.
3) If soldering flux is used, be sure to remove any remaining flux after finishing to soldering operation. (This does not apply in the case of a non-halogen type of flux.) It is recommended that you protect the LCD surface with a cover during soldering to prevent any damage due to flux spatters.

4) When soldering the electroluminescent panel and PC board, the panel and board should not be detached more than three times. This maximum number is determined by the temperature and time conditions mentioned above, though there may be some variance depending on the temperature of the soldering iron.

5) When remove the electroluminescent panel from the PC board, be sure the solder has completely melted, the soldered pad on the PC board could be damaged.

Precautions for Operation
1) Viewing angle varies with the change of liquid crystal driving voltage (VO). Adjust VO to show the best contrast.
2) Driving the LCD in the voltage above the limit shortens its life.
3) Response time is greatly delayed at temperature below the operating temperature range. However, this does not mean the LCD will be out of the order. It will recover when it returns to the specified temperature range.
4) If the display area is pushed hard during operation, the display will become abnormal. However, it will return to normal if it is turned off and then back on.
5) Condensation on terminals can cause an electrochemical reaction disrupting the terminal circuit. Therefore, it must be used under the relative condition of $40^\circ C \pm 5\%$ RH.
6) When turning the power on, input each signal after the positive/negative voltage becomes stable.

Safety
- If the LCD panel breaks, be careful not to get the liquid crystal in your mouth. If the liquid crystal touches your skin or clothes, wash it off immediately using soap and plenty of water.

Handling
- The display panel is made of glass. Do not subject it to a mechanical shock by dropping it or impact.
- If the display panel is damaged and the liquid crystal substance leaks out, be sure not to get any in your mouth. If the substance contacts your skin or clothes, wash it off using soap and water.
- Do not apply excessive force to the display surface or the adjoining areas since this may cause the color tone to vary.
- The polarizer covering the display surface of the LCD module is soft and easily scratched. Handle this polarizer carefully.
- If the display surface becomes contaminated, breathe on the surface and gently wipe it with a soft dry cloth. If it is heavily contaminated, moisten cloth with one of the following solvents:
  - Isopropyl alcohol
  - Ethyl alcohol
- Solvents other than those above-mentioned may damage the polarizer. Especially, do not use the following.
  - Water
  - Ketone
  - Aromatic solvents
- Exercise care to minimize corrosion of the electrode. Corrosion of the electrodes is accelerated by water droplets, moisture condensation or a current flow in a high-humidity environment.
- Install the LCD Module by using the mounting holes. When mounting the LCD module make sure it is free of twisting, warping and distortion. In particular, do not forcibly pull or bend the I/O cable or the backlight cable.
- Do not attempt to disassemble or process the LCD module.
- NC terminal should be open. Do not connect anything.
- If the logic circuit power is off, do not apply the input signals.
To prevent destruction of the elements by static electricity, be careful to maintain an optimum work environment.

- Be sure to ground the body when handling the LCD modules.
- Tools required for assembling, such as soldering irons, must be properly grounded.
- To reduce the amount of static electricity generated, do not conduct assembling and other work under dry conditions.
- The LCD module is coated with a film to protect the display surface. Exercise care when peeling off this protective film since static electricity may be generated.

**Storage**

- When storing the LCD modules, avoid exposure to direct sunlight or to the light of fluorescent lamps.
- Store the module in a dark place where the temperature is 25°C ±10°C and the humidity below 65% RH.
- Do not store the module near organic solvents or corrosive gases.
- Do not crush, shake, or jolt the module (including accessories).

**Cleaning**

- Do not wipe the polarizing plate with a dry cloth, as it may scratch the surface.
- Wipe the module gently with soft cloth soaked with a petroleum benzene.
- Do not use ketonic solvents (ketone and acetone) or aromatic solvents (toluene and xylene), as they may damage the polarizing plate.

**Others:**

- Liquid crystals solidify under low temperature (below the storage temperature range) leading to defective orientation or the generation of air bubbles (black or white). Air bubbles may also be generated if the module is subject to a low temperature.
- If the LCD modules have been operating for a long time showing the same display patterns, the display patterns may remain on the screen as ghost images and a slight contrast irregularity may also appear. A normal operating status can be regained by suspending use for some time. It should be noted that this phenomenon does not adversely affect performance reliability.
- To minimize the performance degradation of the LCD modules resulting from destruction caused by static electricity etc., exercise care to avoid holding the following sections when handling the modules.
  - Exposed area of the printed circuit board.
  - Terminal electrode sections.