**OLED Display Module**

**96RGBx96 (1.10”*) OLED Display**

### DISTINCTIVE CHARACTERISTICS

- Organic LED Technology
- Wide View Angle of 160°
- Exceptional Contrast and Brightness: 50 times greater
  Brightness than previous LCD Products, four times
  more enhanced Resolution
- High Resolution provides sharp, clear Images of very
  small Characters
- Single Power / Built in DC to DC Converter for OEL Panel
- Distinct, Long travel of 5mm
- Sophisticated Housing for Assembly easily
- Support Parallel and Serial Interface

### GERNERAL SPECIFICATIONS

#### Display Specifications
- Display Type: OLED
- Display Mode: Passive Matrix
- Display Color: 65,536 Colors (Maximum)
- Drive Duty: 1/96 Duty
- Number of Pixels: 96(RGB)x96
- Pixel Size: 0.049x0.191 mm
- Pixel Pitch: 0.069x0.207 mm

#### Electrical Characteristic
- Supply Voltage: 2.4 ~ 3.3 V
- Single Voltage Control Display Module
- Built-in DC to DC Power Supply to Drive OLED
- Driver IC: SEPS114A
- Interface: Parallel/Serial/68xx/80xx/4-wire SPI

#### Mechanical Specifications
- Dimension: 29.50x29.50x10.30 mm (LxWxH)
- Window Size: 21.65x21.65 mm (LxW)
- Active Area: 19.852x 19.856 mm
- Assembly: Pitch 1.27mm / 12 Pin Connector*2
- Assembly on PCB Easy & Removable & Flexible

### TYPICAL SWITCH DIMENSIONS

![Example Picture](example.png)
## PIN ASSIGNMENTS

<table>
<thead>
<tr>
<th>Pin No.</th>
<th>Symbol</th>
<th>Type</th>
<th>Function</th>
</tr>
</thead>
</table>
| 1       | VDD     | P    | Power Supply for Core VDD  
This is a voltage supply pin. It must be connected to external source. |
| 2       | VSS     | P    | Ground for System  
This is a ground pin. It must be connected to external source. |
| 3       | SW      | I    | Terminal of Switch. Normally Open. |
| 4       | SW      | I    | Terminal of Switch. Normally Open. |
| 5       | C80     | I    | Select the CPU Type  
Low: 80XX-Series MCU  
High: 68XX-Series MCU |
| 6       | PS      | I    | Select Parallel/Serial Interface Type  
Low: Serial Interface  
High: Parallel Interface |
| 7       | CS#     | I    | Chip Select  
This is the chip select input. The chip is enable for MCU communication only when CS# is pulled low. |
| 8       | RES#    | I    | Power Reset for Controller and Drive  
This is reset signal input. When the pin is low, initialization of the chip is executed. |
| 9       | D/C#    | I    | Data/Command Control  
This pin is Data/Command control pin. When the pin is pulled high, the input at D0–D7 is treated as display data. When the pin is pulled low, the input at D0–D7 will be transferred to the command register. |
| 10      | WR#     | I    | Write or Read/Write Select  
When 80xx interface mode is selected, the pin will be the Write (WR#) input.  
When interfacing to a 68xx-series microprocessor, the pin will be used as Read/Write (R/W#) selection input. Pull this pin to “High” for read mode and pull it to “Low” for write mode. |
| 11      | RD#(E)  | I    | Read or Read/Write Enable  
When 80xx interface mode is selected, the pin will be the Read (RD#) input.  
When interfacing to a 68xx-series microprocessor, the pin will be used as the Enable (E) signal. Read/Write operation is initiated when this pin is pulled high and the CS# is pulled low. |
| 12      | NC      | -    | Reserved Pin |
| 13–20   | D0–D7   | I/O  | Host Data Input/Output Bus  
These pins are 8-bit bi-directional data bus to be connected to the microprocessor’s data bus. |
| PS      | Description |
| 0       | D[0] SCL: Synchronous Clock Input  
D[1] SDI: Serial Data Input  
D[2]: SDO: Serial Data Output  
D[3] R/W: Serial Read (High) / Write (Low) |
| 1       | 8-bit Bus: D[7:0]  
When using SPI, the unused pins must be connected to VSS. |
| 21      | VSS     | P    | Ground for System  
This is a ground pin. It must be connected to external source. |
| 22      | VCC-CTL | I    | OLED Driver Power Supply ON/ OFF Control  
When this pin is pulled high, the panel power supply will be turned ON.  
When this pin is pulled low, the panel power supply will be turned OFF. |
### OLED Display Module

96RGBx96 (1.10”) OLED Display

YOS3C

#### ABSOLUTE MAXIMUM RATINGS

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Min</th>
<th>Max</th>
<th>Unit</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supply Voltage for Operation</td>
<td>$V_{DD}$</td>
<td>-0.3</td>
<td>4</td>
<td>V</td>
<td>1,2</td>
</tr>
<tr>
<td>Supply Voltage for Display</td>
<td>$V_{cc_c}$</td>
<td>-0.3</td>
<td>16</td>
<td>V</td>
<td>1,2</td>
</tr>
<tr>
<td>Operating Temperature</td>
<td>$T_{op}$</td>
<td>-30</td>
<td>70</td>
<td>°C</td>
<td>-</td>
</tr>
<tr>
<td>Storage Temperature</td>
<td>$T_{STG}$</td>
<td>-40</td>
<td>80</td>
<td>°C</td>
<td>-</td>
</tr>
</tbody>
</table>

Note1: All the above voltages are on the basis of "VSS=0V"

Note2: When this module is used beyond the above absolute maximum ratings, permanent breakage of the module may occur. Also for normal operations, it is desirable to use this module under the conditions according to Section 6 “Electrical Characteristics”. If this module is used beyond these conditions, malfunctioning of the module can occur and the reliability of the module may deteriorate.
# ELECTRICAL CHARACTERISTICS

## 1. DC Characteristics

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Symbol</th>
<th>Conditions</th>
<th>Min</th>
<th>TYP</th>
<th>Max</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supply Voltage for Operation</td>
<td>V_DD</td>
<td></td>
<td>2.4</td>
<td>2.8</td>
<td>3.3</td>
<td>V</td>
</tr>
<tr>
<td>Supply Voltage for Display</td>
<td>V_CC_C</td>
<td>Note 3</td>
<td>12.5</td>
<td>13</td>
<td>13.5</td>
<td>V</td>
</tr>
<tr>
<td>High Level Input</td>
<td>V_IH</td>
<td>0.8×V_DD</td>
<td>-</td>
<td>-</td>
<td>V_DD</td>
<td>V</td>
</tr>
<tr>
<td>Low Level Input</td>
<td>V_IL</td>
<td></td>
<td>0</td>
<td>0.4</td>
<td>-</td>
<td>V</td>
</tr>
<tr>
<td>High Level Output</td>
<td>V_OH</td>
<td>IOH = -0.1mA</td>
<td>V_DD-0.4</td>
<td>-</td>
<td>-</td>
<td>V</td>
</tr>
<tr>
<td>Low Level Output</td>
<td>V_OL</td>
<td>IOH = -0.1mA</td>
<td>-</td>
<td>0.4</td>
<td>-</td>
<td>V</td>
</tr>
<tr>
<td>Operating Current for V_DD</td>
<td>I_DD</td>
<td></td>
<td>-</td>
<td>2.5</td>
<td>3.5</td>
<td>mA</td>
</tr>
<tr>
<td>Operating Current for V_CC_C</td>
<td>I_CC</td>
<td>Note 4</td>
<td>-</td>
<td>9.5</td>
<td>11.9</td>
<td>mA</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Note 5</td>
<td>-</td>
<td>17.1</td>
<td>21.4</td>
<td>mA</td>
</tr>
</tbody>
</table>

Note 3: Brightness (L_br) and Supply Voltage for Display (V_CC_C) are subject to the change of the panel characteristics and the customer’s request.

Note 4: V_DD = 2.8V, V_CC_C = 13V, 50% Display Area Turn on.

Note 5: V_DD = 2.8V, V_CC_C = 13V, 100% Display Area Turn on.

## 2. Optics Characteristics

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Symbol</th>
<th>Conditions</th>
<th>Min</th>
<th>Typ</th>
<th>Max</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brightness</td>
<td>L_br</td>
<td>With Polarizer</td>
<td>80</td>
<td>100</td>
<td>-</td>
<td>cd/m²</td>
</tr>
<tr>
<td>C.I.E. (White)</td>
<td>(x)</td>
<td>(y)</td>
<td>0.26</td>
<td>0.30</td>
<td>0.34</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>(x)</td>
<td>(y)</td>
<td>0.29</td>
<td>0.33</td>
<td>0.37</td>
<td>-</td>
</tr>
<tr>
<td>C.I.E. (Red)</td>
<td>(x)</td>
<td>(y)</td>
<td>0.60</td>
<td>0.64</td>
<td>0.68</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>(x)</td>
<td>(y)</td>
<td>0.30</td>
<td>0.34</td>
<td>0.38</td>
<td>-</td>
</tr>
<tr>
<td>C.I.E. (Green)</td>
<td>(x)</td>
<td>(y)</td>
<td>0.27</td>
<td>0.31</td>
<td>0.35</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>(x)</td>
<td>(y)</td>
<td>0.58</td>
<td>0.62</td>
<td>0.66</td>
<td>-</td>
</tr>
<tr>
<td>C.I.E. (Blue)</td>
<td>(x)</td>
<td>(y)</td>
<td>0.10</td>
<td>0.14</td>
<td>0.18</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>(x)</td>
<td>(y)</td>
<td>0.12</td>
<td>0.16</td>
<td>0.20</td>
<td>-</td>
</tr>
<tr>
<td>Dark Room Contrast</td>
<td>CR</td>
<td></td>
<td>-</td>
<td>&gt;2000:1</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>View Angle</td>
<td></td>
<td>&gt;160</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>degree</td>
</tr>
</tbody>
</table>

* Optical measurement taken at V_DD = 2.8V, V_CC_C = 13V.
TIMING CHART

1. 68XX-Series MPU Parallel Interface Timing Characteristics

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Description</th>
<th>Min</th>
<th>Max</th>
<th>Unit</th>
<th>Port</th>
</tr>
</thead>
</table>
| t\textsubscript{AH6} | Address Setup Timing  
(Read)  
(Write) | 10 ns | 5 ns | ns   | CSB  |
| t\textsubscript{AS6} | Address Hold Timing  
(Read)  
(Write) | 10 ns | 5 ns | ns   | RS   |
| T\textsubscript{CYC6} | System Cycle Timing | 200 ns | - ns |  |
| t\textsubscript{ELR6} | Read “L” Pulse Width | 90 ns | - ns | E    |
| t\textsubscript{EH} | Read “H” Pulse Width | 90 ns | - ns |  |
| T\textsubscript{CYC6} | System Cycle Timing | 100 ns | - ns |  |
| t\textsubscript{ELW6} | Write “L” Pulse Width | 45 ns | - ns |  |
| t\textsubscript{EHW6} | Write “H” Pulse Width | 45 ns | - ns |  |
| t\textsubscript{RDD6} | Read Data Output Delay Time  
*CL**15pF | 0 ns | 70 ns | ns   | D[17:9]  |
| t\textsubscript{RDH6} | Data Hold Timing | 0 ns | 70 ns | ns   |  |
| t\textsubscript{DS6} | Data Setup Timing | 40 ns | - ns |  |
| t\textsubscript{DH6} | Data Hold Timing | 10 ns | - ns |  |

(V\textsubscript{DD} = 2.8V, Ta = 25°C)

* All the timing reference is 10% and 90% of V\textsubscript{DD}

![Read Timing Diagram](image)

![Write Timing Diagram](image)
### TIMING CHART

2. **80XX-Series MPU Parallel Interface Timing Characteristics**

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Description</th>
<th>Min</th>
<th>Max</th>
<th>Unit</th>
<th>Port</th>
</tr>
</thead>
<tbody>
<tr>
<td>tASS8</td>
<td>Address Setup Timing</td>
<td>5</td>
<td>-</td>
<td>ns</td>
<td>CSB</td>
</tr>
<tr>
<td>tAH8</td>
<td>Address Hold Timing</td>
<td>5</td>
<td>-</td>
<td>ns</td>
<td>A0</td>
</tr>
<tr>
<td>tCYC8</td>
<td>System Cycle Timing</td>
<td>200</td>
<td>-</td>
<td>ns</td>
<td></td>
</tr>
<tr>
<td>tRDLR8</td>
<td>Read “L” Pulse Width</td>
<td>90</td>
<td>-</td>
<td>ns</td>
<td>RDB</td>
</tr>
<tr>
<td>tRDHR8</td>
<td>Read “H” Pulse Width</td>
<td>90</td>
<td>-</td>
<td>ns</td>
<td></td>
</tr>
<tr>
<td>tCYC8</td>
<td>System Cycle Timing</td>
<td>100</td>
<td>-</td>
<td>ns</td>
<td></td>
</tr>
<tr>
<td>tWRLW8</td>
<td>Write “L” Pulse Width</td>
<td>45</td>
<td>-</td>
<td>ns</td>
<td>WRB</td>
</tr>
<tr>
<td>tWRHW8</td>
<td>Write “H” Pulse Width</td>
<td>45</td>
<td>-</td>
<td>ns</td>
<td></td>
</tr>
<tr>
<td>tRDD8</td>
<td>Read Data Output Delay Time</td>
<td>-</td>
<td>60</td>
<td>ns</td>
<td>D[7:0]</td>
</tr>
<tr>
<td>tDH8</td>
<td>Data Hold Timing</td>
<td>0</td>
<td>60</td>
<td>ns</td>
<td></td>
</tr>
<tr>
<td>tDS8</td>
<td>Data Setup Timing</td>
<td>30</td>
<td>-</td>
<td>ns</td>
<td></td>
</tr>
<tr>
<td>tDH8</td>
<td>Data Hold Timing</td>
<td>10</td>
<td>-</td>
<td>ns</td>
<td></td>
</tr>
</tbody>
</table>

(VDD = 2.8V, Ta = 25°C)

* All the timing reference is 10% and 90% of VDD.

---

**Read Timing**

![Read Timing Diagram](image)

**Write Timing**

![Write Timing Diagram](image)
TIMING CHART

3. Series Interface Timing Characteristics

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Description</th>
<th>Min</th>
<th>Max</th>
<th>Unit</th>
<th>Port</th>
</tr>
</thead>
<tbody>
<tr>
<td>tCYCS</td>
<td>Serial Clock Cycle</td>
<td>200</td>
<td>-</td>
<td>ns</td>
<td>SCL</td>
</tr>
<tr>
<td>tSHW</td>
<td>SCL “L” Pulse Width</td>
<td>90</td>
<td>-</td>
<td>ns</td>
<td>SCL</td>
</tr>
<tr>
<td>tSLW</td>
<td>SCL “H” Pulse Width</td>
<td>90</td>
<td>-</td>
<td>ns</td>
<td>SCL</td>
</tr>
<tr>
<td>tDSS</td>
<td>Data Setup Timing</td>
<td>25</td>
<td>-</td>
<td>ns</td>
<td>SDI</td>
</tr>
<tr>
<td>tDHS</td>
<td>Data Hold Timing</td>
<td>25</td>
<td>-</td>
<td>ns</td>
<td>SDI</td>
</tr>
<tr>
<td>tCSS</td>
<td>CSB-SCL Timing</td>
<td>25</td>
<td>-</td>
<td>ns</td>
<td>CSB</td>
</tr>
<tr>
<td>tCSH</td>
<td>CSB-Hold Timing</td>
<td>25</td>
<td>-</td>
<td>ns</td>
<td>CSB</td>
</tr>
<tr>
<td>tRSS</td>
<td>RS-SCL Timing</td>
<td>25</td>
<td>-</td>
<td>ns</td>
<td>RS</td>
</tr>
<tr>
<td>tRSH</td>
<td>RS-Hold Timing</td>
<td>25</td>
<td>-</td>
<td>ns</td>
<td>RS</td>
</tr>
</tbody>
</table>

*(VDD = 2.8V, Ta = 25°C)*

* All the timing reference is 10% and 90% of VDD.*
FUNCTION SPECIFICATION

1. Commands
   Refer to the Technical Manual for the SEPS114A

2. Power Down and Power up Sequence
   To protect OEL panel and extend the panel life time, the driver IC power up/down routine should include a delay period between high voltage and low voltage power sources during turn on/off. It gives the OEL panel enough time to complete the action of charge and discharge before/after the operation.

   2.1. Power up Sequence
   1. Power up V_DD & V_D dio
   2. Send Display off command
   3. Initialization
   4. Clear Screen
   5. Power up V_CC_C
   6. Delay 100ms
      (when V_CC_C is stable)
   7. Send Display on command

   2.2. Power down Sequence
   1. Send Display off command
   2. Power down Vcc_c
   3. Delay 100ms
      (when Vcc_c is reach 0 and panel is completely discharges)
   4. Power down V

---

Vcc_c
VDD, VDDio
VCC_C

Display on

Display off

Vcc_c
VDD, VDDio
VCC_C

Vdd, Vddio on
Vcc_c off

Vdd, Vddio off
Vcc_c on
3. **Reset Circuit**  
When RSTB input is low, the chip is initialized with the following status:

1. Standby Mode: On  
2. Frame Frequency: 95Hz  
3. Oscillation: Internal Oscillator Off  
4. DDRAM Write Horizontal Address: XS = 0x00, XE = 0x5F  
5. DDRAM Write Vertical Address: YS = 0x00, YE = 0x5F  
6. Display Data RAM Write: MDIR1 = 0, MDIR0 = 0, VH = 0  
7. Row Scan Shift Direction: R0, R1, … , R94, R95  
8. Column Data Shift Direction: C0, C1, … , C286, C287  
9. Display On/Off: Off  
10. Panel Display Size: FX = 0x00, TX = 0x5F, FY = 0x00, TY = 0x5F  
11. Display Data RAM Read Column/Row Address: DX = 0x00, DY = 0x00  
12. Discharge Time: 8 Clock  
13. Peak Pulse Delay: 5 Clock  
14. Peak Pulse Width Time (R/G/B): 5 Clock  
15. Precharge Current (R/G/B): 0μA  
16. Driving Current (R/G/B): 0μA
COMMAND APPLICATION EXAMPLE

Command usage and explanation of an actual example

<Initialization>

OLED_VCC_CTL=0;  // Off power up Panel Vcc
OLED_RESET=0;  // Reset driver IC for 100ms
Delay_100ms (1);
OLED_RESET=1;
Set SOFT_RESET (0x01, 0x00);
Set STANDBY_ON_OFF (0x14, 0x00);
Set DISP_ON_OFF (0x02, 0x00);
Set ANALOG CONTROL (0x0F, 0x40);
Set OSC_ADJUST (0x1A, 0x03);
Set DISPLAYSTART_X (0x38, 0x00);
Set DISPLAYSTART_Y (0x39, 0x00);
Set RGB_IF (0xE0, 0x00);
Set RGB_POL (0xE1, 0x00);
Set DISPLAY_MODE_CONTROL (0xE5, 0x00);
Set CPU_IF (0x0D, 0x00);
Set MEMORY_WRITE/READ (0x1D, 0x01);
Set ROW_SCAN_DIRECTION (0x09, 0x00);
Set COLUMN_CURRENT_R (0x3A, 0x03);
Set COLUMN_CURRENT_G (0x3B, 0x03);
Set COLUMN_CURRENT_B (0x3C, 0x02);
Set ROW_OVERLAP (0x48, 0x03);
Set DISCHARGE_TIME (0x18, 0x03);
Set PEAK_PULSE_DELAY (0x16, 0x00);
Set PEAK_PULSE_WIDTH_R (0x3A, 0x03);
Set PEAK_PULSE_WIDTH_G (0x3B, 0x03);
Set PEAK_PULSE_WIDTH_B (0x3C, 0x02);
Set PRECHARGE_CURRENT_R (0x3D, 0x09);
Set PRECHARGE_CURRENT_G (0x3E, 0x09);
Set SCAN_OFF_LEVEL (0x49, 0x0F);
Set DISPLAY_X1 (0x30, 0x00);
Set DISPLAY_X2 (0x31, 0x5F);
Set DISPLAY_Y1 (0x32, 0x00);
Set DISPLAY_Y2 (0x33, 0x5F);
Clear Screen;
Set DISP_ON_OFF (0x02, 0x01);
OLED_VCC=1;  // Power up Vcc
Delay_100ms(1);  // Dealy 100ms
Set_Display_On(0xAF);  // Display On (0x00/0x01)

If the noise is accidentally occurred at the displaying window during the operation, please reset the display in order to recover the display function.
1. Contents of Reliability Test

<table>
<thead>
<tr>
<th>Item</th>
<th>Conditions</th>
<th>Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>High Temperature Operation</td>
<td>70°C, 240hrs</td>
<td></td>
</tr>
<tr>
<td>Low Temperature Operation</td>
<td>-30°C, 240hrs</td>
<td></td>
</tr>
<tr>
<td>High Temperature Storage</td>
<td>80°C, 240hrs</td>
<td>The operational functions work.</td>
</tr>
<tr>
<td>Low Temperature Storage</td>
<td>-40°C, 240hrs</td>
<td></td>
</tr>
<tr>
<td>High Temperature/ Humidity Operation</td>
<td>60°C, 90% RH, 120hrs</td>
<td></td>
</tr>
<tr>
<td>Thermal Shock</td>
<td>-40°C &lt;-&gt; 85°C, 24 cycles, 60 mins dwell</td>
<td></td>
</tr>
</tbody>
</table>

*The samples used for the above test do not include polarizer.
*No moisture condensation is observed during tests.

2. Lifetime

End of lifetime is specified as 50% of initial brightness.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Min</th>
<th>Max</th>
<th>Unit</th>
<th>Condition</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operating Life Time</td>
<td>10,000</td>
<td>-</td>
<td>hr</td>
<td>100 cd/m², 50% checkerboard</td>
<td>*</td>
</tr>
<tr>
<td>Storage Life Time</td>
<td>20,000</td>
<td>-</td>
<td>hr</td>
<td>Ta = 25°C, 50% RH</td>
<td></td>
</tr>
</tbody>
</table>

*The average operating lifetime at room temperature is estimated by the accelerated operation at high temperature conditions.

10.3. Failure Check Standard

After the completion of the described reliability test, the samples were left at room temperature for 2 hrs prior to conducting the failure test at 23 ± 5°C : 55 ± 15% RH.