



# SURENOO GRAPHIC OLED SERIES DISPLAY

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Part Name: OEL Display Module

SOG12832B\_M091

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Graphic OLED Display Selection Guide

SSD1306



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## 1 Basic Specifications

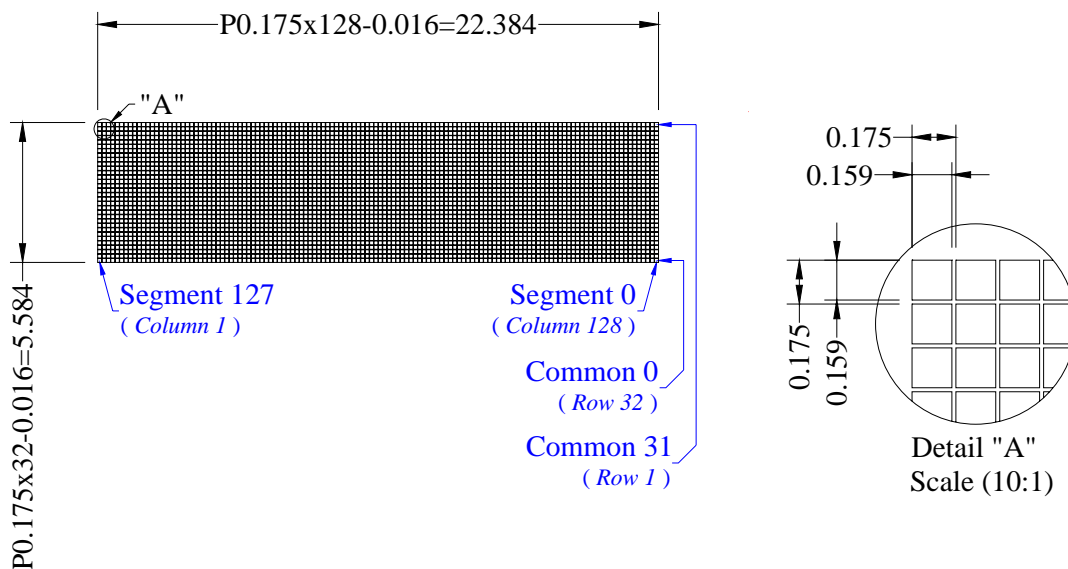
### 1.1 Display Specifications

| Item         | Specs                       |
|--------------|-----------------------------|
| Display Mode | Passive Matrix OLED & White |
| Interface    | I2C                         |
| Drive Duty   | 1/32                        |
| Driver IC    | SSD1306                     |
| Shell        | 0.5T                        |

### 1.2 Mechanical Specifications

| Item            | Specs              | Unit | Remark |
|-----------------|--------------------|------|--------|
| Outline Drawing | 38.0(W)x12.0(H)    | mm   |        |
| Active Area     | 22.384(W)x5.584(H) | mm   |        |
| Lattice         | 128dotsx32dots     | --   |        |
| Pixel Pitch     | 0.175(W)x0.175(H)  | mm   |        |
| Pixel Size      | 0.159(W)x0.159(H)  | mm   |        |

### 1.3 Active Area & Pixel Construction





### 1.4 Mechanical Drawing

| Pin Assignment |         |
|----------------|---------|
| NO.            | 4-Holes |
| 1              | GND     |
| 2              | VCC     |
| 3              | SCL     |
| 4              | SDA     |

**Notes:**

1. Color: White
2. Driver IC: SSD1306
3. Interface: I2C
4. General Tolerance: Dimension,  $\pm 0.2$ , Angle.

|            |                |           |               |
|------------|----------------|-----------|---------------|
| MODULE NO. | SOG12832B_M091 | Glass No. |               |
| DESIGNED   | DAVIDE         | VERIFIED  |               |
| CHECKED    |                | APPROVED  |               |
| UNIT       | mm             | SCALE     | FIT           |
| SIZE       | A4             | FILE NAME | Count Drawing |



## 1.5 Pin Definition

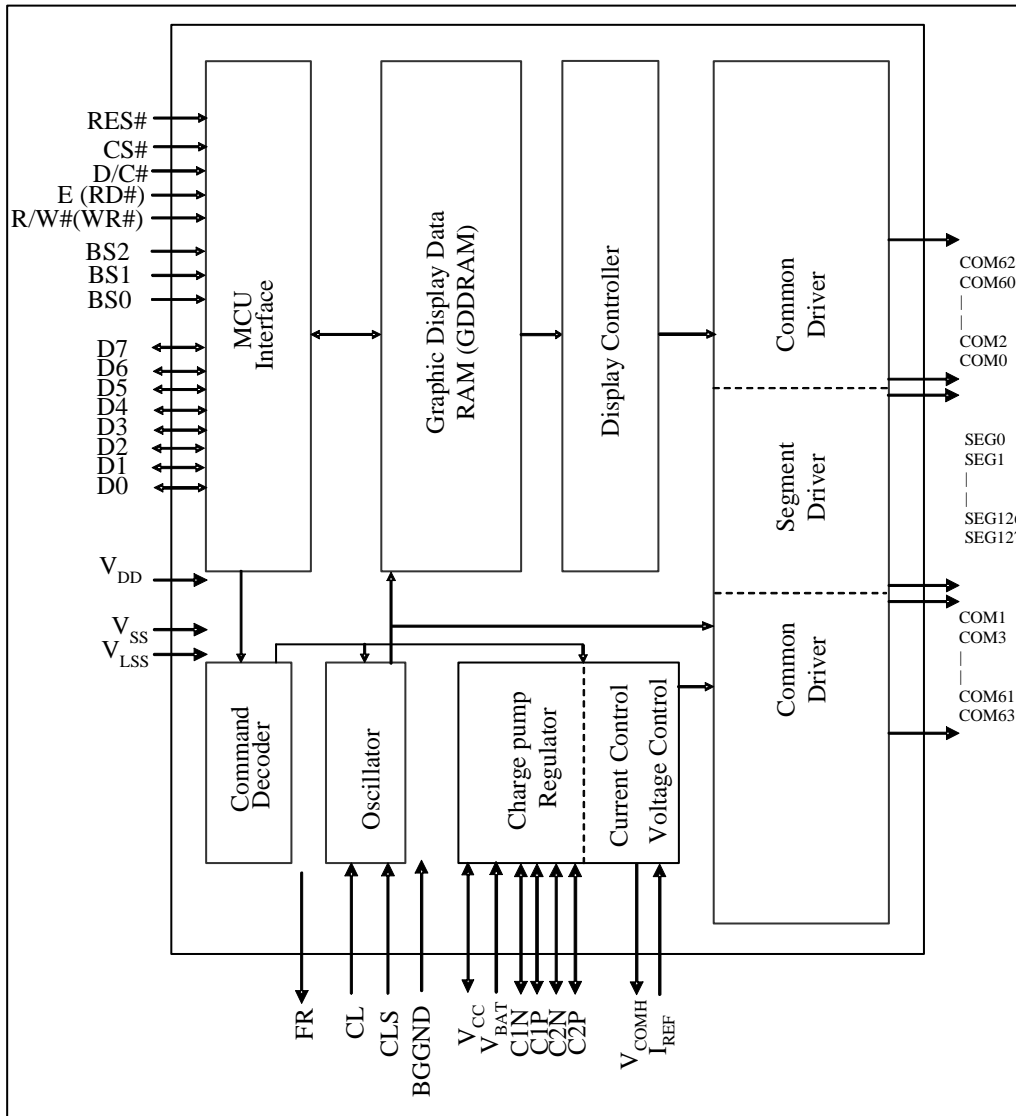
| Pin No. | Symbol | I/O | Function  |
|---------|--------|-----|---|
| 1       | GND    | P   | <i>Ground of Analog Circuit</i><br>This is an analog ground pin. It should be connected to VSS externally.  |
| 2       | VCC    | P   | <i>Power Supply for Display Module Circuit</i><br>This is a voltage supply pin. It connected to external source. VCC=3.3V or 5V.  |
| 3       | SCL    | I   | <i>Serial Clock Input Signal</i><br>The transmission of information in the bus is following a clock signal. Each transmission of data bit is taken place during a single clock period of this pin.  |
| 4       | SDA    | I   | <i>Serial Data Input Signal</i><br>This pin acts as a communication channel. The input data through SDA are latched at the rising edge of SCLK in the sequence of MSB first and converted to 8-bit parallel data and handled at the rising edge of last serial clock. |

**Note**

Default address is 0x78.



### 1.6 Elements Block Diagram



Pins Connected to MCU interface: SCLK(D0), SDA(D1).



## 2. Absolute Maximum Ratings

| Parameter             | Symbol | Min | Max | Unit | Notes |
|-----------------------|--------|-----|-----|------|-------|
| Power Supply Voltage  | VCC    | 0   | 6   | V    | 1,2   |
| Power Supply Current  | Icc    | -   | 11  | mA   | 1,2   |
| Operating Temperature | Top    | -30 | 70  | °C   | -     |
| Storage Temperature   | Tstg   | -40 | 85  | °C   | -     |

Note 1: All the above voltage are on the basis of “VSS=0V”.

Note 2: 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 3. “Electrical Characteristics”. If this module is used beyond these conditions, malfunctioning of the module can occur and the reliability of the module may deteriorate.

## 3. Electrical Characteristics

### 3.1 DC Characteristics

| Characteristics    | Symbol          | Conditions                        | Min | Typ | Max  | Unit |
|--------------------|-----------------|-----------------------------------|-----|-----|------|------|
| Supply Voltage     | VCC             | Ta=25°C                           | 2.0 | 2.8 | 5.5  | V    |
| High Level Input   | V <sub>IH</sub> | I <sub>out</sub> =100uA<br>3.3MHz | 1.6 | -   | 3.3  | V    |
| Low Level Input    | V <sub>IL</sub> | I <sub>out</sub> =100uA<br>3.3MHz | 0   | -   | 0.66 | V    |
| Supply Current     | Icc             | Note1                             | -   | 5.2 | 7    | mA   |
|                    |                 | Note2                             | -   | 8.6 | 10.8 | mA   |
| Sleep Mode Current | Icc, Sleep      |                                   | -   | 1   | 5    | uA   |

Note1: VCC=2.8V, 50% Display Area Turn on;

Note2: VCC=2.8V, 100% Display Area Turn on.





## 3.2 Optics &amp; Electrical Characteristics

| Characteristics    | Symbol          | Conditions                 | Min  | Typ     | Max  | Unit              |
|--------------------|-----------------|----------------------------|------|---------|------|-------------------|
| Brightness         | L <sub>br</sub> | With Polarizer<br>(Note 3) | 120  | 150     | -    | cd/m <sup>2</sup> |
| C.I.E. (White)     | (x)             | Without Polarizer          | 0.26 | 0.32    | 0.34 |                   |
|                    | (y)             |                            | 0.29 | 0.33    | 0.37 |                   |
| Dark Room Contrast | CR              |                            | -    | >2000:1 | -    |                   |
| View Angle         |                 |                            | >160 | -       | -    | degree            |

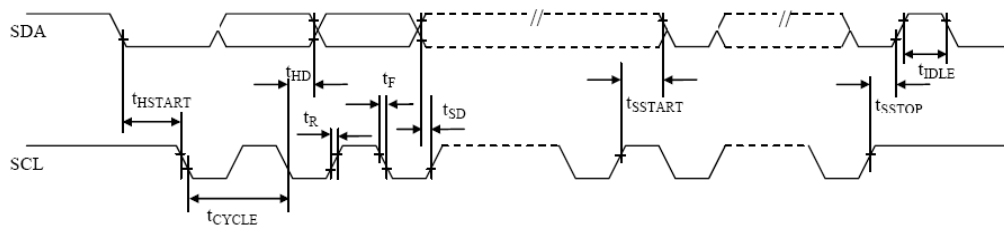
\* Optical measurement taken at V<sub>CC</sub> = 2.8V.



## 3.3 AC Characteristics

 $I^2C$  Interface Timing Characteristics:

| Symbol               | Description  | Min | Max | Unit |
|----------------------|--|-----|-----|------|
| $t_{\text{cycle}}$   | Clock Cycle Time   | 2.5 | -   | us   |
| $t_{\text{HSTART}}$  | Start Condition Hold Time  | 0.6 | -   | us   |
| $t_{\text{HD}}$      | Data Hold Time (for "SDA <sub>OUT</sub> " Pin)                               | 0   | -   | ns   |
|                      | Data Hold Time (for "SDA <sub>IN</sub> " Pin)                                | 300 |     |      |
| $t_{\text{SD}}$      | Data Setup Time  | 100 | -   | ns   |
| $t_{\text{SSSTART}}$ | Start Condition Setup Time<br>(Only relevant for a repeated Start condition) | 0.6 | -   | us   |
| $t_{\text{SSSTOP}}$  | Stop Condition Setup Time  | 0.6 | -   | us   |
| $t_{\text{R}}$       | Rise Time for Data and Clock Pin   |     | 300 | ns   |
| $t_{\text{F}}$       | Fall Time for Data and Clock Pin   |     | 300 | ns   |
| $t_{\text{IDLE}}$    | Idle Time before a New Transmission can Start                                | 1.3 | -   | us   |

\* ( $V_{\text{DD}} - V_{\text{SS}} = 1.65\text{V to } 3.3\text{V}$ ,  $T_{\text{a}} = 25^{\circ}\text{C}$ )



## **4. Functional Specification**

### **4.1 Command Decoder**

Refer to the Technical Manual for the SSD1306.

### **4.2 FR synchronization**

Refer to the Technical Manual for the SSD1306.

### **4.3 Reset Circuit**

When RES# input is low, the chip is initialized with the following status:

1. Display is OFF
2. 128×32 Display Mode
3. Normal segment and display data column and row address mapping (SEG0 mapped to column address 00h and COM0 mapped to row address 00h)
4. Shift register data clear in serial interface
5. Display start line is set at display RAM address 0
6. Column address counter is set at 0
7. Normal scan direction of the COM outputs
8. Contrast control register is set at 7Fh
9. Normal display mode (Equivalent to A4h command)



## 5. Reliability

### 5.1 Contents of Reliability Tests

| Item                                | Conditions                               | Criteria                        |
|-------------------------------------|--|---------------------------------|
| High Temperature Operation          | 70°C, 240 hrs                            | The operational functions work. |
| Low Temperature Operation           | -30°C, 240 hrs                           |                                 |
| High Temperature Storage            | 80°C, 240 hrs                            |                                 |
| Low Temperature Storage             | -40°C, 240 hrs                           |                                 |
| High Temperature/Humidity Operation | 60°C, 90% RH, 120 hrs                    |                                 |
| Thermal Shock                       | -40°C ↔ 85°C, 24 cycles<br>60 mins dwell |                                 |

\* The samples used for the above tests do not include polarizer.

\* No moisture condensation is observed during tests.

### 5.2 Life time

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

| Parameter           | Min     | Max | Unit | Condition                             | Notes |
|---------------------|---------|-----|------|---------------------------------------|-------|
| Operating Life Time | 50,000  | -   | Hrs  | 80 cd/m <sup>2</sup> ,50%checkerboard | 6     |
| Storage Life Time   | 100,000 | -   | Hrs  | Ta=25°C,50%RH                         | -     |

Note 6: The average operating lifetime at room temperature is estimated by the accelerated operation at high temperature conditions.

### 5.3 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.



## 6. Outgoing Quality Control Specifications

### 6.1 Environment Required

Customer's test & measurement are required to be conducted under the following conditions:

|   |            |
|---|------------|
| Temperature:  | 23+/-5°C   |
| Humidity:   | 55+/-15%RH |
| Fluorescent Lamp:   | 30W        |
| Distance between the Panel & Lamp:                            | >=50 cm    |
| Distance between the Panel & Eyes of the Inspector            | >=30 cm    |
| Finger glove (or finger cover) must be worn by the inspector. |            |
| Inspection table or jig must be anti-electrostatic.           |            |

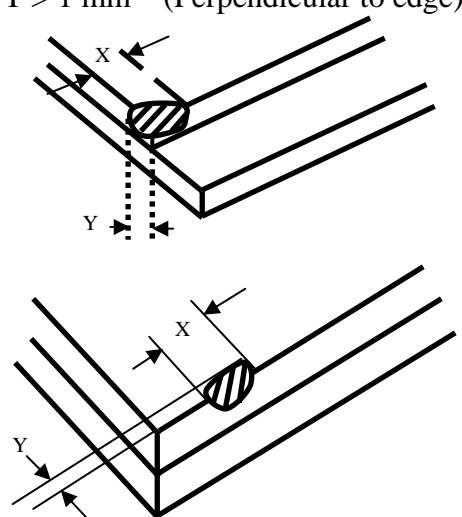
### 6.2 Sampling Plan

Level II, Normal Inspection, Single Sampling, MIL-STD-105E

### 6.3 Criteria & Acceptable Quality Level

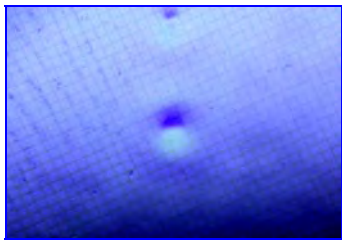
| Partition | AQL  | Definition                              |
|-----------|------|---|
| Major     | 0.65 | Defects in Pattern Check (Display On)   |
| Minor     | 1.0  | Defects in Cosmetic Check (Display Off) |

#### 6.3.1 Cosmetic Check (Display Off) in Non-Active Area

| Check Item                | Classification | Criteria   |
|---------------------------|----------------|--|
| Panel<br>General Chipping | Minor          | <p><math>X &gt; 6 \text{ mm}</math> (Along with Edge)<br/> <math>Y &gt; 1 \text{ mm}</math> (Perpendicular to edge)</p>  |

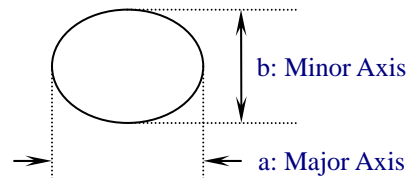
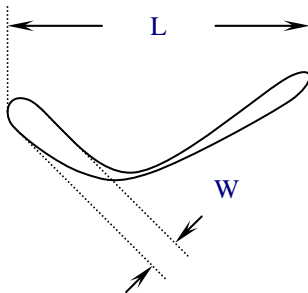


## 6.3.2 Cosmetic Check (Display Off) in Active Area

| Check Item  | Classification | Criteria  |
|---|----------------|---|
| Any Dirt & Scratch on Polarizer's Protective Film             | Acceptable     | Ignore for not Affect the Polarizer   |
| Scratches, Fiber, Line-Shape Defect (On Polarizer)            | Minor          | $W \leq 0.1$ Ignore<br>$W > 0.1, L \leq 2$ $n \leq 1$<br>$L > 2$ $n = 0$  |
| Dirt, Black Spot, Foreign Material, (On Polarizer)            | Minor          | $\Phi \leq 0.1$ Ignore<br>$0.1 < \Phi \leq 0.25$ $n \leq 1$<br>$0.25 < \Phi$ $n = 0$  |
| Dent, Bubbles, White spot (Any Transparent Spot on Polarizer) | Minor          | $\Phi \leq 0.5$<br>→ Ignore if no Influence on Display<br>$0.5 < \Phi$ $n = 0$<br> |
| Fingerprint, Flow Mark (On Polarizer)                         | Minor          | Not Allowable   |

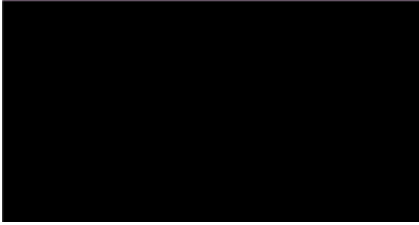
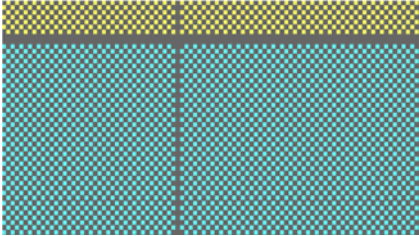
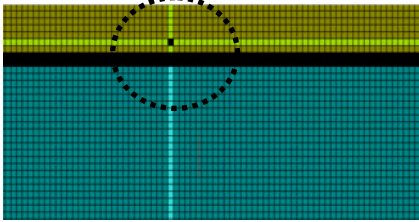
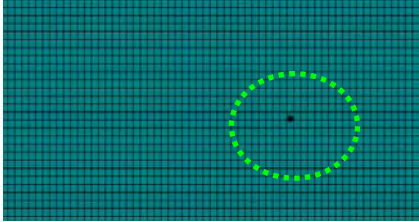
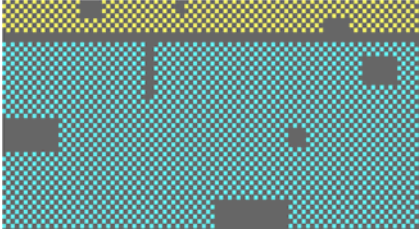
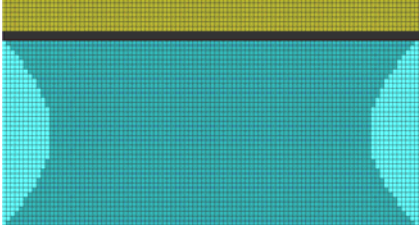
\* Protective film should not be tear off when cosmetic check.

\*\* Definition of W & L &  $\Phi$  (Unit: mm):  $\Phi = (a + b) / 2$





### 6.3.3 Pattern Check (Display On) in Active Area

| Check Item    | Classification | Criteria   |
|---------------|----------------|--|
| No Display    | Major          |    |
| Flicker       | Major          | Not Allowable  |
| Missing Line  | Major          |    |
| Pixel Short   | Major          |   |
| Darker Pixel  | Major          |  |
| Wrong Display | Major          |  |
| Un-uniform    | Major          |  |



## 7. Precautions When Using These OLED Display Modules

### 7.1 Handling Precautions

- 1) Since the display panel is being made of glass, do not apply mechanical impacts such as dropping from a high position.
- 2) If the display panel is broken by some accident and the internal organic substance leaks out, be careful not to inhale nor lick the organic substance.
- 3) If pressure is applied to the display surface or its neighborhood of the OLED display module, the cell structure may be damaged and be careful not to apply pressure to these sections.
- 4) The polarizer covering the surface of the OLED display module is soft and easily scratched. Please be careful when handling the OLED display module.
- 5) When the surface of the polarizer of the OLED display module has soil, clean the surface. It takes advantage of by using following adhesion tape.
  - \* Scotch Mending Tape No. 810 or an equivalentNever try to breathe upon the soiled surface nor wipe the surface using cloth containing solvent such as ethyl alcohol, since the surface of the polarizer will become cloudy.  
Also, pay attention that the following liquid and solvent may spoil the polarizer
  - \* Water
  - \* Ketone
  - \* Aromatic Solvents
- 6) When installing the OLED display module, be careful not to apply twisting stress or deflection stress to the OLED display module. And, do not over bend the film with electrode pattern layouts. These stresses will influence the display performance. Also, secure sufficient rigidity for the outer cases.
- 7) Do not apply stress to the LSI chips and the surrounding molded sections.
- 8) Do not disassemble nor modify the OLED display module.
- 9) Do not apply input signals while the logic power is off.
- 10) Pay sufficient attention to the working environments when handling OLED display modules to prevent occurrence of element breakage accidents by static electricity.
  - \* Be sure to make human body grounding when handling OLED display modules.
  - \* Be sure to ground tools to use or assembly such as soldering irons.
  - \* To suppress generation of static electricity, avoid carrying out assembly work under dry environments.
  - \* Protective film is being applied to the surface of the display panel of the OLED display module. Be careful since static electricity may be generated when exfoliating the protective film.
- 11) Protection film is being applied to the surface of the display panel and removes the protection film before assembling it. At this time, if the OLED display module has been stored for a long period of time, residue adhesive material of the protection film may remain on the surface of the display





panel after removed of the film. In such case, remove the residue material by the method introduced in the above Section 5).

- 12) If electric current is applied when the OLED display module is being dewed or when it is placed under high humidity environments, the electrodes may be corroded and be careful to avoid the above.

## 7.2 Storage Precautions

- 1) When storing OLED display modules, put them in static electricity preventive bags avoiding exposure to direct sun light nor to lights of fluorescent lamps and, also, avoiding high temperature and high humidity environment or low temperature (less than 0° C) environments. (We recommend you to store these modules in the packaged state when they

At that time, be careful not to let water drops adhere to the packages or bags nor let dewing occur with them.

- 2) If electric current is applied when water drops are adhering to the surface of the OLED display module, when the OLED display module is being dewed or when it is placed under high humidity environments, the electrodes may be corroded and be careful about the above.

## 7.3 Designing Precautions

- 1) The absolute maximum ratings are the ratings which cannot be exceeded for OLED display module, and if these values are exceeded, panel damage may be happen.
- 2) To prevent occurrence of malfunctioning by noise, pay attention to satisfy the VIL and VIH specifications and, at the same time, to make the signal line cable as short as possible.
- 3) We recommend you to install excess current preventive unit (fuses, etc.) to the power circuit (VDD). (Recommend value: 0.5A)
- 4) Pay sufficient attention to avoid occurrence of mutual noise interference with the neighboring devices.
- 5) As for EMI, take necessary measures on the equipment side basically.
- 6) When fastening the OLED display module, fasten the external plastic housing section.
- 7) If power supply to the OLED display module is forcibly shut down by such errors as taking out the main battery while the OLED display panel is in operation, we cannot guarantee the quality of this OLED display module.
- 8) The electric potential to be connected to the rear face of the IC chip should be as follows: SSD1331
  - \* Connection (contact) to any other potential than the above may lead to rupture of the IC.

## 7.4 Precautions when disposing of the OLED display modules

- 1) Request the qualified companies to handle industrial wastes when disposing of the OLED display modules. Or, when burning them, be sure to observe the environmental and hygienic laws and regulations.



### 7.5 Other Precautions

- 1) When an OLED display module is operated for a long of time with fixed pattern may remain as an after image or slight contrast deviation may occur. Nonetheless, if the operation is interrupted and left unused for a while, normal state can be restored. Also, there will be no problem in the reliability of the module.
- 2) To protect OLED display modules from performance drops by static electricity rapture, etc., do not touch the following sections whenever possible while handling the OLED display modules.
  - \* Pins and electrodes
  - \* Pattern layouts such as the FPC
- 3) With this OLED display module, the OLED driver is being exposed. Generally speaking, semiconductor elements change their characteristics when light is radiated according to the principle of the solar battery. Consequently, if this OLED driver is exposed to light, malfunctioning may occur.
  - \* Design the product and installation method so that the OLED driver may be shielded from light in actual usage.
  - \* Design the product and installation method so that the OLED driver may be shielded from light during the inspection processes.
- 4) Although this OLED display module stores the operation state data by the commands and the indication data, when excessive external noise, etc. enters into the module, the internal status may be changed. It therefore is necessary to take appropriate measures to suppress noise generation or to protect from influences of noise on the system design.
- 5) We recommend you to construct its software to make periodical refreshment of the operation statuses (re-setting of the commands and re-transference of the display data) to cope with catastrophic noise.



## 8. Appendixes

### 8.1 Display-module Software Initial Setting

```
Write_Command(0xAE); /*display off*/
Write_Command(0x00); /*set lower column address*/
Write_Command(0x10); /*set higher column address*/
Write_Command(0x00); /*set display start line*/
Write_Command(0xB0); /*set page address*/
Write_Command(0x81); /*contract control*/
Write_Command(0xff); /*128*/
Write_Command(0xA1); /*set segment remap*/
Write_Command(0xA6); /*normal / reverse*/
Write_Command(0xA8); /*multiplex ratio*/
Write_Command(0x1F); /*duty = 1/32*/
Write_Command(0xC8); /*Com scan direction*/
Write_Command(0xD3); /*set display offset*/
Write_Command(0x00);
Write_Command(0xD5); /*set osc division*/
Write_Command(0x80);
Write_Command(0xD9); /*set pre-charge period*/
Write_Command(0x04);
Write_Command(0xDA); /*set COM pins*/
Write_Command(0x00);
Write_Command(0xdb); /*set vcomh*/
Write_Command(0x30);
Write_Command(0x8d); /*set charge pump enable*/
Write_Command(0x14);
Write_Command(0xAF); /*display ON*/
```