

# SPECIFICATIONS FOR LIQUID CRYSTAL DISPLAY MODULE

|                          |                       |
|--------------------------|-----------------------|
| <b>CUSTOMER</b>          |                       |
| <b>CUSTOMER Part No:</b> |                       |
| <b>MODULE No:</b>        | <b>ACM041BWVB-H-U</b> |
| <b>DGW VERSION:</b>      | <b>REV.0</b>          |

|                           |
|---------------------------|
| <b>APPROVED SIGNATURE</b> |
|---------------------------|

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|                    |                   |                    |                     |
|--------------------|-------------------|--------------------|---------------------|
| <b>APPROVED BY</b> | <b>CHECKED BY</b> | <b>PREPARED BY</b> | <b>ISSUED DATE:</b> |
|                    | <b>HSU</b>        | <b>GILI</b>        | <b>Oct.28.2022</b>  |

[illegible]

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## Module Classification Information

A    CM    041    B    W    W    B    -    H       -    U  
 1       2       3       4       5       6       7          8       9          10      11

|    |                                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |  |  |  |  |  |  |  |  |
|----|--------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|--|--|--|--|--|--|--|
| 1  | YUDU AMSON Displays, Inc.            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |  |  |  |  |  |  |  |  |
| 2  | Product type : OLED COG              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |  |  |  |  |  |  |  |  |
| 3  | Display Type : Graphic 128 x 64 Dots |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |  |  |  |  |  |  |  |  |
| 4  | Serials No.                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |  |  |  |  |  |  |  |  |
| 5  | LCD Type :                           | N → TN/ Positive / Transflective / Reflective      M → TN/ Negative / Transmissive<br>H → TN/ Positive/ Transmissive                              B → STN/ Blue/ Negative / Transmissive<br>S → STN/ Gray/ Positive / Transflective / Reflective      Z → STN/ Gray/ Positive/ Transmissive<br>U → STN/ Y-G/ Positive / Transflective / Reflective      T → STN/ Y-G/ Positive/ Transmissive<br>F → FSTN/ Positive / Transflective / Reflective          W → FSTN/ Negative / Transmissive<br>K → FSTN/ Positive/ Transmissive                              W → OLED & Black |  |  |  |  |  |  |  |  |
| 6  | Backlight Type :                     | L→ LED / Yellow-Green                                          G→ LED / Green / Guide<br>M→ LED / Amber                                                      W→ LED / White / Guide<br>N→ LED / Red                                                              F→ LED / Blue / Guide<br>O→ LED / Orange                                                        *→ No BackLight / Reflective                                                                                                                                                                                |  |  |  |  |  |  |  |  |
| 7  | LCD View direction /                 | B→ 6:00 View<br>T→ 12:00 View                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |  |  |  |  |  |  |  |  |
| 8  | LCD Temp. Range :                    | H → Wide Temp., 5V , Single Supply Voltage<br>W → Wide Temp., 3.3V, Single Supply Voltage                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |  |  |  |  |  |  |  |  |
| 9  | Frame Material                       | → NO FRAME                              B→ BLACK                              S→ SILVER                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |  |  |  |  |  |  |  |  |
| 10 | Series Number                        | X→ A~Z Number                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |  |  |  |  |  |  |  |  |
| 11 | Series Number                        | X→ --- or 01~99 Number                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |  |  |  |  |  |  |  |  |

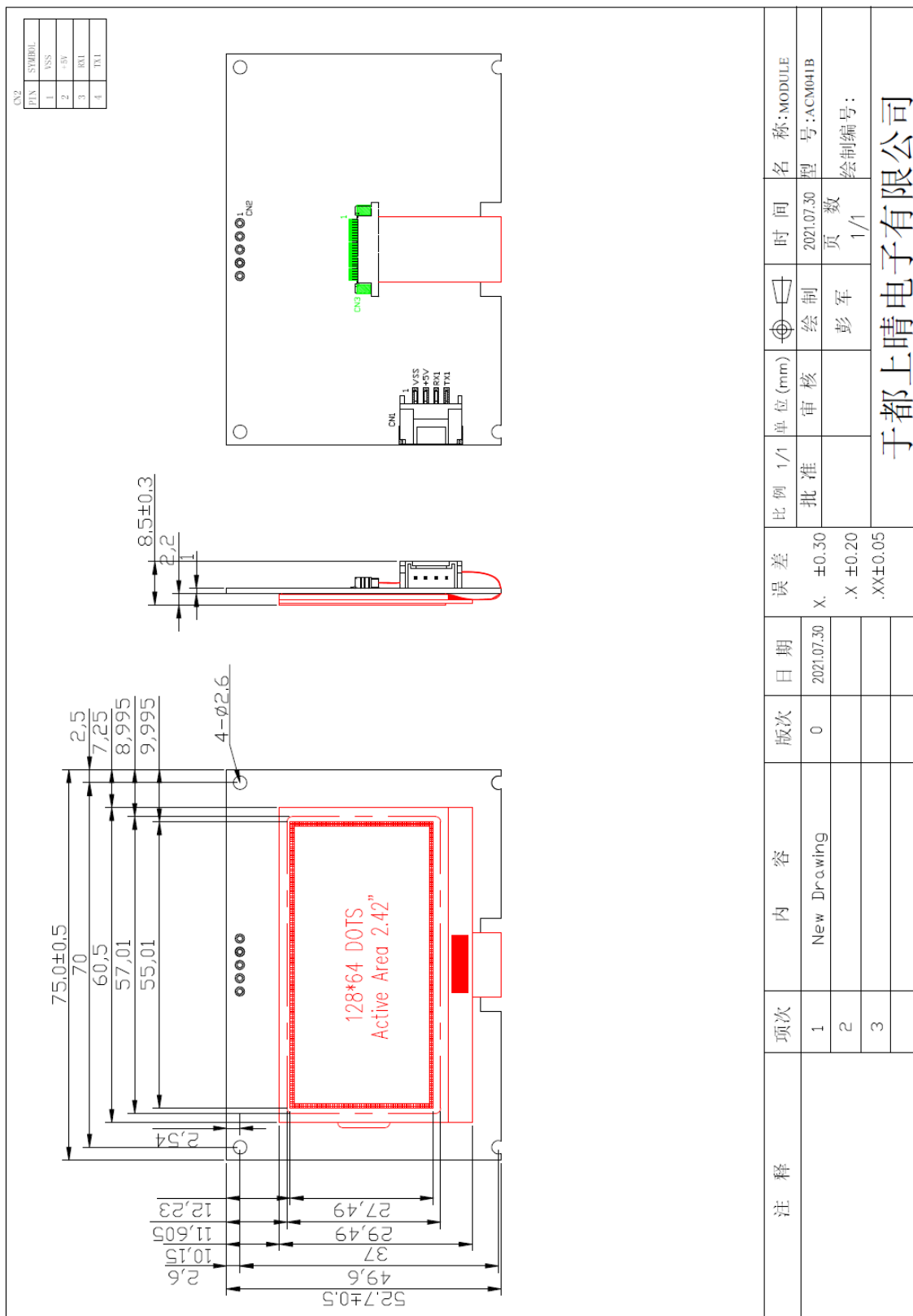
## 1. Precautions in use of OLED Modules

- (1) Avoid applying excessive shocks to the module or making any alterations or modifications to it.
- (2) Don't make extra holes on the printed circuit board, modify its shape or change the components of OLED module.
- (3) Don't disassemble the LCM.
- (4) Don't operate it above the absolute maximum rating.
- (5) Don't drop, bend or twist LCM.
- (6) Soldering: only to the I/O terminals.
- (7) Storage: please storage in anti-static electricity container and clean environment. Don't touch the elastomers connector, especially insert a backlight panel (EL or CCFL)
- (8) LCM technological conditions RoHS

## 2. General Specification

| Item                 | Dimension             | Unit |
|----------------------|-----------------------|------|
| Dot arrangement      | 128 x 64              | Dots |
| Module dimension     | 75.0 x 52.7 x 8.8 Max | mm   |
| View area            | 57.01 x 29.9          | mm   |
| Active area          | 55.01 x 27.49         | mm   |
| Dot size             | 0.40 x 0.40           | mm   |
| Dot pitch            | 0.43 x 0.43           | mm   |
| Display mode         | Passive Matrix        |      |
| Duty Ratio           | 1/64Duty              |      |
| View direction       | 6 o'clock             |      |
| Display color        | OLED White & Black    |      |
| Controller Interface | SSD1309               |      |
| Controller Interface | M031TD2AE UART 115200 |      |
| Built-in             | With DC/DC Converter  |      |

### 3. Mechanical Drawing & Interface





### 3.1 Interface Pin Description

| Pin No. | Pin Out | Level | Description            |
|---------|---------|-------|------------------------|
| 1       | TX1     | H/L   | Serial Transmit Signal |
| 2       | RX1     | H/L   | Serial Receive Signal  |
| 3       | +5V     | +5V   | Power Supply Voltage   |
| 4       | VSS     | 0V    | Power Supply Ground.   |

## 4. Absolute Maximum Ratings

### 4.1 Electrical Absolute Ratings

| Item                              | Symbol                               | Min.   | Max.     | Unit | Note   |
|-----------------------------------|--------------------------------------|--------|----------|------|--------|
| Power Supply for Logic            | $V_{DD}-V_{SS}$                      | -0.3   | 7.0      | Volt |        |
| Power Supply for OLED             | $V_{CC}-V_{SS}$                      | -0.3   | 15.0     | Volt |        |
| Input Voltage                     | $V_I$                                | -0.3   | $V_{DD}$ | Volt |        |
| Life Time (60 cd/m <sup>2</sup> ) | $T_a = 25^{\circ}\text{C}$<br>50% RH | 50,000 | ---      | Hour | Note 1 |

### 4.2 Environmental Absolute Maximum Ratings

| Item                            | Wide Temperature |       |          |       |
|---------------------------------|------------------|-------|----------|-------|
|                                 | Operating        |       | Storage  |       |
|                                 | Min,             | Max.  | Min,     | Max.  |
| Ambient Temperature             | -40°C            | +75°C | -40°C    | +80°C |
| Humidity (without condensation) | Note 2,3         |       | Note 2,3 |       |

Note 1: Software configuration follows. End of lifetime is specified as 50% of initial brightness reached. The average operating lifetime at room temperature is estimated by the accelerated operation at high temperature conditions.

Note 2: Background color changes slightly depending on ambient temperature. This phenomenon is reversible.

Note 3: The defined temperature ranges do not include the polarizer. The maximum withstood temperature of the polarizer should be 80°C.

## 5. Electrical Characteristics

### 5.1 DC Characteristics for logic and OLED

 $T_a=25^{\circ}\text{C}, V_{SS}=0\text{V}$ 

| Item                           | Symbol          | Condition                                     | Min.        | Typ  | Max.        | Unit | note   |
|--------------------------------|-----------------|-----------------------------------------------|-------------|------|-------------|------|--------|
| Power Supply for Logic         | $V_{DD}-V_{SS}$ | -                                             | 4.5         | 5.0  | 5.0         | Volt |        |
| Power Supply for OLED          | $V_{DD}-V_{SS}$ | -                                             | 2.7         | 3.3  | 3.6         | Volt |        |
| Power Supply for OLED          | $V_{CC}-V_{SS}$ | -                                             | 12.5        | 13.0 | 13.5        | Volt | Note 5 |
| Input Voltage                  | $V_{IL}$        | L level                                       | 0           | -    | $0.2V_{DD}$ | Volt |        |
|                                | $V_{IH}$        | H level                                       | $0.8V_{DD}$ | -    | $V_{DD}$    | Volt |        |
| Onput Voltage                  | $V_{OL}$        | L level                                       | 0           | -    | $0.1V_{DD}$ |      |        |
|                                | $V_{OH}$        | H level                                       | $0.9V_{DD}$ | -    | $V_{DD}$    |      |        |
| Operating Current for $V_{pp}$ | $I_{PP}$        | Note 6                                        | -           | 29.7 | 35.8        | mA   |        |
|                                |                 | Note 7                                        | -           | 31.6 | 41.7        |      |        |
|                                |                 | Note 8                                        | -           | 39.6 | 54.9        |      |        |
| Power Supply Current for OLED  | $I_{DD}$        | $V_{DD}=3.3\text{V}$<br>$V_{pp}=13.0\text{V}$ | -           | 39.9 | 55.4        | mA   |        |

Note 5: Brightness (Lbr) and Supply Voltage for Display ( $V_{pp}$ ) are subject to the change of the panel characteristics and the customer's request.

Note 6:  $V_{DD}=3.3\text{V}$ ,  $V_{pp}=13.0\text{V}$  generated by internal DC/DC converter, 30% Display Area Turn on.

Note 7:  $V_{DD}=3.3\text{V}$ ,  $V_{pp}=13.0\text{V}$  generated by internal DC/DC converter, 50% Display Area Turn on. (POR)

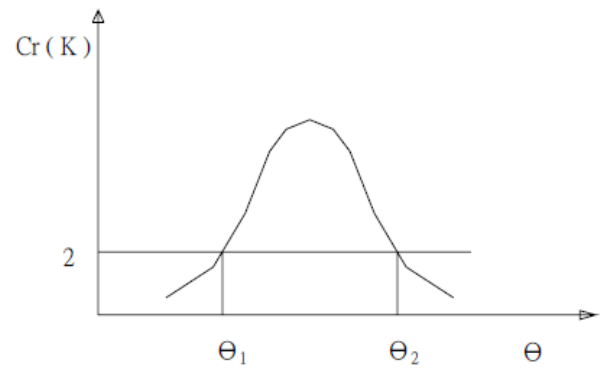
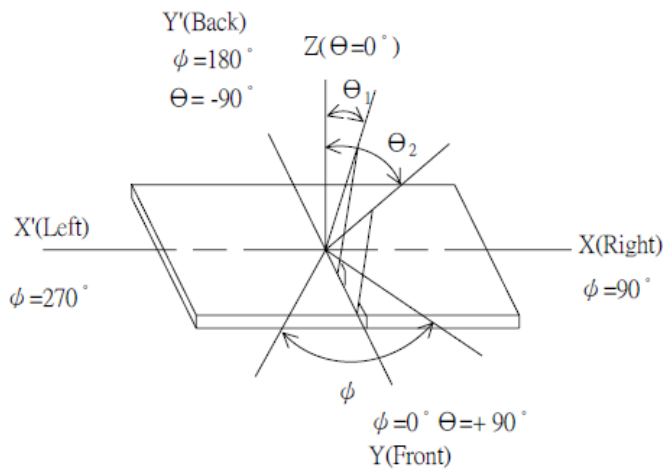
Note 8:  $V_{DD}=3.3\text{V}$ ,  $V_{pp}=13.0\text{V}$  generated by internal DC/DC converter, 100% Display Area Turn on.

## 6. Optical Characteristics

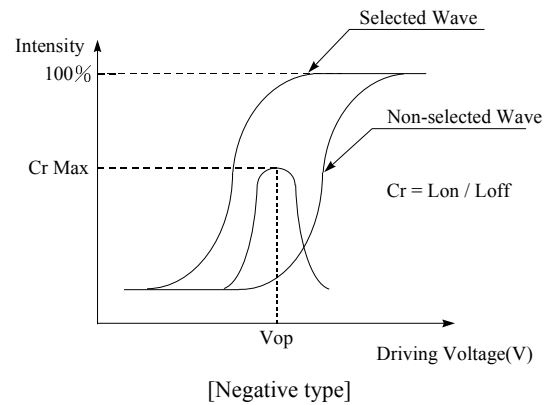
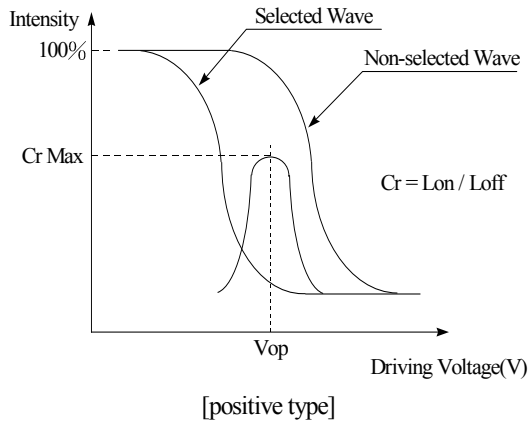
| Item                     | Symbol                | Condition                | Min.             | Typ.             | Max.             | Unit              | note |
|--------------------------|-----------------------|--------------------------|------------------|------------------|------------------|-------------------|------|
| Viewing Angle Range      | $\Theta_2 - \Theta_1$ | $T_a = 25^\circ\text{C}$ | 80               | -                | -                | deg.              | 1,2  |
|                          | $\phi$                |                          | 80               | -                | -                | deg.              |      |
| Contrast Ratio           | CR                    | $T_a = 25^\circ\text{C}$ | CR > 10000:1     |                  |                  | -                 | 3    |
| Response Time(rise)      | Tr                    | $T_a = 25^\circ\text{C}$ | -                | 10               | -                | us                | 4    |
| Response Time(fall)      | Tf                    | $T_a = 25^\circ\text{C}$ | -                | 10               | -                | us                | 4    |
| Brightness               | L                     | Check Board Brightness   | 60               | 80               | -                | cd/m <sup>2</sup> |      |
| Peak Emission Wavelength | C.I.E (White)         |                          | X=0.25<br>Y=0.27 | X=0.29<br>Y=0.31 | X=0.33<br>Y=0.35 | nm                |      |

**Note1:** Definition of angle  $\theta$  and  $\Phi$

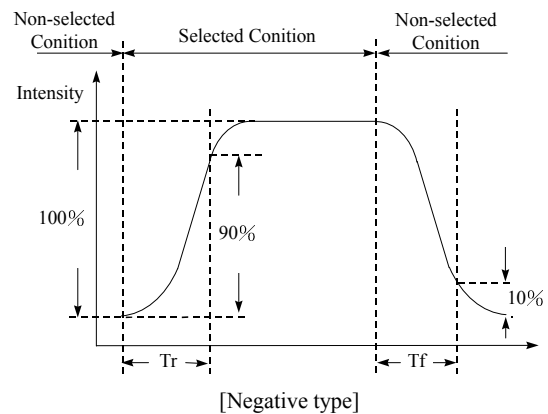
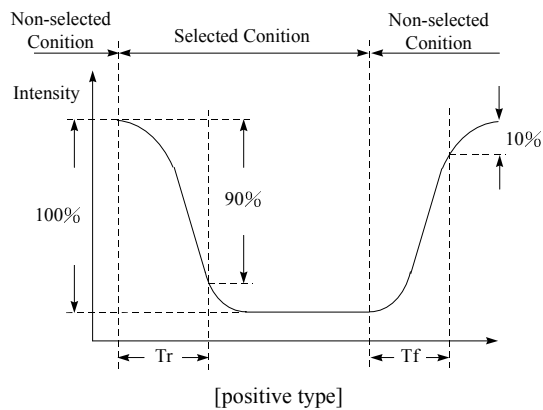
**Note2:** Definition of viewing angle  $\theta$



### Note3: Definition of contrast CR



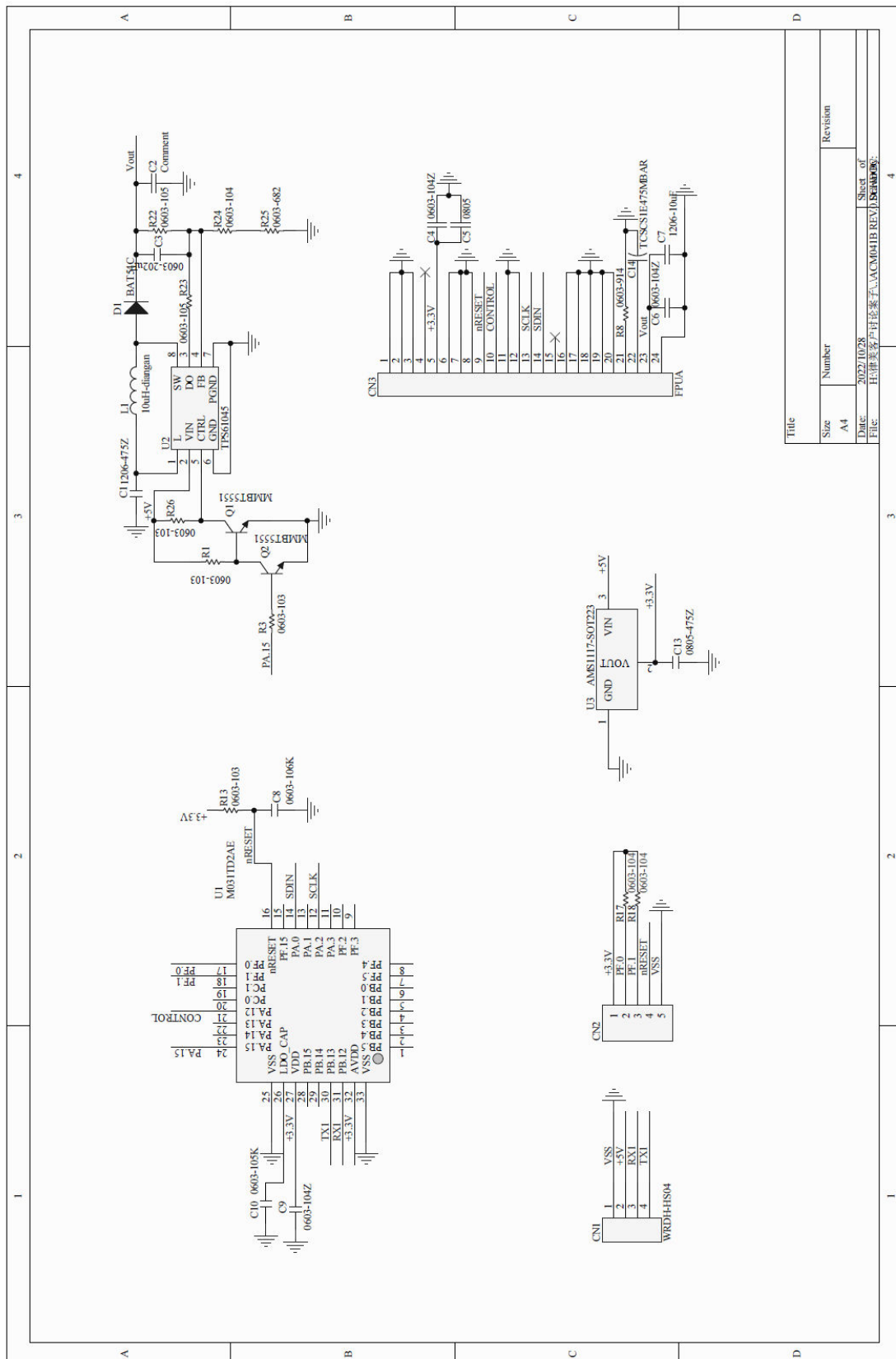
### Note4: Definition of Response Time (Tr, Tf)



**Conditions: Operating Voltage : Vop**  
**Frequency : 64 Hz**

**Viewing Angle( $\theta$ ,  $\phi$ ): 0° , 0°Frame**  
**Driving Wave form : 1/N duty, 1/a bias**

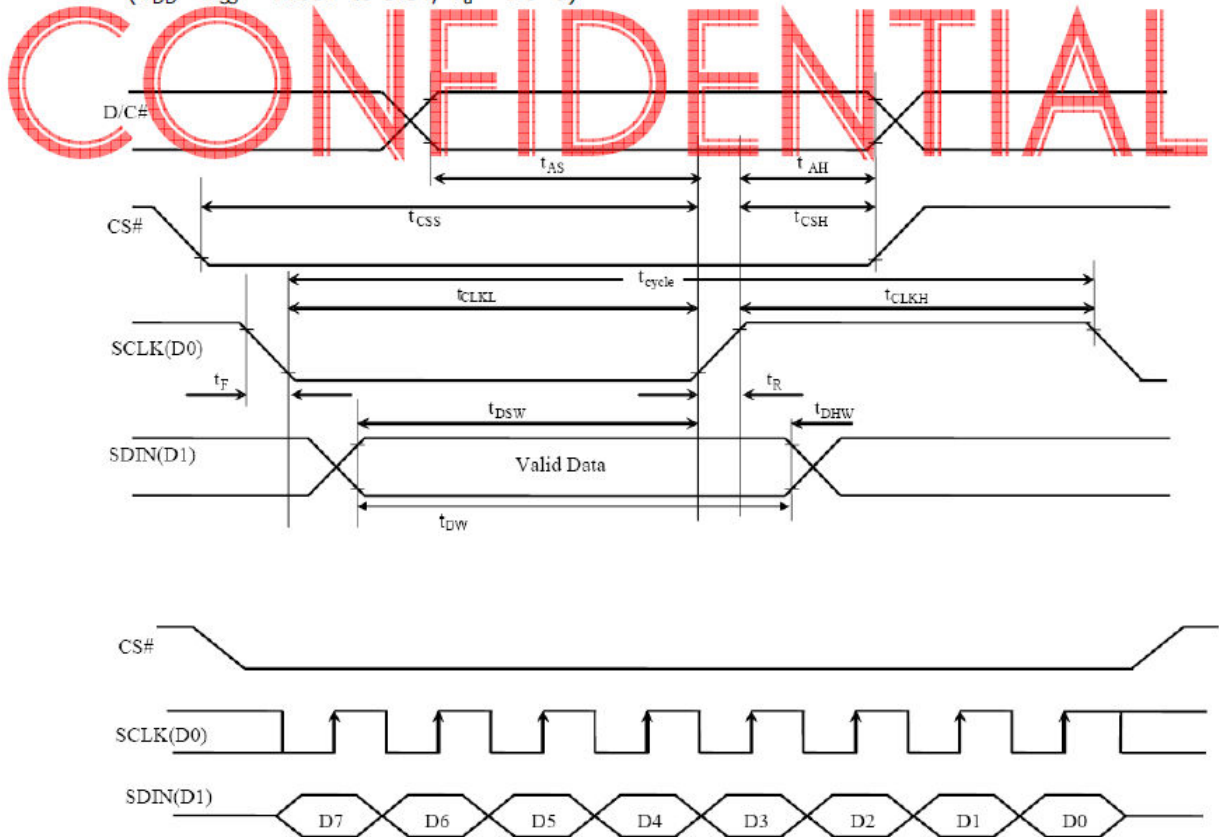
## 7. Block Diagram



## 8. AC Characteristics

| Symbol             | Description            | Min | Max | Unit |
|--------------------|------------------------|-----|-----|------|
| $t_{\text{cycle}}$ | Clock Cycle Time       | 100 | -   | ns   |
| $t_{\text{AS}}$    | Address Setup Time     | 15  | -   | ns   |
| $t_{\text{AH}}$    | Address Hold Time      | 15  | -   | ns   |
| $t_{\text{CSS}}$   | Chip Select Setup Time | 20  | -   | ns   |
| $t_{\text{CSH}}$   | Chip Select Hold Time  | 50  | -   | ns   |
| $t_{\text{DW}}$    | Data Write Time        | 55  | -   | ns   |
| $t_{\text{DSW}}$   | Write Data Setup Time  | 15  | -   | ns   |
| $t_{\text{DHW}}$   | Write Data Hold Time   | 15  | -   | ns   |
| $t_{\text{CLKL}}$  | Clock Low Time         | 50  | -   | ns   |
| $t_{\text{CLKH}}$  | Clock High Time        | 50  | -   | ns   |
| $t_{\text{R}}$     | Rise Time              | -   | 40  | ns   |
| $t_{\text{F}}$     | Fall Time              | -   | 40  | ns   |

\* ( $V_{\text{DD}} - V_{\text{SS}} = 1.65\text{V to } 3.5\text{V}$ ,  $T_a = 25^\circ\text{C}$ )



## 9. Function Specification

### (1) UART CONFIGURATION:

| ITEM         | SETTING VALUE |
|--------------|---------------|
| BAUD RATE    | 115200        |
| DATA BIT     | 8             |
| STOP BIT     | 1             |
| PARITY BIT   | NONE          |
| FLOW CONTROL | NONE          |

### (2) COMMAND LIST:

| Code | Function                                                                                          | Sequence of HEX command mode through UART                                                                                                                                                                                                                                                                      | API for Arduino                                                                                                                                                                                                                    |
|------|---------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| N/A  | Sent a image(192X64 bitmap) to LED Display<br>(An array consist of 1024 bytes bitmap information) | <ol style="list-style-type: none"> <li>1. A "for" loop to send 1024 bytes user define display information</li> <li>2. Wait until receive a module available byte ('E') from LED Display</li> <li>3. Wait 2ms</li> </ol>                                                                                        | <pre>for (i = 0 ; i &lt; 1024; i++) {   Serial.write(User_define_array[i] ); } while (Serial.read() !='E') {} delay(2);</pre>                                                                                                      |
| 0x80 | Write a 5X7 Character                                                                             | <ol style="list-style-type: none"> <li>1. Send 0x80</li> <li>2. Send which line to put this character</li> <li>3. Send which cloumn to put this haracter</li> <li>4. Send character's ASCII code</li> <li>5. Wait until receive a module available byte ('E') from LED Display</li> <li>6. Wait 2ms</li> </ol> | <pre>void Write_5X7_Character( int line, int column, int negative, char Char ) {   Serial.write(0x80);   Serial.write(line);   Serial.write(column);   Serial.print(Char);   while (Serial.read() !='E') {}   delay(2); }</pre>    |
| 0x81 | Write a 8X8 String                                                                                | <ol style="list-style-type: none"> <li>1. Send 0x81</li> <li>2. Send which line to start the string</li> <li>3. Send which cloumn to start the string</li> <li>4. Send string</li> <li>5. Wait until receive a module available byte('E') from LED Display</li> <li>6. Wait 2ms</li> </ol>                     | <pre>void Write_5X7_String( int line, int column, int negative, char * string ) {   Serial.write(0x81);   Serial.write(line);   Serial.write(column);   Serial.print(string);   while (Serial.read() !='E') {}   delay(2); }</pre> |
| 0x82 | Write a 8X16 Character                                                                            | <ol style="list-style-type: none"> <li>1. Send 0x82</li> <li>2. Send which line to put this character</li> <li>3. Send which cloumn to put this haracter</li> <li>4. Send character's ASCII code</li> <li>5. Wait until receive a module available byte('E') from LED Display</li> <li>6. Wait 2ms</li> </ol>  | <pre>void Write_8X16_Character( int line, int column, int negative, char Char ) {   Serial.write(0x82);   Serial.write(line);   Serial.write(column);   Serial.print(Char);   while (Serial.read() !='E') {}   delay(2); }</pre>   |

|      |                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                                                                                                                                                                                                                                                                                          |
|------|-------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 0x83 | Write a 8X16 String     | <ol style="list-style-type: none"> <li>1. Send 0x83</li> <li>2. Send which line to start the string</li> <li>3. Send which column to start the string</li> <li>4. Send string</li> <li>5. Wait until receive a module available byte('E') from LED Display</li> <li>6. Wait 2ms</li> </ol>                                                                                                                                                        | <pre>void Write_8X16_String( int line, int column, int negative, char * string ) {     Serial.write(0x83);     Serial.write(line);     Serial.write(column);     Serial.print(string);     while (Serial.read() !='E') {}     delay(2); }</pre>                                                          |
| 0x84 | Display a 8X8 pattern   | <ol style="list-style-type: none"> <li>1. Send 0x84</li> <li>2. Send the Up Left X coordinate of pattern</li> <li>3. Send the Up Left Y coordinate of pattern</li> <li>4. Send the ID of pattern</li> <li>5. Wait until receive a module available byte ('E') from LED Display</li> <li>6. Wait 2ms</li> </ol>                                                                                                                                    | <pre>void Write_8X8_Pattern( int Up_Left_Xpos, int Up_Left_Ypos, int negative, int Pattern_ID ) {     Serial.write(0x84);     Serial.write(Up_Left_Xpos);     Serial.write(Up_Left_Ypos);     Serial.write(Pattern_ID);     while (Serial.read() !='E') {}     delay(2); }</pre>                         |
| 0x85 | Display a 8X16 pattern  | <ol style="list-style-type: none"> <li>1. Send 0x85</li> <li>2. Send the Up Left X coordinate of pattern</li> <li>3. Send the Up Left Y coordinate of pattern</li> <li>4. Send the ID of pattern</li> <li>5. Wait until receive a module available byte ('E') from LED Display</li> <li>6. Wait 2ms</li> </ol>                                                                                                                                    | <pre>void Write_8X16_Pattern( int Up_Left_Xpos, int Up_Left_Ypos, int negative, int Pattern_ID ) {     Serial.write(0x85);     Serial.write(Up_Left_Xpos);     Serial.write(Up_Left_Ypos);     Serial.write(Pattern_ID);     while (Serial.read() !='E') {}     delay(2); }</pre>                        |
| 0x86 | Display a 16X16 pattern | <ol style="list-style-type: none"> <li>1. Send 0x86</li> <li>2. Send the Up Left X coordinate of pattern</li> <li>3. Send the Up Left Y coordinate of pattern</li> <li>4. Send the ID of pattern</li> <li>5. Wait until receive a module available byte ('E') from LED Display</li> <li>6. Wait 2ms</li> </ol>                                                                                                                                    | <pre>void Write_16X16_Pattern( int Up_Left_Xpos, int Up_Left_Ypos, int negative, int Pattern_ID ) {     Serial.write(0x86);     Serial.write(Up_Left_Xpos);     Serial.write(Up_Left_Ypos);     Serial.write(Pattern_ID);     while (Serial.read() !='E') {}     delay(2); }</pre>                       |
| 0x87 | Display a 32X32 pattern | <ol style="list-style-type: none"> <li>1. Send 0x87</li> <li>2. Send the Up Left X coordinate of pattern</li> <li>3. Send the Up Left Y coordinate of pattern</li> <li>4. Send the ID of pattern</li> <li>5. Wait until receive a module available byte ('E') from LED Display</li> <li>6. Wait 2ms</li> </ol>                                                                                                                                    | <pre>void Write_32X32_Pattern( int Up_Left_Xpos, int Up_Left_Ypos, int negative, int Pattern_ID ) {     Serial.write(0x87);     Serial.write(Up_Left_Xpos);     Serial.write(Up_Left_Ypos);     Serial.write(Pattern_ID);     while (Serial.read() !='E') {}     delay(2); }</pre>                       |
| 0x90 | Draw a line             | <ol style="list-style-type: none"> <li>1. Send 0x90</li> <li>2. Send the X coordinate of first point</li> <li>3. Send the Y coordinate of first point</li> <li>4. Send the X coordinate of second point</li> <li>5. Send the Y coordinate of second point</li> <li>6. Send 1 or 0 for display mode (1 for positive, 0 for negative)</li> <li>7. Wait until receive a module available byte ('E') from LED Display</li> <li>8. Wait 2ms</li> </ol> | <pre>void Draw_Line( int X0_Pos, int Y0_Pos, int X1_Pos, int Y1_Pos, int negative ) {     Serial.write(0x90);     Serial.write(X0_Pos);     Serial.write(Y0_Pos);     Serial.write(X1_Pos);     Serial.write(Y1_Pos);     Serial.write(0 or 1);     while (Serial.read() !='E') {}     delay(2); }</pre> |

|      |                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                                                                                                                                                                                                                                                                                                      |
|------|-------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 0x91 | Draw a Rectangle        | <ol style="list-style-type: none"> <li>1. Send 0x91</li> <li>2. Send the X coordinate of up left corner</li> <li>3. Send the Y coordinate of up left corner</li> <li>4. Send the X coordinate of bottom right corner</li> <li>5. Send the Y coordinate of bottom right corner</li> <li>6. Send 1 or 0 for display mode (1 for positive, 0 for negative)</li> <li>7. Wait until receive a module available byte ('E') from LED Display</li> <li>8. Wait 2ms</li> </ol> | <pre>void Draw_Rectangle( int X0_Pos, int Y0_Pos, int X1_Pos, int Y1_Pos, int negative ) {     Serial.write(0x91);     Serial.write(X0_Pos);     Serial.write(Y0_Pos);     Serial.write(X1_Pos);     Serial.write(Y1_Pos);     Serial.write(0 or 1);     while (Serial.read() !='E') {} }</pre>                      |
| 0x92 | Draw a filled Rectangle | <ol style="list-style-type: none"> <li>1. Send 0x92</li> <li>2. Send the X coordinate of up left corner</li> <li>3. Send the Y coordinate of up left corner</li> <li>4. Send the X coordinate of bottom right corner</li> <li>5. Send the Y coordinate of bottom right corner</li> <li>6. Send 1 or 0 for display mode (1 for positive, 0 for negative)</li> <li>7. Wait until receive a module available byte ('E') from LED Display</li> <li>8. Wait 2ms</li> </ol> | <pre>void Draw_Filled_Rectangle( int X0_Pos, int Y0_Pos, int X1_Pos, int Y1_Pos, int negative ) {     Serial.write(0x92);     Serial.write(X0_Pos);     Serial.write(Y0_Pos);     Serial.write(X1_Pos);     Serial.write(Y1_Pos);     Serial.write(0 or 1);     while (Serial.read() !='E') {}     delay(2); }</pre> |
| 0x93 | Draw a Square           | <ol style="list-style-type: none"> <li>1. Send 0x93</li> <li>2. Send the X coordinate of up left corner</li> <li>3. Send the Y coordinate of up left corner</li> <li>4. Send the width of this square</li> <li>5. Send 1 or 0 for display mode (1 for positive, 0 for negative)</li> <li>6. Wait until receive a module available byte ('E') from LED Display</li> <li>7. Wait 2ms</li> </ol>                                                                         | <pre>void Draw_Square( int X0_Pos, int Y0_Pos,  int width, int negative ) {     Serial.write(0x93);     Serial.write(X0_Pos);     Serial.write(Y0_Pos);     Serial.write(width);     Serial.write(0 or 1);     while (Serial.read() !='E') {}     delay(2); }</pre>                                                  |
| 0x94 | Draw a Circle           | <ol style="list-style-type: none"> <li>1. Send 0x94</li> <li>2. Send the X coordinate of the center</li> <li>3. Send the Y coordinate of the center</li> <li>4. Send the radius of this circle</li> <li>5. Send 1 or 0 for display mode (1 for positive, 0 for negative)</li> <li>6. Wait until receive a module available byte ('E') from LED Display</li> <li>7. Wait 2ms</li> </ol>                                                                                | <pre>void Draw_Circle( int X0_Pos, int Y0_Pos,  int radius, int negative ) {     Serial.write(0x94);     Serial.write(X0_Pos);     Serial.write(Y0_Pos);     Serial.write(radius);     Serial.write(0 or 1);     while (Serial.read() !='E') {}     delay(2); }</pre>                                                |
| 0x95 | Draw a filled Circle    | <ol style="list-style-type: none"> <li>1. Send 0x95</li> <li>2. Send the X coordinate of the center</li> <li>3. Send the Y coordinate of the center</li> <li>4. Send the radius of this circle</li> <li>5. Send 1 or 0 for display mode (1 for positive, 0 for negative)</li> <li>6. Wait until receive a module available byte ('E') from LED Display</li> <li>7. Wait 2ms</li> </ol>                                                                                | <pre>void Draw_Filled_Circle( int X0_Pos, int Y0_Pos, int radius, int negative ) {     Serial.write(0x95);     Serial.write(X0_Pos);     Serial.write(Y0_Pos);     Serial.write(radius);     Serial.write(0 or 1);     while (Serial.read() !='E') {}     delay(2); }</pre>                                          |

|      |                                     |                                                                                                                                                                                                                                                                                                                                                                                            |                                                                                                                                                                                                                                                                                         |
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| 0x96 | Draw a tip upward Triangle          | <ol style="list-style-type: none"> <li>1. Send 0x96</li> <li>2. Send the X coordinate of the tip</li> <li>3. Send the Y coordinate of the tip</li> <li>4. Send the height of the tip to the bottom</li> <li>5. Send 1 or 0 for display mode (1 for positive, 0 for negative)</li> <li>6. Wait until receive a module available byte ('E') from LED Display</li> <li>7. Wait 2ms</li> </ol> | <pre>void Draw_Triangle_Up_Ward( int X0_Pos, int Y0_Pos, int height, int negative ) {     Serial.write(0x96);     Serial.write(X0_Pos);     Serial.write(Y0_Pos);     Serial.write(height);     Serial.write(0 or 1);     while (Serial.read() !='E') {} }</pre>                        |
| 0x97 | Draw a filled tip upward Triangle   | <ol style="list-style-type: none"> <li>1. Send 0x97</li> <li>2. Send the X coordinate of the tip</li> <li>3. Send the Y coordinate of the tip</li> <li>4. Send the height of the tip to the bottom</li> <li>5. Send 1 or 0 for display mode (1 for positive, 0 for negative)</li> <li>6. Wait until receive a module available byte ('E') from LED Display</li> <li>7. Wait 2ms</li> </ol> | <pre>void Draw_Filled_Triangle_Up_Ward( int X0_Pos, int Y0_Pos, int height, int negative ) {     Serial.write(0x97);     Serial.write(X0_Pos);     Serial.write(Y0_Pos);     Serial.write(height);     Serial.write(0 or 1);     while (Serial.read() !='E') {}     delay(2); }</pre>   |
| 0x98 | Draw a tip downward Triangle        | <ol style="list-style-type: none"> <li>1. Send 0x98</li> <li>2. Send the X coordinate of the tip</li> <li>3. Send the Y coordinate of the tip</li> <li>4. Send the height of the tip to the top</li> <li>5. Send 1 or 0 for display mode (1 for positive, 0 for negative)</li> <li>6. Wait until receive a module available byte ('E') from LED Display</li> <li>7. Wait 2ms</li> </ol>    | <pre>void Draw_Triangle_Down_Ward( int X0_Pos, int Y0_Pos, int height, int negative ) {     Serial.write(0x98);     Serial.write(X0_Pos);     Serial.write(Y0_Pos);     Serial.write(height);     Serial.write(0 or 1);     while (Serial.read() !='E') {}     delay(2); }</pre>        |
| 0x99 | Draw a filled tip downward Triangle | <ol style="list-style-type: none"> <li>1. Send 0x99</li> <li>2. Send the X coordinate of the tip</li> <li>3. Send the Y coordinate of the tip</li> <li>4. Send the height of the tip to the top</li> <li>5. Send 1 or 0 for display mode (1 for positive, 0 for negative)</li> <li>6. Wait until receive a module available byte ('E') from LED Display</li> <li>7. Wait 2ms</li> </ol>    | <pre>void Draw_Filled_Triangle_Down_Ward( int X0_Pos, int Y0_Pos, int height, int negative ) {     Serial.write(0x99);     Serial.write(X0_Pos);     Serial.write(Y0_Pos);     Serial.write(height);     Serial.write(0 or 1);     while (Serial.read() !='E') {}     delay(2); }</pre> |
| 0x9A | Draw a tip leftward Triangle        | <ol style="list-style-type: none"> <li>1. Send 0x9a</li> <li>2. Send the X coordinate of the tip</li> <li>3. Send the Y coordinate of the tip</li> <li>4. Send the width of the tip to the right</li> <li>5. Send 1 or 0 for display mode (1 for positive, 0 for negative)</li> <li>6. Wait until receive a module available byte ('E') from LED Display</li> <li>7. Wait 2ms</li> </ol>   | <pre>void Draw_Triangle_Left_Ward( int X0_Pos, int Y0_Pos, int width, int negative ) {     Serial.write(0x9a);     Serial.write(X0_Pos);     Serial.write(Y0_Pos);     Serial.write(width);     Serial.write(0 or 1);     while (Serial.read() !='E') {}     delay(2); }</pre>          |
| 0x9B | Draw a filled tip leftward Triangle | <ol style="list-style-type: none"> <li>1. Send 0x9b</li> <li>2. Send the X coordinate of the tip</li> <li>3. Send the Y coordinate of the tip</li> <li>4. Send the width of the tip to the right</li> <li>5. Send 1 or 0 for display mode (1 for positive, 0 for negative)</li> <li>6. Wait until receive a module available byte ('E') from LED Display</li> <li>7. Wait 2ms</li> </ol>   | <pre>void Draw_Filled_Triangle_Left_Ward( int X0_Pos, int Y0_Pos, int width, int negative ) {     Serial.write(0x9b);     Serial.write(X0_Pos);     Serial.write(Y0_Pos);     Serial.write(width);     Serial.write(0 or 1);     while (Serial.read() !='E') {}     delay(2); }</pre>   |

|      |                                                |                                                                                                                                                                                                                                                                                                                                                                                         |                                                                                                                                                                                                                                                                                        |
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| 0x9C | Draw a tip rightward Triangle                  | <ol style="list-style-type: none"> <li>1. Send 0x9c</li> <li>2. Send the X coordinate of the tip</li> <li>3. Send the Y coordinate of the tip</li> <li>4. Send the width of the tip to the left</li> <li>5. Send 1 or 0 for display mode (1 for positive, 0 for negative)</li> <li>6. Wait until receive a module available byte ('E') from LED Display</li> <li>7. Wait 2ms</li> </ol> | <pre>void Draw_Triangle_Right_Ward( int X0_Pos, int Y0_Pos, int width, int negative ) {     Serial.write(0x9c);     Serial.write(X0_Pos);     Serial.write(Y0_Pos);     Serial.write(width);     Serial.write(0 or 1);     while (Serial.read() !='E') {}     delay(2); }</pre>        |
| 0x9D | Draw a filled tip rightward Triangle           | <ol style="list-style-type: none"> <li>1. Send 0x9d</li> <li>2. Send the X coordinate of the tip</li> <li>3. Send the Y coordinate of the tip</li> <li>4. Send the width of the tip to the left</li> <li>5. Send 1 or 0 for display mode (1 for positive, 0 for negative)</li> <li>6. Wait until receive a module available byte ('E') from LED Display</li> <li>7. Wait 2ms</li> </ol> | <pre>void Draw_Filled_Triangle_Right_Ward( int X0_Pos, int Y0_Pos, int width, int negative ) {     Serial.write(0x9d);     Serial.write(X0_Pos);     Serial.write(Y0_Pos);     Serial.write(width);     Serial.write(0 or 1);     while (Serial.read() !='E') {}     delay(2); }</pre> |
| 0x9E | Set a pixel for positive display (show pixel)  | <ol style="list-style-type: none"> <li>1. Send 0x9e</li> <li>2. Send the X coordinate of the pixel</li> <li>3. Send the Y coordinate of the pixel</li> <li>4. Wait until receive a module available byte ('E') from LED Display</li> <li>5. Wait 2ms</li> </ol>                                                                                                                         | <pre>void Set_Pixel( int X0_Pos, int Y0_Pos ) {     Serial.write(0x9e);     Serial.write(X0_Pos);     Serial.write(Y0_Pos);     while (Serial.read() !='E') {}     delay(2); }</pre>                                                                                                   |
| 0x9F | Set a pixel for negative display (clear pixel) | <ol style="list-style-type: none"> <li>1. Send 0x9f</li> <li>2. Send the X coordinate of the pixel</li> <li>3. Send the Y coordinate of the pixel</li> <li>4. Wait until receive a module available byte ('E') from LED Display</li> <li>5. Wait 2ms</li> </ol>                                                                                                                         | <pre>void Clear_Pixel( int X0_Pos, int Y0_Pos ) {     Serial.write(0x9f);     Serial.write(X0_Pos);     Serial.write(Y0_Pos);     while (Serial.read() !='E') {}     delay(2); }</pre>                                                                                                 |
| 0xA0 | Display image row by row Up Ward               | <ol style="list-style-type: none"> <li>1. Send 0xa0</li> <li>2. Send the speed (typical time is 20ms)</li> <li>3. Wait until receive a module available byte ('E') from LED Display</li> <li>4. Wait 2ms</li> </ol>                                                                                                                                                                     | <pre>void Display_Row_By_Row_Up_Ward ( int Speed ) {     Serial.write(0xa0);     Serial.write(speed);     while (Serial.read() !='E') {}     delay(2); }</pre>                                                                                                                         |
| 0xA1 | Display image row by row Down Ward             | <ol style="list-style-type: none"> <li>1. Send 0xa1</li> <li>2. Send the speed (typical time is 20ms)</li> <li>3. Wait until receive a module available byte ('E') from LED Display</li> <li>4. Wait 2ms</li> </ol>                                                                                                                                                                     | <pre>void Display_Row_By_Row_Down_Ward ( int speed ) {     Serial.write(0xa1);     Serial.write(speed);     while (Serial.read() !='E') {}     delay(2); }</pre>                                                                                                                       |
| 0xA2 | Display image column by column Left Ward       | <ol style="list-style-type: none"> <li>1. Send 0xa2</li> <li>2. Send the speed (typical time is 20ms)</li> <li>3. Wait until receive a module available byte ('E') from LED Display</li> <li>4. Wait 2ms</li> </ol>                                                                                                                                                                     | <pre>void Display_Column_By_Column_Left_Ward ( int speed ) {     Serial.write(0xa2);     Serial.write(Speed);     while (Serial.read() !='E') {}     delay(2); }</pre>                                                                                                                 |

|      |                                           |                                                                                                                                                                                                                     |                                                                                                                                                                         |
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| 0xA3 | Display image column by column Right Ward | <ol style="list-style-type: none"> <li>1. Send 0xa3</li> <li>2. Send the speed (typical time is 20ms)</li> <li>3. Wait until receive a module available byte ('E') from LED Display</li> <li>4. Wait 2ms</li> </ol> | <pre>Void Display_Column_By_Column_Right_Ward ( int Speed ) {     Serial.write(0xa3);     Serial.write(Speed);     while (Serial.read() !='E') {}     delay(2); }</pre> |
| 0xA4 | Erase image row by row Up Ward            | <ol style="list-style-type: none"> <li>1. Send 0xa4</li> <li>2. Send the speed (typical time is 20ms)</li> <li>3. Wait until receive a module available byte ('E') from LED Display</li> <li>4. Wait 2ms</li> </ol> | <pre>void Erase_Row_By_Row_Up_Ward( int Speed ) {     Serial.write(0xa4);     Serial.write(Speed);     while (Serial.read() !='E') {}     delay(2); }</pre>             |
| 0xA5 | Erase image row by row Down Ward          | <ol style="list-style-type: none"> <li>1. Send 0xa5</li> <li>2. Send the speed (typical time is 20ms)</li> <li>3. Wait until receive a module available byte ('E') from LED Display</li> <li>4. Wait 2ms</li> </ol> | <pre>void Erase_Row_By_Row_Down_Ward( int Speed ) {     Serial.write(0xa5);     Serial.write(Speed);     while (Serial.read() !='E') {}     delay(2); }</pre>           |
| 0xA6 | Erase image column by column Left Ward    | <ol style="list-style-type: none"> <li>1. Send 0xa6</li> <li>2. Send the speed (typical time is 20ms)</li> <li>3. Wait until receive a module available byte ('E') from LED Display</li> <li>4. Wait 2ms</li> </ol> | <pre>void Erase_Column_By_Column_Left_Ward( int Speed ) {     Serial.write(0xa6);     Serial.write(Speed);     while (Serial.read() !='E') {}     delay(2); }</pre>     |
| 0xA7 | Erase image column by column Right Ward   | <ol style="list-style-type: none"> <li>1. Send 0xa7</li> <li>2. Send the speed (typical time is 20ms)</li> <li>3. Wait until receive a module available byte ('E') from LED Display</li> <li>4. Wait 2ms</li> </ol> | <pre>void Erase_Column_By_Column_Right_Ward( int Speed ) {     Serial.write(0xa7);     Serial.write(Speed);     while (Serial.read() !='E') {}     delay(2); }</pre>    |
| 0xA8 | Display image Inside Out                  | <ol style="list-style-type: none"> <li>1. Send 0xa8</li> <li>2. Send the speed (typical time is 20ms)</li> <li>3. Wait until receive a module available byte ('E') from LED Display</li> <li>4. Wait 2ms</li> </ol> | <pre>void Display_Inside_Out( int Speed ) {     Serial.write(0xa8);     Serial.write(Speed);     while (Serial.read() !='E') {}     delay(2); }</pre>                   |
| 0xA9 | Display image Outside In                  | <ol style="list-style-type: none"> <li>1. Send 0xa9</li> <li>2. Send the speed (typical time is 20ms)</li> <li>3. Wait until receive a module available byte ('E') from LED Display</li> <li>4. Wait 2ms</li> </ol> | <pre>void Display_Outside_In( int Speed ) {     Serial.write(0xa9);     Serial.write(Speed);     while (Serial.read() !='E') {}     delay(2); }</pre>                   |
| 0xAA | Erase image Inside Out                    | <ol style="list-style-type: none"> <li>1. Send 0xaa</li> <li>2. Send the speed (typical time is 20ms)</li> <li>3. Wait until receive a module available byte ('E') from LED Display</li> <li>4. Wait 2ms</li> </ol> | <pre>void Erase_Inside_Out( int Speed ) {     Serial.write(0xaa);     Serial.write(Speed);     while (Serial.read() !='E') {}     delay(2); }</pre>                     |

|      |                                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                                                                                                                                                                                                                                        |
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| 0xAB | Erase image Outside In              | <ol style="list-style-type: none"> <li>1. Send 0xab</li> <li>2. Send the speed (typical time is 20ms)</li> <li>3. Wait until receive a module available byte ('E') from LED Display</li> <li>4. Wait 2ms</li> </ol>                                                                                                                                                                                                                                | <pre>void Erase_Outside_In( int Speed ) {     Serial.write(0xab);     Serial.write(Speed);     while (Serial.read() !='E') {} }</pre>                                                                                                                                                                                                  |
| 0xD0 | Clear display                       | <ol style="list-style-type: none"> <li>1. Send 0xd0</li> <li>2. Wait until receive a module available byte ('E') from LED Display</li> <li>3. Wait 2ms</li> </ol>                                                                                                                                                                                                                                                                                  | <pre>void Clear_Display_Momery( void ) {     Serial.write(0xd0);     while (Serial.read() !='E') {}     delay(2); }</pre>                                                                                                                                                                                                              |
| 0xD1 | Show the data in the display memory | <ol style="list-style-type: none"> <li>1. Send 0xd1</li> <li>2. Wait until receive a module available byte ('E') from LED Display</li> <li>3. Wait 2ms</li> </ol>                                                                                                                                                                                                                                                                                  | <pre>void Show_Display_Momery( void ) {     Serial.write(0xd1);     while (Serial.read() !='E') {} }</pre>                                                                                                                                                                                                                             |
| 0xD2 | Scroll the whole display upward     | <ol style="list-style-type: none"> <li>1. Send 0xd2</li> <li>2. Send the shift time (typical time is 70ms)</li> <li>3. Wait until receive a module available byte ('E') from LED Display</li> <li>4. Wait 2ms</li> </ol>                                                                                                                                                                                                                           | <pre>void Scroll_Whole_Display_Memory_Up( int shift time ) {     Serial.write(0xd2);     Serial.write(shift time);     while (Serial.read() !='E') {}     delay(2); }</pre>                                                                                                                                                            |
| 0xD3 | Scroll the whole display downward   | <ol style="list-style-type: none"> <li>1. Send 0xd3</li> <li>2. Send the shift time (typical time is 70ms)</li> <li>3. Wait until receive a module available byte ('E') from LED Display</li> <li>4. Wait 2ms</li> </ol>                                                                                                                                                                                                                           | <pre>void Scroll_Whole_Display_Memory_Down( int shift time ) {     Serial.write(0xd3);     Serial.write(shift time);     while (Serial.read() !='E') {}     delay(2); }</pre>                                                                                                                                                          |
| 0xD4 | Scroll the whole display leftward   | <ol style="list-style-type: none"> <li>1. Send 0xd4</li> <li>2. Send the shift time (typical time is 70ms)</li> <li>3. Wait until receive a module available byte ('E') from LED Display</li> <li>4. Wait 2ms</li> </ol>                                                                                                                                                                                                                           | <pre>void Scroll_Whole_Display_Memory_Left( int shift time ) {     Serial.write(0xd4);     Serial.write(shift time);     while (Serial.read() !='E') {}     delay(2); }</pre>                                                                                                                                                          |
| 0xD5 | Scroll the whole display rightward  | <ol style="list-style-type: none"> <li>1. Send 0xd5</li> <li>2. Send the shift time (typical time is 70ms)</li> <li>3. Wait until receive a module available byte ('E') from LED Display</li> <li>4. Wait 2ms</li> </ol>                                                                                                                                                                                                                           | <pre>void Scroll_Whole_Display_Memory_Right( int shift time ) {     Serial.write(0xd5);     Serial.write(shift time);     while (Serial.read() !='E') {}     delay(2); }</pre>                                                                                                                                                         |
| 0xD6 | Scroll the section display upward   | <ol style="list-style-type: none"> <li>1. Send 0xd6</li> <li>2. Send the X coordinate of up left corner</li> <li>3. Send the Y coordinate of up left corner</li> <li>4. Send the X coordinate of bottom right corner</li> <li>5. Send the Y coordinate of bottom right corner</li> <li>6. Send the shift time (typical time is 20ms)</li> <li>7. Wait until receive a module available byte ('E') from LED Display</li> <li>8. Wait 2ms</li> </ol> | <pre>void Scroll_Section_Display_Memory_Up( int X0_Pos, int Y0_Pos, int X1_Pos, int Y1_Pos, int shift time ) {     Serial.write(0xd6);     Serial.write(X0_Pos);     Serial.write(Y0_Pos);     Serial.write(X1_Pos);     Serial.write(Y1_Pos);     Serial.write(shift time);     while (Serial.read() !='E') {};     delay(2); }</pre> |

|      |                                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                                                                                                                                                                                                                                          |
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| 0xD7 | Scroll the section display downward   | <ol style="list-style-type: none"> <li>1. Send 0xd7</li> <li>2. Send the X coordinate of up left corner</li> <li>3. Send the Y coordinate of up left corner</li> <li>4. Send the X coordinate of bottom right corner</li> <li>5. Send the Y coordinate of bottom right corner</li> <li>6. Send the shift time (typical time is 70ms)</li> <li>7. Wait until receive a module available byte ('E') from LED Display</li> <li>8. Wait 2ms</li> </ol> | <pre>void Scroll_Section_Display_Memory_Down( int X0_Pos, int Y0_Pos, int X1_Pos, int Y1_Pos, int shift time ) {     Serial.write(0xd7);     Serial.write(X0_Pos);     Serial.write(Y0_Pos);     Serial.write(X1_Pos);     Serial.write(Y1_Pos);     Serial.write(shift time);     while (Serial.read() !='E') {}     delay(2); }</pre>  |
| 0xD8 | Scroll the section display leftward   | <ol style="list-style-type: none"> <li>1. Send 0xd8</li> <li>2. Send the X coordinate of up left corner</li> <li>3. Send the Y coordinate of up left corner</li> <li>4. Send the X coordinate of bottom right corner</li> <li>5. Send the Y coordinate of bottom right corner</li> <li>6. Send the shift time (typical time is 20ms)</li> <li>7. Wait until receive a module available byte ('E') from LED Display</li> <li>8. Wait 2ms</li> </ol> | <pre>void Scroll_Section_Display_Memory_Left( int X0_Pos, int Y0_Pos, int X1_Pos, int Y1_Pos, int shift time ) {     Serial.write(0xd8);     Serial.write(X0_Pos);     Serial.write(Y0_Pos);     Serial.write(X1_Pos);     Serial.write(Y1_Pos);     Serial.write(shift time);     while (Serial.read() !='E') {}     delay(2); }</pre>  |
| 0xD9 | Scroll the section display rightward  | <ol style="list-style-type: none"> <li>1. Send 0xd9</li> <li>2. Send the X coordinate of up left corner</li> <li>3. Send the Y coordinate of up left corner</li> <li>4. Send the X coordinate of bottom right corner</li> <li>5. Send the Y coordinate of bottom right corner</li> <li>6. Send the shift time (typical time is 70ms)</li> <li>7. Wait until receive a module available byte ('E') from LED Display</li> <li>8. Wait 2ms</li> </ol> | <pre>void Scroll_Section_Display_Memory_Right( int X0_Pos, int Y0_Pos, int X1_Pos, int Y1_Pos, int shift time ) {     Serial.write(0xd9);     Serial.write(X0_Pos);     Serial.write(Y0_Pos);     Serial.write(X1_Pos);     Serial.write(Y1_Pos);     Serial.write(shift time);     while (Serial.read() !='E') {}     delay(2); }</pre> |
| 0xED | Turn Backlight on/off                 | <ol style="list-style-type: none"> <li>1. Send 0xed</li> <li>2. Send backlight on/off mode</li> <li>3. Wait until receive a module available byte ('E') from LED Display</li> <li>4. Wait 2ms</li> </ol>                                                                                                                                                                                                                                           | <pre>void Turn Backlight on/off {     Serial.write(0xed);     Serial.write(mode);     while (Serial.read() !='E') {}     delay(2); }</pre>                                                                                                                                                                                               |
| 0xF0 | Turn display Off                      | <ol style="list-style-type: none"> <li>1. Send 0xf0</li> <li>2. Wait until receive a module available byte ('E') from LED Display</li> <li>3. Wait 2ms</li> </ol>                                                                                                                                                                                                                                                                                  | <pre>void Display_Off( void ) {     Serial.write(0xf0);     while (Serial.read() !='E') {} }</pre>                                                                                                                                                                                                                                       |
| 0xF1 | Turn display On                       | <ol style="list-style-type: none"> <li>1. Send 0xf1</li> <li>2. Wait until receive a module available byte ('E') from LED Display</li> <li>3. Wait 2ms</li> </ol>                                                                                                                                                                                                                                                                                  | <pre>void Display_On( void ) {     Serial.write(0xf1);     while (Serial.read() !='E') {}     delay(2); }</pre>                                                                                                                                                                                                                          |
| 0xF2 | Set the brightness of the LED Display | <ol style="list-style-type: none"> <li>1. Send 0xf2</li> <li>2. Send the level of brightness (0~11)</li> <li>3. Wait until receive a module available byte ('E') from LED Display</li> <li>4. Wait 2ms</li> </ol>                                                                                                                                                                                                                                  | <pre>void Set_Display_Brightness( int brightness ) {     Serial.write(0xf2);     Serial.write(brightness);     while (Serial.read() !='E') {}     delay(2); }</pre>                                                                                                                                                                      |

|      |                                                               |                                                                                                                                   |                                                                                                                                                  |
|------|---------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------|
| 0xF3 | Inverse image                                                 | 1. Send 0xf3<br>2. Wait until receive a module available byte ('E') from LED Display<br>3. Wait 2ms                               | <pre>void Inverse_Image( void ) {     Serial.write(0xf3);     while (Serial.read() !='E') {}     delay(2); }</pre>                               |
| 0xF6 | Change Instruction mode (0 for Hex Command, 1 for AT Command) | 1. Send 0xf6<br>2. Send instruction mode 1<br>3. Wait until receive a module available byte ('E') from LED Display<br>4. Wait 2ms | <pre>int Change_Display_Mode( int mode ) {     Serial.write(0xf6);     Serial.write(1);     while (Serial.read() !='E') {}     delay(2); }</pre> |

### ASCII code of 5X7 fonts and 8X16 fonts

| Hex  | Symbol | Hex  | Symbol | Hex  | Symbol |
|------|--------|------|--------|------|--------|
| 0x20 |        | 0x40 | @      | 0x60 | `      |
| 0x21 | !      | 0x41 | A      | 0x61 | a      |
| 0x22 | "      | 0x42 | B      | 0x62 | b      |
| 0x23 | #      | 0x43 | C      | 0x63 | c      |
| 0x24 | \$     | 0x44 | D      | 0x64 | d      |
| 0x25 | %      | 0x45 | E      | 0x65 | e      |
| 0x26 | &      | 0x46 | F      | 0x66 | f      |
| 0x27 | '      | 0x47 | G      | 0x67 | g      |
| 0x28 | (      | 0x48 | H      | 0x68 | h      |
| 0x29 | )      | 0x49 | I      | 0x69 | i      |
| 0x2a | *      | 0x4a | J      | 0x6a | j      |
| 0x2b | +      | 0x4b | K      | 0x6b | k      |
| 0x2c | ,      | 0x4c | L      | 0x6c | l      |
| 0x2d | -      | 0x4d | M      | 0x6d | m      |
| 0x2e | .      | 0x4e | N      | 0x6e | n      |
| 0x2f | /      | 0x4f | O      | 0x6f | o      |
| 0x30 | 0      | 0x50 | P      | 0x70 | p      |
| 0x31 | 1      | 0x51 | Q      | 0x71 | q      |
| 0x32 | 2      | 0x52 | R      | 0x72 | r      |
| 0x33 | 3      | 0x53 | S      | 0x73 | s      |
| 0x34 | 4      | 0x54 | T      | 0x74 | t      |
| 0x35 | 5      | 0x55 | U      | 0x75 | u      |
| 0x36 | 6      | 0x56 | V      | 0x76 | v      |
| 0x37 | 7      | 0x57 | W      | 0x77 | w      |
| 0x38 | 8      | 0x58 | X      | 0x78 | x      |
| 0x39 | 9      | 0x59 | Y      | 0x79 | y      |
| 0x3a | :      | 0x5a | Z      | 0x7a | z      |
| 0x3b | ;      | 0x5b | ]      | 0x7a | {      |
| 0x3c | <      | 0x5c | \      | 0x7a |        |
| 0x3d | =      | 0x5d | [      | 0x7a | }      |
| 0x3e | >      | 0x5e | ^      | 0x7a | ~      |
| 0x3f | ?      | 0x5f | _      | 0x7a | <-     |

**ASCII code of  
16X16 fonts**

| Hex  | Symbol |
|------|--------|
| 0x30 | 0      |
| 0x31 | 1      |
| 0x32 | 2      |
| 0x33 | 3      |
| 0x34 | 4      |
| 0x35 | 5      |
| 0x36 | 6      |
| 0x37 | 7      |
| 0x38 | 8      |
| 0x39 | 9      |

**No. of 8X16 pattern**

| No. | Symbol |
|-----|--------|
| 0   | 0      |
| 1   | 1      |
| 2   | 2      |
| 3   | 3      |
| 4   | 4      |
| 5   | 5      |
| 6   | 6      |
| 7   | 7      |
| 8   | 8      |
| 9   | 9      |

**No. of 8X8 pattern**

| No. | Symbol |
|-----|--------|
| 0   | 0      |
| 1   | 1      |
| 2   | 2      |
| 3   | 3      |
| 4   | 4      |
| 5   | 5      |
| 6   | 6      |
| 7   | 7      |
| 8   | 8      |
| 9   | 9      |

**No. of 16X16  
pattern**

| No. | Symbol |
|-----|--------|
| 0   | 0      |
| 1   | 1      |
| 2   | 2      |
| 3   | 3      |
| 4   | 4      |
| 5   | 5      |
| 6   | 6      |
| 7   | 7      |
| 8   | 8      |
| 9   | 9      |

**No. of 32X32  
pattern**

| No. | Symbol |
|-----|--------|
| 0   | 0      |
| 1   | 1      |
| 2   | 2      |
| 3   | 3      |
| 4   | 4      |
| 5   | 5      |
| 6   | 6      |
| 7   | 7      |
| 8   | 8      |
| 9   | 9      |
| 10  | °C     |
| 11  | °F     |
| 12  | ☼      |

## 10. Power Reset

### 4.1 Commands

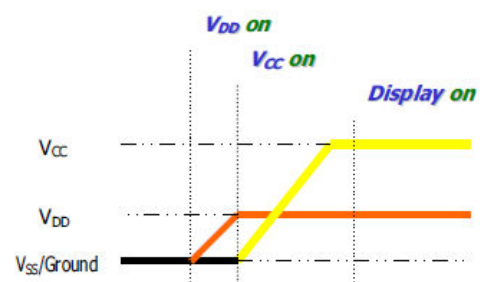
Refer to the Technical Manual for the SSD1309

### 4.2 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.

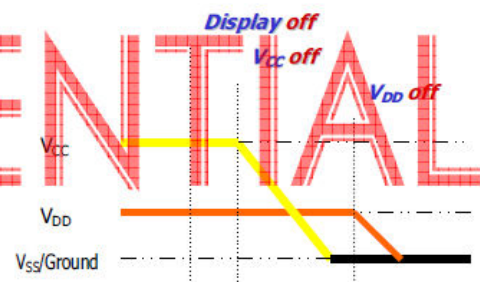
#### 4.2.1 Power up Sequence:

1. Power up  $V_{DD}$
2. Send Display off command
3. Initialization
4. Clear Screen
5. Power up  $V_{CC}$
6. Delay 100ms  
(When  $V_{CC}$  is stable)
7. Send Display on command



#### 4.2.2 Power down Sequence:

1. Send Display off command
2. Power down  $V_{CC}$
3. Delay 100ms  
(When  $V_{CC}$  is reach 0 and panel is completely discharges)
4. Power down  $V_{DD}$



#### Note 9:

- 1) Since an ESD protection circuit is connected between  $V_{DD}$  and  $V_{CC}$  inside the driver IC,  $V_{CC}$  becomes lower than  $V_{DD}$  whenever  $V_{DD}$  is ON and  $V_{CC}$  is OFF.
- 2)  $V_{CC}$  should be kept float (disable) when it is OFF.
- 3) Power Pins ( $V_{DD}$ ,  $V_{CC}$ ) can never be pulled to ground under any circumstance.
- 4)  $V_{DD}$  should not be power down before  $V_{CC}$  power down.

### 4.3 Reset Circuit

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

1. Display is OFF
2. 128×64 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)

## 11. Reliability

The OLED module shall have no failure in the following reliability test. However the following Test of a different item doesn't do by means of the same OLED module.

| Test Item                  | Test Conditions                                                                                     | Note  |
|----------------------------|-----------------------------------------------------------------------------------------------------|-------|
| High temperature operation | 70±3℃ , t=120hrs                                                                                    | 2     |
| Low temperature operation  | -40±3℃ , t=120hrs                                                                                   | 2     |
| High Temperature storage   | 80±3℃ , t=120hrs                                                                                    | 1 , 2 |
| Low Temperature storage    | -40±3℃ , t=120hrs                                                                                   | 1 , 2 |
| Temperature Cycle          | -30℃ ~ 25℃ ~ 80℃<br>30min. 5min. 30min.<br>(1 cycle) Total 10 cycle                                 | 1 , 2 |
| Humidity Test              | 40℃, Humidity 90% , 96 hrs                                                                          | 1 , 2 |
| Vibration Test             | Sweep frequency : 10 ~ 55 , 1.5mmp-p<br>Test direction : X.Y.Z/3 axis<br>Duration : 60min/each axis | 2     |
| ESD Testing                | Contract Discharge Voltage:<br>+1 ~ 5kV and -1 ~ -5kV                                               | 3     |
|                            | Air Discharge Voltage:<br>+1 ~ 8kV and -1 ~ -8kV                                                    |       |

Note 1. The module should not have condensation of water on it.

Note 2. The module should be inspected after 4-hour storage under normal Conditions (15℃ to 35℃ , 45% to 65% RH)

Note 3. There will be discharged ten times at every discharging voltage cycle.  
Energy Storage Capacitance (Cs+Cd) : 150pF±10%  
Discharge Resistance (Rd) : 330Ω±10%  
The voltage gap is 1kV.

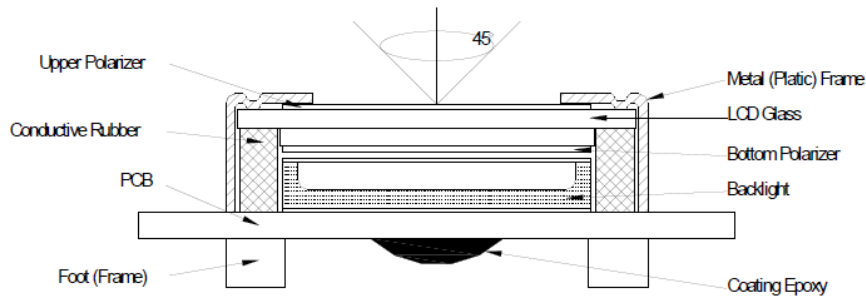
Definitions of life end point

- (1) Current consumption is more than specified value.
- (2) Function of the module is not maintained.
- (3) There is visible degradation of appearance and display quality.
- (4) Contrast ratio is less than 50% of specified minimum value.
- (5) Brightness is less than 50% of specified minimum value.

## 12. Quality

### TEST CONDITIONS

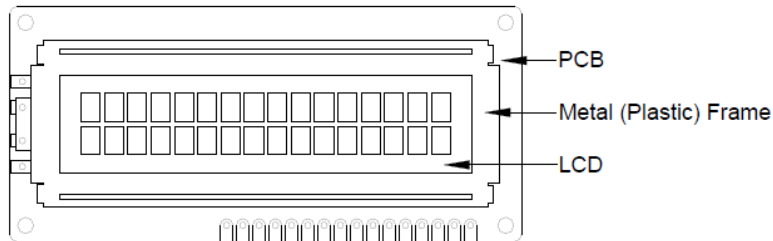
1. Inspection will be done by placing LCM 30cm away from inspector's eyeballs under normal illumination.



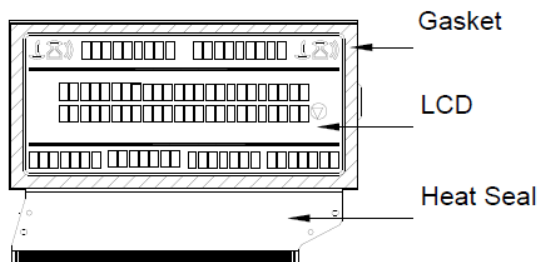
2. View Angle: with in 45° around perpendicular line.

### 8 - 2. Definition

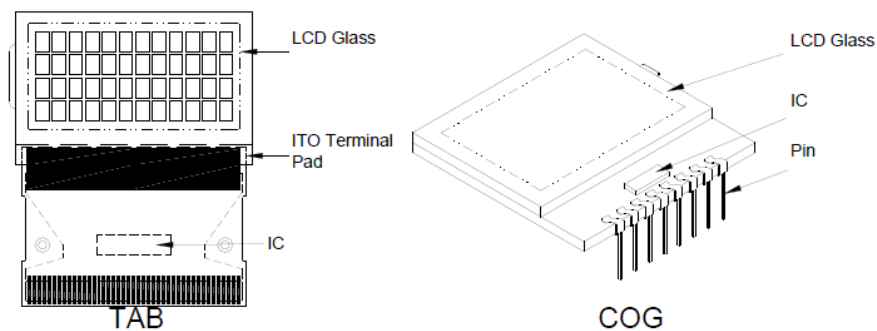
#### 1. COB



#### 2. Heat Seal



#### 3. TAB and COG



### QUALITY SPECIFICATIONS (Continued)

#### 8-3. Sampling Plan and Acceptance

##### 1. Sampling Plan

MIL - STD - 105E ( || ) ordinary single inspection is used.

##### 2. Acceptance

Major defect: AQL = 0.25

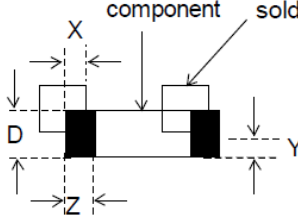
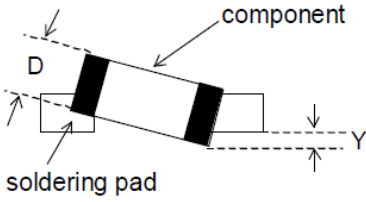
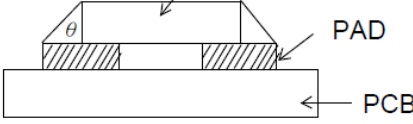
Minor defect: AQL = 0.65

#### 8-4. Criteria

##### 1. COB

| Defect | Inspection Item               | Inspection Standards                                                     |        |
|--------|-------------------------------|--------------------------------------------------------------------------|--------|
| Major  | PCB copper flakes peeling off | Any copper flake in viewing Area should be greater than $1.0\text{mm}^2$ | Reject |
| Major  | Height of coating epoxy       | Exceed the dimension of drawing                                          | Reject |
| Major  | Void or hole of coating epoxy | Expose bonding wire or IC                                                | Reject |
| Major  | PCB cutting defect            | Exceed the dimension of drawing                                          | Reject |

##### 2. SMT

| Defect | Inspection Item                                                                                                     | Inspection Standards            |                  |
|--------|---------------------------------------------------------------------------------------------------------------------|---------------------------------|------------------|
| Minor  | Component marking not readable                                                                                      |                                 | Reject           |
| Minor  | Component height                                                                                                    | Exceed the dimension Of drawing | Reject           |
| Major  | Component solder defect (missing, extra, wrong component or wrong orientation)                                      |                                 | Reject           |
| Minor  | <p>Component position shift</p>  | $X < 3/4Z$<br>$Y > 1/3D$        | Reject<br>Reject |
| Minor  | <p>Component tilt</p>            | $Y > 1/3D$                      | Reject           |
| Minor  | <p>Insufficient solder</p>       | $\theta \leq 20^\circ$          | Reject           |

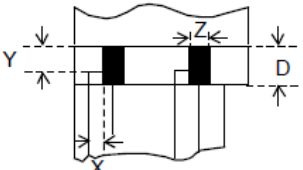
### QUALITY SECIFICATIONS (Continued)

#### 8-4. Criteria (Continued)

#### 3. Metal (Plastic) Frame

| Defect | Inspection Item                               | Inspection Standards                                                                                                                                                  |                       |                              |
|--------|-----------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|------------------------------|
| Major  | Crack / breakage                              | Anywhere                                                                                                                                                              |                       | Reject                       |
| Minor  | Frame Scratch                                 | W                                                                                                                                                                     | L                     | Acceptable of Scratch        |
|        |                                               | $w < 0.03\text{mm}$                                                                                                                                                   | Any                   | Ignore                       |
|        |                                               | $0.03\text{mm} \leq w < 0.25\text{mm}$                                                                                                                                | $L \leq 5.0\text{mm}$ | 5                            |
|        |                                               | $0.25\text{mm} \leq w < 0.4\text{mm}$                                                                                                                                 | $L \leq 5.0\text{mm}$ | 3                            |
|        |                                               | $w \geq 0.4\text{mm}$                                                                                                                                                 | Any                   | 0                            |
|        |                                               | Note: 1. Above criteria applicable to scratch lines with distance greater than 5mm.<br>2. Scratch on the side face of frame (not visible) can be ignored.             |                       |                              |
| Minor  | Frame Dent, Prick<br>$\Phi = \frac{L + W}{2}$ |                                                                                                                                                                       |                       | Acceptable of Dents / Pricks |
|        |                                               | $\Phi \leq 1.0\text{mm}$                                                                                                                                              |                       | 5                            |
|        |                                               | $1.0 < \Phi \leq 1.5\text{mm}$                                                                                                                                        |                       | 3                            |
|        |                                               | $1.5\text{mm} > \Phi$                                                                                                                                                 |                       | 0                            |
|        |                                               | Note: 1. Above criteria applicable to any two dents / pricks with distance greater than 5mm<br>2. Dent / prick on the side face of frame (not visible) can be ignored |                       |                              |
| Minor  | Frame Deformation                             | Exceed the dimension of drawing                                                                                                                                       |                       |                              |
| Minor  | Metal Frame Oxidation                         | Any rust                                                                                                                                                              |                       |                              |

#### 4. Flexible Film Connector (FFC)

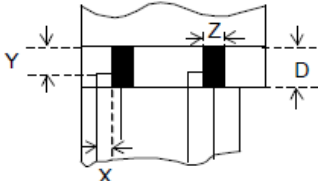
| Defect | Inspection Item                                                                                       | Inspection Standards           |            |
|--------|-------------------------------------------------------------------------------------------------------|--------------------------------|------------|
| Minor  | Tilted soldering                                                                                      | Within the angle $\pm 3^\circ$ | Acceptable |
| Minor  | Uneven solder joint /bump                                                                             |                                | Reject     |
| Minor  | Hole<br>$\Phi = \frac{L + W}{2}$                                                                      | Expose the conductive line     | Reject     |
|        |                                                                                                       | $\Phi > 1.0\text{mm}$          | Reject     |
| Minor  | Position shift<br> | $Y > 1/3D$                     | Reject     |
|        |                                                                                                       | $X > 1/2Z$                     | Reject     |

## 8-4. Criteria (Continued)

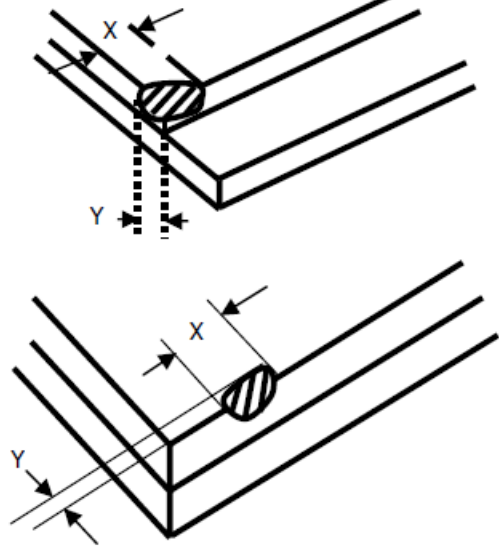
## 5. Screw

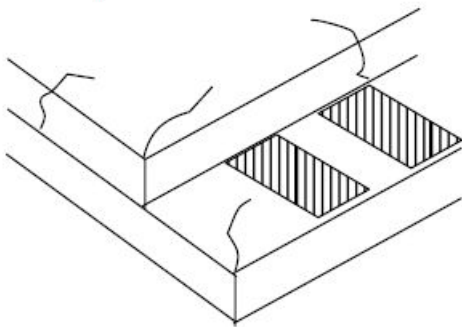
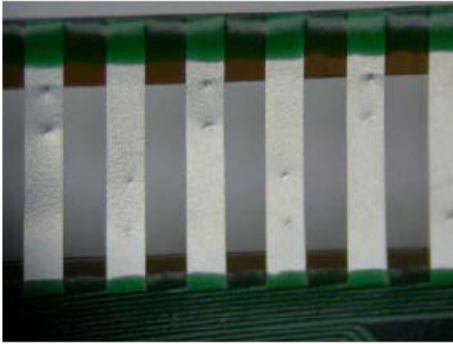
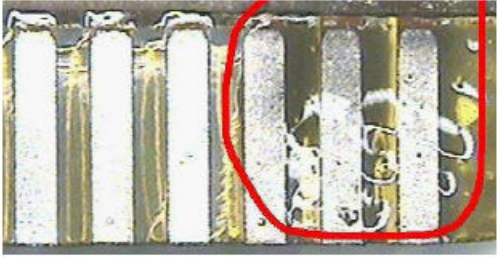
| Defect | Inspection Item      | Inspection Standards             |        |
|--------|----------------------|----------------------------------|--------|
| Major  | Screw missing/loosen |                                  | Reject |
| Minor  | Screw oxidation      | Any rust                         | Reject |
| Minor  | Screw deformation    | Difficult to accept screw driver | Reject |

## 6. Heat seal 、TCP 、FPC

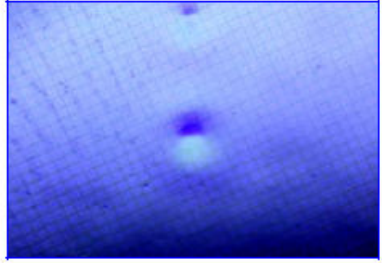
| Defect | Inspection Item                                                                                      |                          | Inspection Standards        |        |
|--------|------------------------------------------------------------------------------------------------------|--------------------------|-----------------------------|--------|
| Major  | Scratch expose conductive layer                                                                      |                          |                             | Reject |
| Minor  | HS Hole                                                                                              | $\Phi = \frac{L + W}{2}$ | $\Phi > 0.2\text{mm}$       | Reject |
| Major  | Adhesion strength                                                                                    |                          | Less than the specification | Reject |
| Minor  | Position shift<br> |                          | $Y > 1/3D$                  | Reject |
|        |                                                                                                      |                          | $X > 1/2Z$                  | Reject |
| Major  | Conductive line break                                                                                |                          |                             | Reject |

## 7. Inspection Specification of OLED modules

| Check Item             | Classification | Criteria                                                                                                                                                                                                      |
|------------------------|----------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Panel 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>  |

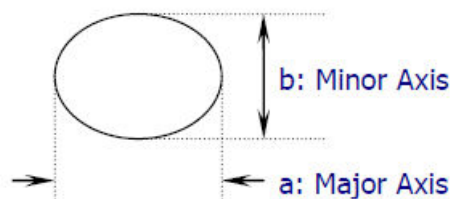
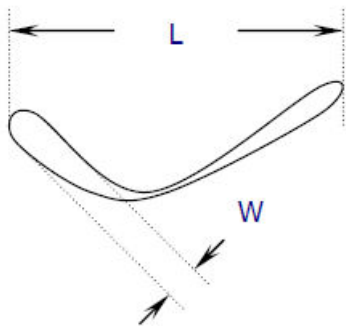
| Check Item                                                       | Classification | Criteria                                                                                                          |
|------------------------------------------------------------------|----------------|-------------------------------------------------------------------------------------------------------------------|
| Panel Crack                                                      | Minor          | Any crack is not allowable.<br> |
| Copper Exposed<br>(Even Pin or Film)                             | Minor          | Not Allowable by Naked Eye Inspection                                                                             |
| Film or Trace Damage                                             | Minor          |                                |
| Terminal Lead Prober Mark                                        | Acceptable     |                               |
| Glue or Contamination on Pin<br>(Couldn't Be Removed by Alcohol) | Minor          |                               |
| Ink Marking on Back Side of panel<br>(Exclude on Film)           | Acceptable     | Ignore for Any                                                                                                    |

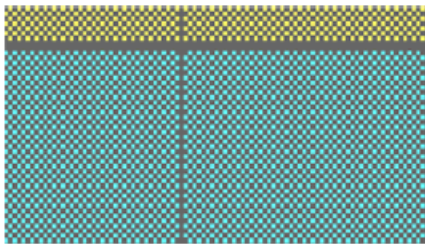
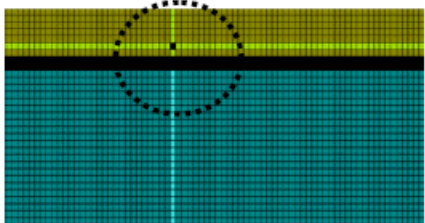
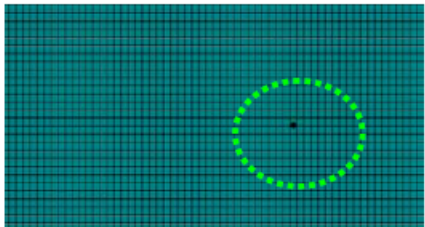
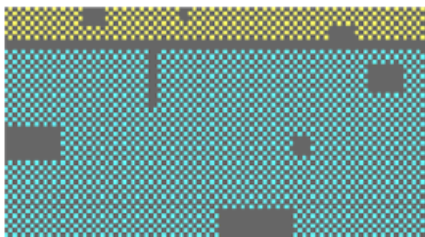
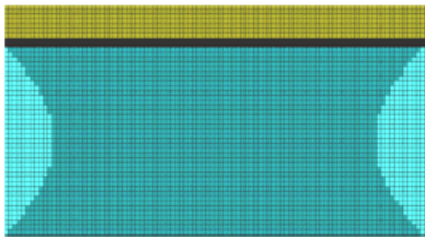
It is recommended to execute in clear room environment (class 10k) if actual in necessary.

| 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>$W > 0.1$<br>$L \leq 2$ $n \leq 1$<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>$0.5 < \Phi$ $n = 0$  |
| 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):  $\Phi = (a + b) / 2$



| Check Item    | Classification | Criteria                                                                             |
|---------------|----------------|--------------------------------------------------------------------------------------|
| No Display    | Major          |    |
| Missing Line  | Major          |    |
| Pixel Short   | Major          |   |
| Darker Pixel  | Major          |  |
| Wrong Display | Major          |  |
| Un-uniform    | Major          |  |

## 13. Handling Precaution

### 1. Mounting Method

-The panel of the OLED Module consists of two thin glass plates with polarizers which easily get damaged since the Module is fixed by utilizing fitting holes in the printed circuit board. Extreme care should be taken when handling the OLED Modules.

### 2. Caution of OLED handling & cleaning

-When cleaning the display surface, use soft cloth with solvent (recommended below) and Wipe lightly.

\*Isopropyl alcohol

\*Ethyl alcohol

\*Trichlorotrifluoroethane

-Do not wipe the display surface with dry or hard materials that will damage the polarize surface.

Do not use the following solvent :

\*Water

\* Acetone

\*Aromatics

### 3. Caution against static charge

-The OLED Module use C-MOSLSI drivers, so we recommend that you connect any unused input terminal to VDD or VSS, do not input any signals before power is turned on. And ground your body, Work/assembly table. And assembly equipment to protect against static electricity.

### 4. Packaging

-Modules use OLED elements, and must be treated as such. Avoid in tense shock and falls from a height.

-To prevent modules from degradation. Do not operate or store them exposed directly to sunshine or high temperature/humidity.

## 5. Caution for operation

- It is indispensable to drive OLED's within the specified voltage limit since the higher voltage than the limit shortens OLED life.
- An electrochemical reaction due to direct current causes OLED deterioration. Avoid the use of direct current drive.
- Response time will be extremely delayed at lower temperature than the operating temperature range and on the other hand at higher temperature OLED's show dark color in them. However those phenomena do not mean malfunction or out of order with OLED's. Which will come back in the specified operating temperature range.
- If the display area is pushed hard during operation, some font will be abnormally displayed but it resumes normal condition after turning off once.

A slight dew depositing on terminals is a cause for electro-chemical reaction resulting in terminal open circuit. Usage under the relative condition of 40 °C, 50%RH or less is required.

### (1) Soldering condition to I/O PIN terminals

Temperature at tip of the iron:  $280 \pm 10^{\circ}\text{C}$

Soldering time: 3~4 sec.

Type of solder: Eutectic solder (containing colophony-flux)

\*Please do not use flux because it may soak into OLED Module or contaminate it.

## 6. Storage

- In the case of storing for a long period of time (for instance. For years) for the purpose or replacement use, The following ways are recommended.
- Storage in a polyethylene bag with sea OLE so as not to enter fresh air outside in it, And with no desiccant.
- Placing in a dark place where neither exposure to direct sunlight nor light is. Keeping temperature in the specified storage temperature range.
- Storing with no touch on polarizer surface by anything else. (It is recommended to store them as they have been contained in the inner container at the time of delivery)

## 7. Safety

- It is recommendable to crash damaged or unnecessary OLED into pieces and wash off liquid crystal by using solvents such as acetone and ethanol. Which should be burned up later.
- When any liquid crystal leaked out of a damaged glass cell comes in contact with your hands, please wash it off well with soap and water.



#### **14. Packing Method**

**T.B.D**