# CONTENTS

## 1. FEATURES

- Small molecular organic light emitting diode.
- Color : White
- Panel resolution : 128x160
- Driver IC : SH1108
- Excellent quick response time.
- Extremely thin thickness for best mechanism design : 1.427 mm
- High contrast : 2,000:1
- Wide viewing angle : 160°
- Strong environmental resistance.
- 8-bit 6800-series parallel interface, 8-bit 8080-series parallel interface, and 3-wire & 4-wire serial peripheral interface, $I^2C$ bus interface.
- Wide range of operating temperature : -40 to 70°C
- Anti-glare polarizer.

## Specification

1. Display: OLED(White)
2. Dot Matrix: 128(c)x160(s)
3. Dot Size: 0.206x0.226mm
4. Dot Pitch: 0.226x0.246 mm
5. Aperture Rate: 84%
6. Active Area: 28.908x39.34mm
7. IC: SH1108
8. General Tolerance:±0.3



128(c)x160(s) Dots
(1.92")

(65.31)
18.76±0.5
46.55±0.2
42.93±0.2 (Cover Glass)
41.93±0.3(AG Polarizer)
(40.34)V/A
P0.246x160-0.02=39.34(A/A)
0.5±0.5
(1)
(1.5)
32.9±0.2
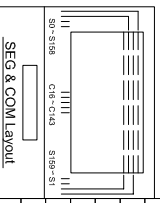31.9±0.3(AG Polarizer)
(29.908)V/A
P0.226x128-0.02=28.908(A/A)
0.5±0.5
(1.996)
(1.496)
4.5±0.3

Single tape
Handler
(15*8mm)

Stiffener
Contact side
0.3±0.03
1.5 Max.
(UV glue)
3.7 Max.
(seal cover IC,black)
AG polarizer
t=0.207mm
0.5
0.7
1.427±0.15
(w/o handler)

0.246
0.02
0.226
0.02
0.206
0.226

0.5±0.07
7±0.2
3.5±0.3
2-Ø0.8±0.1
15.5±0.07
W=0.3±0.03
14±0.1
P0.5(30-1)=14.5±0.05

SEG & COM Layout
S0~S156
C16~C143
S157~S189

### General Tolerance

| Length (mm) | Tolerance(mm) |
|---|---|
| 0 ~ 8 | ±0.1 |
| 8 ~ 25 | ±0.2 |
| 25 ~ 50 | ±0.3 |

CONFIDENTIAL
Third Angle Projection

| | |
|---|---|
| M.E. | E.E. |

| Scale | x |
|---|---|
| Unit | mm |
| Sheet | 1/1 |

Module
Spec.
Approved

PROJECT CODE
PART NAME Module Ass'y
PARTS NO.
REVISION 01
REVISION 01

### SPI & IIC & 8080

Pin Assignment

| NO. | SYMBOL |
|---|---|
| 1 | NC(GND) |
| 2 | VPP |
| 3 | VSEGM |
| 4 | VCOMH |
| 5 | VSL |
| 6 | NC |
| 7 | IREF |
| 8 | VPP |
| 9 | NC |
| 10 | VSS |
| 11 | VCL |
| 12 | VDD |
| 13 | IM0 |
| 14 | IM1 |
| 15 | VDD |
| 16 | IM2 |
| 17 | /CS |
| 18 | /RES |
| 19 | A0 |
| 20 | /WR |
| 21 | /RD |
| 22 | D0 |
| 23 | D1 |
| 24 | D2 |
| 25 | D3 |
| 26 | D4 |
| 27 | D5 |
| 28 | D6 |
| 29 | D7 |
| 30 | VPP |

### Revision

| Revision | Date | Note |
|---|---|---|
| 01 | 2022/03/14 | Module Ass'y(ASR2200019; EPR2200029B) |

## 5. MAXIMUM RATINGS

| ITEM | MIN | MAX | UNIT | Condition | Remark |
|---|---|---|---|---|---|
| Supply Voltage ($V_{DD}$) | -0.3 | 3.6 | V | Ta = 25°C | IC maximum rating |
| Supply Voltage ($V_{PP}$) | 8 | 17 | V | Ta = 25°C | IC maximum rating |
| Operating Temp. | -40 | 70 | °C | - | - |
| Storage Temp | -40 | 85 | °C | - | Note (2) |

Note:

(1) Maximum ratings are those values beyond which damages to the OLED module may occur. The OLED functional operation should be restricted to the limits in the section 6. Electrical Characteristics tables.

(2) The defined temperature ranges do not include the polarizer. The maximum withstood temperature of the polarizer should be 80°C.

## 6. ELECTRICAL CHARACTERISTICS

### 6.1 D.C ELECTRICAL CHARACTERISTICS

| SYMBOL | PARAMETERS | TEST CONDITION | MIN | TYP | MAX | UNIT |
|---|---|---|---|---|---|---|
| $V_{PP}$ | Analog power supply (for OLED panel) | Ta 25°C | 13 | 13.5 | 14 | V |
| $V_{DD}$ | Digital power supply | Ta 25°C | 1.65 | 2.85 | 3.5 | V |
| $V_{IH}$ | High logic input level | | $0.8 * V_{DD}$ | - | $V_{DD}$ | V |
| $V_{IL}$ | Low logic input level | | $V_{SS}$ | - | $0.2 * V_{DD}$ | V |
| $V_{OH}$ | High logic output level | $I_{OH}$ = -0.5mA | $0.8 * V_{DD}$ | - | $V_{DD}$ | V |
| $V_{OL}$ | Low logic output level | $I_{OL}$ = 0.5mA | $V_{SS}$ | - | $0.2 * V_{DD}$ | V |

Note: The $V_{PP}$ input must keep in a stable value; ripple and noise are not allowed.

## 6.2 ELECTRO-OPTICAL CHARACTERISTICS

### PANEL ELECTRICAL SPECIFICATIONS

| PARAMETER | MIN | TYP. | MAX | UNITS | COMMENTS |
|---|---|---|---|---|---|
| Normal mode current (IPP) | - | 66 | 68 | mA | All pixels on (1) |
| | - | 16 | 17 | mA | 20% pixels on (1) |
| Standby mode current (IPP) | - | 5 | 6 | mA | Standby mode 10% pixels on (2) |
| Normal mode power consumption | - | 891 | 918 | mW | All pixels on (1) |
| | - | 216 | 229.5 | mW | 20% pixels on (1) |
| Standby mode power consumption | - | 67.5 | 81 | mW | Standby mode 10% pixels on (2) |
| IDD sleep mode current | - | - | 5 | uA | Sleep mode Current (3) |
| IPP sleep mode current | - | - | 5 | uA | Sleep mode Current (3) |
| Normal mode Luminance | 115 | 145 | | cd/m$^2$ | Display Average |
| Standby Luminance | | 65 | | cd/m$^2$ | |
| CIEx (White) | 0.32 | 0.36 | 0.40 | | CIE1931 |
| CIEy (White) | 0.34 | 0.38 | 0.42 | | CIE1931 |
| Dark Room Contrast | 2000:1 | | | | |
| Viewing Angle | 160 | | | degree | |
| Response Time | | 10 | | µs | |

(1) Normal mode condition :

- Driving Voltage : 13.5V

- Contrast setting : 0xd0

- Frame rate : 105Hz

- Duty setting : 1/128

(2) Standby mode condition :

- Driving Voltage : 13.5V

- Contrast setting : 0x00

- Frame rate : 105Hz

- Duty setting : 1/128

(3) Sleep mode condition :

When send 0xae command OLED display off and memory data will be maintained.

(4) Wake up condition :

When send 0xaf command OLED will be turned on.

## 7. LIFETIME SPECIFICATION

| ITEM | MIN | UNIT | Condition | Remark |
|---|---|---|---|---|
| Life Time | 10,000 | Hrs | 145 cd/m$^2$, 50% checkerboard | Note (1) |
| Life Time | 13,000 | Hrs | 115 cd/m$^2$, 50% checkerboard | Note (2) |

Note:

(A) Under VPP = 13.5V, Ta = 25°C, 50% RH.

(B) Life time is defined the amount of time when the luminance has decayed to less than 50% of the initial measured luminance.

(1) Setting of 145 cd/m$^2$ :

- Contrast setting : 0xd0
- Frame rate : 105Hz
- Duty setting : 1/128

(2) Setting of 115 cd/m$^2$ :

- Contrast setting : 0x80
- Frame rate : 105Hz
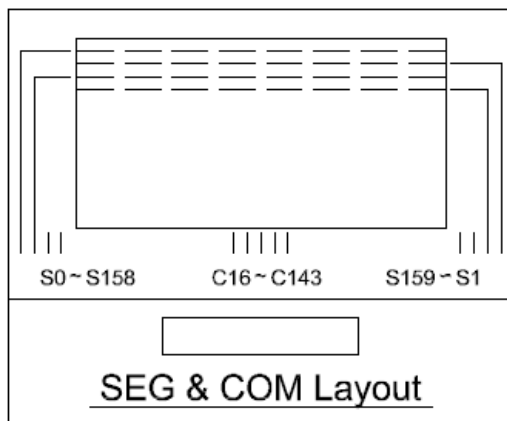- Duty setting : 1/128

# 8. INTERFACE

## 8.1 FUNCTION BLOCK DIAGRAM



RiTdisplay 128x160 OLED Module
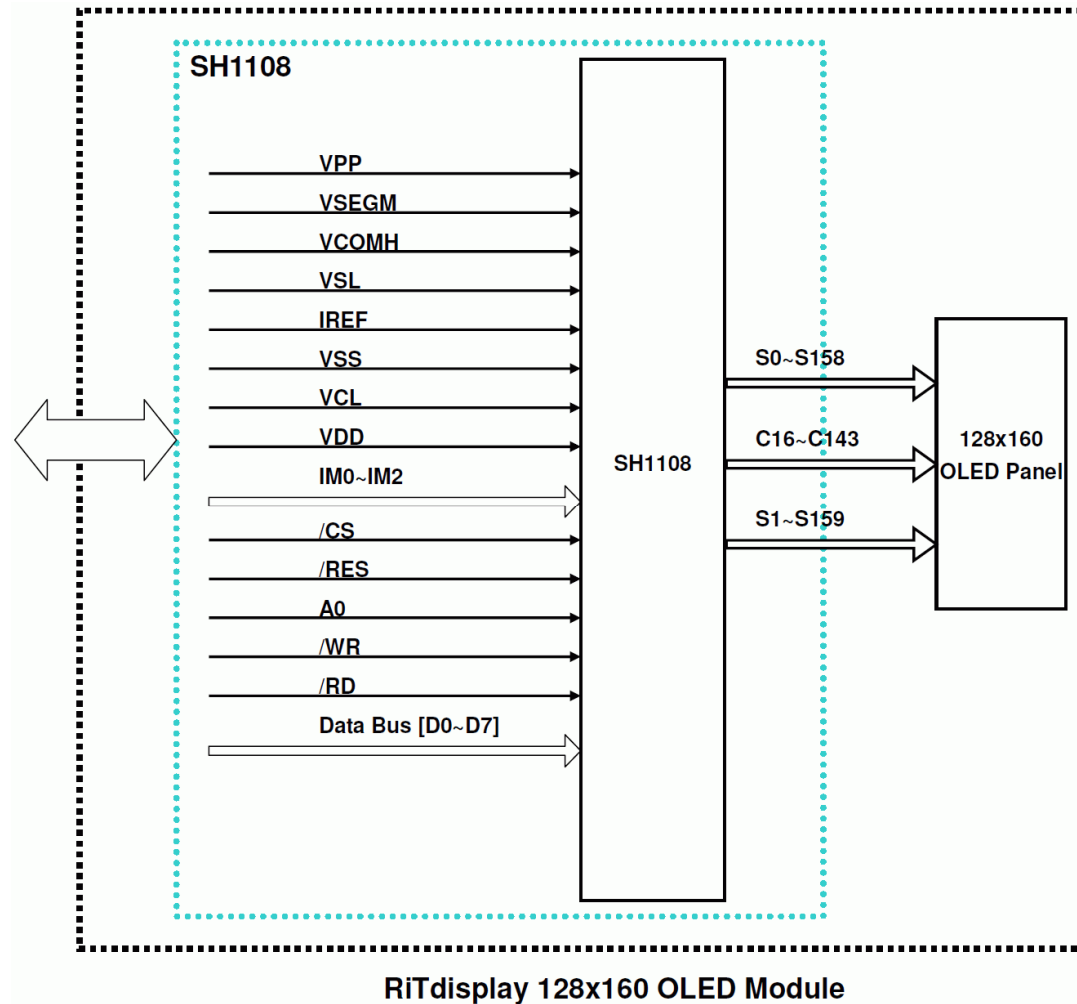
## 8.2 PANEL LAYOUT DIAGRAM

## 8.3 PIN ASSIGNMENTS

| Pin No. | Pin Name | Description | Setting at each interface | | |
|---------|----------|-------------|--------------------|----------------|-----|
| | | | 8080 parallel | 4-Wire SPI | IIC |
| 1 | NC | No connection. | | | |
| 2 | VPP | Power supply for panel driving voltage. | | | |
| 3 | VSEGM | This is voltage output high level for segment pre-charge. A capacitor should be connected between this pin and VSS. | | | |
| 4 | VCOMH | This is voltage output high level for common signals. A capacitor should be connected between this pin and VSS. | | | |
| 5 | VSL | This is a segment voltage reference pin. A capacitor should be connected between this pin and VSS. | | | |
| 6 | NC | No connection. | | | |
| 7 | IREF | This is a segment current reference pin. A resistor should be connected between this pin and VSS. | | | |
| 8 | VPP | Power supply for panel driving voltage. | | | |
| 9 | NC | No connection. | | | |
| 10 | VSS | Ground pin. | | | |
| 11 | VCL | This is a common voltage reference pin. This pin should be connected to VSS externally. | | | |
| 12 | VDD | Power supply for logic and input/output. | | | |
| 13 | IM0 | This is MPU interface mode select pin. | Low | Low | Low |
| 14 | IM1 | This is MPU interface mode select pin. | High | Low | High |
| 15 | VDD | Power supply for logic and input/output. | | | |
| 16 | IM2 | This is MPU interface mode select pin. | High | Low | Low |
| 17 | /CS | This pin is the chip select input. When CS = "L", then the chip select becomes active,and data/command I/O is enabled. | CS# | CS# | Low |
| 18 | /RES | This is a reset signal input pin. When RES is set to "L", the settings are initialized. | | | |
| 19 | A0 | This is the Data/Command control pin that determines whether the data bits are data or a command. A0 = "H": the inputs at D0 to D7 are treated as display data. A0 = "L": the inputs at D0 to D7 are transferred to the command registers. In $I^2C$ interface, this pin serves as SA0 to distinguish the different address of OLED driver. | A0 | A0 | SA0 |
| 20 | /WR | This is a MPU interface input pin. When connected to an 8080 MPU, this is active LOW. This pin connects to the 8080 MPU WR signal. The signals on the data bus are latched at the rising edge of | /WR | Low | Low |

| | | | | | |
|---|---|---|---|---|---|
| | | the WR signal. When connected to a 6800 Series MPU: This is the read/write control signal input terminal.<br>When R/W = "H": Read.<br>When R/W = "L": Write. | | | |
| 21 | /RD | This is a MPU interface input pin. When connected to an 8080 series MPU, it is active LOW. This pin is connected to the RD signal of the 8080 series MPU, and the data bus is in an output status when this signal is "L". When connected to a 6800 series MPU, this is active HIGH. This is used as an enable clock input of the 6800 series MPU. | /RD | Low | Low |
| 22 | D0 | | D0 | SCL | SCL |
| 23 | D1 | This is an 8-bit bi-directional data bus that connects to an 8-bit or 16-bit standard MPU data bus. When the serial interface is selected, then D0 serves as the serial clock input pad (SCL) and D1 serves as the serial data input pad (SI). At this time, D2 to D7 are set to high impedance. When the I$^2$C interface is selected, then D0 serves as the serial clock input pad (SCL) and D1 serves as the serial data input pad (SDA). At this time, D2 to D7 are set to high impedance. | D1 | SI | SDA |
| 24 | D2 | | D2 | Low | Low |
| 25 | D3 | | D3 | Low | Low |
| 26 | D4 | | D4 | Low | Low |
| 27 | D5 | | D5 | Low | Low |
| 28 | D6 | | D6 | Low | Low |
| 29 | D7 | | D7 | Low | Low |
| 30 | NC | No connection. | | | |
| 31 | VPP | Power supply for panel driving voltage. | | | |

**Note**

(1) Low is connected to VSS

(2) High is connected to VDD

## 8.4 GRAPHIC DISPLAY DATA RAM ADDRESS MAP



**RAM map example: ADC=0(POR)**

| Common output | | |
|---|---|---|
| | D=0 | D=1 |
| | 00H | 9fH |
| | 01H | 9eH |
| | 02H | 9dH |
| | 03H | 9cH |
| | 04H | 9bH |
| | 05H | 9aH |
| | 06H | 99H |
| | 07H | 98H |
| | 08H | 97H |
| | 09H | 96H |
| | 0aH | 95H |
| | 0bH | 94H |
| | 0cH | 93H |
| | 0dH | 92H |
| | 0eH | 91H |
| | 0fH | 90H |
| | ····· | ····· |
| | 9cH | 03H |
| | 9dH | 02H |
| | 9eH | 01H |
| | 9fH | 00H |

Display address: 00H, 01H, 02H, 03H, 04H, 05H, 06H, 07H, 08H, 09H, 0aH, 0bH, 0cH, 0dH, 0eH, 0fH, ····· , 9cH, 9dH, 9eH, 9fH

Segment output(ADC=1): Seg0, Seg1, Seg2, Seg3, Seg4, Seg5, Seg6, Seg7, Seg8, Seg9, Seg10, Seg11, Seg12, Seg13, Seg14, Seg15, ⋮, Seg152, Seg153, Seg154, Seg155, Seg156, Seg157, Seg158, Seg159

Page address

| D4 | D3 | D2 | D1 | D0 | | |
|----|----|----|----|----|---|---|
| 1 | 0 | 0 | 1 | 1 | D7–D0 | page19 |
| 1 | 0 | 0 | 1 | 0 | D7–D0 | page18 |
| 1 | 0 | 0 | 0 | 1 | D7–D0 | page17 |
| ⋮ | | | | | | ⋮ |
| 0 | 0 | 0 | 0 | 1 | D7–D0 | page1 |
| 0 | 0 | 0 | 0 | 0 | D7–D0 | page0 |

Column address: Column 0, Column 1, Column 2, Column 3, Column4, Column 5, Column 6, Column 7, Column 8, Column 9, Column 10, Column11, Column12, ····· , Column 157, Column 158, Column 159

**RAM map example: ADC=1(Seg remap)**

## 8.5 INTERFACE TIMING CHART

**System buses Read/Write characteristics 1 (For the 8080 Series Interface MPU)**
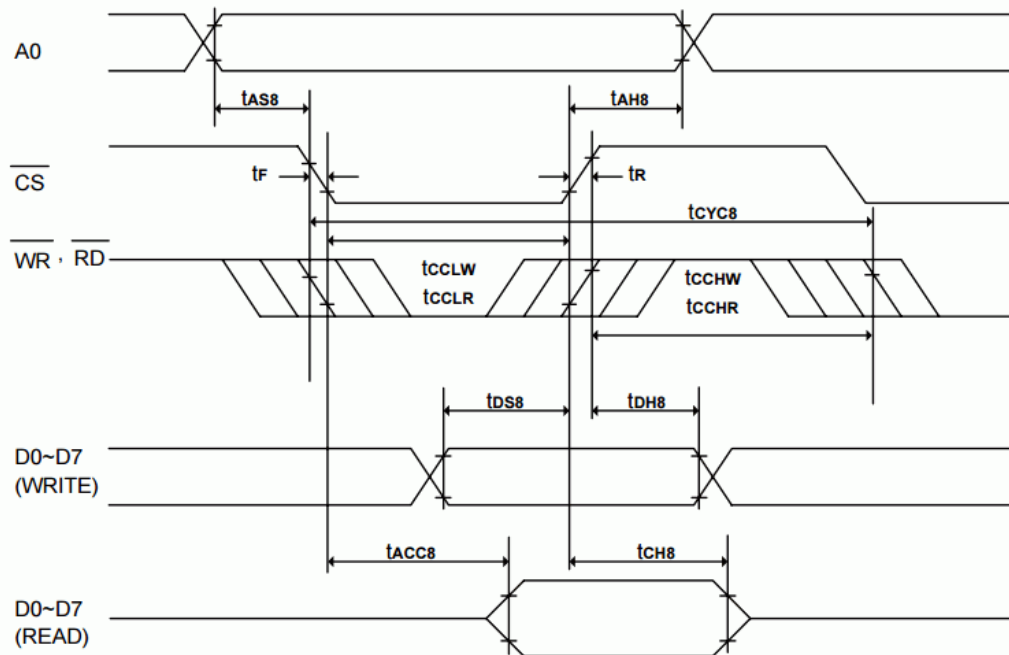


$(V_{DD} = 1.65V - 2.4V, T_A = +25°C)$

| Symbol | Parameter | Min. | Typ. | Max. | Unit | Condition |
|--------|-----------|------|------|------|------|-----------|
| $t_{CYC8}$ | System cycle time | 300 | - | - | ns | |
| $t_{AS8}$ | Address setup time | 0 | - | - | ns | |
| $t_{AH8}$ | Address hold time | 0 | - | - | ns | |
| $t_{DS8}$ | Data setup time | 40 | - | - | ns | |
| $t_{DH8}$ | Data hold time | 30 | - | - | ns | |
| $t_{CH8}$ | Output disable time | 10 | - | 70 | ns | $C_L = 100pF$ |
| $t_{ACC8}$ | $\overline{RD}$ access time | - | - | 280 | ns | $C_L = 100pF$ |
| $t_{CCLW}$ | Control L pulse width (WR) | 100 | - | - | ns | |
| $t_{CCLR}$ | Control L pulse width (RD) | 120 | - | - | ns | |
| $t_{CCHW}$ | Control H pulse width (WR) | 100 | - | - | ns | |
| $t_{CCHR}$ | Control H pulse width (RD) | 100 | - | - | ns | |
| $t_R$ | Rise time | - | - | 15 | ns | |
| $t_F$ | Fall time | - | - | 15 | ns | |

| Symbol | Parameter | Min. | Typ. | Max. | Unit | Condition |
|--------|-----------|------|------|------|------|-----------|
| t$_{CYC8}$ | System cycle time | 300 | - | - | ns | |
| t$_{AS8}$ | Address setup time | 0 | - | - | ns | |
| t$_{AH8}$ | Address hold time | 0 | - | - | ns | |
| t$_{DS8}$ | Data setup time | 40 | - | - | ns | |
| t$_{DH8}$ | Data hold time | 15 | - | - | ns | |
| t$_{CH8}$ | Output disable time | 10 | - | 70 | ns | C$_L$ = 100pF |
| t$_{ACC8}$ | $\overline{RD}$ access time | - | - | 140 | ns | C$_L$ = 100pF |
| t$_{CCLW}$ | Control L pulse width (WR) | 100 | - | - | ns | |
| t$_{CCLR}$ | Control L pulse width (RD) | 120 | - | - | ns | |
| t$_{CCHW}$ | Control H pulse width (WR) | 100 | - | - | ns | |
| t$_{CCHR}$ | Control H pulse width (RD) | 100 | - | - | ns | |
| t$_R$ | Rise time | - | - | 15 | ns | |
| t$_F$ | Fall time | - | - | 15 | ns | |

# 9. POWER ON / OFF SEQUENCE & APPLICATION CIRCUIT
## 9.1 POWER ON / OFF SEQUENCE

**Power on sequence:**

External power is being used immediately after turning on the power:

```
┌─────────────────────────────────────┐
│        VDD is off                    │
│   External power VPP is off          │
└─────────────────────────────────────┘
                  │
                  ▼
┌─────────────────────────────────────┐
│ Turn on the VDD and VPP power,       │
│ keep the RES pin="L"(>10us)          │
└─────────────────────────────────────┘
                  │
                  ▼
┌─────────────────────────────────────┐
│ Release the reset state (RES pin="H")│
│ Reset timing depends on SH1108 data  │
│ sheet                                │
└─────────────────────────────────────┘
                  │
                  ▼
┌─────────────────────────────────────┐
│     Initialized state(Default)       │
└─────────────────────────────────────┘
                  │
                  ▼
┌─────────────────────────────────────┐
│   Set up initial code (user setup)   │
└─────────────────────────────────────┘
                  │
                  ▼
┌─────────────────────────────────────┐
│     Clear internal RAM to "00H"      │
└─────────────────────────────────────┘
                  │
                  ▼
┌─────────────────────────────────────┐
│        Set display on: AFH           │
└─────────────────────────────────────┘
                  │  Wait 100ms
                  ▼
┌─────────────────────────────────────┐
│         Send display data            │
└─────────────────────────────────────┘
```

$t_{rpw}$=+/- no limit

Display on (AFH)

VDD

VPP

$t1$=min.10us

RESB        $t3$=about 100 ms

$t2$=min. 12us

COM/SEG

**Power off sequence：**



VDD

VPP

Display off (AEH)

t=100 ms

## 9.2 APPLICATION CIRCUIT
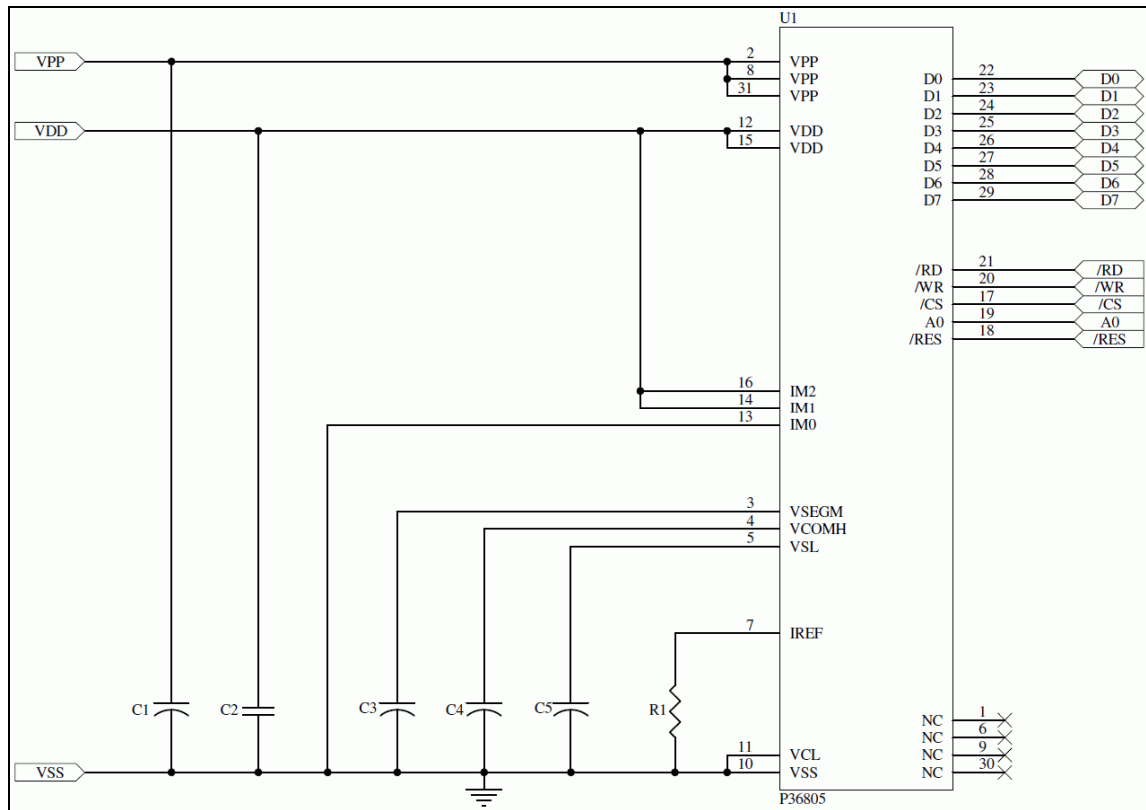


**Recommend components：**

C1 ,C3 ,C4, C5：4.7uF/25V VISHAY (572D475X0025A2T) or (Tantalum type)

C2：1uF/6.3V(0603)

R1: 750K ohm 1%(0603)

**This circuit is for 8080 8bits interface**

## 9.3 COMMAND TABLE

Refer to IC Spec.: SH1108G

# 10. RELIABILITY TEST CONDITIONS

| No. | Items | Specification | Quantity |
|---|---|---|---|
| 1 | High temp. (Non-operation) | 85℃, 240hrs | 5 |
| 2 | High temp. (Operation) | 70℃, 120hrs | 5 |
| 3 | Low temp. (Operation) | -40℃, 120hrs | 5 |
| 4 | High temp. / High humidity (Operation) | 65℃, 90%RH, 120hrs | 5 |
| 5 | Thermal shock (Non-operation) | -40℃ ~85℃ (-40℃ /30min; transit /3min; 85℃ /30min; transit /3min) 1cycle: 66min, 100 cycles | 5 |
| 6 | Vibration | Frequency : 5~50HZ, 0.5G<br>Scan rate : 1 oct/min<br>Time : 2 hrs/axis<br>Test axis : X, Y, Z | 1 Carton |
| 7 | Drop | Height: 120cm<br>Sequence : 1 angle、3 edges and 6 faces<br>Cycles: 1 | 1 Carton |
| 8 | ESD (Non-operation) | Air discharge model, ±8kV, 10 times | 5 |

**Test and measurement conditions**
1. All measurements shall not be started until the specimens attain to temperature stability.
2. The degradation of Polarizer are ignored for item 1, 4 & 5.

**Evaluation criteria**
1. The function test is OK.
2. No observable defects.
3. Luminance: > 50% of initial value.
4. Current consumption: within $\pm$ 50% of initial value.

## 12. PACKING SPECIFICATION

**TBD**

## 13. OUTGOING INSPECTION PROVISION

## 1. 抽樣方法 / SAMPLING METHOD

(1) MIL-STD-1916 / 驗證水準 level III / 正常檢驗 / 單次樣品檢驗
MIL-STD-1916 / inspection level III / normal inspection / single sample inspection

(2) 主要缺陷 Level III；次要缺陷 Level II
Major Level III ; Minor Level II

| 批量 | MIL-STD-1916 樣本代字對照表 驗證水準（VL） | | | | | | |
|---|---|---|---|---|---|---|---|
| | VII | VI | V | IV | III | II | I |
| 2～170 | A | A | A | A | A | A | A |
| 171～288 | A | A | A | A | A | A | B |
| 289～544 | A | A | A | A | A | B | C |
| 545～960 | A | A | A | A | B | C | D |
| 961～1632 | A | A | A | B | C | D | E |
| 1633～3072 | A | A | B | C | D | E | E |
| 3073～5440 | A | B | C | D | E | E | E |
| 5441～9216 | B | C | D | E | E | E | E |
| 9217～17408 | C | D | E | E | E | E | E |
| 17409～30720 | D | E | E | E | E | E | E |
| ≧30721 | E | E | E | E | E | E | E |

## 2. 檢驗條件 / INSPECTION CONDITION

**檢查和測量在下列條件下進行的，除非另有規定。**
The inspection and meaurement are performed under the following conditions, unless otherwise specified.

溫度 / Temperature: 25±5℃
濕度 / Humidity: 50±10%R.H.
壓力 / Pressure: 860~1060hPa (mbar)
檢驗員拿的面板和眼睛之間的距離 / Distance between the panel and eyes of the inspector≧30cm
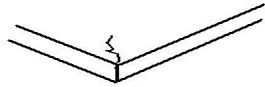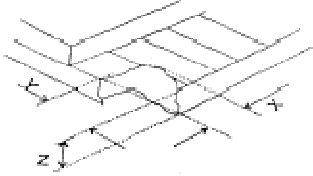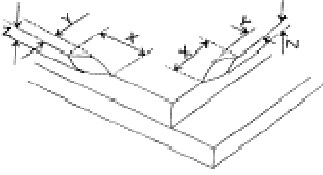
# 3. 品質檢驗規格 / SPECIFICATION FOR QUALITY CHECK

## 3.1 缺陷分類 / DEFECT CLASSIFICATION

| 嚴重度<br>Severity | 檢驗項目<br>Inspection Item | 缺陷<br>Defect | 備註<br>Remark |
|---|---|---|---|
| 主要缺陷<br>Major<br>Defect | 1. 面板<br>Panel | (1) 無顯示<br>Non-displaying | |
| | | (2) 線缺陷<br>Line defects | |
| | | (3) 故障<br>Malfunction | |
| | | (4) 玻璃破損<br>Glass cracked | |
| | 2. 軟板<br>Film | (1) 軟板尺寸超規<br>Film dimension out of<br>specification | 不能組裝<br>Can not be<br>assembled |
| | 3. 尺寸<br>Dimension | (1) 外形尺寸超規<br>Outline dimension out<br>of specification | |
| 次要缺陷<br>Minor<br>Defect | 1. 面板<br>Panel | (1) 玻璃刮傷<br>Glass scratch | 外觀缺陷<br>Appearance<br>defect |
| | | (2) 玻璃切割異常<br>Glass cutting NG | |
| | | (3) 玻璃崩邊、崩角<br>Glass chip | |
| | 2. 偏光板<br>Polarizer | (1) 偏光板刮傷<br>Polarizer scratch | |
| | | (2) 表面汙漬<br>Stains on surface | |
| | | (3) 偏光板氣泡<br>Polarizer bubbles | |
| | 3. 顯示<br>Displaying | (1) 暗點、亮點、髒污<br>Dim spot、Bright spot、dust | |
| | 4. 軟板<br>Film | (1) 損傷<br>Damage | |
| | | (2) 異物<br>Foreign material | |

## 3.2 出貨規格 / OUTGOING SPECIFICATION

| 項目<br>Item | 描述<br>Description | 標準<br>Criterion | | | 允收<br>水準<br>AQL |
|---|---|---|---|---|---|
| I. 面板<br>Panel | 1. 玻璃刮傷<br>Glass scratch | <table><tr><td>寬 / Width<br>(mm)<br>W</td><td>長 / Length<br>(mm)<br>L</td><td>容許個數<br>number of<br>pieces<br>permitted</td></tr><tr><td>W≦0.03</td><td>忽略<br>Ignore</td><td>忽略<br>Ignore</td></tr><tr><td>0.03< W≦0.05</td><td>L≦1</td><td>1</td></tr><tr><td>0.05< W</td><td>------</td><td>無<br>None</td></tr><tr><td>顯示區外<br>beyond A.A.</td><td>------</td><td>忽略<br>Ignore</td></tr></table> | | | 次要<br>Minor |
| | 2. 玻璃破損<br>Glass crack | (1) 裂紋 / Crack<br>擴展裂紋是不能接受的。<br>Propagation crack is not acceptable.<br><br> | | | 主要<br>Major |
| | 3. 玻璃崩邊、崩角<br>Glass chip | (1) 崩角 / Chip on corner<br><br><br><br>(2) 崩邊 / Chip on edge<br><br> | | | 次要<br>Minor |

| 項目<br>Item | 描述<br>Description | 標準<br>Criterion | | | | 允收水準<br>AQL |
|---|---|---|---|---|---|---|
| I. 面板<br>Panel | 3. 玻璃崩邊、崩角<br>Glass chip | **崩角<br>Chip on corner** | **Size (mm)** | **崩邊<br>Chip on edge** | **Size (mm)** | 次要<br>Minor |
| | | X | ≦1.5 | X | ≦3.0 | |
| | | Y | ≦2.0 | Y | ≦1.0 | |
| | | Z | ≦t | Z | ≦t | |
| | | 備註／Note:<br>1. t = 玻璃厚度<br>　t = glass thickness<br>2. 崩邊或崩角延伸到 ITO 導線是不能接受的。<br>　Chip on the corner extending into the ITO contact is not acceptable. | | | | |
| | 4. 尺寸<br>Dimension | 請參閱圖紙的規範。<br>Refer to the drawing of the spec | | | | 主要<br>Major |
| II. 偏光板<br>Polarizer | 1.刮傷<br>Scratch | 點狀按照"項目 II-3 偏光板氣泡"的標準。<br>Spot type in accordance with the criteria of "Item II-3. Polarizer bubble".<br>線狀按照"項目 I-1 玻璃刮傷"的標準。<br>Line type in accordance with the criteria of "Item I-1. Glass scratch". | | | | 次要<br>Minor |
| | 2. 表面汙漬<br>Stains on surface | 表面汙漬無法用軟布或類似的清潔物輕輕擦拭去除。<br>Stains cannot be removed even when wiped lightly with a soft cloth or similar cleaning. | | | | 次要<br>Minor |
| | 3. 偏光板氣泡<br>Polarizer bubble | (mm) | | | | 次要<br>Minor |
| | | **尺寸<br>Size** | | **容許個數<br>number of pieces permitted** | | |
| | | Φ≦0.2 | | 忽略<br>Ignore | | |
| | | 0.2＜Φ≦0.5 | | 2 | | |
| | | 0.5＜Φ | | 0 | | |
| | | 顯示區外<br>beyond A.A. | | 忽略<br>Ignore | | |

| 項目<br>Item | 描述<br>Description | 標準<br>Criterion | | 允收<br>水準<br>AQL |
|---|---|---|---|---|
| III. 顯示<br>Displaying | 1. 耗電<br>Power<br>consumption | 該模組的工作電流消耗不應超出產品規格書的規範。<br>The module operating current consumption should not go beyond the standard indicated in Product Specification | | 主要<br>Major |
| | 2. 像素尺寸<br>Pixel size | 顯示像素的尺寸的公差應規格的±25％之內。<br>The tolerance of display pixel dimension should be within ±25% of specification. | | 次要<br>Minor |
| | 3. 顏色<br>Color | 依據產品規格。<br>Refer to the product specification. | | 主要<br>Major |
| | 4. 亮度<br>Luminance | 依據產品規格。<br>Refer to the product specification. | | 主要<br>Major |
| | 5. 暗點、亮點 、髒污<br>Dimming spot、Lighting spot、Dust | 1. | | 次要<br>Minor |

For item 5, the criterion contains the following table:

| 平均直徑<br>Average diameter<br>D:(mm) | 容許個數<br>number of<br>pieces permitted |
|---|---|
| D ≦0.1 | 忽略<br>Ignore |
| 0.1 ＜ D ≦0.15 | 1 |
| 0.15＜ D ≦0.2 | 1 |
| 0.2 ＜ D | 0 |
| 顯示區外<br>beyond A.A. | 忽略<br>Ignore |

D=(長邊直徑 ＋ 短邊直徑)/2
D=(long diameter + short diameter)/2
像素暗點是不允許。
Pixel off is not allowed.

| 項目<br>Item | 描述<br>Description | 標準<br>Criterion | | | 允收<br>水準<br>AQL |
|---|---|---|---|---|---|
| III. 顯示<br>Displaying | 5. 暗點、亮點 、<br>髒污<br>Dimming<br>spot 、 Lighting<br>spot、Dust | 2.<br>寬<br>width(mm)<br>W | 長<br>length(mm)<br>L | 容許個數<br>number of<br>pieces<br>permitted | 次要<br>Minor |
| | | W≦0.03 | 忽略<br>Ignore | 忽略<br>Ignore | |
| | | 0.03< W≦0.05 | L≦1 | 3 | |
| | | 0.05< W | ------ | 無<br>None | |
| | | 顯示區外<br>beyond A.A. | ------ | 忽略<br>Ignore | |
| IV. 軟板<br>Film | 1. 尺寸<br>Dimension | 軟板尺寸超規。<br>Film dimension out of Spec. | | | 主要<br>Major |
| | 2. 損傷<br>Damage | 破損；深刮傷；深摺痕；深壓痕或其他損害是<br>不能接受的。<br>Crack; deep scratch; deep fold; deep<br>pressure mark or other damage is not<br>acceptable. | | | 次要<br>Minor |
| | 3. 異物<br>Foreign<br>material | 導電異物附著在導線，軟板和玻璃之間的異物<br>是不能接受的。<br>Conductive foreign material sticking to the<br>leads, foreign material between film and<br>glass are not acceptable. | | | 次要<br>Minor |

## 14. APPENDIXES

### APPENDIX 1: DEFINITIONS

### A. DEFINITION OF CHROMATICITY COORDINATE

The chromaticity coordinate is defined as the coordinate value on the CIE 1931 color chart for R, G, B, W.

### B. DEFINITION OF CONTRAST RATIO

The contrast ratio is defined as the following formula:

$$\text{Contrast Ratio} = \frac{\text{Luminance of all pixels on measurement}}{\text{Luminance of all pixels off measurement}}$$

### C. DEFINITION OF RESPONSE TIME

The definition of turn-on response time Tr is the time interval between a pixel reaching 10% of steady state luminance and 90% of steady state luminance. The definition of turn-off response time Tf is the time interval between a pixel reaching 90% of steady state luminance and 10% of steady state luminance. It is shown in Figure 2.
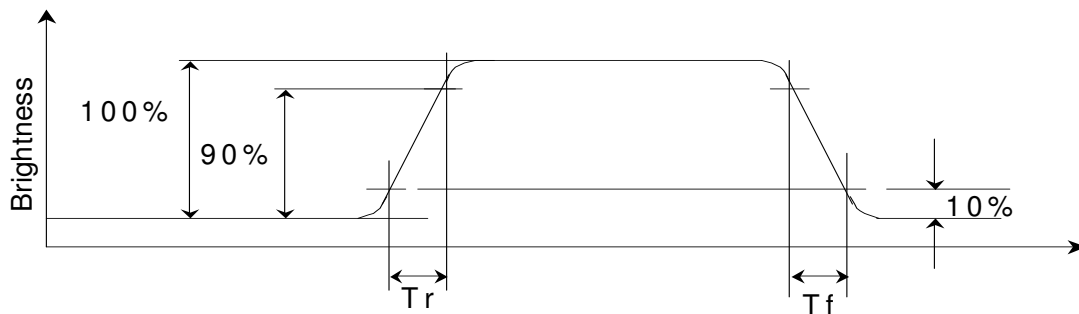


**Figure 2 Response time**

## D. DEFINITION OF VIEWING ANGLE

The viewing angle is defined as Figure 3. Horizontal and vertical (H & V) angles are determined for viewing directions where luminance varies by 50% of the perpendicular value.
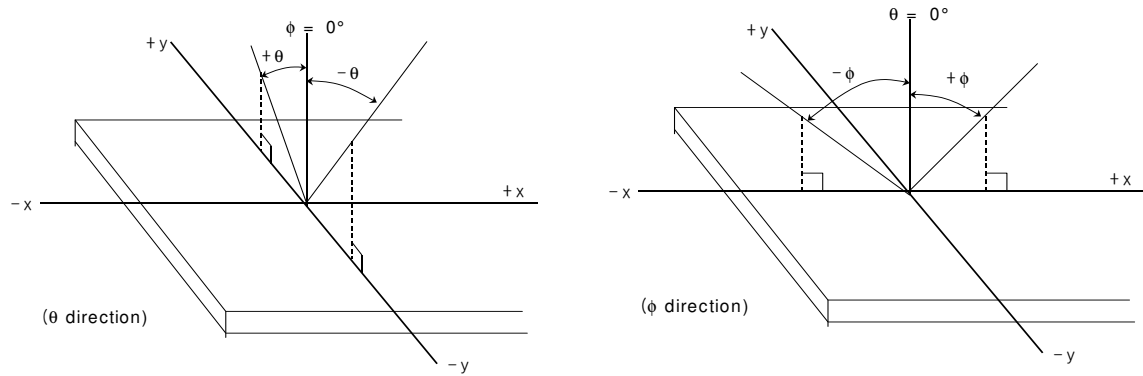
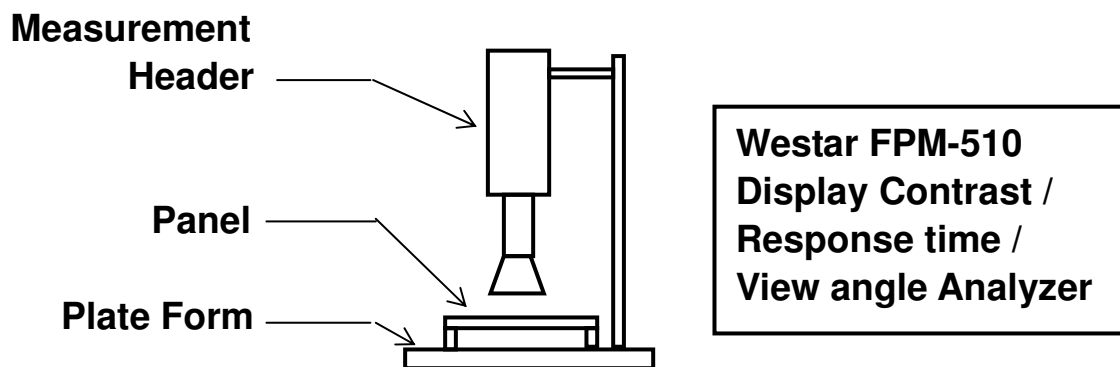**Figure 3 Viewing angle**

## APPENDIX 2: MEASUREMENT APPARATUS

### A. LUMINANCE/COLOR COORDINATE

PHOTO RESEARCH PR-670, MINOLTA CS-100

**Measurement**
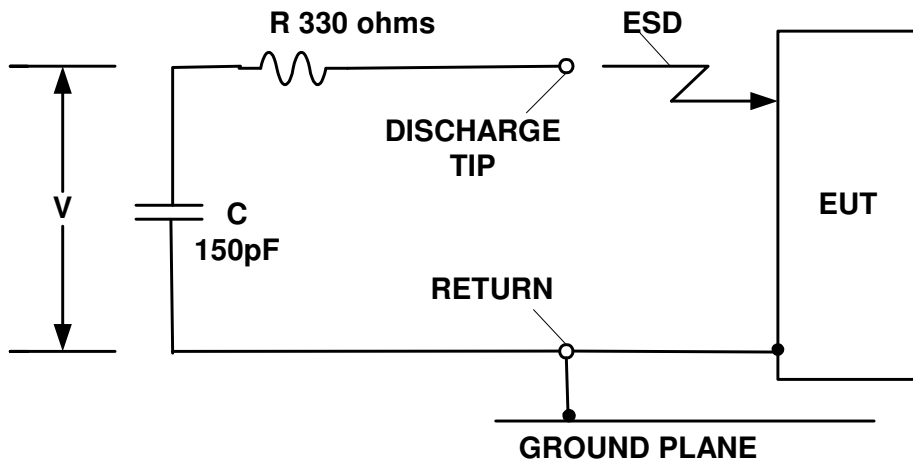**Header**

**Panel**

**Plate Form**

**PR-670** /
**MINOLTA CS-100**
**Color Analyzer**
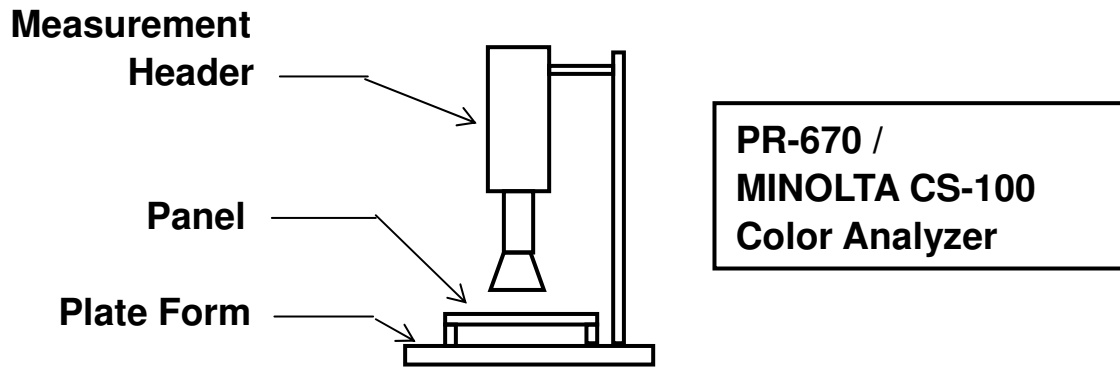
### B. CONTRAST / RESPONSE TIME / VIEWING ANGLE

WESTAR CORPORATION FPM-510

**Measurement**
**Header**

**Panel**

**Plate Form**

**Westar FPM-510**
**Display Contrast** /
**Response time** /
**View angle Analyzer**

## C. ESD ON AIR DISCHARGE MODE

R 330 ohms

ESD

DISCHARGE
TIP

V

C
150pF

EUT

RETURN

GROUND PLANE

# *Precautions for Handling*

1. When handling the module, wear powder-free anti static rubber finger cots/ anti-static clothing, anti-static gloves ,antistatic wrist strap and anti-static shoes
The environment should dispose the static elimination blower, anti-static pad, anti-static chair, and anti-static floor. The humidity maintains usually more than 40%



2. The OLED module is an electronic component and is subject to damage caused by Electro Static Discharge (ESD). And hence normal ESD precautions must be taken when handling it. Also, appropriate ESD protective environment must be administered and maintained in the production line. When handling and assembling the panel, wear an antistatic wrist strap with the alligator clip attached to the ground to prevent ESD damage on the panel. Antistatic wrist strap should touch human body directly instead of gloves. (See below photos).
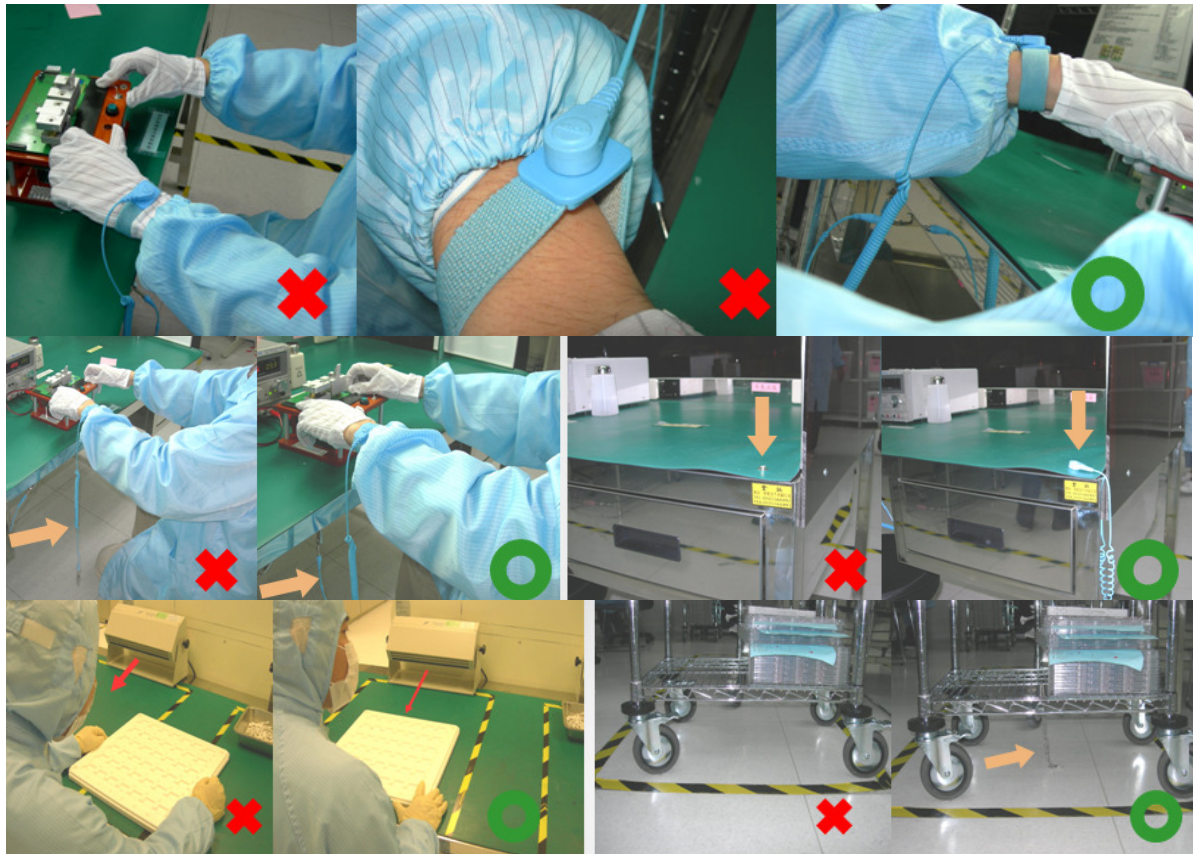
3. The OLED module is consisted of glass and film, and it should avoid pressure, strong impact, or being dropped from a high position.
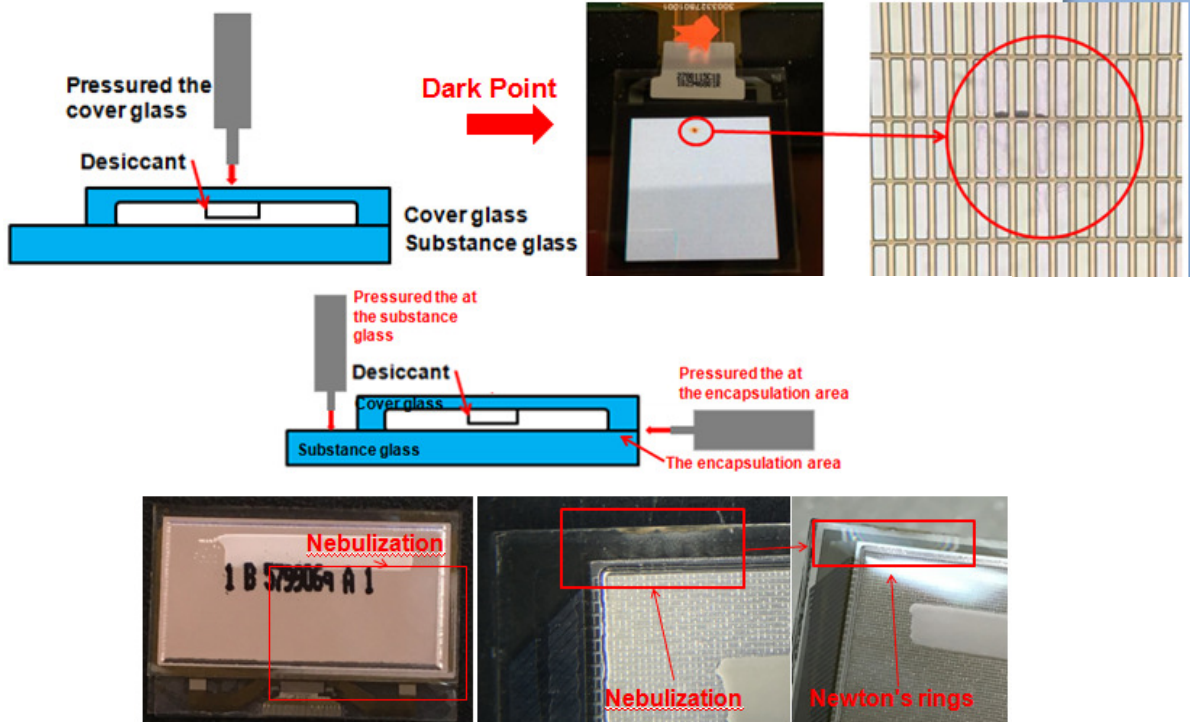
4. Take out the panel one by one from the holding trays for assembly, and never put the panel on top of another one to avoid the scratch.
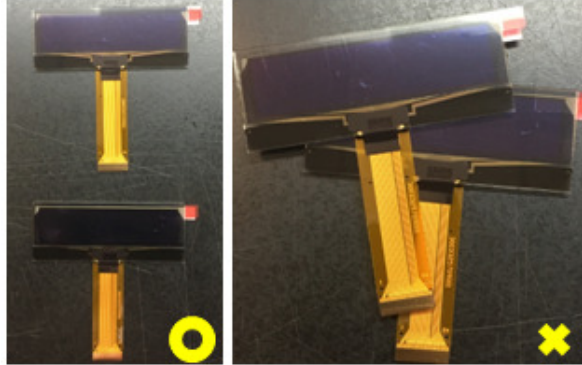


5. Avoid jerk and excessive bend on TAB/FPC/COF, and be careful not to let foreign matter or bezel damage the film.

6. When handling and assembling the module (panel + IC), grab the panel, not the TAB/FPC/COF.
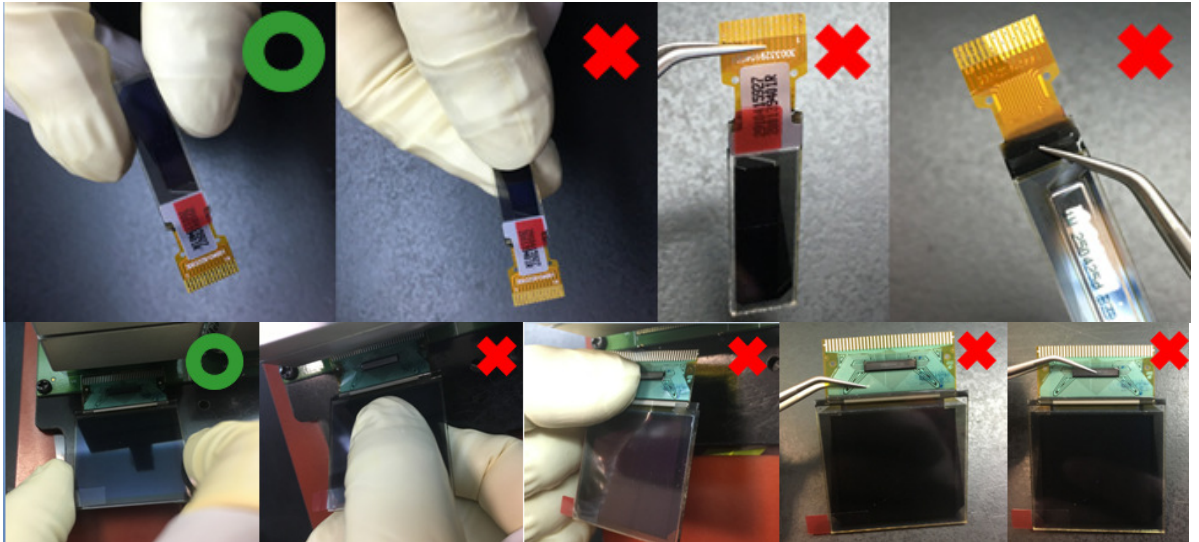


7. Use the tweezers to open the clicks on the connector of PCB before the insertion of FPC/COF, and click them back in. Once the FPC/COF sits properly in the connector, use the tweezers to avoid the damages.



NG Metal tweezers    NG sharp tweezers    OK flat tweezers

8. Please do not bend the film near the substrate glass. It could cause film peeling and TAB/FPC/COF damage. For TAB, It should bend the slit area as actual OLED it is. For FPC or COF, it is suggested to follow below pictures for instruction (distance between substrate glass and bending area >1.5mm; R>0.5mm).
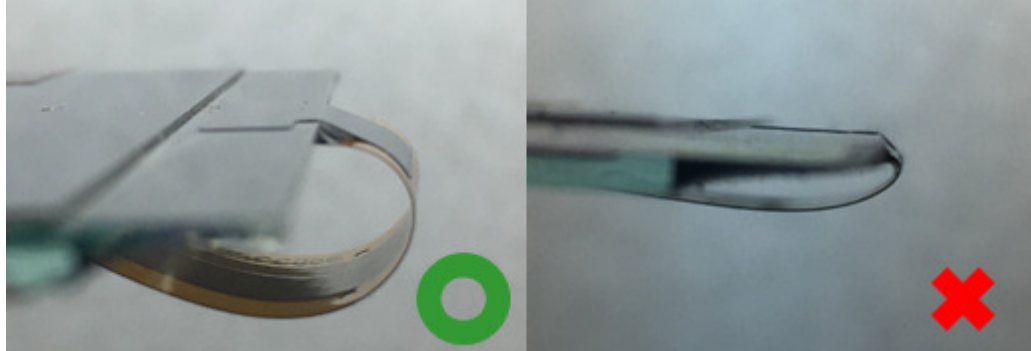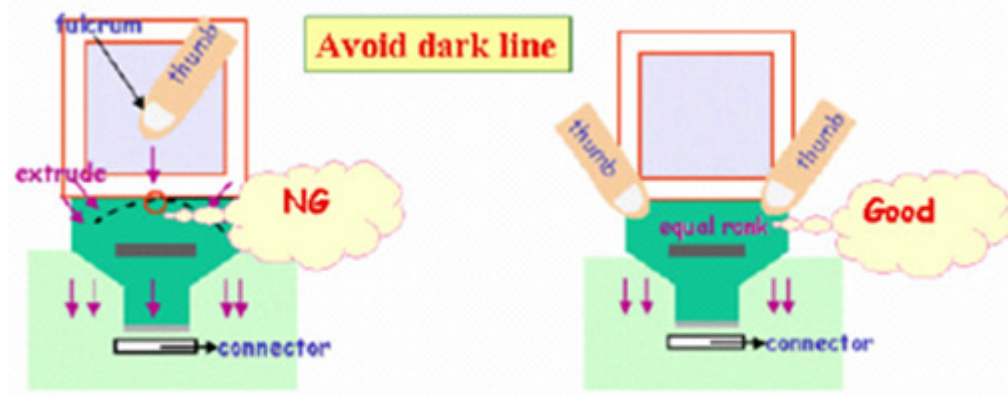


9. Avoid bending the film at IC bonding area. It could damage the IC ILB bonding. It should avoid bending the IC seal area. Please keep the bending distance >1.5mm.
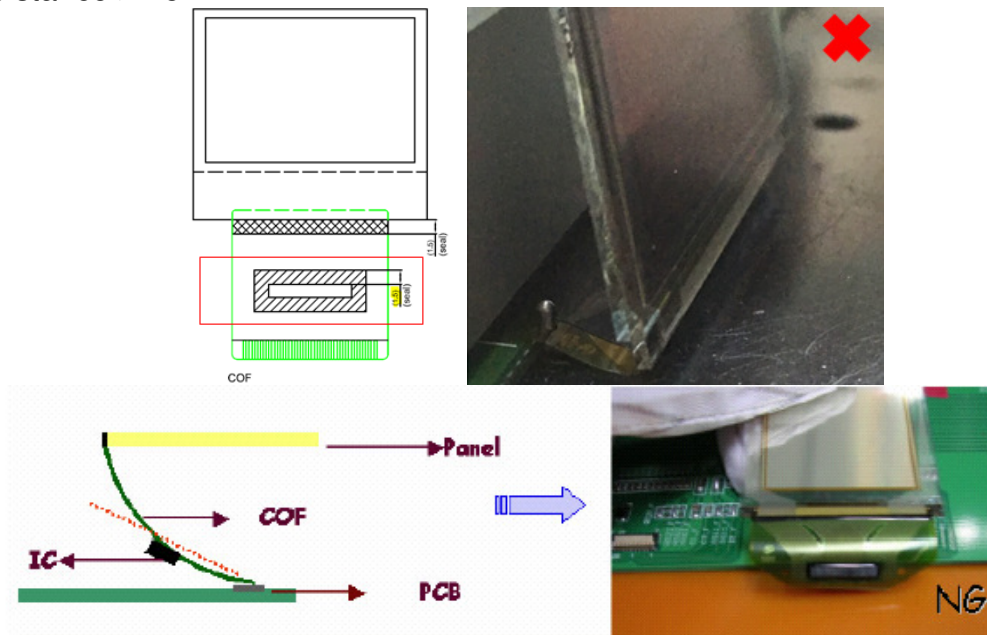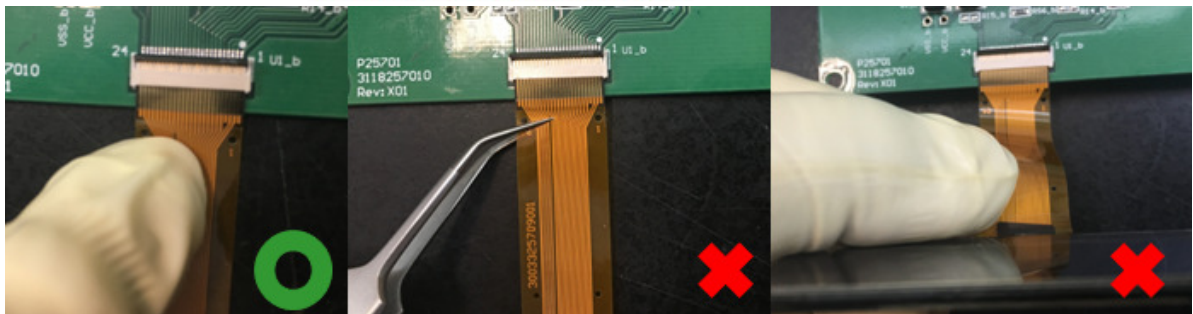
Use finger to insert COF /FPC into the connector when assembling the panel. Please refer to the photo.



**COF: Use both thumbs**



10. Do not wipe the pin of film and polarizer with the dry or hard materials that will damage the surface. When cleaning the display surface, use the soft cloth with solvent, IPA or alcohol, to clean.

11. Protection film is applied to the surface of OLED panel to avoid the scratch. Please remove the protective film before assembling it. If the OLED panel has been stored for a long time, the residue adhesive material of the protective film may remain on the display surface after remove the protective film. Please use the soft cloth with solvent, IPA or alcohol, to clean.

12. When hand or hot-bar soldering TAB/FPC onto PCB, make sure the temperature and timing profiles to meet the requirements of soldering specification (the specification depends on the application or optimized by customer) to prevent the damage of IC pins by inappropriate soldering, and also avoid the high temperature to damage the Organic light-emitting materials.
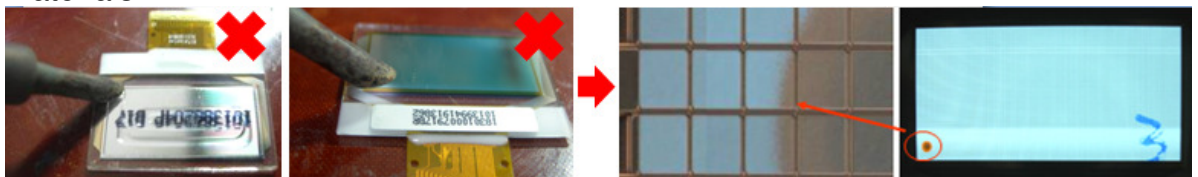
13. Solder residues arise from soldering process have to be cleaned up thoroughly before the module assembly.

14. Use the voltage and current settings listed in the specification to do the function test after the module assembly.

15. Suggestion for soldering process:
    i. TAB Lead- free soldering hot bar process
        1. Use pulse heated bonding tool equipment
        2. Material: Sn/Ag/Cu lead-free solder paste with typical 25um thickness on PCB pad. The TAB pin size and shape may be different, please base on the production line to adjust the thickness of PCB pad and temperature.S
        3. Bonding Force:--4kg per centimeter square as the starting point.
        4. Suggested bonding tool temperature & time profile is as below for reference. Since there are differences in TAB soldering pins, soldering technicians' skills, mechanism…etc., the soldering conditions must be adequately tuned.
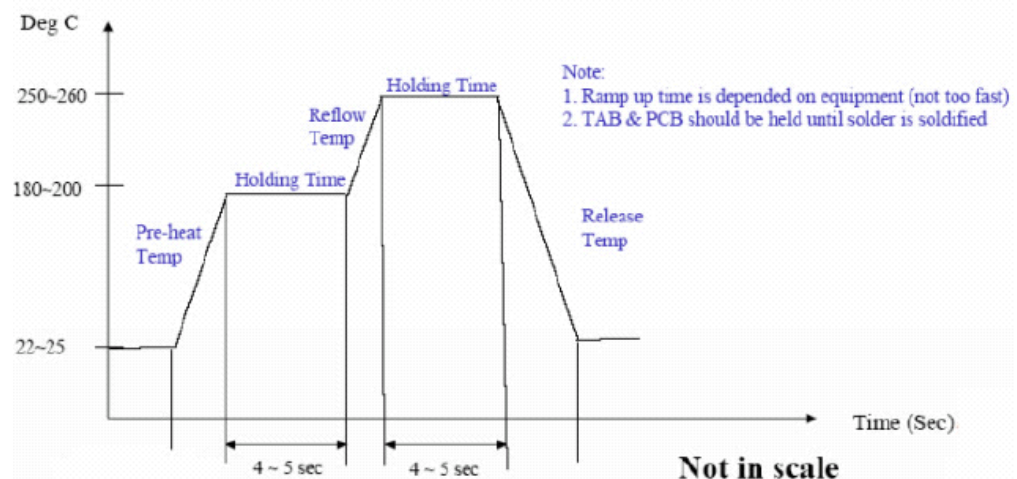


    ii. TAB Lead- free soldering wire process
       In case of manual soldering (Lead- free solder wire)
       1. Solder wire contact iron directly: 280±5°C at 3-5secs
       2. Solder wire contact TAB lead directly (near iron but not contact): 380±5 °C, 3-5secs
       3. Since there are differences in TAB soldering pins, soldering technicians' skills, mechanism…etc., the soldering conditions must be adequately tuned.
    iii. High temperature will result in rapid heat conduction to IC and might cause damage to IC, so please keep the temperature below 380°C. Also, avoid damaging the polyimide and solder resist which might take place at high temperatures. Refold cycles base on the de-soldering status, if the plating of pin was damaged, it can not be used again.

# *Precautions for Electrical*

## 1. Residual Image (Image Sticking)

The OLED is a self-emissive device. As with other self-emissive device or displays consisting of self-emissive pixels, when a static image frozen for a long period of time is changed to another one with all-pixels-on background, residual image or image sticking is noticed by the human eye. Image sticking is due to the luminance difference or contrast between the pixels that were previously turned on and the pixels that are newly turned on. Image sticking depends on the luminance decay curve of the display. The slower the decay, the less prominent the image sticking is. It is strongly recommended that the user employ the following four strategies to minimize image sticking.

1. Employ image scrolling or animation to even out the lit-on time of each and every pixel on the display, also could use sleeping mode for reduced the residual image and extend the power capacity.
2. Minimize the use of all-pixels-on or full white background in their application because when the panel is turned on full white, the image sticking from previously shown patterns is the most revealing. Black background is the best for power savings, greatest visibility, eye appealing, and dazzling displays.
3. Avoid displaying the characters or menu with high brightness level in a fix position for a long time or repeatedly. If necessary, using the auto fadeout technology.
4. If a static logo is used in the reliability test, change the pattern into its inverse (i.e., turn off the while pixels and turn on the previously unlit pixels) and freeze the inverse pattern as long as the original logo is used, so every pixel on the panel can be lit on for about the same time to minimize image sticking, caused by the differential turn-on time between the original and its reverse patterns.
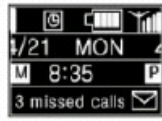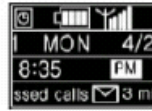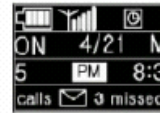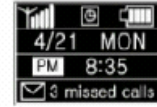


**Black Background**

## Scrolling example
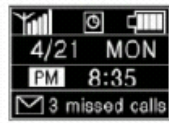


Frame1

Frame2

Frame3

Frame4

Frame5

Example: setup and start

```
comm_out2(0x26); // scrolling setup
comm_out2(0x08); // scrolling numbers/step
comm_out2(0x00); // start page
comm_out2(0x00); // scrolling step/frame
comm_out2(0x08); // end page
comm_out2(0x2F); // start
```
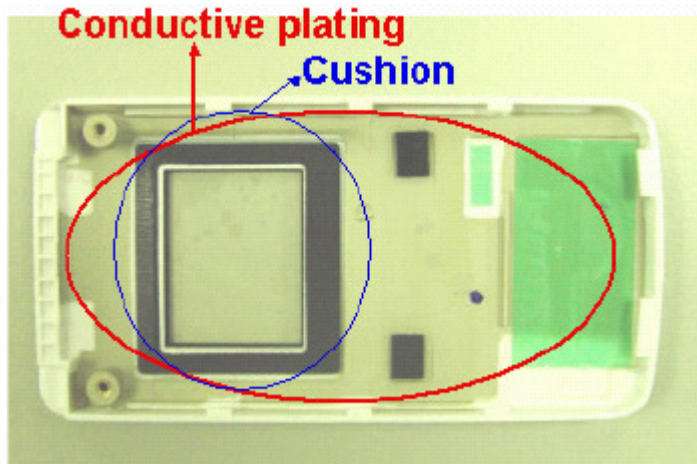
Example: stop

```
comm_out2(0x2E); //stop
```

# *Precautions for Mechanical*

**1. Cushion or Buffer tape on the cover glass**

    It is strongly recommended to have a cushion or buffer tape to apply on the panel backside and front side when assembling OLED panel into module to protect it from damage due to excessive extraneous forces.



    It is recommended that a plating conductive layer be used in the housing for EMI/EMC protection. And, the enough space should be reserved for the IC placement if the IC thickness is thicker than the TAB film when customer design the PCB.

**2. Avoid excessive bending of film when handling or designing the panel into the product**

    The bending of TAB/COF/FPC has to follow the precautions indicated in the specification, extra bending or excessive extraneous forces should be avoided to minimize the chances of film damage. If bending the film is necessary, please bend the designated bending area only. Please refer to items 8 and 9 of Precautions for Handling for more information.

# *Precautions for Storage and Reliability Test*

## 1. Storage

Store the packed cartons or packages at 25℃±5℃, 55%±10%RH. Do not store the OLED module under direct sunlight or UV light. For best panel performance, unpack the cartons and start the production of the panels within six months after the reception of them.

## 2. Reliability Test

TOPWIN only guarantees the reliability of the OLEDs under the test conditions and durations listed in the specification.