# Preliminary Specification

**PRODUCT NUMBER:** 9OL9937701000
**PRODUCT DESCRIPTION:** RGS13160160FR000

| CUSTOMER |
|---|
| |
| **APPROVED BY** |
| |
| **DATE:** |

| RITDISPLAY CORP. APPROVED |
|---|
| |

# REVISION RECORD

| REV. | REVISION DESCRIPTION | REV. DATE | REMARK |
|---|---|---|---|
| X01 | ■ INITIAL RELEASE | 2018. 02. 06 | |
| X02 | ■ Add the panel electrical specifications<br>■ Add the lifetime specifications<br>■ Add the application circuit | 2018. 05. 04 | Page 6, 7, 8, 9 & 16 |

# CONTENTS

## 1. SCOPE

The purpose of this specification is to define the general provisions and quality requirements that apply to the supply of display cells manufactured by RiTdisplay. This document, together with the Module Assembly Drawing, is the highest-level specification for this product. It describes the product, identifies supporting documents and contains specifications.

## 2. WARRANTY

RiTdisplay warrants that the products delivered pursuant to this specification (or order) will conform to the agreed specifications for twelve (12) months from the shipping date ("Warranty Period"). RiTdisplay is obligated to repair or replace the products which are found to be defective or inconsistent with the specifications during the Warranty Period without charge, on condition that the products are stored in the original packages at 25℃±5℃, 55%±10%RH or used as the conditions specified in the specifications.

Nevertheless, RiTdisplay is not obligated to repair or replace the products without charge if the defects or inconsistency are caused by the force majeure or the reckless behaviors of the customer.

After the Warranty Period, all repairs or replacements of the products are subject to charge.

## 3. FEATURES

- Small molecular organic light emitting diode.
- Color : 65K colors
- Panel resolution : 160x3x160
- Driver IC : SSD1333Z
- Excellent quick response time.
- Extremely thin thickness for best mechanism design : 1.22 mm
- High contrast : 2000:1
- Wide viewing angle : 160°
- Interface: 8 bits 6800/8080-series parallel Interface, 4 wire Serial Peripheral Interface.
- Wide range of operating temperature : -40 to 70℃

# 4. MECHANICAL DATA

| NO | ITEM | SPECIFICATION | UNIT |
|---|---|---|---|
| 1 | Dot Matrix | 160 x 3 x 160 | dot |
| 2 | Dot Size | 0.029 (W) x 0.123 (H) | $mm^2$ |
| 3 | Dot Pitch | 0.049 (W) x 0.147 (H) | $mm^2$ |
| 4 | Active Area | 23.5 (W) x 23.496 (H) | $mm^2$ |
| 5 | Panel Size | 28.7 (W) x 30.63 (H) | $mm^2$ |
| 6* | Panel Thickness | 1.22 ± 0.1 | mm |
| 7 | Module Size | 28.7 (W) x 45.63 (H) x 1.22 (T) | $mm^3$ |
| 8 | Diagonal A/A size | 1.31 | inch |
| 9 | Module Weight | TBD | gram |

* Panel thickness includes substrate glass, cover glass and UV glue thickness.

## 5. MAXIMUM RATINGS

| ITEM | MIN | MAX | UNIT | Condition | Remark |
|---|---|---|---|---|---|
| Supply Voltage ($V_{DD}$) | -0.3 | 4 | V | Ta = 25℃ | IC maximum rating |
| Supply Voltage (Vcc) | 8 | 19 | V | Ta = 25℃ | IC maximum rating |
| Operating Temp. | -40 | 70 | ℃ | - | - |
| Storage Temp | -40 | 85 | ℃ | - | 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℃.

## 6. ELECTRICAL CHARACTERISTICS

### 6.1 D.C ELECTRICAL CHARACTERISTICS

| SYMBOL | PARAMETER | TEST CONDITION | MIN | TYP | MAX | UNIT |
|---|---|---|---|---|---|---|
| $V_{CC}$ | Operating Voltage (for OLED panel) | Ta = 25℃ | 16.5 | 17 | 17.5 | V |
| $V_{DD}$ | Digital power supply | Ta = 25℃ | 1.65 | 1.8 | 3.5 | V |
| $V_{OH}$ | High Logic Output Level | $I_{OUT}$ = 100uA, 10MHz | 0.9* $V_{DD}$ | - | $V_{DD}$ | V |
| $V_{OL}$ | Low Logic Output Level | $I_{OUT}$ = 100uA, 10MHz | 0 | - | 0.1*$V_{DD}$ | V |
| $V_{IH}$ | High Logic Input Level | - | 0.8* $V_{DD}$ | - | $V_{DD}$ | V |
| $V_{IL}$ | Low Logic Input Level | - | 0 | - | 0.2*$V_{DD}$ | V |

Note: The $V_{CC}$ 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 (ICC) | - | 36 | 38 | mA | All pixels on (1) |
| | - | 8 | 9 | mA | 20% pixels on (1) |
| Standby mode current (ICC) | - | 2 | 3 | mA | Standby mode 10% pixels on (2) |
| Normal mode power consumption | - | 612 | 646 | mW | All pixels on (1) |
| | - | 136 | 153 | mW | 20% pixels on (1) |
| Standby mode power consumption | - | 34 | 51 | mW | Standby mode 10% pixels on (2) |
| IDD sleep mode current | - | - | 10 | uA | Sleep mode Current (3) |
| ICC sleep mode current | - | - | 10 | uA | Sleep mode Current (3) |
| Normal Luminance | 80 | 100 | - | cd/m$^2$ | Display Average |
| Standby Luminance | - | 20 | - | cd/m$^2$ | |
| CIEx(White) | 0.27 | 0.32 | 0.37 | | x, y (CIE 1931) |
| CIEy(White) | 0.30 | 0.35 | 0.40 | | |
| CIEx(Red) | 0.57 | 0.62 | 0.67 | | |
| CIEy(Red) | 0.30 | 0.35 | 0.40 | | |
| CIEx(Green) | 0.28 | 0.33 | 0.38 | | |
| CIEy(Green) | 0.51 | 0.56 | 0.61 | | |
| CIEx(Blue) | 0.09 | 0.14 | 0.19 | | |
| CIEy(Blue) | 0.07 | 0.12 | 0.17 | | |
| Dark Room Contrast | 2000:1 | | | | |
| Viewing Angle | 160 | | | degree | |
| Response Time | | 10 | | μs | |

Note:

(1) Normal mode condition :

- Driving Voltage(VCC) : 17V
- Master contrast setting : 0x0f
- Red contrast setting : 0x21
- Green contrast setting : 0x21
- Blue contrast setting : 0x21
- Frame rate : 105Hz
- Duty setting : 1/160

(2) Standby mode condition :

- Driving Voltage(VCC) : 17V
- Master contrast setting : 0x0f
- Red contrast setting : 0x0a

- Green contrast setting : 0x0a
- Blue contrast setting : 0x0a
- Frame rate : 105Hz
- Duty setting : 1/160

(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 | 100 cd/m$^2$, 50% alternating checkerboard | Note (1) |
| Life Time | 12,000 | Hrs | 80 cd/m$^2$, 50% alternating checkerboard | Note (2) |

Note:

(A) Under Vcc = 17V

(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 100 cd/m$^2$ :

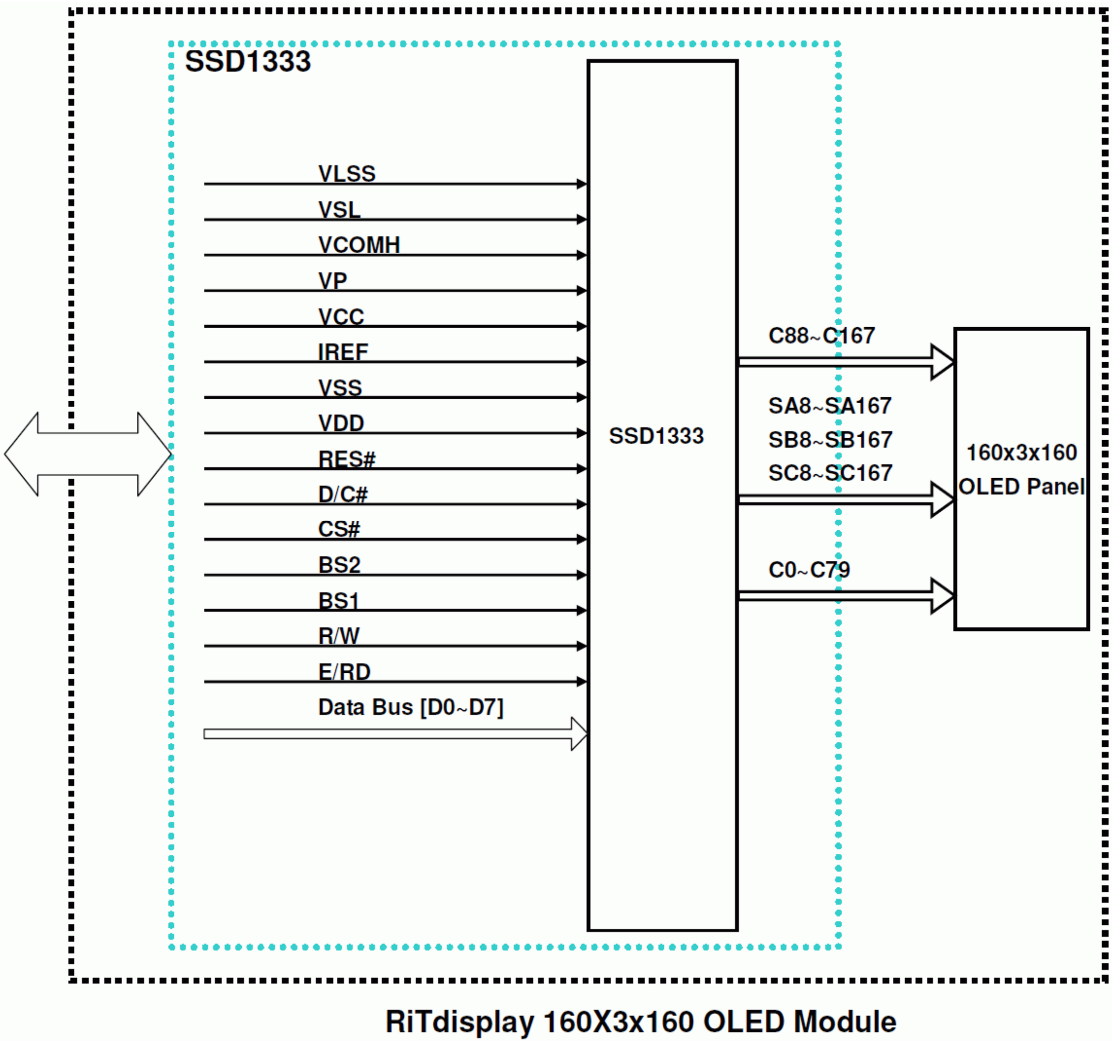
- Master contrast setting : 0x0f
- Red contrast setting : 0x21
- Green contrast setting : 0x21
- Blue contrast setting : 0x21
- Frame rate : 105Hz
- Duty setting : 1/160

(2) Setting of 80 cd/m$^2$ :

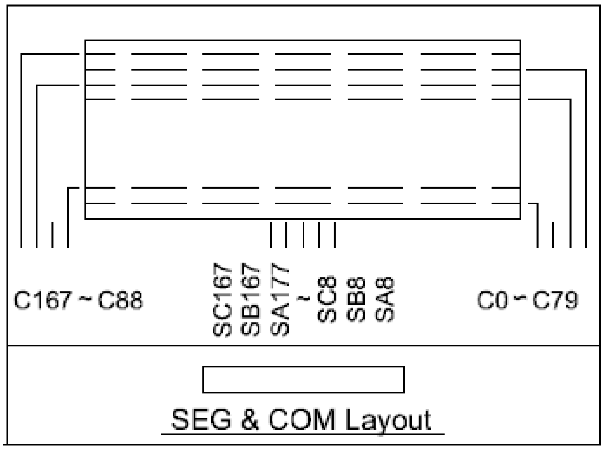
- Master contrast setting : 0x0b
- Red contrast setting : 0x1c
- Green contrast setting : 0x1c
- Blue contrast setting : 0x1c
- Frame rate : 105Hz
- Duty setting : 1/160

# 8. INTERFACE

## 8.1 FUNCTION BLOCK DIAGRAM



## 8.2 PANEL LAYOUT DIAGRAM



## 8.3 PIN ASSIGNMENTS

| Pin No. | Pin Name | Description | Setting at each interface | | |
|---|---|---|---|---|---|
| | | | 8080 parallel | SPI | IIC |
| 1 | VLSS | Analog system ground pin. | | | |
| 2 | VSL | This is segment voltage reference pin. | | | |
| 3 | VCOMH | COM signal deselected voltage level. A capacitor should be connected between this pin and VSS. | | | |
| 4 | VP | This pin is the segment pre-charge voltage reference pin. | | | |
| 5 | VCC | Power supply for panel driving voltage. | | | |
| 6 | IREF | This is an internal voltage reference pin. A capacitor should be connected to this pin and VSS. | | | |
| 7 | VSS | Ground pin. | | | |
| 8 | VDD | Power supply pin for core logic operation. | | | |
| 9 | RES# | This is a reset signal input. Low active. | | | |
| 10 | D/C# | This pin is Data/Command control pin | D/C# | D/C# | NA |
| 11 | CS# | This pin is the chip select input. Low active. | CS# | CS# | NA |
| 12 | BS2 | MCU bus interface selection pins. | High | Low | NA |
| 13 | BS1 | | High | Low | NA |
| 14 | R/W | This pin is read / write control input pin connecting to the MCU interface.<br>8080: data write enable pin; 6800:Read/Write select pin. | R/W | Tie LOW | NA |
| 15 | E/RD | 8080: data read enable pin; 6800:Read/Write enable pin.When serial interface is selected, this pin must be connected to VSS. | E/RD | Tie LOW | NA |
| 16 | D0 | These pins are bi-directional data bus connecting to the MCU data bus.<br>When serial interface mode is selected, D2, D1 should be tied together as the serial data input: SDIN, and D0 will be the serial clock input: SCLK. | D0 | SCLK | NA |
| 17 | D1 | | D1 | SDIN | NA |
| 18 | D2 | | D2 | SDIN | NA |
| 19 | D3 | | D3 | Tie LOW | NA |
| 20 | D4 | | D4 | Tie LOW | NA |
| 21 | D5 | | D5 | Tie LOW | NA |
| 22 | D6 | | D6 | Tie LOW | NA |
| 23 | D7 | | D7 | Tie LOW | NA |

| | | | | | |
|---|---|---|---|---|---|
| 24 | VSS | Ground pin. | | | |
| 25 | VDD | Power supply pin for core logic operation. | | | |
| 26 | VCC | Power supply for panel driving voltage. | | | |
| 27 | VP | This pin is the segment pre-charge voltage reference pin. | | | |
| 28 | VCOMH | COM signal deselected voltage level.<br>A capacitor should be connected between this pin and VSS. | | | |
| 29 | VSL | This is segment voltage reference pin. | | | |
| 30 | VLSS | Analog system ground pin. | | | |

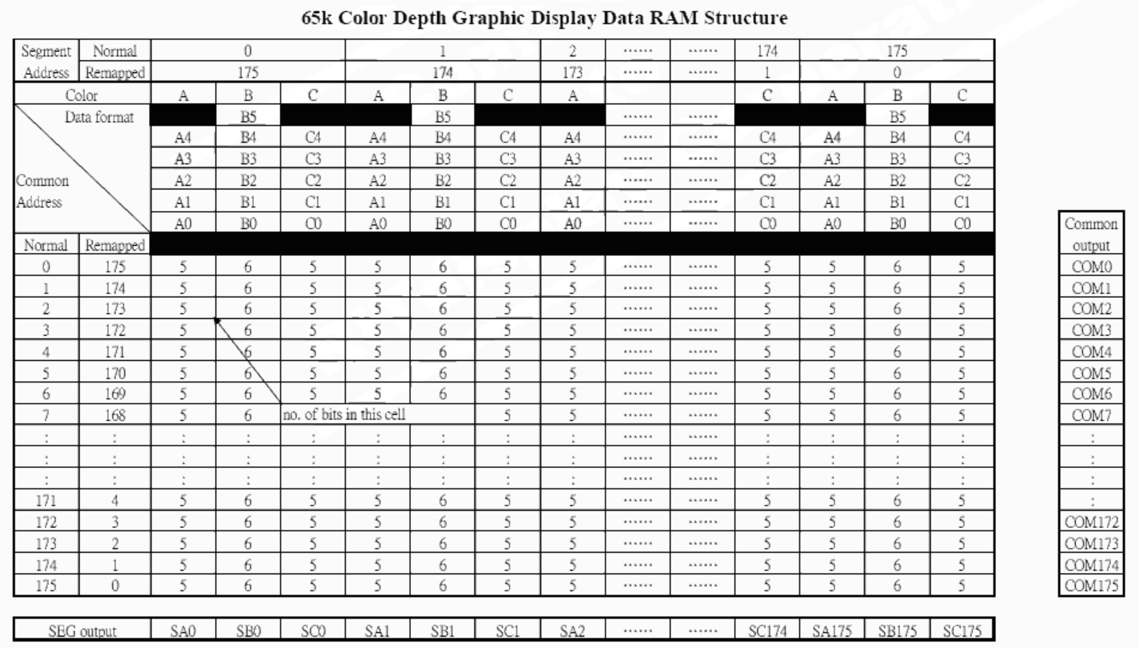
**Note**

(1) Low is connected to VSS

(2) High is connected to VDD

## 8.4 GRAPHIC DISPLAY DATA RAM ADDRESS MAP

The GDDRAM is a bit mapped static RAM holding the pattern to be displayed. The RAM size is 176 x 176 x16bits. For mechanical flexibility, re-mapping on both Segment and Common outputs can be selected by software. Each pixel has 16-bit data. Sub-pixels for color A, C have 5 bits and B have 6 bits. The arrangement of data pixel in graphic display data RAM is shown below figures.



**65k Color Depth Graphic Display Data RAM Structure**

| Segment Address | Normal | 0 | | | 1 | | | 2 | …… | …… | 174 | 175 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Remapped | 175 | | | 174 | | | 173 | …… | …… | 1 | 0 | | | |
| Color | | A | B | C | A | B | C | A | | | C | A | B | C | |
| Data format | | ■ | B5 | ■ | ■ | B5 | ■ | ■ | …… | …… | ■ | ■ | B5 | ■ | |
| | | A4 | B4 | C4 | A4 | B4 | C4 | A4 | …… | …… | C4 | A4 | B4 | C4 | |
| | | A3 | B3 | C3 | A3 | B3 | C3 | A3 | …… | …… | C3 | A3 | B3 | C3 | |
| Common | | A2 | B2 | C2 | A2 | B2 | C2 | A2 | …… | …… | C2 | A2 | B2 | C2 | |
| Address | | A1 | B1 | C1 | A1 | B1 | C1 | A1 | …… | …… | C1 | A1 | B1 | C1 | |
| | | A0 | B0 | C0 | A0 | B0 | C0 | A0 | …… | …… | C0 | A0 | B0 | C0 | Common output |
| Normal | Remapped | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | |
| 0 | 175 | 5 | 6 | 5 | 5 | 6 | 5 | 5 | …… | …… | 5 | 5 | 6 | 5 | COM0 |
| 1 | 174 | 5 | 6 | 5 | 5 | 6 | 5 | 5 | …… | …… | 5 | 5 | 6 | 5 | COM1 |
| 2 | 173 | 5 | 6 | 5 | 5 | 6 | 5 | 5 | …… | …… | 5 | 5 | 6 | 5 | COM2 |
| 3 | 172 | 5 | 6 | 5 | 5 | 6 | 5 | 5 | …… | …… | 5 | 5 | 6 | 5 | COM3 |
| 4 | 171 | 5 | 6 | 5 | 5 | 6 | 5 | 5 | …… | …… | 5 | 5 | 6 | 5 | COM4 |
| 5 | 170 | 5 | 6 | 5 | 5 | 6 | 5 | 5 | …… | …… | 5 | 5 | 6 | 5 | COM5 |
| 6 | 169 | 5 | 6 | 5 | 5 | 6 | 5 | 5 | …… | …… | 5 | 5 | 6 | 5 | COM6 |
| 7 | 168 | 5 | 6 | no. of bits in this cell | | | 5 | 5 | …… | …… | 5 | 5 | 6 | 5 | COM7 |
| : | : | : | : | : | : | : | : | : | …… | …… | : | : | : | : | : |
| : | : | : | : | : | : | : | : | : | …… | …… | : | : | : | : | : |
| : | : | : | : | : | : | : | : | : | …… | …… | : | : | : | : | : |
| 171 | 4 | 5 | 6 | 5 | 5 | 6 | 5 | 5 | …… | …… | 5 | 5 | 6 | 5 | : |
| 172 | 3 | 5 | 6 | 5 | 5 | 6 | 5 | 5 | …… | …… | 5 | 5 | 6 | 5 | COM172 |
| 173 | 2 | 5 | 6 | 5 | 5 | 6 | 5 | 5 | …… | …… | 5 | 5 | 6 | 5 | COM173 |
| 174 | 1 | 5 | 6 | 5 | 5 | 6 | 5 | 5 | …… | …… | 5 | 5 | 6 | 5 | COM174 |
| 175 | 0 | 5 | 6 | 5 | 5 | 6 | 5 | 5 | …… | …… | 5 | 5 | 6 | 5 | COM175 |

| SEG output | SA0 | SB0 | SC0 | SA1 | SB1 | SC1 | SA2 | …… | …… | SC174 | SA175 | SB175 | SC175 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|

## 8.5 INTERFACE TIMING CHART

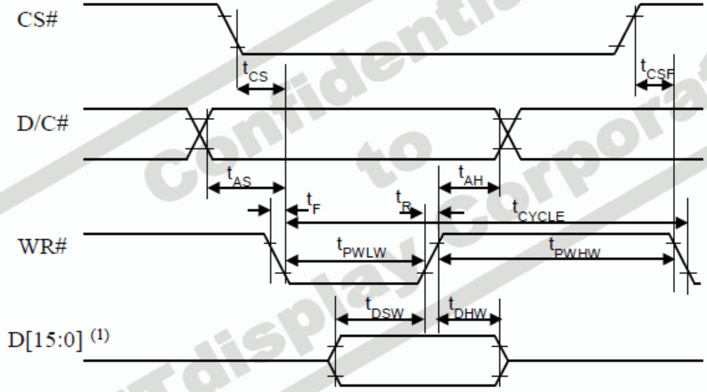
**8080-Series MCU Parallel Interface Timing Characteristics**

($V_{DD}$- $V_{SS}$ =1.65V to 3.5V, $T_A$ = 25°C)

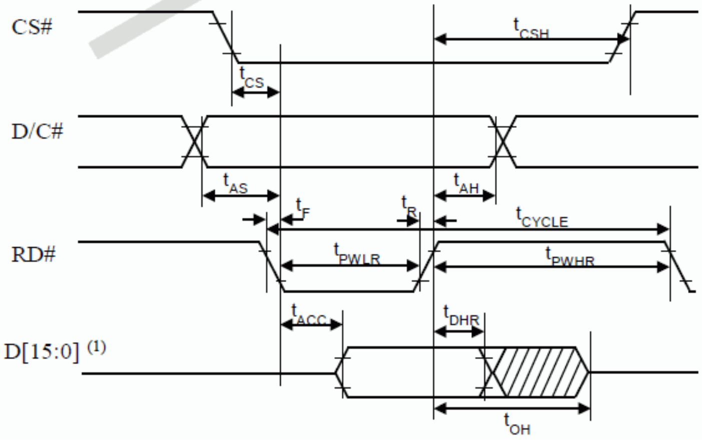
| Symbol | Parameter | Min | Typ | Max | Unit |
|---|---|---|---|---|---|
| $t_{CYCLE}$ | Clock Cycle Time (write) | 300 | - | - | ns |
| $t_{AS}$ | Address Setup Time | 10 | - | - | ns |
| $t_{AH}$ | Address Hold Time | 0 | - | - | ns |
| $t_{DSW}$ | Write Data Setup Time | 40 | - | - | ns |
| $t_{DHW}$ | Write Data Hold Time | 7 | - | - | ns |
| $t_{DHR}$ | Read Data Hold Time | 20 | - | - | ns |
| $t_{OH}$ | Output Disable Time | - | - | 46 | ns |
| $t_{ACC}$ | Access Time | - | - | 140 | ns |
| $t_{PWLR}$ | Read Low Time | 150 | - | - | ns |
| $t_{PWLW}$ | Write Low Time | 60 | - | - | ns |
| $t_{PWHR}$ | Read High Time | 60 | - | - | ns |
| $t_{PWHW}$ | Write High Time | 60 | - | - | ns |
| $t_R$ | Rise Time | - | - | 15 | ns |
| $t_F$ | Fall Time | - | - | 15 | ns |
| $t_{CS}$ | Chip select setup time | 0 | - | - | ns |
| $t_{CSH}$ | Chip select hold time to read signal | 0 | - | - | ns |
| $t_{CSF}$ | Chip select hold time | 20 | - | - | ns |

**8080-series MCU parallel interface characteristics**

Write cycle



Read cycle



**Note**

(1) when 8 bit used: D[7:0] instead; when 16 bit used: [15:0] instead.

# 9. POWER ON / OFF SEQUENCE & APPLICATION CIRCUIT

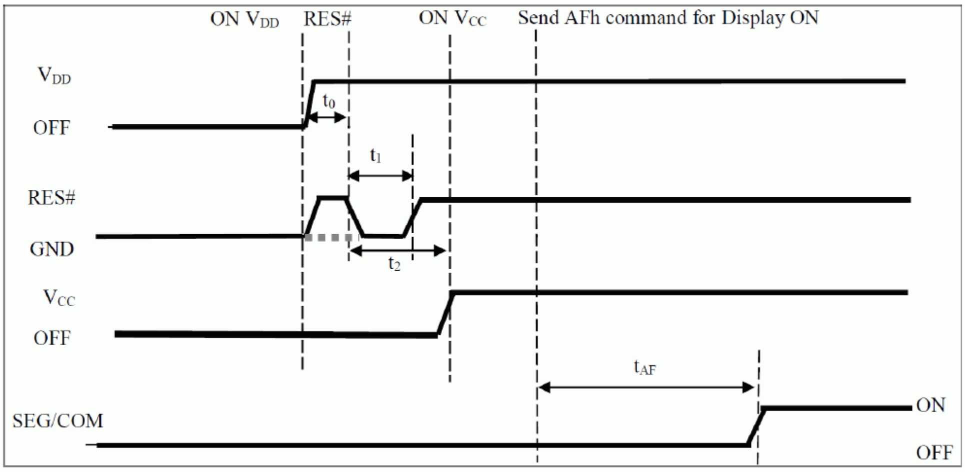
## 9.1 POWER ON / OFF SEQUENCE

The following figures illustrate the recommended power ON and power OFF sequence of SSD1333.

*Power ON sequence*:

1. Power ON VDD
2. After VDD become stable, wait at least 20ms ($t_0$), set RES# pin LOW (logic low) for at least 3us ($t_1$)(4) and then HIGH (logic high).
3. After set RES# pin LOW (logic low), wait for at least 3us ($t_2$). Then Power ON VCC.(1)
4. After VCC become stable, send command AFh for display ON. SEG/COM will be ON after 100ms($t_{AF}$).

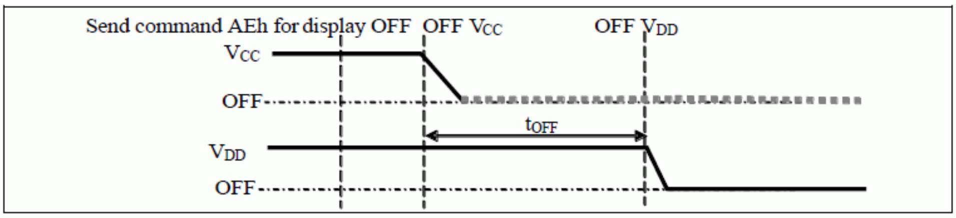
The Power ON sequence



*Power OFF sequence*:

1. Send command AEh for display OFF.
2. Power OFF VCC.(1), (2)
3. Power OFF VDD after $t_{OFF}$.(4) (where Minimum $t_{OFF}$=80ms, typical $t_{OFF}$=100ms)

The Power OFF sequence



**Note:**

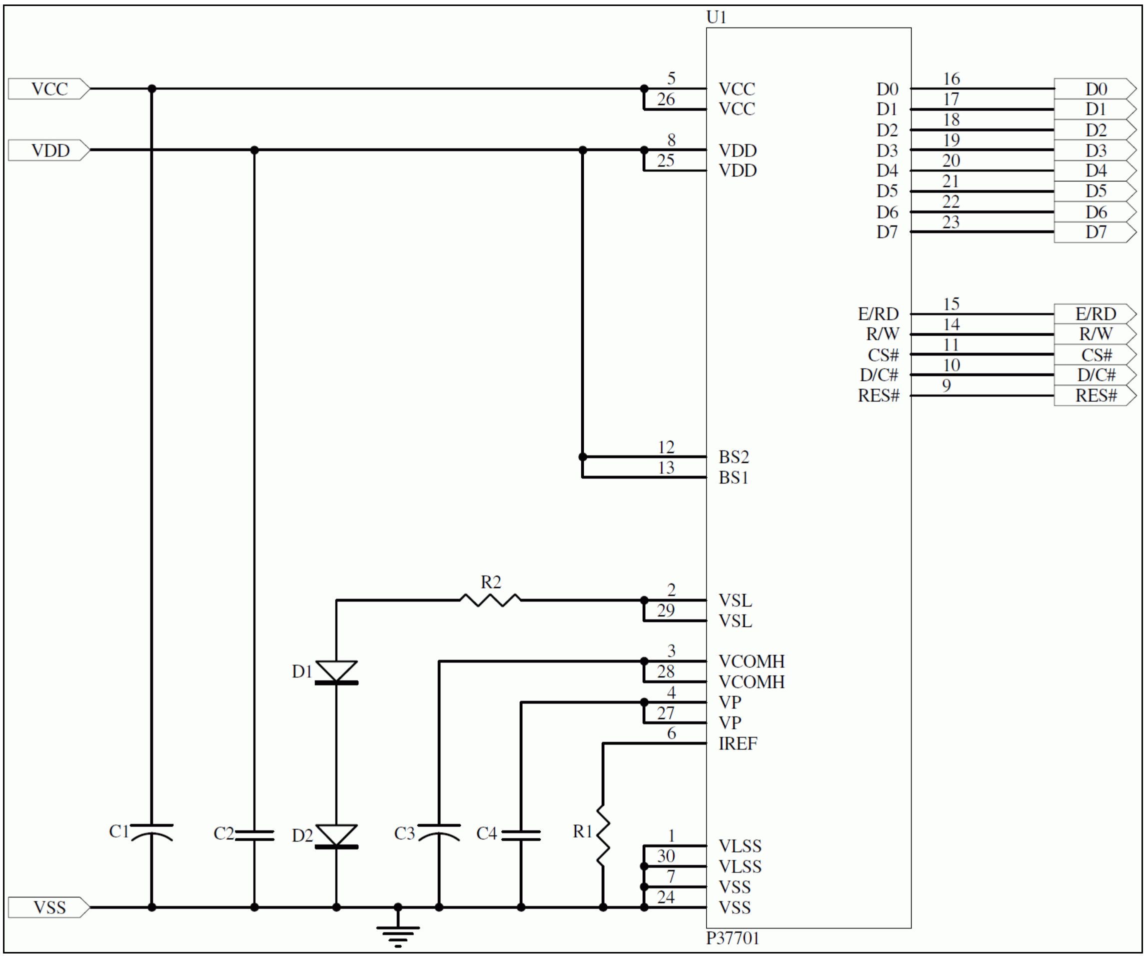
(1)$V_{CC}$ should be kept float (i.e. disable) when it is OFF.

(2) Power Pins ($V_{DD}$, $V_{CC}$) can never be pulled to ground under any circumstance.

(3) The register values are reset after $t_1$.

(4) $V_{DD}$ should not be Power OFF before $V_{CC}$ Power OFF.

## 9.2 APPLICATION CIRCUIT



**Recommend components:**

C1 : 4.7uF/25V(0805)

C3 : 4.7uF/25V (Tantalum type) or VISHAY (572D475X0025A2T)

C2, C4 : 1uF/16V(0603)

R1 : 1M ohm (0603) 1%

R2 : 49.9 ohm 1/4W

D1, D2 : RB480K (ROHM)

**This circuit is for 8080 8bit interface.**

## 9.3 COMMAND TABLE

Refer to IC Spec.: SSD1333

## 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, 96hrs | 5 |
| 5 | Thermal shock (Non-operation) | -40℃ ~85℃ (-40℃ /30min; transit /3min; 85℃ /30min; transit /3min) 1cycle: 66min, 20 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 |

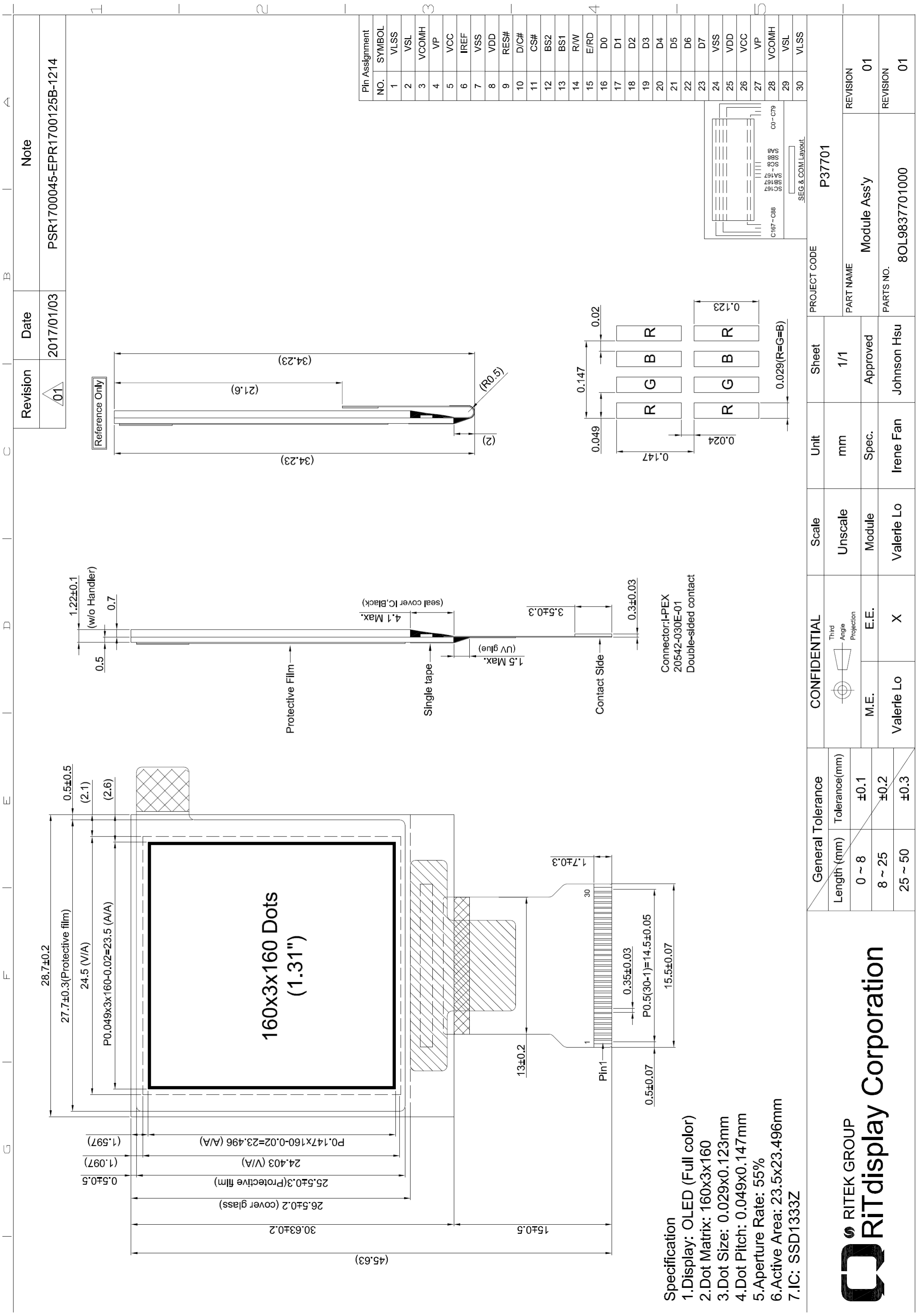
**Test and measurement conditions**

1. All measurements shall not be started until the specimens attain to temperature stability.

**Evaluation criteria**

1. The function test is OK.
2. No observable defects.
3. Luminance: > 50% of initial value.
4. Current consumption: within ± 50% of initial value.

# 11. EXTERNAL DIMENSION



| Revision | Date | Note |
|---|---|---|
| 01 | 2017/01/03 | PSR1700045-EPR1700125B-1214 |

Pin Assignment

| NO. | SYMBOL |
|---|---|
| 1 | VLSS |
| 2 | VSL |
| 3 | VCOMH |
| 4 | VP |
| 5 | VCC |
| 6 | IREF |
| 7 | VSS |
| 8 | VDD |
| 9 | RES# |
| 10 | D/C# |
| 11 | CS# |
| 12 | BS2 |
| 13 | BS1 |
| 14 | R/W |
| 15 | E/RD |
| 16 | D0 |
| 17 | D1 |
| 18 | D2 |
| 19 | D3 |
| 20 | D4 |
| 21 | D5 |
| 22 | D6 |
| 23 | D7 |
| 24 | VSS |
| 25 | VDD |
| 26 | VCC |
| 27 | VP |
| 28 | VCOMH |
| 29 | VSL |
| 30 | VLSS |

Specification
1.Display: OLED (Full color)
2.Dot Matrix: 160x3x160
3.Dot Size: 0.029x0.123mm
4.Dot Pitch: 0.049x0.147mm
5.Aperture Rate: 55%
6.Active Area: 23.5x23.496mm
7.IC: SSD1333Z

General Tolerance

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

| CONFIDENTIAL | | Scale | Unit | Sheet | PROJECT CODE | |
|---|---|---|---|---|---|---|
| | | Unscale | mm | 1/1 | P37701 | |
| M.E. | E.E. | Module | Spec. | Approved | PART NAME<br>Module Ass'y | REVISION<br>01 |
| Valerie Lo | X | Valerie Lo | Irene Fan | Johnson Hsu | PARTS NO.<br>8OL9837701000 | REVISION<br>01 |

RITEK GROUP
RiTdisplay Corporation

## 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

MIL-STD-1916樣本代字對照表

| 批量 | 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.

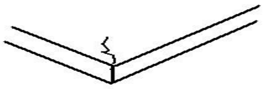
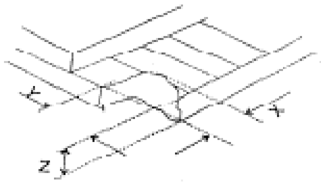
溫度 / Temperature: 25±5℃
濕度 / Humidity: 50±10%R.H.
壓力 / Pressure: 860~1060hPa (mbar)
檢驗員拿的面板和眼睛之間的距離 / Distance between the panel and eyes of the inspector≧30cm

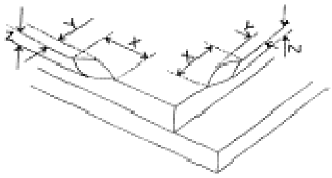
# 3. 品質檢驗規格 / SPECIFICATION FOR QUALITY CHECK

## 3.1 缺陷分類 / DEFECT CLASSIFICATION

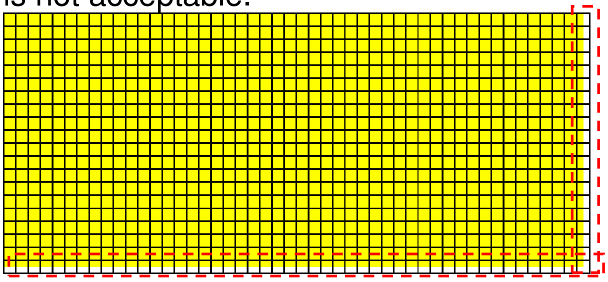
| 嚴重度<br>Severity | 檢驗項目<br>Inspection Item | 缺陷<br>Defect | 備註<br>Remark |
|---|---|---|---|
| 主要缺陷<br>Major Defect | 1. 面板<br>Panel | (1) 無顯示<br>Non-displaying | |
| | | (2) 線缺陷<br>Line defects | |
| | | (3) 故障<br>Malfunction | |
| | | (4) 玻璃破損<br>Glass cracked | |
| | 2. 軟板<br>Film | (1) 軟板尺寸超規<br>Film dimension out of specification | 不能組裝<br>Can not be assembled |
| | 3. 尺寸<br>Dimension | (1) 外形尺寸超規<br>Outline dimension out of specification | |
| 次要缺陷<br>Minor Defect | 1. 面板<br>Panel | (1) 玻璃刮傷<br>Glass scratch | 外觀缺陷<br>Appearance 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

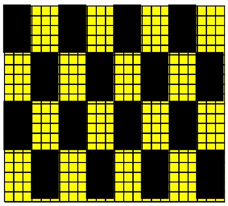
<table>
<tr><th>項目<br>Item</th><th>描述<br>Description</th><th>標準<br>Criterion</th><th>允收水準<br>AQL</th></tr>
<tr><td>I. 面板<br>Panel</td><td>1. 髒污<br>Dust</td><td>無法去除的不純物或污染物大小超過 2/3 畫素，是不能接受的。<br>Dust that can not be cleared and greater than 2/3 pixels size is not acceptable.</td><td>次要<br>Minor</td></tr>
<tr><td></td><td>2. 玻璃刮傷<br>Glass scratch</td><td>
<table>
<tr><th>寬 / Width (mm) W</th><th>長 / Length (mm) L</th><th>容許個數 number of pieces permitted</th></tr>
<tr><td>W≦0.05</td><td>忽略<br>Ignore</td><td>忽略<br>Ignore</td></tr>
<tr><td>0.05< W≦0.1</td><td>L≦2</td><td>2</td></tr>
<tr><td>0.1< 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>
備註 / Note:<br>The distance between two defect can not be less than 10mm.</td><td>次要<br>Minor</td></tr>
<tr><td></td><td>3. 玻璃破損<br>Glass crack</td><td>(1) 裂紋 / Crack<br>擴展裂紋是不能接受的。<br>Propagation crack is not acceptable.<br></td><td>主要<br>Major</td></tr>
<tr><td></td><td>4. 玻璃崩邊、崩角<br>Glass chip</td><td>(1) 崩角 / Chip on corner<br><br> </td><td>次要<br>Minor</td></tr>
</table>

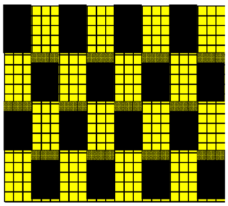
<table>
<tr><th>項目<br>Item</th><th>描述<br>Description</th><th>標準<br>Criterion</th><th>允收水準<br>AQL</th></tr>
<tr><td rowspan="3">I. 面板<br>Panel</td><td>4. 玻璃崩邊、崩角<br>Glass chip</td><td>(2) 崩邊 / Chip on edge<br><table><tr><th>崩角<br>Chip on corner</th><th>Size<br>(mm</th><th>崩邊<br>Chip on edge</th><th>Size<br>( m)</th></tr><tr><td>X</td><td>≦1.5</td><td>X</td><td>≦3.0</td></tr><tr><td>Y</td><td>≦2.0</td><td>Y</td><td>≦1.0</td></tr><tr><td>Z</td><td>≦t</td><td>Z</td><td>≦t</td></tr></table>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.</td><td>次要<br>Minor</td></tr>
<tr><td>5. 封膠膠寬<br>Sealing glue width</td><td>Sealing glue discontinuity and glue width less than 0.3mm is not acceptable.</td><td>主要<br>Major</td></tr>
<tr><td>6. 尺寸<br>Dimension</td><td>請參閱圖紙的規範。<br>Refer to the drawing of the spec</td><td>主要<br>Major</td></tr>
<tr><td>II. 偏光板<br>Polarizer</td><td>1.刮傷<br>Scratch</td><td>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”.</td><td>次要<br>Minor</td></tr>
</table>

<table>
<tr><th>項目<br>Item</th><th>描述<br>Description</th><th>標準<br>Criterion</th><th>允收水準<br>AQL</th></tr>
<tr><td rowspan="2">II. 偏光板<br>Polarizer</td><td>2. 表面汙漬<br>Stains on surface</td><td>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.</td><td>次要<br>Minor</td></tr>
<tr><td>3. 偏光板氣泡<br>Polarizer bubble</td><td>(mm)<table>
<tr><th>尺寸<br>Size</th><th>容許個數<br>number of pieces permitted</th></tr>
<tr><td>Φ≦0.2</td><td>忽略<br>Ignore</td></tr>
<tr><td>0.2＜Φ≦0.5</td><td>2</td></tr>
<tr><td>0.5＜Φ</td><td>0</td></tr>
<tr><td>顯示區外<br>beyond A.A.</td><td>忽略<br>Ignore</td></tr>
</table></td><td>次要<br>Minor</td></tr>
<tr><td rowspan="8">III. 顯示<br>Displaying</td><td>1. 耗電<br>Power consumption</td><td>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</td><td>主要<br>Major</td></tr>
<tr><td>2. 像素尺寸<br>Pixel size</td><td>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.</td><td>次要<br>Minor</td></tr>
<tr><td>3. 顏色<br>Color</td><td>依據產品規格。<br>Refer to the product specification.</td><td>主要<br>Major</td></tr>
<tr><td>4. 亮度<br>Luminance</td><td>依據產品規格。<br>Refer to the product specification.</td><td>主要<br>Major</td></tr>
<tr><td>5. 亮線<br>Bright line</td><td>未點亮畫面出現亮線，是不能接受的。<br>Bright line when all display off is not acceptable.</td><td>主要<br>Major</td></tr>
<tr><td>6. 黑線<br>Black line</td><td>全點亮畫面出現黑線，是不能接受的。<br>Black line when all display on is not acceptable.</td><td>主要<br>Major</td></tr>
<tr><td>7. 暗淡線<br>Dim line</td><td>周圍亮度差異 10%以上，是不能接受的。<br>The surrounding brightness different more than 10% is not acceptable.</td><td>次要<br>Minor</td></tr>
<tr><td>8. 亮度區塊異常<br>Luminance area uniformity</td><td>區塊亮度差異 10%以上，是不能接受的。<br>The surrounding area brightness different more than 10% is not acceptable.</td><td>次要<br>Minor</td></tr>
</table>

<table>
<tr><th>項目<br>Item</th><th>描述<br>Description</th><th>標準<br>Criterion</th><th>允收水準<br>AQL</th></tr>
<tr><td>III. 顯示<br>Displaying</td><td>9. 顏色區塊異常<br>Color uniformity area</td><td>區塊顏色差異 10%以上，是不能接受的。<br>The surrounding area color different more than 10% is not acceptable.</td><td>次要<br>Minor</td></tr>
<tr><td></td><td>10. 邊緣 pixel 亮度不均<br>Edge row or column luminance uniformity</td><td>邊緣 pixel 任一排亮度不均佔 1/2 面積以上，是不能接受的。<br>Edge pixel any row or column luminance uniformity accounted for more than 1/2 area is not acceptable.<br></td><td>次要<br>Minor</td></tr>
<tr><td></td><td>11. 暗點、亮點 、髒污<br>Dimming spot、Lighting spot、Dust</td><td>1.<br><table>
<tr><th>平均直徑<br>Average diameter D:(mm)</th><th>容許個數<br>number of pieces permitted</th></tr>
<tr><td>D ≦0.1</td><td>忽略<br>Ignore</td></tr>
<tr><td>0.1 ＜ D ≦0.2</td><td>2</td></tr>
<tr><td>0.2 ＜ D</td><td>0</td></tr>
<tr><td>顯示區外<br>beyond A.A.</td><td>忽略<br>Ignore</td></tr>
</table>
D=長邊直徑<br>D=long diameter<br>像素暗點是不允許。<br>Pixel off is not allowed.</td><td>次要<br>Minor</td></tr>
</table>

<table>
<tr><th>項目<br>Item</th><th>描述<br>Description</th><th>標準<br>Criterion</th><th>允收水準<br>AQL</th></tr>
<tr><td>III. 顯 示<br>Displaying</td><td>11. 暗點、亮點 、髒污<br>Dimming spot 、 Lighting spot、Dust</td><td>2.
<table>
<tr><th>寬<br>width(mm)<br>W</th><th>長<br>length(mm)<br>L</th><th>容許個數<br>number of pieces permitted</th></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≦3</td><td>3</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></td><td>次要<br>Minor</td></tr>
<tr><td></td><td>12. 微亮點/線</td><td>依限度樣品判定。<br>Judge by limit sample.


正常畫面


NG 畫面

正常畫面

NG 畫面</td><td>次要<br>Minor</td></tr>
<tr><td>IV. 軟板<br>Film</td><td>1. 尺寸<br>Dimension</td><td>軟板尺寸超規。<br>Film dimension out of Spec.</td><td>主要<br>Major</td></tr>
<tr><td></td><td>2. 損傷<br>Damage</td><td>破損；深刮傷；深摺痕；深壓痕或其他損害是不能接受的。<br>Crack; deep scratch; deep fold; deep pressure mark or other damage is not acceptable.</td><td>次要<br>Minor</td></tr>
<tr><td></td><td>3. 異物<br>Foreign material</td><td>導電異物附著在導線，軟板和玻璃之間的異物是不能接受的。<br>Conductive foreign material sticking to the leads, foreign material between film and glass are not acceptable.</td><td>次要<br>Minor</td></tr>
</table>

# 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.

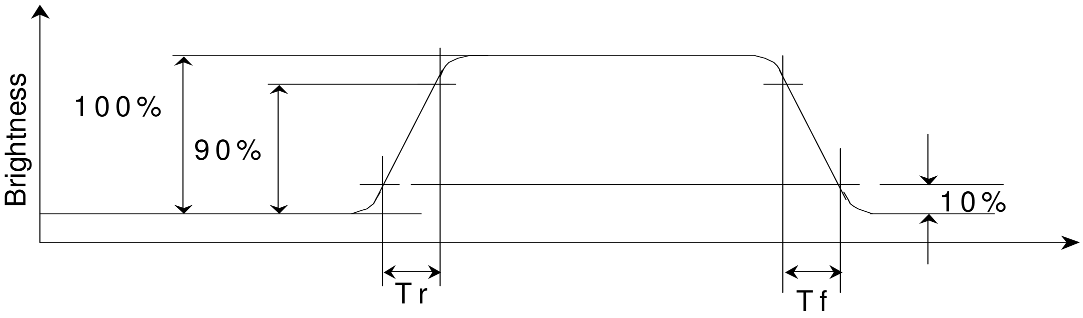


Figure 2 Response time

## 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.

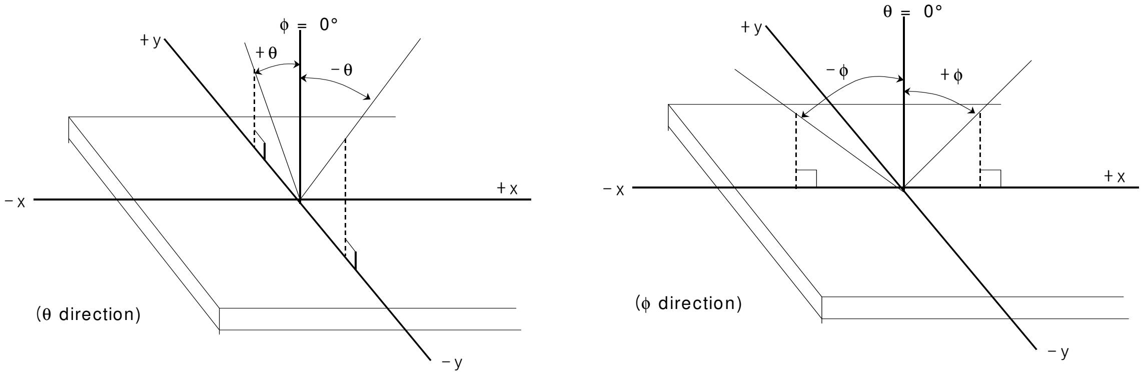
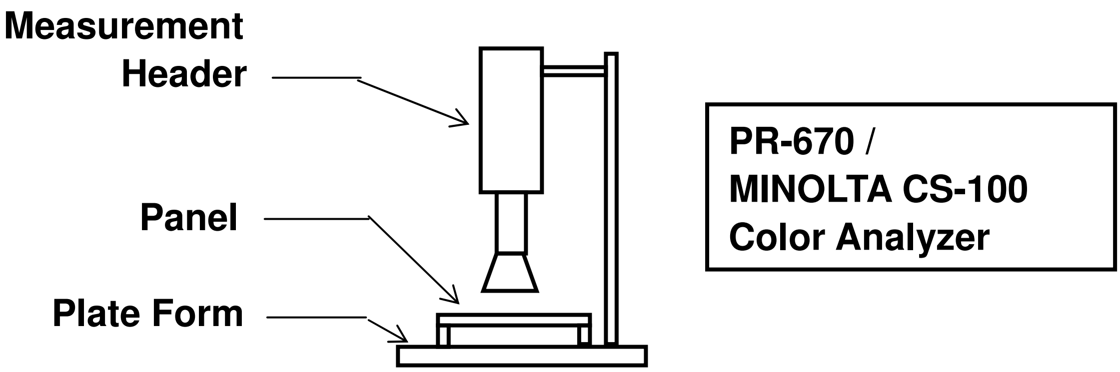


Figure 3 Viewing angle

## APPENDIX 2: MEASUREMENT APPARATUS

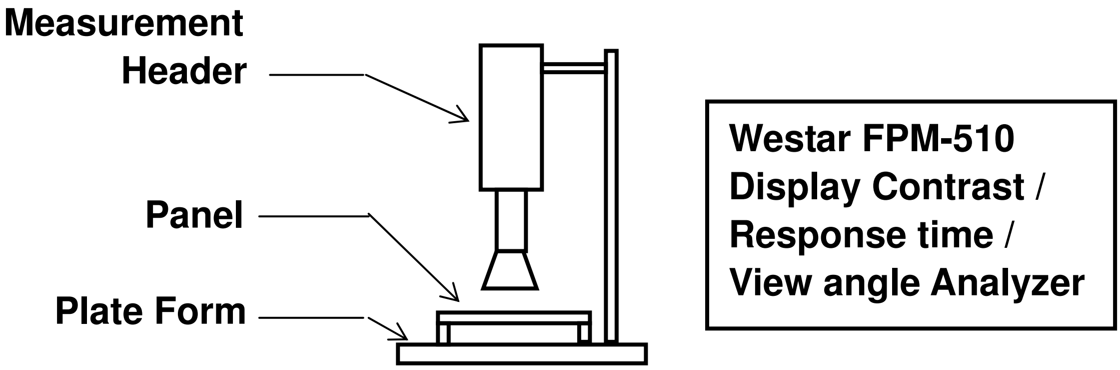
### A. LUMINANCE/COLOR COORDINATE

PHOTO RESEARCH PR-670, MINOLTA CS-100

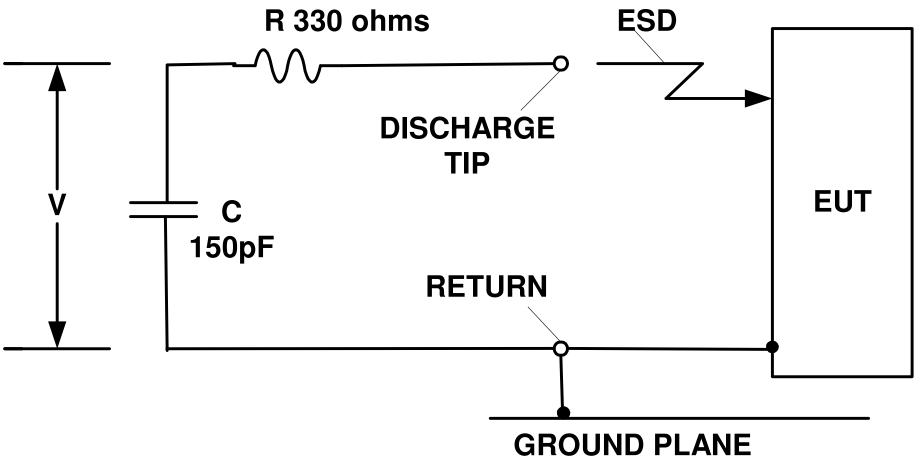


### B. CONTRAST / RESPONSE TIME / VIEWING ANGLE

WESTAR CORPORATION FPM-510



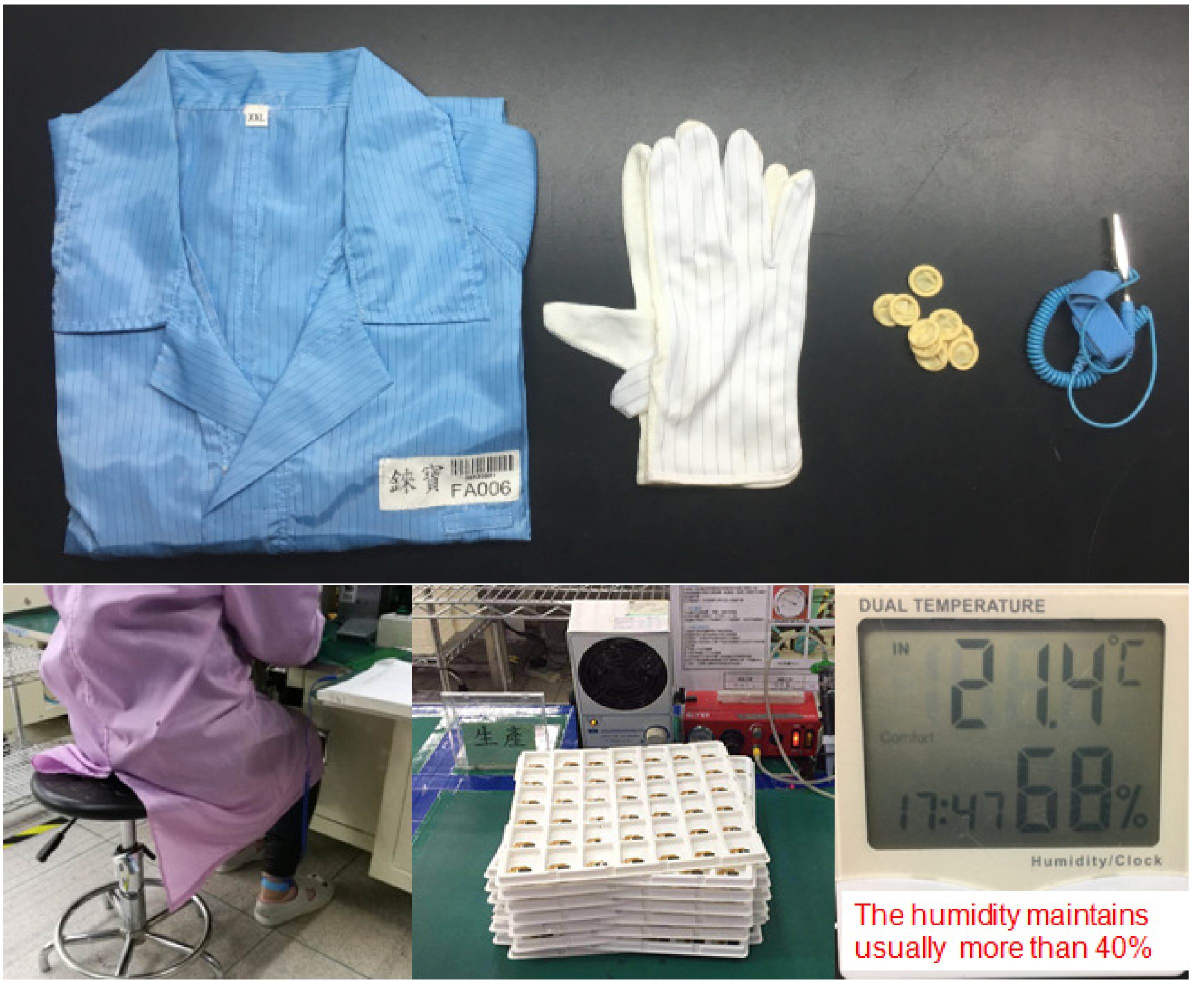
## C. ESD ON AIR DISCHARGE MODE



## APPENDIX 3: PRECAUTIONS FOR USING THE OLED MODULE

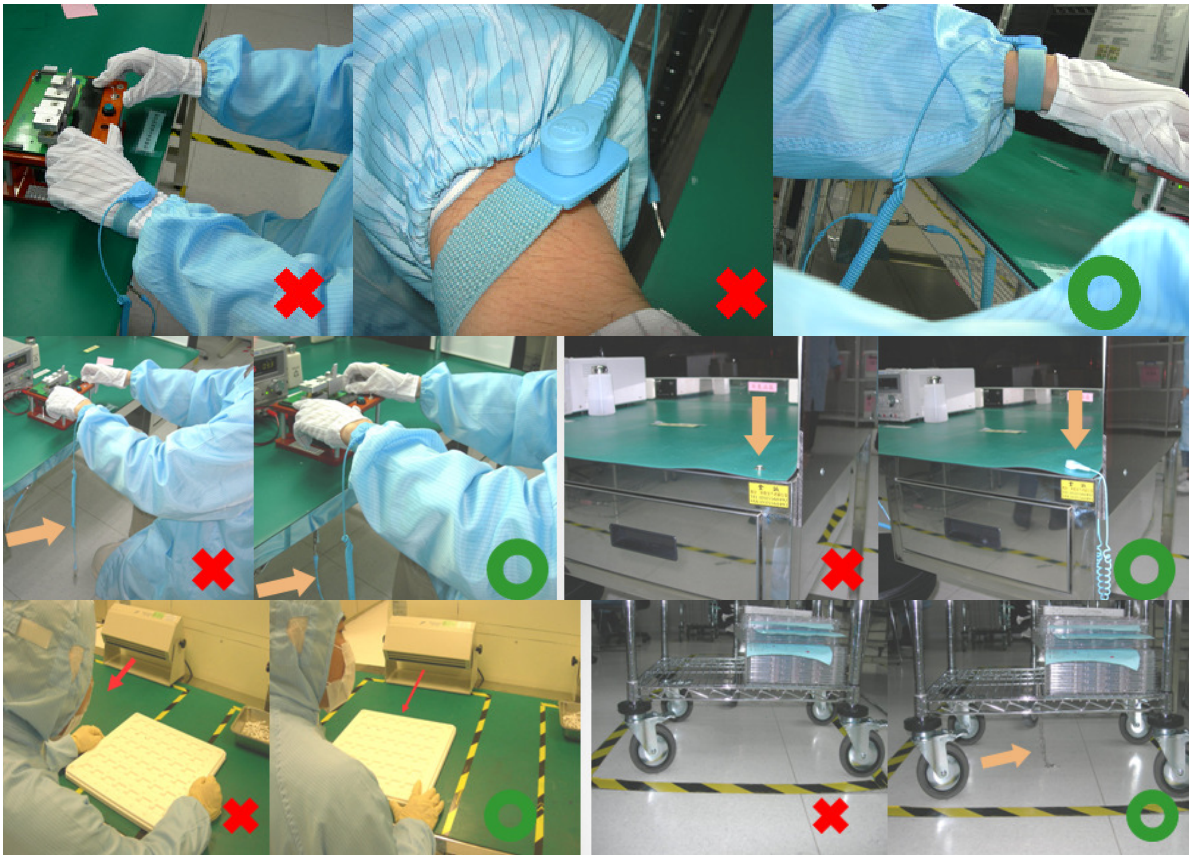
### *Precautions for Handling*

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%

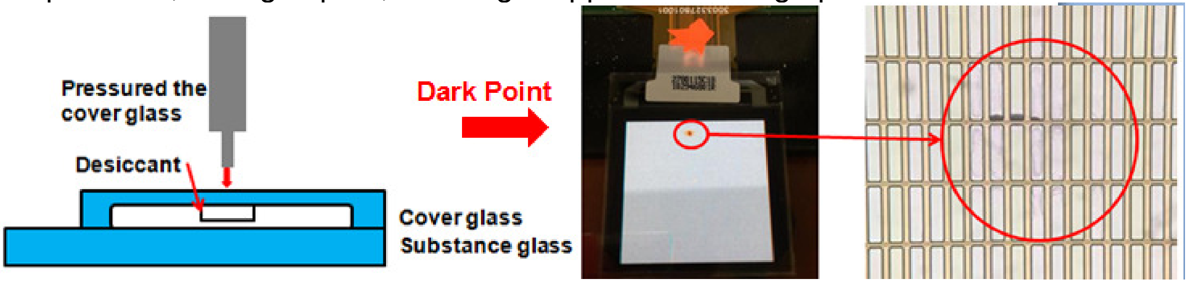


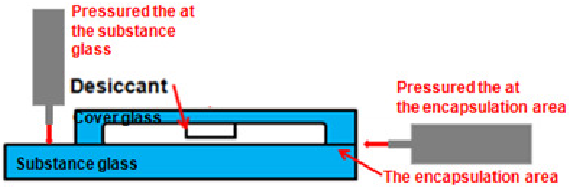
The humidity maintains usually more than 40%

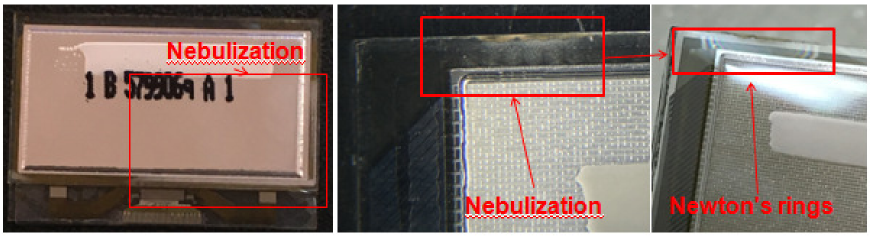
2. The OLED module is an electronic component and is subject to damage caused by Electro Static Discharge (ESD). And hence normal ESD precautions must be taken when handling it. Also, appropriate ESD protective environment must be administered and maintained in the production line. When handling and 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).



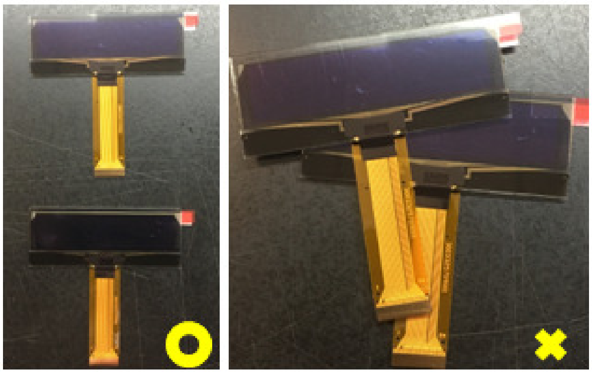
3. The OLED module is consisted of glass and film, and it should avoid pressure, strong impact, or being dropped from a high position.





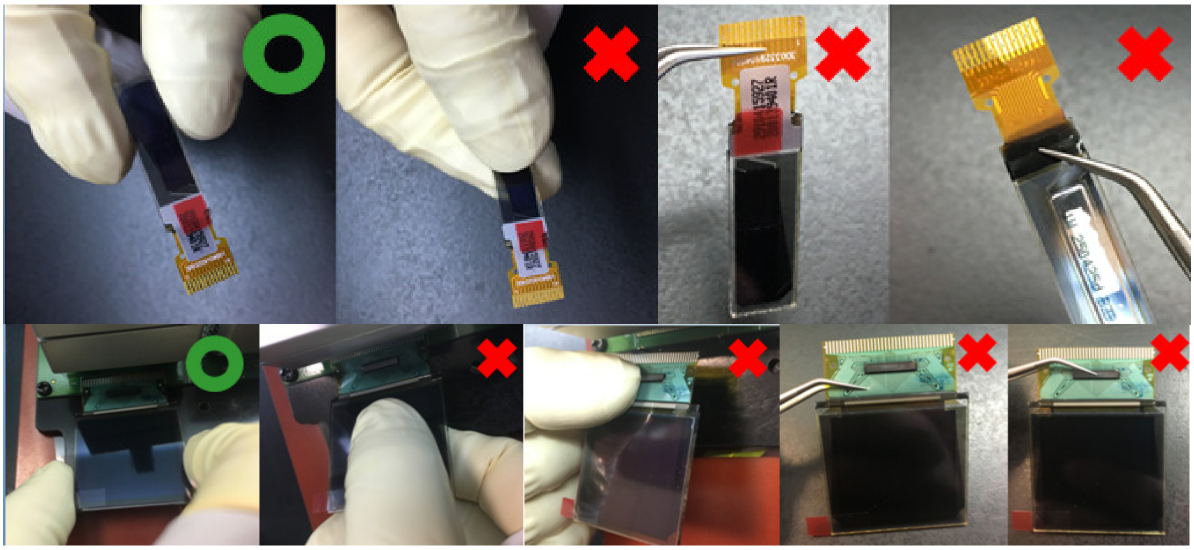


4. Take out the panel one by one from the holding trays for assembly, and never put the panel on top of another one to avoid the scratch.



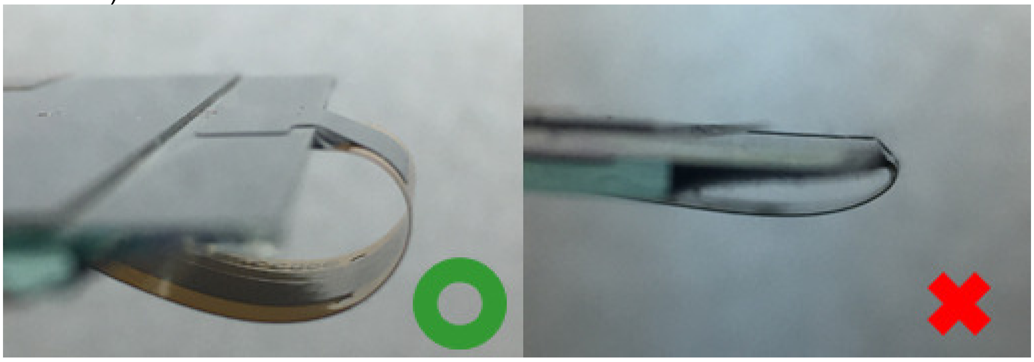
5. Avoid jerk and excessive bend on TAB/FPC/COF, and be careful not to let foreign matter or bezel damage the film.

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

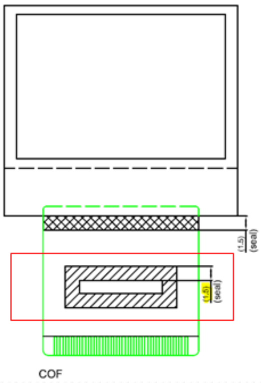


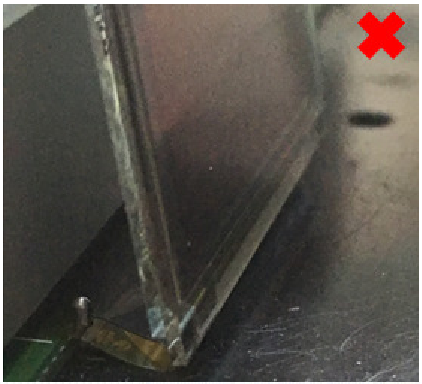
7. Use the tweezers to open the clicks on the connector of PCB before the insertion of FPC/COF, and click them back in. Once the FPC/COF sits properly in the connector, use the tweezers to avoid the damages.

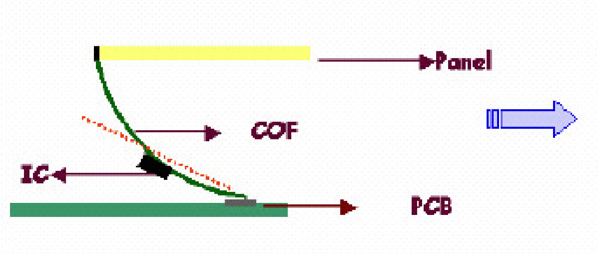
8. Please do not bend the film near the substrate glass. It could cause film peeling and TAB/FPC/COF damage. For TAB, It should bend the slit area as actual OLED it is. For FPC or COF, it is suggested to follow below pictures for instruction (distance between substrate glass and bending area >1.5mm;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



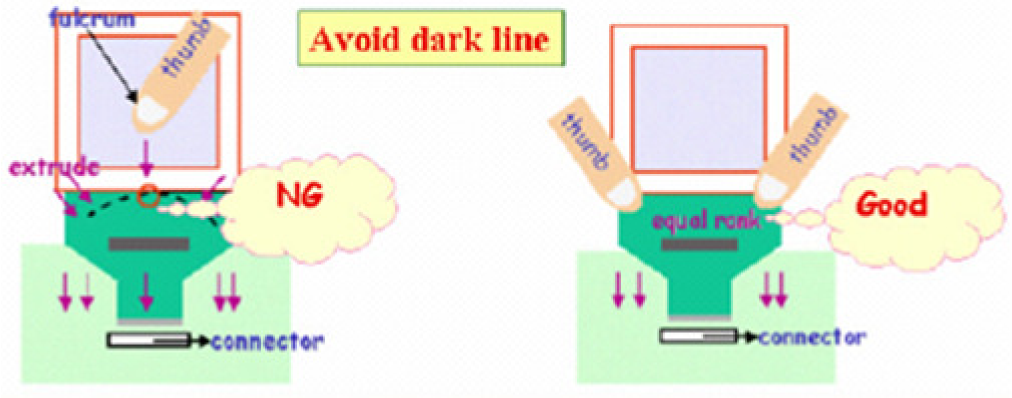
9. Avoid bending the film at IC bonding area. It could damage the IC ILB bonding. It should avoid bending the IC seal area. Please keep the bending distance >1.5mm.



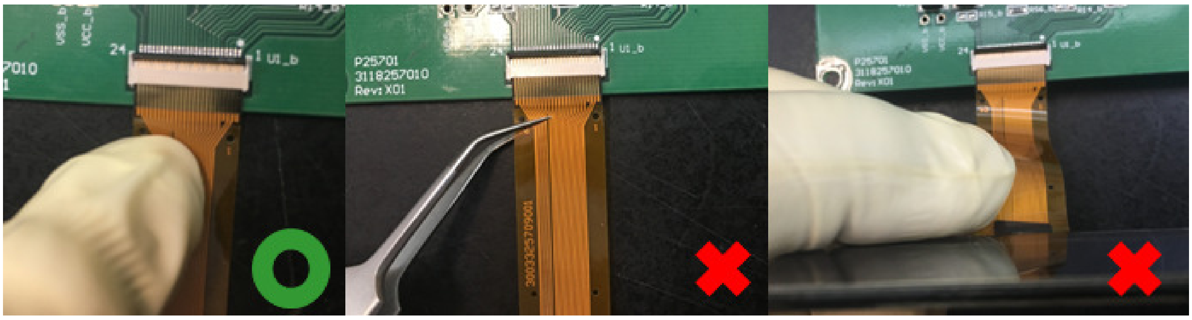




Use finger to insert COF /FPC into the connector when assembling the panel. Please refer to the photo.



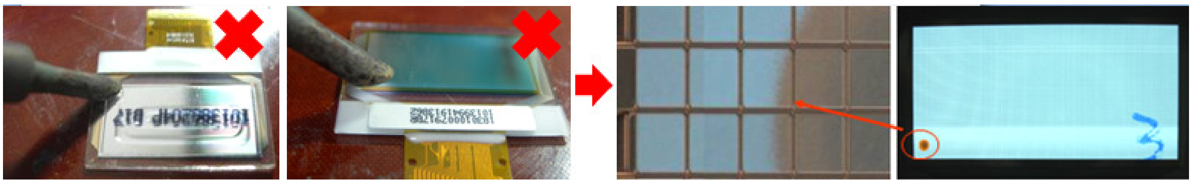
**COF: Use both thumbs**



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.

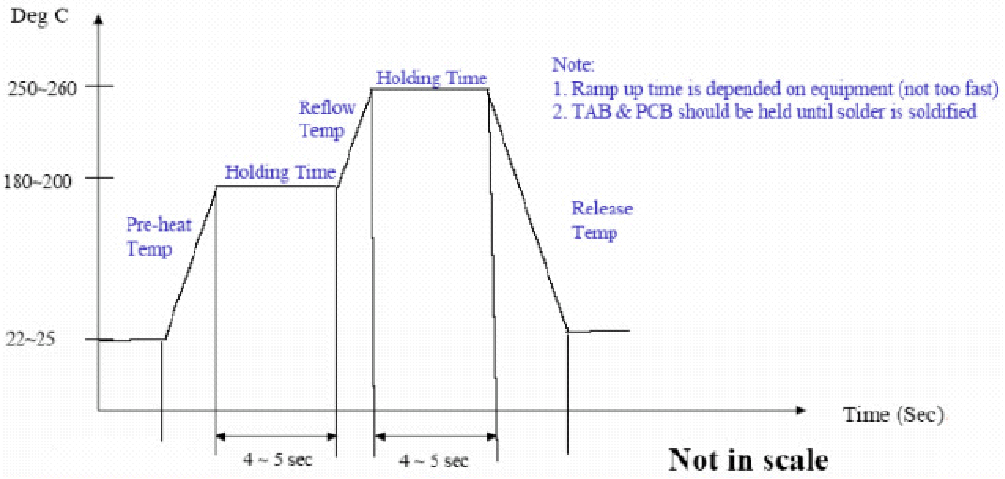
12. When hand or hot-bar soldering TAB/FPC onto PCB, make sure the temperature and timing profiles to meet the requirements of soldering specification (the specification depends on the application or optimized by customer) to prevent the damage of IC pins by inappropriate soldering, and also avoid the 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.



Note:
1. Ramp up time is depended on equipment (not too fast)
2. TAB & PCB should be held until solder is soldified

    ii. TAB Lead- free soldering wire process
    In case of manual soldering (Lead- free solder wire)
    1. Solder wire contact iron directly: 280±5℃ at 3-5secs
    2. Solder wire contact TAB lead directly (near iron but not contact): 380±5 ℃, 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℃. 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. Design using the settings in the specification

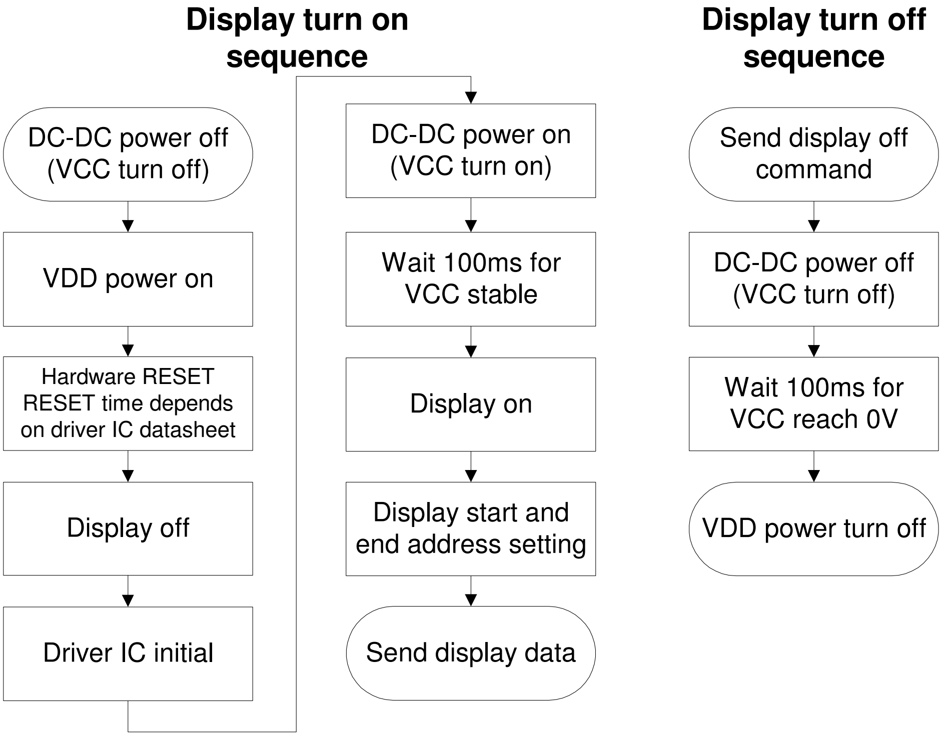
It is very important to design and operate the panel using the settings listed in the specification. It includes voltage, current, frame rate and duty cycle... etc. Operation the OLED outside the range of the specification should be entirely avoided to ensure proper operation of the OLED.

## 2. Maximum Ratings

To ensure the proper operation of the panel, never design the panel with parameters running over the maximum ratings listed in the specification. Also the logic voltages such as VIL and VIH have to be within the specified range in the specification to prevent any improper operation of the panel.

## 3. Power on/off procedure

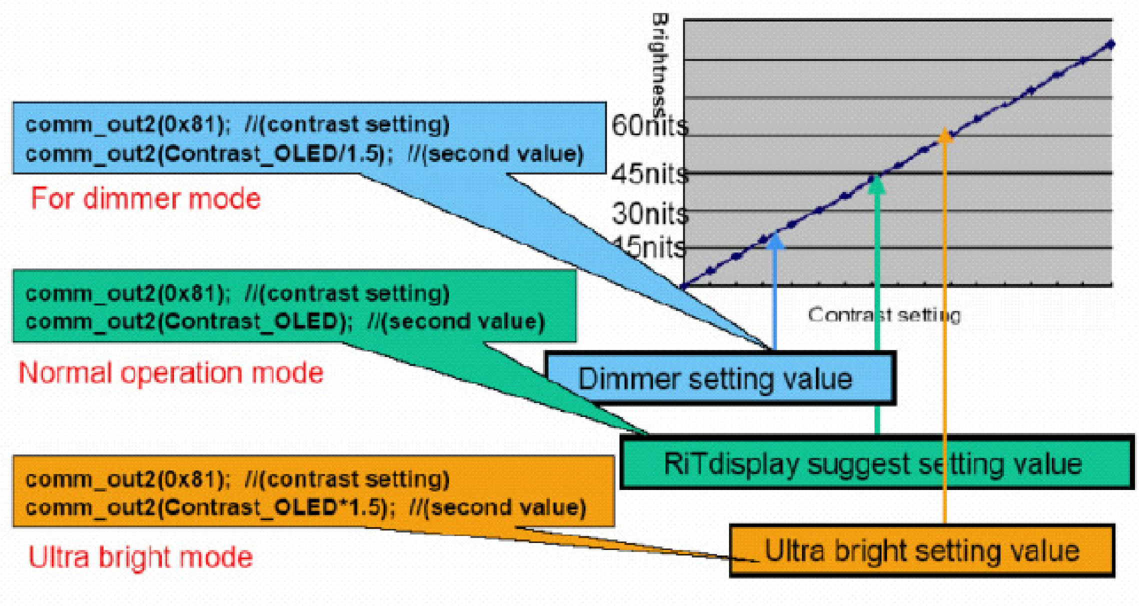
To avoid any inadvertent effects resulting from inappropriate power on/off operations, please follow the directions of power on/off procedure on page 6. Any operation that does not comply with the procedure could cause permanent damage of the IC and should be avoided. When the logic power is not on, do not activate any input signal. Abrupt shutdown of power to the module, while the OLED panel is on, would cause OLED panel malfunction.



## 4. Power savings

To save power consumption of the OLED, please use partial display or sleep mode when the panel is not fully activated. Also, if possible, make the black background to save power.

The OLED is a self-luminous device and a particular pixel cluster or image can be lit on via software control. So power savings can be achieved by partial display or dimming down the luminance. Depending on the application, the user can choose among Ultra Bright Mode, Normal Operation Mode, and Sleeping Mode. The power consumption is almost in directly proportion to the brightness of the panel, and also in directly proportion to the number of pixels lit on the panel. The customer can save the power by the use of black background and sleeping mode. One benefit from using these design schemes is the extension of the OLED lifetime.



```
comm_out2(0x81);  //(contrast setting)
comm_out2(Contrast_OLED/1.5);  //(second value)
```

```
comm_out2(0x81);  //(contrast setting)
comm_out2(Contrast_OLED);  //(second value)
```

```
comm_out2(0x81);  //(contrast setting)
comm_out2(Contrast_OLED*1.5);  //(second value)
```

## 5. Adjusting the luminance of the panel

Although there are a couple of ways to adjust the luminance of the panel, it is strongly recommended that the customer change the contrast setting to adjust the luminance of the panel. Adjusting voltages to achieve desired luminance is not allowed. Be aware that the adjustment of luminance would accompany the change of lifetime of the panel and its power consumption as well.

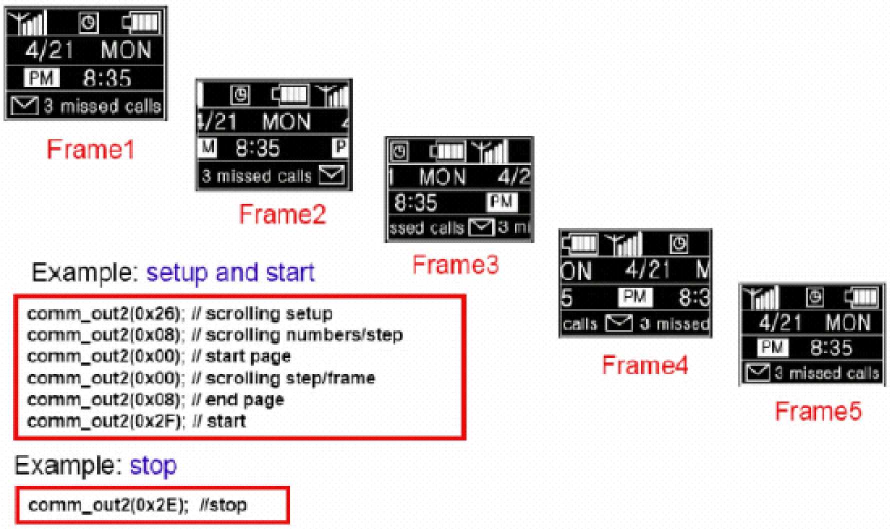
## 6. Residual Image (Image Sticking)

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**



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
```

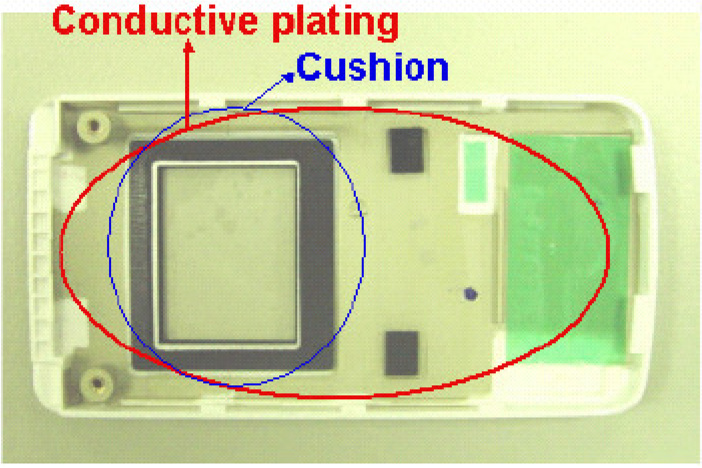
Example: stop

```
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

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