

Preliminary Specification

PRODUCT NAME: 1.0" 96X64 Yellow OLED

PRODUCT NO.: PMO15201

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| |
| APPROVED BY |
| |
| DATE: |

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|-------------------------------------|
| PACER INTERNATIONAL APPROVED |
| |

REVISION RECORD

| REV. | REVISION DESCRIPTION | REV. DATE | REMARK |
|------|--|--------------|--------------------|
| X01 | ■ INITIAL RELEASE | 2006. 05. 05 | |
| X02 | ■ Add the operating conditions for different luminance ■ Modify the panel electrical specification | 2006. 05. 24 | Page 6, 7 & 8 |
| X03 | ■ Add remarks of maximum ratings ■ Modify D.C electrical characteristics ■ Modify reliability test and measurement conditions ■ Add packing specification | 2006. 09. 04 | Page 6, 7, 15 & 17 |

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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 Pacer. 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

Pacer 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"). Pacer 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 or used as the conditions specified in the specifications. Nevertheless, Pacer 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 : Yellow
- Panel resolution : 96*64
- Driver IC : SSD1305
- Excellent Quick response time : 10 μ s
- Extremely thin thickness for best mechanism design : 1.62 mm
- High contrast : 500:1
- Wide viewing angle : 160 \square
- Strong environmental resistance.
- 8-bit 8080-series Parallel Interface.
- Wide range of operating temperature : -40 to 70 $^{\circ}$ C
- Anti-glare polarizer.

4. MECHANICAL DATA

| NO | ITEM | SPECIFICATION | UNIT |
|----|-------------------|-------------------------------|-----------------|
| 1 | Dot Matrix | 96 x 64 | dot |
| 2 | Dot Size | 0.19 (W) x 0.19 (H) | mm ² |
| 3 | Dot Pitch | 0.21 (W) x 0.21 (H) | mm ² |
| 4 | Aperture Rate | 82 | % |
| 5 | Active Area | 20.14 (W) x 13.42 (H) | mm ² |
| 6 | Panel Size | 25.34 (W) x 22.5 (H) | mm ² |
| 7 | Panel Thickness | 1.62 ± 0.1 | mm |
| 8 | Module Size | 25.34 (W) x 32 (H) x 1.62 (T) | mm ³ |
| 9 | Diagonal A/A size | 1.0 | inch |
| 10 | Module Weight | TBD | gram |

5. MAXIMUM RATINGS

| ITEM | MIN | MAX | UNIT | Condition | Remark |
|-----------------------------|--------|-----|------|--|-------------------|
| Supply Voltage (V_{DD}) | -0.3 | 3.5 | V | Ta = 25°C | IC maximum rating |
| Supply Voltage (V_{CC}) | 8 | 16 | V | Ta = 25°C | IC maximum rating |
| Operating Temp. | -40 | 70 | °C | | |
| Storage Temp | -40 | 85 | °C | | |
| Humidity | | 85 | % | | |
| Life Time | 33,000 | - | Hrs | 120 cd/m ² , 50% checkerboard | Note (1) |
| Life Time | 40,000 | - | Hrs | 100 cd/m ² , 50% checkerboard | Note (2) |
| Life Time | 50,000 | - | Hrs | 80 cd/m ² , 50% checkerboard | Note (3) |

Note:

(A) Under $V_{CC} = 12V$, $T_a = 25^\circ C$, 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 120 cd/m² :

- Contrast setting : 0x71
- Frame rate : 85 Hz
- Duty setting : 1/64

(2) Setting of 100 cd/m² :

- Contrast setting : 0x57
- Frame rate : 85 Hz
- Duty setting : 1/64

(3) Setting of 80 cd/m² :

- Contrast setting : 0x43
- Frame rate : 85 Hz
- Duty setting : 1/64

6. ELECTRICAL CHARACTERISTICS

6.1 D.C ELECTRICAL CHARACTERISTICS

| SYMBOL | PARAMETERS | TEST CONDITION | MIN | TYP | MAX | UNIT |
|-----------|--|----------------|------------------|-----|------------------|---------|
| V_{CC} | Analog power supply (for OLED panel) | | 11.5 | 12 | 12.5 | V |
| V_{DD} | Digital power supply | | 2.4 | 2.7 | 3.5 | V |
| I_{DD} | Operating current for V_{DD} $V_{DD} = 2.7V$, $V_{CC} = 12V$, $I_{REF} = 10\mu A$ No loading, All Display ON | Contrast=FF | - | 100 | - | μA |
| I_{CC} | Operating current for V_{CC} $V_{DD} = 2.7V$, $V_{CC} = 12V$, $I_{REF} = 10\mu A$, No loading, All Display ON | Contrast=FF | - | 550 | - | μA |
| V_{IH} | Hi logic input level | | 0.8* V_{DD} | - | V_{DD} | V |
| V_{IL} | Low logic input level | | 0 | - | 0.2* V_{DD} | V |
| V_{OH} | Hi logic output level | | 0.9* V_{DD} | - | V_{DD} | V |
| V_{OL} | Low logic output level | | 0 | - | 0.1* V_{DD} | V |
| I_{SEG} | Segment on output current $V_{DD}=2.7V$, $V_{CC}=12V$, $I_{REF}=10\mu A$, Display on, Segment pin under test is connected with a 20K resistive load to V_{SS} | Contrast=FF | 294 | 320 | 346 | μA |
| | | Contrast=AF | - | 220 | - | μA |
| | | Contrast=7F | - | 159 | - | μA |
| | | Contrast=3F | - | 79 | - | μA |
| | | Contrast=0F | - | 19 | - | μA |

6.2 ELECTRO-OPTICAL CHARACTERISTICS

PANEL ELECTRICAL SPECIFICATIONS

| PARAMETER | MIN | TYP. | MAX | UNITS | COMMENTS |
|----------------------------------|-------|------|------|-------------------|-------------------------------|
| Normal mode current consumption | - | 8 | 10 | mA | All pixels on |
| Standby mode current consumption | - | TBD | TBD | mA | Standby mode 10% pixels on |
| Normal mode power consumption | - | 96 | 120 | mW | All pixels on |
| Standby mode power consumption | - | TBD | TBD | mW | Standby mode 10% pixels on |
| Pixel Luminance | 80 | 100 | | cd/m ² | Display Average |
| Standby Luminance | | TBD | | cd/m ² | |
| CIE _x (Yellow) | 0.43 | 0.47 | 0.51 | | CIE1931 |
| CIE _y (Yellow) | 0.45 | 0.49 | 0.53 | | CIE1931 |
| Dark Room Contrast | 500:1 | | | | |
| Viewing Angle | 160 | | | degree | |
| Response Time | | 10 | | μs | |

Normal mode condition :

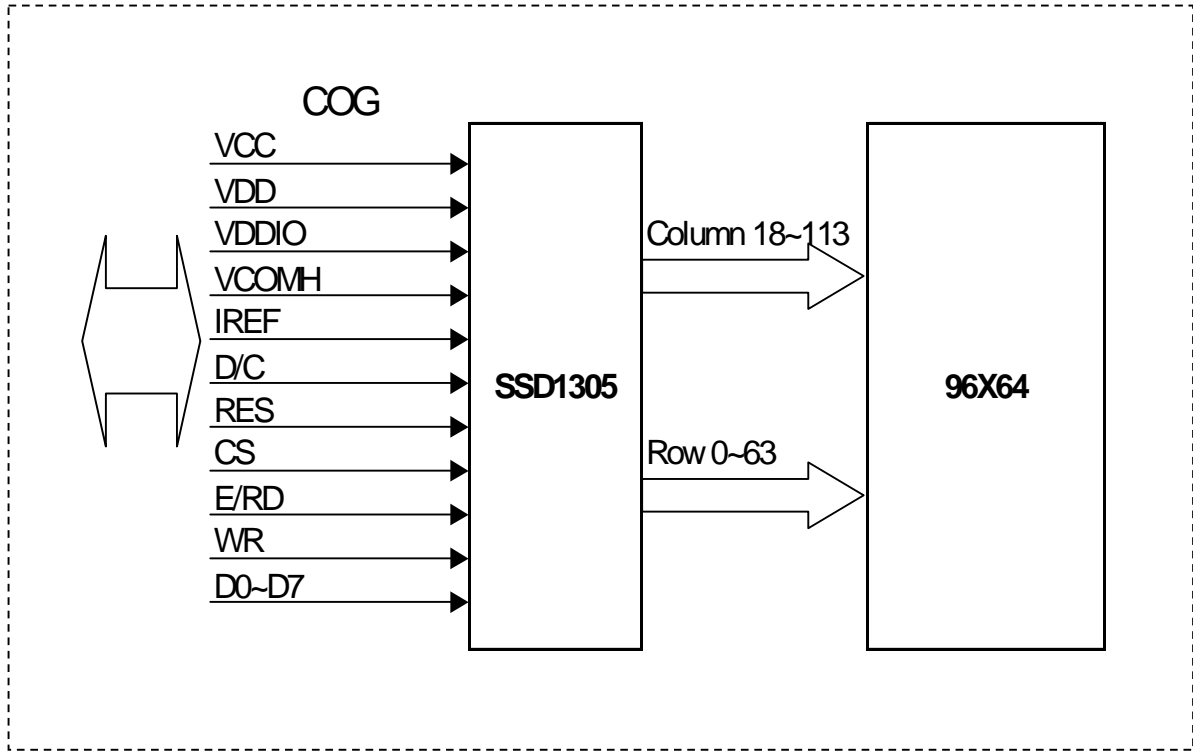
- Driving Voltage : 12V
- Contrast setting : 0x57
- Frame rate : 85 Hz
- Duty setting : 1/64

Standby mode condition :

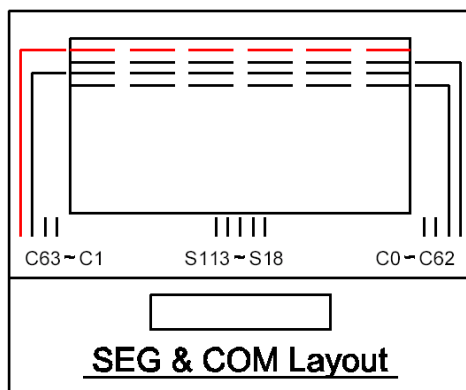
- Driving Voltage : TBD
- Contrast setting : TBD
- Frame rate : 85 Hz
- Duty setting : 1/64

7. INTERFACE

7.1 FUNCTION BLOCK DIAGRAM



7.2 PANEL LAYOUT DIAGRAM



7.3 PIN ASSIGNMENTS

| PIN NAME | PIN NO | DESCRIPTION |
|----------|--------|--|
| NC | 1 | No connection. |
| VSS | 2 | Ground. |
| VCC | 3 | Power supply for analog circuit. |
| VCOMH | 4 | Com Voltage Output. A capacitor should be connected between this pin and V_{SS} . |
| IREF | 5 | Reference current input pin. A resistor should be connected between this pin and V_{SS} . |
| VDD | 6 | Power supply for logic circuit. |
| VDDIO | 7 | This pin is a power supply pin of I/O buffer. |
| D7 | 8 | Data bus(for parallel interface) |
| D6 | 9 | Data bus(for parallel interface) |
| D5 | 10 | Data bus(for parallel interface) |
| D4 | 11 | Data bus(for parallel interface) |
| D3 | 12 | Data bus(for parallel interface) |
| D2 | 13 | Data bus(for parallel interface) |
| D1 | 14 | Data bus(for parallel interface) |
| D0 | 15 | Data bus(for parallel interface) |
| E/RD | 16 | MCU interface input. Data read operation is initiated when it's pull low. |
| WR | 17 | MCU interface input. Data write operation is initiated when it's pull low. |
| D/C | 18 | Data/ Command control. Pull high for write/read display data. Pull low for write command or read status. |
| RES | 19 | Reset signal input. When it's low, initialization of SSD1305 is executed. |
| CS | 20 | Chip select input. |
| VDDIO | 21 | This pin is a power supply pin of I/O buffer. |
| VDD | 22 | Power supply for logic circuit. |
| VSS | 23 | Ground. |
| VSS | 24 | Ground. |
| VCOMH | 25 | Com Voltage Output. A capacitor should be connected between this pin and V_{SS} . |
| VCC | 26 | Power supply for analog circuit. |
| NC | 27 | No connection. |

7.4 GRAPHIC DISPLAY DATA RAM ADDRESS MAP

The GDDRAM is a bit mapped static RAM holding the bit pattern to be displayed. The size of the RAM is 132x64= 8448bits.

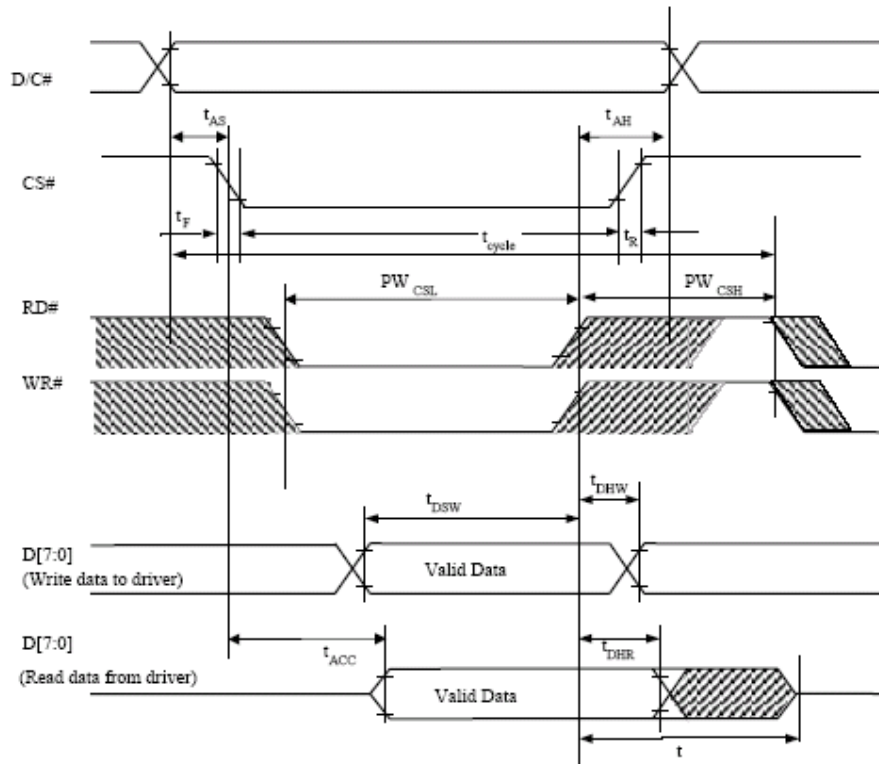
For mechanical flexibility, re-mapping on both Segment and Common outputs can be selected by software.

| OUT | Row Address | | | Column Address | OUT | | | | | | | | | | | | |
|--------|---------------|---------------|--------|----------------|-----------|-----------|------|------|------|------|------|------|------|------|--|--|--|
| | Direction='1' | Direction='0' | | | Remap='0' | Remap='1' | SEG0 | SEG1 | SEG2 | SEG3 | SEG4 | SEG5 | SEG6 | SEG7 | | | |
| COM0 | 0x3Fh | 0x00h | PAGE 0 | D0 | | | | | | | | | | | | | |
| COM1 | 0x3Eh | 0x01h | | D1 | | | | | | | | | | | | | |
| COM2 | 0x3Dh | 0x02h | | D2 | | | | | | | | | | | | | |
| COM3 | 0x3Ch | 0x03h | | D3 | | | | | | | | | | | | | |
| COM4 | 0x3Bh | 0x04h | | D4 | | | | | | | | | | | | | |
| COM5 | 0x3Ah | 0x05h | | D5 | | | | | | | | | | | | | |
| COM6 | 0x39h | 0x06h | | D6 | | | | | | | | | | | | | |
| COM7 | 0x38h | 0x07h | | D7 | | | | | | | | | | | | | |
| COM8 | 0x37h | 0x08h | PAGE 1 | D0 | | | | | | | | | | | | | |
| COM9 | 0x36h | 0x09h | | D1 | | | | | | | | | | | | | |
| COM10 | 0x35h | 0x0Ah | | D2 | | | | | | | | | | | | | |
| COM11 | 0x34h | 0x0Bh | | D3 | | | | | | | | | | | | | |
| COM12 | 0x33h | 0x0Ch | | D4 | | | | | | | | | | | | | |
| COM13 | 0x32h | 0x0Dh | | D5 | | | | | | | | | | | | | |
| COM14 | 0x31h | 0x0Eh | | D6 | | | | | | | | | | | | | |
| COM15 | 0x30h | 0x0Fh | | D7 | | | | | | | | | | | | | |
| COM16 | 0x2Fh | 0x10h | PAGE 2 | D0 | | | | | | | | | | | | | |
| COM17 | 0x2Eh | 0x11h | | D1 | | | | | | | | | | | | | |
| COM18 | 0x2Dh | 0x12h | | D2 | | | | | | | | | | | | | |
| COM19 | 0x2Ch | 0x13h | | D3 | | | | | | | | | | | | | |
| COM20 | 0x2Bh | 0x14h | | D4 | | | | | | | | | | | | | |
| COM21 | 0x2Ah | 0x15h | | D5 | | | | | | | | | | | | | |
| COM22 | 0x29h | 0x16h | | D6 | | | | | | | | | | | | | |
| COM23 | 0x28h | 0x17h | | D7 | | | | | | | | | | | | | |
| ... | | | | | | | | | | | | | | | | | |
| COM48 | 0x0Fh | 0x30h | PAGE 6 | D0 | | | | | | | | | | | | | |
| COM49 | 0x0Eh | 0x31h | | D1 | | | | | | | | | | | | | |
| COM50 | 0x0Dh | 0x32h | | D2 | | | | | | | | | | | | | |
| COM51 | 0x0Ch | 0x33h | | D3 | | | | | | | | | | | | | |
| COM52 | 0x0Bh | 0x34h | | D4 | | | | | | | | | | | | | |
| COM53 | 0x0Ah | 0x35h | | D5 | | | | | | | | | | | | | |
| COM54 | 0x09h | 0x36h | | D6 | | | | | | | | | | | | | |
| COM55 | 0x08h | 0x37h | | D7 | | | | | | | | | | | | | |
| COM56 | 0x07h | 0x38h | PAGE 7 | D0 | | | | | | | | | | | | | |
| COM57 | 0x06h | 0x39h | | D1 | | | | | | | | | | | | | |
| COM58 | 0x05h | 0x3Ah | | D2 | | | | | | | | | | | | | |
| COM59 | 0x04h | 0x3Bh | | D3 | | | | | | | | | | | | | |
| COM60 | 0x03h | 0x3Ch | | D4 | | | | | | | | | | | | | |
| COM61 | 0x02h | 0x3Dh | | D5 | | | | | | | | | | | | | |
| COM62 | 0x01h | 0x3Eh | | D6 | | | | | | | | | | | | | |
| COM63 | 0x00h | 0x3Fh | | D7 | | | | | | | | | | | | | |
| ... | | | | | | | | | | | | | | | | | |
| SEG128 | | | | | | | | | | | | | | | | | |
| SEG129 | | | | | | | | | | | | | | | | | |
| SEG130 | | | | | | | | | | | | | | | | | |
| SEG131 | | | | | | | | | | | | | | | | | |

7.5 INTERFACE TIMING CHART

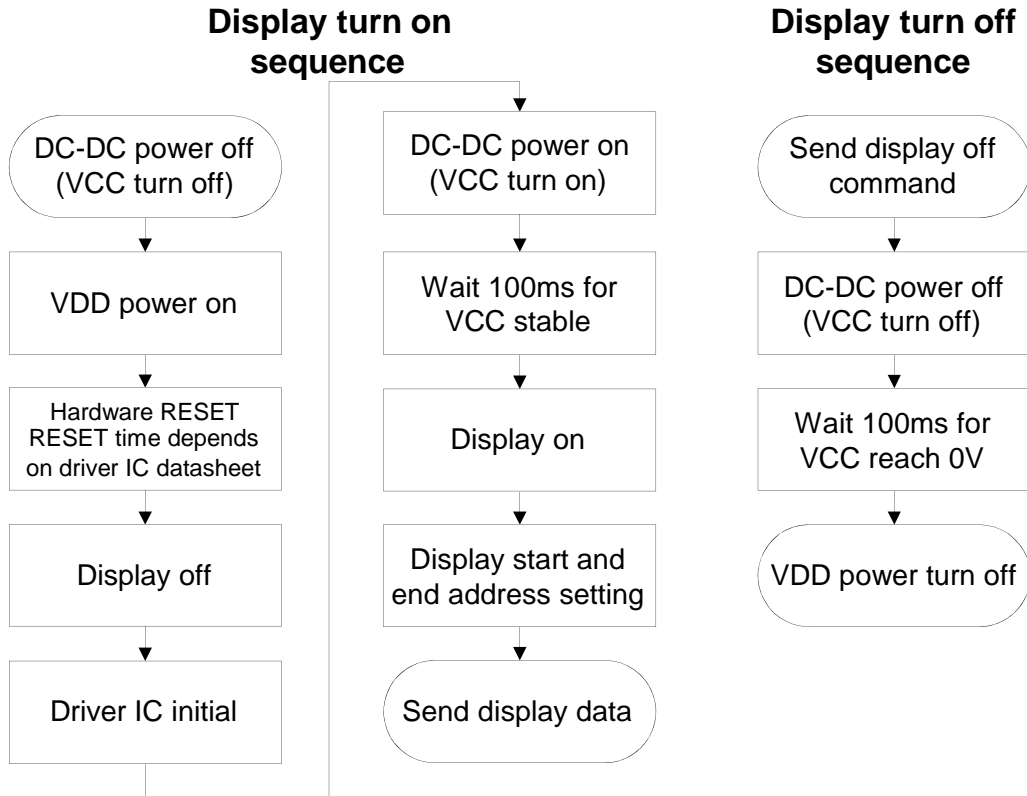
8080-Series MCU Parallel Interface Timing Characteristics

| Symbol | Parameter | Min | Typ | Max | Unit |
|-------------------|--------------------------------------|-----|-----|-----|------|
| t_{cycle} | Clock Cycle Time | 300 | - | - | ns |
| t_{AS} | Address Setup Time | 0 | - | - | 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 | - | - | 70 | ns |
| t_{ACC} | Access Time | - | - | 140 | ns |
| PW _{CSL} | Chip Select Low Pulse Width (read) | 120 | - | - | ns |
| | Chip Select Low Pulse Width (write) | 60 | - | - | ns |
| PW _{CSH} | Chip Select High Pulse Width (read) | 60 | - | - | ns |
| | Chip Select High Pulse Width (write) | 60 | - | - | ns |
| t_R | Rise Time | - | - | 15 | ns |
| t_F | Fall Time | - | - | 15 | ns |



8. POWER ON / OFF SEQUENCE & APPLICATION CIRCUIT

8.1 POWER ON / OFF SEQUENCE



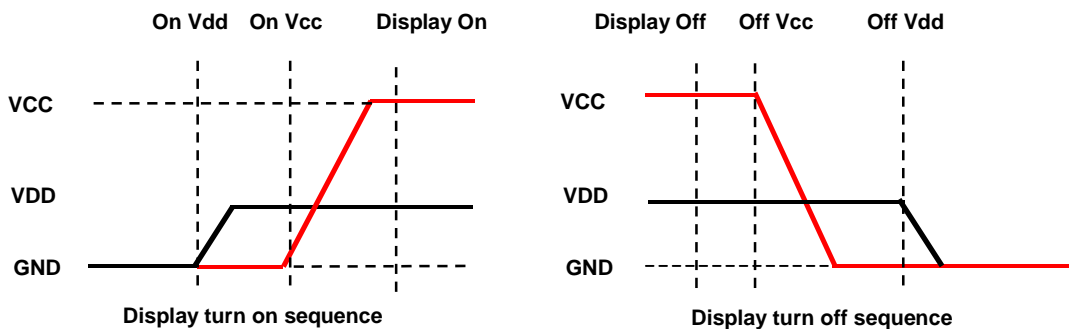
To protect OLED panel and extend the panel lifetime, the driver IC power up/down routine should include a delay period between high voltage and low voltage power sources turn on/off.

Power up Sequence:

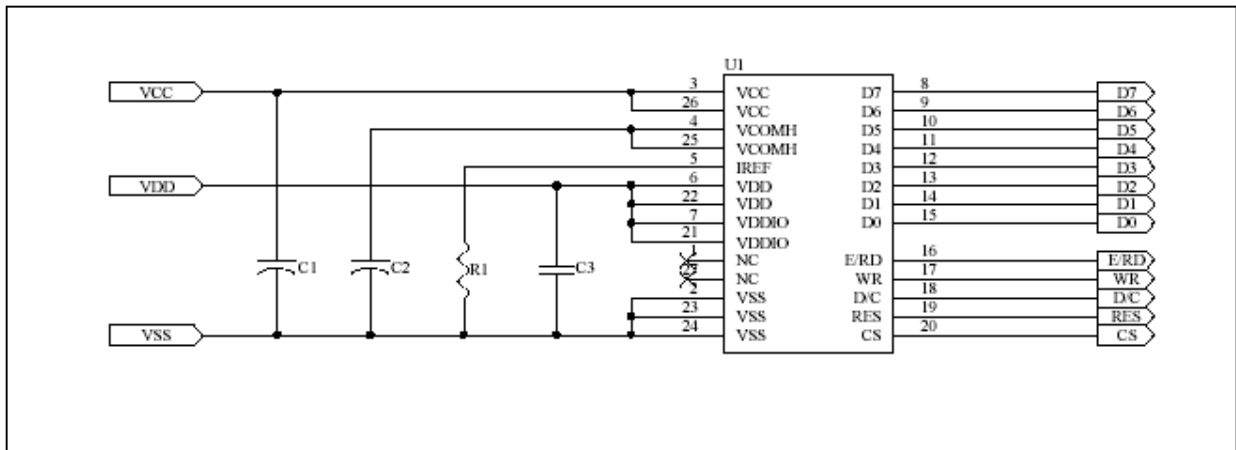
1. Power up Vdd
2. Hardware RESET
3. Send display off command
4. Power up Vcc
5. Delay 100ms (when Vcc is stable)
6. Send Display on command

Power down Sequence:

1. Send Display off command
2. Power down Vcc
3. Delay 100ms (When Vcc is reach 0 and panel is completely discharges)
4. Power down Vdd



8.2 APPLICATION CIRCUIT



8.3 COMMAND TABLE

Refer to IC Spec.: SSD1305

9. RELIABILITY TEST CONDITIONS

| No. | Items | Specification | Quantity |
|-----|---|---|----------|
| 1 | High temp. (Non-operation) | 85°C, 240hrs | 5 |
| 2 | High temp. (Operation) | 70°C, 120hrs | 5 |
| 3 | Low temp. (Operation) | -40°C, 120hrs | 5 |
| 4 | High temp. / High humidity (Operation) | 65°C, 90%RH, 120hrs | 5 |
| 5 | Thermal shock (Non-operation) | -40°C ~85°C (-40°C /30min; transit /3min; 85°C /30min; transit /3min) 1cycle: 66min, 100 cycles | 5 |
| 6 | Vibration | Frequency : 5~50HZ, 0.5G Scan rate : 1 oct/min Time : 2 hrs/axis Test axis : X, Y, Z | 1 Carton |
| 7 | Drop | Height: 120cm Sequence : 1 angle □ 3 edges and 6 faces 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. All-pixels-on is used as operation test pattern.
3. 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 ± 50% of initial value.

11. PACKING SPECIFICATION

| | | | |
|----|------------|--------------------------|------|
| | Revision | Date | Note |
| A1 | 2006/06/22 | Packing Tray Instruction | |

4G 矽膠乾燥劑(不織布)
P/N:3000000500

真空包裝袋 ONY/LDPE
P/N:3003000012
480x285x90mm
抽真空6秒，壓力170

Anistatic Bubble Bag
P/N:3003000013
420x(350~450)mm

Pizza Box
P/N:3001000005
345x285x88，B 裝

Label
P/N:3006000000
x2 pcs

單色 Carton
P/N:3000000009
385x305x203mm

Label
P/N:3006000000
x1 pcs

EPE Cover Foam
P/N:3002000102
285.4x228x1mm

P15101 Module
P/N:9815201000
Face Down
旋轉堆疊

Packing Tray
P/N:3008000080
330x270x11mm，±0.7mm

旋轉堆疊

以膠帶固定

旋轉放置

CONFIDENTIAL

| | | | | | |
|-------------------|---------------|--------|-------------|--------------|--------------------------|
| General Tolerance | | Scale | Unit | Sheet | PROJECT CODE |
| Length (mm) | Tolerance(mm) | 1:3.5 | mm | 1/1 | P15201 |
| 0 ~ 8 | ±0.1 | Module | Spec. | Approved | PART NAME |
| 8 ~ 25 | ±0.2 | M.E. | Irene Fan | Strong T sai | Packing Tray Instruction |
| 25 ~ 50 | ±0.3 | E.E. | David Li | Kevan Huang | PARTS NO. |
| | | M.E. | Iven Lee | Strong T sai | 9915201000 |
| | | E.E. | Kevan Huang | Strong T sai | REVISION |
| | | | | | 01 |
| | | | | | REVISION |
| | | | | | 01 |

| Item | Part No. | Description | QTY |
|------|------------|--------------------------------------|-----|
| 1 | 9815201000 | P15201 Module Assy | 480 |
| 2 | 3008000080 | Tray 330x270x11mm, PET, ±0.7mm | 24 |
| 3 | 3002000102 | EPE Cover Foam 285.4x228x1mm | 40 |
| 4 | 3000000500 | 4G 矽膠乾燥劑(不織布) | 10 |
| 5 | 3003000012 | 真空包裝袋 480x285x90mm | 2 |
| 6 | 3003000013 | Anistatic Bubble Bag 420x(350~450)mm | 2 |
| 7 | 3001000005 | Pizza Box 345x285x88，B 裝 | 2 |
| 8 | 3006000000 | Label 385x305x203mm | 1 |
| 9 | 3006000000 | Label | 3 |
| 10 | 3006000000 | 打膠膠帶 W=6mm, L=90cm | |

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12. 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 T_r 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 T_f 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.

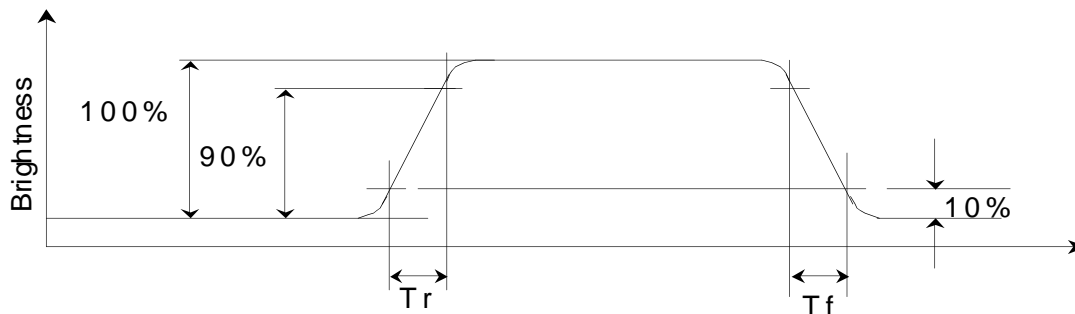


Figure 2 Response time

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.

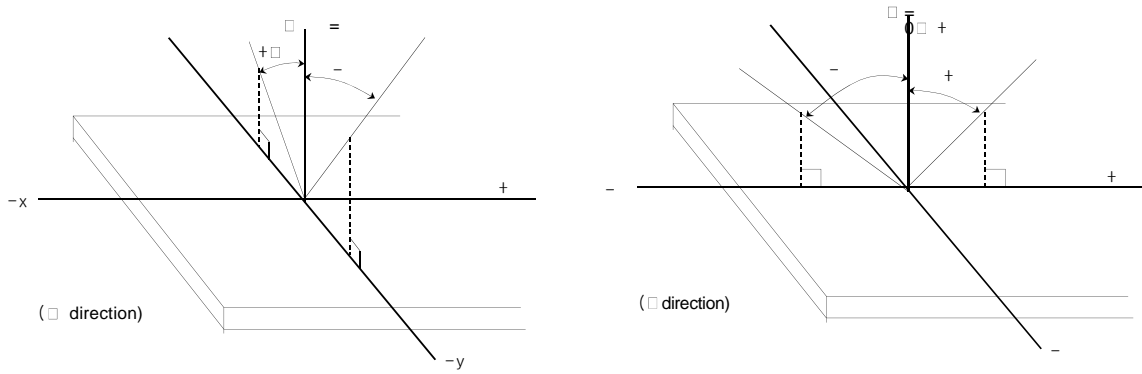
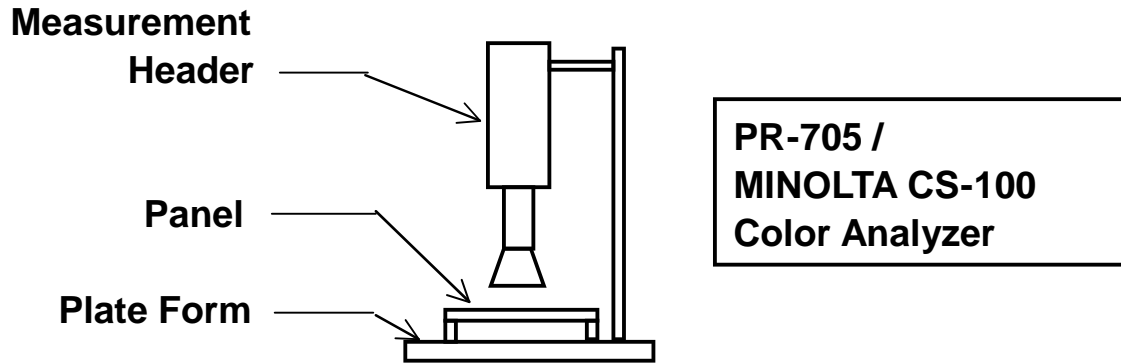


Figure 3 Viewing angle

APPENDIX 2: MEASUREMENT APPARATUS

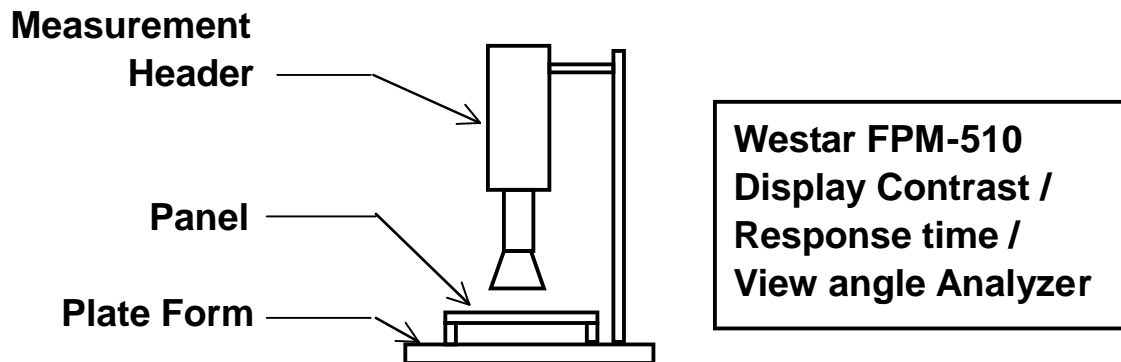
A. LUMINANCE/COLOR COORDINATE

PHOTO RESEARCH PR-705, MINOLTA CS-100

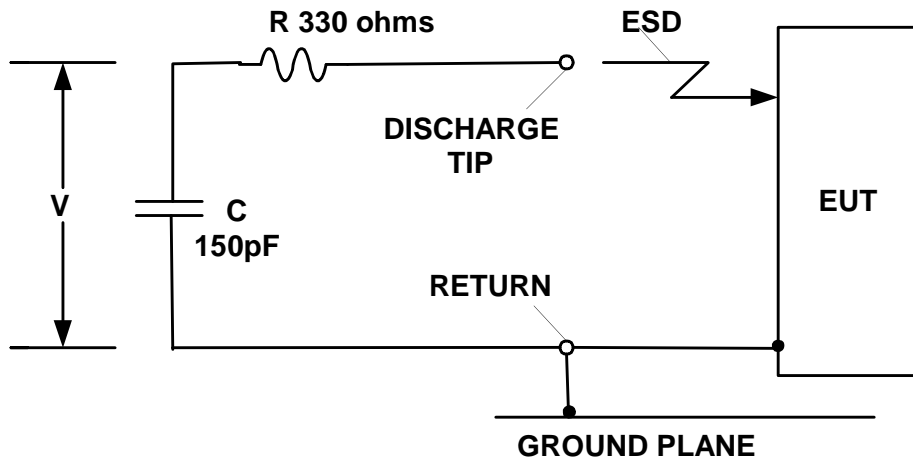


B. CONTRAST / RESPONSE TIME / VIEWING ANGLE

WESTAR CORPORATION FPM-510



C. ESD ON AIR DISCHARGE MODE



APPENDIX 3: PRECAUTIONS

A. RESIDUE IMAGE

Because the pixels are lighted in different time, the luminance of active pixels may reduce or differ from inactive pixels. Therefore, the residue image will occur. To avoid the residue image, every pixel needs to be lighted up uniformly.