
Specification for Approval

PRODUCT NAME: GPO12832T2.23
PRODUCT NO.:

CUSTOMER
APPROVED BY
DATE:

REVISION RECORD

REV.	REVISION DESCRIPTION	REV. DATE	REMARK
X01	INITIAL RELEASE	2013. 09. 06	
A01	■ Transfer from X version ■ Add the information of module weight ■ Add the packing specification	2013. 11. 20	Page 5 & 17
A02	■ Add adhesive	2013. 12. 31	Page 4, 5 & 16

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1. FEATURES

- Small molecular organic light emitting diode.
 - Color : White
 - Panel matrix : 128*32
 - Driver IC : SSD1305
 - Excellent quick response time.
 - Extremely thin thickness for best mechanism design : 2.427mm
 - High contrast : 2000:1
 - Wide viewing angle : 160°
 - 8-bit 6800-series Parallel Interface, 8-bit 8080-series Parallel Interface, Serial Peripheral Interface, I²C Interface.
 - Wide range of operating temperature : -40 to 70 °C
 - Anti-glare polarizer.
-

4. MECHANICAL DATA

NO	ITEM	SPECIFICATION	UNIT
1	Dot Matrix	128 (W) x 32 (H)	dot
2	Dot Size	0.41 (W) x 0.39 (H)	mm ²
3	Dot Pitch	0.43 (W) x 0.41 (H)	mm ²
4	Aperture Rate	90	%
5	Active Area	55.02 (W) x 13.1 (H)	mm ²
6	Panel Size	62 (W) x 24 (H)	mm ²
7*	Panel Thickness	1.82 ± 0.1	mm
8	Module Size	62 (W) x 60 (H) x 2.427 (D)	mm ³
9	Diagonal A/A size	2.23	inch
10	Module Weight	6.22 ± 10%	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	3.5	V	$T_a = 25^\circ\text{C}$	IC maximum rating
Supply Voltage (V_{CC})	8	16	V	$T_a = 25^\circ\text{C}$	IC maximum rating
Operating Temp.	-40	70	$^\circ\text{C}$		
Storage Temp	-40	85	$^\circ\text{C}$		
Humidity	-	85	%		
Life Time	15,000	-	Hrs	200 cd/m ² , 50% checkerboard	Note (1)
Life Time	16,000	-	Hrs	180 cd/m ² , 50% checkerboard	Note (2)
Life Time	18,000	-	Hrs	160 cd/m ² , 50% checkerboard	Note (3)

Note:

(A) Under $V_{CC} = 12.5\text{V}$, $T_a = 25^\circ\text{C}$, 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.

(C) More command setting (Initial code), please see the application note.

(1) Setting of 200 cd/m² :

- Contrast setting : 0xc6
- Set Vcomh: 0x3c
- Frame rate : 105Hz
- Duty setting : 1/32

(2) Setting of 180 cd/m² :

- Contrast setting : 0xae
- Set Vcomh: 0x3c
- Frame rate : 105Hz
- Duty setting : 1/32

(3) Setting of 160 cd/m² :

- Contrast setting : 0x9a
 - Set Vcomh: 0x3c
 - Frame rate : 105Hz
 - Duty setting : 1/32
-

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)	-	12	12.5	13	V
V_{DD}	Digital power supply	-	2.4	-	3.5	V
V_{DDIO}	Power supply for I/O pins	-	1.6	-	V_{DD}	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	300	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	1000	μA
V_{IH}	Hi logic input level		0.8* V_{DDIO}	-	-	V
V_{IL}	Low logic input level		-	-	0.2* V_{DDIO}	V
V_{OH}	Hi logic output level		0.9* V_{DDIO}	-	-	V
V_{OL}	Low logic output level		-	-	0.1* V_{DDIO}	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	-	33	35	mA	All pixels on (1)
Standby mode current consumption	-	2	3	mA	Standby mode 10% pixels on(2)
Normal mode power consumption	-	412.5	437.5	mW	All pixels on (1)
Standby mode power consumption	-	25	37.5	mW	Standby mode 10% pixels on(2)
Normal Luminance	160	180		cd/m ²	Display Average
Standby Luminance	-	20			
CIE _x (White)	0.25	0.29	0.33		x, y (CIE 1931)
CIE _y (White)	0.27	0.31	0.35		
Dark Room Contrast	2000:1				
Viewing Angle	160			degree	
Response Time		10		μs	

(1) Normal mode condition :

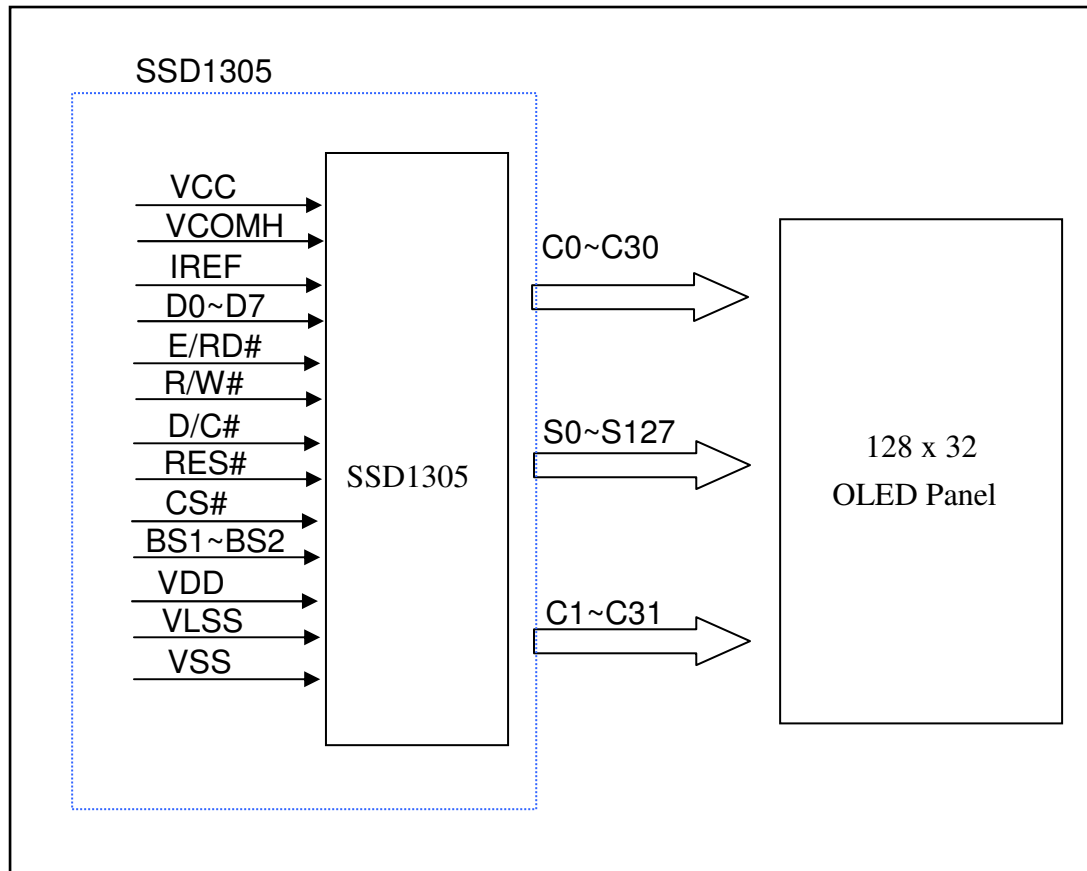
- Driving Voltage : 12.5V
- Contrast setting : 0xae
- Set Vcomh: 0x3c
- Frame rate : 105Hz
- Duty setting : 1/32

(2) Standby mode condition :

- Driving Voltage : 12.5V
 - Contrast setting : 0x0f
 - Set Vcomh: 0x3c
 - Frame rate : 105Hz
 - Duty setting : 1/32
-

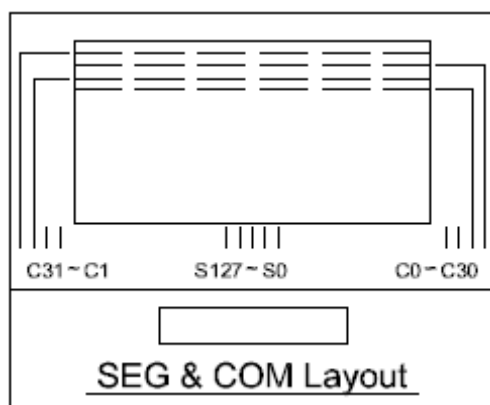
7. INTERFACE

7.1 FUNCTION BLOCK DIAGRAM



128x32 OLED Module

7.2 PANEL LAYOUT DIAGRAM



7.3 PIN ASSIGNMENTS

Pin No.	Pin Name	Description
1	NC	No connection.
2	VLSS	It should be connect to VSS externally.
3	VSS	This is ground pin.
4	NC	No connection.
5	VDD	Power supply pin for core logic operation.
6	BS1	Interface select pin.
7	BS2	Interface select pin.
8	CS#	Chip select input.
9	RES#	Reset signal input.
10	D/C#	Data/Command control pin. Pull high for write/read display data. Pull log for write command or read status.
11	R/W#	Data write operation is initiated when it's pull low.
12	E/RD#	Data read operation is initiated when it's pull low.
13	D0	These pins are bi-directional data bus connecting to the MCU data bus. When serial interface mode is selected, D0 will be the serial clock input: SCL; D1 will be the serial data input: SDA and D2 should be kept NC. When I2C mode is selected, D2, D1 should be tied together and serve as SDAout, SDAin in application and D0 is the serial clock input, SCL.
14	D1	
15	D2	
16	D3	
17	D4	
18	D5	
19	D6	
20	D7	
21	IREF	The current reference input pin. This pin should be connected to ground through a resistor.
22	VCOMH	The COM voltage reference pin, This pin should be connected to ground through a capacitor.
23	VCC	Power supply for panel driving voltage.
24	NC	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 $132 \times 64 = 8448$ bits.

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

Row Address			Column Address		OUT							
Direction = '1' Direction = '0'					Remap = '0'		Remap = '1'					
OUT												
COM0	0x3Fh	0x00h	PAGE 0	D0					SEG0			
COM1	0x3Eh	0x01h		D1					SEG1			
COM2	0x3Dh	0x02h		D2					SEG2			
COM3	0x3Ch	0x03h		D3					SEG3			
COM4	0x3Bh	0x04h		D4					SEG4			
COM5	0x3Ah	0x05h		D5					SEG5			
COM6	0x39h	0x06h		D6					SEG6			
COM7	0x38h	0x07h		D7					SEG7			
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								

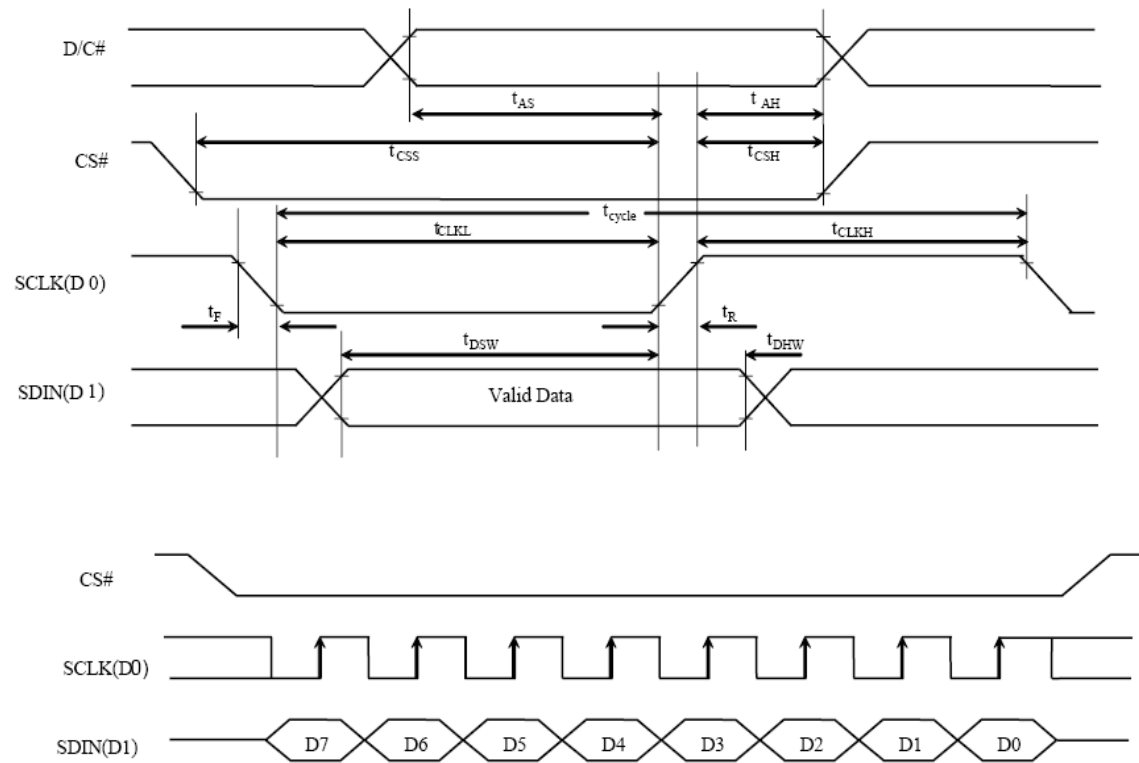
7.5 INTERFACE TIMING CHART

Serial Interface Timing Characteristics

($V_{DD} - V_{SS} = 2.4V$ to $3.5V$, $V_{DDIO} = V_{DD}$, $T_A = 25^\circ C$)

Symbol	Parameter	Min	Typ	Max	Unit
t_{cycle}	Clock Cycle Time	250	-	-	ns
t_{AS}	Address Setup Time	150	-	-	ns
t_{AH}	Address Hold Time	150	-	-	ns
t_{CSS}	Chip Select Setup Time	120	-	-	ns
t_{CSH}	Chip Select Hold Time	60	-	-	ns
t_{DSW}	Write Data Setup Time	50	-	-	ns
t_{DHW}	Write Data Hold Time	15	-	-	ns
t_{CLKL}	Clock Low Time	100	-	-	ns
t_{CLKH}	Clock High Time	100	-	-	ns
t_R	Rise Time	-	-	40	ns
t_F	Fall Time	-	-	40	ns

Serial Interface Characteristics



8. POWER ON / OFF SEQUENCE & APPLICATION CIRCUIT

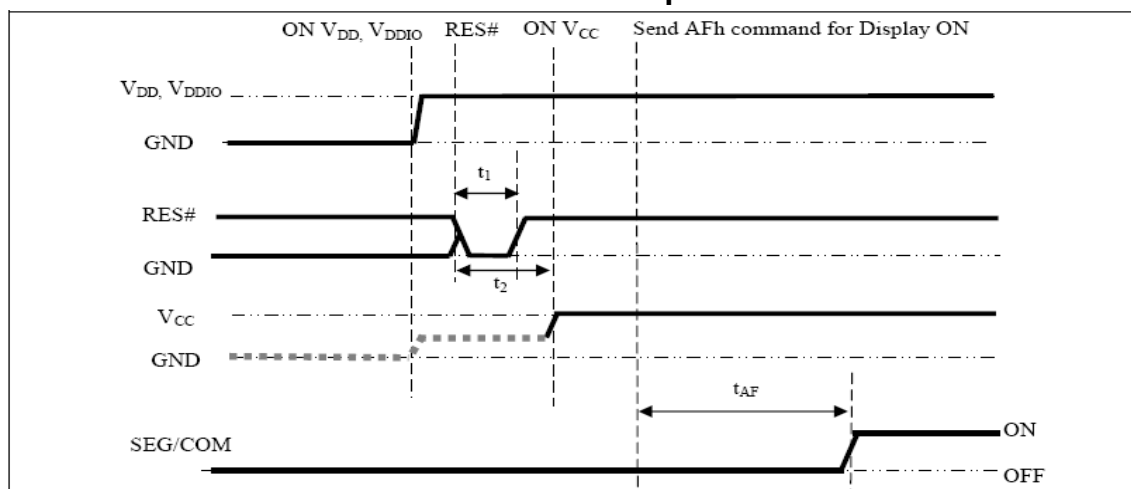
8.1 POWER ON / OFF SEQUENCE

The following figures illustrate the recommended power ON and power OFF sequence of SSD1305.

Power ON sequence :

1. Power ON V_{DD} , V_{DDIO} .
2. After V_{DD} , V_{DDIO} become stable, set RES# pin LOW (logic low) for at least $3\mu s(t_1)^{(4)}$ and then HIGH (logic high).
3. After set RES# pin LOW (logic low), wait for at least $3\mu s(t_2)$. Then Power ON $V_{CC}^{(1)}$.
4. After V_{CC} become stable, send command AFh for display ON. SEG/COM will be ON after $100ms(t_{AF})$.

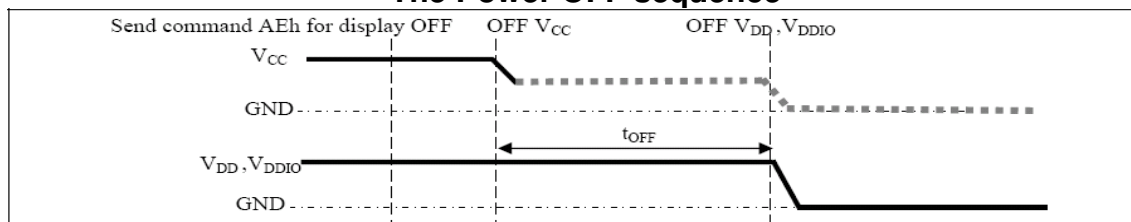
The Power ON sequence



Power OFF sequence:

1. Send command AEh for display OFF.
2. Power OFF $V_{CC}^{(1), (2), (3)}$
3. Wait for t_{OFF} . Power OFF V_{DD} , V_{DDIO} . (where Minimum $t_{OFF}=80ms^{(5)}$, Typical $t_{OFF}=100ms$)

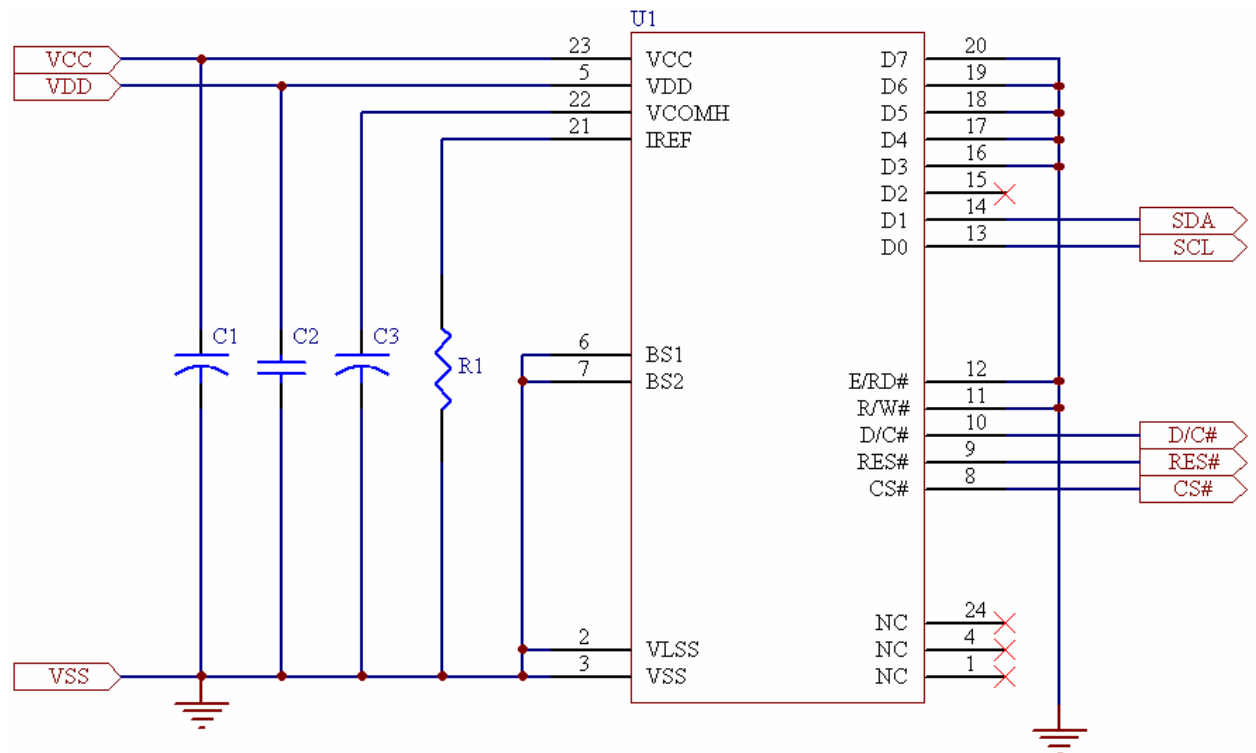
The Power OFF sequence



Note:

- (1) Since an ESD protection circuit is connected between V_{DD} , V_{DDIO} and V_{CC} , V_{CC} becomes lower than V_{DD} whenever V_{DD} , V_{DDIO} is ON and V_{CC} is OFF as shown in the dotted line of V_{CC} in above figures.
 - (2) V_{CC} should be kept disabled when it is OFF.
 - (3) Power Pins(V_{DD} , V_{CC}) can never be pulled to ground under any circumstance.
 - (4) The register values are reset after t_1 .
 - (5) V_{DD} should not be Power OFF before V_{CC} Power OFF.
-

8.2 APPLICATION CIRCUIT



Recommend components :

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

C2 : 4.7uF/16V (0805)

R1 : 1M ohm 1% (0603)

This circuit is designed for SPI interface.

8.3 COMMAND TABLE

Refer to SSD1305 IC Spec.

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 $\pm$ 50% of initial value.
-

Revision		Date	Note
.01		2013/11/08	Packing Tray Instruction

80L9825704000
Module Ass'y For P25704 x16 pcs

①

700P257021002 ②
Tray 330x270x8.7mm T=0.5mm, PET, P25702

RTD3010000003
③ 5G Silica Gel Desiccants
5G 乾燥劑

x 1 pcs (empty)

x 4 pcs

x 20 pcs

x 21 pcs
⑨ Tape
3208000125

Vacuum packing : 4 sec
抽真空 : 4 秒

④ RTD3003000012
Vacuum Bag ONY/LDPE
真空包裝袋
480x285x90

⑤ RTD3003000016
Antistatic Bubble bag 440x(350+450)mm
抗靜電氣泡袋

⑥ RTD3001000005
Pizza Box 345x285x88,B corrugated

⑦ RTD3000000009
Carton 385x305x203mm

⑧ RTD3006000000
Label x2 pcs

⑧ RTD3006000000
Label x1 pcs

ITEM	PART No.	DESC	QTY
	80L9825704000		1
1	80L9825704000	Module Ass'y For P25704	640
2	700P257021002	Tray 330x270x8.7 T:0.5mm PET P25702	42
3	RTD3010000003	5G Silica Gel Desiccants	8
4	RTD3003000012	Vacuum Bag ONY/LDPE 480x285x90	2
5	RTD3003000016	Antistatic Bubble bag 440x(350+450)mm	2
6	RTD3001000005	Pizza Box 345x285x88,B corrugated	2
7	RTD3000000009	Carton 385x305x203mm	1
8	RTD3006000000	Label	3
9	RTD3208000125	Tape, W=48mm, L=910cm	

General Tolerance		CONFIDENTIAL	Scale	Unit	Sheet	PROJECT CODE	
Length (mm)	Tolerance(mm)	Third Angle Projection M.E. E.E.	1:15	mm	1/1	PART NAME	VERSION
0 ~ 8	±0.1		Module	Spec.	Approved	Packing Tray Instruction	01
8 ~ 25	±0.2					PARTS NO.	VERSION
25 ~ 50	±0.3						01

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.

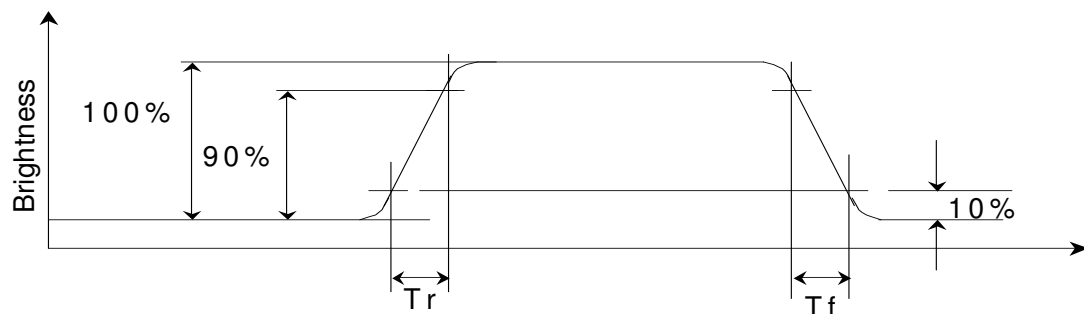


Figure 2: Response time

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.

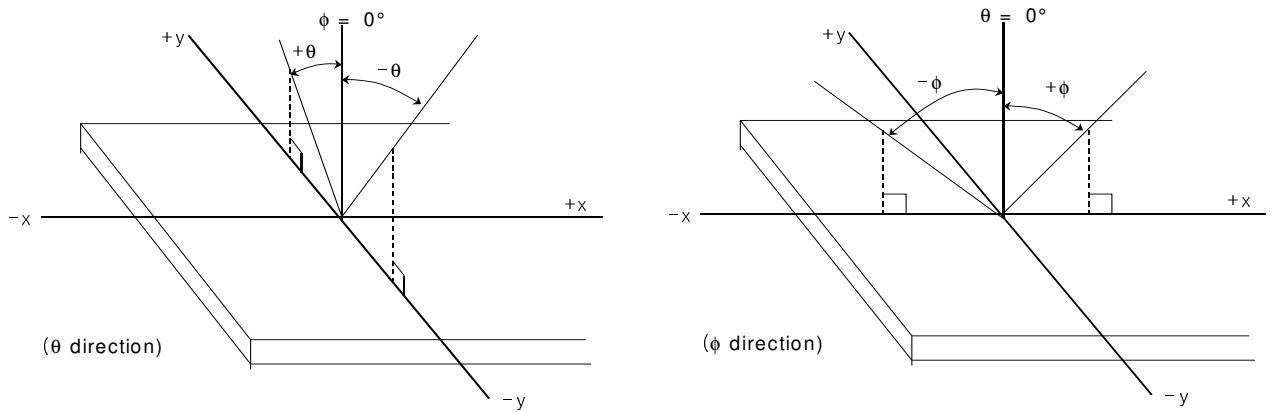
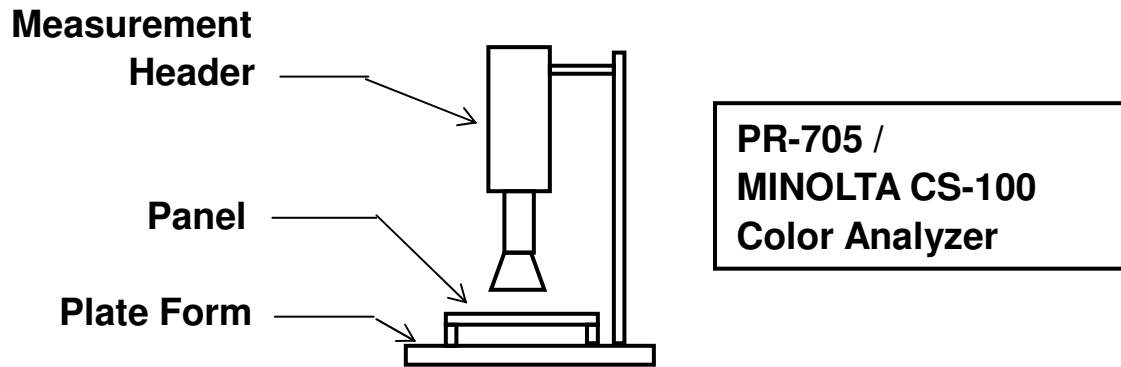


Figure 3: Viewing Angle

APPENDIX 2: MEASUREMENT APPARATUS

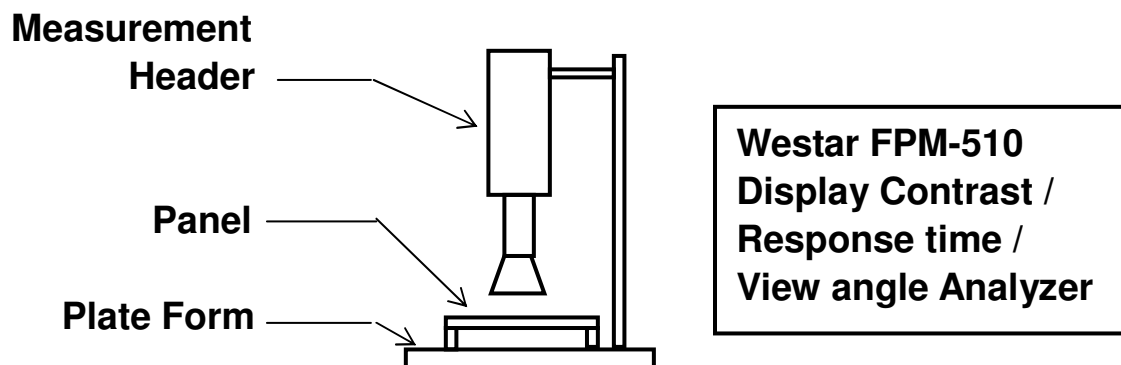
A. LUMINANCE/COLOR COORDINATE

PHOTO RESEARCH PR-705, MINOLTA CS-100

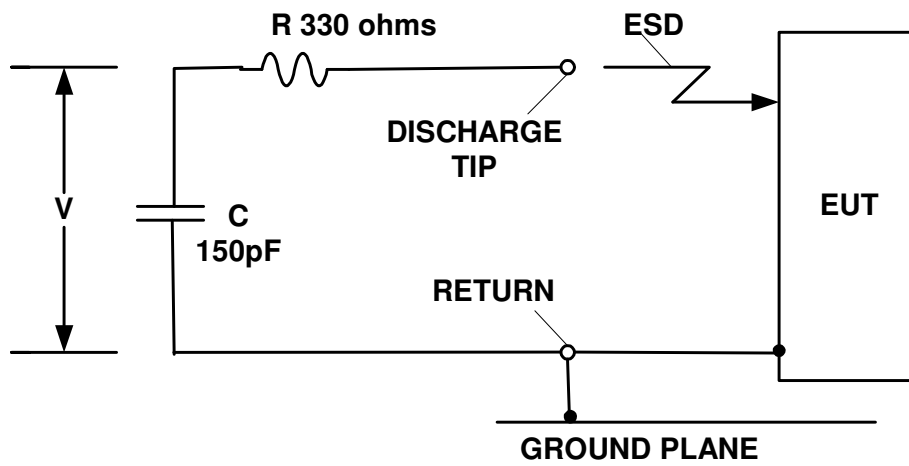


B. CONTRAST / RESPONSE TIME / VIEW ANGLE

WESTAR CORPORATION FPM-510



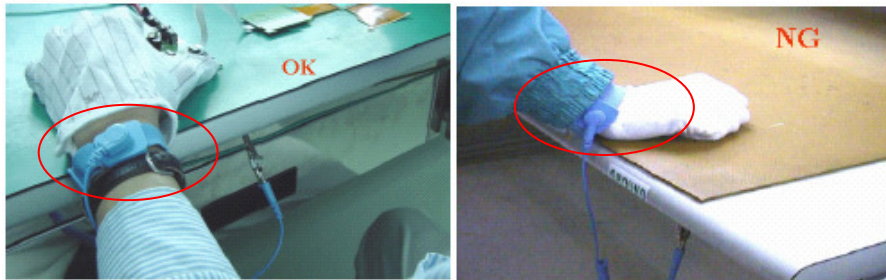
C. ESD ON AIR DISCHARGE MODE



APPENDIX 3: PRECAUTIONS FOR USING THE OLED MODULE

Precautions for Handling

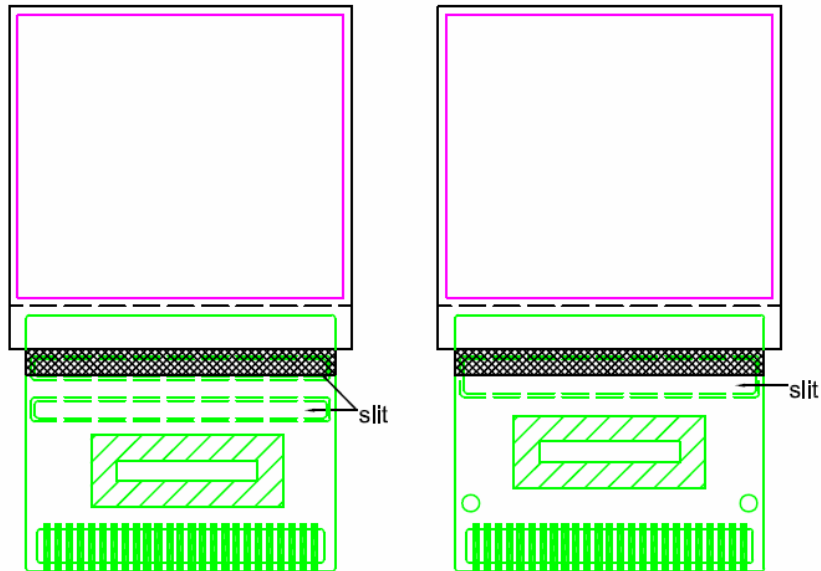
1. When handling the module, wear powder-free antistatic rubber finger cots, and be careful not to bend and twist it.
2. The OLED module is consisted of glass and film, and it should avoid pressure, strong impact, or being dropped from a high position.
3. The OLED module is an electronic component and 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. Also, ground the tools being used for panel assembly and make sure the working environment is not too dry to cause ESD problems. Antistatic wrist strap should touch human body directly instead of gloves. (See below photos).



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.

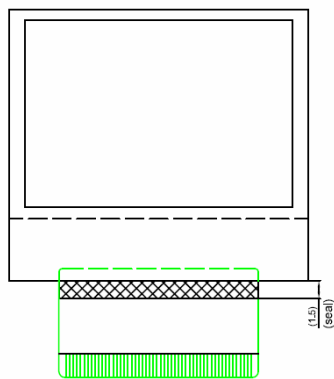


-
8. Please do not bend the film near the substrate glass. It could cause film peeling and TAB/FPC/COF damage. For TAB, It should bend the slit area as actual OLED it is. For FPC or COF, it is suggested to follow below pictures for instruction (distance between substrate glass and bending area $>1.5\text{mm}$;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

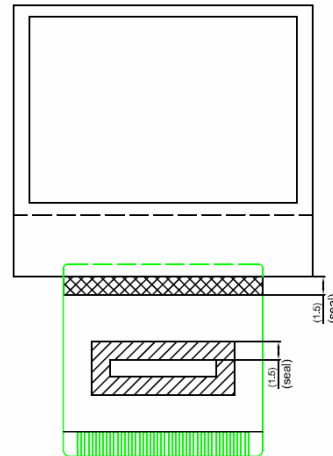


TAB

TAB



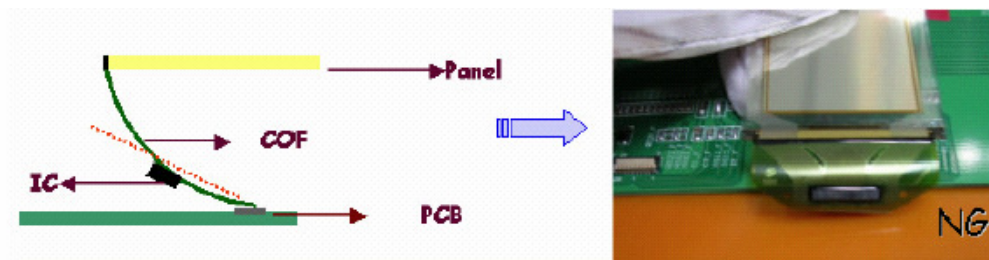
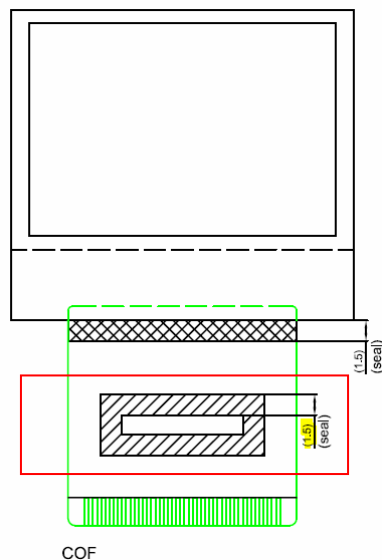
FPC



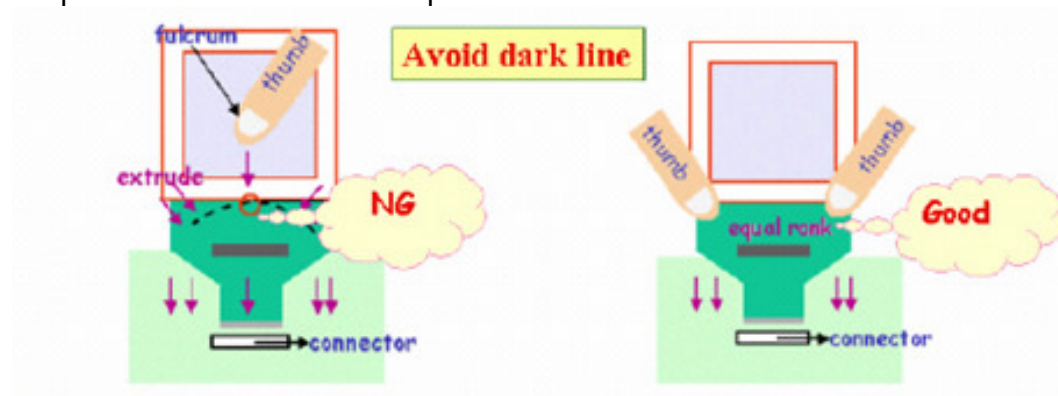
COF



-
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 $>1.5\text{mm}$.

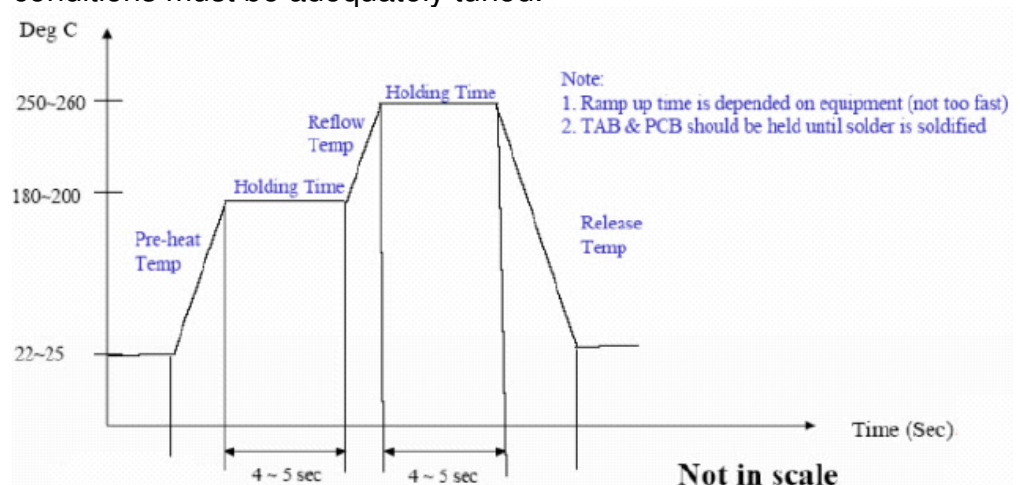


10. Use both thumbs to insert COF into the connector when assembling the panel. Please refer to the photo.



11. The working area for the panel should be kept clean. If the panel is accidentally dropped on the floor, do visual inspection of the panel first. Please use clean-room wiping cloth moistened with alcohol to wipe it off if dirt or grease stains the panel.
-

-
12. 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.
 13. 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.
 14. 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.
 15. Solder residues arise from soldering process have to be cleaned up thoroughly before the module assembly.
 16. Use the voltage and current settings listed in the specification to do the function test after the module assembly.
 17. 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.
 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: $280\pm 5^{\circ}\text{C}$ at 3-5secs
 - 2. Solder wire contact TAB lead directly (near iron but not contact): $380\pm 5^{\circ}\text{C}$, 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. Design using the settings in the specification

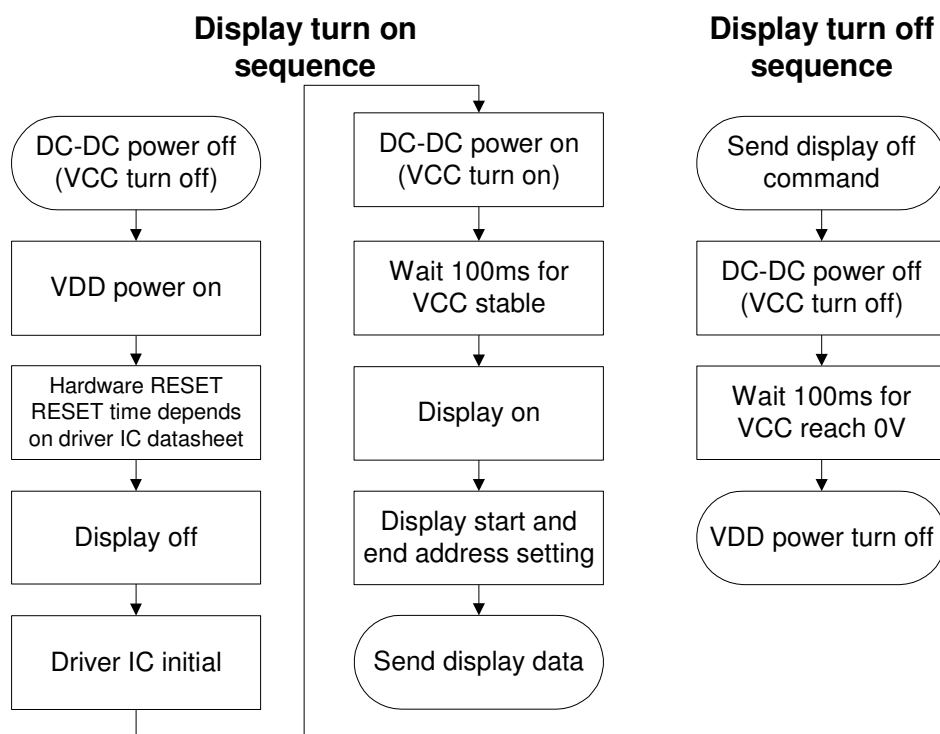
It is very important to design and operate the panel using the settings listed in the specification. It includes voltage, current, frame rate and duty cycle... etc. Operation the OLED outside the range of the specification should be entirely avoided to ensure proper operation of the OLED.

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

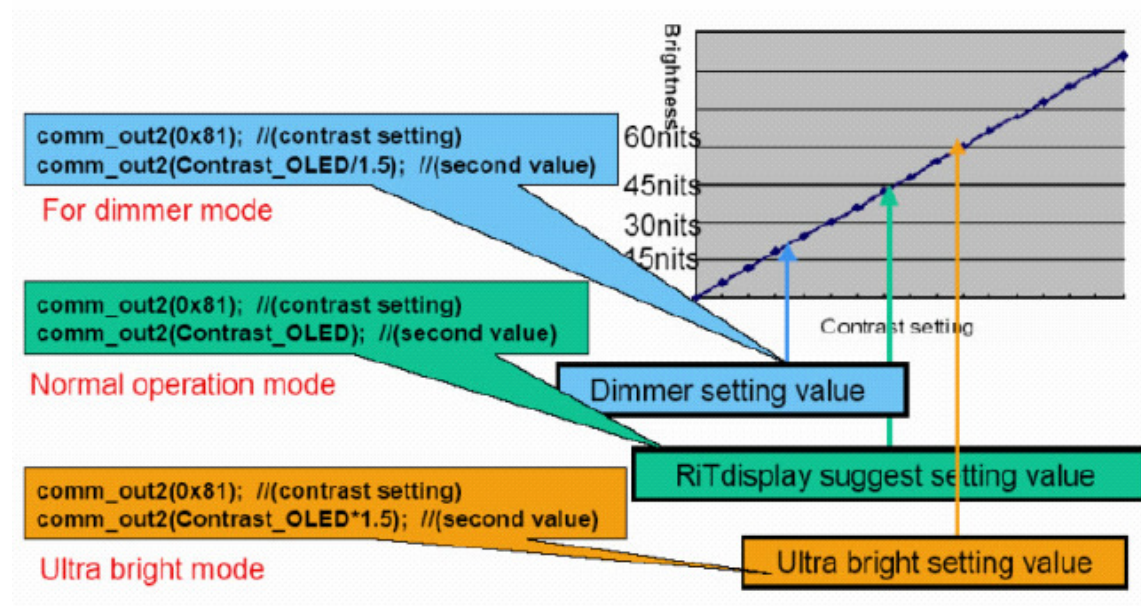
To avoid any inadvertent effects resulting from inappropriate power on/off operations, please follow the directions of power on/off procedure on page 6. Any operation that does not comply with the procedure could cause permanent damage of the IC and should be avoided. When the logic power is not on, 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.



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 three 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. 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.



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
```

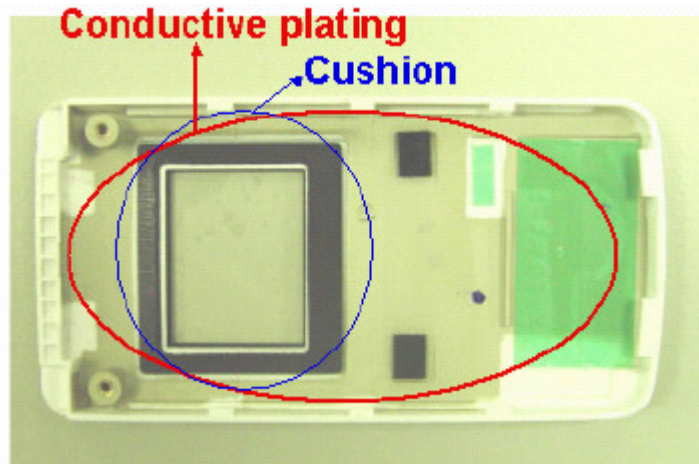
Example: stop

```
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 $25^{\circ}\text{C} \pm 5^{\circ}\text{C}$, $55\% \pm 10\%\text{RH}$. 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.