SPECIFICATION

PART NO. : OEL9M0068-W-E

This specification may be changed without any notice in order to improve performance or quality etc.
Please contact TRULY Semiconductors LTD. OLED R&D department for updated specification and product status before designing for this product or releasing the order.

PRODUCT CONTENTS

TRULY®信利		Customer	
Written by	Mi Chaofeng	Approved by	
Checked by	Yang Xueyu		
Approved by	Zhang Weicang		

REVISION HISTORY

Rev.	Contents	Date
0.0	First release	2010-09-07
1.0	Update the schematic	2011-12-12
1.1	Update the drawing(P.5) and update electro-optical characteristics	2014-04-03

n PHYSICAL DATA

No.	Items:	Specification:	Unit
1	Diagonal Size	0.91	Inch
2	Resolution	128(H) x 32(V)	Dots
3	Active Area	22.38(W) x 5.58(H)	mm^2
4	Outline Dimension (Panel)	30.00(W) x 11.50(H)	mm^2
5	Pixel Pitch	0.175(W) x 0.175(H)	mm^2
6	Pixel Size	0.155(W) x 0.155(H)	mm^2
7	Driver IC	SSD1307Z	-
8	Display Color	White	-
9	Gray Scale	1	Bit
10	Interface	SPI/IIC	-
11	IC package type	COG	-
12	Thickness	1.45±0.1	mm
13	Weight	TBD	g
14	Duty	1/32	-

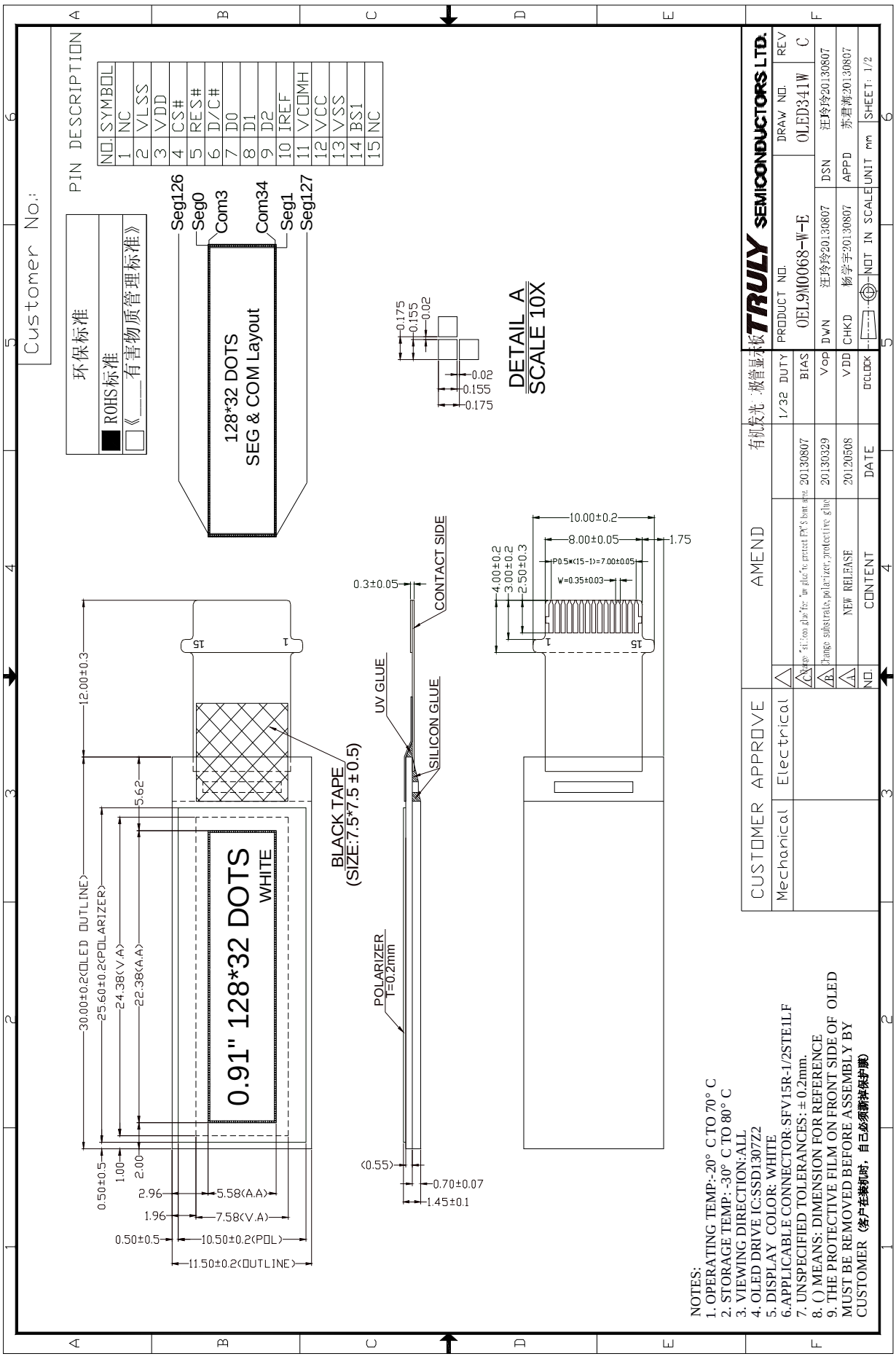
n ABSOLUTE MAXIMUM RATINGS

Unless otherwise specified, V_{SS} = 0V (Ta = 25℃)

Items		Symbol	Min	Typ.	Max	Unit
Supply Voltage	Logic	V_{DD}	-0.3	-	4	V
	Driving	V_{CC}	0	-	16.0	V
Operating Temperature		Top	-20	-	70	℃
Storage Temperature		Tst	-30	-	80	℃
Humidity		-	-	-	90	%RH

NOTE:
Permanent device damage may occur if **ABSOLUTE MAXIMUM RATINGS** are exceeded. Functional operation should be restricted to the conditions as detailed in the operational sections of this data sheet. Exposure to absolute maximum rating conditions for extended periods may affect reliability.

n EXTERNAL DIMENSIONS



n ELECTRICAL CHARACTERISTICS

◆DC Characteristics

Unless otherwise specified, V_{SS} = 0V ,V_{DD}=1.65V to 3.3V (Ta = 25℃)

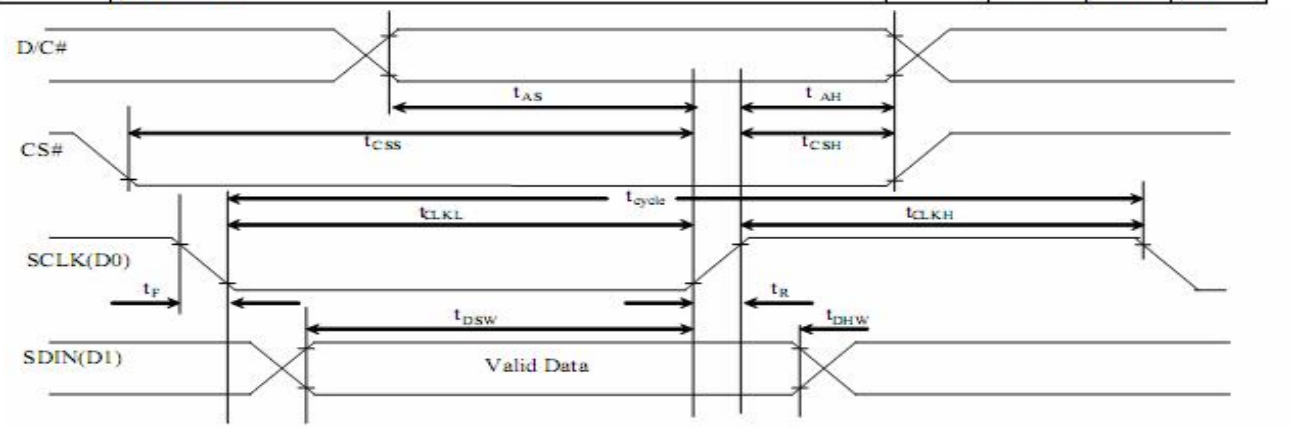
Items		Symbol	Min	Typ.	Max	Unit
Supply Voltage	Logic	V_{DD}	1.65	-	3.3	V
	Operating	V_{CC}	7.0	-	15.0	V
Input Voltage	High Voltage	V_{IH}	0.8 x V_{DD}	-	-	V
	Low Voltage	V_{IL}	-	-	0.2 x V_{DD}	V
Output Voltage	High Voltage	V_{OH}	0.9 x V_{DD}	-	-	V
	Low Voltage	V_{OL}	-	-	0.1x V_{DD}	V

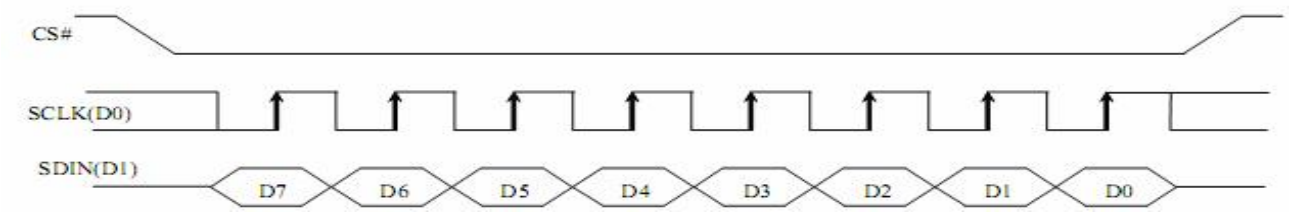
◆AC Characteristics

1. SPI Interface

(VDD - VSS = 1.65V~3.3V, TA = 25°C)

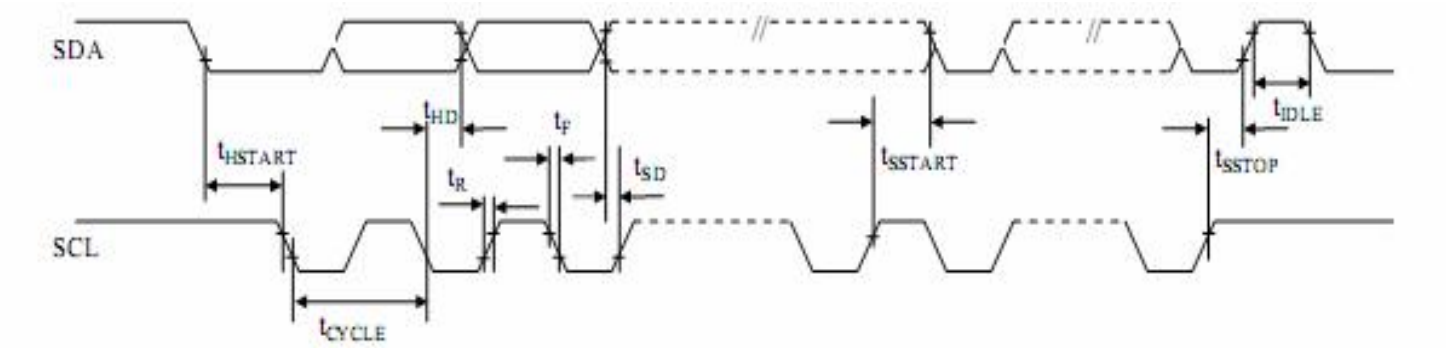
Symbol	Parameter	Min	Typ	Max	Unit
t_{cycle}	Clock Cycle Time	100	-	-	ns
t_{AS}	Address Setup Time	15	-	-	ns
t_{AH}	Address Hold Time	15	-	-	ns
t_{CSS}	Chip Select Setup Time	20	-	-	ns
t_{CSH}	Chip Select Hold Time	10	-	-	ns
t_{DSW}	Write Data Setup Time	15	-	-	ns
t_{DHW}	Write Data Hold Time	15	-	-	ns
t_{CLKL}	Clock Low Time	20	-	-	ns
t_{CLKH}	Clock High Time	20	-	-	ns
t_R	Rise Time	-	-	40	ns
t_F	Fall Time	-	-	40	ns





2. IIC Interface

Symbol	Parameter	Min	Typ	Max	Unit
t_{cycle}	Clock Cycle Time	2.5	-	-	us
t_{HSTART}	Start condition Hold Time	0.6	-	-	us
t_{HD}	Data Hold Time (for "SDA_{OUT}" pin)	0	-	-	ns
	Data Hold Time (for "SDA_{IN}" pin)	300	-	-	ns
t_{SD}	Data Setup Time	100	-	-	ns
t_{SSTART}	Start condition Setup Time (Only relevant for a repeated Start condition)	0.6	-	-	us
t_{SSTOP}	Stop condition Setup Time	0.6	-	-	us
t_R	Rise Time for data and clock pin	-	-	300	ns
t_F	Fall Time for data and clock pin	-	-	300	ns
t_{IDLE}	Idle Time before a new transmission can start	1.3	-	-	us

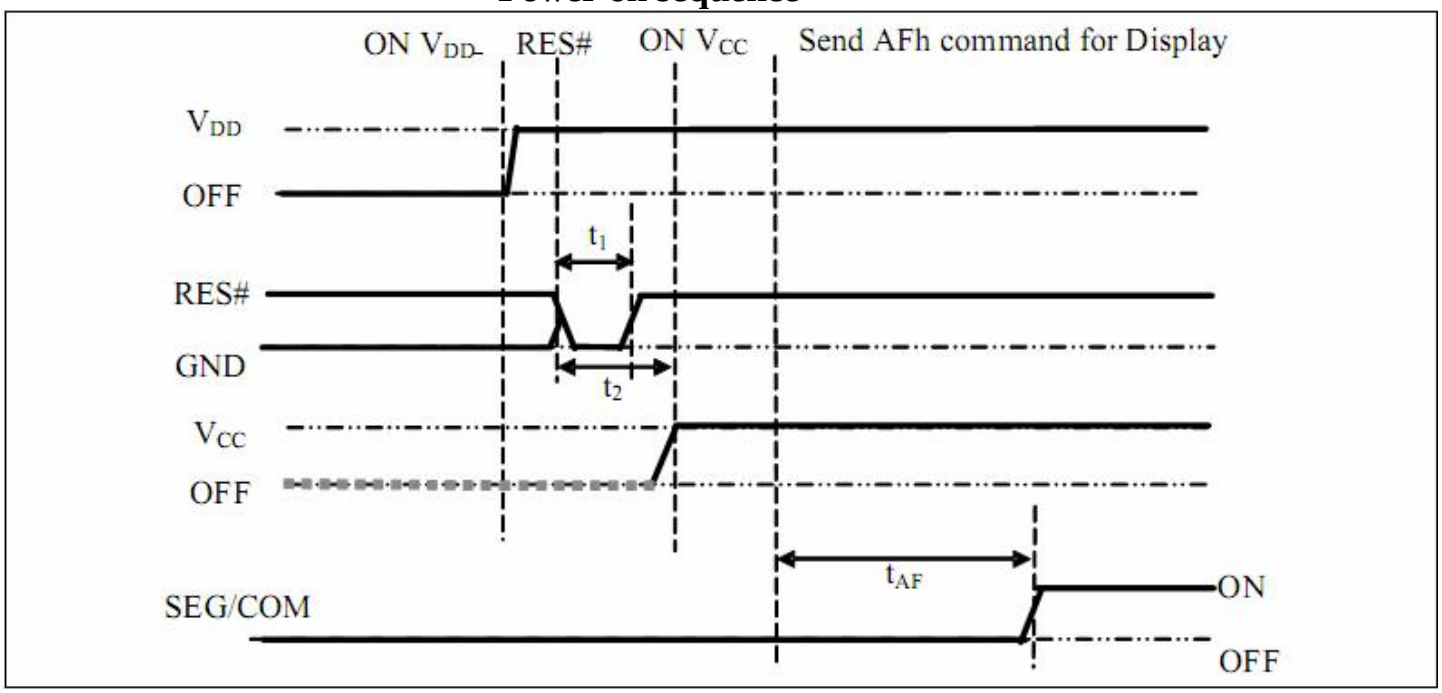


3. Power on and off sequence

Power ON sequence:

1. Power ON VDD
2. After VDD become stable, set RES# pin LOW (logic low) for at least 3us (t1) [3], and then HIGH (logic high).
3. After set RES# pin LOW (logic low), wait for at least 3us (t2). Then Power ON VCC.[1]
4. After VCC become stable, send command AFh for display ON. SEG/COM will be ON after 100ms (tAF).

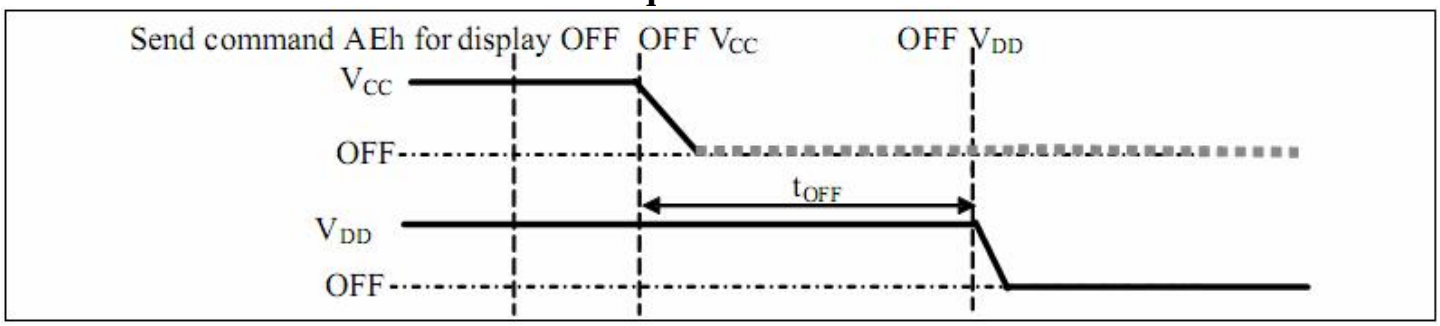
Power on sequence



Power OFF sequence:

1. Send command AEh for display OFF.
2. Power OFF VCC.[1], [2]
3. Power OFF VDD after tOFF[4] (typical tOFF=100ms)

Power off sequence



Note:

(1) VCC should be kept float (i.e. disable) when it is OFF.
(2) Power Pins (VDD, VCC) can never be pulled to ground under any circumstance.
(3) The register values are reset after t1.
(4) VDD should not be Power OFF before VCC Power OFF.

n ELECTRO-OPTICAL CHARACTERISTICS (Ta=25℃)

Items		Symbol	Min.	Typ.	Max.	Unit	Remark
Operating Luminance		L	100	125	-	cd /m^2	White
Power Consumption		P	-	34	41	mW	30% pixels ON L=125cd/m^2
Frame Frequency		Fr	-	100	-	Hz	
Color Coordinate	White	CIE x	0.25	0.29	0.33	CIE1931	Darkroom
		CIE y	0.29	0.32	0.37		
Response Time	Rise	Tr	-	-	0.02	ms	-
	Decay	Td	-	-	0.02	ms	-
Contrast Ratio*		Cr	10000:1	-	-		Darkroom
Viewing Angle		△ θ	160	-	-	Degree	-
Operating Life Time*		Top	20,000	-	-	Hours	L=125cd/m^2

Note:

1. **120cd/m^2** is based on V_{DD}=3.0V, V_{CC}=11.0V, contrast register value is 0x3B;
2. **Contrast ratio** is defined as follows:

$$\text{Contrast ratio} = \frac{\text{Photo – detector output with OLED being “white”}}{\text{Photo – detector output with OLED being “black”}}$$

3. **Life Time** is defined when the Luminance has decayed to less than 50% of the initial Luminance specification. (Odd and even chess board alternately displayed), (The initial value should be closed to the typical value after adjusting.).

n INTERFACE PIN CONNECTIONS

NO.	Symbol	Description
1	NC	No connection.
2	VLSS	Analog ground pin. It should be connected to VSS externally.
3	VDD	Power supply pin for core logic operation.
4	CS#	Chip select pin. (Active LOW)
5	RES#	Reset pin input, when the pin is pulled low, initialization of the chip is executed .Keep this pin HIGH (i.e. connected to VDD) during normal operation.
6	D/C#	In SPI mode, this pin is data/command control pin, when it is pulled HIGH, (i.e. connected to VDD), the data at d0 (SDIN) pin is treated as data. When it is pulled LOW, the data at d0 (SDIN) pin will be transferred to the command register. In IIC mode, this pin acts as SA0 for slave address selection.
7	D0	In SPI mode, this pin is serial clock input SCLK. In IIC mode, this pin is used as serial clock input SCL， must be connected to pull-up resistor。
8	D1	In SPI mode, this pin is treated as serial data input pin SDIN. In IIC mode, D1 and D2 should be tied together and serve as $SDA_{in,}$ SDA_{out} ， must be connected to pull-up resistor
9	D2	In SPI mode, D2 pin should be left open. In IIC mode, D2, D1 should be tied together and serve as SDA_{out} , $SDA_{in.}$
10	IREF	This is segment output current reference pin. A resistor should be connected between this pin and VSS to maintain the IREF current at 10uA.
11	VCOMH	The pin is for COM signal deselected voltage level.A capacitor should be connected between this pin and VSS.
12	VCC	Power supply for panel driving voltage. This is also the most positive power voltage
13	VSS	This is a ground pin.
14	BS1	MCU bus interface selection pin. When it is pulled HIGH, the interface is set as IIC; the interface will be 4-wire SPI while this pin is pulled LOW.
15	NC	No connection.

MCU Bus Interface Pin Selection

Pin name	Serial Interface	I2C Interface
BS1	0	1

Note: 0 is connected to Vss
1 is connected to VDD.

n COMMAND TABLE

1. Fundamental Command Table

D/C#	Hex	D7	D6	D5	D4	D3	D2	D1	D0	Command	Description
0 0	81 A[7:0]	1 A_7	0 A_6	0 A_5	0 A_4	0 A_3	0 A_2	0 A_1	1 A_0	Set Contrast Control	Double byte command to select 1 out of 256 contrast steps. Contrast increases as the value increases. (RESET = 7Fh)
0	A4/A5	1	0	1	0	0	1	0	X_0	Entire Display ON	A4h, X_0=0b: Resume to RAM content display (RESET) Output follows RAM content A5h, X_0=1b: Entire display ON Output ignores RAM content
0	A6/A7	1	0	1	0	0	1	1	X_0	Set Normal/Inverse Display	A6h, X[0]=0b: Normal display (RESET) 0 in RAM: OFF in display panel 1 in RAM: ON in display panel A7h, X[0]=1b: Inverse display 0 in RAM: ON in display panel 1 in RAM: OFF in display panel
0	AE AF	1	0	1	0	1	1	1	X_0	Set Display ON/OFF	AEh, X[0]=0b:Display OFF (sleep mode) (RESET) AFh X[0]=1b:Display ON in normal mode

2. Scrolling Command Table

D/C#	Hex	D7	D6	D5	D4	D3	D2	D1	D0	Command	Description
0	26/27	0	0	1	0	0	1	1	X_0	Continuous Horizontal Scroll Setup	26h, X[0]=0, Right Horizontal Scroll 27h, X[0]=1, Left Horizontal Scroll (Horizontal scroll by 1 column)
0	A[7:0]	0	0	0	0	0	0	0	0		A[7:0] : Dummy byte (Set as 00h)
0	B[2:0]	*	*	*	*	*	B_2	B_1	B_0		B[2:0] : Define start page address 000b – PAGE0 | 011b – PAGE3 | 110b – invalid 001b – PAGE1 | 100b – PAGE4 | 111b – invalid 010b – PAGE2 | 101b – invalid
0	C[2:0]	*	*	*	*	*	C_2	C_1	C_0		C[2:0] : Set time interval between each scroll step in terms of frame frequency 000b – 5 frames | 100b – 3 frames 001b – 64 frames | 101b – 4 frames 010b – 128 frames | 110b – 25 frame 011b – 256 frames | 111b – 2 frame
0	D[2:0]	*	*	*	*	*	D_2	D_1	D_0		D[2:0] : Define end page address 000b – PAGE0 | 011b – PAGE3 | 110b – invalid 001b – PAGE1 | 100b – PAGE4 | 111b – invalid 010b – PAGE2 | 101b – invalid The value of D[2:0] must be larger or equal to B[2:0]
0	E[7:0]	0	0	0	0	0	0	0	0		E[7:0] : Dummy byte (Set as 00h)
0	F[7:0]	1	1	1	1	1	1	1	1		F[7:0] : Dummy byte (Set as FFh)

2. Scrolling Command Table

D/C#	Hex	D7	D6	D5	D4	D3	D2	D1	D0	Command	Description
0	29/2A	0	0	1	0	1	0	X_1	X_0	Continuous Vertical and Horizontal Scroll Setup	29h, X_1X_0=01b : Vertical and Right Horizontal Scroll 2Ah, X_1X_0=10b : Vertical and Left Horizontal Scroll (Horizontal scroll by 1 column) A[7:0] : Dummy byte (Set as 00h) B[2:0] : Define start page address 000b – PAGE0 | 011b – PAGE3 | 110b – invalid 001b – PAGE1 | 100b – PAGE4 | 111b –invalid 010b – PAGE2 | 101b – invalid | C[2:0] : Set time interval between each scroll step in terms of frame frequency 000b – 5 frames | 100b – 3 frames 001b – 64 frames | 101b – 4 frames 010b – 128 frames | 110b – 25 frame 011b – 256 frames | 111b – 2 frame D[2:0] : Define end page address 000b – PAGE0 | 011b – PAGE3 | 110b – invalid 001b – PAGE1 | 100b – PAGE4 | 111b – invalid 010b – PAGE2 | 101b – invalid | The value of D[2:0] must be larger or equal to B[2:0] E[5:0] : Vertical scrolling offset e.g. E[5:0]= 01h refer to offset =1 row E[5:0] =26h refer to offset =38 rows **Note** (1) No continuous vertical scrolling is available.
0	2E	0	0	1	0	1	1	1	0	Deactivate scroll	Stop scrolling that is configured by command 26h/27h/29h/2Ah. **Note** (1) After sending 2Eh command to deactivate the scrolling action, the ram data needs to be rewritten.
0	2F	0	0	1	0	1	1	1	1	Activate scroll	Start scrolling that is configured by the scrolling setup commands :26h/27h/29h/2Ah with the following valid sequences: Valid command sequence 1: 26h ;2Fh. Valid command sequence 2: 27h ;2Fh. Valid command sequence 3: 29h ;2Fh. Valid command sequence 4: 2Ah ;2Fh. For example, if "26h; 2Ah; 2Fh." commands are issued, the setting in the last scrolling setup command, i.e. 2Ah in this case, will be executed. In other words, setting in the last scrolling setup command overwrites the setting in the previous scrolling setup commands.

2. Scrolling Command Table

D/C#	Hex	D7	D6	D5	D4	D3	D2	D1	D0	Command	Description
0	A3	1	0	1	0	0	0	1	1	Set Vertical Scroll Area	A[5:0] : Set No. of rows in top fixed area. The No. of rows in top fixed area is referenced to the top of the GDDRAM (i.e. row 0).[RESET = 0d] B[5:0] : Set No. of rows in scroll area. This is the number of rows to be used for vertical scrolling. The scroll area starts in the first row below the top fixed area. [RESET = 39d] **Note** (1) A[5:0]+B[5:0] <= MUX ratio (2) B[5:0] <= MUX ratio (3a) Vertical scrolling offset (E[5:0] in 29h/2Ah) < B[5:0] (3b) Set Display Start Line (X5X4X3X2X1X0 of 40h~66h) < B[5:0] (4) The last row of the scroll area shifts to the first row of the scroll area. (5) For 39d MUX display A[5:0] = 0, B[5:0]=39 : whole area scrolls A[5:0]= 0, B[5:0] < 39 : top area scrolls A[5:0] + B[5:0] < 39 : central area scrolls A[5:0] + B[5:0] = 39 : bottom area scrolls
0	A[5:0]	*	*	A_5	A_4	A_3	A_2	A_1	A_0		
0	B[5:0]	*	*	B_5	B_4	B_3	B_2	B_1	B_0		

3. Addressing Setting Command Table

D/C#	Hex	D7	D6	D5	D4	D3	D2	D1	D0	Command	Description
0	00~0F	0	0	0	0	X_3	X_2	X_1	X_0	Set Lower Column Start Address for Page Addressing Mode	Set the lower nibble of the column start address register for Page Addressing Mode using X[3:0] as data bits. The initial display line register is reset to 0000b after RESET. **Note** (1) This command is only for page addressing mode.
0	10~17	0	0	0	1	0	X_2	X_1	X_0	Set Higher Column Start Address for Page Addressing Mode	Set the higher nibble of the column start address register for Page Addressing Mode using X[2:0] as data bits. The initial display line register is reset to 0000b after RESET. **Note** (1) This command is only for page addressing mode.
0	20	0	0	1	0	0	0	0	0	Set Memory Addressing Mode	A[1:0] = 00b, Horizontal Addressing Mode A[1:0] = 01b, Vertical Addressing Mode A[1:0] = 10b, Page Addressing Mode (RESET) A[1:0] = 11b, Invalid
0	A[1:0]	*	*	*	*	*	*	A_1	A_0		

3. Addressing Setting Command Table											
D/C#	Hex	D7	D6	D5	D4	D3	D2	D1	D0	Command	Description
0 0 0	21 A[6:0] B[6:0]	0 * *	0 A_6 B_6	1 A_5 B_5	0 A_4 B_4	0 A_3 B_3	0 A_2 B_2	0 A_1 B_1	1 A_0 B_0	Set Column Address	Setup column start and end address A[6:0] : Column start address, range : 0-127d, (RESET=0d) B[6:0]: Column end address, range : 0-127d, (RESET =127d) **Note** (1) This command is only for horizontal or vertical addressing mode.
0 0 0	22 A[2:0] B[2:0]	0 * *	0 * *	1 * *	0 * *	0 * *	0 A_2 B_2	1 A_1 B_1	0 A_0 B_0	Set Page Address	Setup page start and end address A[2:0] : Page start Address, range : 0-4d, (RESET = 0d) B[2:0] : Page end Address, range : 0-4d, (RESET = 4d) **Note** (1) This command is only for horizontal or vertical addressing mode.
0	B0~B4	1	0	1	1	0	X_2	X_1	X_0	Set Page Start Address for Page Addressing Mode	Set GDDRAM Page Start Address (PAGE0~PAGE4) for Page Addressing Mode using X[2:0]. **Note** (1) This command is only for page addressing mode.

4. Hardware Configuration (Panel resolution & layout related) Command Table											
D/C#	Hex	D7	D6	D5	D4	D3	D2	D1	D0	Command	Description
0	40~66	0	1	X_5	X_4	X_3	X_2	X_1	X_0	Set Display Start Line	Set display RAM display offset from 0d-38d using $X_5X_4X_3X_2X_1X_0$. Display offset is reset to 000000b during RESET.
0	A0/A1	1	0	1	0	0	0	0	X_0	Set Segment Re-map	A0h, X[0]=0b: column address 0 is mapped to SEG0 (RESET) A1h, X[0]=1b: column address 127 is mapped to SEG0
0 0	A8 A[5:0]	1 *	0 *	1 A_5	0 A_4	1 A_3	0 A_2	0 A_1	0 A_0	Set Multiplex Ratio	Set MUX ratio to N+1 MUX N=A[5:0] : from 16MUX to 39MUX, RESET= 100110b (i.e.38d , 39Mux) A[5:0] from 0 to 14 are invalid entry.
0	C0/C8	1	1	0	0	X_3	0	0	0	Set COM Output Scan Direction	C0h, X[3]=0b: normal mode (RESET) Scan from COM0 to COM[N –1] C8h, X[3]=1b: remapped mode. Scan from COM[N-1] to COM0 Where N is the Multiplex ratio.
0 0	D3 A[5:0]	1 *	1 *	0 A_5	1 A_4	0 A_3	0 A_2	1 A_1	1 A_0	Set Display Offset	Set vertical shift by COM from 0d~38d. The value is reset to 00h after RESET.

4. Hardware Configuration (Panel resolution & layout related) Command Table											
D/C#	Hex	D7	D6	D5	D4	D3	D2	D1	D0	Command	Description
0	DA	1	1	0	1	1	0	1	0	Set SEG Pins Hardware Configuration	A[4]=0b, Sequential SEG pin configuration A[4]=1b(RESET), Alternative (odd/even) SEG pin configuration A[5]=0b(RESET), Disable SEG Left/Right remap A[5]=1b, Enable SEG Left/Right remap
0	A[5:4]	0	0	A_5	A_4	0	0	1	0		

n INITIALIZATION CODE

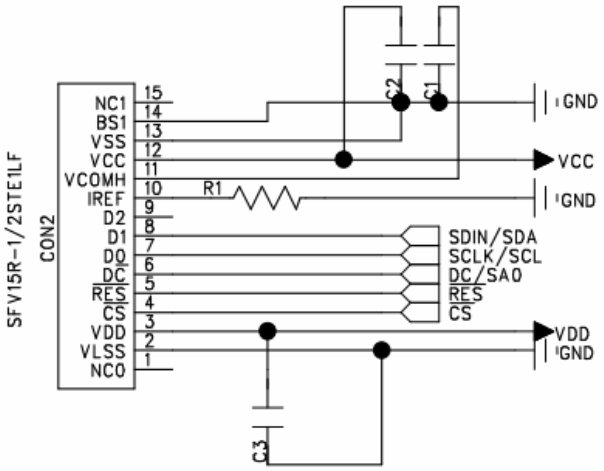
```
void InitOLED_MASTER_SH1307(void)
{
WMLCDCOM(0xae);       //display off

 WMLCDCOM(0x04);      //set column address for page addressing mode
 WMLCDCOM(0x10);      //set column address

 WMLCDCOM(0x20);      //set page mode
 WMLCDCOM(0x02);

 WMLCDCOM(0x22);      //set page address
 WMLCDCOM(0x00);
 WMLCDCOM(0x04);

 WMLCDCOM(0x40);      //set display start line

 WMLCDCOM(0x81);      //set contrast
 WMLCDCOM(0x3b);

 WMLCDCOM(0xa1);      //set segment remap

 WMLCDCOM(0xa4);      //entire display on

 WMLCDCOM(0xa6);      //set nomal/inverse display

 WMLCDCOM(0xa8);      //set multiplex ratio
 WMLCDCOM(0x1f);

 WMLCDCOM(0xc0);      //set com output scan direction

 WMLCDCOM(0xb0);      //set page start address for page addressing mode

 WMLCDCOM(0xd3);
 WMLCDCOM(0x24);      //set display offset

 WMLCDCOM(0xd5);      //set display frequency
 WMLCDCOM(0x81);

 WMLCDCOM(0xd9);      //set pre_charge period
 WMLCDCOM(0x22);

 WMLCDCOM(0xda);      //set seg pin hardware configuration
 WMLCDCOM(0x12);

 WMLCDCOM(0xdb);      //set vcom deselect level
 WMLCDCOM(0x30);

 WMLCDCOM(0xaf);      //diplay on
}
```

Note：

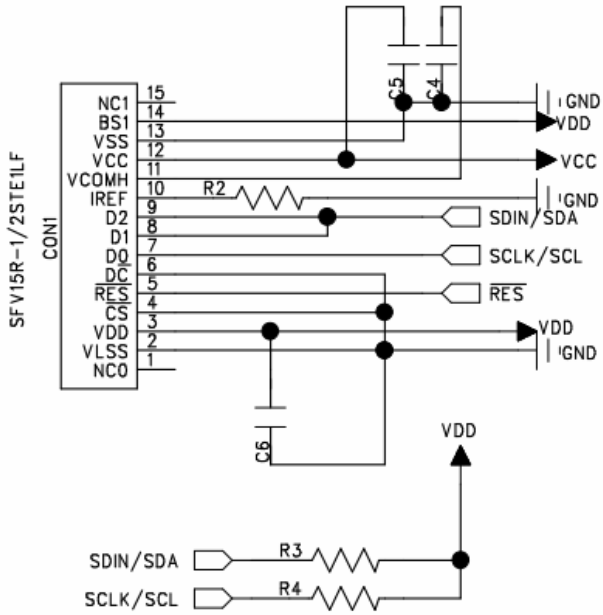
Set appropriate parameters of initialization base on actual application.

n SCHEMATIC EXAMPLE

SPI interface



IIC interface



NOTE:

1. **R1=R2=(V_{CC}-3)V/10uA=(12-3)V/10uA≈910KΩ,R3=R4=10K, C1=C2=C4=C5=2.2uF， C3=C6=1.0uF;**
2. **The VCC should connect a external voltage;**
3. **In SPI, the read function is not possible.**

n RELIABILITY TESTS

Item		Condition	Criterion
High Temperature Storage (HTS)		80±2℃, 200 hours	1. After testing, the function test is ok. 2. After testing, no addition to the defect. 3. After testing, the change of luminance should be within +/- 50% of initial value. 4. After testing, the change for the mono and area color must be within (+/-0.02, +/-0.02) and for the full color it must be within (+/-0.04, +/-0.04) of initial value based on 1931 CIE coordinates. 5. After testing, the change of total current consumption should be within +/- 50% of initial value.
High Temperature Operating (HTO)		70±2℃, 96 hours	
Low Temperature Storage (LTS)		-30±2℃, 200 hours	
Low Temperature Operating (LTO)		-20±2℃, 96 hours	
High Temperature / High Humidity Storage (HTHHS)		50±3℃, 90%±3%RH, 120 hours	
Thermal Shock (Non-operation) (TS)		-20±2℃ ~ 25℃ ~ 70±2℃ (30min) (5min) (30min) 10cycles	
Vibration (Packing)	10~55~10Hz,amplitude 1.5mm, 1 hour for each direction x, y, z	1. One box for each test. 2. No addition to the cosmetic and the electrical defects.	
Drop (Packing)	Height : 1 m, each time for 6 sides, 3 edges, 1 angle		
ESD (finished product housing)	±4kV (R: 330Ω C: 150pF , 10times, air discharge)	1. After testing, cosmetic and electrical defects should not happen. 2. In case of malfunction or defect caused by ESD damage, it would be judged as a good part if it would be recovered to normal state after resetting.	

Note: 1) For each reliability test, the sample quantity is 3, and only for one test item.
2) The HTHHS test is requested the Pure Water(Resistance＞10MΩ).
3) The test should be done after 2 hours of recovery time in normal environment.

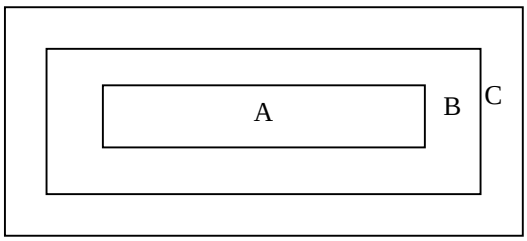
n OUTGOING QUALITY CONTROL SPECIFICATION

◆Standard

According to GB/T2828.1-2003/ISO 2859-1：1999 and ANSI/ASQC Z1.4-1993, General Inspection Level II.

◆Definition

1 Major defect: The defect that greatly affect the usability of product.
2 Minor defect: The other defects, such as cosmetic defects, etc.
3 Definition of inspection zone:



Zone A: Active Area

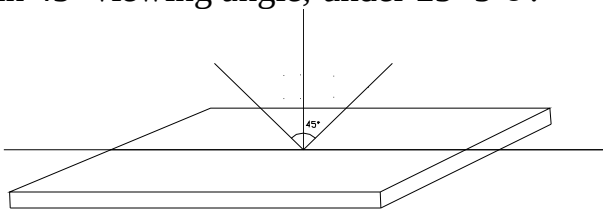
Zone B: Viewing Area except Zone A

Zone C: Outside Viewing Area

Note: As a general rule, visual defects in Zone C are permissible, when it is no trouble of quality and assembly to customer`s product.

◆Inspection Methods

1 The general inspection: under 20W x 2 or 40W fluorescent light, about 30cm viewing distance, within 45º viewing angle, under 25±5℃.



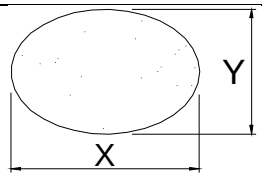
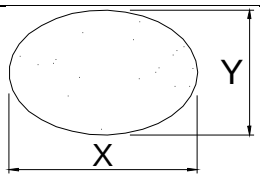
2 The luminance and color coordinate inspection : By PR705 or BM-7 or the equal equipments, in the dark room, under 25±5℃.

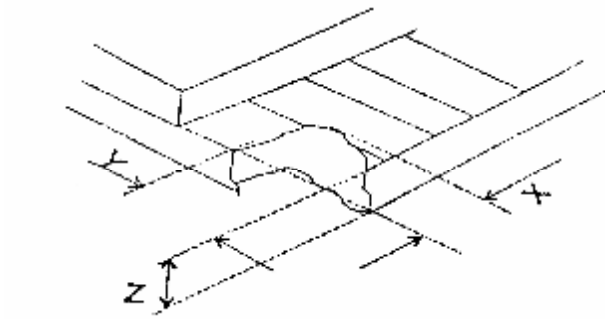
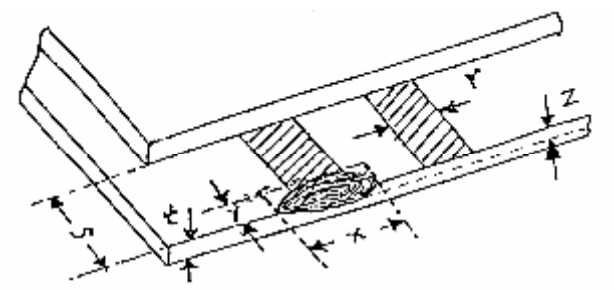
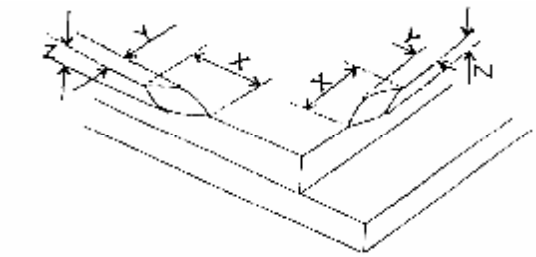
◆Inspection Criteria

1 Major defect : AQL= 0.65

Item	Criterion
Function Defect	1. No display or abnormal display is not accepted
	2. Open or short is not accepted.
	3. Power consumption exceeding the spec is not accepted.
Outline Dimension	Outline dimension exceeding the spec is not accepted.
Glass Crack	Glass crack tends to enlarge is not accepted.

2 Minor Defect: AQL= 1.5

<table>
<tr><td>Item</td><td colspan="4">Criterion</td></tr>
<tr><td rowspan="5">Spot Defect (dimming and lighting spot)</td><td colspan="2" rowspan="2">Size (mm)</td><td colspan="2">Accepted Qty</td></tr>
<tr><td>Area A + Area B</td><td>Area C</td></tr>
<tr><td rowspan="3">  </td><td>Φ≦0.07</td><td colspan="2">Ignored</td></tr>
<tr><td>0.07＜Φ≦0.10</td><td>3</td><td rowspan="3">Ignored</td></tr>
<tr><td>0.10＜Φ≦0. 15</td><td>1</td></tr>
<tr><td colspan="4">Note : Φ= (x + y) / 2</td><td>0.15＜Φ</td><td>0</td></tr>
<tr><td rowspan="5">Line Defect (dimming and lighting line)</td><td>L (Length) : mm</td><td>W (Width) : mm</td><td>Area A + Area B</td><td>Area C</td></tr>
<tr><td>/</td><td>W≦0.02</td><td colspan="2">Ignored</td></tr>
<tr><td>L≦3.0</td><td>0.02＜W≦0.03</td><td>2</td><td rowspan="3">Ignored</td></tr>
<tr><td>L≦2.0</td><td>0.03＜W≦0.05</td><td>1</td></tr>
<tr><td>/</td><td>0.05＜W</td><td>As spot defect</td></tr>
<tr><td colspan="5">Remarks: The total of spot defect and line defect shall not exceed 4 pcs. The distance between two lines defects must exceed 1 mm</td></tr>
<tr><td>Polarizer Stain</td><td colspan="4">Stain which can be wiped off lightly with a soft cloth or similar cleaning is accepted, otherwise, according to the Spot Defect and the Line Defect.</td></tr>
<tr><td rowspan="7">Polarizer Scratch</td><td colspan="4">1. If scratch can be seen during operation, according to the criterions of the Spot Defect and the Line Defect.</td></tr>
<tr><td colspan="4">2. If scratch can be seen only under non-operation or some special angle, the criterion is as below :</td></tr>
<tr><td>L (Length) : mm</td><td>W (Width) : mm</td><td>Area A + Area B</td><td>Area C</td></tr>
<tr><td>/</td><td>W≦0.02</td><td colspan="2">Ignore</td></tr>
<tr><td>3.0＜L≦5.0</td><td>0.02＜W≦0.04</td><td>2</td><td rowspan="3">Ignore</td></tr>
<tr><td>L≦3.0</td><td>0.04＜W≦0.06</td><td>1</td></tr>
<tr><td>/</td><td>0.06＜W</td><td>0</td></tr>
<tr><td rowspan="5">Polarizer Air Bubble</td><td colspan="2">Size</td><td>Area A + Area B</td><td>Area C</td></tr>
<tr><td rowspan="4">  </td><td>Φ≦0.20</td><td colspan="2">Ignored</td></tr>
<tr><td>0.20＜Φ≦0.30</td><td>2</td><td rowspan="3">Ignored</td></tr>
<tr><td>0.30＜Φ≦0.50</td><td>1</td></tr>
<tr><td>0.50＜Φ</td><td>0</td></tr>
</table>

<table>
<tr><td rowspan="4">Glass Defect (Glass Chipped)</td><td>1. On the corner
 
(mm)
<table><tr><td>x</td><td>≤ 1.5</td></tr><tr><td>y</td><td>≤ 1.5</td></tr><tr><td>z</td><td>≤ t</td></tr></table></td></tr>
<tr><td>2. On the bonding edge
 
(mm)
<table><tr><td>x</td><td>≤ a / 4</td></tr><tr><td>y</td><td>≤ s / 3 &≤0.7</td></tr><tr><td>z</td><td>≤ t</td></tr></table></td></tr>
<tr><td>3. On the other edges
 
(mm)
<table><tr><td>x</td><td>≤ a / 8</td></tr><tr><td>y</td><td>≤ 0.7</td></tr><tr><td>z</td><td>≤ t</td></tr></table></td></tr>
<tr><td>Note: t: glass thickness ; s: pad width ; a: the length of the edge</td></tr>
<tr><td>TCP Defect</td><td>Crack, deep fold and deep pressure mark on the TCP are not accepted</td></tr>
<tr><td>Pixel Size</td><td>The tolerance of display pixel dimension should be within ±20% of the spec</td></tr>
<tr><td>Luminance</td><td>Refer to the spec or the reference sample</td></tr>
<tr><td>Color</td><td>Refer to the spec or the reference sample</td></tr>
</table>

n CAUTIONS IN USING OLED MODULE

◆Precautions For Handling OLED Module:

1. OLED module consists of glass and polarizer. Pay attention to the following items when handling:
   i. Avoid drop from high, avoid excessive impact and pressure.
   ii. Do not touch, push or rub the exposed polarizers with anything harder than an HB pencil lead.
   iii. If the surface becomes dirty, breathe on the surface and gently wipe it off with a soft dry cloth. If it is terrible dirty, moisten the soft cloth with Isopropyl alcohol or Ethyl alcohol. Other solvents may damage the polarizer. Especially water, Ketone and Aromatic solvents.
   iv. Wipe off saliva or water drops immediately, contact the polarizer with water over a long period of time may cause deformation.
   v. Please keep the temperature within specified range for use and storage. Polarization degradation, bubble generation or polarizer peeling-off may occur with high temperature and high humidity.
   vi. Condensation on the surface and the terminals due to cold or anything will damage, stain or dirty the polarizer, so make it clean as the way of iii.
2. Do not attempt to disassemble or process the OLED Module.
3. Make sure the TCP or the FPC of the Module is free of twisting, warping and distortion, do not pull or bend them forcefully, especially the soldering pins. On the other side, the SLIT part of the TCP is made to bend in the necessary case.
4. When assembling the module into other equipment, give the glass enough space to avoid excessive pressure on the glass, especially the glass cover which is much more fragile.
5. Be sure to keep the air pressure under 120 kPa, otherwise the glass cover is to be cracked.
6. Be careful to prevent damage by static electricity:
   i. Be sure to ground the body when handling the OLED Modules.
   ii. All machines and tools required for assembling, such as soldering irons, must be properly grounded.
   iii. Do not assemble and do no other work under dry conditions to reduce the amount of static electricity generated. A relative humidity of 50%-60% is recommended.
   iv. Peel off the protective film slowly to avoid the amount of static electricity generated.
   v. Avoid to touch the circuit, the soldering pins and the IC on the Module by the body.
   vi. Be sure to use anti-static package.
7. Contamination on terminals can cause an electrochemical reaction and corrade the terminal circuit, so make it clean anytime.
8. All terminals should be open, do not attach any conductor or semiconductor on the terminals.
9. When the logic circuit power is off, do not apply the input signals.
10. Power on sequence: $V_{DD} \rightarrow V_{CC}$, and power off sequence: $V_{CC} \rightarrow V_{DD}$.
11. Be sure to keep temperature, humidity and voltage within the ranges of the spec, otherwise shorten Module’ s life time, even make it damaged.
12. Be sure to drive the OLED Module following the Specification and datasheet of IC controller, otherwise something wrong may be seen.

13.When displaying images, keep them rolling, and avoid one fixed image displaying more than 30 seconds, otherwise the residue image is to be seen. This is the speciality of OLED.

◆Precautions For Soldering OLED Module:

1. Soldering temperature : 260°C ± 10°C.
2. Soldering time : 3-4 sec.
3. Repeating time : no more than 3 times.
4. If soldering flux is used, be sure to remove any remaining flux after finishing soldering operation. (This does not apply in the case of a non-halogen type of flux.) It is recommended to protect the surface with a cover during soldering to prevent any damage due to flux spatters.

◆ Precautions For Storing OLED Module:

1. Be sure to store the OLED Module in the vacuum bag with desiccant.
2. If the Module can not be used up in 1 month after the bag being opened, make sure to seal the Module in the vacuum bag with desiccant again.
3. Store the Module in a dark place, do not expose to sunlight or fluorescent light.
4. The polarizer surface should not touch any other objects. It is recommended to store the Module in the shipping container.
5. It is recommended to keep the temperature between 0°C and 30°C , the relative humidity not over 60%.

◆ Limited Warranty

Unless relevant quality agreements signed with customer and law enforcement, for a period of 12 months from date of production, all products (except automotive products) TRULY will replace or repair any of its OLED modules which are found to be functional defect when inspected in accordance with TRULY OLED acceptance standards (copies available upon request). Cosmetic/visual defects must be returned to TRULY within 90 days of shipment. Confirmation of such date should be based on freight documents. The warranty liability of TRULY is limited to repair and/or replacement on the terms above. TRULY will not be responsible for any subsequent or consequential events.

◆Return OLED Module Under Warranty:

1. No warranty in the case that the precautions are disregarded.
2. Module repairs will be invoiced to the customer upon mutual agreement. Modules must be returned with sufficient description of the failures or defects.

◆PRIOR CONSULT MATTER

1. For TRULY standard products , we keep the right to change material ,process … for improving the product property without any notice on our customer.
2. If you have special requirement about reliability condition, please let us know before you start the test on our samples.