SPECIFICATION

PART NO. : P7232-001A

OLED
Display
72 X 32
0.48"

PRODUCT CONTENTS

		Customer	
Written by	**ChenYongquan**	**Approved by**	
Checked by	**Yang Xueyu**		
Approved by	**Zhang Weicang**		

REVISION HISTORY

Rev.	Contents	Date
1.0	First Release.	2014-06-04
1.1	Update the Schematic Example	2014-07-08
1.2	Update the Electro-Optical Characteristics	2016-04-01

■ PHYSICAL DATA

No.	Items:	Specification:	Unit
1	Diagonal Size	0.48	Inch
2	Resolution	72(H) x 32(V)	Dots
3	Active Area	11.210 (W) x 4.970(H)	mm^2
4	Outline Dimension (Panel)	14.90 (W) x 11.29(H)	mm^2
5	Pixel Pitch	0.156 (W) x 0.156(H)	mm^2
6	Pixel Size	0.136(W) x 0.136(H)	mm^2
7	Driver IC	SSD1309Z	-
8	Display Color	White	-
9	Gray scale	1	Bit
10	Interface	4-SPI	-
11	IC package type	COG	-
12	Thickness	1.20±0.1	mm
13	Weight	TBD	g
14	Duty	1/32	-

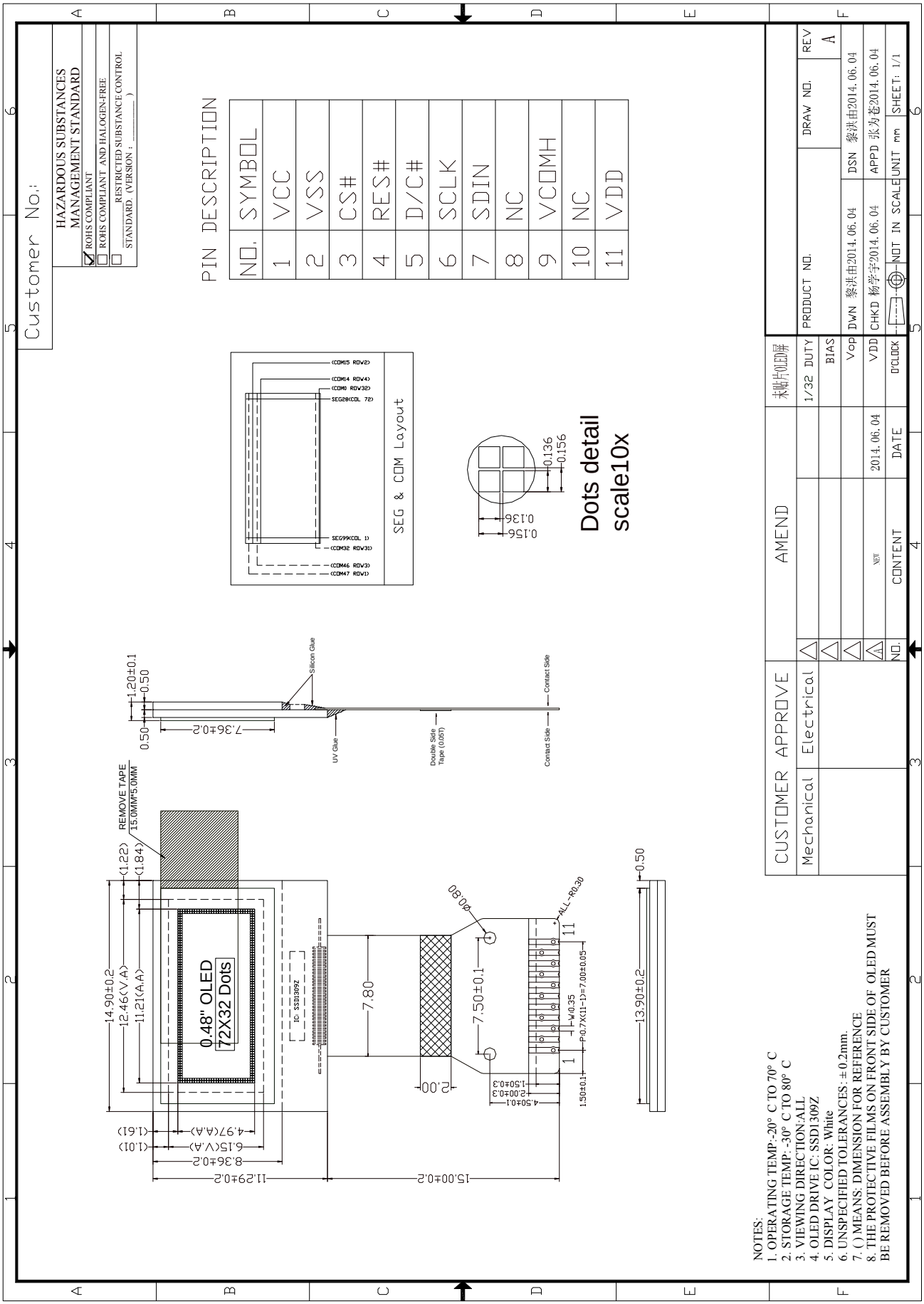
■ ABSOLUTE MAXIMUM RATINGS

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

Items		Symbol	Min	Typ.	Max	Unit
Supply Voltage	Logic	VDD	-0.3	-	4.0	V
	Driving	VCC	0	-	17.0	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.

■ EXTERNAL DIMENSIONS



■ ELECTRICAL CHARACTERISTICS

◆DC Characteristics

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

Items		Symbol	Min	Typ.	Max	Unit
Supply Voltage	Logic	VDD	1.65	3	3.3	V
	Driving	VCC	7.0	10.0	16.0	V
Input Voltage	High Voltage	V_{IH}	0.8 x VDD	-	-	V
	Low Voltage	V_{IL}	-	-	0.2 x VDD	V
Output Voltage	High Voltage	V_{OH}	0.9x VDD	-	-	V
	Low Voltage	V_{OL}	-	-	0.1 x VDD	V

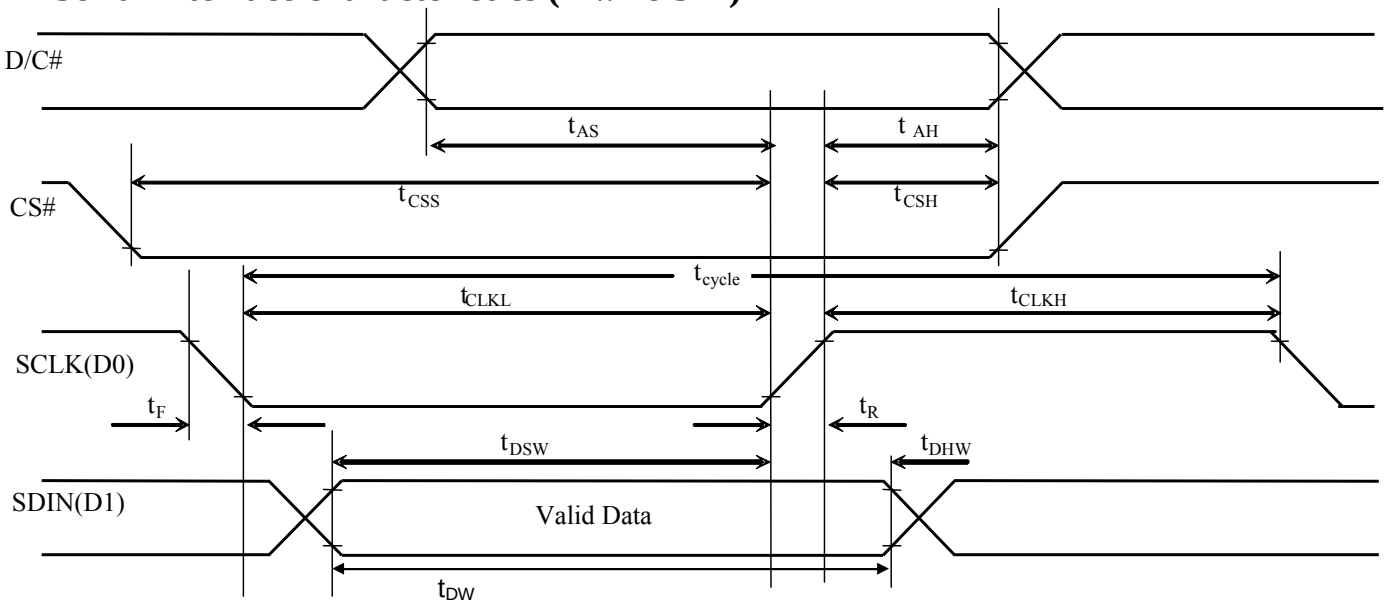
◆AC Characteristics

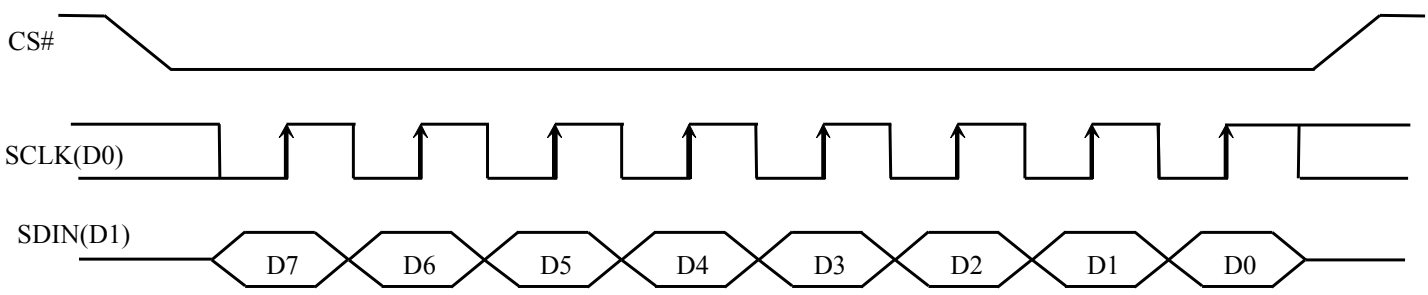
Serial Interface Timing Characteristics (4-wire SPI)

(VDD - VSS=1.65~3.3V,TA=+25℃)

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	50	-	-	ns
t_{DW}	Data Write Time	55	-	-	ns
t_{DSW}	Write Data Setup Time	15	-	-	ns
t_{DHW}	Write Data Hold Time	15	-	-	ns
t_{CLKL}	Clock Low Time	50	-	-	ns
t_{CLKH}	Clock High Time	50	-	-	ns
t_R	Rise Time	-	-	40	ns
t_F	Fall Time	-	-	40	ns

Serial interface characteristics (4-wire SPI)





■ ELECTRO-OPTICAL CHARACTERISTICS (Ta=25℃)

Items		Symbol	Min.	Typ.	Max.	Unit	Remark
Operating Luminance		L	200	250*	-	cd /m2	White
Power Consumption		P	-	15	20	mW	30% pixels ON L=250cd/m^2
Frame Frequency		Fr	-	100	-	Hz	-
Color Coordinate	White	CIE x	0.22	0.26	0.30	CIE1931	Darkroom
		CIE y	0.26	0.30	0.34		
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	10000	-	-	Hours	L=250cd/m2

Note:

1. L=250 cd/m^2 is based on V_{DD}=3.0V ,V_{cc}=10.0V, contrast command setting 0X1A;

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.)

■ INTERFACE PIN CONNECTIONS

No.	Symbol	Description
1	VCC	Power supply for panel driving voltage. This is also the most positive power voltage supply pin.
2	VSS	Ground pin. It must be connected to external ground.
3	CS#	This pin is the chip select input connecting to the MCU. The chip is enabled for MCU communication only when CS# is pulled LOW (active LOW).
4	RES#	This pin is reset signal input. When the pin is pulled LOW, initialization of the chip is executed. Keep this pin pull HIGH during normal operation.
5	D/C#	This pin is Data/Command control pin connecting to the MCU.
6	SCLK	The serial clock input PIN
7	SDIN	The serial data input PIN
8	NC	No connection.
9	VCOMH	COM signal deselected voltage level. Connected to VCC.
10	NC	No connection.
11	VDD	Power supply pin for core logic operation.

■ 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 A7	0 A6	0 A5	0 A4	0 A3	0 A2	0 A1	1 A0	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	X0	Entire Display ON	A4h, X0=0b: Resume to RAM content display (RESET) Output follows RAM content. A5h, X0=1b: Entire display ON Output ignores RAM content.
0	A6/A7	1	0	1	0	0	1	1	X0	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	X0	Set Display ON/OFF	AEh, X[0]=0b:Display OFF (sleep mode) (RESET) AFh X[0]=1b:Display ON in normal mode
0	E3	1	1	1	0	0	0	1	1	NOP	Command for no operation.
0 0	FD A[2]	1 0	1 0	1 0	1 1	1 0	1 A2	0 1	1 0	Set Command Lock	A[2]: MCU protection status. A[2] = 0b, Unlock OLED driver IC MCU interface from entering command (RESET). A[2] = 1b, Lock OLED driver IC MCU interface from entering command. **Note:** The locked OLED driver IC MCU interface prohibits all commands and memory access except the FDh command

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	X0	Continuous Horizontal Scroll Setup	26h, X[0]=0, Right Horizontal Scroll 27h, X[0]=1, Left Horizontal Scroll A[7:0] : Dummy byte (Set as 00h) Horizontal scroll by 1 column B[2:0] : Define start page address
0	A[7:0]	0	0	0	0	0	0	0	0		
0	B[2:0]	*	*	*	*	*	B2	B1	B0		
0	C[2:0]	*	*	*	*	*	C2	C1	C0		
0	D[2:0]	*	*	*	*	*	D2	D1	D0		
0	E[7:0]	0	0	0	0	0	0	0	0		
0	F[7:0]	F7	F6	F5	F4	F3	F2	F1	F0		
0	G[7:0]	G7	G6	G5	G4	G3	G2	G1	G0		

000b – PAGE0	011b – PAGE3	110b – PAGE6
001b – PAGE1	100b – PAGE4	111b – PAGE7
010b – PAGE2	101b – PAGE5	

C[2:0] : Set time interval between each scroll step in terms of frame frequency

000b – 5 frames	100b – 2 frames
001b – 64 frames	101b – 3 frames
010b – 128 frames	110b – 4 frames
011b – 256 frames	111b – 1 frames

D[2:0] : Define end page address

000b – PAGE0	011b – PAGE3	110b – PAGE6
001b – PAGE1	100b – PAGE4	111b – PAGE7
010b – PAGE2	101b – PAGE5	

E[7:0] : Dummy byte (Set as 00h)
F[7:0] : Define the start column (RESET = 00h)
G[7:0] : Define the end column address (RESET = 7Fh)

Notes:
(1) The value of D[2:0] must be larger than or equal to B[2:0]
(2) The value of G[7:0] must be larger than or equal to F[7:0]

2. Scrolling Command Table

<table>
<tr><th>D/C#</th><th>Hex</th><th>D7</th><th>D6</th><th>D5</th><th>D4</th><th>D3</th><th>D2</th><th>D1</th><th>D0</th><th>Command</th><th>Description</th></tr>
<tr><td>0</td><td>29/2A</td><td>0</td><td>0</td><td>1</td><td>0</td><td>1</td><td>0</td><td>X1</td><td>X0</td><td>Continuous Vertical and Horizontal Scroll Setup</td><td>29h, X1X0=01b : Vertical and Right Horizontal Scroll
2Ah, X1X0=10b : Vertical and Left Horizontal Scroll
A[0] : Set number of column scroll offset
0b No horizontal scroll
1b Horizontal scroll by 1 column
B[2:0] : Define start page address
<table><tr><td>000b – PAGE0</td><td>011b – PAGE3</td><td>110b – PAGE6</td></tr><tr><td>001b – PAGE1</td><td>100b – PAGE4</td><td>111b – PAGE7</td></tr><tr><td>010b – PAGE2</td><td>101b – PAGE5</td><td></td></tr></table>C[2:0] : Set time interval between each scroll step in terms of frame frequency
<table><tr><td>000b – 5 frames</td><td>100b – 2 frames</td></tr><tr><td>001b – 64 frames</td><td>101b – 3 frames</td></tr><tr><td>010b – 128 frames</td><td>110b – 4 frames</td></tr><tr><td>011b – 256 frames</td><td>111b – 1 frames</td></tr></table>D[2:0] : Define end page address
<table><tr><td>000b – PAGE0</td><td>011b – PAGE3</td><td>110b – PAGE6</td></tr><tr><td>001b – PAGE1</td><td>100b – PAGE4</td><td>111b – PAGE7</td></tr><tr><td>010b – PAGE2</td><td>101b – PAGE5</td><td></td></tr></table>E[5:0] : Vertical scrolling offset
e.g. E[5:0]= 01h refer to offset =1 row
E[5:0] =3Fh refer to offset =63 rows
F[7:0] : Define the start column (RESET = 00h)
G[7:0] : Define the end column address (RESET = 7Fh)

Note:
(1) The value of D[2:0] must be larger than or equal to B[2:0]
(2) The value of G[7:0] must be larger than or equal to F[7:0]</td></tr>
<tr><td>0</td><td>2E</td><td>0</td><td>0</td><td>1</td><td>0</td><td>1</td><td>1</td><td>1</td><td>0</td><td>Deactivate scroll</td><td>Stop scrolling that is configured by command 26h/27h/29h/2Ah.
Note:
After sending 2Eh command to deactivate the scrolling action, the ram data needs to be rewritte</td></tr>
</table>

2. Scrolling Command Table

D/C#	Hex	D7	D6	D5	D4	D3	D2	D1	D0	Command	Description
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.
0 0 0	A3 A[5:0] B[6:0]	1 * *	0 * B6	1 A5 B5	0 A4 B4	0 A3 B3	0 A2 B2	1 A1 B1	1 A0 B0	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 = 0] B[6:0] : 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 = 64] **Note:** (1) A[5:0]+B[6:0] <= MUX ratio (2) B[6:0] <= MUX ratio (3a) Vertical scrolling offset (E[5:0] in 29h/2Ah) < B[6:0] (3b) Set Display Start Line (X5X4X3X2X1X0 of 40h~7Fh) < B[6:0] (4) The last row of the scroll area shifts to the first row of the scroll area. (5) For 64d MUX display A[5:0] = 0, B[6:0]=64 : whole area scrolls A[5:0]= 0, B[6:0] < 64 : top area scrolls A[5:0] + B[6:0] < 64 : central area scrolls A[5:0] + B[6:0] = 64 : bottom area scrolls (6) When vertical scrolling is enabled by command 29h / 2Ah, the vertical scroll area is defined by this command
0 0 0 0 0 0 0 0	2C/2D A[7:0] B[2:0] C[7:0] D[2:0] E[7:0] F[7:0] G[7:0]	0 0 * 0 * 0 F7 G7	0 0 * 0 * 0 F6 G6	1 0 * 0 * 0 F5 G5	0 0 * 0 * 0 F4 G4	1 0 * 0 * 0 F3 G3	1 0 B2 0 D2 0 F2 G2	0 0 B1 0 D1 0 F1 G1	X0 0 B0 1 D0 0 F0 G0	Content Scroll Setup	2Ch, X[0]=0, Right Horizontal Scroll by one column 2Dh, X[0]=1, Left Horizontal Scroll by one column A[7:0] : Dummy byte (Set as 00h) Horizontal scroll by 1 column B[2:0] : Define start page address 000b – PAGE0 | 011b – PAGE3 | 110b – PAGE6 001b – PAGE1 | 100b – PAGE4 | 111b – PAGE7 010b – PAGE2 | 101b – PAGE5 | C[7:0] : Dummy byte (Set as 01h) D[2:0] : Define end page address 000b – PAGE0 | 011b – PAGE3 | 110b – PAGE6 001b – PAGE1 | 100b – PAGE4 | 111b – PAGE7 010b – PAGE2 | 101b – PAGE5 | E[7:0] : Dummy byte (Set as 00h) F[7:0] : Define the start column (RESET = 00h) G[7:0] : Define the end column address (RESET 7Fh) **Note:** (1) The value of D[2:0] must be larger than or equal to B[2:0] (2) The value of G[7:0] must be larger than F[7:0] (3) A delay time of 2 *FrameFreq* must be set if sending the command of 2Ch / 2Dh consecutively.

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	X3	X2	X1	X0	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:** This command is only for page addressing mode
0	10~1F	0	0	0	1	X3	X2	X1	X0	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[3:0] as data bits. The initial display line register is reset to 0000b after RESET. **Note:** This command is only for page addressing mode
0 0	20 A[1:0]	0 *	0 *	1 *	0 *	0 *	0 *	0 A1	0 A0	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 0 0	21 A[7:0] B[7:0]	0 A7 B7	0 A6 B6	1 A5 B5	0 A4 B4	0 A3 B3	0 A2 B2	0 A1 B1	1 A0 B0	Set Column Address	Setup column start and end address A[7:0] : Column start address, range : 0-127d, (RESET=0d) B[7:0]: Column end address, range : 0-127d, (RESET =127d) **Note:** 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 A2 B2	1 A1 B1	0 A0 B0	Set Page Address	Setup page start and end address A[2:0] : Page start Address, range : 0-7d, (RESET = 0d) B[2:0] : Page end Address, range : 0-7d, (RESET = 7d) **Note:** This command is only for horizontal or vertical addressing mode.
0	B0~B7	1	0	1	1	0	X2	X1	X0	Set Page Start Address for Page Addressing Mode	Set GDDRAM Page Start Address (PAGE0~PAGE7) for Page Addressing Mode using X[2:0]. **Note :** 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	40~7F	0	1	X5	X4	X3	X2	X1	X0	Set Display Start Line	Set display RAM display start line register from 0-63 using X5X3X2X1X0. Display start line register is reset to 000000b during RESET.
0	A0/A1	1	0	1	0	0	0	0	X0	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 A5	0 A4	1 A3	0 A2	0 A1	0 A0	Set Multiplex Ratio	Set MUX ratio to N+1 MUX N=A[5:0] : from 16MUX to 64MUX, RESET= 111111b (i.e. 63d, 64MUX) A[5:0] from 0 to 14 are invalid entry.
0	C0/C8	1	1	0	0	X3	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 A5	1 A4	0 A3	0 A2	1 A1	1 A0	Set Display Offset	Set vertical shift by COM from 0d~63d The value is reset to 00h after RESET.
0 0	DA A[5:4]	1 0	1 0	0 A5	1 A4	1 0	0 0	1 1	0 0	Set COM Pins Hardware Configuration	A[4]=0b, Sequential COM pin configuration A[4]=1b (RESET), Alternative COM pin configuration A[5]=0b (RESET), Disable COM Left/Right remap A[5]=1b, Enable COM Left/Right remap
0 0	DC A[1:0]	1 0	1 0	0 0	1 0	1 0	1 0	0 A1	0 A0	Set GPIO	A[1:0] GPIO : 00 pin HiZ, Input disabled 01 pin HiZ, Input enabled 10 pin output LOW [RESET] 11 pin output HIGH

5. Timing & Driving Scheme Setting Command Table

D/C#	Hex	D7	D6	D5	D4	D3	D2	D1	D0	Command	Description
0 0	D5 A[7:0]	1 A7	1 A6	0 A5	1 A4	0 A3	1 A2	0 A1	1 A0	Set Display Clock Divide Ratio/Oscillator Frequency	A[3:0] : Define the divide ratio (D) of the display clocks (DCLK): Divide ratio= A[3:0] + 1, RESET is 0000b (divide ratio = 1) A[7:4] : Set the Oscillator Frequency, FOSC. Oscillator Frequency increases with the value of A[7:4] and vice versa. RESET is 0111b Range:0000b~1111b Frequency increases as setting value increases.
0 0	D9 A[7:0]	1 A7	1 A6	0 A5	1 A4	1 A3	0 A2	0 A1	1 A0	Set Pre-charge Period	A[3:0] : Phase 1 period of up to 15 DCLK Clock 0 is invalid entry (RESET=2h) A[7:4] : Phase 2 period of up to 15 DCLK Clock 0 is invalid entry (RESET=2h)
0 0	DB A[5:2]	1 0	1 0	0 A5	1 A4	1 A3	0 A2	1 0	1 0	Set VCOMH Deselect Level	

A[5:2]	Hex code	VCOMH deselect level
0000b	00h	~ 0.64 x VCC
1101b	34h	~ 0.78 x VCC (RESET)
1111b	3Ch	~ 0.84 x VCC

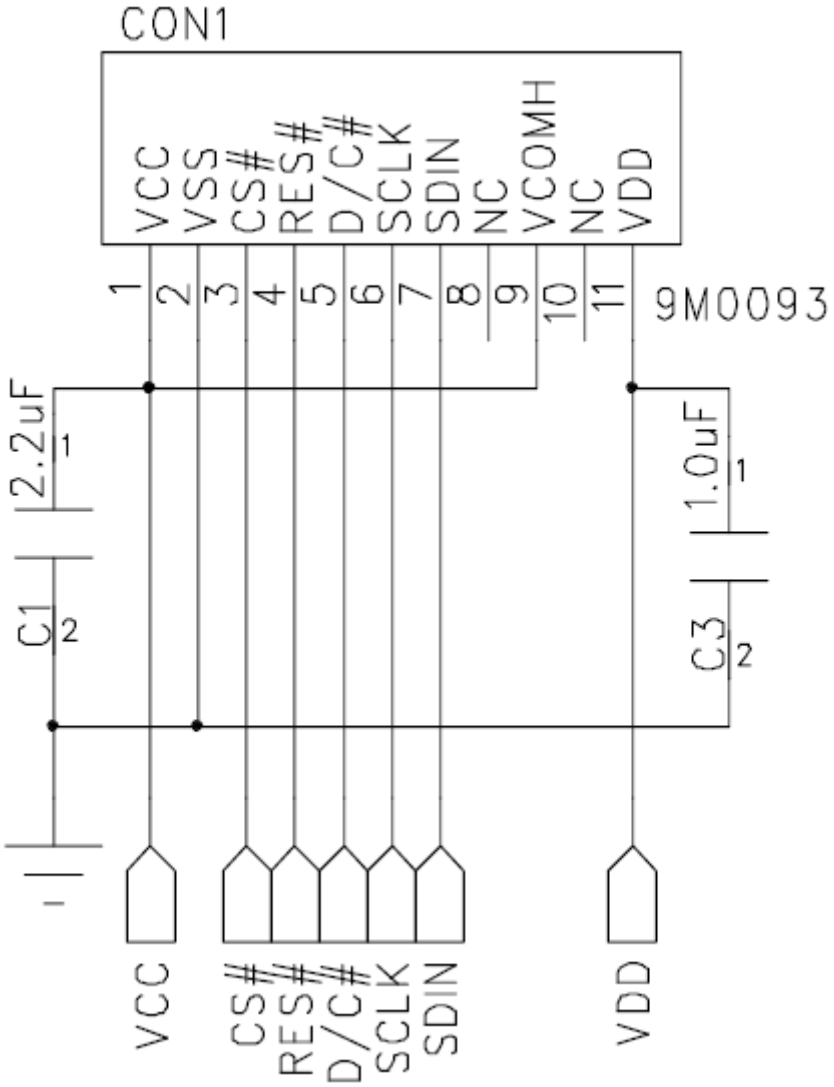
Note： "*" stands for "Don't care".

■ INITIALIZATION CODE

```
void InitOLED_MASTER_SSD1309(void)
{
  MainOLED_WCom(0xFD);          //Set Command Lock
  MainOLED_WCom(0x12);
  MainOLED_WCom(0xAE);          //Display OFF(sleep mode)(RESET)
  MainOLED_WCom(0x81);          //Contarst Control(00H-FFH)
  MainOLED_WCom(CONTRAST);
  MainOLED_WCom(0xA4);          //Entire Display ON
  MainOLED_WCom(0xA6);          //Set Normal Display

  MainOLED_WCom(0x8D);          //Set DC-DC (charge Pump)
  MainOLED_WCom(0x14);          //Enable charge Pump
  MainOLED_WCom(0xD8);          //Set low power display mode
  MainOLED_WCom(0x05);          //Lower power display mode

  MainOLED_WCom(0XAD);
  MainOLED_WCom(0X48);

  MainOLED_WCom(0x40);          //Set Display Strart Line (040H-07FH)
  MainOLED_WCom(0xA1);          //Set Segment Re-Map
  MainOLED_WCom(0xA8);          //Set Multiplex Ratio 64
  MainOLED_WCom(0x1F);
  MainOLED_WCom(0xC8);          //Com Scan Com1-Com64

  MainOLED_WCom(0xD3);          //Set Display Offset(00H-3FH)
  MainOLED_WCom(0x00);
  MainOLED_WCom(0xDA);          //Com Pin Configuration
  MainOLED_WCom(0x12);
  MainOLED_WCom(0xD5);          //Set Frame Frequency
  MainOLED_WCom(0x80);
  MainOLED_WCom(0xD9);          //Set Pre-Charge Period
  MainOLED_WCom(0xF1);
  MainOLED_WCom(0xDB);          //Set VCOM Deselect Level
  MainOLED_WCom(0x20);

  MainOLED_WCom(0xAF);          //Dsplay ON

}
```

■ SCHEMATIC EXAMPLE

◆Serial Interface Application Circuit:



■ RELIABILITY TESTS

<table>
<tr><th colspan="2">Item</th><th>Condition</th><th>Criterion</th></tr>
<tr><td colspan="2">High Temperature Storage
(HTS)</td><td>80±2℃, 200 hours</td><td rowspan="6">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.</td></tr>
<tr><td colspan="2">High Temperature Operating
(HTO)</td><td>70±2℃, 96 hours</td></tr>
<tr><td colspan="2">Low Temperature Storage
(LTS)</td><td>-30±2℃, 200 hours</td></tr>
<tr><td colspan="2">Low Temperature Operating
(LTO)</td><td>-20±2℃, 96 hours</td></tr>
<tr><td colspan="2">High Temperature / High Humidity Storage
(HTHHS)</td><td>50±3℃, 90%±3%RH, 120 hours</td></tr>
<tr><td colspan="2">Thermal Shock (Non-operation)
(TS)</td><td>-20±2℃ ~ 25℃ ~ 70±2℃
(30min) (5min) (30min)
10cycles</td></tr>
<tr><td>Vibration (Packing)</td><td>10~55~10Hz,amplitude 1.5mm, 1 hour for each direction x, y, z</td><td colspan="2" rowspan="2">1. One box for each test.
2. No addition to the cosmetic and the electrical defects.</td></tr>
<tr><td>Drop (Packing)</td><td>Height : 1 m, each time for 6 sides, 3 edges, 1 angle</td></tr>
<tr><td>ESD (finished product housing)</td><td>±4kV (R: 330Ω C: 150pF , 10times, air discharge)</td><td colspan="2">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.</td></tr>
</table>

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.

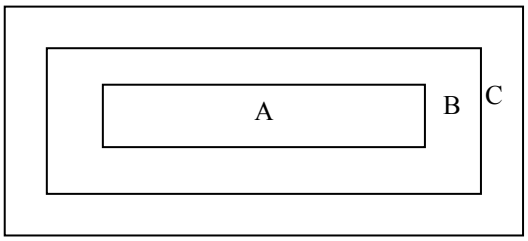
■ OUTGOING QUALITY CONTROL SPECIFICATION

◆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

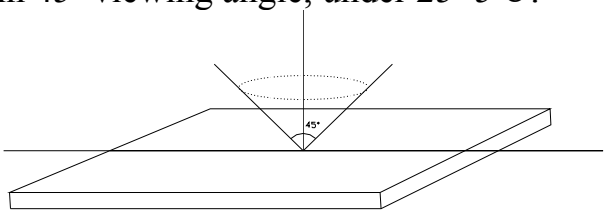
Zone B: Viewing Area except Zone A

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℃.



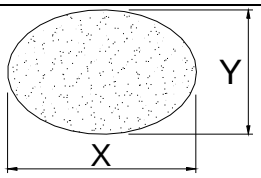
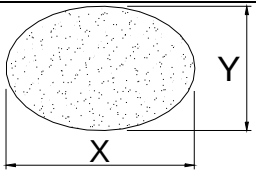
2 The luminance and color coordinate inspection : By PR705 or BM-7 or the equal equipments, in the dark room, under 25±5℃.

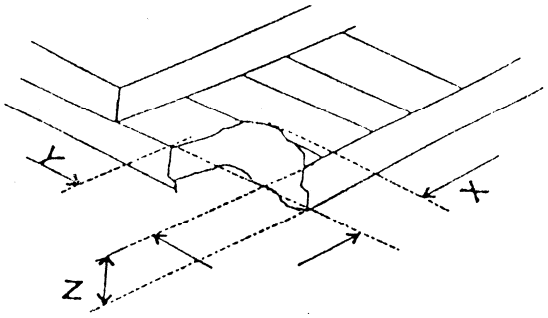
◆Inspection Criteria

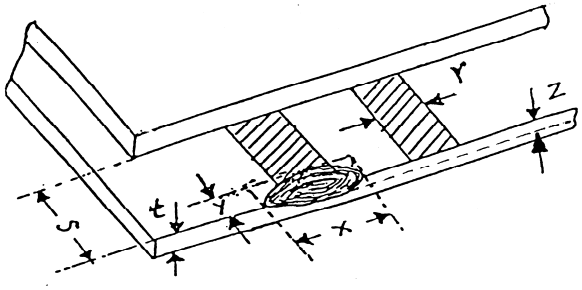
1 Major defect : AQL= 0.65

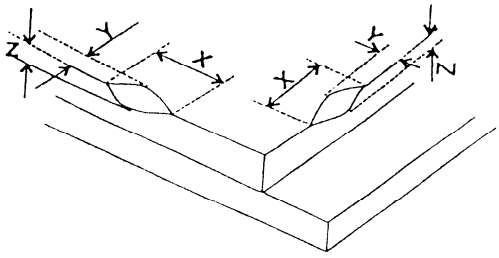
Item	Criterion
Function Defect	1. No display or abnormal display is not accepted
	2. Open or short is not accepted.
	3. Power consumption exceeding the spec is not accepted.
Outline Dimension	Outline dimension exceeding the spec is not accepted.
Glass Crack	Glass crack tends to enlarge is not accepted.

2 Minor Defect : AQL= 1.5

<table>
<tr><td>Item</td><td colspan="4">Criterion</td></tr>
<tr><td rowspan="6">Spot Defect (dimming and lighting spot)</td><td colspan="2">Size (mm)</td><td>Accepted Qty</td><td></td></tr>
<tr><td colspan="2"></td><td>Area A + Area B</td><td>Area C</td></tr>
<tr><td rowspan="4">  </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>0.15＜Φ</td><td>0</td></tr>
<tr><td colspan="4">Note : Φ= (x + y) / 2</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 Chiped)</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>

■ 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 dessicant.
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 dessicant 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) Huaersheng will replace or repair any of its OLED modules which are found to be functional defect when inspected in accordance with Huaersheng OLED acceptance standards (copies available upon request). Cosmetic/visual defects must be returned to Huaersheng within 90 days of shipment. Confirmation of such date should be based on freight documents. The warranty liability of Huaersheng is limited to repair and/or replacement on the terms above. Huaersheng 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 Huaersheng 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.