

# SPECIFICATION

PART NO. : OEL9M0039-W-E

**OLED**  
**128X128** **1.50"**

This specification may be changed without any notice in order to improve performance or quality etc.

Please contact OLED R&D department TRULY Semiconductors LTD. for updated specification and product status before designing for this product or releasing the order.

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### REVISION HISTORY

Rev.	Contents	Date
0.0	Preliminary	2007-8-23
0.1	Supplement power consumption and life time item	2010-11-9

■ **PHYSICAL DATA**

No.	Items:	Specification:	Unit
1	Diagonal Size	1.50	Inch
2	Resolution	128(H) x 128(V)	Lines
3	Active Area	26.86 (W) x26.86(H)	mm
4	Outline Dimension (Panel)	34.90(W) x 37.80(H)	mm
5	Pixel Pitch	0.210(W) x 0.210(H)	mm
6	Pixel Size	0.190(W) x 0.190(H)	mm
7	Driver IC	SSD1329Z	-
8	Display Color	White	-
9	Grayscale	4	Bit
10	Interface	Parallel / Serial	-
11	IC package type	COG	-
12	Thickness	1.5±0.1	mm
13	Weight	<4.0	g
14	Duty	1/128	-

■ **ABSOLUTE MAXIMUM RATINGS**

Unless otherwise specified,  $V_{SS} = 0V$

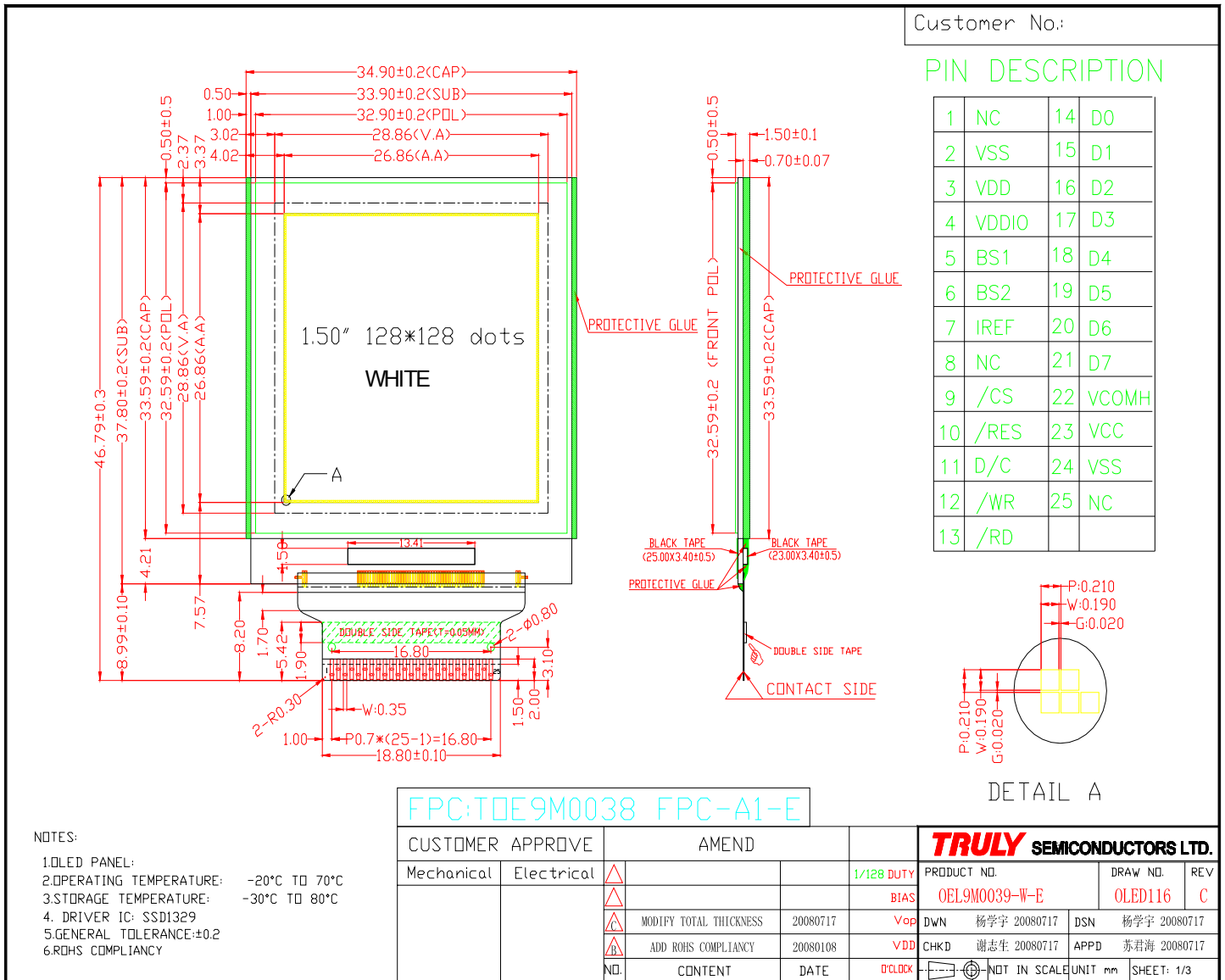
(  $T_a = 25$  )

Items		Symbol	Min	Typ.	Max	Unit
Supply Voltage	Logic	$V_{DD}$	-0.3	-	4.0	V
	I/O buffer	$V_{DDIO}$	-0.3	-	4.0	V
	Driving	$V_{CC}$	0	-	18.0	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,  $V_{SS} = 0V$ ,  $V_{DD} = 2.4V$  to  $3.5V$  (  $T_a = 25$  )

Items		Symbol	Min	Typ.	Max	Unit
Supply Voltage	Logic	$V_{DD}$	2.4	3.0	3.5	V
	I/O buffer	$V_{DDIO}$	1.7	3.0	$V_{DD}$	V
	Operating	$V_{CC}$	9.0	15.0	16.0	V
Input Voltage	High Voltage	$V_{IH}$	$0.8 \times V_{DD}$	-	$V_{DD}$	V
	Low Voltage	$V_{IL}$	$V_{SS}$	-	$0.2 \times V_{DD}$	V
Output Voltage	High Voltage	$V_{OH}$	$0.9 \times V_{DD}$	-	$V_{DD}$	V
	Low Voltage	$V_{OL}$	$V_{SS}$	-	$0.1 \times V_{DD}$	V

### AC Characteristics

Use 8080/6800-Series MPU Parallel Interface or Serial Interface

#### 1:6800 Series MPU Parallel Interface

Conditions:

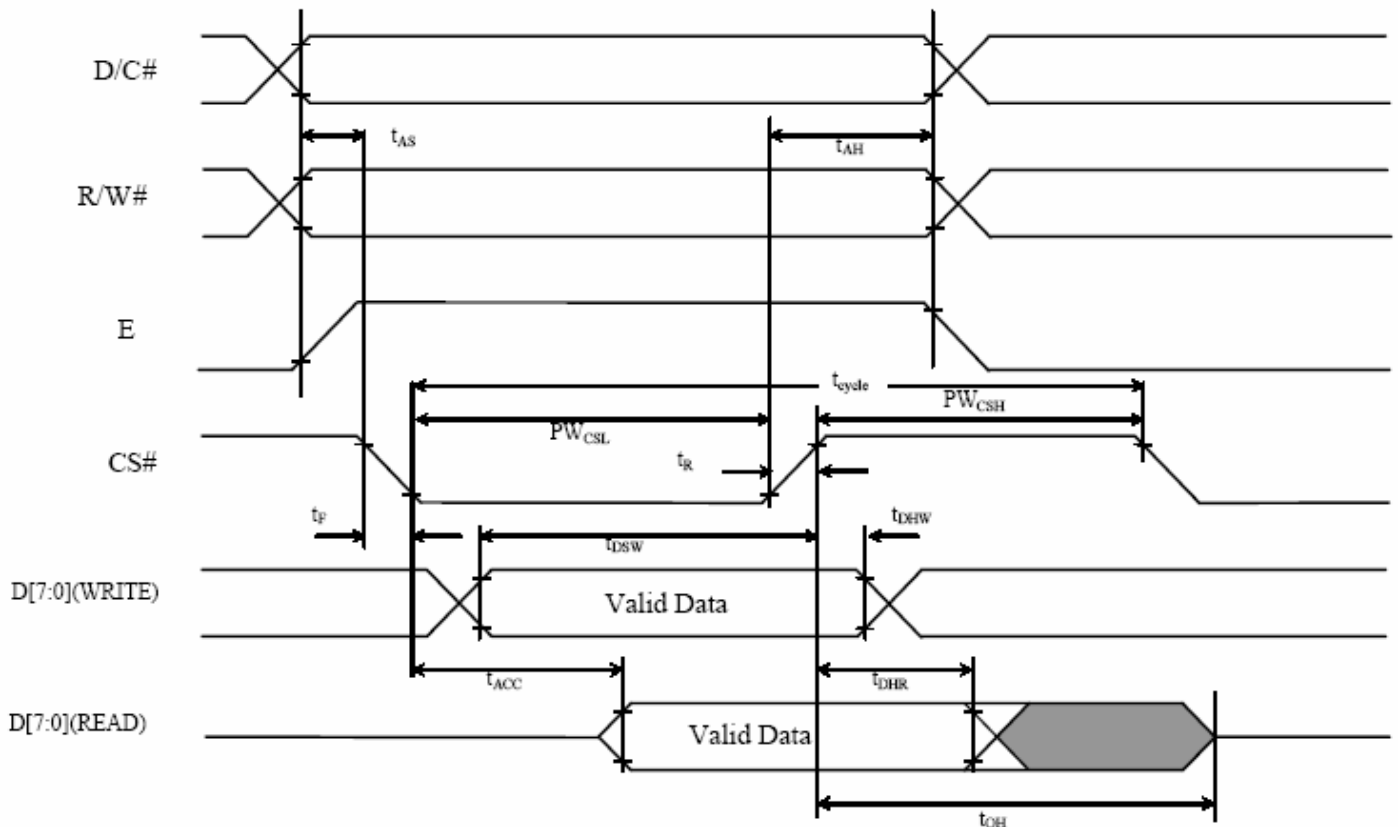
$$V_{DD} \sim V_{SS} = 2.4 \text{ to } 3.5\text{V}$$

$$T_A = 25^\circ\text{C}$$

6800-Series MPU 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	15	-	-	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

6800-series MPU parallel interface characteristics



**2:8080 Series MPU Parallel Interface**

**Conditions:**

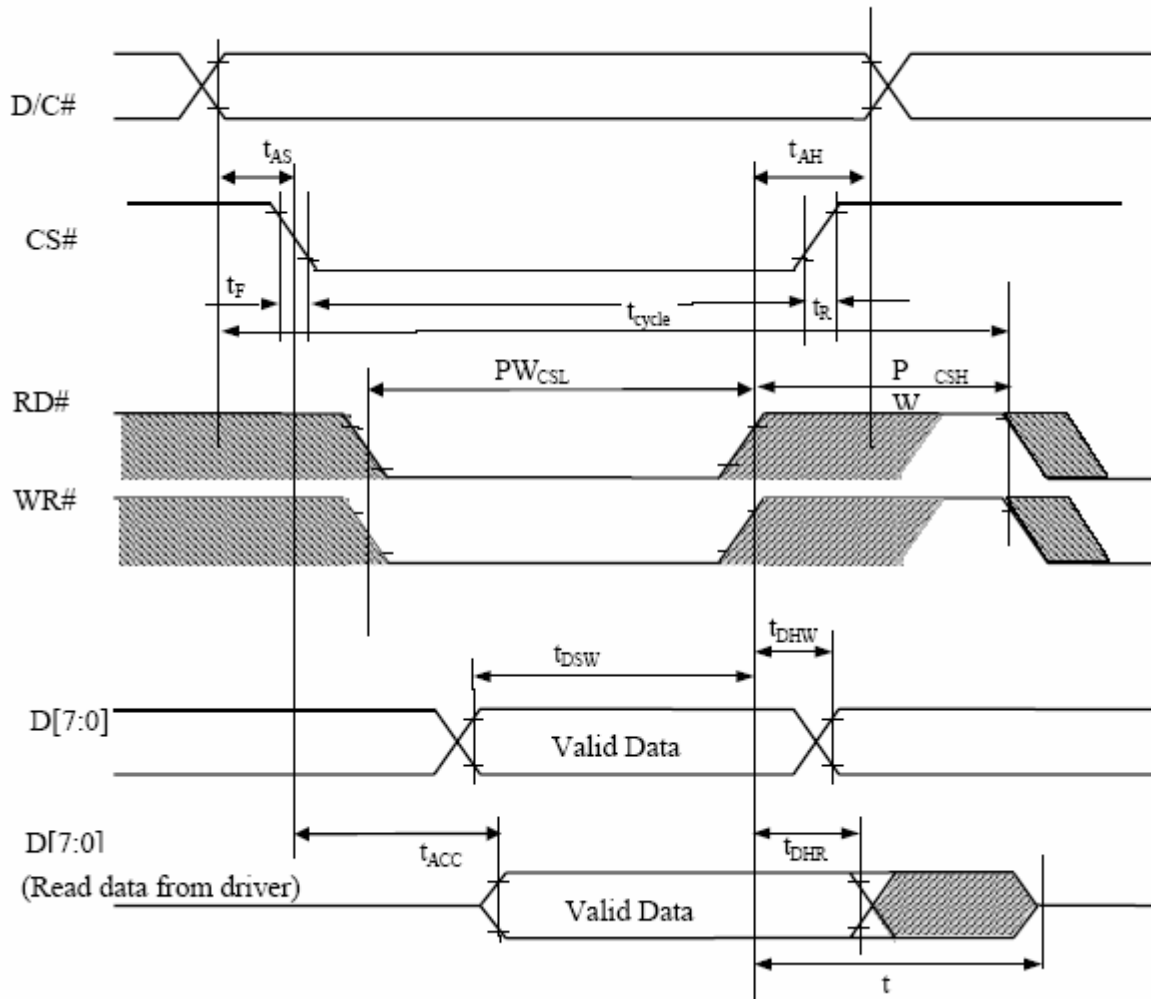
$V_{DD} \sim V_{SS} = 2.4 \text{ to } 3.5V$

$T_A = 25^\circ C$

**8080-Series MPU 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	15	-	-	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

**8080-series MPU parallel interface characteristics**



### 3:Serial Interface

**Conditions:**

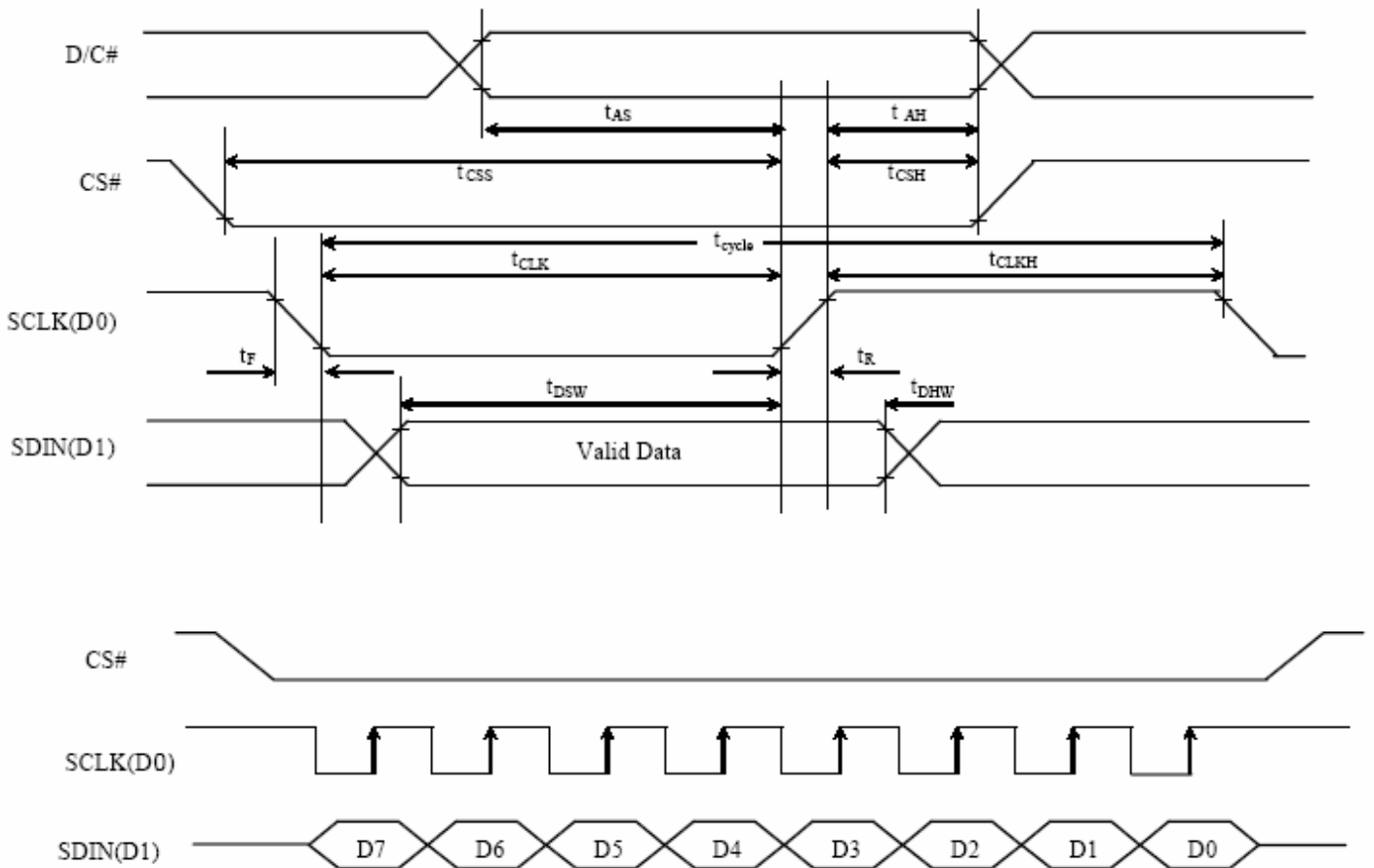
$V_{DD} \sim V_{SS} = 2.4 \text{ to } 3.5\text{V}$

$T_A = 25^\circ\text{C}$

Serial Interface Timing Characteristics

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	100	-	-	ns
$t_{DHW}$	Write Data Hold Time	100	-	-	ns
$t_{CLKL}$	Clock Low Time	100	-	-	ns
$t_{CLKH}$	Clock High Time	100	-	-	ns
$t_r$	Rise Time	-	-	15	ns
$t_f$	Fall Time	-	-	15	ns

Serial interface characteristics



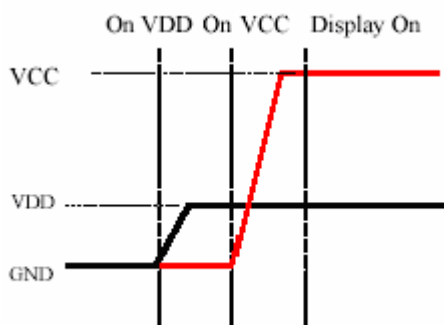


**■ TIMING OF POWER SUPPLY**

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

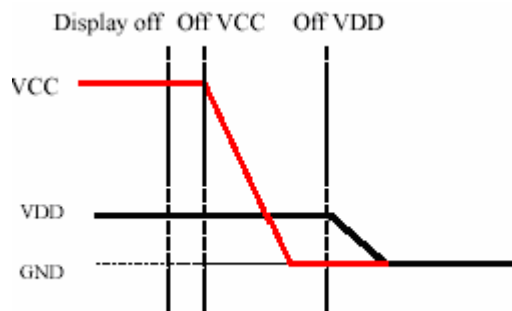
Power up Sequence:

1. Power up  $V_{DD}$
2. Delay 100ms
3. Power up  $V_{CC}$  (High Voltage)
4. Delay 100ms
5. Send Display ON command



Power down Sequence:

1. Send Display OFF command
2. Power down  $V_{CC}$ (High Voltage)
3. Delay 100ms
4. Power down  $V_{DD}$



■ **ELECTRO-OPTICAL CHARACTERISTICS (Ta=25 )**

Items		Symbol	Min.	Typ.	Max.	Unit	Remark
Operating Luminance		L	31	36*	-	cd /m <sup>2</sup>	WHITE
Power Consumption		P	-	130	160	mW	30% pixels ON L=36cd/m <sup>2</sup>
Frame Frequency		Fr	-	100	-	Hz	
Color Coordinate	WHITE	CIE x	0.26	0.3	0.34	CIE1931	Darkroom
		CIE y	0.29	0.33	0.38		
Response Time	Rise	Tr	-	-	0.02	ms	-
	Decay	Td	-	-	0.02	ms	-
Contrast Ratio*		Cr	10000:1	-	-		Darkroom
Viewing Angle Uniformity		θ	160	-	-	Degree	-
Operating Life Time*		Top	30,300	-	-	Hours	L=36cd/m <sup>2</sup>

Note:

1. **36cd/m<sup>2</sup>** is based on V<sub>DD</sub>=3.0V, V<sub>CC</sub>=13.0V, contrast command setting 0x7F;

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 alternatively displayed)

(The initial value should be closed to the typical value after adjusting.)

■ INTERFACE PIN CONNECTIONS

No	Symbol	Description
1	NC	No connection
2	VSS	Ground
3	VDD	Power supply pin
4	VDDIO	Power supply for I/O buffer
5	BS1	MCU bus interface selection pin
6	BS2	MCU bus interface selection pin
7	IREF	Segment output current reference pin
8	NC	No connection
9	/CS	Chip select input pin
10	/RES	Reset signal input pin
11	D/C	Data /Command control pin
12	/WR	MCU interface input pin
13	/RD	MCU interface input pin
14	D0	Data bus or as SCLK in Serial mode
15	D1	Data bus or as SDIN in Serial mode
16	D2	Data bus or <b>should be left open in Serial mode</b>
17	D3	Data bus or connected to Ground in Serial mode
18	D4	Data bus or connected to Ground in Serial mode
19	D5	Data bus or connected to Ground in Serial mode
20	D6	Data bus or connected to Ground in Serial mode
21	D7	Data bus or connected to Ground in Serial mode
22	VCOMH	High level voltage output of COM signal
23	VCC	High voltage supply for OLED panel
24	VSS	Ground
25	NC	No connection

■ **COMMAND TABLE**

**Write command table**

(D/C# =0, R/W#(WR#)=0, E (RD#)=1)

D/C	Hex	D7	D6	D5	D4	D3	D2	D1	D0	Command	Description
0 0 0	15 A[5:0] B[5:0]	0 * *	0 * *	0 A <sub>5</sub> B <sub>5</sub>	1 A <sub>4</sub> B <sub>4</sub>	0 A <sub>3</sub> B <sub>3</sub>	1 A <sub>2</sub> B <sub>2</sub>	0 A <sub>1</sub> B <sub>1</sub>	1 A <sub>0</sub> B <sub>0</sub>	Set Column Address	Second command A[5:0] sets the column start address from 0-63, POR = 00H.  Third command B[5:0] sets the column end address from 0-63, POR = 3FH.
0 0 0	75 A[6:0] B[6:0]	0 * *	1 A <sub>6</sub> B <sub>6</sub>	1 A <sub>5</sub> B <sub>5</sub>	1 A <sub>4</sub> B <sub>4</sub>	0 A <sub>3</sub> B <sub>3</sub>	1 A <sub>2</sub> B <sub>2</sub>	0 A <sub>1</sub> B <sub>1</sub>	1 A <sub>0</sub> B <sub>0</sub>	Set Row address	Second command A[6:0]sets the row start address from 0-79, POR = 00H.  Third command B[6:0] sets the row end address from 0-79, POR = 4FH.
0 0	81 A[6:0]	1 *	0 A <sub>6</sub>	0 A <sub>5</sub>	0 A <sub>4</sub>	0 A <sub>3</sub>	0 A <sub>2</sub>	0 A <sub>1</sub>	1 A <sub>0</sub>	Set Contrast Control Register	Double byte command to select 1 out of 128 contrast steps. Contrast increases as level increase. The level is set to 40H after POR
0	84~86	1	0	0	0	0	1	X <sub>1</sub>	X <sub>0</sub>	Set Current Range	84H = Quarter Current Range (POR) 85H = Half Current Range 86H = Full Current Range
0 0	A0 A[6:0]	1 *	0 A <sub>6</sub>	1 A <sub>5</sub>	0 A <sub>4</sub>	0 A <sub>3</sub>	0 A <sub>2</sub>	0 A <sub>1</sub>	0 A <sub>0</sub>	Set Re-map	A[0]=0, Disable Column Address Re-map (POR) A[0]=1, Enable Column Address Re-map A[1]=0, Disable Nibble Re-map (POR) A[1]=1, Enable Nibble Re-map A[2]=0, Horizontal Address Increment (POR) A[2]=1, Vertical Address Increment A[4]=0, Disable COM Re-map disable (POR) A[4]=1, Enable COM Re-map A[5]=0, Reserved (POR) A[5]=1, Reserved A[6]=0, Disable COM Split Odd Even (POR) A[6]=1, Enable COM Split Odd Even
0 0	A1 A[6:0]	1 *	0 A <sub>6</sub>	1 A <sub>5</sub>	0 A <sub>4</sub>	0 A <sub>3</sub>	0 A <sub>2</sub>	0 A <sub>1</sub>	1 A <sub>0</sub>	Set Display Start Line	Set display RAM display start line register from 0-79.  Display start line register is reset to 00H after POR.
0 0	A2 A[6:0]	1 *	0 A <sub>6</sub>	1 A <sub>5</sub>	0 A <sub>4</sub>	0 A <sub>3</sub>	0 A <sub>2</sub>	1 A <sub>1</sub>	0 A <sub>0</sub>	Set Display Offset	Set vertical scroll by COM from 0-79. The value is reset to 00H after POR.
0	A4~A7	1	0	1	0	0	X <sub>2</sub>	X <sub>1</sub>	X <sub>0</sub>	Set Display Mode	A4H = Normal Display (POR) A5H = Entire Display On, all pixels turns on in GS level 15  A6H = Entire Display Off, all pixels turns off A7H = Inverse Display

D/C	Hex	D7	D6	D5	D4	D3	D2	D1	D0	Command	Description										
0 0	A8 A[6:0]	1 *	0 A <sub>6</sub>	1 A <sub>5</sub>	0 A <sub>4</sub>	1 A <sub>3</sub>	0 A <sub>2</sub>	0 A <sub>1</sub>	0 A <sub>0</sub>	Set Multiplex Ratio	The next command determines multiplex ratio N from 16MUX-80MUX, POR=4FH(80MUX)										
0 0	AD A[1:0]	1 *	0 *	1 *	0 *	1 *	1 *	0 A <sub>1</sub>	1 A <sub>0</sub>	Set Master Configuration	A[0] = 0, Disable DC-DC converter A[0] = 1, Enable DC-DC converter (POR) A[1] = 0, Disable internal V <sub>COMH</sub> A[1] = 1, Enable internal V <sub>COMH</sub> (POR)										
0	AE~AF	1	0	1	0	X <sub>3</sub>	1	1	1	Set Display On/Off	AEH = Display Off (Sleep mode) (POR) AFH = Display On										
0 0 0	B1 A[3:0] A[7:4]	1 * A <sub>7</sub>	0 * A <sub>6</sub>	1 * A <sub>5</sub>	1 * A <sub>4</sub>	0 A <sub>3</sub>	0 A <sub>2</sub>	0 A <sub>1</sub>	1 A <sub>0</sub>	Set Phase Length	A[3:0] = P1, phase 1 period of 1-15 DCLKs, POR = 3DCLKS = 3H  A[7:4] = P2, phase 2 period of 1-15 DCLKs, POR = 5DCLKS = 5H										
0 0	B2 A[7:0]	1 A <sub>7</sub>	0 A <sub>6</sub>	1 A <sub>5</sub>	1 A <sub>4</sub>	0 A <sub>3</sub>	0 A <sub>2</sub>	1 A <sub>1</sub>	0 A <sub>0</sub>	Set Row Period	The next command sets the number of DCLKs, K, per row between 2-158 DCLKS. POR = 37DCLKS = 25H The K value should be set as K = P1+P2+GS15 pulse width (POR: 3+5+29DCLKS)										
0 0 0	B3 A[3:0] A[7:4]	1 * A <sub>7</sub>	0 * A <sub>6</sub>	1 * A <sub>5</sub>	1 * A <sub>4</sub>	0 A <sub>3</sub>	0 A <sub>2</sub>	1 A <sub>1</sub>	1 A <sub>0</sub>	Set Display Clock Divide Ratio/Oscillator Frequency	The lower nibble (A[3:0]) of the next command sets the divide ratio of the display clocks: <table border="1" style="margin-left: 20px;"> <thead> <tr> <th>A[3:0]</th> <th>Divide ratio</th> </tr> </thead> <tbody> <tr> <td>0000b</td> <td>1</td> </tr> <tr> <td>0001b (POR)</td> <td>2</td> </tr> <tr> <td>:</td> <td>:</td> </tr> <tr> <td>1111b</td> <td>16</td> </tr> </tbody> </table> The higher nibble (A[7:4]) of the next command sets the Oscillator Frequency. Oscillator Frequency increases with the value of A[7:4] and vice versa. Range:0000b~1111b POR= 0100b represents 655KHz, typical step value: 5% of previous value	A[3:0]	Divide ratio	0000b	1	0001b (POR)	2	:	:	1111b	16
A[3:0]	Divide ratio																				
0000b	1																				
0001b (POR)	2																				
:	:																				
1111b	16																				
0 0	B8 A[2:0] B[2:0] B[6:4] C[2:0] C[6:4] D[2:0] D[6:4] E[2:0] E[6:4] F[2:0] F[6:4] G[2:0] G[6:4] H[2:0] H[6:4]	1 *	0 * * B <sub>6</sub> * C <sub>6</sub> * D <sub>6</sub> * E <sub>6</sub> * F <sub>6</sub> * G <sub>6</sub> * H <sub>6</sub>	1 * * B <sub>5</sub> * C <sub>5</sub> * D <sub>5</sub> * E <sub>5</sub> * F <sub>5</sub> * G <sub>5</sub> * H <sub>5</sub>	1 * * B <sub>4</sub> *	1 *	0 A <sub>2</sub>	0 A <sub>1</sub>	0 A <sub>0</sub>	Set Gray Scale Table	The next eight bytes of command set the gray scale level of GS1-15 as below:  A[2:0] = L1, POR=1 B[2:0] = L2, POR=1 B[6:4] = L3, POR=1 C[2:0] = L4, POR=1 C[6:4] = L5, POR=1 D[2:0] = L6, POR=1 D[6:4] = L7, POR=1 E[2:0] = L8, POR=1 E[6:4] = L9, POR=1 F[2:0] = L10, POR=1 F[6:4] = L11, POR=1 G[2:0] = L12, POR=1 G[6:4] = L13, POR=1 H[2:0] = L14, POR=1										

D/C	Hex	D7	D6	D5	D4	D3	D2	D1	D0	Command	Description
0 0	BE A[5:0]	1 *	0 *	1 A5	1 A4	1 A3	1 A2	1 A1	0 A0	Set VCOMH Voltage	Second command A[5:0] sets the $V_{COMH}$ voltage level  A[5:0] : 000000 0.51* $V_{REF}$ 000001 0.52* $V_{REF}$ ..... 011101 0.81* $V_{REF}$ (POR) 011110 0.82* $V_{REF}$ 011111 0.84* $V_{REF}$
0 0	BC A[7:0]	1 A7	0 A6	1 A5	1 A4	1 A3	1 A2	0 A1	0 A0	Set Precharge Voltage	Second command A[7:0] sets the precharge voltage level  A[7:0] 1xxxxxxx connects to $V_{COMH}$ (POR) 001xxxxx 1.0* $V_{REF}$ 00000000 0.51* $V_{REF}$ 00000001 0.52* $V_{REF}$ ..... 00011111 0.84* $V_{REF}$
0	E3	1	1	1	0	0	0	1	1	NOP	Command for No Operation

◆ **Read command table**

(D/C#=0, R/W#(WR#)=1, E(RD#)=1 for 6800 or E(RD#)=0 for 8080)

D <sub>7</sub> D <sub>6</sub> D <sub>5</sub> D <sub>4</sub> D <sub>3</sub> D <sub>2</sub> D <sub>1</sub> D <sub>0</sub>	Status Register Read	D7 = 0:reserved D7 = 1:reserved D6 = 0:indicates the display is ON D6 = 1:indicated the display is OFF D5 = 0:reserved D5 = 1:reserved D4 = 0:reserved D4 = 1:reserved
---	----------------------	---

Note: Patterns other than that given in Command Table are prohibited to enter to the chip as a command; Otherwise, unexpected result will occur

**■ INITIALIZATION CODE**

```
Void init_oled()  
{  
//Set Column Address  
Writecommand(0x15);  
Writecommand(0x00);  
Writecommand(0x3f);  
  
//Set Row Address  
Writecommand(0x75);  
Writecommand(0x00);  
Writecommand(0x7f);  
  
//Set Re_map  
Writecommand(0xa0);  
Writecommand(0x51);  
  
//Set Display Start Line  
Writecommand(0xa1);  
Writecommand(0x00);  
  
//Set Display Offset  
Writecommand(0xa2);  
Writecommand(0x00);  
  
//Set Display Mode  
Writecommand(0xa4);  
  
//Set MUX Radio  
Writecommand(0xa8);  
Writecommand(0x7f);  
  
//Set Frame Frequency  
Writecommand(0xb2);  
Writecommand(0x23);  
  
//Set Front Clock Divider/Oscillator Frequency  
Writecommand(0xb3);  
Writecommand(0x51);  
  
//Set Contrast Current  
Writecommand(0x81);  
Writecommand(0x7F);  
  
//second pre_charge speed  
Writecommand(0x82);
```

```
Writecommand(0xfe);

//first pre_charge voltage
Writecommand(0xbc);
Writecommand(0x1f);

//first pre_charge phase length
Writecommand(0xb1);
Writecommand(0x53);

//Set Second Pre_Charge Period
Writecommand(0xbb);
Writecommand(0x07);

//Set Vcom
Writecommand(0xbe);
Writecommand(0x1f);

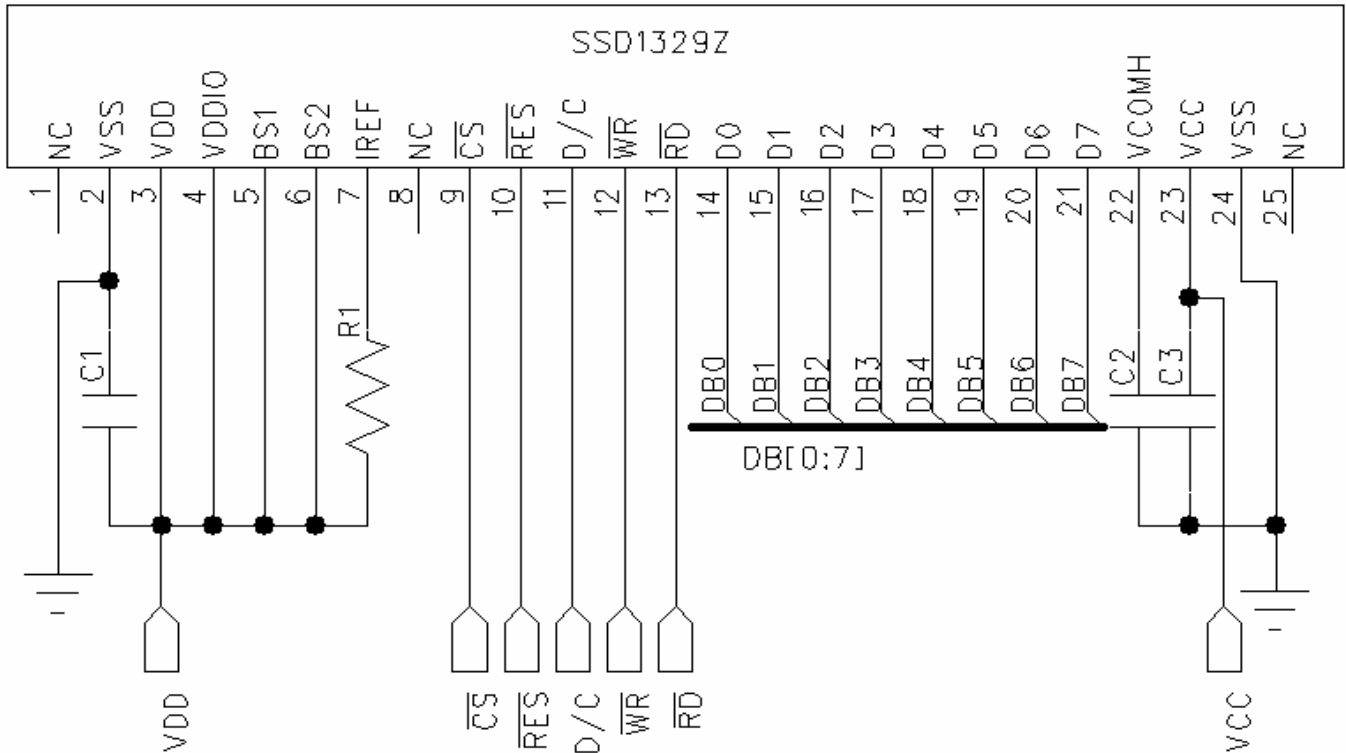
//Set Default Gray Scale table
//Set Look Up table for Gray Scale Pulse Width
Writecommand(0xB8); //SET GS
Writecommand(0x04); //GS1
Writecommand(0x06); //GS2
Writecommand(0x08); //GS3
Writecommand(0x0A); //GS4
Writecommand(0x0C); //GS5
Writecommand(0x0E); //GS6
Writecommand(0x10); //GS7
Writecommand(0x12); //GS8
Writecommand(0x14); //GS9
Writecommand(0x16); //GS10
Writecommand(0x18); //GS11
Writecommand(0x1A); //GS12
Writecommand(0x1C); //GS13
Writecommand(0x1E); //GS14
Writecommand(0x20); //GS15

//Set Sleep mode ON/OFF
Writecommand(0xAF); //DSPLAY ON
}
```

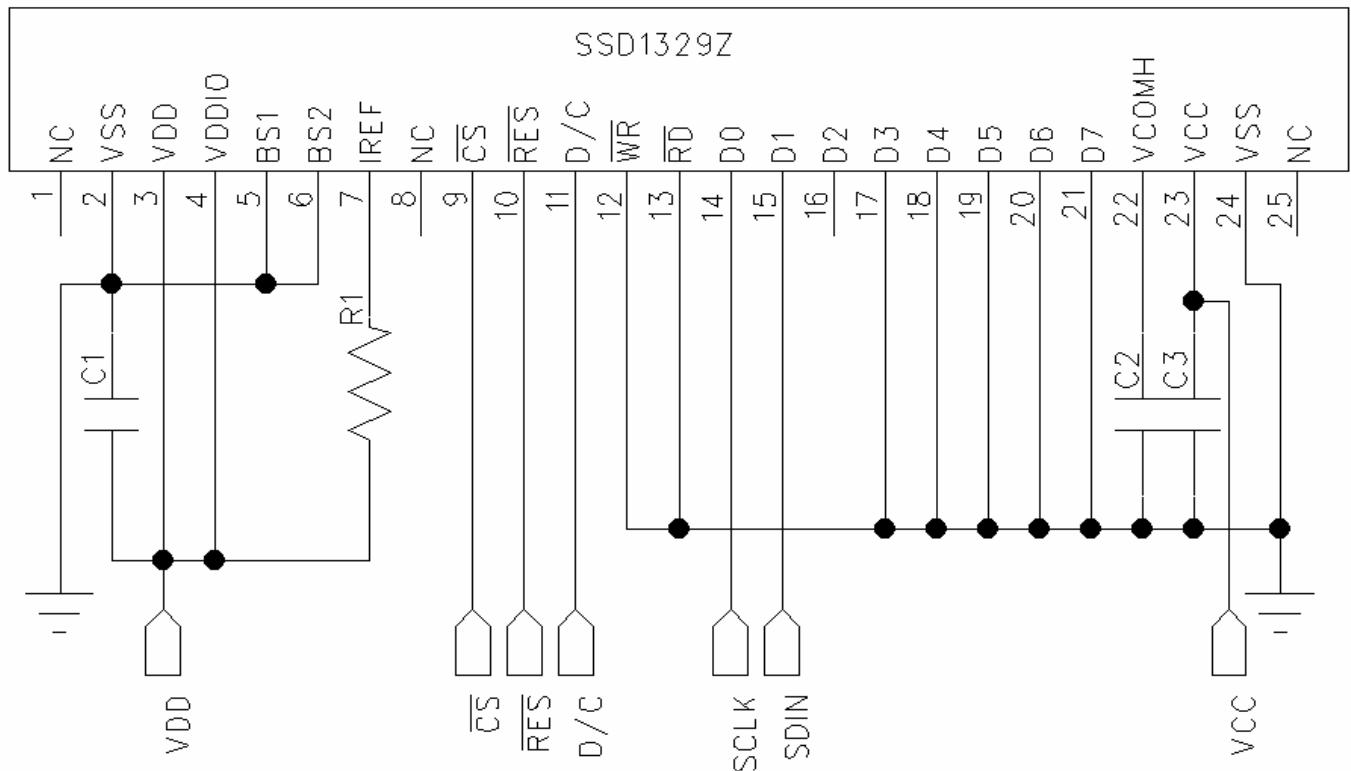


■ SCHEMATIC EXAMPLE

8080 Series Interface Application Circuit(External  $V_{DD}=3.0V, V_{CC}=13.0V$ ):



Serial Interface Application Circuit(External  $V_{DD}=3.0V, V_{CC}=13.0V$ ):



NOTE:

1. C1~C3: 1uF in which C2 and C3 have to be tantalum capacitors , R1: 200Kohm
2. The  $V_{CC}$  should connect a external voltage.
3. In Serial interface mode , the read function is not possible.

■ **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	
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.

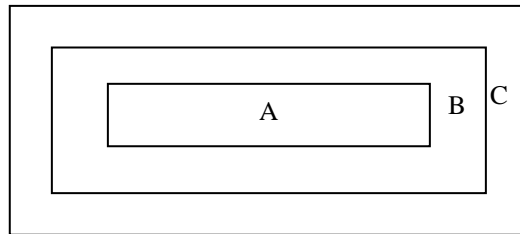
## ■OUTGOING QUALITY CONTROL SPECIFICATION

### 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

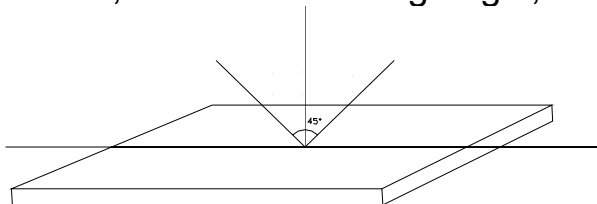
Zone C: Outside Viewing Area

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 45° viewing angle, under 25±5 .



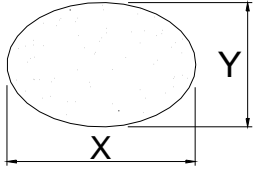
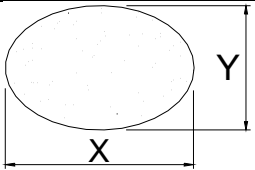
- 2 The luminance and color coordinate inspection : By PR705 or BM-7 or the equal equipments, in the dark room, under 25±5 .

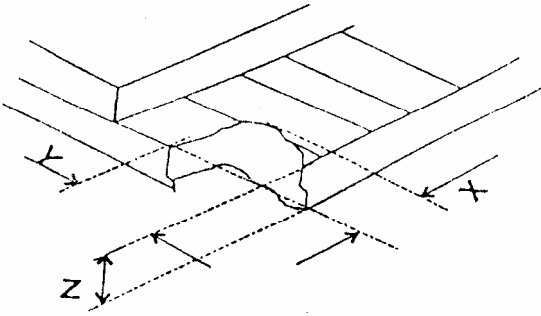
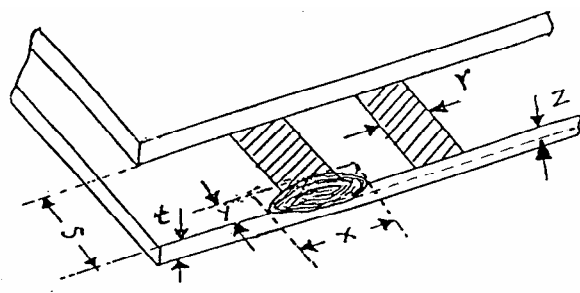
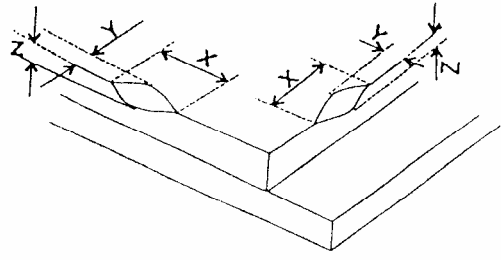
### Inspection Criteria

- 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

Item	Criterion			
Spot Defect (dimming and lighting spot)	Size (mm)		Accepted Qty	
			Area A + Area B	Area C
		$\Phi \leq 0.10$	Ignored	
		$0.10 < \Phi \leq 0.15$	3	Ignored
		$0.15 < \Phi \leq 0.20$	1	
$0.20 < \Phi$		0		
Note : $\Phi = (x + y) / 2$				
Line Defect (dimming and lighting line)	L ( Length ) : mm	W ( Width ) : mm	Area A + Area B	Area C
	/	W $\leq 0.03$	Ignored	
	L $\leq 3.0$	$0.03 < W \leq 0.05$	2	Ignored
	L $\leq 2.0$	$0.05 < W \leq 0.08$	1	
	/	$0.08 < W$	As spot defect	
Remarks: The total of spot defect and line defect shall not exceed 4 pcs.				
Polarizer Stain	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.			
Polarizer Scratch	1. If scratch can be seen during operation, according to the criterions of the Spot Defect and the Line Defect.			
	2. If scratch can be seen only under non-operation or some special angle, the criterion is as below :			
	L ( Length ) : mm	W ( Width ) : mm	Area A + Area B	Area C
	/	W $\leq 0.03$	Ignore	
	$5.0 < L \leq 10.0$	$0.03 < W \leq 0.05$	2	Ignored
	L $\leq 5.0$	$0.05 < W \leq 0.08$	1	
/	$0.08 < W$	0		
Polarizer Air Bubble	Size		Area A + Area B	Area C
		$\Phi \leq 0.20$	Ignored	
		$0.20 < \Phi \leq 0.50$	2	Ignored
		$0.50 < \Phi \leq 0.80$	1	
		$0.80 < \Phi$	0	

Glass Defect (Glass Chipped )	<p>1. On the corner</p>  <p>(mm)</p> <table border="1" data-bbox="1069 302 1436 470"> <tr> <td>x</td> <td><math>\leq 2.0</math></td> </tr> <tr> <td>y</td> <td><math>\leq S</math></td> </tr> <tr> <td>z</td> <td><math>\leq t</math></td> </tr> </table>	x	$\leq 2.0$	y	$\leq S$	z	$\leq t$
	x	$\leq 2.0$					
	y	$\leq S$					
	z	$\leq t$					
<p>2. On the bonding edge</p>  <p>(mm)</p> <table border="1" data-bbox="1069 761 1436 929"> <tr> <td>x</td> <td><math>\leq a / 2</math></td> </tr> <tr> <td>y</td> <td><math>\leq s / 3</math></td> </tr> <tr> <td>z</td> <td><math>\leq t</math></td> </tr> </table>	x	$\leq a / 2$	y	$\leq s / 3$	z	$\leq t$	
x	$\leq a / 2$						
y	$\leq s / 3$						
z	$\leq t$						
<p>3. On the other edges</p>  <p>(mm)</p> <table border="1" data-bbox="1069 1187 1436 1355"> <tr> <td>x</td> <td><math>\leq a / 5</math></td> </tr> <tr> <td>y</td> <td><math>\leq 1.0</math></td> </tr> <tr> <td>z</td> <td><math>\leq t</math></td> </tr> </table>	x	$\leq a / 5$	y	$\leq 1.0$	z	$\leq t$	
x	$\leq a / 5$						
y	$\leq 1.0$						
z	$\leq t$						
<p>Note: t: glass thickness ; s: pad width ; a: the length of the edge</p>							
TCP Defect	Crack, deep fold and deep pressure mark on the TCP are not accepted						
Pixel Size	The tolerance of display pixel dimension should be within $\pm 20\%$ of the spec						
Luminance	Refer to the spec or the reference sample						
Color	Refer to the spec or the reference sample						

**■ 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 corrode 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:  $V_{DD} \rightarrow V_{PP}$ , and power off sequence:  $V_{PP} \rightarrow V_{DD}$ .

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 :  $260^{\circ}\text{C} \pm 10^{\circ}\text{C}$ .
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  $0^{\circ}\text{C}$  and  $30^{\circ}\text{C}$  , 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.