SPECIFICATION

Part Number:HG-2428TG33730P01

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		Customer	
Written by		**Approved by**	
Checked by			
Approved by			

REVISION HISTORY

Rev.	Contents	Date
1.0	First Release	2012-03-20
1.1	Update Electro-optical Characteristics and Initialization Code	2012-06-06

■ PHYSICAL DATA

No.	Items:	Specification:	Unit
1	Diagonal Size	3.37	Inch
2	Resolution	240(H) x 128(V)	Dots
3	Active Area	75.58 (W) x 40.30(H)	mm^2
4	Outline Dimension (Panel)	89.52 (W) x 54.41(H)	mm^2
5	Pixel Pitch	0.315 (W) x 0.315(H)	mm^2
6	Pixel Size	0.290 (W) x 0.290 (H)	mm^2
7	Driver IC	SSD1322Z2	-
8	Display Color	Green	-
9	Grayscale	4	Bit
10	Interface	Parallel / Serial	-
11	IC package type	COG with ZIF tail	-
12	Thickness	2.05 ± 0.2	mm
13	Weight	20	g
14	Duty	1/128	-

■ ABSOLUTE MAXIMUM RATINGS

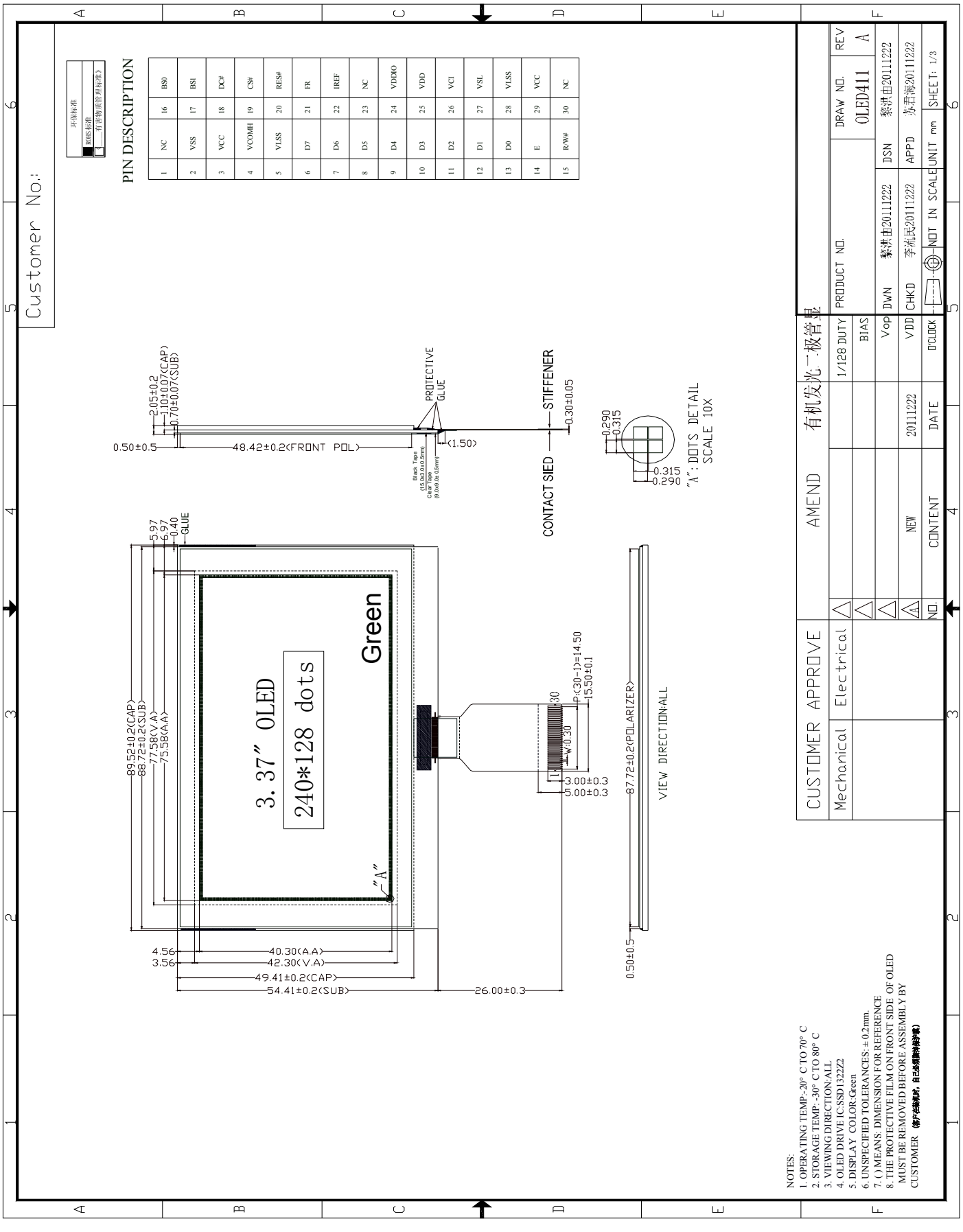
Unless otherwise specified, V_{SS} = 0V (Ta = 25℃)

Items		Symbol	Min	Typ.	Max	Unit
Supply Voltage	I/O	V_{DDIO}	-0.5	-	V_{CI}	V
	Logic	V_{CI}	-0.3	-	3.6	V
	Driving	V_{CC}	-0.5	-	21.0	V
	Core Logic	V_{DD}	-0.5	-	2.75	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



1	NC	16	BS0
2	VSS	17	BS1
3	VCC	18	DC#
4	VCOMH	19	CS#
5	VLSS	20	RES#
6	D7	21	FR
7	D6	22	IREF
8	D5	23	NC
9	D4	24	VDDIO
10	D3	25	VDD
11	D2	26	VCI
12	D1	27	VSL
13	D0	28	VLSS
14	E	29	VCC
15	R/W#	30	NC

■ ELECTRICAL CHARACTERISTICS

◆DC Characteristics

Unless otherwise specified, V_{SS} = 0V, V_{CI}=2.4V to 3.5V. (Ta = 25℃)

Items		Symbol	Min	Typ.	Max	Unit
Supply Voltage	I/O	V_{DDIO}	1.65	-	V_{CI}	V
	Logic	V_{CI}	2.4	3.0	3.5	V
	Operating	V_{CC}	10.0	16.0	20.0	V
	Core Logic	V_{DD}	2.4	-	2.6	V
Input Voltage	High Voltage	V_{IH}	0.8 x V_{DDIO}	-	V_{DDIO}	V
	Low Voltage	V_{IL}	0	-	0.2 x V_{DDIO}	V
Output Voltage	High Voltage	V_{OH}	0.9x V_{DDIO}	-	V_{DDIO}	V
	Low Voltage	V_{OL}	0	-	0.1 x V_{DDIO}	V

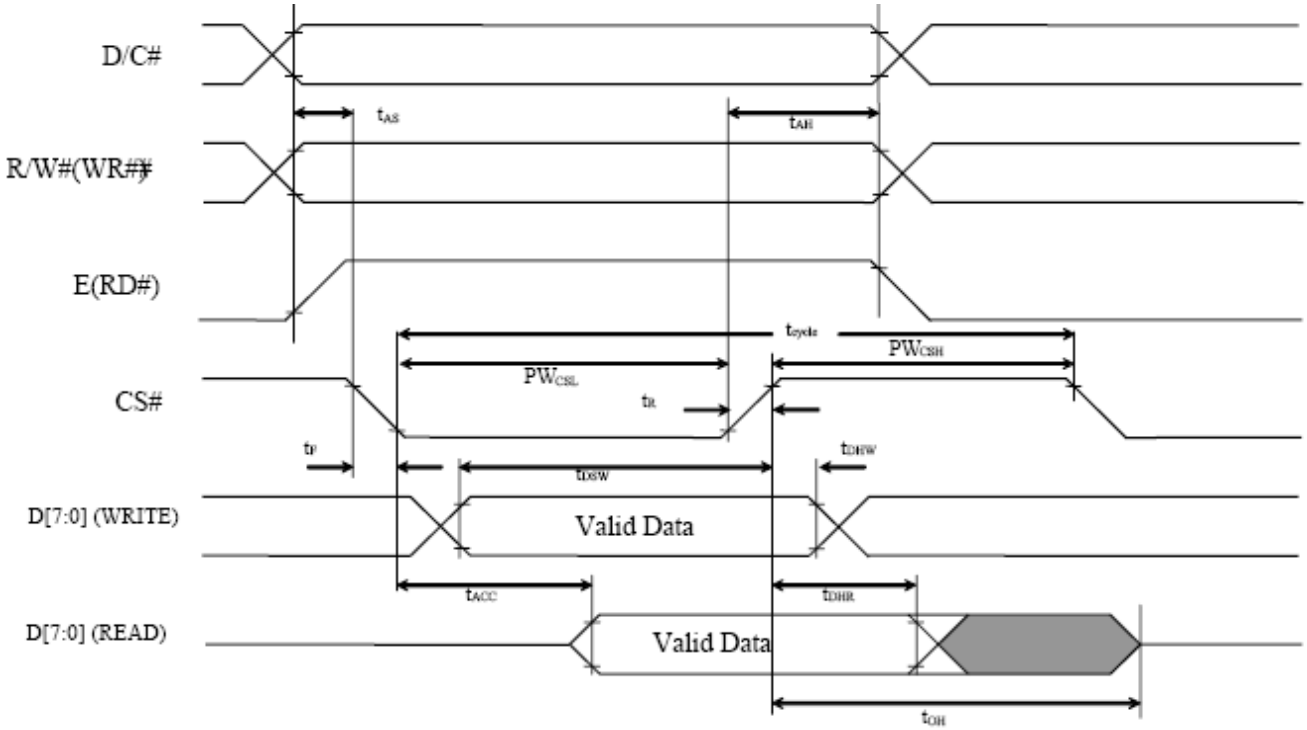
◆AC Characteristics

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

1. 6800 Series MPU Parallel Interface

(V_{DD} - V_{SS} = 2.4 to 2.6V, V_{DDIO}=1.6V, V_{CI} = 3.3V, T_A = 25°C)

Symbol	Parameter	Min	Typ	Max	Unit
t_{cycle}	Clock Cycle Time	300	-	-	ns
t_{AS}	Address Setup Time	10	-	-	ns
t_{AH}	Address Hold Time	0	-	-	ns
t_{DSW}	Write Data Setup Time	40	-	-	ns
t_{DHW}	Write Data Hold Time	7	-	-	ns
t_{DHR}	Read Data Hold Time	20	-	-	ns
t_{OH}	Output Disable Time	-	-	70	ns
t_{ACC}	Access Time	-	-	140	ns
PW_{CSL}	Chip Select Low Pulse Width (read) Chip Select Low Pulse Width (write)	120 60	-	-	ns
PW_{CSH}	Chip Select High Pulse Width (read) Chip Select High Pulse Width (write)	60 60	-	-	ns
t_R	Rise Time	-	-	15	ns
t_F	Fall Time	-	-	15	ns

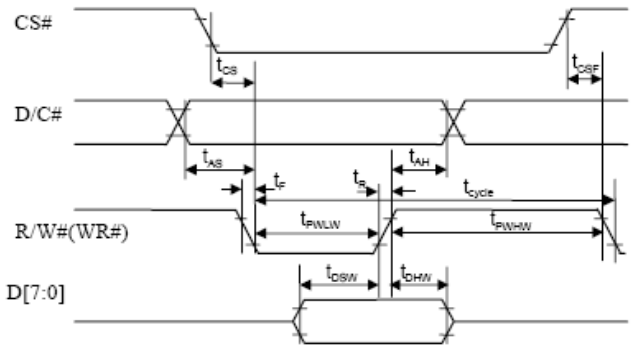


2. 8080 Series MPU Parallel Interface

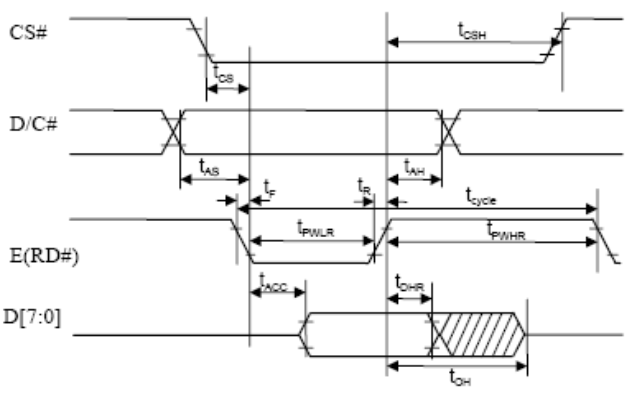
(V_{DD} - V_{SS} = 2.4 to 2.6V, V_{DDIO}=1.6V, V_{CI} = 3.3V, T_A = 25°C)

Symbol	Parameter	Min	Typ	Max	Unit
t_{cycle}	Clock Cycle Time	300	-	-	ns
t_{AS}	Address Setup Time	10	-	-	ns
t_{AH}	Address Hold Time	0	-	-	ns
t_{DSW}	Write Data Setup Time	40	-	-	ns
t_{DHW}	Write Data Hold Time	7	-	-	ns
t_{DHR}	Read Data Hold Time	20	-	-	ns
t_{OH}	Output Disable Time	-	-	70	ns
t_{ACC}	Access Time	-	-	140	ns
t_{PWLR}	Read Low Time	150	-	-	ns
t_{PWLW}	Write Low Time	60	-	-	ns
t_{PWHR}	Read High Time	60	-	-	ns
t_{PWHW}	Write High Time	60	-	-	ns
t_R	Rise Time	-	-	15	ns
t_F	Fall Time	-	-	15	ns
t_{CS}	Chip select setup time	0	-	-	ns
t_{CSH}	Chip select hold time to read signal	0	-	-	ns
t_{CSF}	Chip select hold time	20	-	-	ns

Write cycle



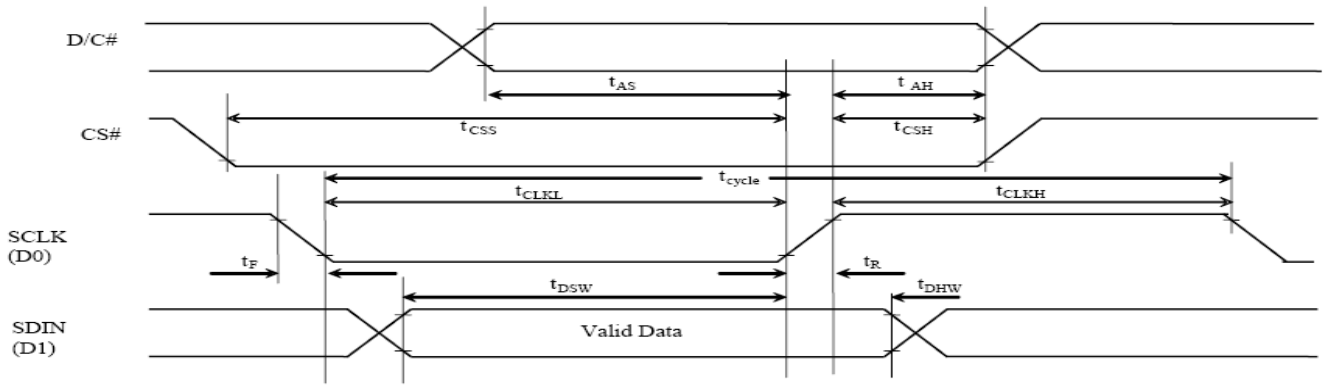
Read cycle

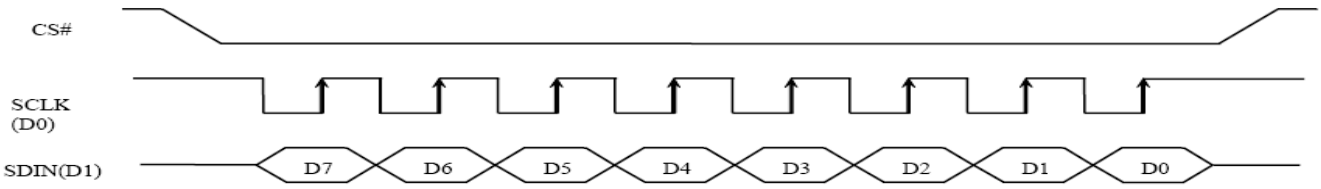


3. 4-Wire Serial Interface

(V_{DD} - V_{SS} = 2.4 to 2.6V, V_{DDIO}=1.6V, V_{CI} = 3.3V, T_A = 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	-	-	15	ns
t_F	Fall Time	-	-	15	ns

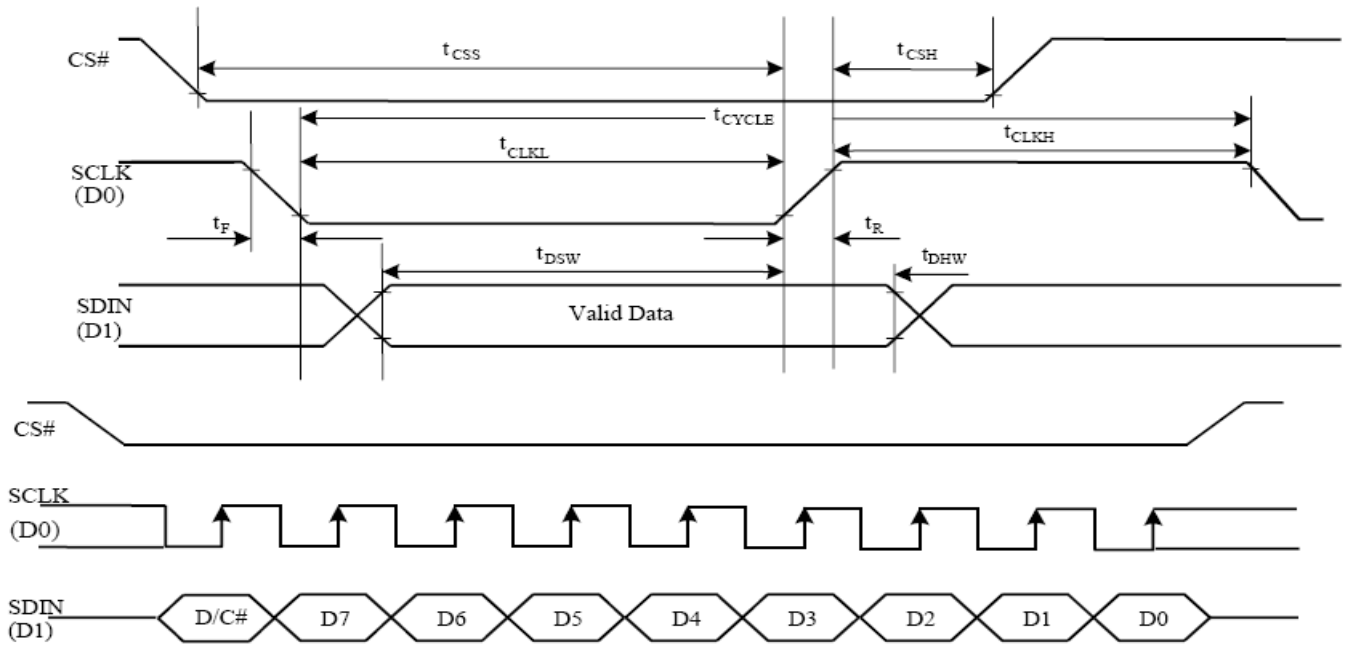




4. 3-Wire Serial Interface

(V_{DD} - V_{SS} = 2.4 to 2.6V, V_{DDIO}=1.6V, V_{CI} = 3.3V, T_A = 25°C)

Symbol	Parameter	Min	Typ	Max	Unit
t_{cycle}	Clock Cycle Time	100	-	-	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	-	-	15	ns
t_F	Fall Time	-	-	15	ns

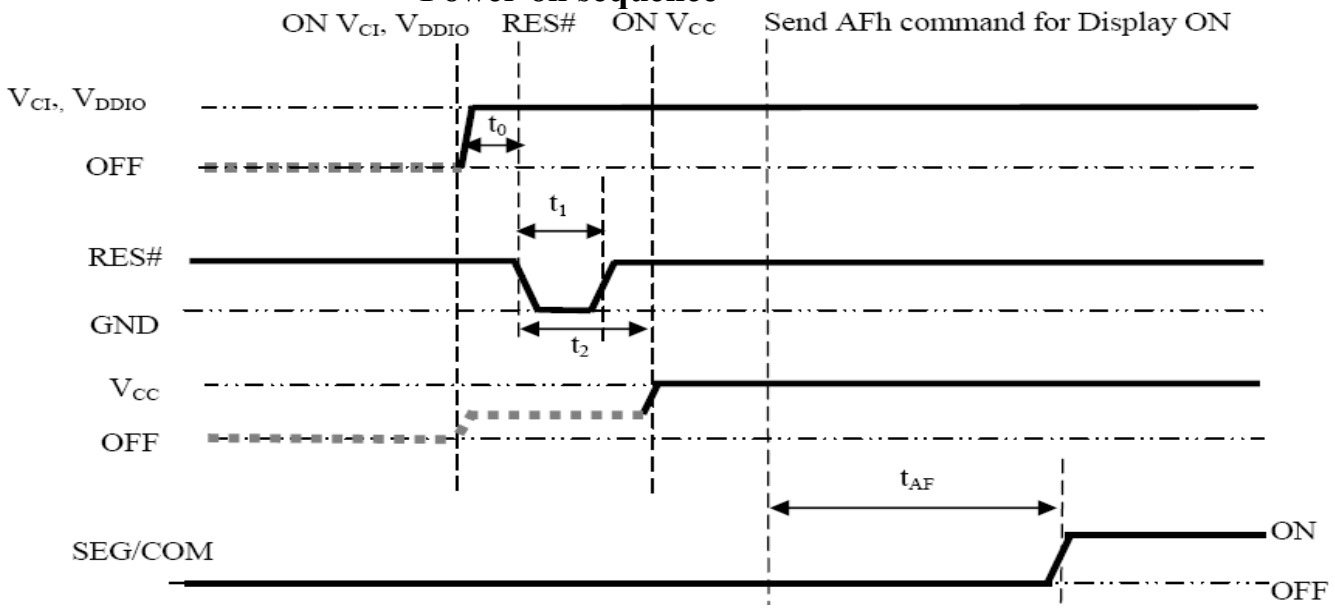


5. TIMING OF POWER SUPPLY

◆*Power ON sequence*:

1. Power ON $V_{CI,}$ $V_{DDIO.}$
2. After $V_{CI,}$ V_{DDIO} becomes stable, set wait time at least 1ms (t_0) for internal V_{DD} become stable. Then set RES# pin LOW (logic low) for at least 100us (t_1) [4] and then HIGH (logic high).
3. After set RES# pin LOW (logic low), wait for at least 100us (t_2). Then Power ON V_{CC}.[1]
4. After V_{CC} become stable, send command AFh for display ON. SEG/COM will be ON after 200ms(t_{AF}).

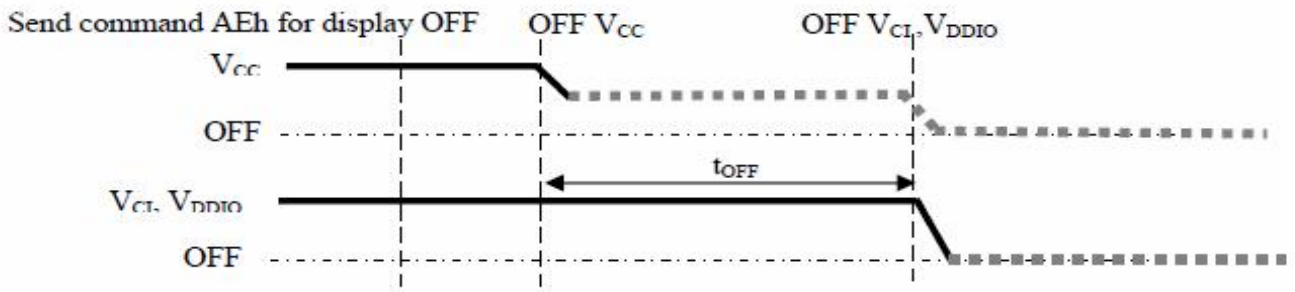
Power on sequence



◆*Power OFF sequence*:

1. Send command AEh for display OFF.
2. Power OFF $V_{CC.}$ [1], [2], [3]
3. Wait for t_{OFF}. Power OFF $V_{CI,}$ $V_{DDIO.}$(where Minimum t_{OFF}=0ms (5), Typical t_{OFF}=100ms)

Power off sequence



Note:

[1] Since an ESD protection circuit is connected between $V_{CI,}$ V_{DDIO} and V_{CC}, V_{CC} becomes lower than V_{CI} whenever $V_{CI,}$ V_{DDIO} is ON and V_{CC} is OFF as shown in the dotted line of V_{CC} in Figure above.

[2] V_{CC} should be kept float (disable) when it is OFF.

[3] Power pins ($V_{CI,}$ V_{CC}) can never be pulled to ground under any circumstance.

[4] The register values are reset after t_1.

[5] VCI, V_{DDIO} should not be Power OFF before VCC Power OFF.

■ ELECTRO-OPTICAL CHARACTERISTICS (Ta=25℃)

Items		Symbol	Min.	Typ.	Max.	Unit	Remark
Operating Luminance		L	60	70	-	cd /m^2	Green
Power Consumption		P	-	400	480	mW	30% pixels ON L=70cd/m^2
Frame Frequency		Fr	-	100	-	Hz	-
Color Coordinate	Green	CIE x	0.270	0.310	0.350	CIE1931	Darkroom
		CIE y	0.580	0.620	0.660		
Response Time	Rise	Tr	-	-	0.02	ms	-
	Decay	Td	-	-	0.02	ms	-
Contrast Ratio*		Cr	10000:1	-	-	-	Darkroom
Viewing Angle range		△ θ	160	-	-	Degree	-
Operating Life Time*		Top	35,000	-	-	Hours	L=70cd/m^2

Note:

1. 70cd/m^2 is based on V_{CI}=3.0V, V_{CC}=16.0V, contrast command setting 0xDF;

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

<table>
<tr><th>No</th><th>Symbol</th><th>Description</th></tr>
<tr><td>1</td><td>NC</td><td>No connection</td></tr>
<tr><td>2</td><td>VSS</td><td>Ground. Common Voltage Reference Pin</td></tr>
<tr><td>3</td><td>VCC</td><td>Power supply for panel driving voltage. Segment voltage</td></tr>
<tr><td>4</td><td>VCOMH</td><td>COM signal deselected voltage level. High Level Voltage Output Of COM Signal</td></tr>
<tr><td>5</td><td>VLSS</td><td>Analog system ground pin. Voltage Supply</td></tr>
<tr><td>6-13</td><td>D7-D0</td><td>These pins are bi-directional data bus connecting to the MCU data bus. Unused pins are recommended to tie LOW. (Except for D2 pin in SPI mode, D2 is pulled low in SPI mode).</td></tr>
<tr><td>14</td><td>E (RD#)</td><td>MCU Interface Input pin, in 6800 parallel mode, it is used as enable signal, read/write operation is initiated when this pin is set high with chip selected. In 8080 parallel mode, this pin receives read signal, read operation is initiated when this is pulled low with chip selected. When SPI interface is selected, this pin must be connected to ground.</td></tr>
<tr><td>15</td><td>R/W#(WR#)</td><td>MCU Interface Input pin, in 6800 parallel mode, it is used as read/write selection input, read mode will be carried out when This pin is pulled high while write mode with this pin pulled low. In 8080 parallel mode, this pin will be write input, write operation is initiated when this is pulled low with chip selected. When SPI interface is selected, this pin must be connected to ground.</td></tr>
<tr><td>16-17</td><td>BS0-1</td><td>MCU bus interface selection pins. Select appropriate logic setting as described in the following table.
<table>
<tr><th>BS[1:0]</th><th>Bus Interface Selection</th></tr>
<tr><td>00</td><td>4 line SPI</td></tr>
<tr><td>01</td><td>3 line SPI</td></tr>
<tr><td>10</td><td>8-bit 8080 parallel</td></tr>
<tr><td>11</td><td>8-bit 6800 parallel</td></tr>
</table>
</td></tr>
<tr><td>18</td><td>DC#</td><td>This pin is Data/Command control pin connected to the MCU. When the pin is pulled HIGH, the content at D[7:0] will be interpreted as data. When the pin is pulled LOW, the content at D[7:0] will be interpreted as command.</td></tr>
<tr><td>19</td><td>CS#</td><td>This pin is the chip select input connected to the MCU. The chip is enabled for MCU communication only when CS# is pulled LOW.</td></tr>
<tr><td>20</td><td>RES#</td><td>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.</td></tr>
</table>

21	FR	This pin is No Connection pins. Nothing should be connected to this pin. This pin should be left open individually.
22	IREF	This pin is the segment output current reference pin. A resistor should be connected between this pin and VSS to maintain the current around 10uA.
23	NC	No connection.
24	VDDIO	Power supply for interface logic level. It should be matched with the MCU interface voltage level.
25	VDD	Power supply pin for core logic operation. A capacitor is required to connect between this pin and VSS.
26	VCI	Low voltage power supply. VCI must always be equal to or higher than VDD and VDDIO.
27	VSL	This is segment voltage reference pin. When external VSL is used, connect with resistor and diode to ground
28	VLSS	Analog system ground pin.
29	VCC	Power supply for panel driving voltage. Segment Voltage
30	NC	No Connection.

■ COMMAND TABLE

D/C#	Hex	D7	D6	D5	D4	D3	D2	D2	D0	Command	Description
0	00	0	0	0	0	0	0	0	0	Enable Gray Scale table	This command is sent to enable the Gray Scale table setting (command B8h)
0 1 1	15 A[6:0] B[6:0]	0 * *	0 A_6 B_6	0 A_5 B_5	1 A_4 B_4	0 A_3 B_3	1 A_2 B_2	0 A_1 B_1	1 A_0 B_0	Set Column Address	Set Column start and end address A[6:0]: Start Address. [reset=0] B[6:0]: End Address. [reset=119] Range from 0 to 119
0	5C	0	1	0	1	1	1	0	0	Write RAM Command	Enable MCU to write Data into RAM
0	5D	0	1	0	1	1	1	0	1	Read RAM Command	Enable MCU to read Data from RAM
0 1 1	75 A[6:0] B[6:0]	0 * *	1 A_6 B_6	1 A_5 B_5	1 A_4 B_4	0 A_3 B_3	1 A_2 B_2	0 A_1 B_1	1 A_0 B_0	Set Row Address	Set Row start and end address A[6:0]: Start Address. [reset=0] B[6:0]: End Address. [reset=127] Range from 0 to 127
0 1 1	A0 A[7:0] B[4]	1 0 *	0 0 *	1 A_5 0	0 A_4 B_4	0 0 0	0 A_2 0	0 A_1 0	0 A_0 1	Set Re-map and Dual COM Line mode	A[0]=0b, Horizontal address increment [reset] A[0]=1b, Vertical address increment A[1]=0b, Disable Column Address Re-map [reset] A[1]=1b, Enable Column Address Re-map A[2]=0b, Disable Nibble Re-map [reset] A[2]=1b, Enable Nibble Re-map A[4]=0b, Scan from COM0 to COM[N –1] [reset] A[4]=1b, Scan from COM[N-1] to COM0, where N is the Multiplex ratio A[5]=0b, Disable COM Split Odd Even [reset] A[5]=1b, Enable COM Split Odd Even B[4], Enable / disable Dual COM Line mode 0b, Disable Dual COM mode [reset] 1b, Enable Dual COM mode (MUX ≤ 63) **Note** (1) COM Split Odd Even mode must be disabled (A[5]=0b) when enabling the Dual COM mode (B[4]=1b) Details refer to Section 10.1.6
0 1	A1 A[6:0]	1 *	0 A_6	1 A_5	0 A_4	0 A_3	0 A_2	0 A_1	1 A_0	Set Display Start Line	Set display RAM display start line register from 0-127 Display start line register is reset to 00h after RESET

D/C#	Hex	D7	D6	D5	D4	D3	D2	D2	D0	Command	Description
0 1	A2 A[6:0]	1 *	0 A_6	1 A_5	0 A_4	0 A_3	0 A_2	1 A_1	0 A_0	Set Display Offset	Set vertical scroll by COM from 0-127 The value is reset to 00H after RESET
0	A4~A7	1	0	1	0	0	X_2	X_1	X_0	Set Display Mode	A4h = Entire Display OFF, all pixels turns OFF in GS level 0 A5h = Entire Display ON, all pixels turns ON in GS level 15 A6h = Normal Display [reset] A7h = Inverse Display (GS0 → GS15, GS1 → GS14, GS2 → GS13, …)
0 1 1	A8 A[6:0] B[6:0]	1 0 0	0 A_6 B_6	1 A_5 B_5	0 A_4 B_4	1 A_3 B_3	0 A_2 B_2	0 A_1 B_1	0 A_0 B_0	Enable Partial Display	This command turns ON partial mode. The partial mode display area is defined by the following two parameters, A[6:0]: Address of start row in the display area B[6:0]: Address of end row in the display area, where B[6:0] must be ≥ A[6:0]
0	A9	1	0	1	0	1	0	0	1	Exit Partial Display	This command is sent to exit the Partial Display mode
0 1	AB A[0]	1 0	0 0	1 0	0 0	1 0	0 0	1 0	1 A_0	Function Selection	A[0]=0b, Select external V_{DD} A[0]=1b, Enable internal V_{DD} regulator [reset]
0	AE~AF	1	0	1	0	1	1	1	X_0	Set Sleep mode ON/OFF	AEh = Sleep mode ON (Display OFF) AFh = Sleep mode OFF (Display ON)
0 1	B1 A[7:0]	1 A_7	0 A_6	1 A_5	1 A_4	0 A_3	0 A_2	0 A_1	1 A_0	Set Phase Length	A[3:0] Phase 1 period (reset phase length) of 5~31 DCLK(s) clocks as follow: A[3:0] / Phase 1 period 0000 / invalid 0001 / invalid 0010 / 5 DCLKs 0011 / 7 DCLKs 0100 / 9 DCLKs [reset] : / : 1111 / 31 DCLKs A[7:4] Phase 2 period (first pre-charge phase length) of 3~15 DCLK(s) clocks as follow: A[7:4] / Phase 2 period 0000 / invalid 0001 / invalid 0010 / invalid 0011 / 3 DCLKs : / : 0111 / 7 DCLKs [reset] : / : 1111 / 15 DCLKs

<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>D2</th><th>D0</th><th>Command</th><th>Description</th></tr>
<tr><td>0
1</td><td>B3
A[7:0]</td><td>1
A_7</td><td>0
A_6</td><td>1
A_5</td><td>1
A_4</td><td>0
A_3</td><td>0
A_2</td><td>1
A_1</td><td>1
A_0</td><td>Set Front Clock Divider / Oscillator Frequency</td><td>A[3:0] [reset=0], divide by DIVSET where
<table><tr><th>A[3:0]</th><th>DIVSET</th></tr><tr><td>0000</td><td>divide by 1</td></tr><tr><td>0001</td><td>divide by 2</td></tr><tr><td>0010</td><td>divide by 4</td></tr><tr><td>0011</td><td>divide by 8</td></tr><tr><td>0100</td><td>divide by 16</td></tr><tr><td>0101</td><td>divide by 32</td></tr><tr><td>0110</td><td>divide by 64</td></tr><tr><td>0111</td><td>divide by 128</td></tr><tr><td>1000</td><td>divide by 256</td></tr><tr><td>1001</td><td>divide by 512</td></tr><tr><td>1010</td><td>divide by 1024</td></tr><tr><td>>=1011</td><td>invalid</td></tr></table>
A[7:4] Oscillator frequency, frequency increases as level increases [reset=0101b]</td></tr>
<tr><td>0
1
1</td><td>B4
A[1:0]
B[7:3]</td><td>1
1
B_7</td><td>0
0
B_6</td><td>1
1
B_5</td><td>1
0
B_4</td><td>0
0
B_3</td><td>1
0
1</td><td>0
A_1
0</td><td>0
A_0
1</td><td>Display Enhancement A</td><td>A[1:0] = 00b: Enable external VSL
A[1:0] = 10b: Internal VSL [reset]

B[7:3] = 11111b: Enhanced low GS display quality
B[7:3] = 10110b: Normal [reset]</td></tr>
<tr><td>0
1</td><td>B5
A[3:0]</td><td>1
*</td><td>0
*</td><td>1
*</td><td>1
*</td><td>0
A_3</td><td>1
A_2</td><td>0
A_1</td><td>1
A_0</td><td>Set GPIO</td><td>A[1:0] GPIO0: 00 pin HiZ, Input disabled
01 pin HiZ, Input enabled
10 pin output LOW [reset]
11 pin output HIGH

A[3:2] GPIO1: 00 pin HiZ, Input disabled
01 pin HiZ, Input enabled
10 pin output LOW [reset]
11 pin output HIGH</td></tr>
<tr><td>0
1</td><td>B6
A[3:0]</td><td>1
*</td><td>0
*</td><td>1
*</td><td>1
*</td><td>0
A_3</td><td>1
A_2</td><td>1
A_1</td><td>0
A_0</td><td>Set Second Precharge Period</td><td>A[3:0] Second Pre-charge period
0000b 0 dclk
0001b 1 dclk
.....
1000b 8 dclks [reset]
.....
1111b 15 dclks</td></tr>
</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>D2</th><th>D0</th><th>Command</th><th>Description</th></tr>
<tr><td>0</td><td>B8</td><td>1</td><td>0</td><td>1</td><td>1</td><td>1</td><td>0</td><td>0</td><td>0</td><td rowspan="11">Set Gray Scale Table</td><td rowspan="11">The next 15 data bytes define Gray Scale (GS) Table by setting the gray scale pulse width in unit of DCLK's (ranges from 0d ~ 180d)

A1[7:0]: Gamma Setting for GS1,
A2[7:0]: Gamma Setting for GS2,
:
A14[7:0]: Gamma Setting for GS14,
A15[7:0]: Gamma Setting for GS15

Note
(1) 0 ≤ Setting of GS1 < Setting of GS2 < Setting of GS3..... < Setting of GS14 < Setting of GS15

Refer to Section 8.8 for details

(2) The setting must be followed by the Enable Gray Scale Table command (00h)</td></tr>
<tr><td>1</td><td>A1[7:0]</td><td>$A1_7$</td><td>$A1_6$</td><td>$A1_5$</td><td>$A1_4$</td><td>$A1_3$</td><td>$A1_2$</td><td>$A1_1$</td><td>$A1_0$</td></tr>
<tr><td>1</td><td>A2[7:0]</td><td>$A2_7$</td><td>$A2_6$</td><td>$A2_5$</td><td>$A2_4$</td><td>$A2_3$</td><td>$A2_2$</td><td>$A2_1$</td><td>$A2_0$</td></tr>
<tr><td>1</td><td>.</td><td>.</td><td>.</td><td>.</td><td>.</td><td>.</td><td>.</td><td>.</td><td>.</td></tr>
<tr><td>1</td><td>.</td><td>.</td><td>.</td><td>.</td><td>.</td><td>.</td><td>.</td><td>.</td><td>.</td></tr>
<tr><td>1</td><td>.</td><td>.</td><td>.</td><td>.</td><td>.</td><td>.</td><td>.</td><td>.</td><td>.</td></tr>
<tr><td>1</td><td>A14[7:0]</td><td>$A14_7$</td><td>$A14_6$</td><td>$A14_5$</td><td>$A14_4$</td><td>$A14_3$</td><td>$A14_2$</td><td>$A14_1$</td><td>$A14_0$</td></tr>
<tr><td>1</td><td>A15[7:0]</td><td>$A15_7$</td><td>$A15_6$</td><td>$A15_5$</td><td>$A15_4$</td><td>$A15_3$</td><td>$A15_2$</td><td>$A15_1$</td><td>$A15_0$</td></tr>
<tr><td>0</td><td>B9</td><td>1</td><td>0</td><td>1</td><td>1</td><td>1</td><td>0</td><td>0</td><td>1</td><td>Select Default Linear Gray Scale table</td><td>The default Linear Gray Scale table is set in unit of DCLK's as follow

GS0 level pulse width = 0;
GS1 level pulse width = 0;
GS2 level pulse width = 8;
GS3 level pulse width = 16;
:
:
GS14 level pulse width = 104;
GS15 level pulse width = 112

Refer to Section 8.8 for details</td></tr>
<tr><td>0
1</td><td>BB
A[4:0]</td><td>1
*</td><td>0
*</td><td>1
*</td><td>1
A_4</td><td>1
A_3</td><td>0
A_2</td><td>1
A_1</td><td>1
A_0</td><td>Set Pre-charge voltage</td><td>Set pre-charge voltage level.[reset = 17h]

<table><tr><th>A[4:0]</th><th>Hex code</th><th>pre-charge voltage</th></tr><tr><td>00000</td><td>00h</td><td>0.20 x V_{CC}</td></tr><tr><td>:</td><td>:</td><td>:</td></tr><tr><td>11111</td><td>1Fh</td><td>0.60 x V_{CC}</td></tr></table></td></tr>
<tr><td>0
1</td><td>BE
A[2:0]</td><td>1
*</td><td>0
*</td><td>1
*</td><td>1
*</td><td>1
0</td><td>1
A_2</td><td>1
A_1</td><td>0
A_0</td><td>Set V_{COMH}</td><td>Set COM deselect voltage level [reset = 04h]

<table><tr><th>A[2:0]</th><th>Hex code</th><th>V_{COMH}</th></tr><tr><td>000</td><td>00h</td><td>0.72 x V_{CC}</td></tr><tr><td>:</td><td>:</td><td>:</td></tr><tr><td>100</td><td>04h</td><td>0.80 x V_{CC} [reset]</td></tr><tr><td>:</td><td>:</td><td>:</td></tr><tr><td>111</td><td>07h</td><td>0.86 x V_{CC}</td></tr></table></td></tr>
<tr><td>0
1</td><td>C1
A[7:0]</td><td>1
A_7</td><td>1
A_6</td><td>0
A_5</td><td>0
A_4</td><td>0
A_3</td><td>0
A_2</td><td>0
A_1</td><td>1
A_0</td><td>Set Contrast Current</td><td>A[7:0]: Contrast current value, range:00h~FFh,
i.e. 256 steps for I_{SEG} current [reset = 7Fh]</td></tr>
</table>

D/C#	Hex	D7	D6	D5	D4	D3	D2	D2	D0	Command	Description
0	C7	1	1	0	0	0	1	1	1	Master Contrast Current Control	A[3:0] =
1	A[3:0]	*	*	*	*	A_3	A_2	A_1	A_0		0000b, reduce output currents for all colors to 1/16 0001b, reduce output currents for all colors to 2/16 : 1110b, reduce output currents for all colors to 15/16 1111b, no change [reset]
0	CA	1	1	0	0	1	0	1	0	Set MUX Ratio	A[6:0]: Set MUX ratio from 16MUX ~ 128MUX
1	A[6:0]	*	A_6	A_5	A_4	A_3	A_2	A_1	A_0		A[6:0] = 15d represents 16MUX : A[6:0] = 127d represents 128MUX [reset]
0	D1	1	1	0	1	0	0	0	1	Display Enhancement B	
1	A[5:4]	1	0	A_5	A_4	0	0	1	0		A[5:4] = 00b: Reserved A[5:4] = 10b: Normal [reset]
1	20	0	0	1	0	0	0	0	0		
0	FD	1	1	1	1	1	1	0	1	Set Command Lock	A[2]: MCU protection status [reset = 12h]
1	A[2]	0	0	0	1	0	A_2	1	0		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** (1) The locked OLED driver IC MCU interface prohibits all commands and memory access except the FDh command

■ INITIALIZATION CODE

```
void Inital_SSD1322()
{
 WMLCDCOM(0xFD);//Command lock setting
 WMLCDDATA(0x12);

 WMLCDCOM(0xAE);//Display OFF

 WMLCDCOM(0x15);//column address setting
 WMLCDDATA(0x24);
 WMLCDDATA(0x5F);

 WMLCDCOM(0x75);//row address setting
 WMLCDDATA(0x00);
 WMLCDDATA(0x7F);

 WMLCDCOM(0xA0);//re_map&dual com mode
 WMLCDDATA(0x24);
 WMLCDDATA(0x01);//Disable dual com mode

 WMLCDCOM(0xA1);//display start line
 WMLCDDATA(0x00);

 WMLCDCOM(0xA2);//display offset
 WMLCDDATA(0x00);

 WMLCDCOM(0xA6);//normal display
```

```
WMLCDCOM(0xA8);//partial display setting
WMLCDDATA(0x00);//start row
WMLCDDATA(0x7F);//end row

//WMLCDCOM(0xA9);//exit partial display mode

WMLCDCOM(0xAB);//function selection
WMLCDDATA(0x01);//enable internal vdd

WMLCDCOM(0xB1);//phase length setting
WMLCDDATA(0xD2);//phase1=9dclk.phase2=7dclk

WMLCDCOM(0xB3);//front clock divider&oscillator freq
WMLCDDATA(0xE1);

WMLCDCOM(0xB4);//display enhancement A
WMLCDDATA(0xA0);//external VSL
WMLCDDATA(0xFD);//normal or 11111101 to enhance low GS

 WMLCDCOM(0xB6);//second precharge period setting
WMLCDDATA(0x08);

 WMLCDCOM(0xBB);//set precharge voltage
WMLCDDATA(0x1F);

WMLCDCOM(0xBE);//set VCOMH voltage
WMLCDDATA(0x06);//0.80*VCC

WMLCDCOM(0xB5);//GPIO SETTING
WMLCDDATA(0x0A);

WMLCDCOM(0xB8); //Gray scale setting
WMLCDDATA(0x00); //GS1
WMLCDDATA(0x08); //GS2
WMLCDDATA(0x10); //GS3
WMLCDDATA(0x18); //GS4
WMLCDDATA(0x20); //GS5
WMLCDDATA(0x28); //GS6
WMLCDDATA(0x30); //GS7
WMLCDDATA(0x38); //GS8
WMLCDDATA(0x40); //GS9
WMLCDDATA(0x48); //GS10
WMLCDDATA(0x50); //GS11
WMLCDDATA(0x58); //GS12
WMLCDDATA(0x60); //GS13
WMLCDDATA(0x68); //GS14
WMLCDDATA(0x70); //GS15
WMLCDCOM(0x00); //Enable gray scale setting

 //WMLCDCOM(0xB9);//gray scale setting
```

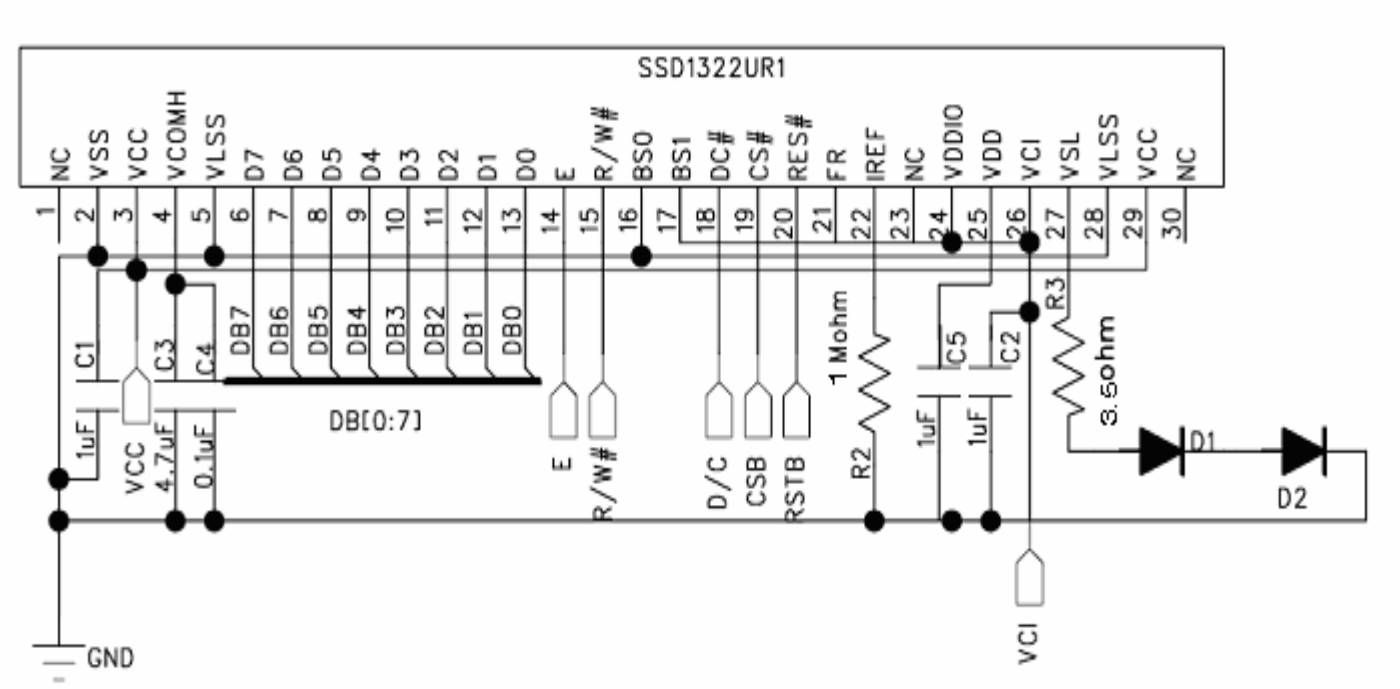
```
  WMLCDCOM(0xC1);//contrast set
  WMLCDDATA(CONTRAST);

  WMLCDCOM(0xC7);//master current set
  WMLCDDATA(0x0F);

  WMLCDCOM(0xCA);//mux set
  WMLCDDATA(0x7F);

  WMLCDCOM(0xD1);//display enhancement B
  WMLCDDATA(0xA2);
  WMLCDDATA(0x20);

  WMLCDCOM(0xAF);//Display ON

}
```

Note：

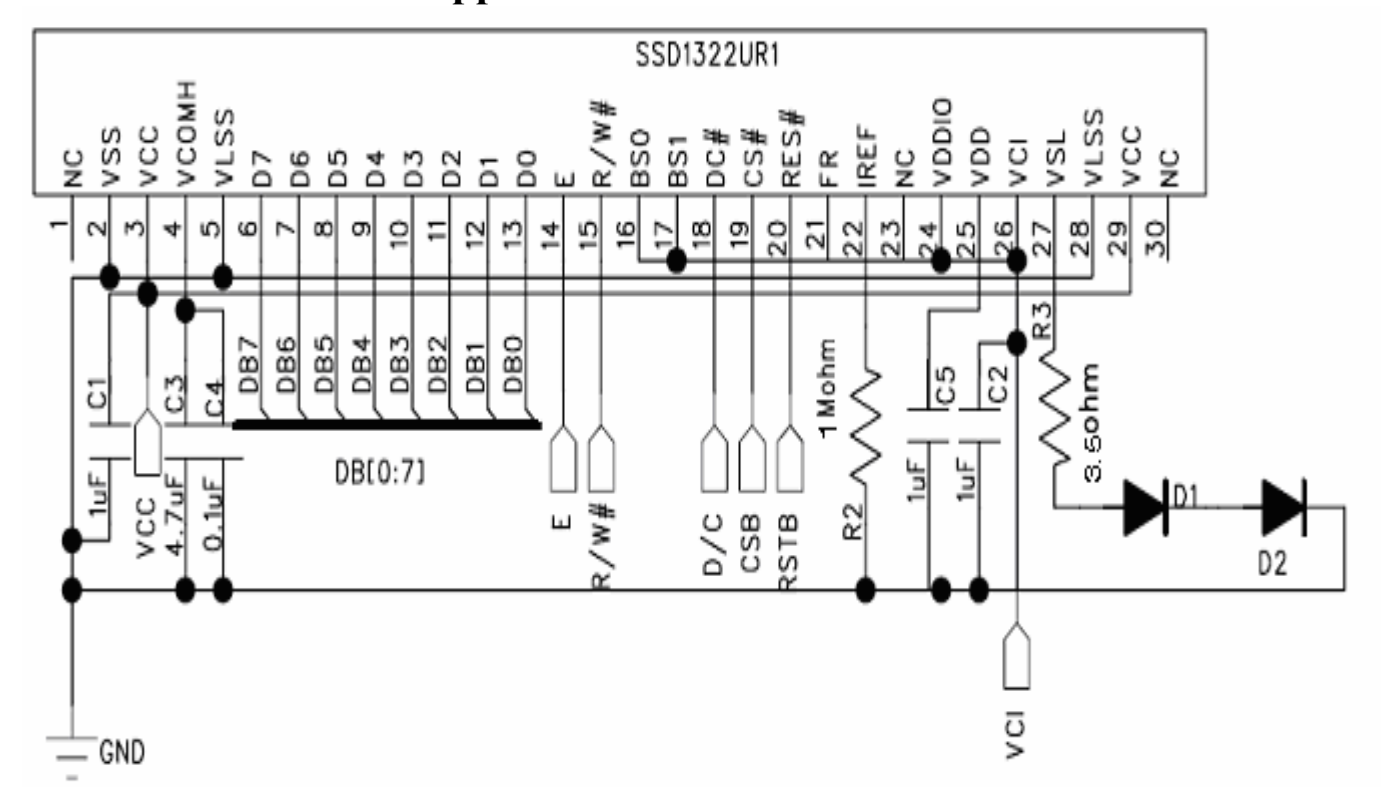
Please set appropriate parameters of initialization base on actual application.

■ SCHEMATIC EXAMPLE

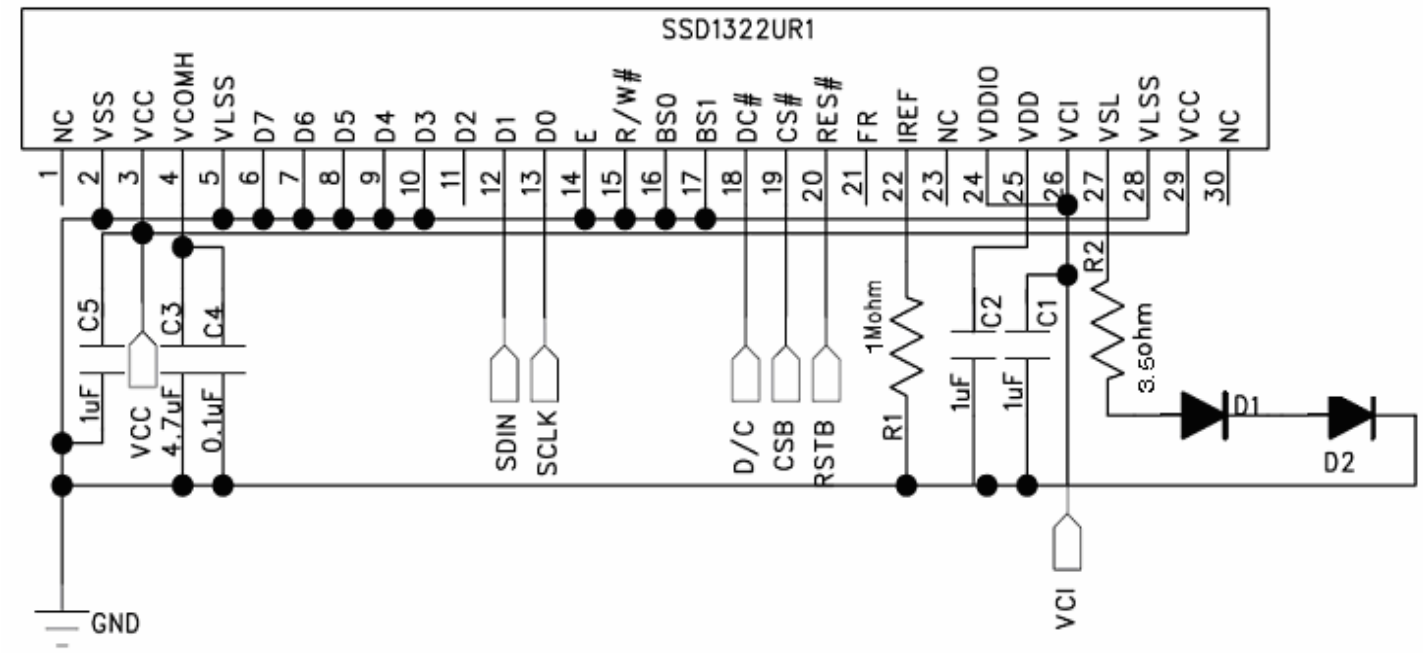
◆8080 Series Interface Application Circuit:



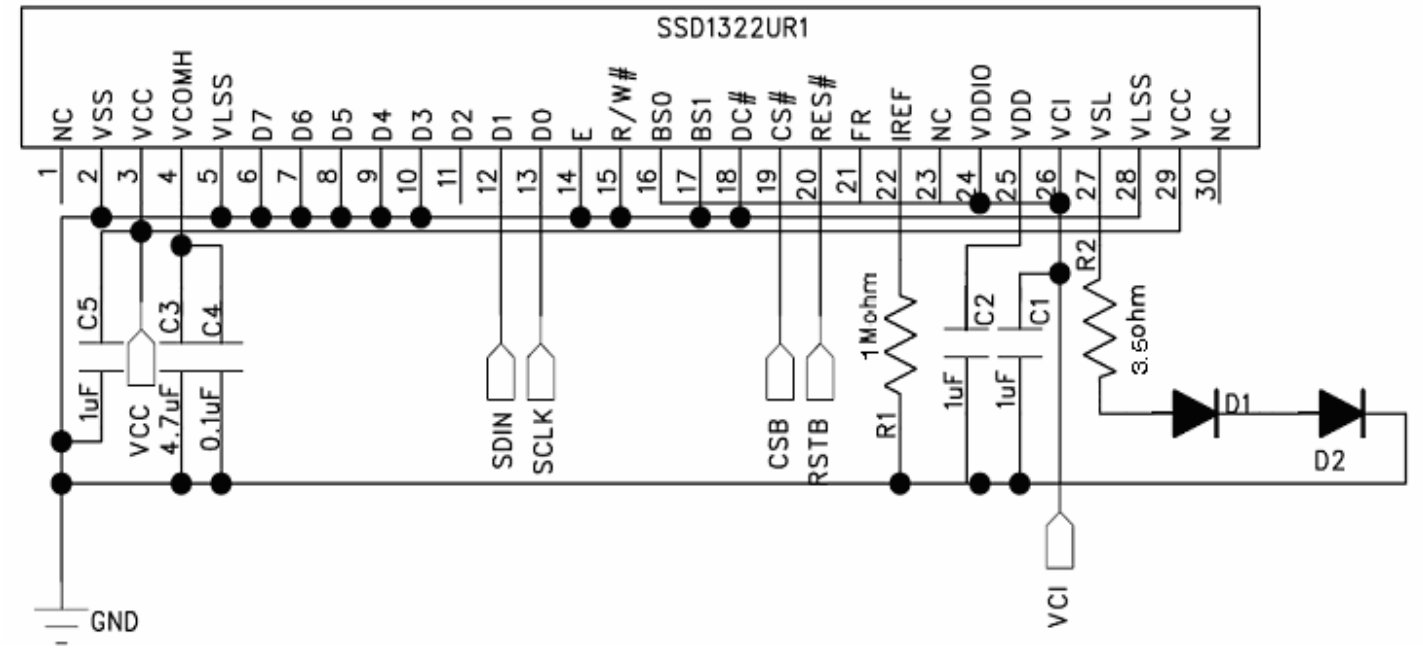
◆6800 Series Interface Application Circuit:



◆4-wire SPI Interface Application Circuit:



◆3-wire SPI Interface Application Circuit:



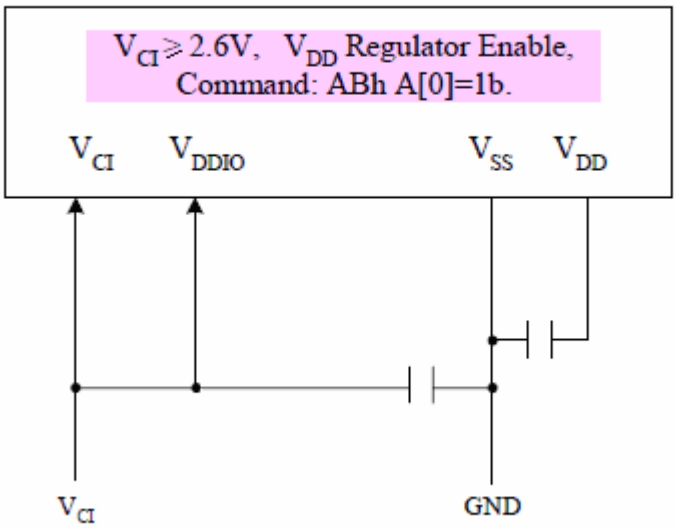
For Above Circuits:
Voltage at IREF = VCC – 6V. For VCC = 16.0V, VCI=3.0V, IREF = 10uA;
R1 = (Voltage at IREF - VSS) / IREF= (16 - 6) / 10uA= 1MΩ.
R2 = 3.5Ω, 1/8W
D1&D2: Vth = 0.7V, 1N4148
C1 ~ C2, C3, C5: 4.7uF(1)
C4: 0.1uF(2)
The value of components is recommended value. Select appropriate value against module application.

Note:

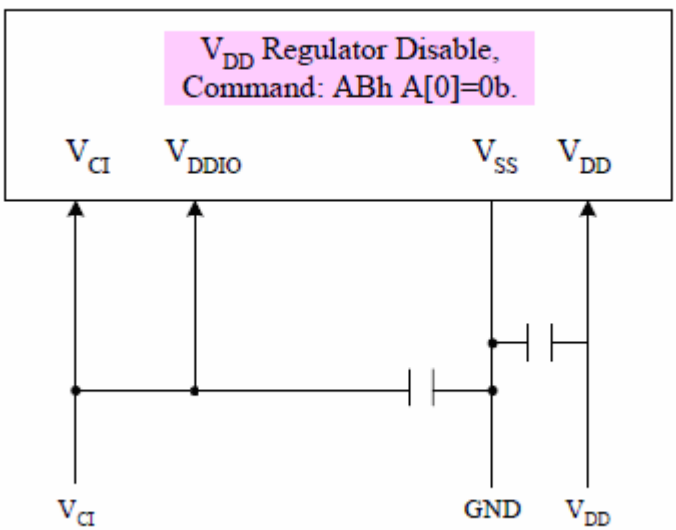
In SSD1322, the power supply pin for core logic operation, VDD, can be supplied by external source or internally regulated through the VDD regulator. The internal VDD regulator is enabled by setting bit A[0] to 1b in command ABh "Function Selection". VCI should be larger than 2.6V when using the internal VDD regulator. The typical regulated VDD is about 2.5V It should be notice that, no matter VDD is supplied by external source or internally regulated; VCI must always be set equivalent to or higher than VDD and VDDIO.

The following figure shows the VDD regulator pin connection scheme:

V_{CI} > 2.6V, V_{DD} regulator enable pin connection scheme



V_{CI} < 2.6V, V_{DD} regulator disable pin connection scheme



■ 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.

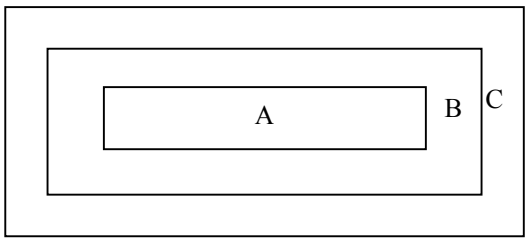
■ OUTGOING QUALITY CONTROL SPECIFICATION

◆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

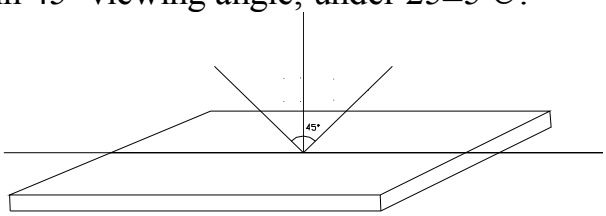
Zone B: Viewing Area except Zone A

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℃.



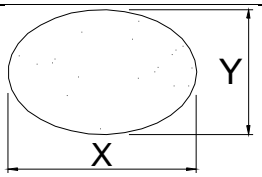
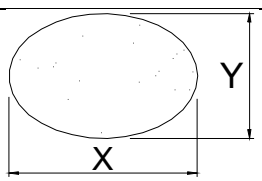
2 The luminance and color coordinate inspection : By PR705 or BM-7 or the equal equipments, in the dark room, under 25±5℃.

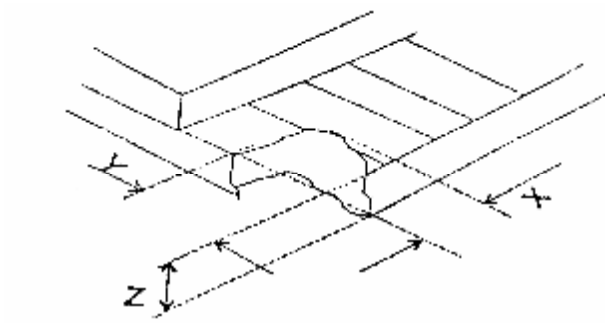
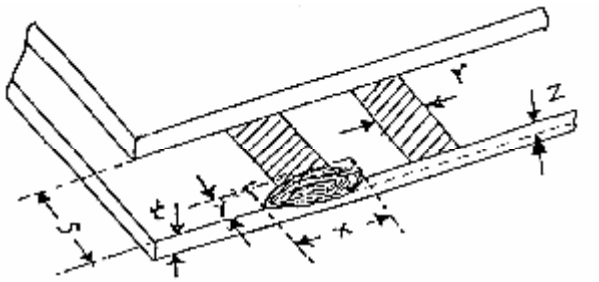
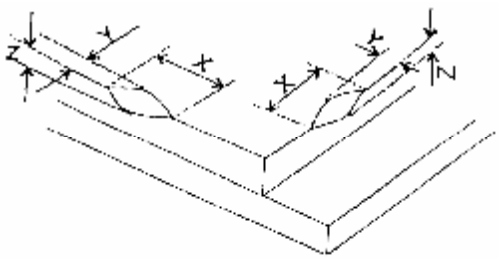
◆Inspection Criteria

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="5">Spot Defect (dimming and lighting spot)</td><td colspan="2">Size (mm)</td><td colspan="2">Accepted Qty</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="8">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 colspan="2">Crack, deep fold and deep pressure mark on the TCP are not accepted</td></tr>
<tr><td>Pixel Size</td><td colspan="2">The tolerance of display pixel dimension should be within ±20% of the spec</td></tr>
<tr><td>Luminance</td><td colspan="2">Refer to the spec or the reference sample</td></tr>
<tr><td>Color</td><td colspan="2">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) will replace or repair any of its OLED modules which are found to be functional defect when inspected in accordance with OLED acceptance standards (copies available upon request). Cosmetic/visual defects must be returned to within 90 days of shipment. Confirmation of such date should be based on freight documents. The warranty liability of is limited to repair and/or replacement on the terms above. 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