SPECIFICATION

PART NO. : OEL9M0082-Y-E

OLED
Display
128X128
1.13"

This specification maybe changed without any notice in order to improve performance or quality etc.
Please contact TRULY Semiconductors LTD. OLED R&D department for update specification and product status before design for this product or release the order.

PRODUCT CONTENTS

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REVISION HISTORY

Rev.	Contents	Date
1.0	Preliminary	2012-04-16
1.1	Modify the Operating Life Time (P.11)	2012-08-06
1.2	Update the instruction list.	2013-06-15

n PHYSICAL DATA

No.	Items:	Specification:	Unit
1	Diagonal Size	1.13	Inch
2	Resolution	128(H) x 128(V)	Dots
3	Active Area	Ø 28.80	mm^2
4	Outline Dimension (Panel)	37.62(W) x 41.31(H)	mm^2
5	Pixel Pitch	0.225(W) x 0.225(H)	mm^2
6	Pixel Size	0.205(W) x0.205(H)	mm^2
7	Driver IC	SSD1329Z	-
8	Display Color	Yellow	-
9	Grayscale	4	Bit
10	Interface	Parallel / Serial	-
11	IC package type	COG	-
12	Thickness	1.45±0.1	mm
13	Weight	3.7±0.2	g
14	Duty	1/128	-

n ABSOLUTE MAXIMUM RATINGS

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

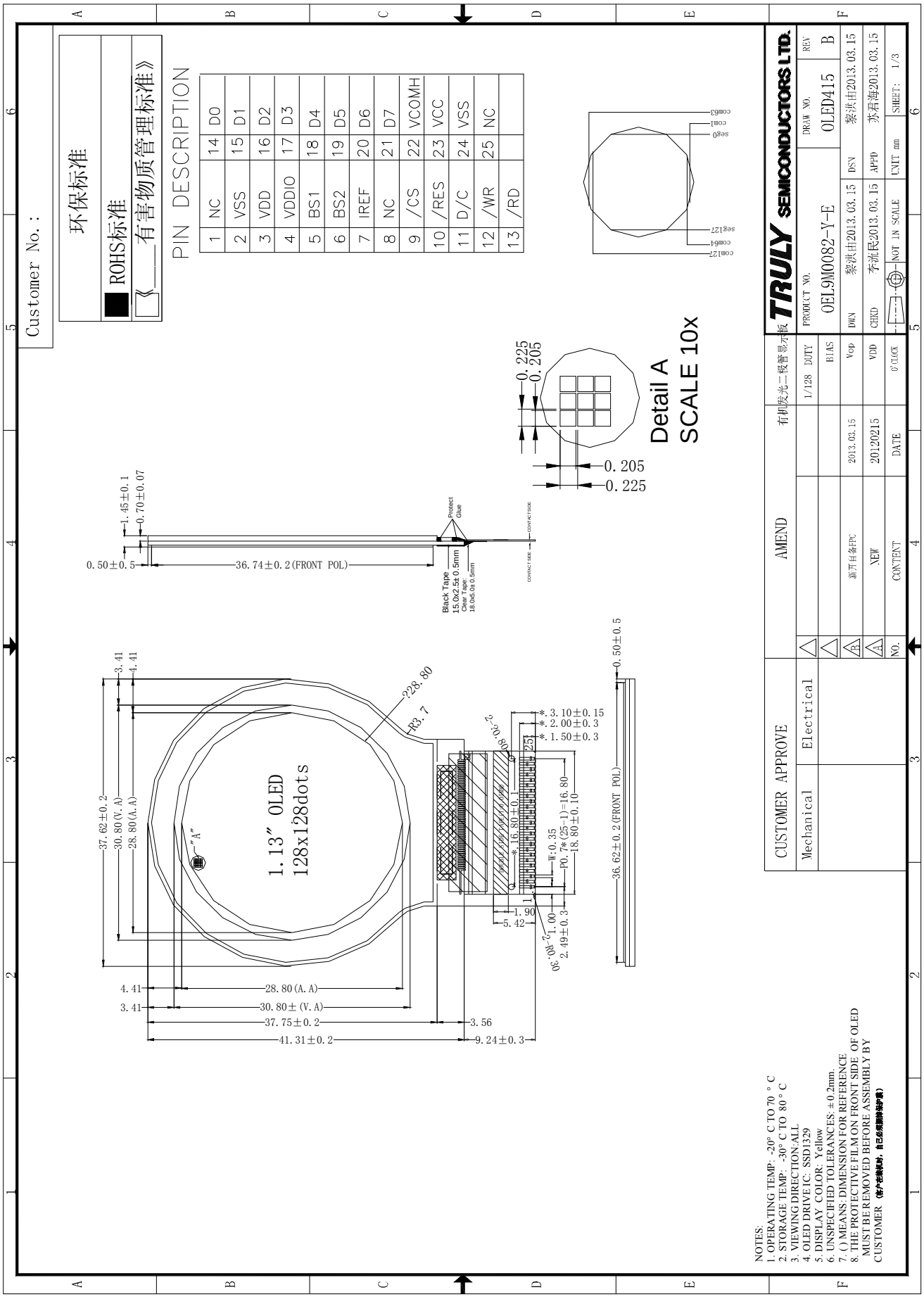
Items		Symbol	Min	Typ.	Max	Unit
Supply Voltage	**Logic**	V_{DD}	-0.3	-	4.0	V
	I/O buffer	V_{DDIO}	-0.3	-	4.0	V
	Driving	V_{CC}	0	-	18.0	V
Operating Temperature		Top	-20	-	70	℃
Storage Temperature		Tst	-30	-	80	℃
Humidity		-	-	-	90	%RH

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.

n EXTERNAL DIMENSIONS



n ELECTRICAL CHARACTERISTICS

◆DC Characteristics

Unless otherwise specified, V_{SS} = 0V ,V_{DD}=2.4V to 3.5V (Ta = 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	13.0	16.0	V
Input Voltage	High Voltage	V_{IH}	0.8 x V_{DD}	-	V_{DD}	V
	Low Voltage	V_{IL}	V_{SS}	-	0.2 x V_{DD}	V
Output Voltage	High Voltage	V_{OH}	0.9 x V_{DD}	-	V_{DD}	V
	Low Voltage	V_{OL}	V_{SS}	-	0.1 x V_{DD}	V

◆AC Characteristics

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

1:6800 Series MPU Parallel Interface

Conditions:

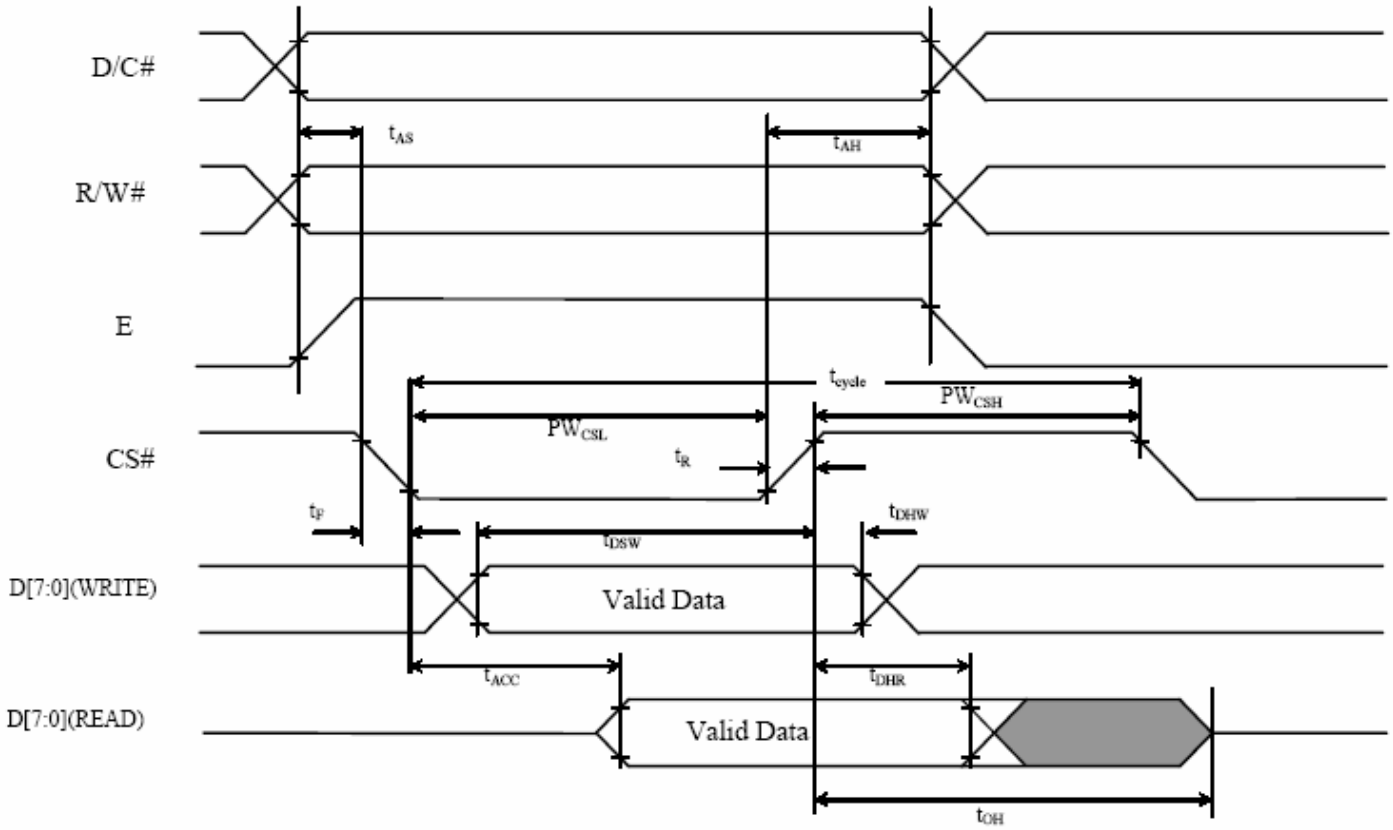
V_{DD} ~ V_{SS} = 2.4 to 3.5V

T_A = 25°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) 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

6800-series MPU parallel interface characteristics



2:8080 Series MPU Parallel Interface

Conditions:

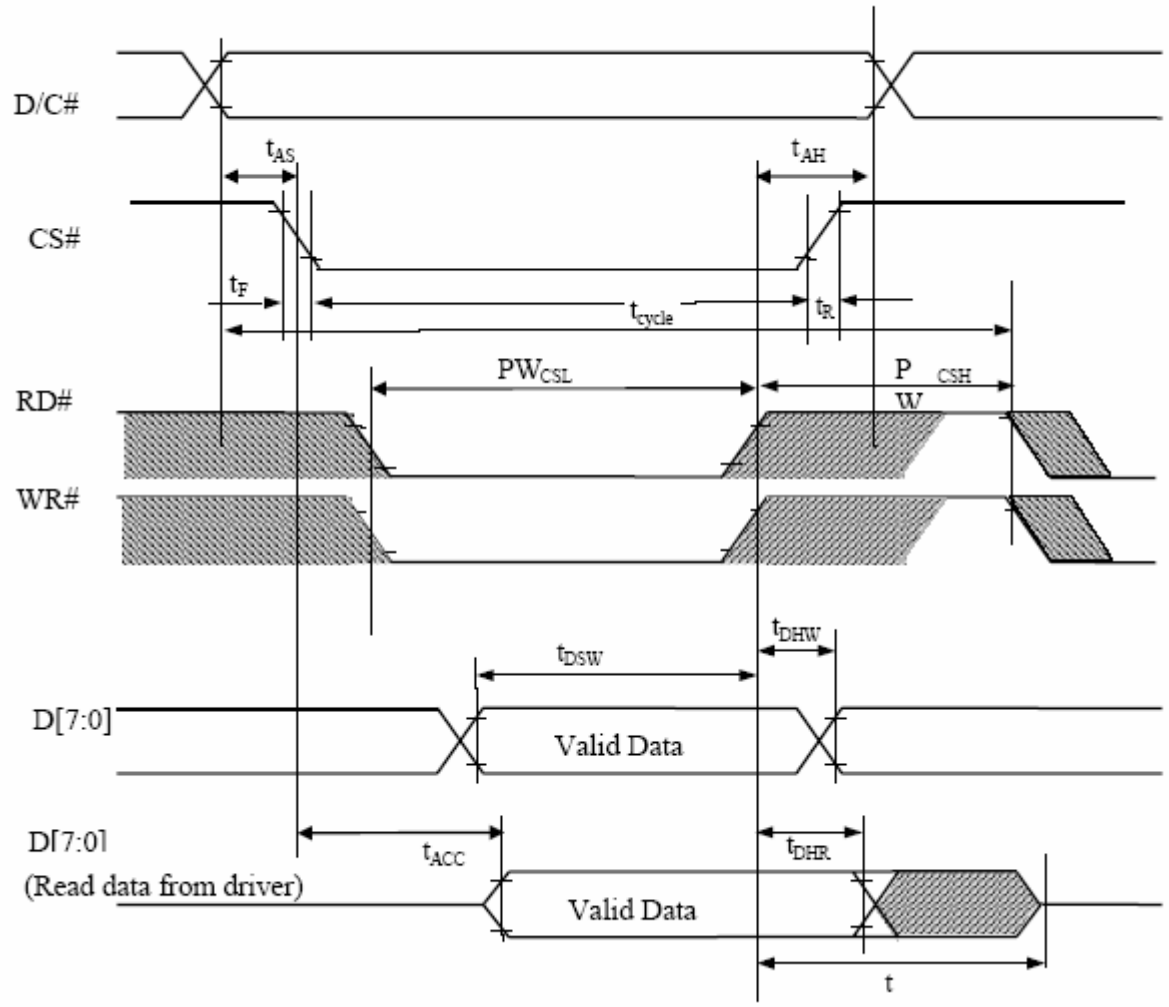
V_{DD} ~ V_{SS} = 2.4 to 3.5V

T_A = 25°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) 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

8080-series MPU parallel interface characteristics



3:Serial Interface

Conditions:

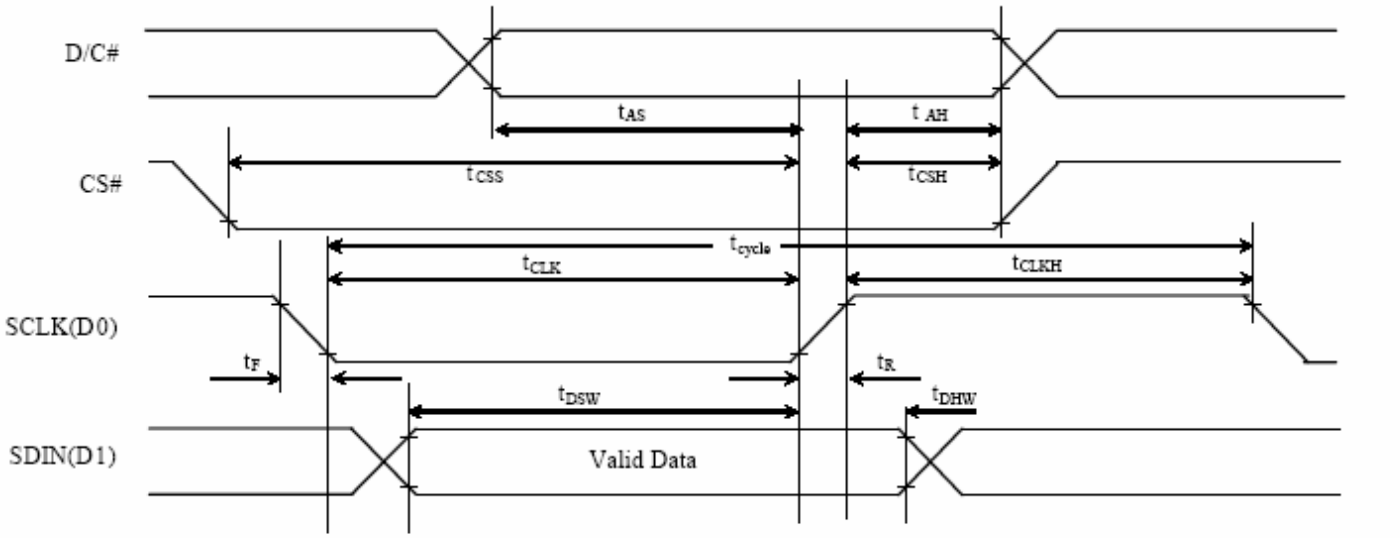
V_{DD} ~ V_{SS} = 2.4 to 3.5V

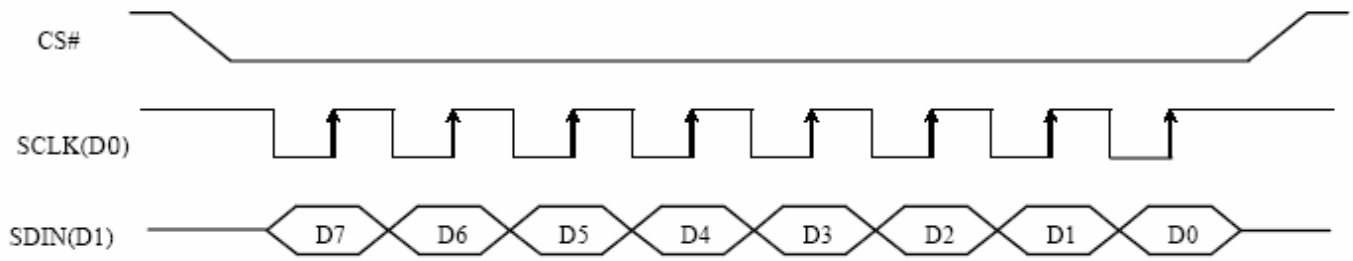
T_A = 25°C

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



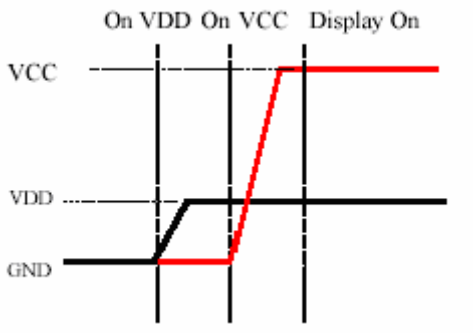


n TIMING OF POWER SUPPLY

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.

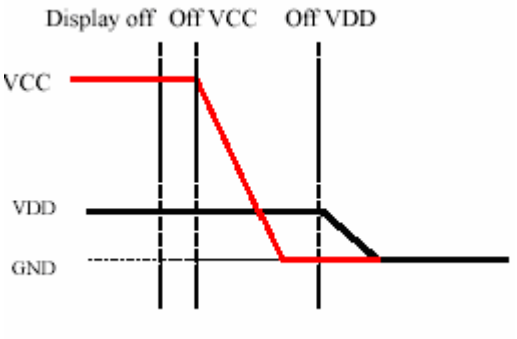
Power up Sequence:

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}**



n ELECTRO-OPTICAL CHARACTERISTICS (Ta=25℃)

Items		Symbol	Min.	Typ.	Max.	Unit	Remark
Operating Luminance		L	65	80	-	cd /m^2	Yellow
Power Consumption		P	-	135	160	mW	30% pixels ON L=80cd/m^2
Frame Frequency		Fr	-	100	-	Hz	
Color Coordinate	Yellow	CIE x	0.42	0.46	0.50	CIE1931	Darkroom
		CIE y	0.48	0.52	0.56		
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	35,000	-	-	Hours	L=80cd/m^2

Note:

1. 80cd/m^2 is base on V_{DD}=3.0V, V_{CC}=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 alternately displayed)

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

n INTERFACE PIN CONNECTIONS

No	Symbol	Description
1	NC	No connection
2	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 should be left open in Serial mode
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

n COMMAND TABLE

◆Write command table

(D/C# = 0, R/W# (WR#) = 0, E (RD#) = 1) unless specific setting is stated

Fundamental Command Table

D/C#	Hex	D7	D6	D5	D4	D3	D2	D2	D0	Command	Description
0 0 0	15 A[5:0] B[5:0]	0 * *	0 * *	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	Setup Column start and end address A[5:0]: Start Address, range:00h~3Fh, (RESET = 00h) B[5:0]: End Address, range:00h~3Fh, (RESET = 3Fh) Please refers to Section 8.10 Graphic Display Data RAM (GDDRAM) for relationship between Column Address setting and GDDRAM structure.
0 0 0	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	Setup Row start and end address A[6:0]: Start Address, range:00h~7Fh, (RESET = 00h) B[6:0]: End Address, range:00h~7Fh, (RESET = 7Fh) Please refers to 8.10 Graphic Display Data RAM (GDDRAM) for relationship between Row Address setting and GDDRAM structure.
0 0	81 A[7:0]	1 A_7	0 A_6	0 A_5	0 A_4	0 A_3	0 A_2	0 A_1	1 A_0	Set Contrast Current	A[7:0]: Set Contrast Value, range:0~ 255, (RESET = 80h)
0 0	82 A[7:0]	1 A_7	0 A_6	0 A_5	0 A_4	0 A_3	0 A_2	1 A_1	0 A_0	Set Second Pre-charge Speed	A[7:1]: Set Second Pre-charge Speed A[7:1] = 0000000b, Second Pre-charge speed = 1 A[7:1] = 0000001b, Second Pre-charge speed = 3 : A[7:1] = 1111111b, Second Pre-charge speed = 255 The RESET value of A[7:1] depends on the value of the contrast current (81h) and is equal to: 2*81h A[7:0] +1 (maximum 7Fh) A[0] = 0, Disable doubling the Second Pre-charge speed (RESET) A[0] = 1, Enable doubling the Second Pre-charge speed Please refer to Figure 10-3 for the illustration of difference Second Pre-charge speed settings.
0 0	90 A[7:0]	1 *	0 *	0 A_5	1 A_4	0 *	0 *	0 A_1	0 A_0	Set Master Icon Control	A[1:0]: Icon control A[1:0] = 00b, Icon RESET to normal display (RESET) A[1:0] = 01b, Icon All ON (without altering icon ON / OFF register) A[1:0] = 10b, Icon All OFF (without altering icon ON/ OFF register) A[4] = 0b, Disable icon display (RESET) A[4] = 1b, Enable icon display A[5] = 0b, Disable V_{ICON} charge pump circuit (RESET) A[5] = 1b, Enable V_{ICON} charge pump circuit

Fundamental Command Table

D/C#	Hex	D7	D6	D5	D4	D3	D2	D2	D0	Command	Description
0	91	1	0	0	1	0	0	0	1	Set Icon Current Range	A[7:0]: Set Icon current range A[7:0] = 00h, max icon current = 0.0uA A[7:0] = 01h, max icon current = 0.5uA A[7:0] = 02h, max icon current = 1.0uA A[7:0] = 03h, max icon current = 1.5uA A[7:0] = 04h, max icon current = 2.0uA ... ... A[7:0] = FCh, max icon current = 126.0uA A[7:0] = FDh, max icon current = 126.5uA A[7:0] = FEh, max icon current = 127.0uA A[7:0] = FFh, max icon current = 127.5uA (RESET) **Note** (1) The larger the icon current range is, the better the uniformity is.
0	A[7:0]	A_7	A_6	A_5	A_4	A_3	A_2	A_1	A_0		
0	92	1	0	0	1	0	0	1	0	Set Individual Icon Current	Set each Icon current by the formula: (AN[6:0] / 127) x max icon current, where the max icon current is defined by the command "Set icon current range" 91h and N=0~63. e.g. Icon Current of ICS0 = (A0[6:0]/127) x max icon current. A0[6:0]: icon current for ICS0, range: 00h~7Fh A1[6:0]: icon current for ICS1, range: 00h~7Fh ... ... A62[6:0]: icon current for ICS62, range: 00h~7Fh A63[6:0]: icon current for ICS63, range: 00h~7Fh **Note** (1) All 64 levels (1 level for each ICS signals) of icon current must be entered, in order to operate this command properly. (2) The icon current of the unused icon pins must be set to zero by this command.
0	A0[6:0]	*	$A0_6$	$A0_5$	$A0_4$	$A0_3$	$A0_2$	$A0_1$	$A0_0$		
0	A1[6:0]	*	$A1_6$	$A1_5$	$A1_4$	$A1_3$	$A1_2$	$A1_1$	$A1_0$		
...	...	...	...	...	...	...	...	...	...		
...	...	...	...	...	...	...	...	...	...		
0	A62[6:0]	*	$A62_6$	$A62_5$	$A62_4$	$A62_3$	$A62_2$	$A62_1$	$A62_0$		
0	A63[6:0]	*	$A63_6$	$A63_5$	$A63_4$	$A63_3$	$A63_2$	$A63_1$	$A63_0$		
0	93	1	0	0	1	0	0	1	1	Set Individual Icon ON / OFF Register	Individual icon selection: A[5:0]: select one of the 64 icons from ICS0 ~ ICS63 A[7:6] = 00b, turn OFF selected icon A[7:6] = 01b, turn ON selected icon A[7:6] = 11b, blink selected icon e.g A[7:0] = 01000000b, turn ON icon ICS0 A[7:0] = 00111111b, turn OFF icon ICS63
0	A[7:0]	A_7	A_6	A_5	A_4	A_3	A_2	A_1	A_0		
0	94	1	0	0	1	0	1	0	0	Set Icon ON / OFF Registers	A[7:6]: Master control of Icon register A[7:6] = 00b, turn OFF all icon A[7:6] = 01b, turn ON all icon A[7:6] = 11b, blink all icons
0	A[7:6]	A_7	A_6	*	*	*	*	*	*		

Fundamental Command Table

D/C#	Hex	D7	D6	D5	D4	D3	D2	D2	D0	Command	Description
0	95	1	0	0	1	0	1	0	1	Set Icon Blinking Cycle	A[2:0]: Set Icon blinking cycle:
0	A[7:0]	*	*	0	1	*	A_2	A_1	A_0		

A[2:0]	blinking cycle	A[2:0]	blinking cycle
000b	0.25sec	100b	1.25sec
001b	0.50sec	101b	1.50sec
010b	0.75sec	110b	1.75sec
011b	1.00sec(RESET)	111b	2.00sec

Note

(1) Blinking cycles is measured at reset icon frame frequency and duty ratio of 50% (refer to Figure 10-4 for the meaning of 50% duty ratio)

(2) There is 10% tolerance in the above blinking cycle values.

(3) A[5:4] must be set to 01b.

D/C#	Hex	D7	D6	D5	D4	D3	D2	D2	D0	Command	Description
0	96	1	0	0	1	0	1	1	0	Set Icon Driving Scheme and Icon Frame Frequency	A[2:0]: Set icon DC drive / AC drive duty ratio
0	A[7:0]	A_7	A_6	A_5	A_4	*	A_2	A_1	A_0		

000b DC drive (RESET)
001b 63 / 64 duty ratio
010b 62 / 64 duty ratio
011b 61 / 64 duty ratio
100b 60 / 64 duty ratio
101b 59 / 64 duty ratio
110b 58 / 64 duty ratio
111b 57 / 64 duty ratio

A[7:4]: Set icon frame frequency

The icon frame frequency (F_{IFRM}) is calculated by this formula:

$$F_{IFRM} = \frac{64000}{64 \times (A[7:4]+1)}$$

where A[7:4] is ranged from 8~15 as follow.

A[7:4] setting			
0101b	5d	1011b	11d
0110b	6d	1100b	12d
0111b	7d	1101b	13d
1000b	8d	1110b	14d
1001b	9d (RESET)	1111b	15d
1010b	10d		

Example: when in default case,

$$F_{IFRM} = \frac{64000}{64 \times (9+1)} = 100Hz$$

Note

(1) Icon frame frequency must NOT be set to 0000b.

(2) There is 10% tolerance in the above frequency value

Fundamental Command Table											
D/C#	Hex	D7	D6	D5	D4	D3	D2	D2	D0	Command	Description
0 0	A0 A[7:0]	1 A_7	0 A_6	1 A_5	0 A_4	0 A_3	0 A_2	0 A_1	0 A_0	Set Re-map	Re-map setting in Graphic Display Data RAM (GDDRAM) A[7:0]: Remap (RESET = 00h) A[0] = 0b, Disable Column Address Re-map (RESET) A[0] = 1b, Enable Column Address Re-map A[1] = 0b, Disable Nibble Re-map (RESET) A[1] = 1b, Enable Nibble Re-map A[2] = 0b, Enable Horizontal Address Increment (RESET) A[2] = 1b, Enable Vertical Address Increment A[4] = 0b, Disable COM Re-map (RESET) A[4] = 1b, Enable COM Re-map A[6] = 0b, Disable COM Split Odd Even (RESET) A[6] = 1b, Enable COM Split Odd Even
0 0	A1 A[7:0]	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	A[6:0]: Vertical shift by setting the starting address of display RAM from 0 ~ 127 (RESET = 00h)
0 0	A2 A[7:0]	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	A[6:0]: Set vertical offset by COM from 0 ~ 127 (RESET = 00h) e.g. Set A[6:0] to 010000b to move COM16 towards COM0 direction for 16 row
0 0 0 0	A4 A5 A6 A7	1 1 1 1	0 0 0 0	1 1 1 1	0 0 0 0	0 0 0 0	1 1 1 1	0 0 1 1	0 1 0 1	Set Display Mode	A4: Normal display (RESET) A5: All ON (All pixels have gray scale of 15, GS15) A6: All OFF (All pixels have gray scale of 0, GS0) A7: Inverse Display (GS0 → GS15, GS1 → GS14, GS2 → GS13, …)
0 0	A8 A[6:0]	0 *	0 A_6	0 A_5	1 A_4	0 A_3	1 A_2	0 A_1	1 A_0	Set MUX Ratio	A[6:0]: Set MUX ratio from 16MUX ~ 128MUX: A[6:0] = 15 represents 16MUX A[6:0] = 16 represents 17MUX : A[6:0] = 126 represents 127MUX A[6:0] = 127 represents 128MUX (RESET) It should be noted that A[6:0]=0~14 is not allowed.
0 0	AE AF	1 1	0 0	1 1	0 0	1 1	1 1	1 1	0 1	Set Sleep mode ON / OFF	A[0] = 0b, Sleep mode ON (The display is OFF) A[0] = 1b, Sleep mode OFF (The display is ON)

Fundamental Command Table

D/C#	Hex	D7	D6	D5	D4	D3	D2	D2	D0	Command	Description
0	B1	1	0	1	1	0	0	0	1	Set Phase Length	A[7:0]: RESET and first pre-charge phase length (RESET=53h) A[3:0]: Phase 1 period of 1~15 DCLK's (RESET=3h) e.g. A[3:0] = 1111b, 15 DCLK Clock A[7:4]: Phase 2 period of 1~15 DCLK's (RESET=5h) e.g. A[7:4] = 1111b, 15 DCLK Clocks **Note** (1) 0 DCLK is invalid in phase 1 & phase 2
0	A[7:0]	A_7	A_6	A_5	A_4	A_3	A_2	A_1	A_0		
0	B2	1	0	1	1	0	0	1	0	Set Frame Frequency	Set the frame frequency of the matrix display A[6:0]:Total number of DCLK's per row. Ranging from 14h to 4Eh DCLK's (RESET = 23h) Then the frame Frequency = DCLK freq /A[6:0]. **Note** (1) It is recommend to set B2 A[6:0] to B1 A[3:0] + pulse width of GS15
0	A[6:0]	*	A_6	A_5	A_4	A_3	A_2	A_1	A_0		
0	B3	1	0	1	1	0	0	1	1	Set Front Clock Divider /Oscillator Frequency	A[3:0]: Define divide ratio (D) of display clock (DCLK) Divide ratio=A[3:0]+1 (RESET is 0000b, i.e. divide ratio = 1) A[7:4]: Set the Oscillator Frequency, F_{OSC}. Oscillator Frequency increases with the value of A[7:4] and vice versa. Range:0h~Fh (RESET= 0h represents 500KHz, typical step value: 4% of previous value)
0	A[7:0]	A_7	A_6	A_5	A_4	A_3	A_2	A_1	A_0		
0	B7	1	0	1	1	0	1	1	1	Set Default Gray Scale Table	The default gray scale table is set in unit of DCLKs as follow: GS1 level Pulse width = 2 DCLKs GS2 level Pulse width = 4 DCLKs GS3 level Pulse width = 6 DCLKs … … … GS13 level Pulse width = 26 DCLKs GS14 level Pulse width = 28 DCLKs GS15 level Pulse width = 30 DCLKs **Note** (1) The pulse width is counted from Phase 2 to Phase 4. (2) The pulse width DCLKs of each GS is bounded by above values in spite of the settings in Phase 2 period and Phase 3 period (refer to command B1h, BBh)

Fundamental Command Table

D/C#	Hex	D7	D6	D5	D4	D3	D2	D2	D0	Command	Description
0	B8	1	0	1	1	1	0	0	0	Look Up Table for Gray Scale Pulse width	Set gray scale (GS1~GS15) pulse width in unit of DCLKs. A1[5:0], value for GS1 level Pulse width A2[5:0], value for GS2 level Pulse width ... A14[5:0], value for GS14 level Pulse width A15[5:0], value for GS15 level Pulse width **Note** (1) The pulse width value of GS1, GS2, ... , GS15 should not be equal. i.e. 0<GS1<GS2 .... <GS15 (2) The pulse width is counted from Phase 2 to Phase 4. (3) The pulse width DCLKs of each GS is bounded by above settings in spite of the settings in Phase 2 period and Phase 3 period (refer to command B1h, BBh)
0	A1[5:0]	*	*	$A1_5$	$A1_4$	$A1_3$	$A1_2$	$A1_1$	$A1_0$		
0	A2[5:0]	*	*	$A2_5$	$A2_4$	$A2_3$	$A2_2$	$A2_1$	$A2_0$		
...	...	...	...	...	...	...	...	...	...		
...	...	...	...	...	...	...	...	...	...		
...	...	...	...	...	...	...	...	...	...		
0	A14[5:0]	*	*	$A14_5$	$A14_4$	$A14_3$	$A14_2$	$A14_1$	$A14_0$		
0	A15[5:0]	*	*	$A15_5$	$A15_4$	$A15_3$	$A15_2$	$A15_1$	$A15_0$		
0	BB	1	0	1	1	1	0	1	1	Set Second Pre-charge Period	A[3:0]: Set Second pre-charge period 0000b 0 DCLK 0001b 1 DCLKs 0010b 2 DCLKs : 0111b 7 DCLKs (RESET) : 1111b 15 DCLKs
0	A[3:0]	*	*	*	*	A_3	A_2	A_1	A_0		
0	BC	1	0	1	1	1	1	0	0	Set First Pre-charge voltage, V_P	A[5:0]: Set First Pre-charge voltage 000000b 0.30 x V_{CC} 000001b 0.31 x V_{CC} ... 001111b 0.45 x V_{CC} (RESET) ... 011111b 0.63 x V_{CC} 1xxxxxb 1.00 x V_{CC} or connect to V_{COMH} if $V_{CC} > V_{COMH}$
0	A[5:0]	*	*	A_5	A_4	A_3	A_2	A_1	A_0		
0	BE	1	0	1	1	1	1	1	0	Set V_{COMH}	A[4:0]: Output level high voltage for COM signal 00000b 0.51 x V_{CC} 01000b 0.58 x V_{CC} 10000b 0.66 x V_{CC} 11000b 0.75 x V_{CC} 11111b 0.84 x V_{CC} (RESET)
0	A[4:0]	0	0	0	A_4	A_3	A_2	A_1	A_0		
0	E3	1	1	1	0	0	0	1	1	NOP	Command for No Operation
0	FD	1	1	1	1	1	1	0	1	Set Command Lock	A[2]: MCU protection status [reset = 12h] 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.
0	A[2]	0	0	0	1	0	A_2	1	0		

Set (GAC) (D/C# = 0, R/W#(WR#)= 0, E(RD#) = 1) unless specific setting is stated

Graphic acceleration command											
D/C#	Hex	D7	D6	D5	D4	D3	D2	D2	D0	Command	Description
0	23	0	0	1	0	0	0	1	1	Graphic Acceleration Command Options	A[0] = 0b: Disable Fill rectangle A[0] = 1b: Enable Fill rectangle (RESET) A[1] = 0b: Disable x-wrap A[1] = 1b: Enable wrap around in x-direction during copying and scrolling (RESET) A[4] = 0b: Disable reverse copy (RESET) A[4] = 1b: Enable reverse during copying.
0	A[4:0]	*	*	*	A_4	*	*	A_1	A_0		
0	24	0	0	1	0	0	1	0	0	Draw Rectangle	A[5:0]: Column Address of Start B[6:0]: Row Address of Start C[5:0]: Column Address of End D[6:0]: Row Address of End E[7:0]: Set Gray scale pattern E[7:0] This byte is divided into two nibbles. The most significant 4 bits represent the gray scale level of the left pixel of each group. The least significant 4 bits represent the gray scale level of the right pixel of each group. Please refer to Figure 10-16 for the gray scale pattern setting examples. **Note:** (1) $0 \le A < C \le 63$ (2) $0 \le B < D \le 127$
0	A[5:0]	*	*	A_5	A_4	A_3	A_2	A_1	A_0		
0	B[6:0]	*	B_6	B_5	B_4	B_3	B_2	B_1	B_0		
0	C[5:0]	*	*	C_5	C_4	C_3	C_2	C_1	C_0		
0	D[6:0]	*	D_6	D_5	D_4	D_3	D_2	D_1	D_0		
0	E[7:0]	E_7	E_6	E_5	E_4	E_3	E_2	E_1	E_0		
0	25	0	0	1	0	0	1	0	1	Copy	A[5:0]: Column Address of Start B[6:0]: Row Address of Start C[5:0]: Column Address of End D[6:0]: Row Address of End E[5:0]: Column Address of New Start F[6:0]: Row Address of New Start **Note:** (1) $0 \le A < C \le 63$ (2) $0 \le B < D \le 127$ (3) $0 \le E \le 63$ (4) $0 \le F \le 127$
0	A[5:0]	*	*	A_5	A_4	A_3	A_2	A_1	A_0		
0	B[6:0]	*	B_6	B_5	B_4	B_3	B_2	B_1	B_0		
0	C[5:0]	*	*	C_5	C_4	C_3	C_2	C_1	C_0		
0	D[6:0]	*	D_6	D_5	D_4	D_3	D_2	D_1	D_0		
0	E[5:0]	*	*	E_5	E_4	E_3	E_2	E_1	E_0		
0	F[6:0]	*	F_6	F_5	F_4	F_3	F_2	F_1	F_0		

Graphic acceleration command											
D/C#	Hex	D7	D6	D5	D4	D3	D2	D2	D0	Command	Description
0	26	0	0	1	0	0	1	1	0	Horizontal and Vertical Scroll	A[5:0]: 1~63 horizontal offset in number of 2~126 column 0 no horizontal scroll B[6:0]: 0~127 start row address for horizontal scroll C[1:0]: scrolling time interval 00b 6 frames 01b 10 frames 10b 100 frames 11b 200 frames D[7:0]: number of rows to be H-scrolled B+D <= 128 E[6:0]: 1~63 simultaneous continuous vertical scroll offset in number of row 0 no vertical scroll **Note:** (1) Scrolling operates during display on. (2) The parameters should not be changed after scrolling is activated
0	A[5:0]	*	*	A_5	A_4	A_3	A_2	A_1	A_0		
0	B[6:0]	*	B_6	B_5	B_4	B_3	B_2	B_1	B_0		
0	C[1:0]	*	*	*	*	*	*	C_1	C_0		
0	D[7:0]	D_7	D_6	D_5	D_4	D_3	D_2	D_1	D_0		
0	E[6:0]	*	E_6	E_5	E_4	E_3	E_2	E_1	E_0		
0	2E	0	0	1	0	1	1	1	0	Stop Moving	This command deactivates the scrolling action. **Note** (1) After sending 2Eh command to deactivate the scrolling action, the ram data needs to be rewritten.
0	2F	0	0	1	0	1	1	1	1	Start Moving	This command activates the scrolling function according to the setting done by Horizontal & Vertical Scroll command 26h.

u Read command table

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

$D_7D_6D_5D_4D_3D_2D_1D_0$	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

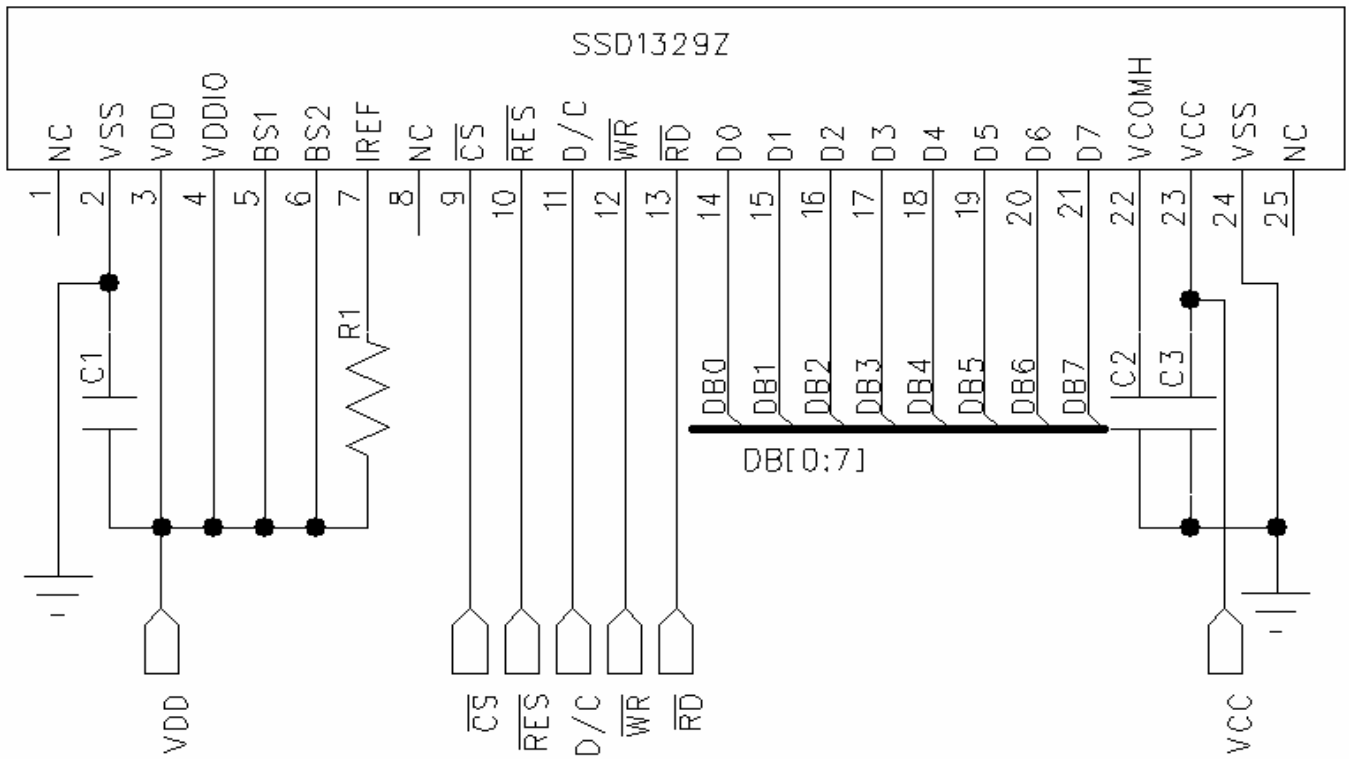
n INITIALIZATION CODE

```
Void  init_oled()
{
  //DISPLAY OFF
   Writecommand(0xAE);

 //Set Column Address
    Writecommand(0x15);
    Writecommand(0x00);
    Writecommand(0x3f);

    //Set Row Address
    Writecommand(0x75);
    Writecommand(0x00);
    Writecommand(0x7f);

   //Set Contrast Current
    Writecommand(0x81);
    Writecommand(0x7F);

    //second pre_charge speed
    Writecommand(0x82);
     Writecommand(0xFE);

    //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);

    //first pre_charge phase length
    Writecommand(0xB1);
```

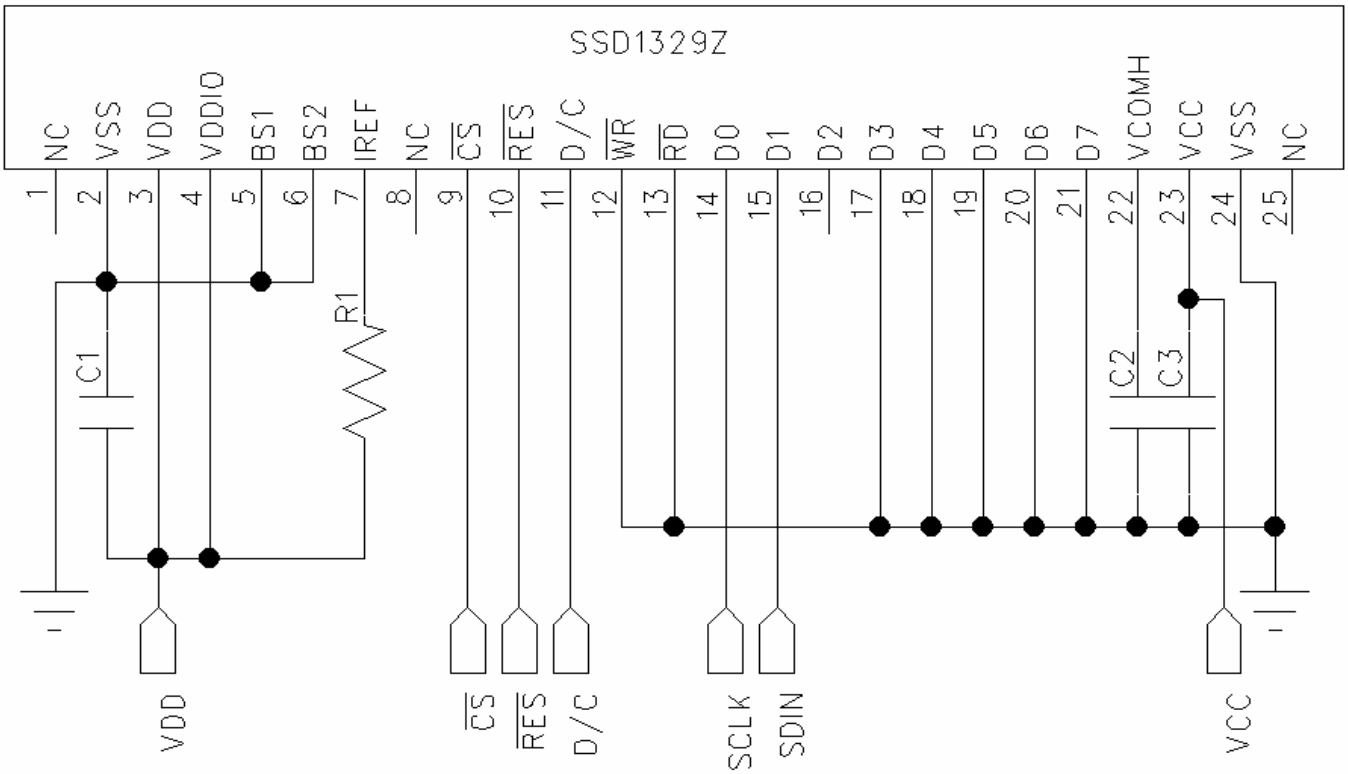
```
    Writecommand(0x53);

   //Set Frame Frequency
    Writecommand(0xB2);
    Writecommand(0x23);

    //Set Front Clock Divider/Oscillator Frequency
    Writecommand(0xB3);
    Writecommand(0x51);

  //Set Default Gray Scale table
    Writecommand(0xB7);

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

    //first pre_charge voltage
    Writecommand(0xBC);
    Writecommand(0x1F);

    //Set Vcomh
    Writecommand(0xBE);
    Writecommand(0x1F);

    //Set Command Lock
    Writecommand(0xFD);
    Writecommand(0x12);

     //DISPLAY ON
     Writecommand(0xAF);
}
```

n SCHEMATIC EXAMPLE

◆8080 Series Interface Application Circuit



◆Serial Interface Application Circuit



NOTE:

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

n RELIABILITY TESTS

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

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

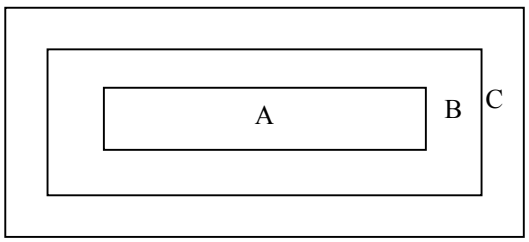
n OUTGOING QUALITY CONTROL SPECIFICATION

◆Standard

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

◆Definition

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



Zone A: Active Area

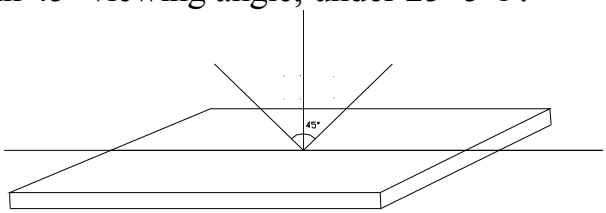
Zone B: Viewing Area except Zone A

Zone C: Outside Viewing Area

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

◆Inspection Methods

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



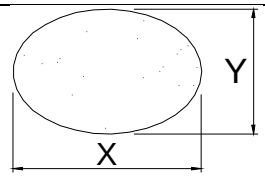
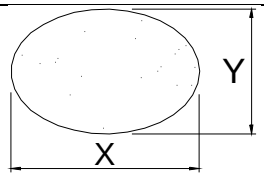
2 The luminance and color coordinate inspection : By PR705 or BM-7 or the equal equipments, in the dark room, under 25±5℃.

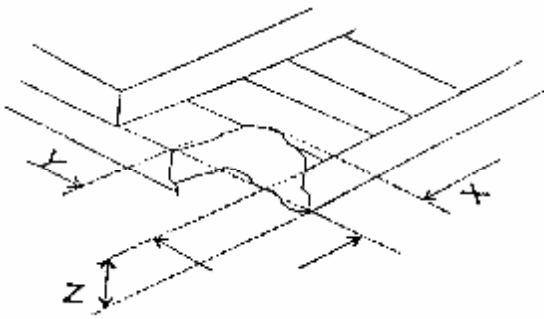
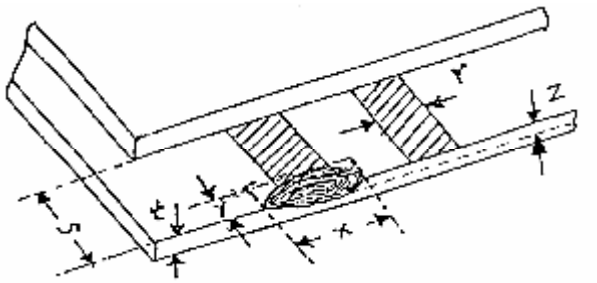
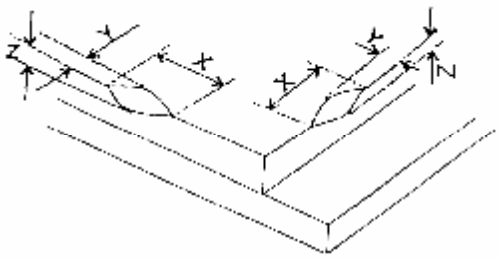
◆Inspection Criteria

1 Major defect : AQL= 0.65

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

2 Minor Defect : AQL= 1.5

<table>
<tr><td>Item</td><td colspan="4">Criterion</td></tr>
<tr><td rowspan="5">Spot Defect (dimming and lighting spot)</td><td colspan="2" rowspan="2">Size (mm)</td><td colspan="2">Accepted Qty</td></tr>
<tr><td>Area A + Area B</td><td>Area C</td></tr>
<tr><td rowspan="3">  </td><td>Φ≦0.07</td><td colspan="2">Ignored</td></tr>
<tr><td>0.07＜Φ≦0.10</td><td>3</td><td rowspan="3">Ignored</td></tr>
<tr><td>0.10＜Φ≦0. 15</td><td>1</td></tr>
<tr><td colspan="4">Note : Φ= (x + y) / 2</td><td>0.15＜Φ</td><td>0</td></tr>
<tr><td rowspan="5">Line Defect (dimming and lighting line)</td><td>L (Length) : mm</td><td>W (Width) : mm</td><td>Area A + Area B</td><td>Area C</td></tr>
<tr><td>/</td><td>W≦0.02</td><td colspan="2">Ignored</td></tr>
<tr><td>L≦3.0</td><td>0.02＜W≦0.03</td><td>2</td><td rowspan="3">Ignored</td></tr>
<tr><td>L≦2.0</td><td>0.03＜W≦0.05</td><td>1</td></tr>
<tr><td>/</td><td>0.05＜W</td><td>As spot defect</td></tr>
<tr><td colspan="5">Remarks: The total of spot defect and line defect shall not exceed 4 pcs. The distance between two lines defects must exceed 1 mm</td></tr>
<tr><td>Polarizer Stain</td><td colspan="4">Stain which can be wiped off lightly with a soft cloth or similar cleaning is accepted, otherwise, according to the Spot Defect and the Line Defect.</td></tr>
<tr><td rowspan="6">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>

n CAUTIONS IN USING OLED MODULE

◆Precautions For Handling OLED Module:

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

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

◆Precautions For Soldering OLED Module:

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

◆ Precautions For Storing OLED Module:

1. Be sure to store the OLED Module in the vacuum bag with 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) 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.