SUNLIKE DISPLAY   Model No: SO2002A

GENERAL SPECIFICATION

ITEM	DESCRIPTION				
Product No	SO2002AWWB-UA-WB-U				
OLED Type	OLED White & Black				
Rear Polarizer	Reflective / Positive				
Backlight Type	OLED				
OLED Color	☐ Yellow	☐ Green	☐ Amber	White	☐
Temperature Range	Wide Temp., 3.3V, Single Supply Voltage				
Frame	Black				

TO BE VERY CAREFUL !

The OLED driver ICs are made by CMOS process, which are very easy to be damaged by static charge, make sure the user is grounded when handling the LCM.
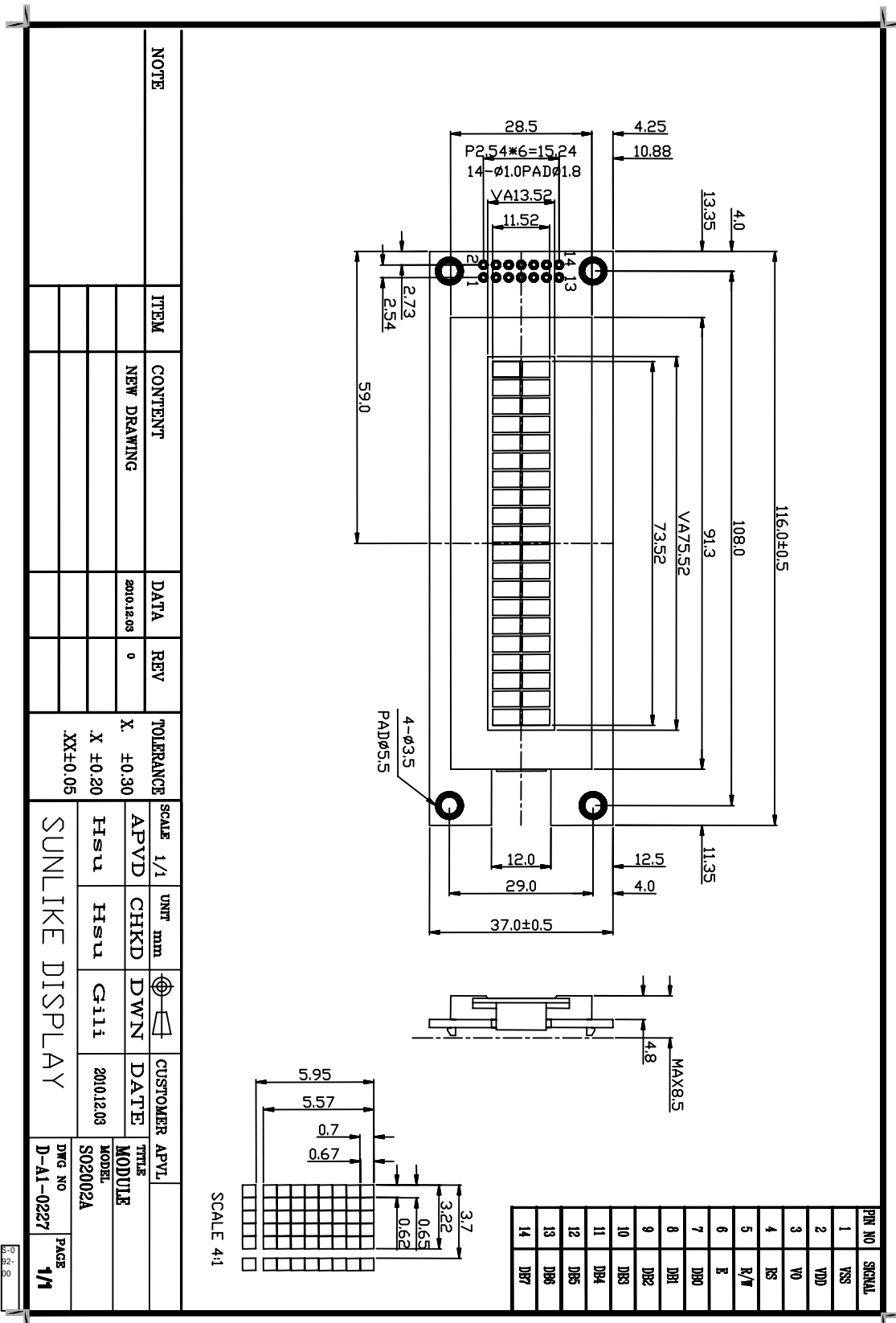
PIN NO	SIGNAL
1	VSS
2	VDD
3	V0
4	RS
5	R/W
6	E
7	DB0
8	DB1
9	DB2
10	DB3
11	DB4
12	DB5
13	DB6
14	DB7

NOTE		
ITEM	CONTENT	
	NEW DRAWING	

DATA	REV
2010.12.03	0

TOLERANCE	
X.	±0.30
X	±0.20
XX	±0.05

SCALE 1/1	UNIT mm		
APVD	CHKD	DWN	CUSTOMER APVL
Hsu	Hsu	Gili	
		DATE 2010.12.03	

SUNLIKE DISPLAY

TITLE	MODULE
MODEL	SO2002A
DWG NO	D-A1-0227
PAGE	1/1

SCALE 4:1

ABSOLUTE MAXIMUM RATING

(1) Electrical Absolute Ratings

Item	Symbol	Min.	Max.	Unit	Note
Power Supply for Logic	$V_{DD}-V_{SS}$	-0.3	5.5	Volt	
Power Supply for OLED	$V_{DD}-V_{CC}$	-0.3	13.0	Volt	
Input Voltage	V_I	-0.3	V_{DD}	Volt	
Life Time (100 cd/m2)	$V_{CC} = 7.25V$ $T_a = 25°C$ 50% RH	50,000	---	Hour	

(2) Environmental Absolute Maximum Ratings

Item	Wide Temperature			
	Operating		Storage	
	Min,	Max.	Min,	Max.
Ambient Temperature	-40	+70	-40	+85
Humidity(without condensation)	Note 4,5		Note 4,6	

Note 2   Ta 50   : 80% RH max

Ta>50   : Absolute humidity must be lower than the humidity of 85%RH at 50

Note 3   Ta at -20   will be<48hrs at 70   will be <120hrs when humidity is higher than 70%.

Note 4   Background color changes slightly depending on ambient temperature. This phenomenon is reversible.

Note 5   Ta 70   : 75RH max

Ta>70   : absolute humidity must be lower than the humidity of 75%RH at 70

Note 6   Ta at -30   will be <48hrs, at 80   will be <120hrs when humidity is higher than 70%.

SUNLIKE DISPLAY   Model No: SO2002A

ELECTRICAL CHARACTERISTICS

Item	Symbol	Condition	Min.	Typ	Max.	Unit	note
Power Supply for Logic	V_{DD}-V_{SS}	-	2.4	3.3	3.6	Volt	
Power Supply for OLED	V_{CC}-V_{SS}	-	11.5	12.0	12.5	Volt	
Input Voltage	V_{IL}	L level	0	-	0.2 V_{DD}	Volt	
	V_{IH}	H level	0.8 V_{DD}	-	V_{DD}	Volt	
Onput Voltage	V_{OL}	L level	0	-	0.1 V_{DD}		
	V_{OH}	H level	0.9 V_{DD}	-	V_{DD}		
LCM Recommend OLED Module Driving Voltage	V_O –V_{SS}	Ta 0	-	-	-	Volt	
		Ta 25	9.0	10.0	11.5		
		Ta 50	-	-	-		
Power Supply Current for OLED	I_{DD}	V_{DD} =3.3V V_O-V_{SS} =10.0V	-	50.0	80.0	mA	

OPTICAL CHARACTERISTICS

Item	Symbol	Condition	Min.	Typ	Max.	Unit	note
Viewing angle range	f(12 o'clock)	When Cr 20	-	75	-	Degree	9,10
	b(6 o'clock)		-	75	-		
	l(9 o'clock)		-	65	-		
	r(3 o'clock)		-	65	-		
Rise Time	Tr	V_O-V_{SS} =10.0V Ta=25	-	40		mS	
Fall Time	Tf		-	40			
Frame frequency	Frm		-	64	-	Hz	8,10
Contrast	Cr		-	20	-		7
The Brightness Of Backlight	L		120	150	-	cd/	
Peak Emission Wavelength	C.I.E (White)		X=0.25 Y=0.27	X=0.29 Y=0.31	X=0.33 Y=0.33	nm	

SUNLIKE DISPLAY   Model No: SO2002A

MECHANICAL SPECIFICATION

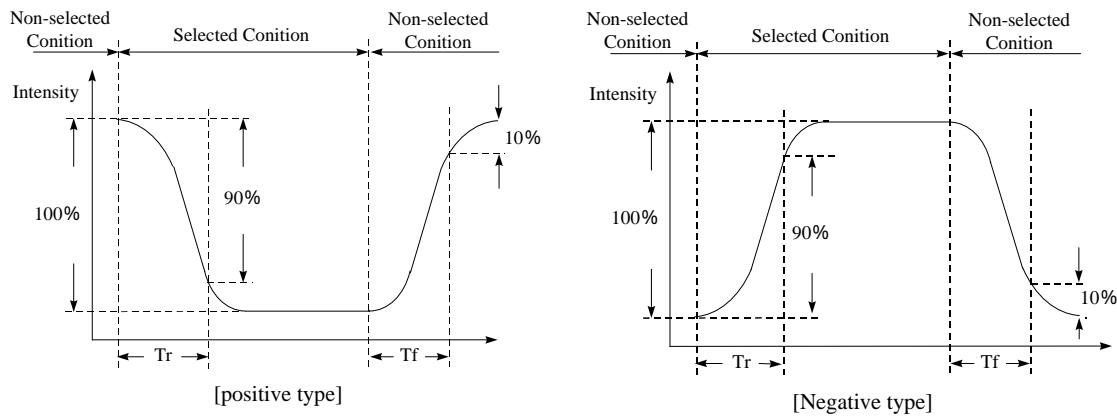| ITEM	DESCRIPTION
Product No.	SO2002A
Viewing Area	75.52(W)mm×13.52(H)mm
Module Size	116.0(W)×37.0(H)×8.5 max(D)
Dot Size	0.62(W)mm×0.67(H)mm
Dot Pitch	0.65(W)mm×0.70(H)mm
Display Format	20 characters (W)×2 lines (H)
Duty Ratio	1/16 Duty
Controller	US2066 or Equivalent

INTERFACE PIN ASSIGNMENT

Pin No.	Pin Out	Level	Description
1	VSS	0V	Power Supply Ground
2	VDD	3.3V	Power Supply Voltage
3	Vo	---	Contrast Adj
4	RS	H/L	Register Select
5	R/W	H/L	Read / Write
6	E	H,H L	Enable Signal
7	DB0	H/L	Data Bit 0
8	DB1	H/L	Data Bit 1
9	DB2	H/L	Data Bit 2
10	DB3	H/L	Data Bit 3
11	DB4	H/L	Data Bit 4
12	DB5	H/L	Data Bit 5
13	DB6	H/L	Data Bit 6
14	DB7	H/L	Data Bit 7

[Note 7] Definition of Operation Voltage (Vop)

[positive type]

$Cr = Loff / Lon$

[Negative type]

$Cr = Lon / Loff$
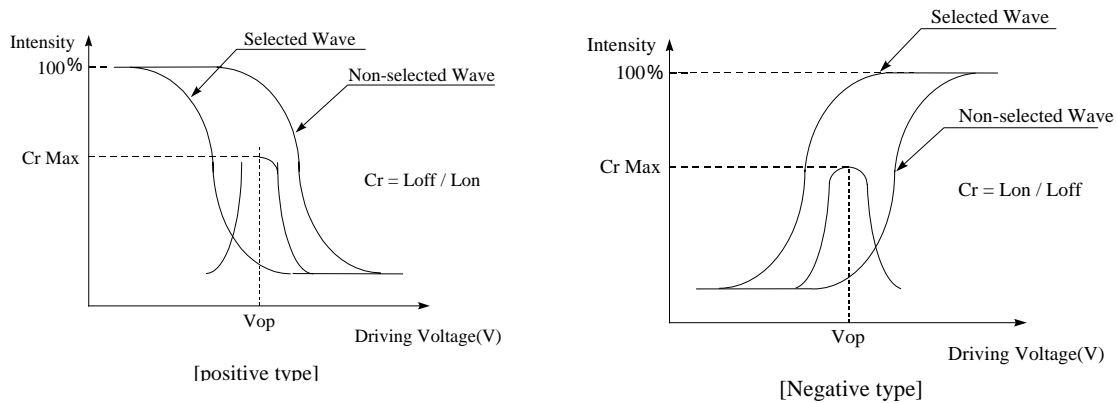
[Note 8] Definition of Response Time (Tr, Tf)

[positive type]

[Negative type]

Conditions:

   Operating Voltage : Vop   **Viewing Angle(,   ): 0° , 0°**
Frame Frequency : 64 Hz   **Driving Wave form : 1/N duty, 1/a bias**

[Note 9] Definition of Viewing Direction
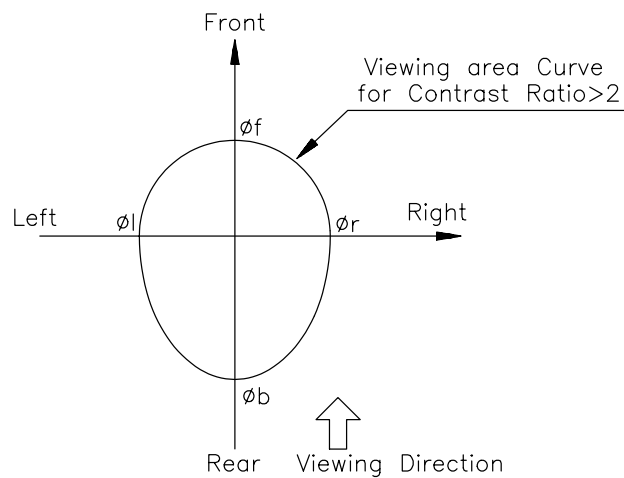
[Note 10] Definition of viewing angle

BLOCK DIAGRAM

DB7
DB0

E
R/W
RS
V□
VDD
Vss

OLED
CONTROLLER

COM16

SEG80

OLED PANEL

POWER SUPPLY

OLED
Modult

VDD

Vo

VSS

VDD

Vr 20K HOM
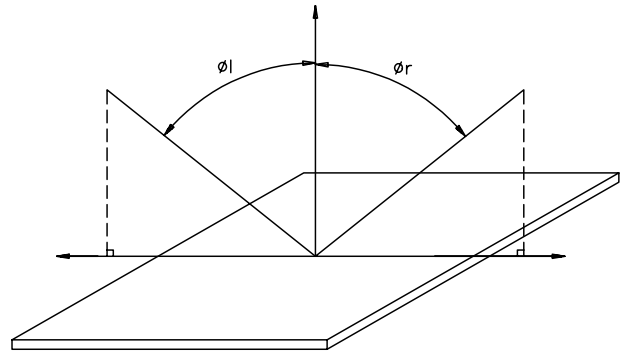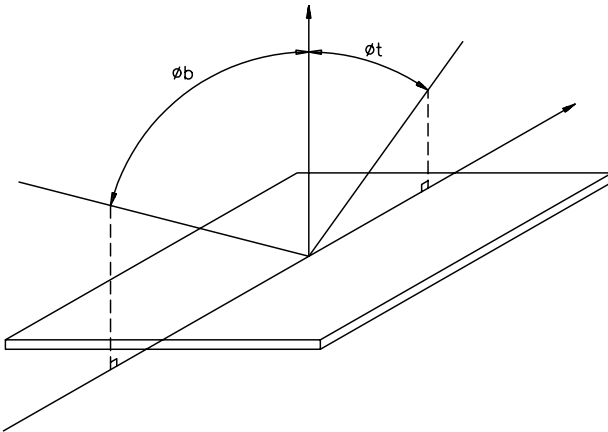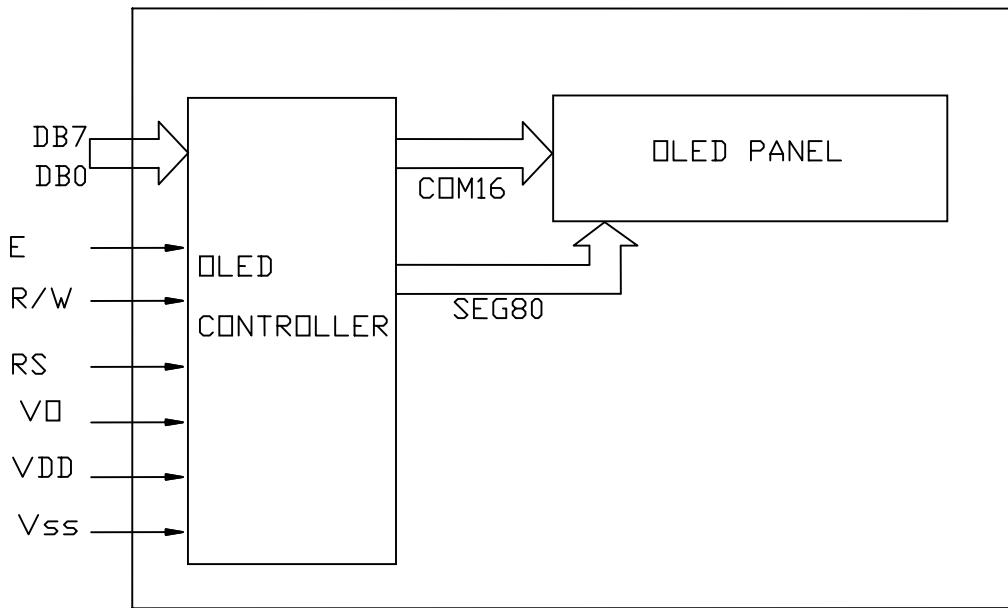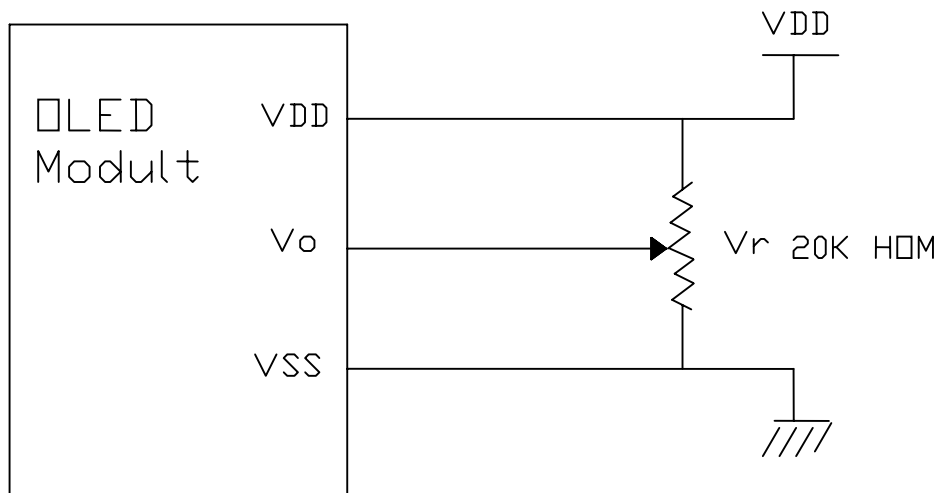
TIMING CHARACTERISTICS

AC Characteristics (VSS=0V , VDD=1.65V to 3.3V , Ta=0 to 50   )

Mode	Characteristics	Symbol	Min.	Typ.	Max.	Unit
Write Mode	E Cycle Time	t_C	400	-	-	ns
	E Rise/Fall Time	t_R, t_F	-	-	15	ns
	E Pulse Width (High,Low)	t_W	250	-	-	ns
	R/W And RS Setup Time	t_{SU1}	13	-	-	ns
	R/W And RS Hold Time	t_{H1}	10	-	-	ns
	Data Setup Time	t_{SU2}	35	-	-	ns
	Data Hold Time	t_{H2}	18	-	-	ns
Read Mode	E Cycle Time	t_C	400	-	-	ns
	E Rise /Fall Time	t_R, t_F	-	-	15	ns
	E Pulse Width(High , Low)	t_W	50	-	-	ns
	R/W And RS Setup Time	t_{SU}	0	-	-	ns
	R/W And RS Hold Time	t_H	13	-	-	ns
	Data Setup Time	t_D	90	-	100	ns
	Data Hold Time	t_{DH}	10	-	-	ns

## Read/Write Timing Chart
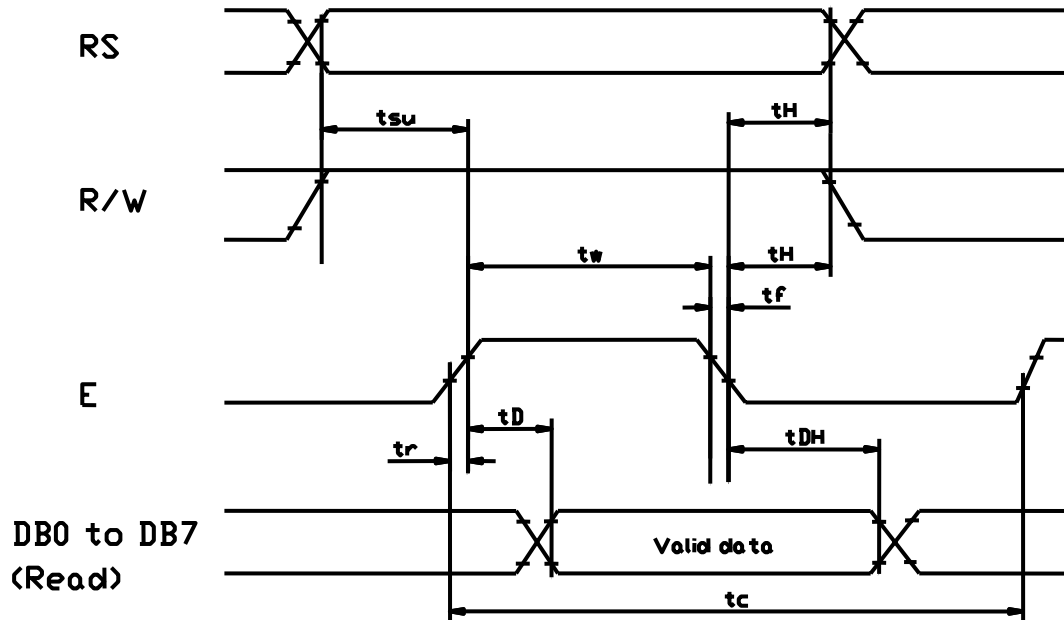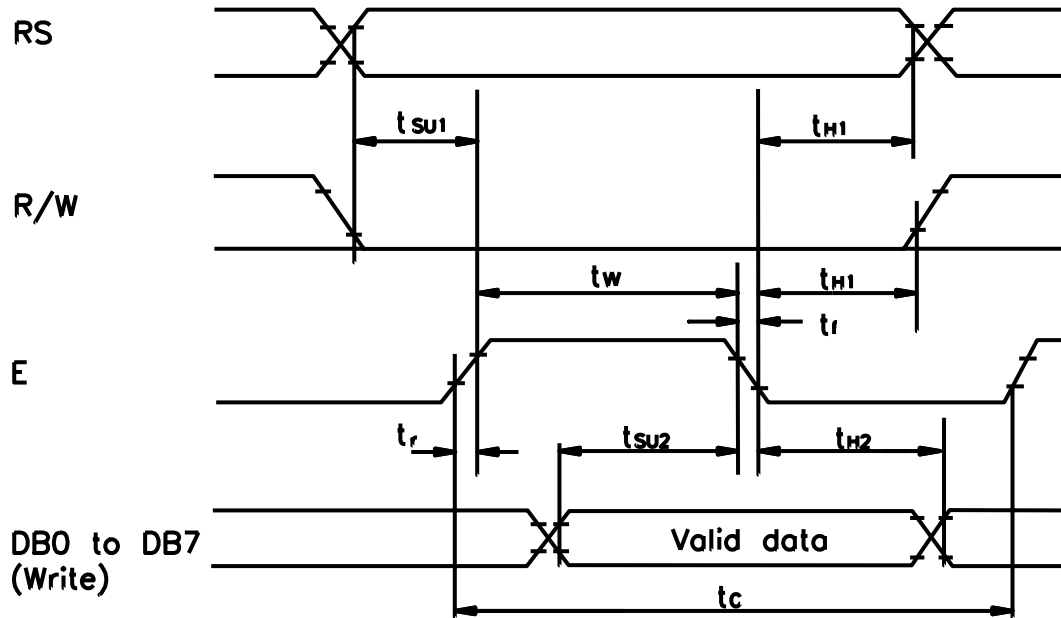
FUNCTIONAL SPECIFICATION

Commands

Power down and Power up Sequence

To protect OEL 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 during turn on/off. It gives the OEL panel enough time to complete the action of charge and discharge before/after the operation.
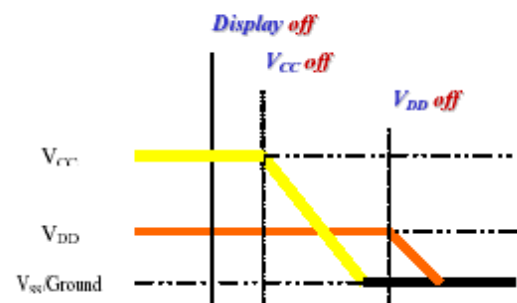
Power up Sequence:

1. Power up V_{DD}
2. Send Display off command
3. Initialization
4. Clear Screen
5. Power up V_{CC}
6. Delay 100ms
    (When V_{CC} is stable)
7. Send Display on command
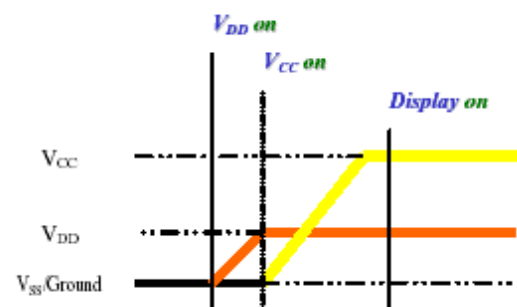
Power down Sequence:

1. Send Display off command
2. Power down V_{CC}
3. Delay 100ms
    (When V_{CC} is reach 0 and panel is completely discharges)
4. Power down V_{DD}

Note :

1) Since an ESD protection circuit is connected between V_{DD} and V_{CC} inside the driver IC, V_{CC} becomes lower than V_{DD} whenever V_{DD} is ON and V_{CC} is OFF.
2) V_{CC} should be kept float (disable) when it is OFF.
3) Power Pins (V_{DD}, V_{CC}) can never be pulled to ground under any circumstance.
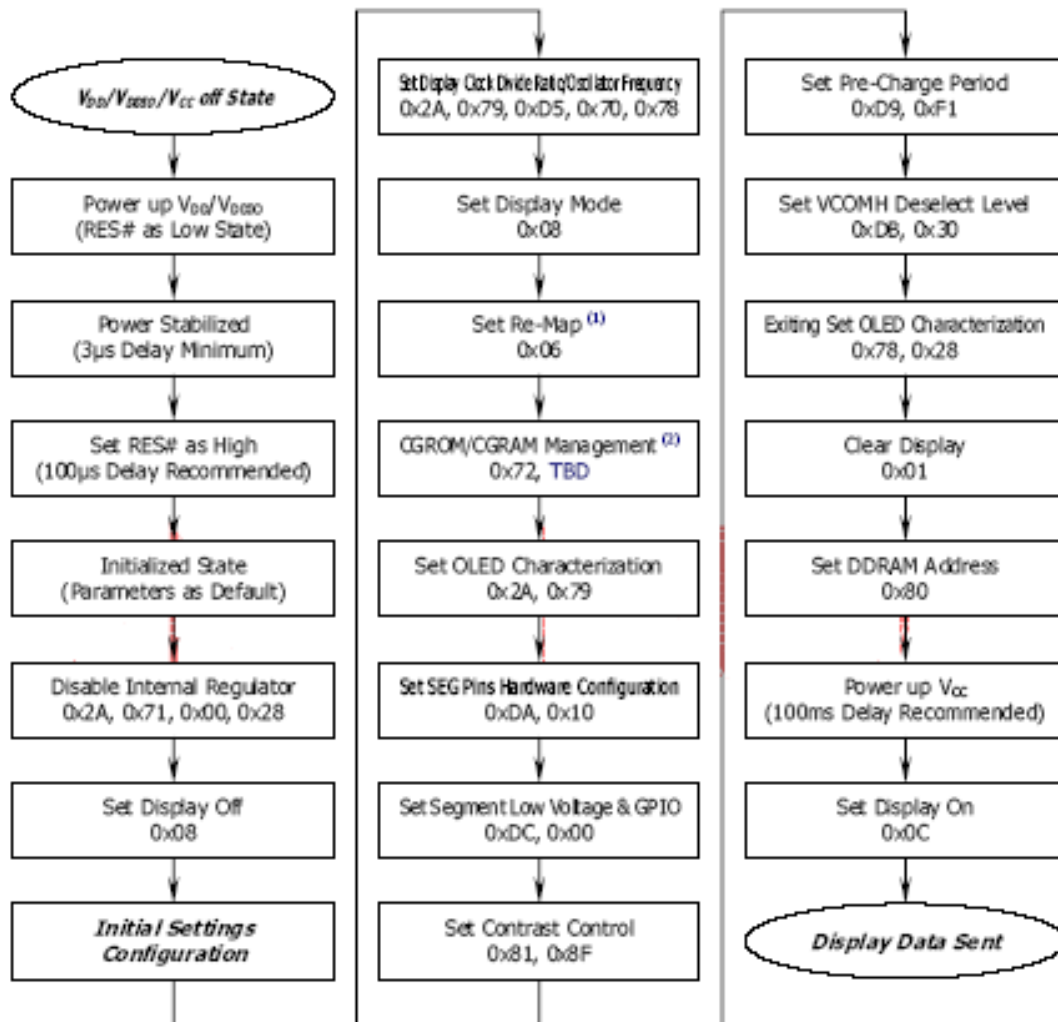4) V_{DD} should not be power down before V_{CC} power down.

RESET CIRCUIT

When RES# input is low, the chip is initialized with the following status:

1. Display off, Cursor off, Blink off.
2. Power Down off.
3. 5-dot font is default.
4. Display Shift Disable.
5. CGRAM address is 00h. SEGRAM address is 00h.
6. DDRAM address is 00h.
7. Display start line is set at display RAM address 0
8. Column address counter is set at 0
9. Normal scan direction of the COM outputs
10. Contrast control register is set at 7Fh

ACTUAL APPLICATION EXAMPLE

<Power up Sequence>

Column 1:

(V_DD/V_DDIO/V_CC off State)

↓

Power up V_DD/V_DDIO
(RES# as Low State)

↓

Power Stabilized
(3µs Delay Minimum)

↓

Set RES# as High
(100µs Delay Recommended)

↓

Initialized State
(Parameters as Default)

↓

Disable Internal Regulator
0x2A, 0x71, 0x00, 0x28

↓

Set Display Off
0x08

↓

*Initial Settings
Configuration*

Column 2:

Set Display Clock Divide Ratio/Oscillator Frequency
0x2A, 0x79, 0xD5, 0x70, 0x78

↓

Set Display Mode
0x08

↓

Set Re-Map [1]
0x06

↓

CGROM/CGRAM Management [2]
0x72, TBD

↓

Set OLED Characterization
0x2A, 0x79

↓

Set SEG Pins Hardware Configuration
0xDA, 0x10

↓

Set Segment Low Voltage & GPIO
0xDC, 0x00

↓

Set Contrast Control
0x81, 0x8F

Column 3:

Set Pre-Charge Period
0xD9, 0xF1

↓

Set VCOMH Deselect Level
0xDB, 0x30

↓

Exiting Set OLED Characterization
0x78, 0x28

↓

Clear Display
0x01

↓

Set DDRAM Address
0x80

↓

Power up V_CC
(100ms Delay Recommended)

↓

Set Display On
0x0C

↓

(*Display Data Sent*)

US2066 CGROM CHARACTER CODE

ROM A (ROM[1:0] = [0:0])

ROM B (ROM[1:0] = [0:1])

ROM C (ROM[1:0] = [1:0])

SUNLIKE DISPLAY   Model No: SO2002A

Commands

Instruction	Instruction code										Description	Execution Time(Fosc is 540 kHz)	POR Hex
	RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0			
IS=X , RE=X , SD=0													
Clear Display	0	0	0	0	0	0	0	0	0	1	Write"20H"toDDRAM.and set DDRAM address to"00H" from AC	1.52 mS	
IS=X , RE=0 , SD=0													
Return Home	0	0	0	0	0	0	0	0	1	*	Set DDRAM address to "00H" from AC and return cursor to its original position if shifted. The contents of DDRAM are not changed.	1.52 mS	
Entry Mode Set	0	0	0	0	0	0	0	1	I/D	S	Sets cursor move direction and specifies display shift. These operations are performed during data write and read.	37 μS	06H
Display ON/OFF	0	0	0	0	0	0	1	D	C	B	D=1 entire display on C=1 cursor on B=1 blink on	37 μS	08H
Function Set	0	0	0	0	1	*	N	DH	RE (0)	IS	N number of line is 2/1 DH Double height font control for 2-line mode enable/disable Extension register RE Extension register IS	37 μS	20H
IS=0 , RE=0 , SD=0													
Cursor or Display Shift	0	0	0	0	0	1	S/C	R/L	*	*	Set cursor moving and display shift control bit, and the direction, without changing DDRAM data.	37 μS	10H
Set CG RAM Address	0	0	0	1	AC5	AC4	AC3	AC2	AC1	AC0	Set CGRAM address in address counter.	37 μS	
IS=0 , RE=X , SD=0													
Set DDRAM RAM Address	0	0	1	AC6	AC5	AC4	AC3	AC2	AC1	AC0	Set DDRAM address in address counter.	37 μS	
Read Busy Flag and Address	0	1	BF	AC6	AC5	AC4	AC3	AC2	AC1	AC0	Whether during internal operation or not can be known by reading BF. The contents of address counter can also be read.	0 μS	
Write Data	1	0	D7	D6	D5	D4	D3	D2	D1	D0	Write data into internal RAM (DDRAM/CGRAM)	37 μS	
Read Data	1	1	D7	D6	D5	D4	D3	D2	D1	D0	Read data from internal RAM (DDRAM/CGRAM)	37 μS	

SUNLIKE DISPLAY   Model No: SO2002A

Instruction	Instruction code										Description	Execution Time(Fosc is 540 kHz)	POR Hex
	RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0			
IS=0 , RE=1 , SD=0													
Function Set	0	0	0	0	1	*	N	BE	RE (1)	REV	N Number of line is 2/1 BE CGRAM blink enable RE(1) Extension register REV Reverse bit	37 μS	20H
Entry Mode Set	0	0	0	0	0	0	0	1	BDC	BDS	Common bi-direction function BDC= "0" COM31->COM0 BDC= "1" COM0-> COM31 Segment bi-direction function BDS= "0" SEG99-> SEG0 BDS= "1" SEG0-> SEG99	37 μS	06H
Set Scroll Quantity	0	0	1	*	SQ5	SQ4	SQ3	SQ2	SQ1	SQ0	Set the quantity of horizontal dot scroll. Scroll Quantity (0 - 48)	37 μS	80H
OLED Characterization	0	0	0	1	1	1	1	0	0	SD	SD=0 Normal register SD=1 Extension register	37 μS	78H
Double Height (4-line)/ Display-dot shift	0	0	0	0	0	1	UD2	UD1	*	DH'	UD2, UD1: Assign different double height formats, DH': Display shift enable selection bit.	37 μS	1CH
IS=1 , RE=1 , SD=0													
Shift / Scroll Enable	0	0	0	0	0	1	DS4/ HS4	DS3/ HS3	DS2/ HS2	DS1/ HS1	**When DH'=1 Shift Enable** DS Display shift per line enable **When DH'=0 Scroll Enable** HS Horizontal scroll per line enable	37 μS	1FH

SUNLIKE DISPLAY   Model No: SO2002A

Instruction	Instruction code										Description	Execution Time(Fosc is 540 kHz)	POR Hex
	RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0			
IS=X , RE=1 , SD=0													
Extended Function Set	0	0	0	0	0	0	1	FW	B/W	NW	FW Font Width control B/W Black/White Inversion enable bit NW 4 Line mode enable bit	37 µS	08H
Function Selection A	0 1	0 0	0 A7	1 A6	1 A5	1 A4	0 A3	0 A2	0 A1	1 A0	This double byte command enable or disable the internal VDD	37 µS	71H [5CH]
Function Selection B	0 1	0 0	0 *	1 *	1 *	1 *	0 RO1	0 RO0	1 OP1	0 OP0	Beside using CGROM OP[1:0] CGROM CGRAM 00b 240 8 01b 248 8 10b 250 6 11b 256 0 Select character ROM RO[1:0] ROM 00b A 01b B 10b C 11b Invalid	37 µS	72H [0FH]
Set Contrast Control	0 0	0 0	1 A7	0 A6	0 A5	0 A4	0 A3	0 A2	0 A1	1 A0	This command sets the Contrast Setting of the display.	37 µS	81H [7FH]
Set Display Clock Divide Ratio/Oscillator Frequency	0 0	0 0	1 A7	1 A6	0 A5	1 A4	0 A3	1 A2	0 A1	1 A0	Display Clock Divide Ratio (A[3:0]) Oscillator Frequency (A[7:4])	37 µS	D5H [70H]
Set Phase Length	0 0	0 0	1 A7	1 A6	0 A5	1 A4	1 A3	0 A2	0 A1	1 A0	This double byte command sets the length of phase 1 and 2 of segment waveform of the driver.	37 µS	D9H [78H]
Set SEG Pins Hardware Configuration	0 0	0 0	1 1	1 0	0 0	1 A5	1 A4	0 0	1 0	0 0	This double byte command changes the mapping between the display	37 µS	DAH [10H]
Set VCOMH Deselect Level	0 0	0 0	1 1	1 0	0 A6	1 A5	1 A4	0 0	1 0	1 0	A[6:4] Hex code VCOMH deselect level 000b 00h 0.65xVcc 001b 10h 0.71xVcc 010b 20h 0.77xVcc 011b 30h 0.83xVcc 100b 40h 1xVcc	37 µS	DBH [40H]
Function Selection C	0 0	0 0	1 1	1 A7	0 0	1 0	1 0	1 0	0 A1	0 A0	This double byte command consists of two functions	37 µS	DCH [00H]
Crosstalk Compensation	0	0	1	1	0	1	1	1	1	1	TBD	37 µS	DFH

Note
(1) POR stands for Power On Reset Values
(2) "*"and "x" stand for "Don't care"
(3) The locked OLED driver IC MCU interface prohibits all commands access except logic bit SD is set to 1b
(4) Refer to Table 0-1 and
(5) Table 0-2 for the details of logic bits IS , RE and SD.
(6) Cursor & Blink is ON, that performs alternate between all the high data and display character at the cursor position.
If fosc has 540kHz frequency, blinking has 370 ms interval.

HANDLING PRECAUTION

1. Mounting Method

The panel of the OLED Module consists of two thin glass plates with polarizes which easily get damaged since the Module is fixed by utilizing fitting holes in the printed circuit board. Extreme care should be taken when handling the OLED Modules.

2. Caution of OLED handling & cleaning

When cleaning the display surface, use soft cloth with solvent (recommended below) and Wipe lightly.

-Isopropyl alcohol

-Ethyl alcohol

-Trichlorotriflorothane

Do not wipe the display surface with dry or hard materials that will damage the polarize surface.

Do not use the following solvent

-Water

-Kettle

-Aromatics

3. Caution against static charge

The OLED Module use C-MOSLSI drivers, so we recommend end that you connect any unused input terminal to VDD or VSS, do not input any signals before power is turned on. And ground your body, Work/assembly table. And assembly equipment to protect against static electricity.

4. Packaging

-Modules use OLED elements, and must be treated as such. Avoid in tense shock and falls from a height.

-To prevent modules from degradation. Do not operate or store them exposed directly to sunshine or high temperature/humidity.

5. Caution for operation

-It is indispensable to drive LCD's with in the specified voltage limit since the higher voltage than the limit shorten LCD life.

An electrochemical reaction due to direct current causes LCD deterioration, Avoid the use of direct current drive.

-Response time will be extremely delayed at lower temperature than the operating temperature range and on the other hand at higher temperature LCD's show dark color in them. However those phenomena do not mean malfunction or out of order with LCD's. Which will come back in the specified operating temperature range.

- If the display area is pushed hard during operation, some font will be abnormally displayed but it resumes normal condition after turning off once.

- A slight dew depositing on terminals is a cause for electro-chemical reaction resulting in terminal open circuit. Usage under the relative condition of 40   , 50%RH or less is required.

6. Storage

In the case of storing for a long period of time (for instance. For years) for the purpose or replacement use, The following ways are recommended.

- Storage in a polyethylene bag with sealed so as not to enter fresh air outside in it, And with no desiccant.

- Placing in a dark place where neither exposure to direct sunlight nor light is. Keeping temperature in the specified storage temperature range.

-Storing with no touch on polarizer surface by the anything else. (It is recommended to store them as they have been contained in the inner container at the time of delivery)

7. Safety

- It is recommendable to crash damaged or unnecessary LCD into pieces and wash off liquid crystal by using solvents such as acetone and ethanol. Which should be burned up later.

- When any liquid crystal leaked out of a damaged glass cell comes in contact with your hands, please wash it off well with soap and water.