

**SPECIFICATIONS FOR
LIQUID CRYSTAL DISPLAY MODULE**

MODEL NO : SO2002AWYB-UC-WB-U

CUSTOMER :AKIZUKI

APPROVED SIGNATURE

DSGD :

CHKD : Gili Wang

APPD : Chuan-Lin Hsu

DATE : Sep.12.2014

**SUNLIKE DISPLAY TECHNOLOGY CO .
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Revision Record

No.	Date	Model No.	Version	Remarks
1	Mar.31.2014	SO2002AWYB-UC-WB-U	REV.0	Sample RoHS-Compliant
2	Aug.11.2014	SO2002AWYB-UC-WB-U	REV.1	SPE Change P7 SDA_in /SDA_out
3	Aug.18.2014	SO2002AWYB-UC-WB-U	REV.2	SPE Change P7 SDA_in/SDA_out are tied together.
4	Sep.12.2014	SO2002AWYB-UC-WB-U	REV.3	SPE Change P12 Serial Interface Timing IO = SCL / SDA = 2.4-3.6V

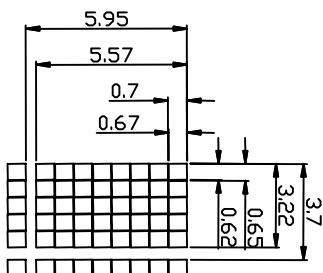
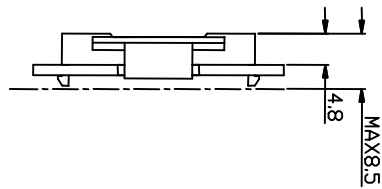
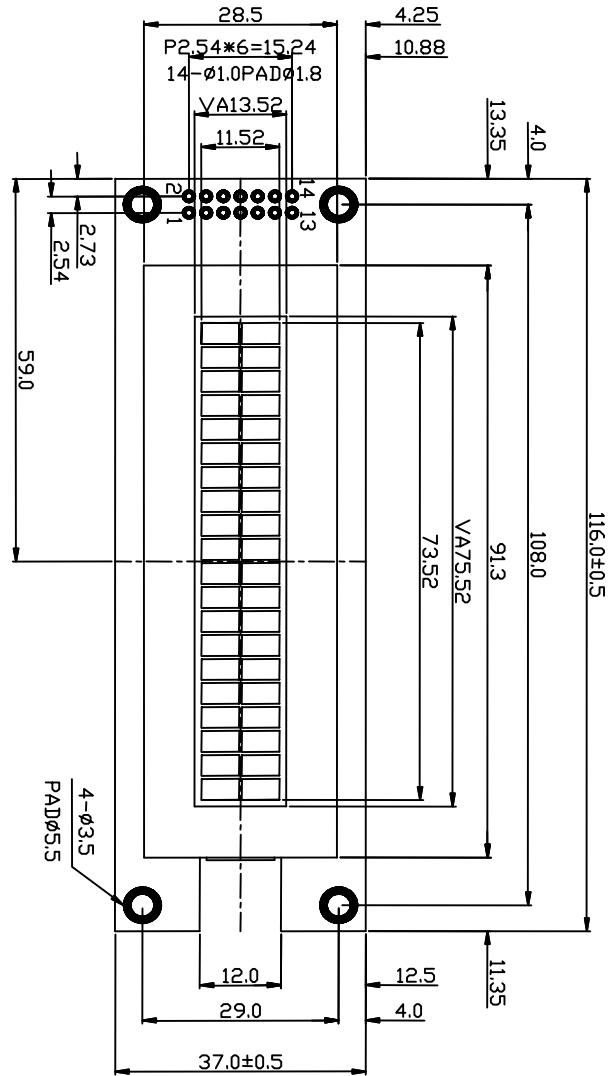
GENERAL SPECIFICATION

ITEM	DESCRIPTION				
Product No	SO2002AWYB-UC-WB-U				
OLED Type	OLED White & Black				
Rear Polarizer	Reflective / Positive				
Backlight Type	OLED				
OLED Color	Yellow	<input type="checkbox"/> Green	<input type="checkbox"/> Amber	<input type="checkbox"/> White	<input type="checkbox"/>
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.

This parts comply with RoHs



PIN NO	SIGNAL
1	VSS
2	VDD
3	/CS
4	SMD
5	NC
6	NC
7	SCL
8	SMD In
9	SMD out
10-14	NC

NOTE	ITEM	CONTENT	DATA	REV	TOLERANCE	SCALE 1/1	UNIT mm	CHKD	DWYN	DATE	TITLE	CUSTOMER APVL.
		CHANGE NUMBER	2011.10.20	0	X. ±0.30	APVD					MODULE	
					X ±0.20	Hsu	Hsu	Gili	2011.10.20		MODEL	
					.XX±0.05						S02002A	
SUNLIKE DISPLAY												
											DWG NO	PAGE
											A-49-0002	1/1

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/m ²)	$V_{CC} = 7.25V$ $T_a = 25^{\circ}C$ 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 $T_a = 50$: 80% RH max

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

Note 3 T_a 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 $T_a = 70$: 75RH max

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

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

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	$V_{CC}-V_{SS}$	BUILT_IN	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
Dark Room Contrast	Cr		-	2000:1	-		7
Brightness	L		120	150	-	cd/m ²	
Peak Emission Wavelength	C.I.E (Yellow)	CIE1931	X=0.46 Y=0.45	X=0.50 Y=0.49	X=0.54 Y=0.53	nm	

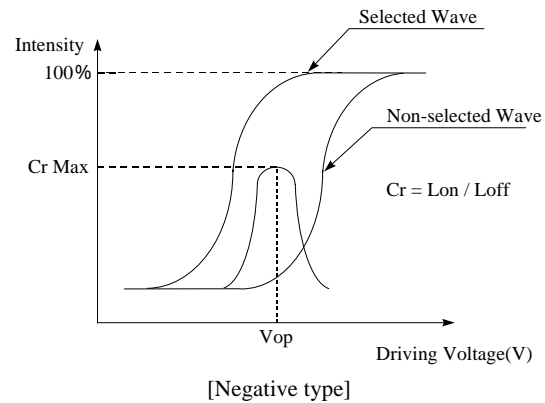
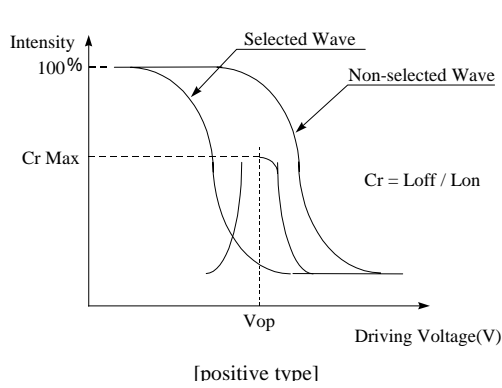
MECHANICAL SPECIFICATION

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
Interface	I ² C Serial
Controller	US2066 or Equivalent

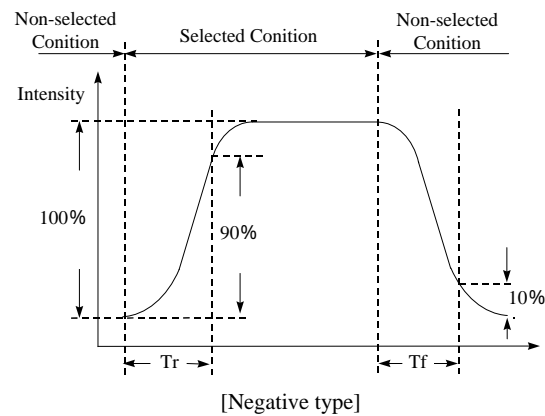
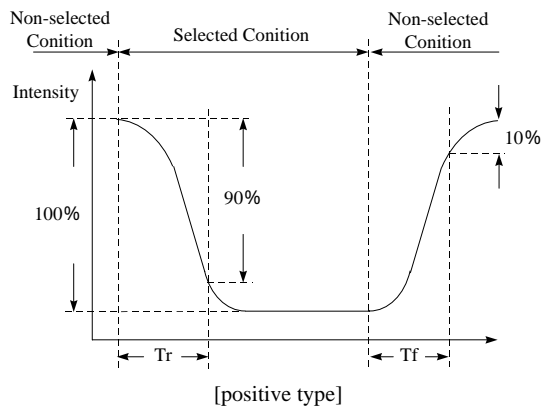
INTERFACE PIN ASSIGNMENT

Pin No.	Pin Out	Level	Description
1	VSS	0V	Power Supply Ground
2	VDD	3.3V	Power Supply Voltage
3	/CS	L	Chip Select Signal , Default Low
4	SA0	H	Slave address , Default Hi
5	NC	---	No Connection
6	NC	---	No Connection
7	SCL	H/L	IIC Bus Serial Clock Input
8	SDA_in	H/L	IIC Bus Serial Data “SDA in” and “SDA out” are tied together and serve as SDA.
9	SDA_out	H/L	
10 14	NC	---	No Connection

[Note 7] Definition of Operation Voltage (V_{op})



[Note 8] Definition of Response Time (T_r , T_f)



Conditions:

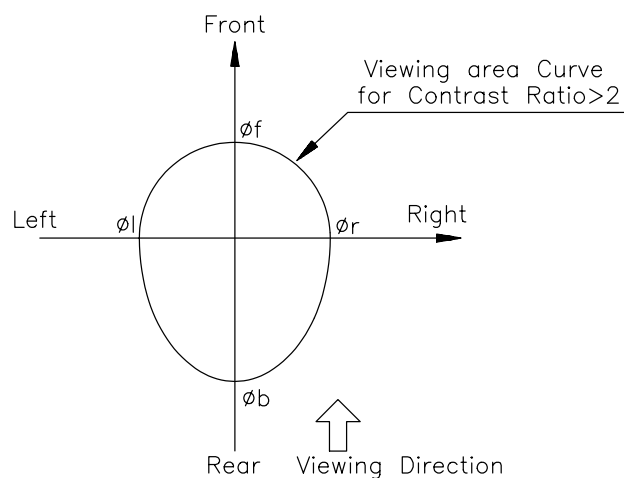
Operating Voltage : V_{op}

Frame Frequency : 64 Hz

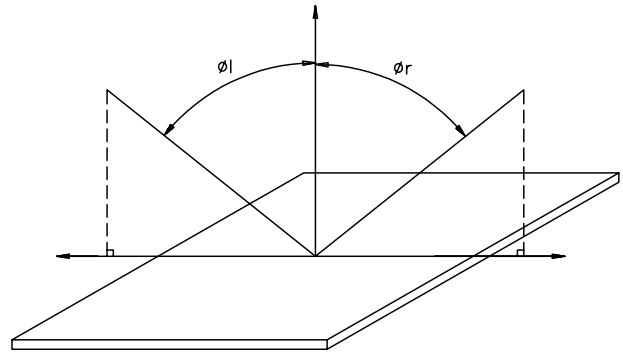
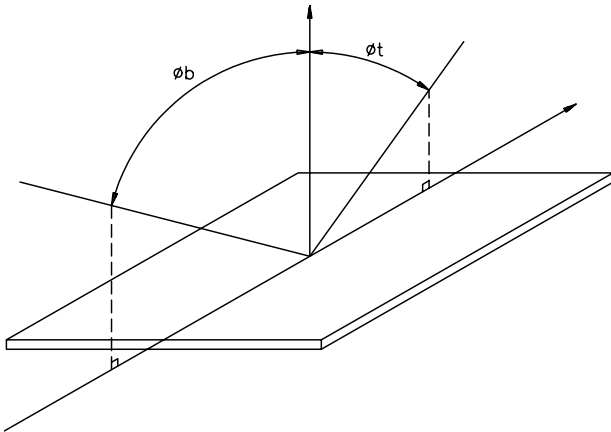
Viewing Angle(,): 0° , 0°

Driving Wave form : 1/N duty, 1/a bias

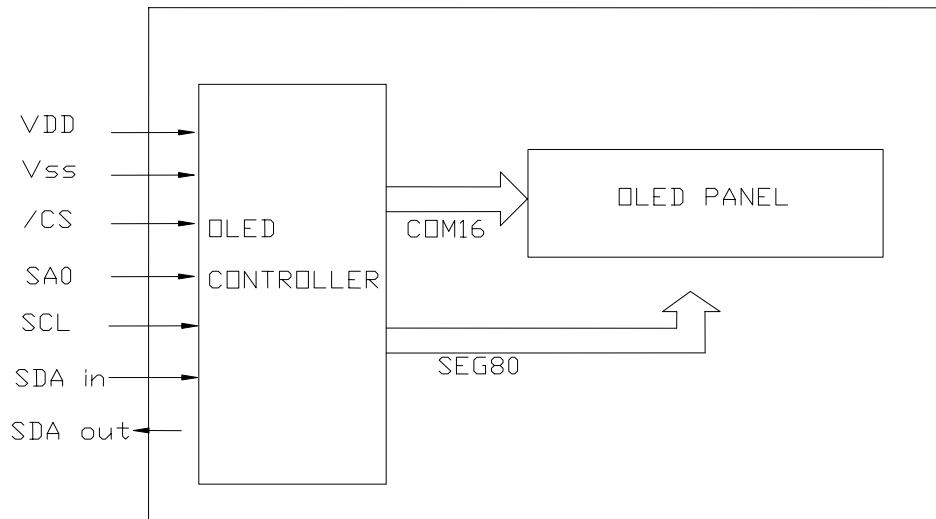
[Note 9] Definition of Viewing Direction



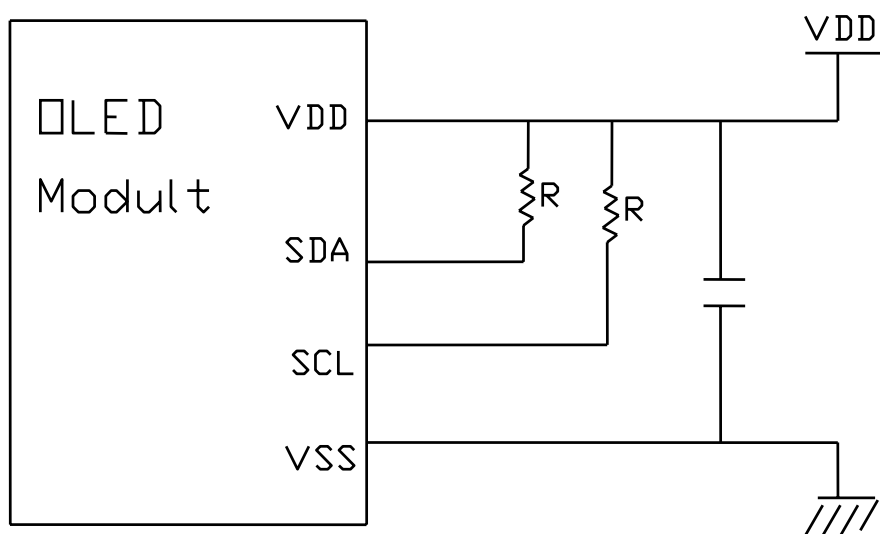
[Note 10] Definition of viewing angle



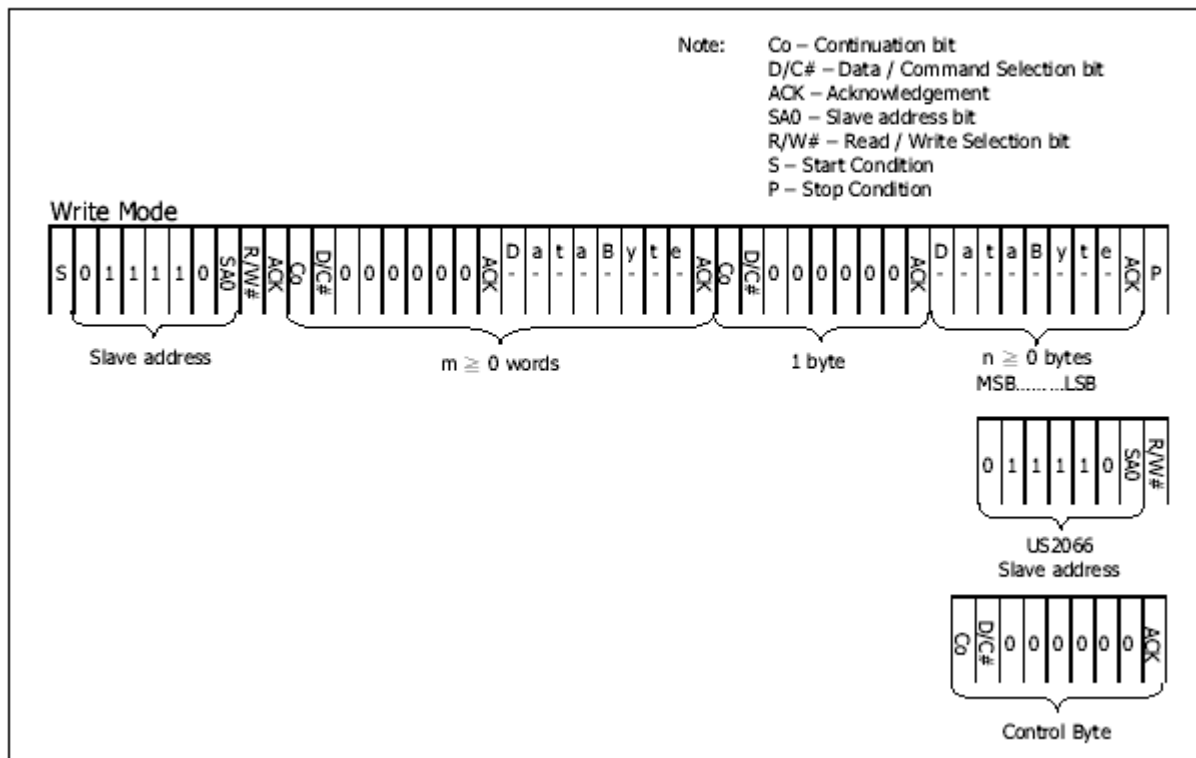
BLOCK DIAGRAM



POWER SUPPLY

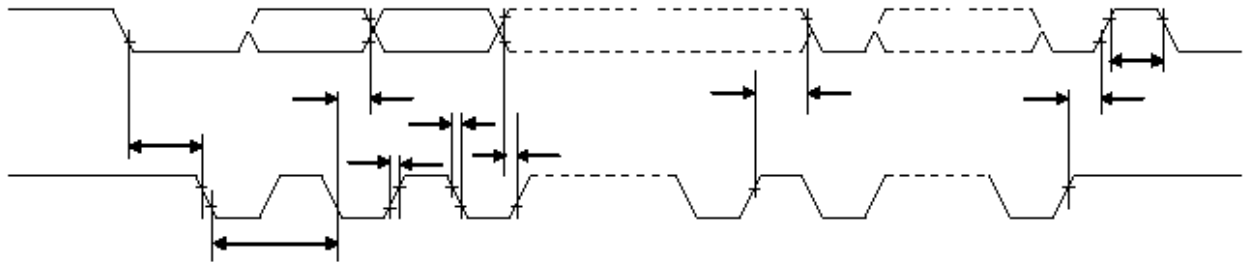


I²C-bus data format



I²C Timing Characteristics**I²C Timing Characteristics**(T_A = 25°C, V_{DDIO} = 2.4-3.6V, V_{SS} = 0V)

Symbol	Parameter	Min	Typ	Max	Unit
t _{cycle}	Clock Cycle Time	2.5	-	-	us
t _{HSTART}	Start condition Hold Time	0.6	-	-	us
t _{HD}	Data Hold Time (for "SDA _{OUT} " pin)	5	-	-	ns
	Data Hold Time (for "SDA _{IN} " pin)	300	-	-	ns
t _{SD}	Data Setup Time	100	-	-	ns
t _{SSTART}	Start condition Setup Time (Only relevant for a repeated Start condition)	0.6	-	-	us
t _{SSTOP}	Stop condition Setup Time	0.6	-	-	us
t _R	Rise Time for data and clock pin	-	-	300	ns
t _F	Fall Time for data and clock pin	-	-	300	ns
t _{IDLE}	Idle Time before a new transmission can start	1.3	-	-	us

Note: All timings are based on 20% to 80% of V_{DDIO}-V_{SS}**I²C Timing Characteristics**

FUNCTIONAL SPECIFICATION

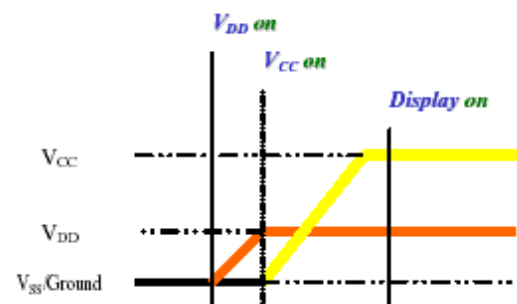
Commands

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.

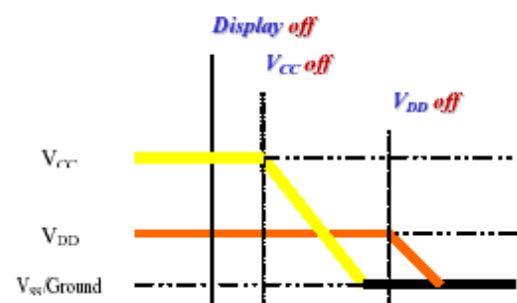
Power up Sequence:

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.

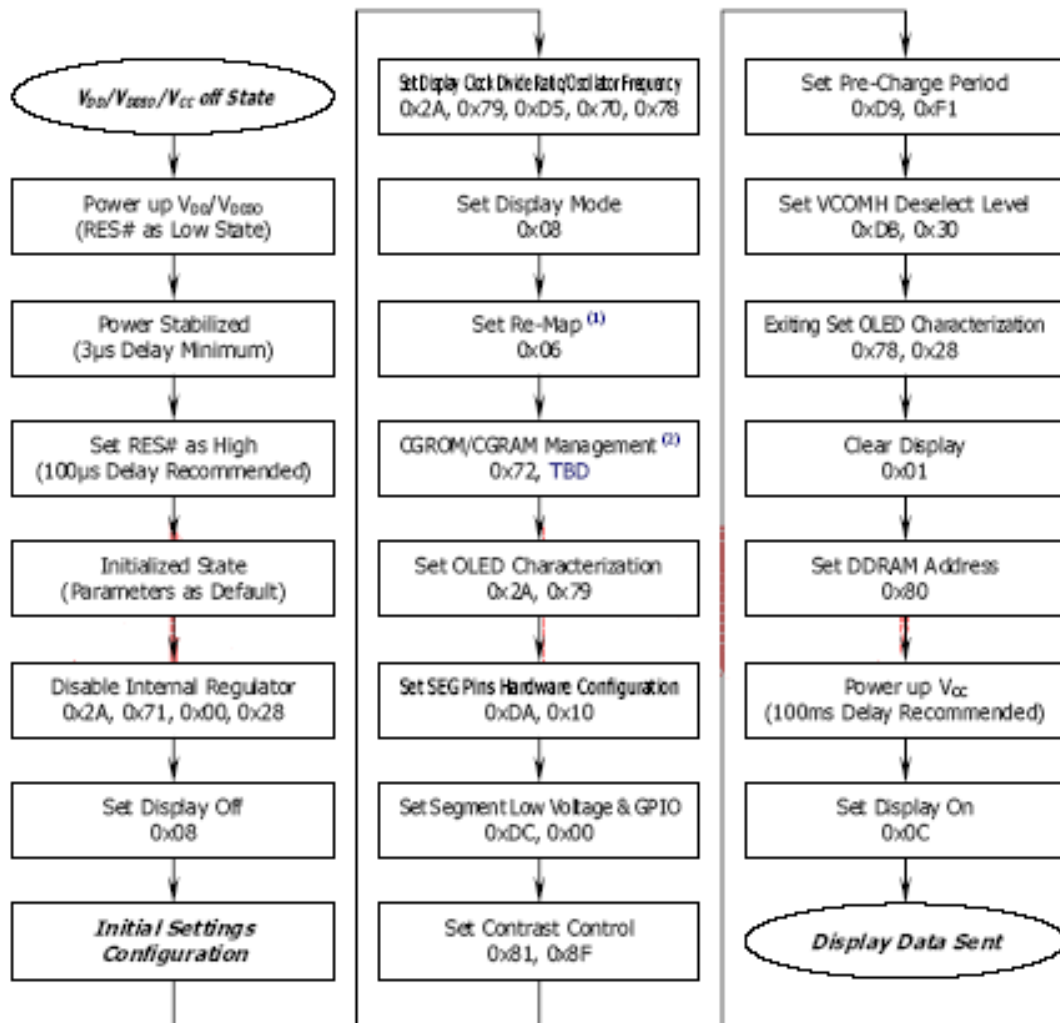
RESET CIRCUIT

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>



US2066 CGROM CHARACTER CODE

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

k7~4 k3~0	0000	0001	0002	0011	0100	0101	0110	0111	1000	1001	1010	1011	1100	1101	1110	1111
0000																
0001																
0010																
0011																
0100																
0101																
0110																
0111																
1000																
1001																
1010																
1011																
1100																
1101																
1110																
1111																

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

0000	0001	0010	0011	0100	0101	0110	0111	1000	1001	1010	1011	1100	1101	1110	1111
0000															
0001															
0010															
0011															
0100															
0101															
0110															
0111															
1000															
1001															
1010															
1011															
1100															
1101															
1110															
1111															

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

0000	0001	0002	0011	0100	0101	0110	0111	1000	1001	1010	1011	1100	1101	1110	1111
0000	0001	0002	0011	0100	0101	0110	0111	1000	1001	1010	1011	1100	1101	1110	1111
0010	0011	0100	0101	0110	0111	1000	1001	1010	1011	1100	1101	1110	1111	1111	1111
0011	0100	0101	0110	0111	1000	1001	1010	1011	1100	1101	1110	1111	1111	1111	1111
0100	0101	0110	0111	1000	1001	1010	1011	1100	1101	1110	1111	1111	1111	1111	1111
0101	0110	0111	1000	1001	1010	1011	1100	1101	1110	1111	1111	1111	1111	1111	1111
0110	0111	1000	1001	1010	1011	1100	1101	1110	1111	1111	1111	1111	1111	1111	1111
0111	1000	1001	1010	1011	1100	1101	1110	1111	1111	1111	1111	1111	1111	1111	1111
1000	1001	1010	1011	1100	1101	1110	1111	1111	1111	1111	1111	1111	1111	1111	1111
1001	1010	1011	1100	1101	1110	1111	1111	1111	1111	1111	1111	1111	1111	1111	1111
1010	1011	1100	1101	1110	1111	1111	1111	1111	1111	1111	1111	1111	1111	1111	1111
1011	1100	1101	1110	1111	1111	1111	1111	1111	1111	1111	1111	1111	1111	1111	1111
1100	1101	1110	1111	1111	1111	1111	1111	1111	1111	1111	1111	1111	1111	1111	1111
1101	1110	1111	1111	1111	1111	1111	1111	1111	1111	1111	1111	1111	1111	1111	1111
1110	1111	1111	1111	1111	1111	1111	1111	1111	1111	1111	1111	1111	1111	1111	1111
1111	1111	1111	1111	1111	1111	1111	1111	1111	1111	1111	1111	1111	1111	1111	1111

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	

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

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 <table><tr><td>OP[1:0]</td><td>CGROM</td><td>CGRAM</td></tr><tr><td>00b</td><td>240</td><td>8</td></tr><tr><td>01b</td><td>248</td><td>8</td></tr><tr><td>10b</td><td>250</td><td>6</td></tr><tr><td>11b</td><td>256</td><td>0</td></tr></table> Select character ROM <table><tr><td>RO[1:0]</td><td>ROM</td></tr><tr><td>00b</td><td>A</td></tr><tr><td>01b</td><td>B</td></tr><tr><td>10b</td><td>C</td></tr><tr><td>11b</td><td>Invalid</td></tr></table>	OP[1:0]	CGROM	CGRAM	00b	240	8	01b	248	8	10b	250	6	11b	256	0	RO[1:0]	ROM	00b	A	01b	B	10b	C	11b	Invalid	37 μS	72H [0FH]
OP[1:0]	CGROM	CGRAM																																				
00b	240	8																																				
01b	248	8																																				
10b	250	6																																				
11b	256	0																																				
RO[1:0]	ROM																																					
00b	A																																					
01b	B																																					
10b	C																																					
11b	Invalid																																					
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 0	1 0	0 A5	1 A4	1 0	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 0	1 A6	0 A5	1 A4	1 0	0 0	1 0	1 0	<table><tr><td>A [6:4]</td><td>Hex</td><td>VCOMH deselection code</td></tr><tr><td></td><td></td><td>level</td></tr><tr><td>000b</td><td>00h</td><td>0.65xVcc</td></tr><tr><td>001b</td><td>10h</td><td>0.71xVcc</td></tr><tr><td>010b</td><td>20h</td><td>0.77xVcc</td></tr><tr><td>011b</td><td>30h</td><td>0.83xVcc</td></tr><tr><td>100b</td><td>40h</td><td>1xVcc</td></tr></table>	A [6:4]	Hex	VCOMH deselection code			level	000b	00h	0.65xVcc	001b	10h	0.71xVcc	010b	20h	0.77xVcc	011b	30h	0.83xVcc	100b	40h	1xVcc	37 μS	DBH [40H]				
A [6:4]	Hex	VCOMH deselection code																																				
		level																																				
000b	00h	0.65xVcc																																				
001b	10h	0.71xVcc																																				
010b	20h	0.77xVcc																																				
011b	30h	0.83xVcc																																				
100b	40h	1xVcc																																				
Function Selection C	0 0	0 0	1 0	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 polarizers 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
- Trichlorotrifluoroethane

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

Do not use the following solvent :

- Water
- Kettle
- Aromatics

3. Caution against static charge

The OLED Module uses CMOS drivers, so we recommend 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 intense 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 within the specified voltage limit since the higher voltage than the limit shortens 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%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 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.