Crystalfontz America, Incorporated

GRAPHICS LCD MODULE SPECIFICATIONS

CFAL12832D-B

Crystalfontz America, Incorporated
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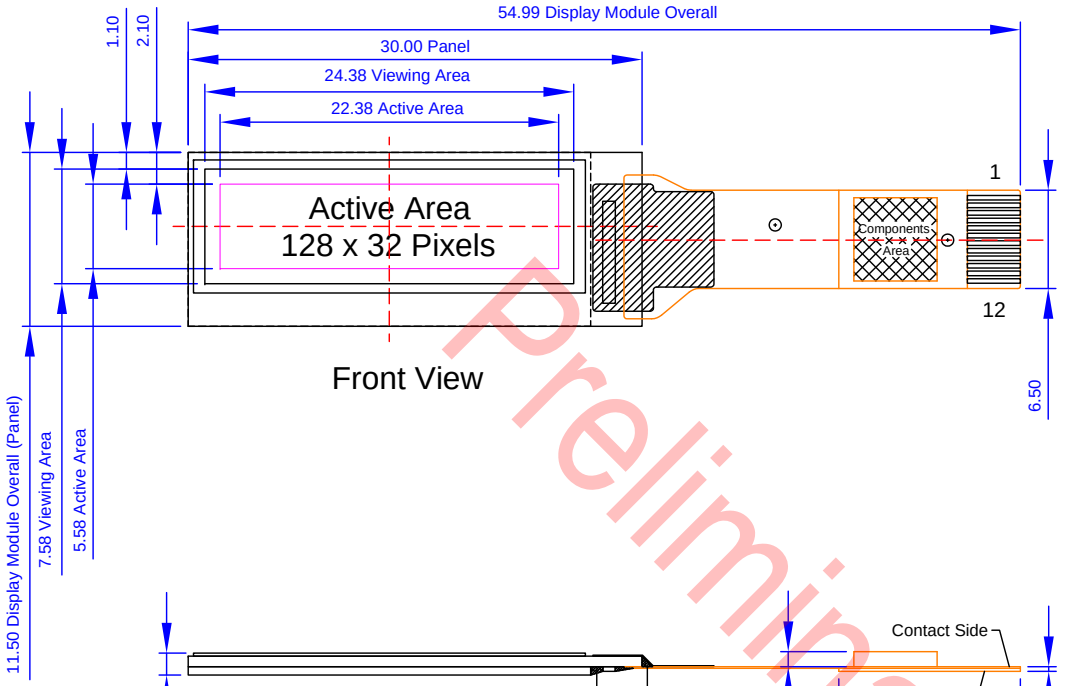
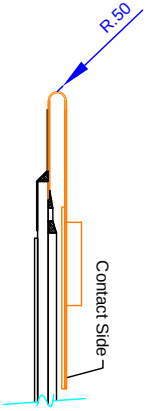
■ PHYSICAL DATA

No.	Items:	Specification:	Unit
1	Diagonal Size	0.91	Inch
2	Display Mode	Passive Matrix OEL Display	-
3	Resolution	128(H)x32(V)	Dots
4	Active Area	22.384 (W) x 5.584 (H)	mm
5	Outline Dimension	30.0 (W) x 11.5(H)x1.45(D)	mm
6	Pixel Pitch	0.175 (W) x 0.175 (H)	mm
7	Pixel Size	0.159 (W) x 0.159 (H)	mm
8	Driver IC	SSD1306	-
9	Display Color	Monochrome (White)	-
11	Interface	3/4-wire SPI/I2C	-
12	Weight	--	g
13	Duty	1/64	-





FPC Bend Detail

Note:

1. Drawing deemed accurate but not guaranteed.
2. FPC = Flexible Printed Circuit. Dimensions may vary.
3. Diagonal = 0.91"

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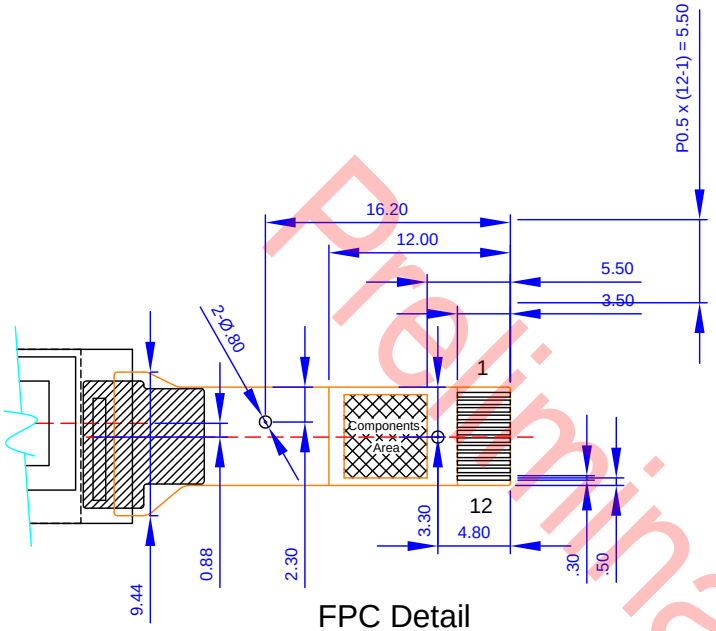
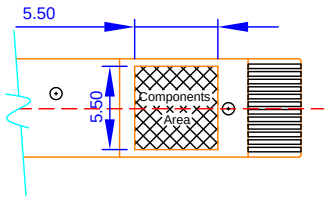
Part No.(s):	Scale:	Drawing Number:	Hardware Rev.:
CFAL12832D-B	Not to scale	CFAL12832D-B	
	Units: Millimeters	Date: 2014-12-02	Sheet: 1 of 3



FPC Detail



Components Area
Keep Out

Note:

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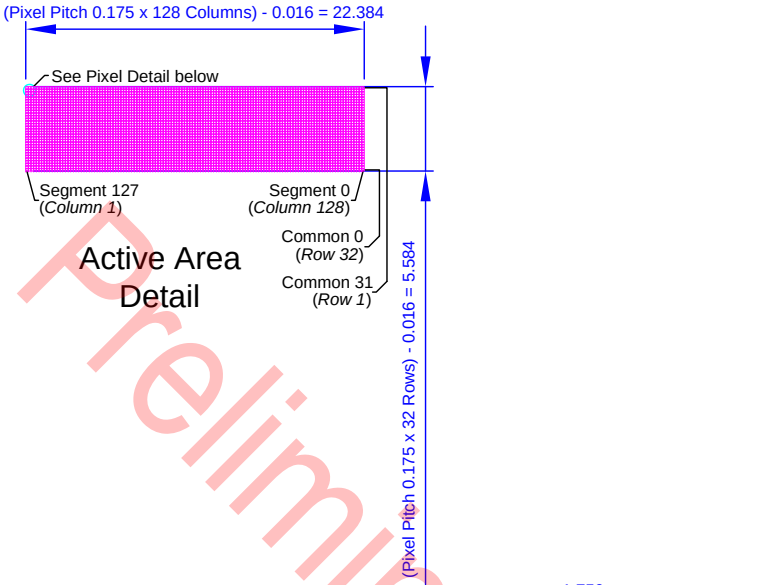
Part No.(s):	Scale:	Drawing Number:	Hardware Rev.:
CFAL12832D-B	Not to scale	CFAL12832D-B	
	Units: Millimeters	Date: 2014-12-02	Sheet: 2 of 3



Note:

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2. FPC = Flexible Printed Circuit. Dimensions may vary.
3. Diagonal = 0.91"

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Part No.(s):	Scale:	Drawing Number:	Hardware Rev.:
CFAL12832D-B	Not to scale	CFAL12832D-B	
	Units: Millimeters	Date: 2014-12-02	Sheet: 3 of 3

■ ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	Min	Max	Unit	Notes
Supply Voltage for Logic	V_{DD}	-0.3	4	V	1, 2
Supply Voltage for Display	V_{CC}	0	11	V	1, 2
Operating Temperature	T_{OP}	-30	70	°C	-
Storage Temperature	T_{STG}	-40	80	°C	-

Note 1: All the above voltages are on the basis of "VSS = 0V".

Note 2: When this module is used beyond the above absolute maximum ratings, permanent breakage of the module may occur. Also, for normal operations, it is desirable to use this module under the conditions according to Section 3. "Optics & Electrical Characteristics". If this module is used beyond these conditions, malfunctioning of the module can occur and the reliability of the module may deteriorate.

■ ELECTRICAL CHARACTERISTICS

DC Characteristics

Characteristics	Symbol	Conditions	Min	Typ	Max	Unit
Supply Voltage for Logic	V_{DD}	-	3.0	3.2	3.3	V
Supply Voltage for DC/DC	*V_{BAT}*	*Internal DC/DC Enable*	*3.3*	*-*	*4.2*	*V*
Supply Voltage for Display (Generated by Internal DC/DC)	*V_{CC}*	*Note 3*	*7*	*7.25*	*7.5*	*V*
High Level Input	V_{IH}	-	$0.8\times V_{DD}$	-	V_{DD}	V
Low Level Input	V_{IL}	-	0	-	$0.2\times V_{DD}$	V
High Level Output	V_{OH}	I_{OUT} = 100µA, 3.3MHz	$0.9\times V_{DD}$	-	V_{DD}	V
Low Level Output	V_{OL}	I_{OUT} = 100µA, 3.3MHz	0	-	$0.1\times V_{DD}$	V
Operating Current for V_{DD}	I_{DD}	-	-	180	300	µA
Operating Current for V_{CC} (V_{CC} Supplied Externally)	I_{CC}	Note 4	-	4.3	5.4	mA
		Note 5	-	6.8	8.5	mA
Operating Current for V_{BAT} (V_{CC} Generated by Internal DC/DC)	*I_{BAT}*	*Note 4*	*-*	*12.6*	*15.8*	*mA*
		Note 5	*-*	*18.4*	*23.0*	*mA*
Sleep Mode Current for V_{DD}	$I_{DD, SLEEP}$	-	-	1	5	µA
Sleep Mode Current for V_{CC}	$I_{CC, SLEEP}$	-	-	1	5	µA

Note 3: Brightness (L_{br}) and Supply Voltage for Display (V_{CC}) are subject to the change of the panel characteristics and the customer's request.

Note 4: V_{DD} = 2.8V, V_{CC} = 7.25V, 50% Display Area Turn on.

Note 5: V_{DD} = 2.8V, V_{CC} = 7.25V, 100% Display Area Turn on.

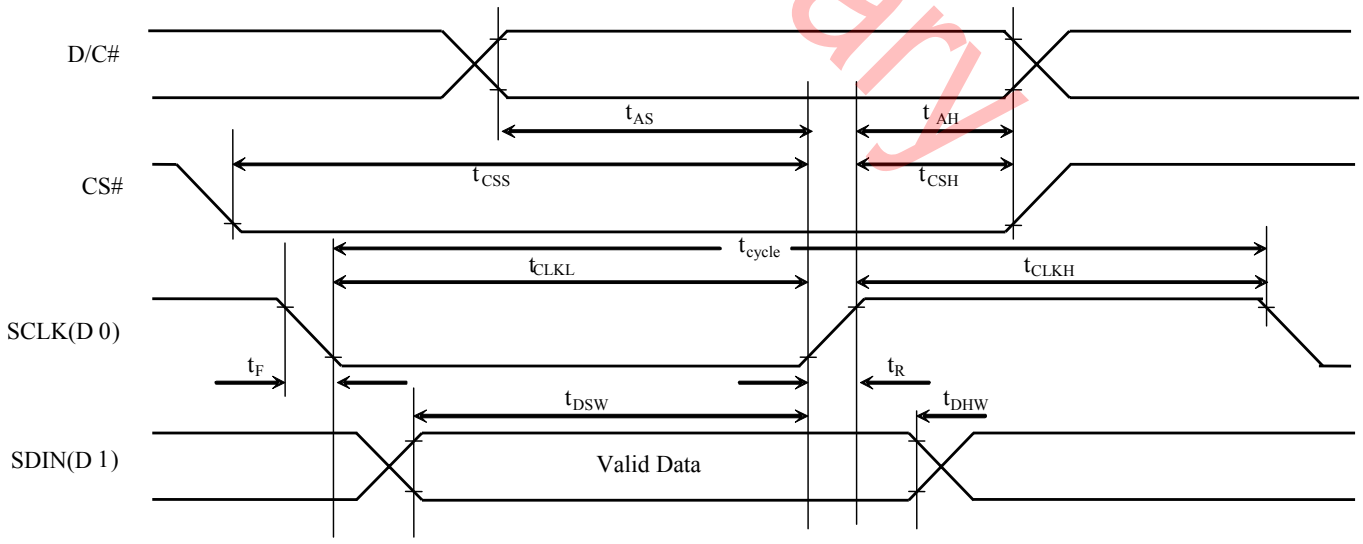
* Software configuration follows Section 4.4 Initialization.

Optics Characteristics

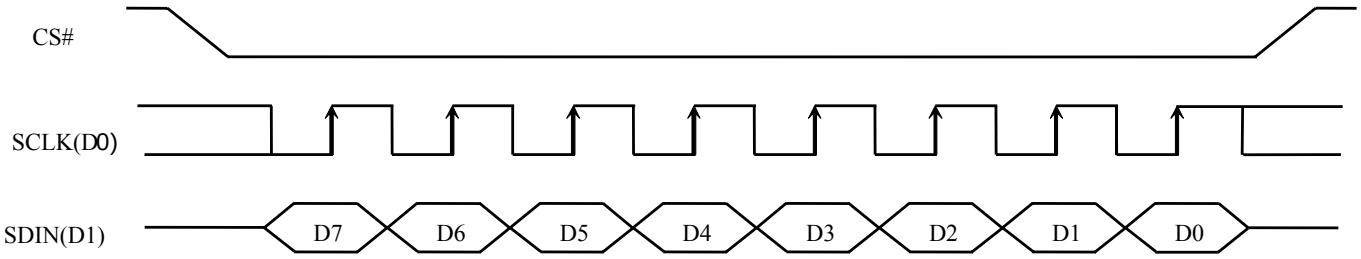
Characteristics	Symbol	Conditions	Min	Typ	Max	Unit
Brightness	L_{br}	With Polarizer (Note 3)	120	150	-	cd/m^2
C.I.E. (White)	(x) (y)	Without Polarizer	0.26 0.29	0.32 0.33	0.34 0.37	
Dark Room Contrast	CR		-	>2000:1	-	
View Angle			>160	-	-	degree

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	-	-	40	ns
t_F	Fall Time	-	-	40	ns

4-wire Serial Interface Timing Characteristics



4-wire Serial interface characteristics

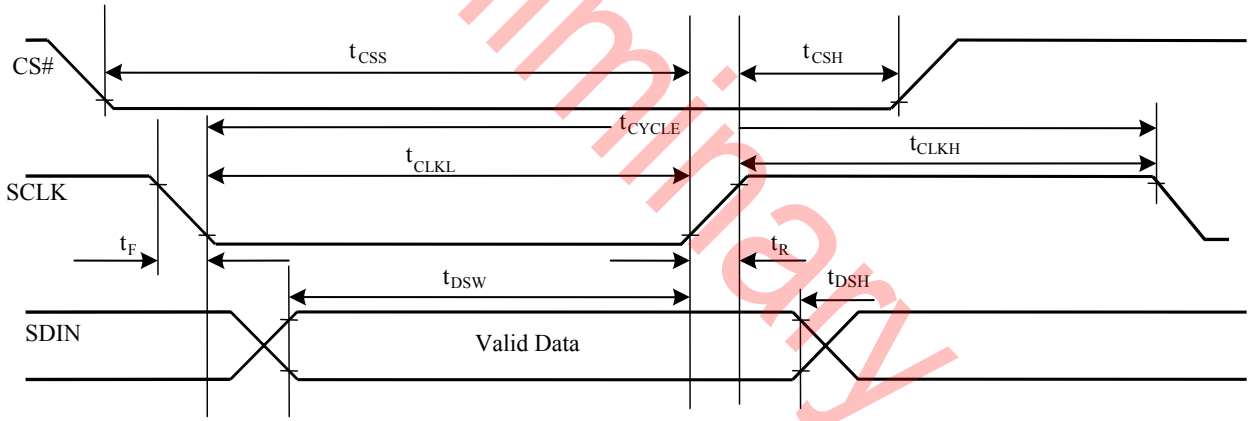


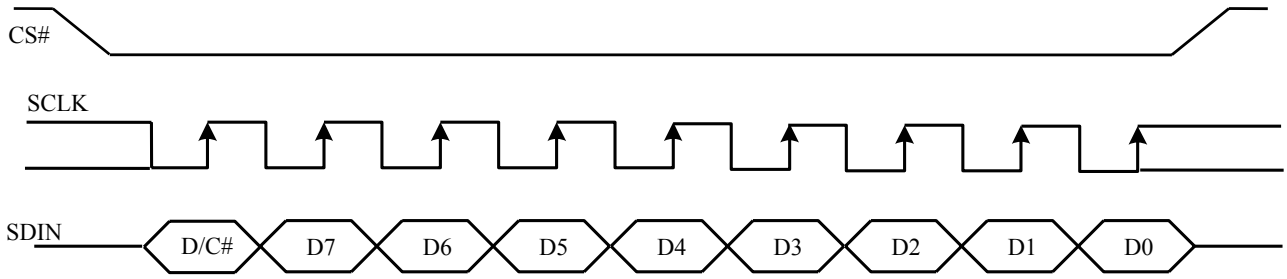
4-wire Serial interface characteristics

(V_{DD} - V_{SS} = 1.65V to 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	-	-	40	ns
t_F	Fall Time	-	-	40	ns

3-wire Serial Interface Timing Characteristics





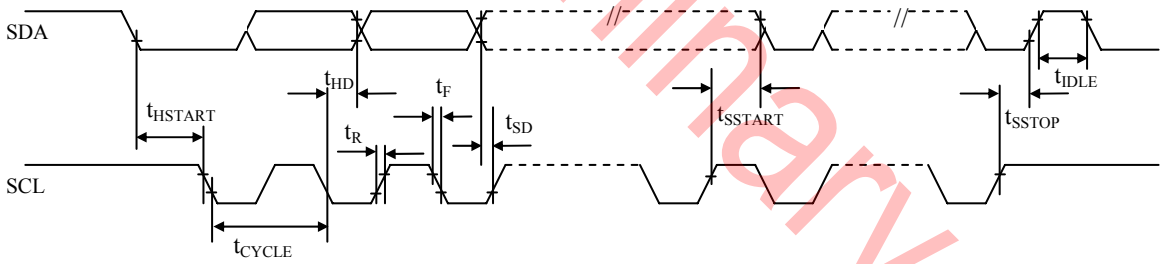
3-wire Serial interface characteristics

Conditions:

V_{DD} - V_{SS} = V_{DD} - V_{SS} = 1.65V to 3.3V
T_A = 25°C

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)	0	-	-	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

I²C Interface Timing Characteristics



I²C interface Timing characteristics

1.1 Commands

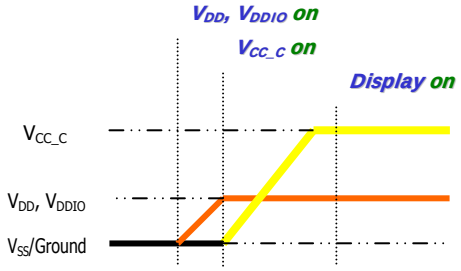
Refer to the Technical Manual for the SSD1306

1.2 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.

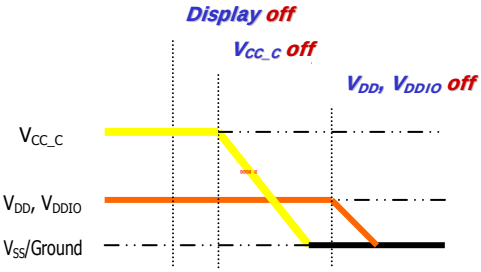
1.2.1 Power up Sequence:

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



1.2.2 Power down Sequence:

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



Note 8:

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

1.3 Reset Circuit

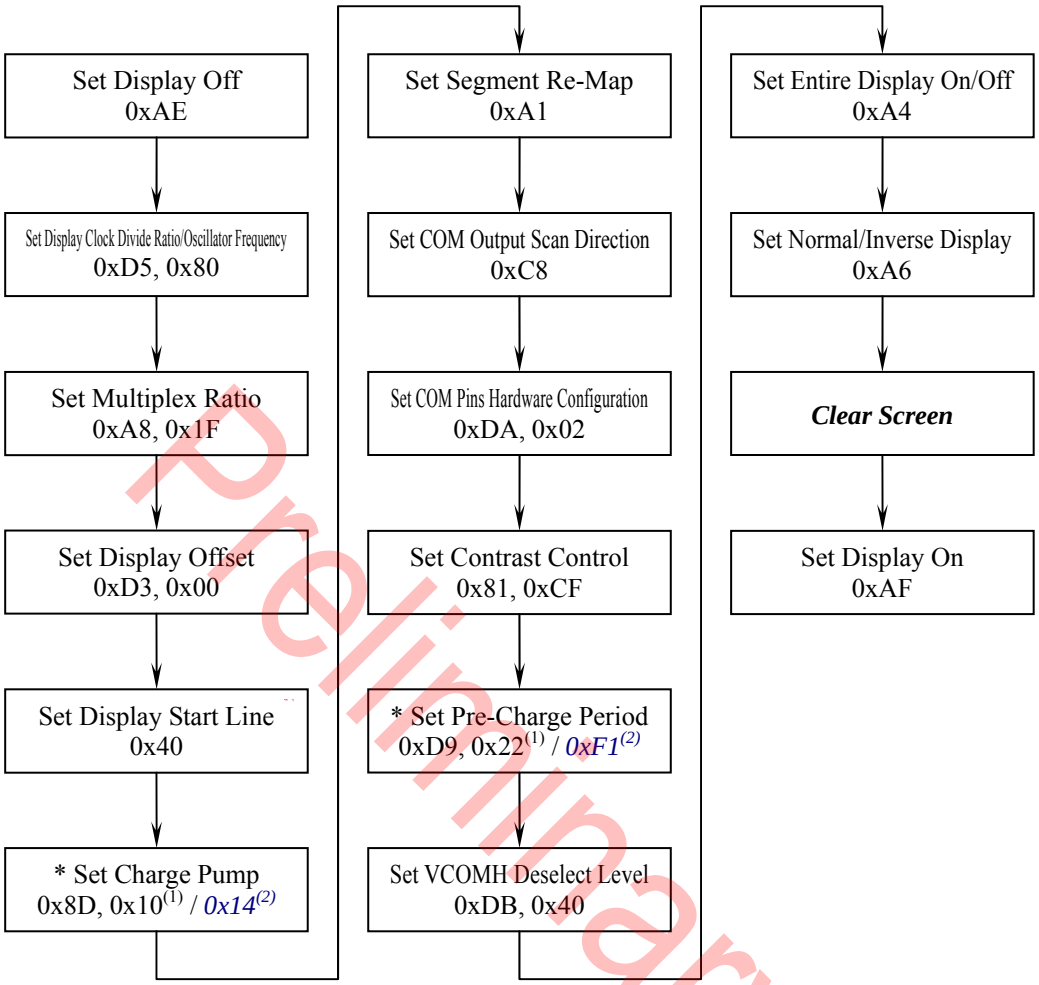
When RES# input is low, the chip is initialized with the following status:

1. Display is OFF
2. 128×64 Display Mode
3. Normal segment and display data column and row address mapping (SEG0 mapped to column address 00h and COM0 mapped to row address 00h)
4. Shift register data clear in serial interface
5. Display start line is set at display RAM address 0
6. Column address counter is set at 0
7. Normal scan direction of the COM outputs
8. Contrast control register is set at 7Fh
9. Normal display mode (Equivalent to A4h command)

1.4 Actual Application Example

Command usage and explanation of an actual example

<Initialization>



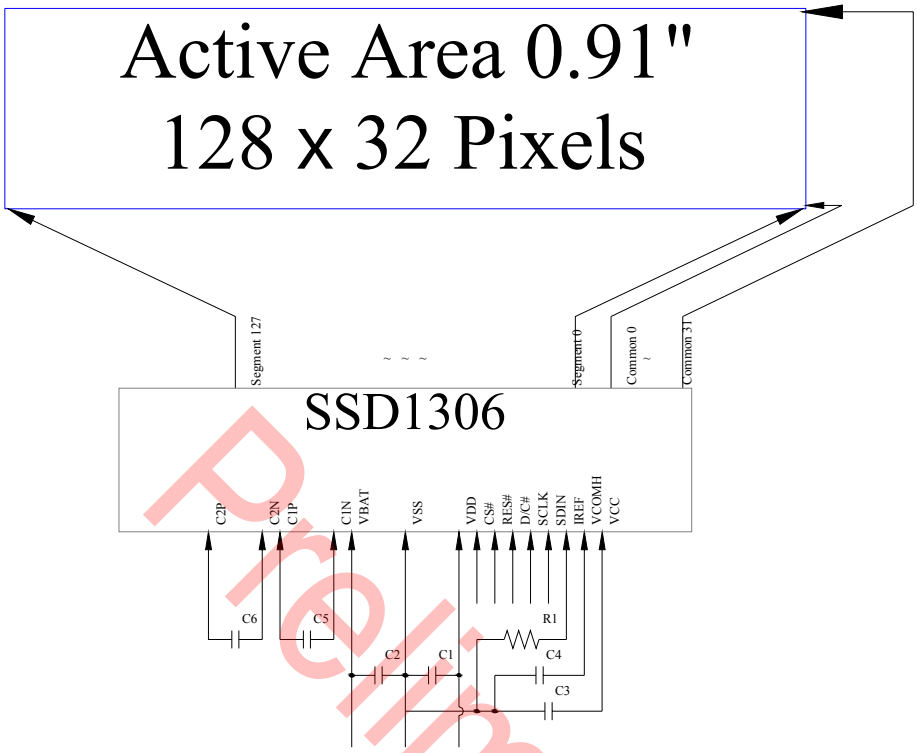
* Written Value for Parameters
(1) ➔ V_{CC} Supplied Externally
(2) ➔ *V_{CC} Generated by Internal DC/DC Circuit*

If the noise is accidentally occurred at the displaying window during the operation, please reset the display in order to recover the display function.

■ INTERFACE PIN CONNECTIONS

1. Block Diagram

1.1 V_{CC} Generated by Internal DC/DC Circuit



Pins connected to MCU interface: CS#, RES#, D/C#, SCLK, and SDIN

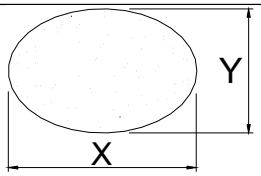
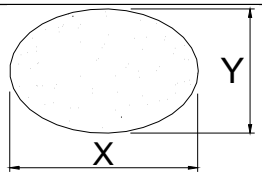
C1, C2, C5, C6: 1µF
C3, C4: 2.2µF
R1: 390kΩ, R1 = (Voltage at IREF – VSS) / IREF

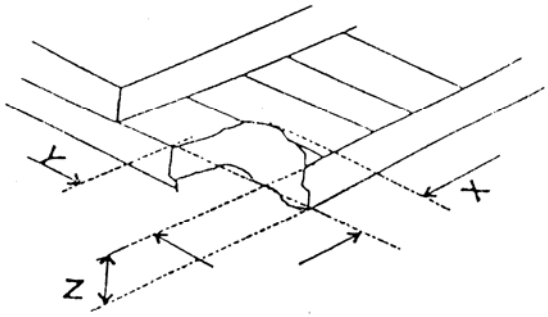
2. Pin Definition

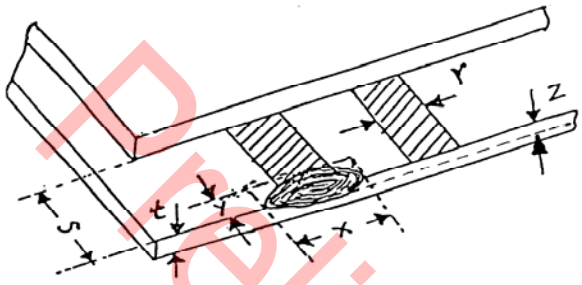
<table>
<tr><th>Pin Number</th><th>Symbol</th><th>Type</th><th>Function</th></tr>
<tr><td>1,12</td><td>GND</td><td>P</td><td>This is a ground pin. It also acts as a reference for the logic pins, the OEL driving voltages, and the analog circuits. It must be connected to external ground.</td></tr>
<tr><td>2-4</td><td>D2-D0</td><td>I/O</td><td>These are 3-bit bi-directional data bus to be connected to the microprocessor's data bus. When serial interface mode is selected, D0 will be the serial clock input: SCLK; D1 will be the serial data input: SDIN and D2 should be kept NC. When I^2C mode is selected, D2, D1 should be tied together and serve as SDA_{out}, SDA_{in} in application and D0 is the serial clock input, SCL.</td></tr>
<tr><td>5</td><td>D/C#</td><td>I</td><td>This pin is Data/Command control pin. When the pin is pulled high and serial interface mode is selected, the data at SDIN is treated as data. When it is pulled low, the data at SDIN will be transferred to the command register. For detail relationship to MCU interface signals, please refer to the Timing Characteristics Diagrams.</td></tr>
<tr><td>6</td><td>RES#</td><td>I</td><td>This pin is reset signal input. When the pin is low, initialization of the chip is executed.</td></tr>
<tr><td>7</td><td>CS#</td><td>I</td><td>This pin is the chip select input. The chip is enabled for MCU communication only when CS# is pulled low.</td></tr>
<tr><td>8-9</td><td>BS1-BS0</td><td>I</td><td><table><tr><th>Pin Name</th><th>I^2C Interface</th><th>4-wire Serial interface</th><th>3-wire Serial interface</th></tr><tr><td>BS0</td><td>0</td><td>0</td><td>1</td></tr><tr><td>BS1</td><td>1</td><td>0</td><td>0</td></tr></table></td></tr>
<tr><td>10</td><td>VDD</td><td>P</td><td>This is a voltage supply pin. It must be connected to external source.</td></tr>
<tr><td>11</td><td>VBAT</td><td>P</td><td>This is the power supply pin for the internal buffer of the DC/DC voltage converter. It m ust be connected to external source when the converter is used.</td></tr>
</table>

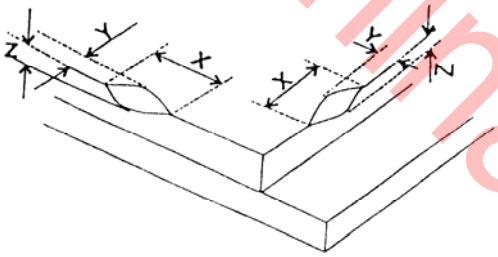
■ RELIABILITY TESTS

<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℃, 240 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℃, 240 hours</td></tr>
<tr><td colspan="2">Low Temperature Storage
(LTS)</td><td>-40±2℃, 240 hours</td></tr>
<tr><td colspan="2">Low Temperature Operating
(LTO)</td><td>-30±2℃, 240 hours</td></tr>
<tr><td colspan="2">High Temperature / High Humidity Storage
(HTHHS)</td><td>60±3℃, 90%±3%RH, 120 hours</td></tr>
<tr><td colspan="2">Thermal Shock (Non-operation)
(TS)</td><td>-40±2℃ ~ 25℃ ~ 85±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>
</table>

<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="3">  </td><td>Φ≦0.10</td><td colspan="2">Ignored</td></tr>
<tr><td>0.10＜Φ≦0.15</td><td>3</td><td rowspan="3">Ignored</td></tr>
<tr><td>0.15＜Φ≦0. 20</td><td>1</td></tr>
<tr><td></td><td>0.20＜Φ</td><td>0</td><td></td></tr>
<tr><td></td><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≦0.03</td><td colspan="2">Ignored</td></tr>
<tr><td>L≦3.0</td><td>0.03＜W≦0.05</td><td>2</td><td rowspan="3">Ignored</td></tr>
<tr><td>L≦2.0</td><td>0.05＜W≦0.08</td><td>1</td></tr>
<tr><td>/</td><td>0.08＜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.</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≦0.03</td><td colspan="2">Ignore</td></tr>
<tr><td>5.0＜L≦10.0</td><td>0.03＜W≦0.05</td><td>2</td><td rowspan="3">Ignore</td></tr>
<tr><td>L≦5.0</td><td>0.05＜W≦0.08</td><td>1</td></tr>
<tr><td>/</td><td>0.08＜W</td><td>0</td><td></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≦0.50</td><td>2</td><td rowspan="3">Ignored</td></tr>
<tr><td>0.50＜Φ≦0.80</td><td>1</td></tr>
<tr><td>0.80＜Φ</td><td>0</td><td></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>≤ 2.0</td></tr><tr><td>y</td><td>≤ S</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 / 2</td></tr><tr><td>y</td><td>≤ s / 3</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 / 5</td></tr><tr><td>y</td><td>≤ 1.0</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>

■ 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: $V_{DD} \rightarrow V_{PP}$, and power off sequence: $V_{PP} \rightarrow V_{DD}$.
11. Be sure to keep temperature, humidity and voltage within the ranges of the spec, otherwise shorten Module’ s life time, even make it damaged.
12. Be sure to drive the OLED Module following the Specification and Datasheet of IC controller, otherwise something wrong may be seen.

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

◆Precautions For Soldering OLED Module:

1. Soldering temperature : 260°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%.