Product Specification

Customer:
Approved by

1. Basic Specifications

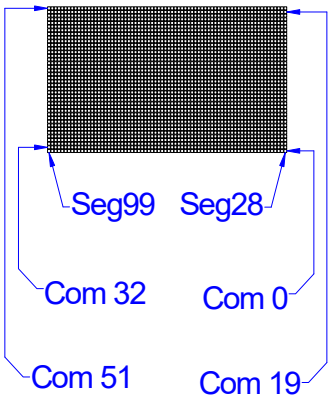
1.1 Display Specifications

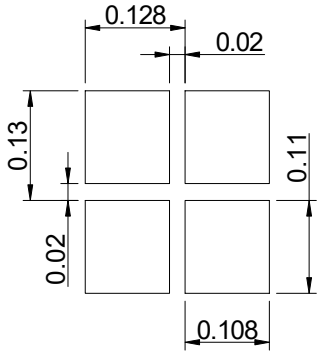
1) Display Mode: Passive Matrix
2) Display Color: Monochrome (White)
3) Drive Duty: 1/40 Duty

1.2 Mechanical Specifications

1) Outline Drawing: According to the annexed outline drawing
2) Number of Pixels: 72 × 40
3) Panel Size: 12 × 11 × 1.25 (mm)
4) Active Area: 9.196 × 5.18 (mm)
5) Pixel Pitch: 0.128 × 0.13 (mm)
6) Pixel Size: 0.108 × 0.11 (mm)
7) Weight: TBD

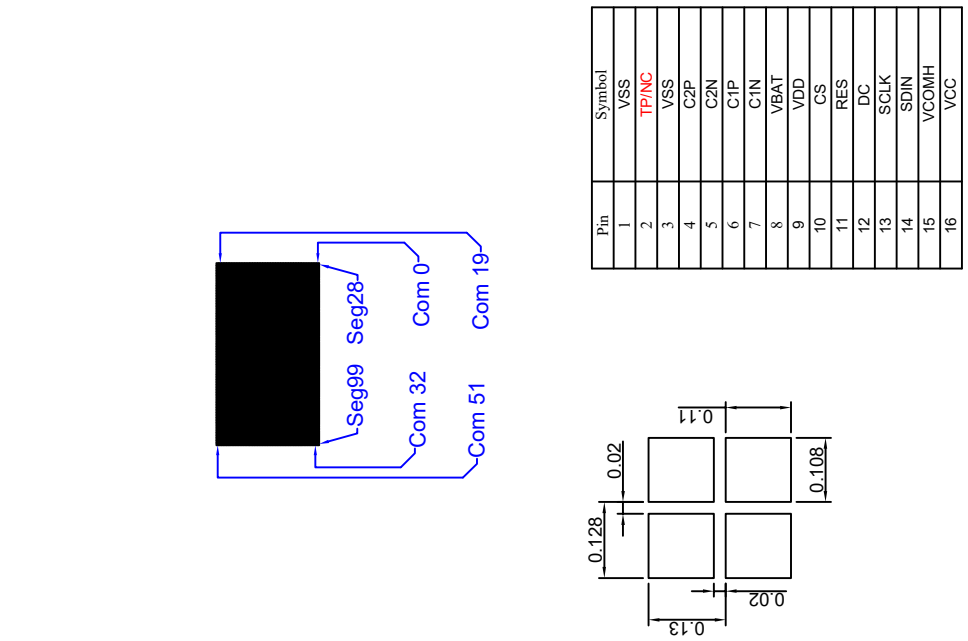
1.3 Active Area / Memory Mapping & Pixel Construction

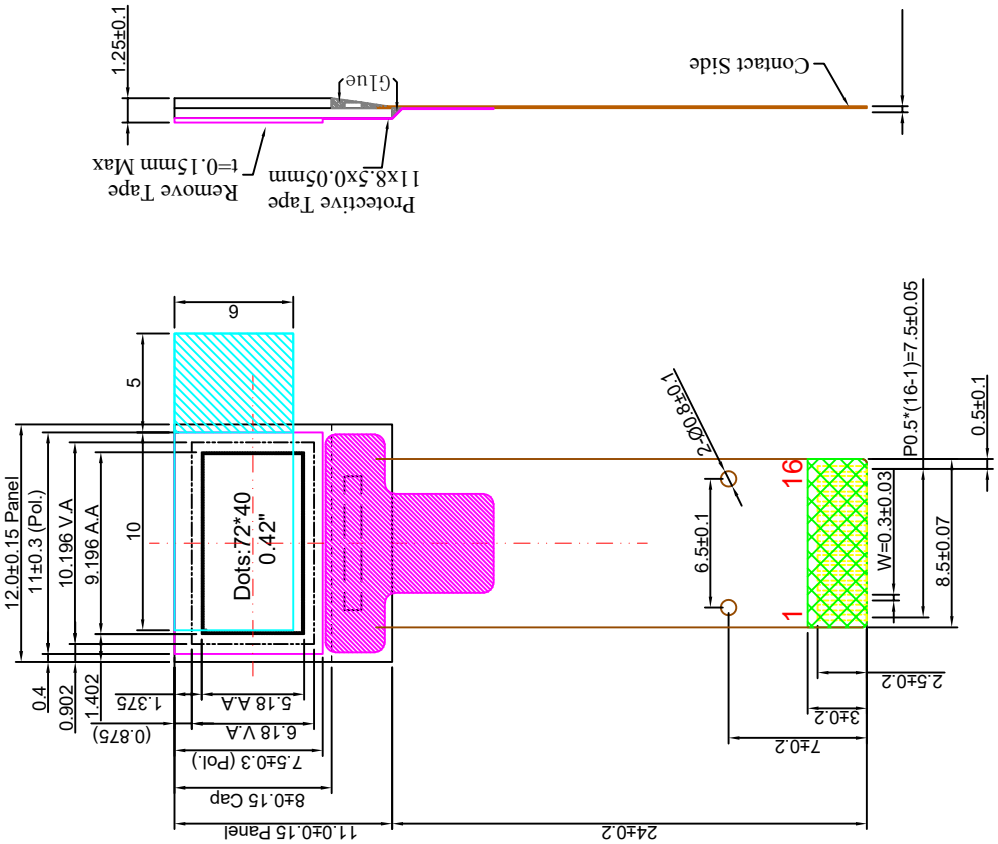




Scale 30:1

1.4 Mechanical Drawing





1.5 Pin Definition

Pin Number	Symbol	I/O	Function
Power Supply			
9	VDD	P	**Power Supply for Logic** This is a voltage supply pin. It must be connected to external source.
1 ,3	VSS	P	**Ground of Logic Circuit** This is a ground pin. It acts as a reference for the logic pins. It must be connected to external ground.
16	VCC	P	**Power Supply for OEL Panel** This is the most positive voltage supply pin of the chip. A stabilization capacitor should be connected between this pin and V_{SS} when the converter is used. It must be connected to external source when the converter is not used.
Driver			
15	VCOMH	O	**Voltage Output High Level for COM Signal** This pin is the input pin for the voltage output high level for COM signals. A capacitor should be connected between this pin and V_{SS}.
DC/DC Converter			
8	VBAT	P	**Power Supply for DC/DC Converter Circuit** This is the power supply pin for the internal buffer of the DC/DC voltage converter. It must be connected to external source when the converter is used. It should be connected to V_{DD} when the converter is not used.
6 / 7 4 / 5	C1P / C1N C2P / C2N	I	**Positive Terminal of the Flying Inverting Capacitor** **Negative Terminal of the Flying Boost Capacitor** The charge-pump capacitors are required between the terminals. They must be floated when the converter is not used.
Interface			
11	RES#	I	**Power Reset for Controller and Driver** This pin is reset signal input. When the pin is low, initialization of the chip is executed. Keep this pin pull high during normal operation.
2	TP/NC	O	**NC**
10	CS	I	**Chip Select** This pin is the chip select input. The chip is enabled for MCU communication only when CS# is pulled low.
12	DC	I	**Data/Command Control** This pin is Data/Command control pin. When the pin is pulled high, the input at D7~D0 is treated as display data. When the pin is pulled low, the input at D7~D0 will be transferred to the command register. When the pin is pulled high and serial interface mode is selected, the data at SDIN will be interpreted as data. When it is pulled low, the data at SDIN will be transferred to the command register. In I^2C mode, this pin acts as SA0 for slave address selection. For detail relationship to MCU interface signals, please refer to the Timing Characteristics Diagrams.
13~14	SCLK,SDIN	I	**Host Data Input/Output Bus** When serial mode is selected, SDIN will be the serial data input SDIN , SCLK will be the serial clock input SCLK.

2. 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	16	V	1, 2
Supply Voltage for DC/DC (Internal DC/DC Enable)	*V_{bat}*	*-0.3*	*5*	*V*	*1, 2*
Operating Temperature	T_{OP}	-40	85	°C	
Storage Temperature	T_{STG}	-40	85	°C	3
Life Time (430 cd/m^2)		10,000	-	hour	4
Life Time (360 cd/m^2)		30,000	-	hour	4
Life Time (300 cd/m^2)		50,000	-	hour	4

3. Optics & Electrical Characteristics

3.1 Optics Characteristics

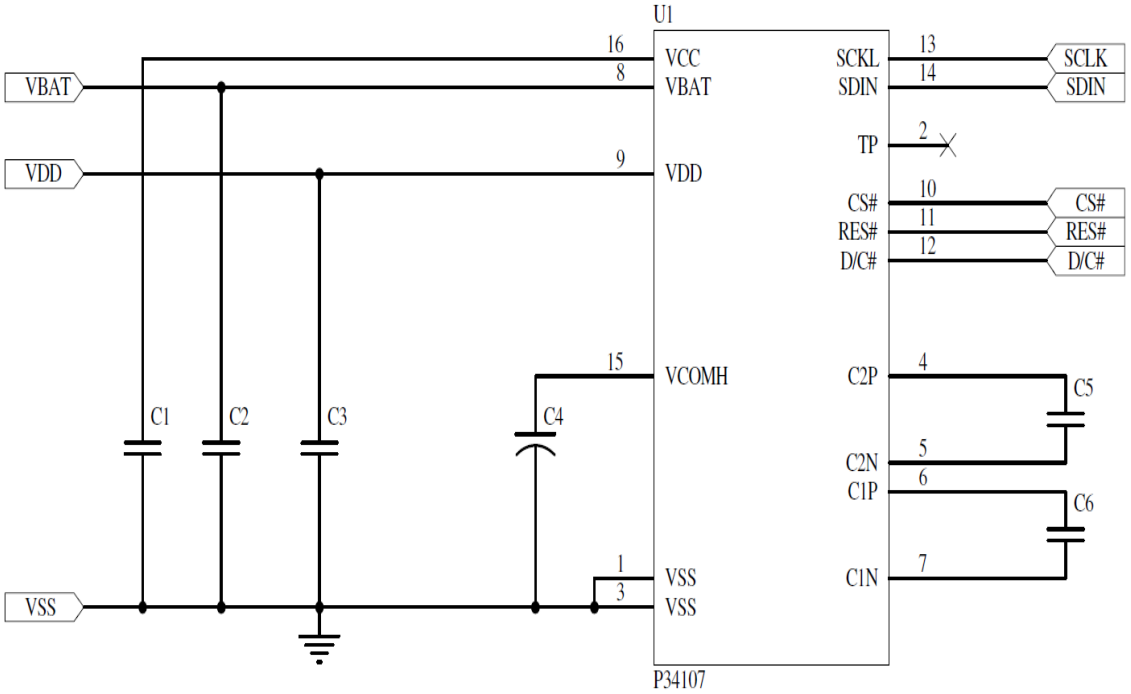
Characteristics	Symbol	Conditions	Min	Typ	Max	Unit
Brightness (V_{CC} Supplied Externally)	L_{br}	Note 5	360	-	-	cd/m^2
Brightness (V_{CC} Generated by Internal DC/DC)	*L_{br}*	*Note 6*	*360*	*430*	-	*cd/m^2*
C.I.E. (White)	(x) (y)	C.I.E. 1931	0.28 0.31	0.32 0.35	0.36 0.39	
Dark Room Contrast	CR		-	2000:1	-	
Viewing Angle			-	Free	-	degree

* Optical measurement taken at V_{DD} = 2.8V, V_{CC} = 9V.
Software configuration follows Section 4.4 Initialization.

3.2 DC Characteristics

Characteristics	Symbol	Conditions	Min	Typ	Max	Unit
Supply Voltage for Logic	V_{DD}		1.65	2.8	3.3	V
Supply Voltage for Display (Supplied Externally)	V_{CC}	Note 5 (Internal DC/DC Disable)	8.5	9	9.5	V
Supply Voltage for DC/DC	*V_{BAT}*	*Internal DC/DC Enable*	*3.5*	*-*	*4.2*	*V*
Supply Voltage for Display (Generated by Internal DC/DC)	*V_{CC}*	*Note 6 (Internal DC/DC Enable)*	-	9	-	*V*
High Level Input	V_{IH}	I_{OUT} = 100μA, 3.3MHz	0.8×V_{DD}	-	V_{DD}	V
Low Level Input	V_{IL}	I_{OUT} = 100μA, 3.3MHz	0	-	0.2×V_{DD}	V
High Level Output	V_{OH}	I_{OUT} = 100μA, 3.3MHz	0.9×V_{DD}	-	V_{DD}	V
Low Level Output	V_{OL}	I_{OUT} = 100μA, 3.3MHz	0	-	0.1×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 7	-	5	10	mA
Operating Current for V_{BAT} (V_{CC} Generated by Internal DC/DC)	*I_{BAT}*	*Note 8*	-	*22*	*25*	*mA*
Sleep Mode Current for V_{DD}	$I_{DD, SLEEP}$		-	1	10	μA
Sleep Mode Current for V_{CC}	$I_{CC, SLEEP}$		-	2	10	μA

3.3.1.2 **SPI Interface with Internal Charge Pump**



Recommended components：

C1: 2.2uF/25V(0805)

C2, C3, C5, C6: 1uF/16V(0603)

C4: 4.7uF/25V (Tantalum type) or VISHAY (572D475X0025A2T)

This circuit is for 4-wire SPI interface

Notes:

VDD: 1.65~3.3V, it should be equal to MPU I/O voltage.

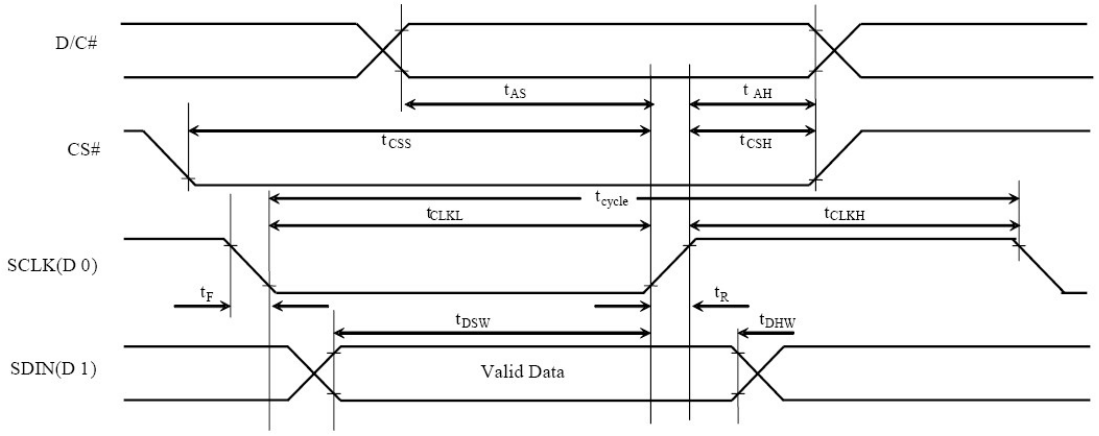
VBAT_in: 3.5~4.2V

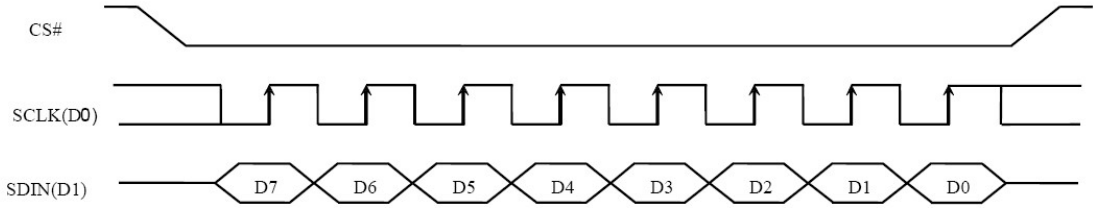
* VBAT will be connected to VDD when VCC be connected to external source (9V).

3.3.2.1 **Serial Interface Timing Characteristics: (4-wire SPI)**

* (V_{DD} - V_{SS} = 1.65V to 3.3V, T_a = 25°C)

Symbol	Description	Min	Max	Unit
t_{cycle}	Clock Cycle Time	300	-	ns
t_{AS}	Address Setup Time	5	-	ns
t_{AH}	Address Hold Time	0	-	ns
t_{DSW}	Write Data Setup Time	40	-	ns
t_{DHW}	Write Data Hold Time	7	-	ns
t_{DHR}	Read Data Hold Time	20	-	ns
t_{OH}	Output Disable Time	-	70	ns
t_{ACC}	Access Time	-	140	ns
PW_{CSL}	Chip Select Low Pulse Width (Read)	120	-	ns
	Chip Select Low Pulse width (Write)	60		
PW_{CSH}	Chip Select High Pulse Width (Read)	60	-	ns
	Chip Select High Pulse Width (Write)	60		
t_R	Rise Time	-	40	ns
t_F	Fall Time	-	40	ns





4. Functional Specification

4.1 Commands

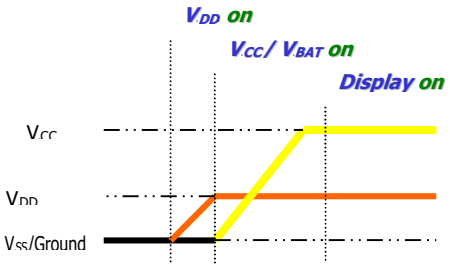
Refer to the Technical Manual for the SSD1315

4.2 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.

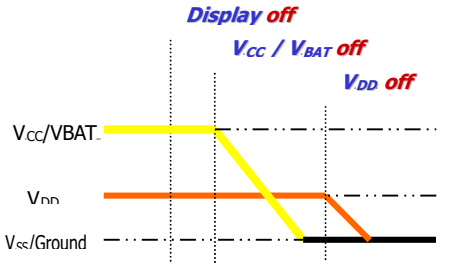
4.2.1 Power up Sequence:

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



4.2.2 Power down Sequence:

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



Note 13:

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} / V_{BAT} should be kept float (disable) when it is OFF.
3) Power Pins (V_{DD}, V_{CC}, V_{BAT}) can never be pulled to ground under any circumstance.
4) V_{DD} should not be power down before V_{CC} / V_{BAT} power down.

4.3 Reset Circuit

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

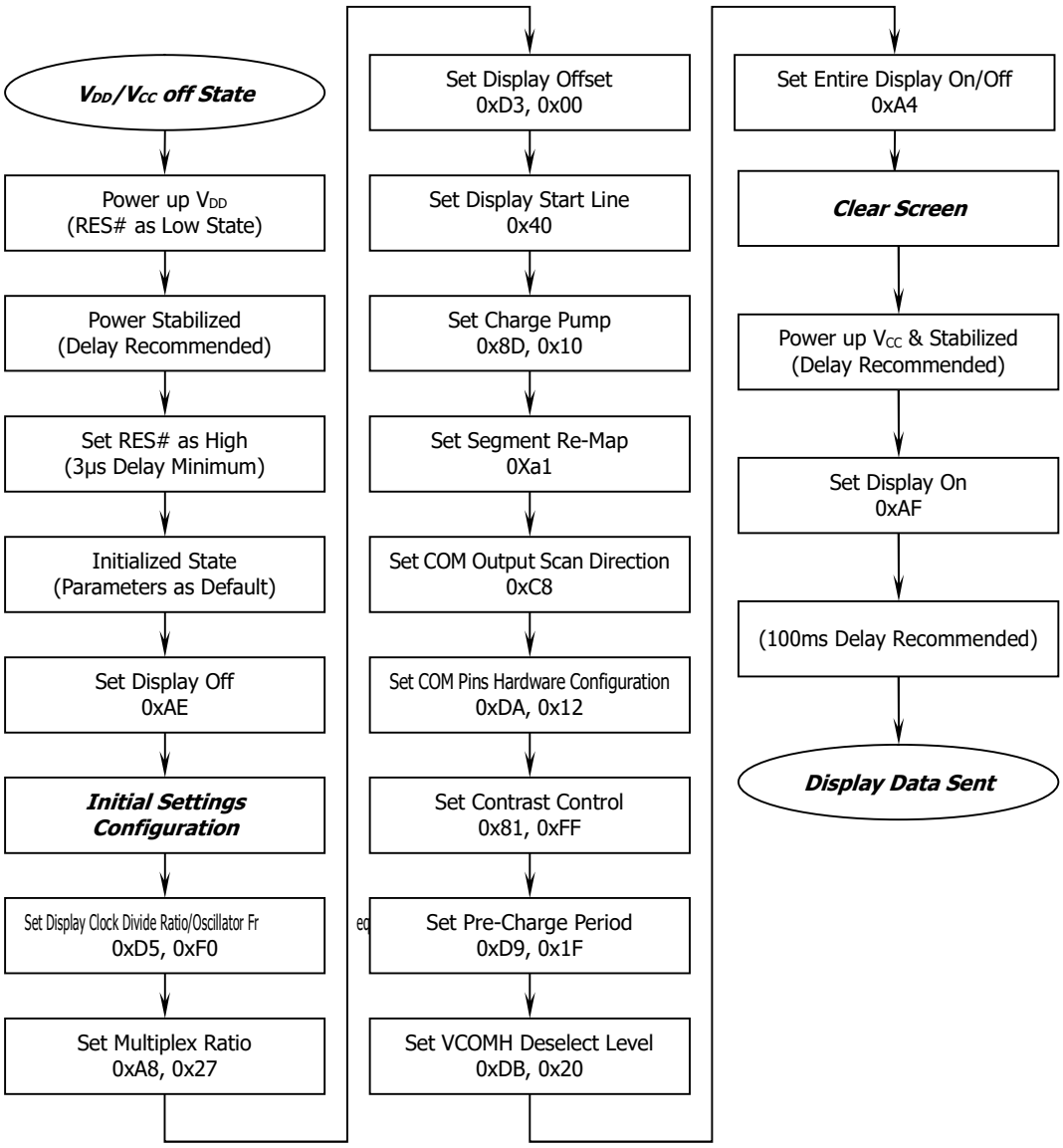
1. Display is OFF
2. 72×40 Display Mode
3. Normal segment and display data column and row address mapping (SEG0 mapped to column address 00h and COM0 mapped to row address 00h)
4. Shift register data clear in serial interface
5. Display start line is set at display RAM address 0
6. Column address counter 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)

4.4 Actual Application Example

Command usage and explanation of an actual example

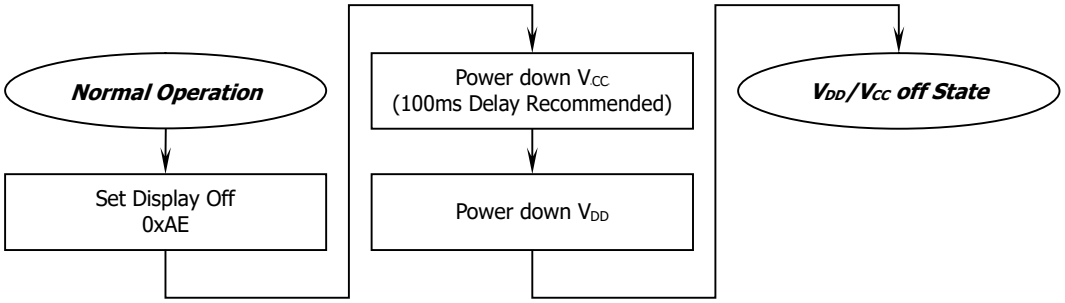
4.4.1 V_{CC} Supplied Externally

<Power up Sequence>

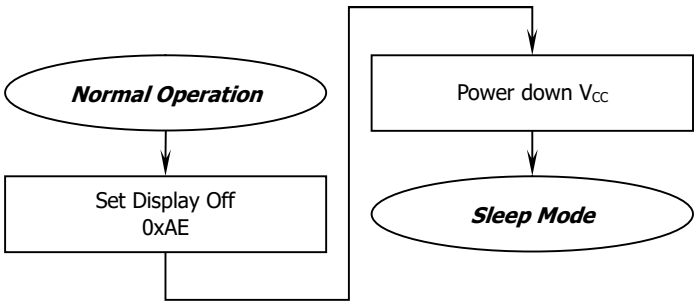


If the noise is accidentally occurred at the displaying window during the operation, please reset the display in order to recover the display function.

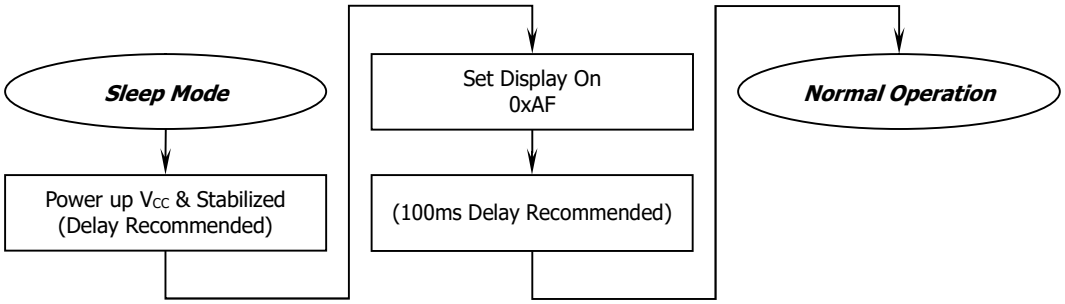
<Power down Sequence>



<Entering Sleep Mode>



<Exiting Sleep Mode>



External setting

```
void SSD1315()
{
    RES=0;
    delay(1000);
    RES=1;
    delay(1000);

      write_i(0xAE);      /*display off*/

      write_i(0xD5);      /*set osc division*/
      write_i(0xF0);

      write_i(0xA8);      /*multiplex ratio*/
      write_i(0x27);      /*duty = 1/40*/

      write_i(0xD3);      /*set display offset*/
```

```
        write_i(0x00);

        write_i(0x40);      /*Set Display Start Line */

        write_i(0x8d);      /*set charge pump enable*/
        write_i(0x10);

        write_i(0x20);       /*Set page address mode*/
        write_i(0x02);

        write_i(0xA1);      /*set segment remap*/

        write_i(0xC8);      /*Com scan direction*/

        write_i(0xDA);      /*set COM pins*/
        write_i(0x12);

        write_i(0xAD);      /*Internal IREF Setting*/
        write_i(0x30);

        write_i(0x81);      /*contract control*/
        write_i(0xAF);      /*128*/

        write_i(0xD9);      /*set pre-charge period*/
        write_i(0x1F);

        write_i(0xdb);      /*set vcomh*/
        write_i(0x20);

        write_i(0xA4);      /*Set Entire Display On/Off*/

        write_i(0xA6);      /*normal / reverse*/

        write_i(0x0C);      /*set lower column address*/
        write_i(0x11);      /*set higher column address*/

        write_i(0xAF);      /*display ON*/
}
```

I2C Mode

```
void write_w(unsigned char dat)
{
    unsigned char m,da;
    unsigned char j;
    da=dat;
    for(j=0;j<8;j++)
    {
       m=da;
       SCL=0;
       m=m&0x80;
       if(m==0x80)
           {
              SDA=1;
           }
       else
           {
              SDA=0;
           }
       da=da<<1;
       SCL=1;
     }
     SCL=0;
     SCL=1;
}

void write_i(unsigned char ins)
{    start();
    write_w(0x78);
    write_w(0x00);
    write_w(ins);
    stop();
}
void write_d(unsigned char dat)
{
    start();
    write_w(0x78);
    write_w(0x40);
    write_w(dat);
    stop();
}

 void   start()
{
   SCL=1;
   SDA=1;
```

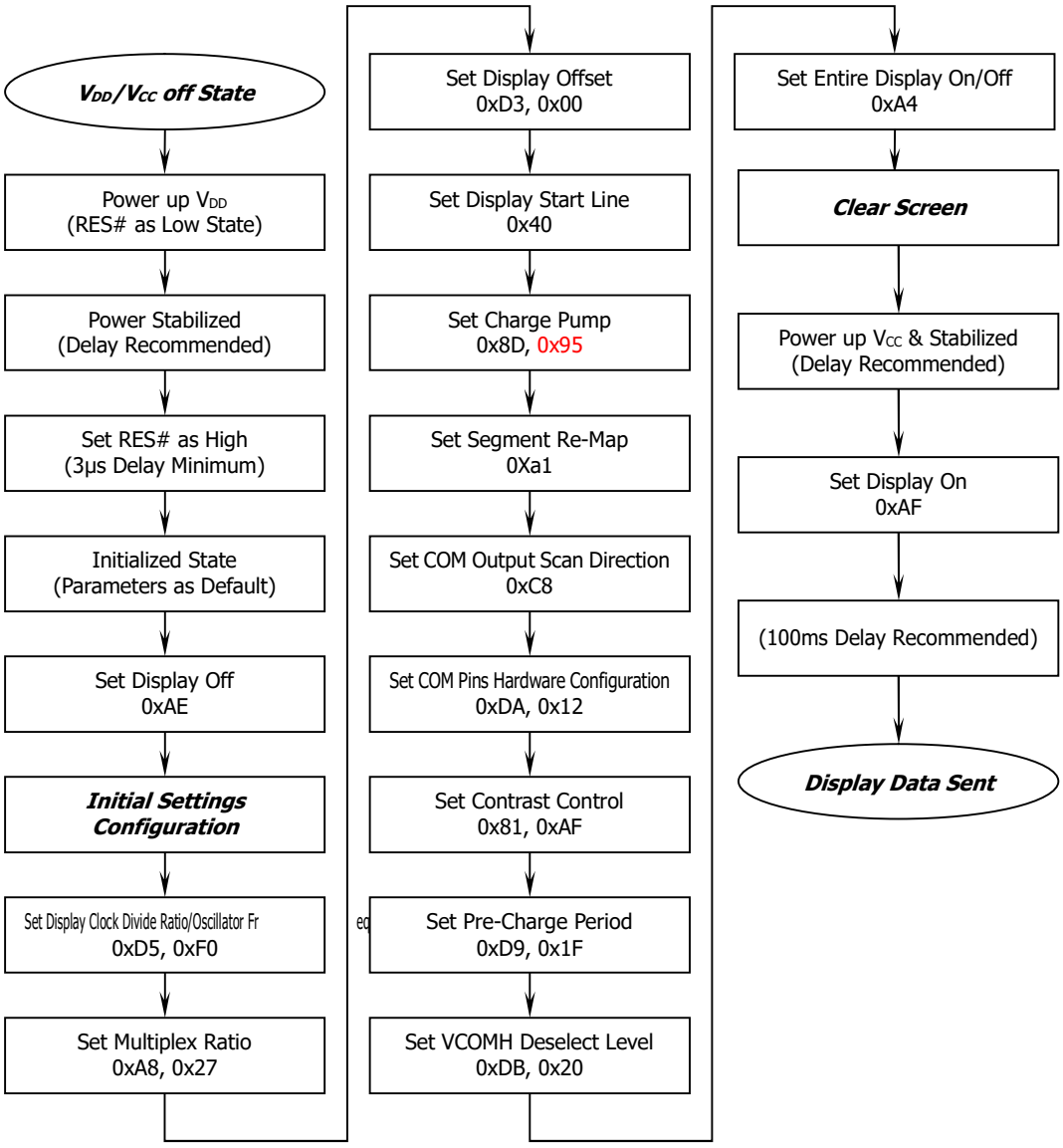
```
  SDA=0;
  SCL=0;
}

void   stop()
{
  SCL=0;
  SDA=0;
  SDA=1;
  SCL=1;
}
```

4- wire SPI Mode

```
void write_i(unsigned char   ins)
{
  unsigned char   m,da;
  unsigned int j;
      DC=0;
      CS=0;
      da=ins;
  for(j=0;j<8;j++)
     {
       m=da;
       SCL=0;
       m=m&0x80;
       if(m==0x80)
         {
            SDA=1;
          }
        else
          {
               SDA=0;
          }

         da=da<<1;
         SCL=1;
       }
  CS=1;
}

void write_d(unsigned char   dat)
{
  unsigned char   m,da;
  unsigned int j;
      DC=1;
      CS=0;
```

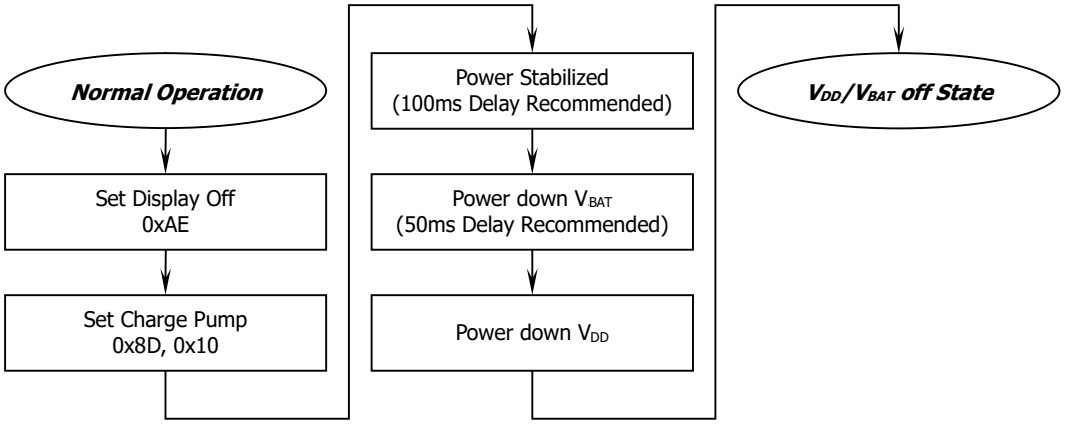
```
      da=dat;
  for(j=0;j<8;j++)
     {
       m=da;
       SCL=0;
       m=m&0x80;
       if(m==0x80)
         {
            SDA=1;
          }
        else
          {
               SDA=0;
          }

         da=da<<1;
         SCL=1;
       }
  CS=1;
}

void delay(unsigned int t)
{
      while(t>0)
        {
           t--;
        }
}
```

4.4.2 V_{CC} Generated by Internal DC/DC Circuit
<Power up Sequence>

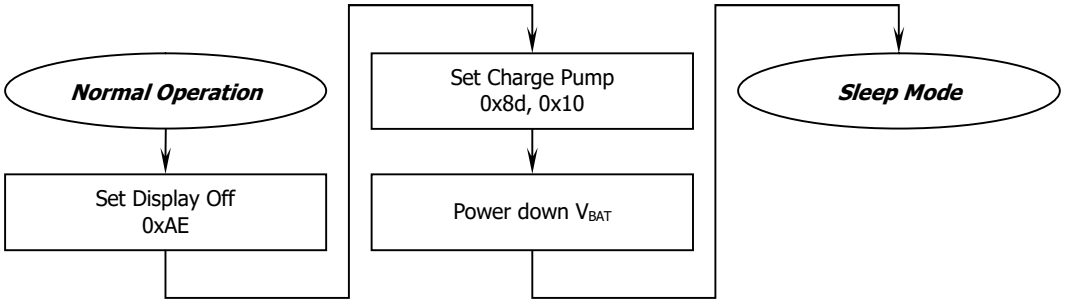


If the noise is accidentally occurred at the displaying window during the operation, please reset the display in order to recover the display function.

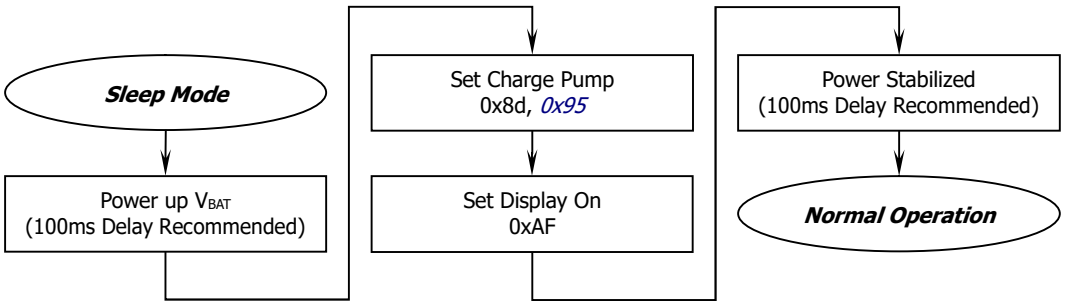
<Power down Sequence>



<Entering Sleep Mode>



<Exiting Sleep Mode>



Internal setting（Charge pump）

```
void SSD1315()
{
    RES=0;
    delay(1000);
    RES=1;
    delay(1000);

      write_i(0xAE);      /*display off*/

      write_i(0xD5);      /*set osc division*/
```

```
write_i(0xF0);

write_i(0xA8);      /*multiplex ratio*/
write_i(0x27);      /*duty = 1/40*/

write_i(0xD3);      /*set display offset*/
write_i(0x00);

write_i(0x40);      /*Set Display Start Line */

write_i(0x8d);      /*set charge pump enable*/
write_i(0x95);

write_i(0x20);       /*Set page address mode*/
write_i(0x02);

write_i(0xA1);      /*set segment remap*/

write_i(0xC8);      /*Com scan direction*/

write_i(0xDA);      /*set COM pins*/
write_i(0x12);

write_i(0xAD);      /*Internal IREF Setting*/
write_i(0x30);

write_i(0x81);      /*contract control*/
write_i(0xAF);      /*128*/

write_i(0xD9);      /*set pre-charge period*/
write_i(0x1F);

write_i(0xdb);      /*set vcomh*/
write_i(0x20);

write_i(0xA4);      /*Set Entire Display On/Off*/

write_i(0xA6);      /*normal / reverse*/

write_i(0x0C);      /*set lower column address*/
write_i(0x11);      /*set higher column address*/

write_i(0xAF);      /*display ON*/                              }
```

I2C Mode

```
void write_w(unsigned char dat)
{
    unsigned char m,da;
    unsigned char j;
    da=dat;
    for(j=0;j<8;j++)
    {
      m=da;
      SCL=0;
      m=m&0x80;
      if(m==0x80)
          {
            SDA=1;
          }
      else
          {
            SDA=0;
          }
      da=da<<1;
      SCL=1;
     }
     SCL=0;
     SCL=1;
}

void write_i(unsigned char ins)
{
    start();
    write_w(0x78);
    write_w(0x00);
    write_w(ins);
    stop();
}

void write_d(unsigned char dat)
{
    start();
    write_w(0x78);
    write_w(0x40);
    write_w(dat);
    stop();
}

 void   start()
{
   SCL=1;
```

```
  SDA=1;
  SDA=0;
  SCL=0;
}

void   stop()
{
  SCL=0;
  SDA=0;
  SDA=1;
  SCL=1;
}
```

4- wire SPI Mode

```
void write_i(unsigned char   ins)
{
  unsigned char   m,da;
  unsigned int j;
      DC=0;
      CS=0;
      da=ins;
  for(j=0;j<8;j++)
     {
       m=da;
       SCL=0;
       m=m&0x80;
       if(m==0x80)
          {
             SDA=1;
           }
        else
          {
               SDA=0;
           }

         da=da<<1;
         SCL=1;
       }
  CS=1;
}

void write_d(unsigned char   dat)
{
  unsigned char   m,da;
  unsigned int j;
      DC=1;
```

```
        CS=0;
        da=dat;
    for(j=0;j<8;j++)
       {
         m=da;
         SCL=0;
         m=m&0x80;
         if(m==0x80)
           {
              SDA=1;
            }
          else
            {
                 SDA=0;
            }

           da=da<<1;
           SCL=1;
         }
    CS=1;
}


void delay(unsigned int t)
{
        while(t>0)
          {
             t--;
          }
}
```