Specification for Mono OLED Display module

1.10" OLED Display module

Manufacturer	Truly Semiconductors LTD
Part n°	OEL9T0000-W-E
Ordering n°	OEL9T0000-W-E
Customer Part n°	n/a
Revision n°	1.0
Issue Date	2017/05/03

Customer's Approval

Company name	
Printed name	
Job title	
Signature	
Approval Stage:	This product is approved for the following production stage: - ☐ Sample / Prototype ☐ Pre-Production ☐ Mass Production
Approval Date	

Supplied by Anders Electronics plc
Manufactured by Truly Semiconductors LTD

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SPECIFICATION

PART NO. : OEL9T0000-W-E

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

PRODUCT CONTENTS

TRULY®信利		Customer	
Written by	He Chuanlong	Approved by	
Checked by	Yang Xueyu		
Approved by	Zhang Weicang		

REVISION HISTORY

Rev.	Contents	Date
1.0	First release.	2017-05-03

■ PHYSICAL DATA

PHYSICAL DATA FOR OLED

No.	Items:	Specification:	Unit
1	Diagonal Size	1.1	Inch
2	Resolution	196(H) x 96(V)	Dots
3	Active Area	25.03 (W) x 11.22(H)	mm^2
4	Outline Dimension (Panel)	30.08 (W) x 18.90(H)	mm^2
5	Pixel Pitch	0.1171 (W) x 0.1278(H)	mm^2
6	Pixel Size	0.0921(W) x 0.1028(H)	mm^2
7	Driver IC	SSD1357	-
8	Display Color	White	-
9	Gray scale	1	Bit
10	Interface	4-SPI/I^2C	-
11	IC package type	COG	-
12	Thickness	1.20±0.1	mm
13	Weight	1.40±0.1	g
14	Duty	1/96	-

PHYSICAL DATA FOR TOUCH PANEL

No.	Items:	Specification:	Unit
1	Outline Dimension	33.70 (W) x 26.20 (H)	mm2
2	Driver IC	CP8CTST241	-
3	Construction	GF	-
3.1	First Layer	Strengthen Glass: 0.7	mm
3.2	Second Layer	OCA: 0.075	mm
3.3	Third Later	ITO film with sensor: 0.125	mm
4	Glass Material	Corning Gorilla 2320	-
5	Interface	I^2C	-
6	Surface Hardness	5H(Pressure 500 gf, 45 deg)	-
7	Surface Treatments	AF+AR	-
8	Weight	2.1±0.1	g
9	Support points	1finger-touch+Gesture operation	-
10	Transmissivity	> 85%	@550nm

■ ABSOLUTE MAXIMUM RATINGS

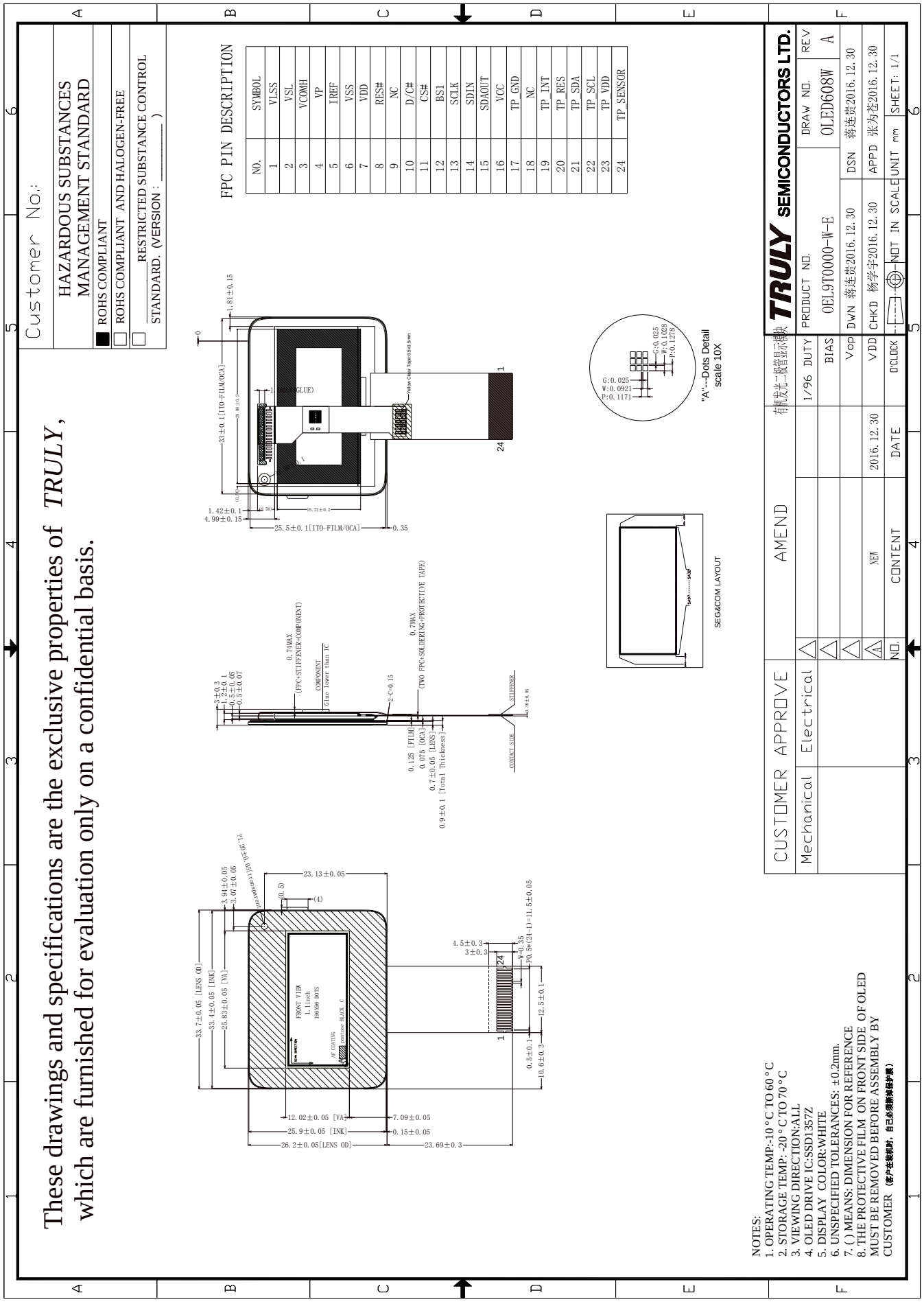
Unless otherwise specified, V_{SS} = 0V (Ta = 25℃)

Items		Symbol	Min	Typ.	Max	Unit
Supply Voltage	Logic	VDD	-0.3	-	4.0	V
		TP_VDD	-0.5	-	6.0	V
	Driving	VCC	-0.5	-	19.0	V
Operating Temperature		Top	-10	-	60	℃
Storage Temperature		Tst	-20	-	70	℃
Humidity(≤40℃)		-	-	-	90	%RH
Humidity(40~60℃)		-	-	-	60	%RH
Humidity(>60℃)		-	-	-	50	%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.

■ EXTERNAL DIMENSIONS



■ ELECTRICAL CHARACTERISTICS

◆DC Characteristics

Unless otherwise specified, V_{SS} = 0V, VDD=1.65V to 3.5V. (Ta = 25℃)

Items		Symbol	Min	Typ.	Max	Unit
Supply Voltage	Logic	VDD	1.65	3.0	3.5	V
		TP_VDD	1.71	2.1	5.5	V
	Driving	VCC	8.0	-	18.0	V
Input Voltage	High Voltage	V_{IH}	0.8 x VDD	-	VDD	V
	Low Voltage	V_{IL}	0	-	0.2 x VDD	V
Output Voltage	High Voltage	V_{OH}	0.9 x VDD	-	VDD	V
	Low Voltage	V_{OL}	0	-	0.1 x VDD	V

◆AC Characteristics

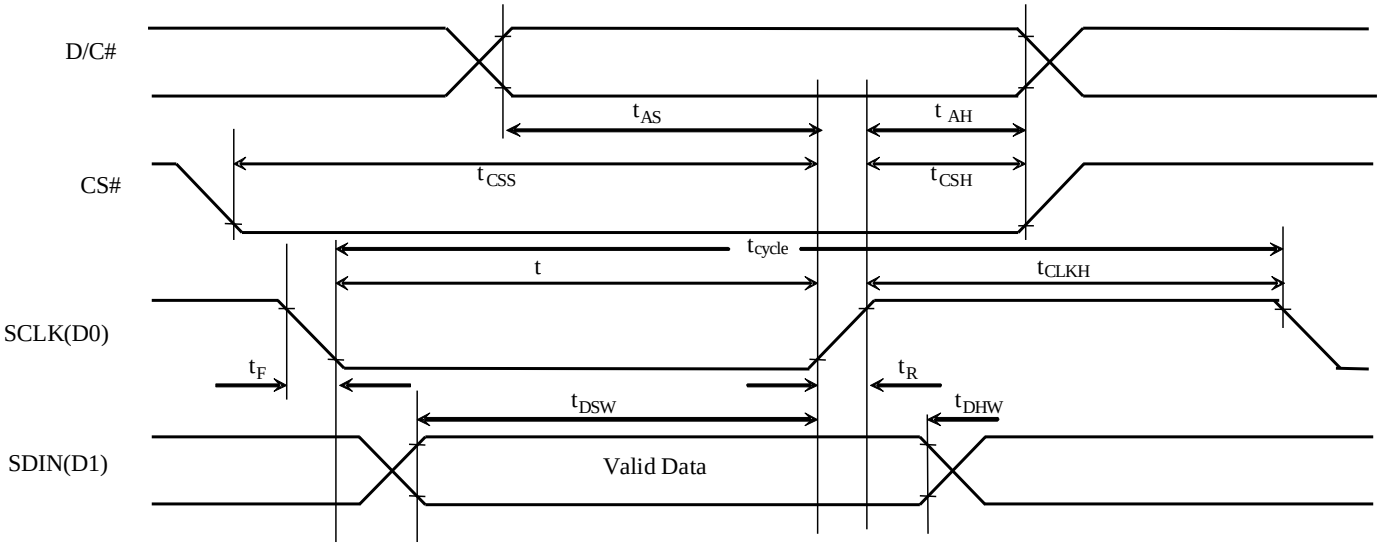
1. 4-wire Serial Interface Timing Characteristics

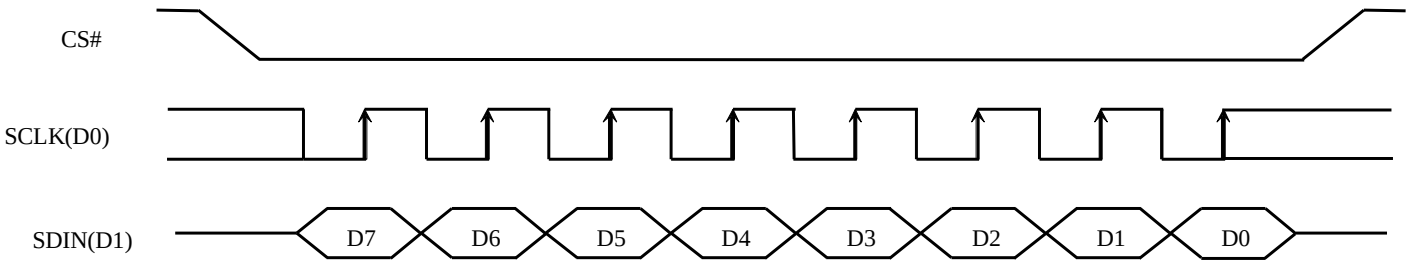
Serial Interface Timing Characteristics (4-wire SPI)

(V_{DD}- V_{SS} =1.65V to 3.5V, T_A = 25℃)

Symbol	Parameter	Min	Typ	Max	Unit
t_{cycle}	Clock Cycle Time	100	-	-	ns
t_{AS}	Address Setup Time	15	-	-	ns
t_{AH}	Address Hold Time	42	-	-	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	20	-	-	ns
t_{CLKL}	Clock Low Time	20	-	-	ns
t_{CLKH}	Clock High Time	20	-	-	ns
t_R	Rise Time	-	-	15	ns
t_F	Fall Time	-	-	15	ns

Serial interface characteristics (4-wire SPI)





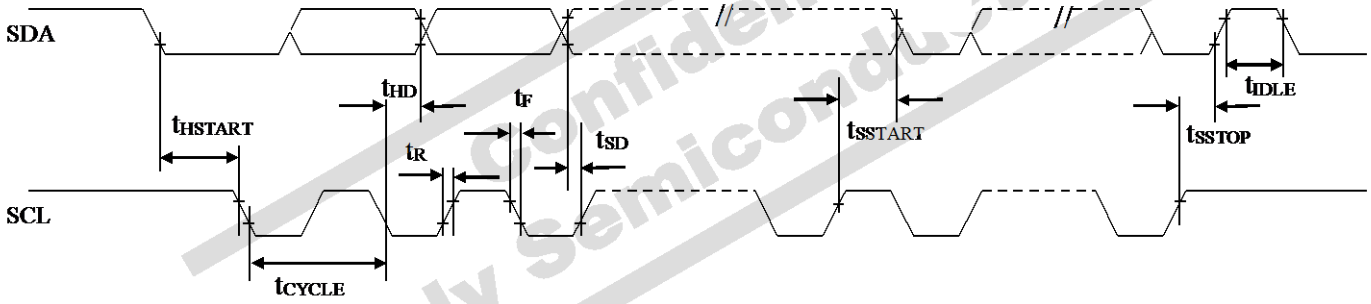
2. I²C Interface Timing Characteristics

I²C Interface Timing Characteristics

(V_{DD}- V_{SS} =1.65V to 3.5V, 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 "SDAOUT" 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



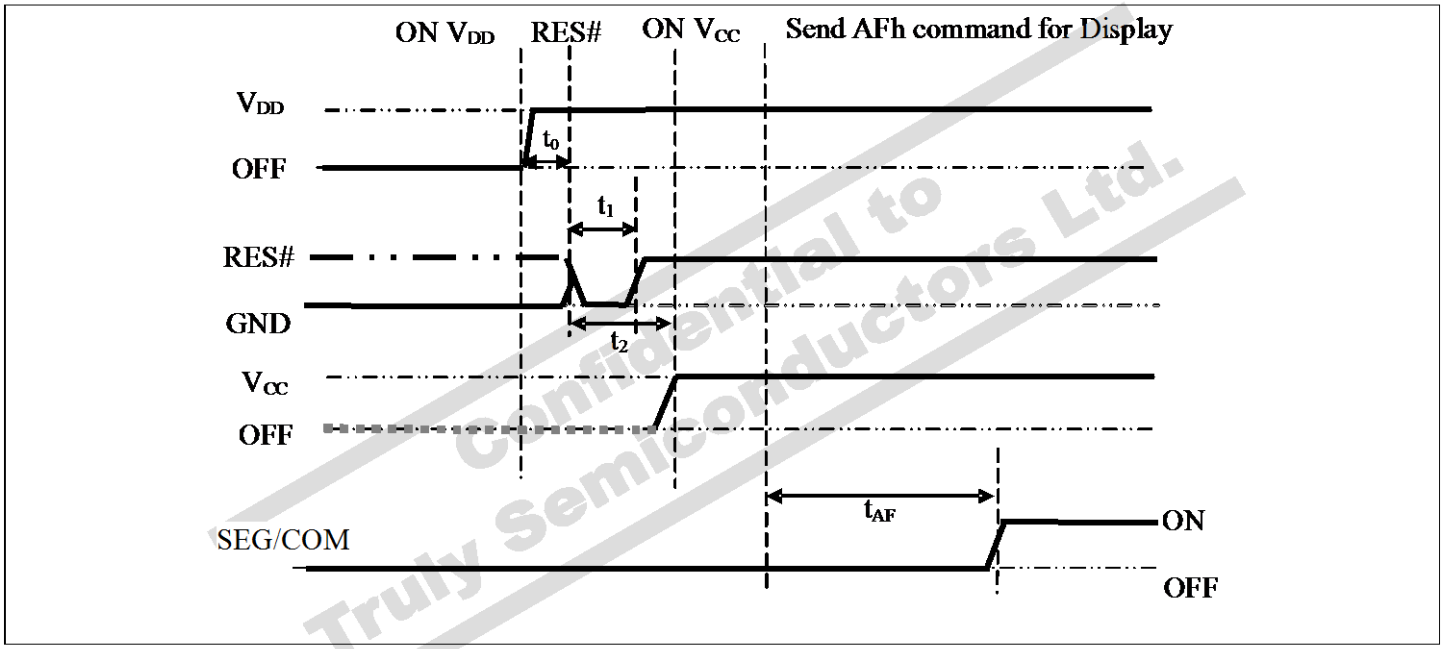
◆Power ON and OFF Sequence

The following figures illustrate the recommended power ON and power OFF sequence of SSD1357.

Power ON sequence:

1. Power ON V_{DD}
2. After V_{DD} become stable, wait at least 20ms (t_0), set RES# pin LOW (logic low) for at least 3us (t_1) (4) and then HIGH (logic high).
3. After set RES# pin LOW (logic low), wait for at least 3us (t_2). Then Power ON V_{CC}.(1)
4. After V_{CC} become stable, send command AFh for display ON. SEG/COM will be ON after 200ms (t_{AF}).
5. After V_{DD} become stable, wait for at least 300ms to send command.

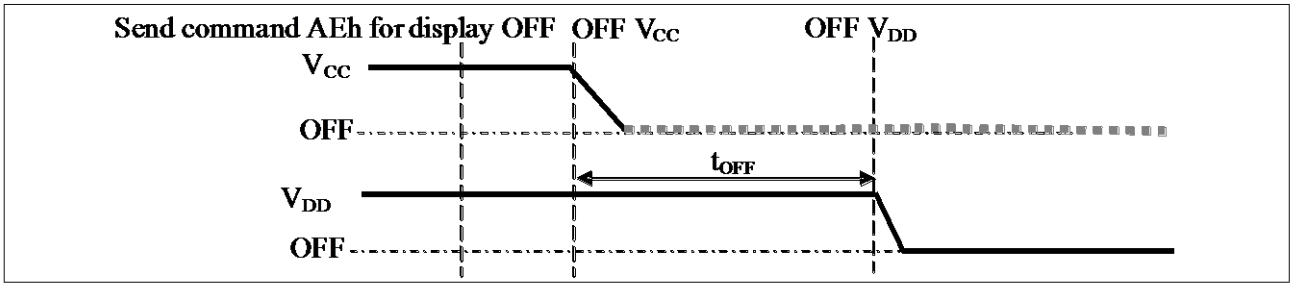
The Power ON sequence



Power OFF sequence:

1. Send command AEh for display OFF.
2. Power OFF V_{CC}.(1), (2)
3. Power OFF V_{DD} after t_{OFF}.(4) (where Minimum t_{OFF}=0ms, typical t_{OFF}=100ms)

The Power OFF sequence



Note:

(1) V_{CC} should be kept float (i.e. disable) when it is OFF.

(2) Power Pins (V_{DD}, V_{CC}) can never be pulled to ground under any circumstance.

(3) The register values are reset after t_1.

(4) V_{DD} should not be Power OFF before V_{CC} Power OFF.

■ ELECTRO-OPTICAL CHARACTERISTICS (Ta=25℃)

Items		Symbol	Min.	Typ.	Max.	Unit	Remark
Operating Luminance		L	115	120*	-	cd /m2	White
Power Consumption		P	-	100	150	mW	30% pixels ON L=120cd/m^2
Frame Frequency		Fr	-	100	-	Hz	-
Color Coordinate	White	CIE x	0.260	0.290	0.320	CIE1931	Darkroom
		CIE y	0.300	0.330	0.360		
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	13,000	-	-	Hours	L=120cd/m2

Note:

1. L=120 cd/m^2 is based on V_{DD}=3.0V, Vcc=13.0V,
contrast command setting A:B:C = 0x7F:0x65:0x7F;

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.)

■ INTERFACE PIN CONNECTIONS

No	Symbol	Description
1	VLSS	Analog system ground pin. It must be connected to external ground.
2	VSL	This is segment voltage (output low level) reference pin. This pin has to connect with resistor and diode to ground (details depends on application).
3	VCOMH	COM signal deselected voltage level. A capacitor should be connected between this pin and VSS.
4	VP	This pin is the segment pre-charge voltage reference pin. A capacitor can be connected between this pin and VSS to improve vision performance. No external power supply is allowed to connect to this pin.
5	IREF	This pin is the segment output current reference pin. IREF is supplied externally. A resistor should be connected between this pin and VSS to maintain the current around 10uA.
6	VSS	Ground pin. It must be connected to external ground.
7	VDD	Power supply pin for core logic operation. A capacitor should be connected between this pin and VSS.
8	RES#	This pin is reset signal input. When the pin is pulled LOW, initialization of the chip is executed. Keep this pin pull HIGH during normal operation.
9	NC	No connection.
10	D/C#	In 4-SPI mode, this pin is Data/Command control pin connecting to the MCU. When the pin is pulled HIGH, the data at SDIN will be interpreted as data. When the pin is pulled LOW, the data at SDIN will be transferred to a command register. In I^2C mode, this pin acts as SA0 for slave address selection.
11	CS#	This pin is the chip select input connecting to the MCU. The chip is enabled for MCU communication only when CS# is pulled LOW (active LOW).
12	BS1	MCU bus interface selection pin. When the pin is pulled HIGH, the interface will be set as 4 line SPI. When the pin is pulled LOW, the interface will be set as I^2C
13	SCLK	Serial clock input
14	SDIN	Serial data input
15	SDAOUT	When I2C mode is selected, SDIN and SDAOUT should be tied together and serve as SDAout.
16	VCC	Power supply for panel driving voltage. This is also the most positive power voltage supply pin. A capacitor should be connected between this pin and VSS.

17	TP_GND	Ground pin for TP IC. It must be connected to external ground.
18	NC	No connection.
19	TP_INT	Interrupt pin for TP IC. Trigger a low level when touch occur.
20	TP_RES	Reset pin for TP IC. Restart TP by a GPIO of host CPU
21	TP_SDA	I^2C data input and output pin for TP IC.
22	TP_SCL	I^2C clock input pin for TP IC.
23	TP_VDD	Digital power supply for TP IC.
24	TP_SENSOR	Sensor pin for TP IC. Can be used to develop wrist operation function.

■ COMMAND TABLE

(D/C# = 0, R/W#(WR#)= 0, E(RD#) = 1) unless specific setting is stated
Single byte command (D/C# = 0), Multiple byte command (D/C# = 0 for first byte, D/C# = 1 for other bytes)

Fundamental Command Table

D/C#	Hex	D7	D6	D5	D4	D3	D2	D1	D0	Command	Description
0	15	0	0	0	1	0	1	0	1	Set Column Address	A[6:0]: Start Address. [reset=0] B[6:0]: End Address. [reset=127] Range from 0 to 127
1	A[6:0]	*	A_6	A_5	A_4	A_3	A_2	A_1	A_0		
1	B[6:0]	*	B_6	B_5	B_4	B_3	B_2	B_1	B_0		
0	75	0	1	1	1	0	1	0	1	Set Row Address	A[6:0]: Start Address. [reset=0] B[6:0]: End Address. [reset=127] Range from 0 to 127
1	A[6:0]	*	A_6	A_5	A_4	A_3	A_2	A_1	A_0		
1	B[6:0]	*	B_6	B_5	B_4	B_3	B_2	B_1	B_0		
0	5C	0	1	0	1	1	1	0	0	Write RAM Command	Enable MCU to write Data into RAM
0	5D	0	1	0	1	1	1	0	1	Read RAM Command	Enable MCU to read Data from RAM
0	A0	1	0	1	0	0	0	0	0	Set Re-map / Color Depth (Display RAM to Panel)	A[0]=0b, Horizontal address increment [reset] A[0]=1b, Vertical address increment A[1]=0b, Column address 0 is mapped to SEG0 [reset] A[1]=1b, Column address 127 is mapped to SEG0 A[2]=0b, Color sequence: A → B → C [reset] A[2]=1b, Color sequence is swapped: C → B → A A[3]=0b, Reserved [reset] A[3]=1b, Reserved A[4]=0b, Scan from COM0 to COM[N −1] [reset] A[4]=1b, Scan from COM[N-1] to COM0. Where N is the Multiplex ratio. A[5]=0b, Disable COM Split Odd Even A[5]=1b, Enable COM Split Odd Even [reset] A[7:6] Set Color Depth, 00b: 256color 01b: 65k color [reset] 10b: 262k color 11b Pseudo 262k color, 16-bit format 2 Refer to Product Preview Table 6-6 for details
1	A[7:0]	A_7	A_6	A_5	A_4	A_3	A_2	A_1	A_0		
1	B[7:0]	0	0	0	0	0	0	0	0		

Fundamental Command Table											
D/C#	**Hex**	**D7**	**D6**	**D5**	**D4**	**D3**	**D2**	**D1**	**D0**	**Command**	**Description**
0 1	A1 A[6:0]	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	Set vertical scroll by RAM from 0~127. [reset=00h]
0 1	A2 A[6:0]	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	Set vertical scroll by Row from 0-127. [reset=00h]
0	A4~A7	1	0	1	0	0	1	X_1	X_0	Set Display Mode	A4h: All OFF A5h: All ON (All pixels have GS63) A6h : Reset to normal display [reset] A7h: Inverse Display (GS0 -> GS63, GS1 -> GS62, ...)
0	AE~AF	1	0	1	0	1	1	1	X_0	Set Sleep mode ON/OFF	AEh = Sleep mode On (Display OFF) AFh = Sleep mode OFF (Display ON)
0 1	B1 A[7:0]	1 A_7	0 A_6	1 A_5	1 A_4	0 A_3	0 A_2	0 A_1	1 A_0	Set Reset (Phase 1) / Pre-charge (Phase 2) period	A[3:0] Phase 1 period of 2~30 DCLK(s) clocks [reset=0100b] A[3:0]: 0 invalid 1 = 2 DCLKs 2 = 4 DCLKs : 15 = 30DCLKs A[7:4] Phase 2 period of 2~30 DCLK(s) clocks [reset=1000b] A[7:4]: 0 invalid 1 = 2 DCLKs 2 = 4 DCLKs : 15 =30DCLKs Note (1) 0 DCLK is invalid in phase 1 & phase 2

Fundamental Command Table

D/C#	Hex	D7	D6	D5	D4	D3	D2	D1	D0	Command	Description
0	B3	1	0	1	1	0	0	1	1	Front Clock Divider (DivSet)/ Oscillator Frequency	A[3:0] [reset=0000b], divide by DIVSET where A[3:0] = DIVSET: 0000 divide by 1; 0001 divide by 2; 0010 divide by 4; 0011 divide by 8; 0100 divide by 16; 0101 divide by 32; 0110 divide by 64; 0111 divide by 128; 1000 divide by 256; >=1001 invalid A[7:4] Oscillator frequency, frequency increases as level increases [reset=0010b]
1	A[7:0]	A_7	A_6	A_5	A_4	A_3	A_2	A_1	A_0		
0	B6	1	0	1	1	0	1	0	0	Set Second Pre-charge Period	A[3:0] Set Second Pre-charge Period 0000b invalid 0001b 1 DCLKS 0010b 2 DCLKS .... 1000 8 DCLKS [reset] .... 1111 15 DCLKS
1	A[3:0]	0	0	0	0	A_3	A_2	A_1	A_0		
0	B8	1	0	1	1	1	0	0	0	Master Look Up Table for Gray Scale Pulse width (Color A,B,C)	The next 63 data bytes define Gray Scale (GS) Table by setting the gray scale pulse width in unit of DCLK's (ranges from 0d ~ 180d). A1[7:0]: Gamma Setting for GS1, A2[7:0]: Gamma Setting for GS2, : A62[7:0]: Gamma Setting for GS62, A63[7:0]: Gamma Setting for GS63 **Note** (1) 0 ≤Setting of GS1 < Setting of GS2 < Setting of GS3..... < Setting of GS62 < Setting of GS63 (2) GS0 does not has pre-charge and current drive stages. (3) GS1 can be set as only pre-charge but no current drive stage by input gamma setting for GS1 equals 0. (4) When command B8h is input only, color A, B, C will follow the master LUT. (5) When command BCh is input, it selects individual LUT for color A, GS1~31A; When command BDh is input, it selects individual LUT for color C, GS1~31C (6) To select individual LUT for color B, A and C, command B8h should be input before command BCh and BDh,
1	A1[7:0]	$A1_7$	$A1_6$	$A1_5$	$A1_4$	$A1_3$	$A1_2$	$A1_1$	$A1_0$		
1	A2[7:0]	$A2_7$	$A2_6$	$A2_5$	$A2_4$	$A2_3$	$A2_2$	$A2_1$	$A2_0$		
1	.	.	.	.	.	.	.	.	.		
1	.	.	.	.	.	.	.	.	.		
1	.	.	.	.	.	.	.	.	.		
1	A62[7:0]	$A62_7$	$A62_6$	$A62_5$	$A62_4$	$A62_3$	$A62_2$	$A62_1$	$A62_0$		
1	A63[7:0]	$A63_7$	$A63_6$	$A63_5$	$A63_4$	$A63_3$	$A63_2$	$A63_1$	$A63_0$		

Fundamental Command Table

<table>
<tr><th>D/C#</th><th>Hex</th><th>D7</th><th>D6</th><th>D5</th><th>D4</th><th>D3</th><th>D2</th><th>D1</th><th>D0</th><th>Command</th><th>Description</th></tr>
<tr><td>0</td><td>B9</td><td>1</td><td>0</td><td>1</td><td>1</td><td>1</td><td>0</td><td>0</td><td>1</td><td>Use Built-in Linear LUT [reset= linear]</td><td>Reset to default Look Up Table:
<table><tr><th>Color A</th><th>Color B</th><th>Color C</th></tr><tr><td>GS1A = 0 DCLK</td><td>GS1B = 0 DCLK</td><td>GS1C = 0 DCLK</td></tr><tr><td>GS2A = 4 DCLK</td><td>GS2B = 2 DCLK</td><td>GS2C = 4 DCLK</td></tr><tr><td>GS3A = 8 DCLK</td><td>GS3B = 4 DCLK</td><td>GS3C = 8 DCLK</td></tr><tr><td>...</td><td>...</td><td>...</td></tr><tr><td>GS31A = 120 DCLK</td><td>GS62B = 122 DCLK</td><td>GS31C = 120 DCLK</td></tr><tr><td></td><td>GS63B = 124 DCLK</td><td></td></tr></table></td></tr>
<tr><td>0
1</td><td>BB
A[4:0]</td><td>1
0</td><td>0
0</td><td>1
0</td><td>1
A_4</td><td>1
A_3</td><td>0
A_2</td><td>1
A_1</td><td>1
A_0</td><td>Set Pre-charge voltage</td><td>Set pre-charge voltage level.[reset = 11110b]
<table><tr><td>A[4:0]</td><td>Hex code</td><td>pre-charge voltage</td></tr><tr><td>00000</td><td>00h</td><td>0.10 x V_{CC}</td></tr><tr><td>:</td><td>:</td><td>:</td></tr><tr><td>11110</td><td>1Eh</td><td>0.50 x V_{CC} [reset]</td></tr><tr><td>11111</td><td>1Fh</td><td>0.5133 x V_{CC}</td></tr></table>Note
(1)Pre-charge voltage level must be smaller than COM deselect voltage level</td></tr>
<tr><td>0
1
1
1
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1
1
1</td><td>BC
A1[7:0]
A2[7:0]
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A30[7:0]
A31[7:0]</td><td>1
$A1_7$
$A2_7$
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$A30_7$
$A31_7$</td><td>0
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$A1_0$
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$A30_0$
$A31_0$</td><td>Individual Look Up Table for Gray Scale Pulse width (Color A)</td><td>The next 31 data bytes define Gray Scale (GS) Table by setting the gray scale pulse width in unit of DCLK’s (ranges from 0d ~ 180d) for color A.

A1[7:0]: Gamma Setting for GS1A,
A2[7:0]: Gamma Setting for GS2A,
:
A62[7:0]: Gamma Setting for GS30A,
A63[7:0]: Gamma Setting for GS31A

Note
(1) 0 ≤Setting of GS1 < Setting of GS2 < Setting of GS3..... < Setting of GS30 < Setting of GS31
(2) GS0 does not has pre-charge and current drive stages.
(3) GS1 can be set as only pre-charge but no current drive stage by input gamma setting for GS1 equals 0.
(4) When command B8h is input, it selects one LUT for color A, B and C. i.e. GS1~31A, GS1~63B and GS1~31C are updated.
(5) Command B8h should be input before command BCh and BDh to select individual LUT for color B, A and C.</td></tr>
</table>

Fundamental Command Table

D/C#	Hex	D7	D6	D5	D4	D3	D2	D1	D0	Command	Description
0	BD	1	0	1	1	1	1	0	1	Individual Look Up Table for Gray Scale Pulse width (Color C)	The next 31 data bytes define Gray Scale (GS) Table by setting the gray scale pulse width in unit of DCLK's (ranges from 0d ~ 180d) for color C. A1[7:0]: Gamma Setting for GS1C, A2[7:0]: Gamma Setting for GS2C, : A62[7:0]: Gamma Setting for GS30C, A63[7:0]: Gamma Setting for GS31C **Note** (1) 0 ≤Setting of GS1 < Setting of GS2 < Setting of GS3..... < Setting of GS30 < Setting of GS31 (2) GS0 does not has pre-charge and current drive stages. (3) GS1 can be set as only pre-charge but no current drive stage by input gamma setting for GS1 equals 0. (4) When command B8h is input, it selects one LUT for color A, B and C. i.e. GS1~31A, GS1~63B and GS1~31C are updated. (5) Command B8h should be input before command BCh and BDh to select individual LUT for color B, A and C.
1	A1[7:0]	$A1_7$	$A1_6$	$A1_5$	$A1_4$	$A1_3$	$A1_2$	$A1_1$	$A1_0$		
1	A2[7:0]	$A2_7$	$A2_6$	$A2_5$	$A2_4$	$A2_3$	$A2_2$	$A2_1$	$A2_0$		
1	.	.	.	.	.	.	.	.	.		
1	.	.	.	.	.	.	.	.	.		
1	.	.	.	.	.	.	.	.	.		
1	A30[7:0]	$A30_7$	$A30_6$	$A30_5$	$A30_4$	$A30_3$	$A30_2$	$A30_1$	$A30_0$		
1	A31[7:0]	$A31_7$	$A31_6$	$A31_5$	$A31_4$	$A31_3$	$A31_2$	$A31_1$	$A31_0$		
0	BE	1	0	1	1	1	1	1	0	Set V_{COMH} Voltage	Set COM deselect voltage level [reset = 05h] **A[2:0] / Hex code / V_{COMH}** 000 / 00h / 0.72 x V_{CC} : / : / : 101 / 05h / 0.82 x V_{CC} [reset] : / : / : 111 / 07h / 0.86 x V_{CC}
1	A[2:0]	0	0	0	0	0	A_2	A_1	A_0		
0	C1	1	1	0	0	0	0	0	1	Set Contrast Current for Color A,B,C	A[7:0] Contrast Value Color A [reset=7Fh] B[7:0] Contrast Value Color B [reset=7Fh] C[7:0] Contrast Value Color C [reset=7Fh]
1	A[7:0]	A_7	A_6	A_5	A_4	A_3	A_2	A_1	A_0		
1	B[7:0]	B_7	B_6	B_5	B_4	B_3	B_2	B_1	B_0		
1	C[7:0]	C_7	C_6	C_5	C_4	C_3	C_2	C_1	C_0		
0	C7	1	1	0	0	0	1	1	1	Master Contrast Current Control	A[3:0] : 0000b reduce output currents for all colors to 1/16 0001b reduce output currents for all colors to 2/16 .... 1110b reduce output currents for all colors to 15/16 1111b no change [reset]
1	A[3:0]	*	*	*	*	A_3	A_2	A_1	A_0		
0	CA	1	1	0	0	1	0	1	0	Set MUX Ratio	A[6:0] MUX ratio 4MUX ~ 128MUX, [reset=127], (Range from 3 to 127)
1	A[6:0]	0	A_6	A_5	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

Fundamental Command Table											
D/C#	**Hex**	**D7**	**D6**	**D5**	**D4**	**D3**	**D2**	**D1**	**D0**	**Command**	**Description**
0 1	FD A[7:0]	1 A_7	1 A_6	1 A_5	1 A_4	1 A_3	1 A_2	0 A_1	1 A_0	Set Command Lock	A[7:0]: MCU protection status [reset = 12h] A[7:0] = 12h, Unlock OLED driver IC MCU interface from entering command [reset] A[7:0] = 16h, 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.

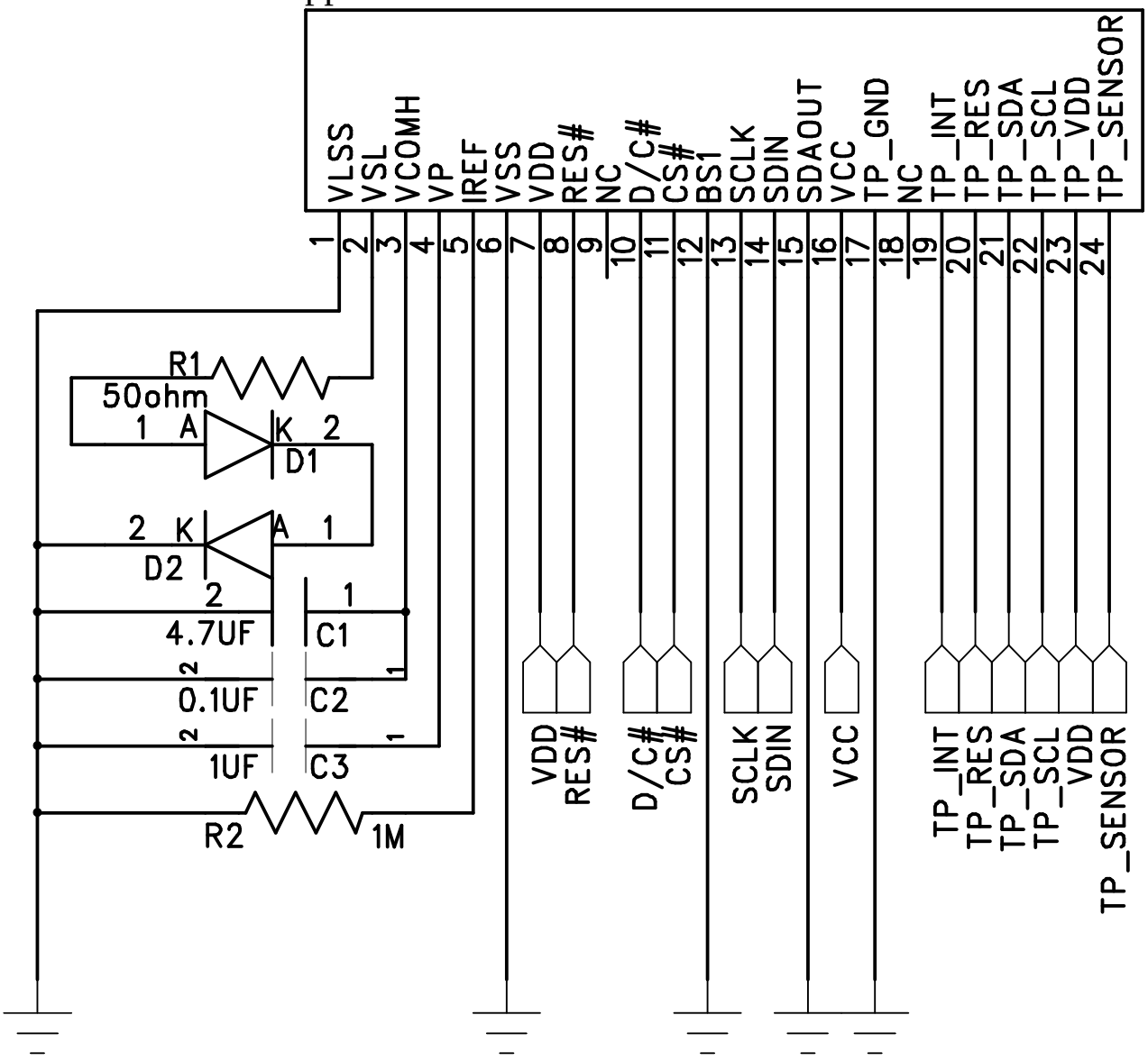
Note
(1) "*" stands for "Don't care".

■ INITIALIZATION CODE

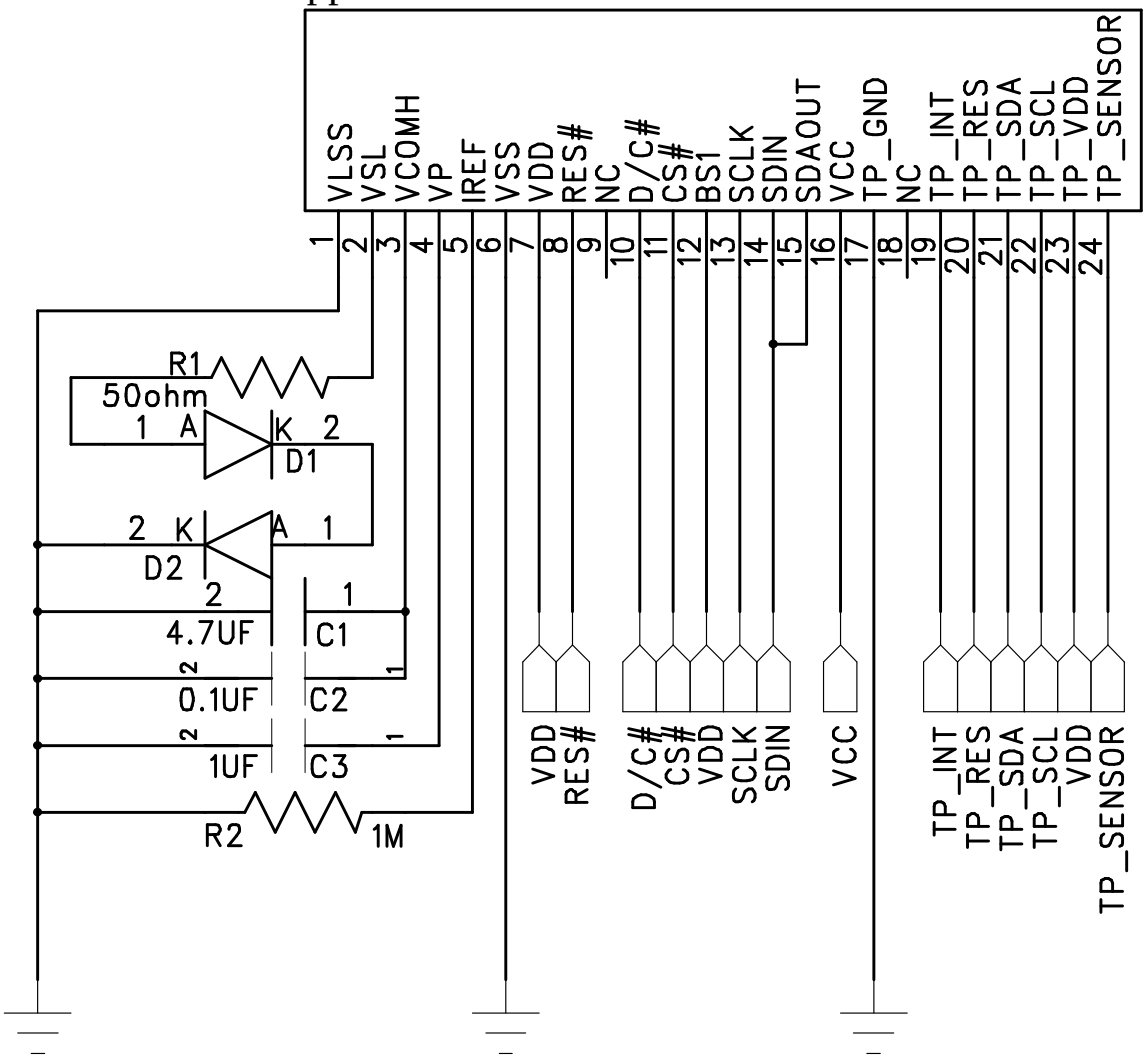
```
void InitOLED_SSD1357(void)     /* IC initialization function */
{
   Write_Command(0xAE);       //Sleep mode On (Display OFF)

   Write_Command(0xA0);       //Set Re-map / Color Depth (Display RAM to Panel)
   Write_Data(0xA4);          //262k color
                              //Enable COM Split Odd Even
                              //Color sequence is swapped: C->B->A
   Write_Command(0xA1);       //Set Display Start Line
   Write_Data(0x00);
   Write_Command(0xA2);       //Set Display Offset
   Write_Data(0);
   Write_Command(0xA6);       //Reset to normal display

   Write_Command(0xB1);       //Set Reset (Phase 1)/Pre-charge (Phase 2) period
   Write_Data(0x84);          //8 DCLKs/16 DCLKs

   Write_Command(0xB3);       //Front Clock Divider (DivSet)/Oscillator Frequency
   Write_Data(0x00);          //divide by 1

   Write_Command(0xB6);       //Set Second Pre-charge Period
   Write_Data(0x08);          //8 DCLKS

   Write_Command(0xB9);       //Use Built-in Linear LUT [reset= linear]

   Write_Command(0xBB);       //Set Pre-charge voltage
   Write_Data(0x1E);          //0.50 x VCC

   Write_Command(0xBE);       //Set VCOMH Voltage
   Write_Data(0x05);          //0.82 x VCC

   Write_Command(0xC1);       //Set Contrast Current for Color A,B,C
   Write_Data(CONTRAST_A);//0x7F
   Write_Data(CONTRAST_B);//0x65
   Write_Data(CONTRAST_C);//0x7F

   Write_Command(0xC7);       //Master Contrast Current Control
   Write_Data(0x0F);          //no change

   Write_Command(0xCA);       //Set MUX Ratio
   Write_Data(0x5F);          //96 duty

   Write_Command(0xAF);       //Sleep mode OFF (Display ON)
}
```

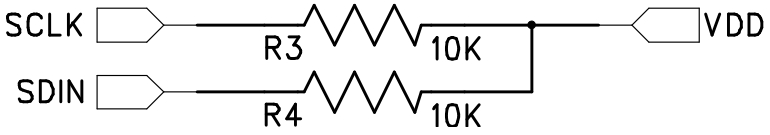
■ SCHEMATIC EXAMPLE

◆4-SPI Interface Application Circuit:



◆I2C Interface Application Circuit:





Note:

(1) The values are recommended value. Select appropriate value against module application.

(2) It is recommended to tie VLSS and VSS at one common ground point to minimize circulating ground noise.

■ RELIABILITY TESTS

Item		Condition	Criterion
High Temperature Storage (HTS)		70±2℃, 120 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)		60±2℃, 96 hours	
Low Temperature Storage (LTS)		-20±2℃, 120 hours	
Low Temperature Operating (LTO)		-10±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.

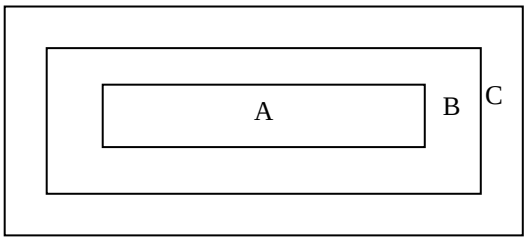
■ OUTGOING QUALITY CONTROL SPECIFICATION

◆Standard

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

◆Definition

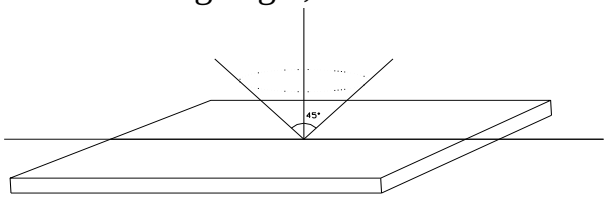
1 Major defect : The defect that greatly affect the usability of product.
2 Minor defect : The other defects, such as cosmetic defects, etc.
3 Definition of inspection zone:



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 45 ºviewing angle, under 25±5℃.



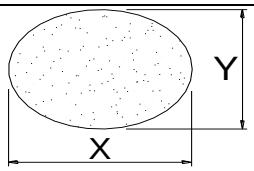
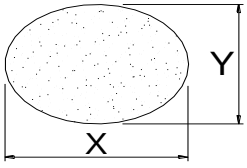
2 The luminance and color coordinate inspection : By PR705 or BM-7 or the equal equipments, in the dark room, under 25±5℃.

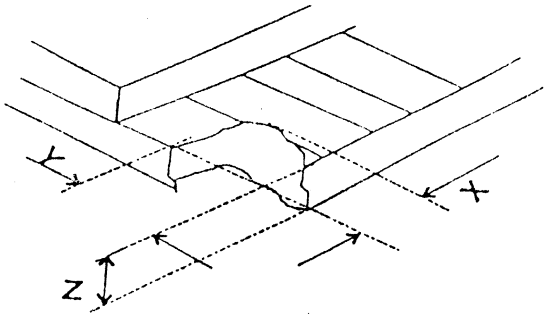
◆Inspection Criteria

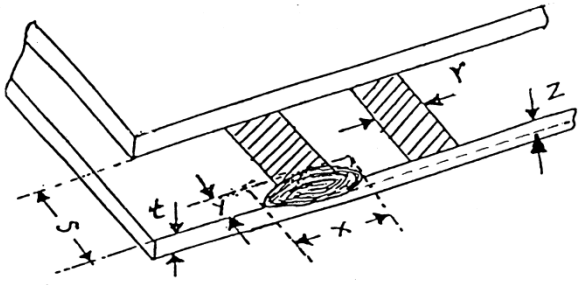
1 Major defect : AQL= 0.65

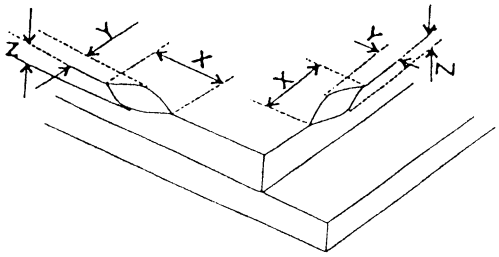
Item	Criterion
Function Defect	1. No display or abnormal display is not accepted
	2. Open or short is not accepted.
	3. Power consumption exceeding the spec is not accepted.
Outline Dimension	Outline dimension exceeding the spec is not accepted.
Glass Crack	Glass crack tends to enlarge is not accepted.

2 Minor Defect : AQL= 1.5

<table>
<tr><td>Item</td><td colspan="4">Criterion</td></tr>
<tr><td rowspan="6">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="4">  </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>0.15＜Φ</td><td>0</td></tr>
<tr><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≦0.02</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>

■ 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 cannot 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.