SPECIFICATION

PART NO. : OEL9M1004-L4-E

OLED
Display
1.52"
128RGBX128

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

PRODUCT CONTENTS

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

REVISION HISTORY

Rev.	Contents	Date
1.0	Initial release.	2013-7-31
1.1	update ELECTRO-OPTICAL CHARACTERISTICS	2014-1-17

n PHYSICAL DATA

No.	Items:	Specification:	Unit
1	Diagonal Size	1.52	Inch
2	Resolution	128RGB x 128	Dots
3	Active Area	27.23 (W) x 27.23(H)	mm^2
4	Outline Dimension (Panel)	35.50 (W) x 34.60(H)	mm^2
5	Pixel Pitch	0.213 (W) x 0.213 (H)	mm^2
6	Pixel Size	0.183 (W) x 0.183 (H)	mm^2
7	Driver IC	SSD1355U8R1	-
8	Display Color	262K	-
10	Interface	Parallel / SPI	-
11	IC package type	COF	-
12	Thickness	1.45 ± 0.1	mm
13	Weight	TBD	g
14	Duty	1/128	-

n ABSOLUTE MAXIMUM RATINGS

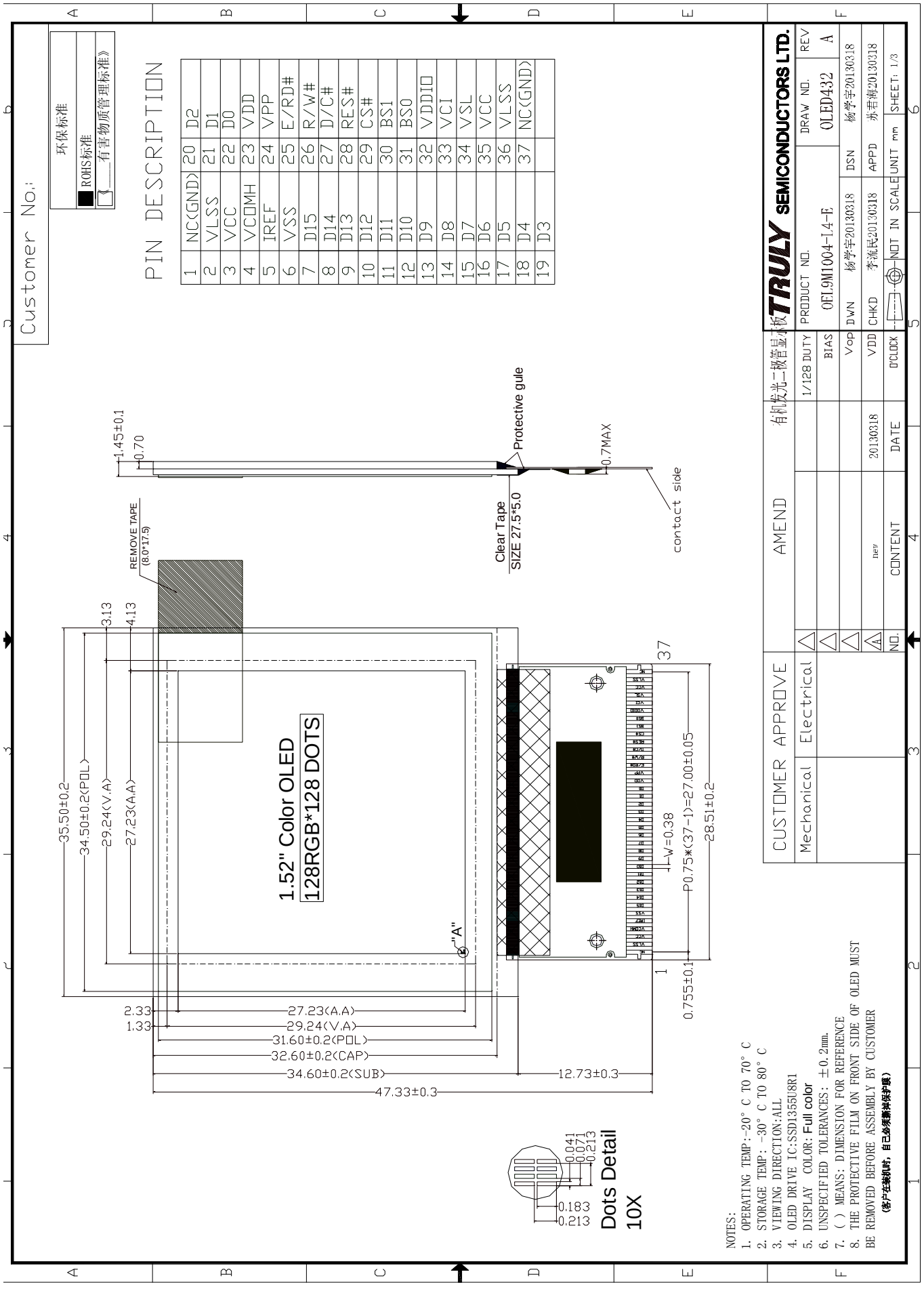
Unless otherwise specified, V_{SS} = 0V (Ta = 25℃)

Items		Symbol	Min	Typ.	Max	Unit
Supply Voltage	Logic	V_{DD}	-0.5	-	2.75	V
	I/O buffer	V_{DDIO}	-0.5	-	V_{CI}	V
	Driving	V_{CC}	-0.5	-	22.0	V
Operating Temperature		Top	-20	-	70	℃
Storage Temperature		Tst	-30	-	80	℃
Humidity		-	-	-	90	%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.

n EXTERNAL DIMENSIONS



n ELECTRICAL CHARACTERISTICS

◆DC Characteristics

Unless otherwise specified, V_{SS} = 0V , V_{DD}=1.65V to 2.6V , V_{CI}=2.4V to 3.5V
(Ta = +25℃)

Items		Symbol	Min	Typ.	Max	Unit
Supply Voltage	Logic	V_{DD}	2.4	-	2.6	V
	I/O buffer	V_{DDIO}	1.6	-	V_{CI}	V
	Operating	V_{CC}	10.0	-	21.0	V
Input Voltage	High Voltage	V_{IH}	0.8 x V_{DDIO}	-	V_{DDIO}	V
	Low Voltage	V_{IL}	0	-	0.2 x V_{DDIO}	V
Output Voltage	High Voltage	V_{OH}	0.9 x V_{DDIO}	-	V_{DDIO}	V
	Low Voltage	V_{OL}	0	-	0.1 x V_{DDIO}	V

◆AC Characteristics

Conditions (Unless otherwise specified):
Voltage referenced to VSS
VDD = 2.4V to 2.6V
VDDIO = 2.8V
VCI = 2.8V
TA = 25℃

AC Characteristics

Symbol	Parameter	Test Condition	Min	Typ	Max	Unit
F_{OSC} (1)	Oscillation Frequency of Display Timing Generator	V_{CI} = 2.8V	1.28	1.43	1.6	MHz
F_{FRM}	Frame Frequency for 160 MUX Mode	128x160 Graphic Display Mode, Display ON, Internal Oscillator Enabled	-	F_{OSC} * 1/(D*K*160) (2)	-	Hz
t_{RES}	Reset low pulse width (RES#)	-	2000	-	-	ns

Note：

(1) FOSC stands for the frequency value of the internal oscillator and the value is measured when command D2h A [7:4] is in default value.

(2) D: divide ratio set by command D2h A[3:0]
K: Phase 1 period +Phase 2 period + 75

6800-Series MCU Parallel Interface Timing Characteristics

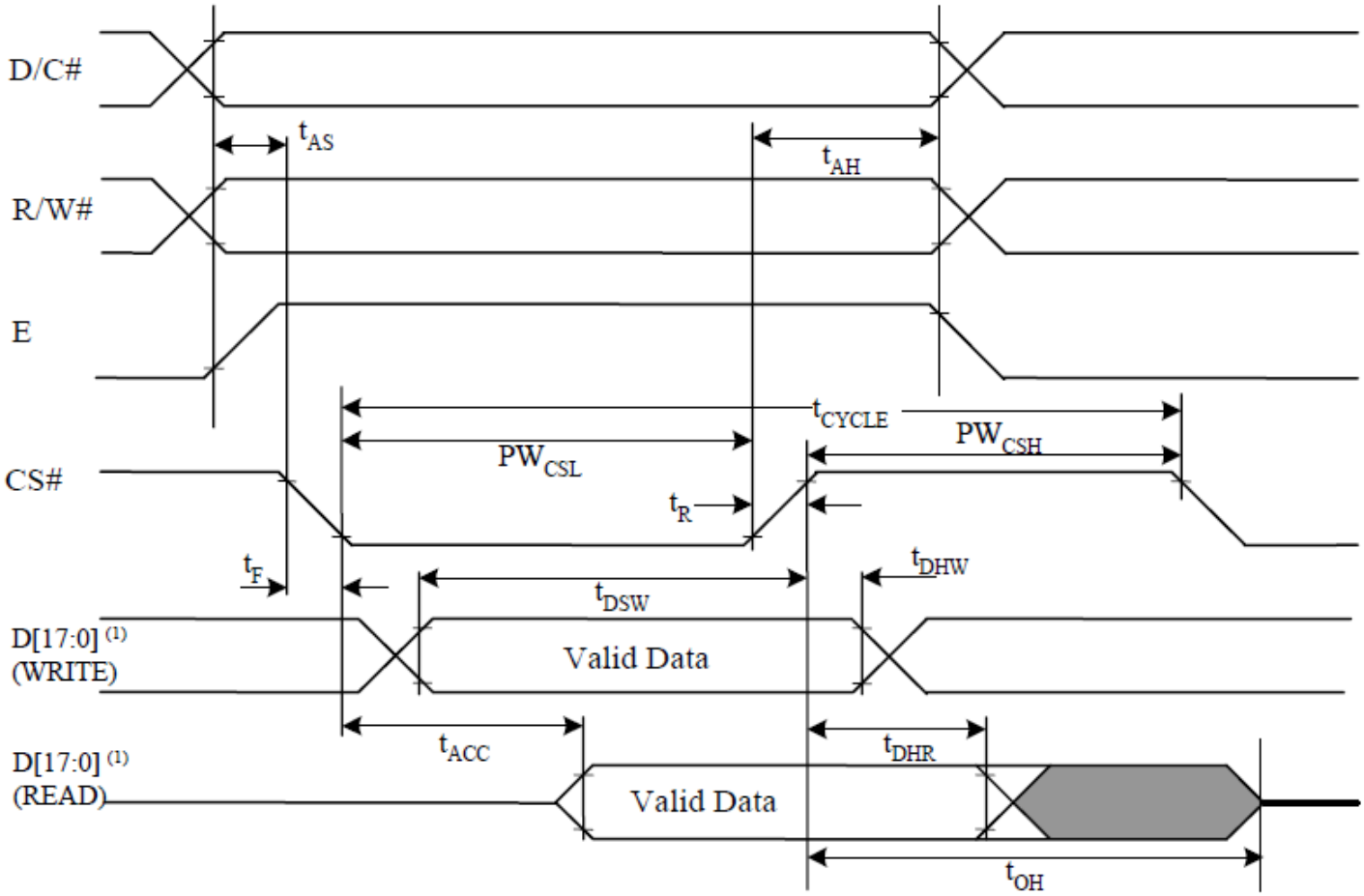
(V_{DD} - V_{SS} = 2.4 to 2.6V, V_{DDIO}=1.6V, V_{CI} = 2.8V, T_A = 25°C)

Symbol	Parameter	Min	Typ	Max	Unit
t_{CYCLE}	Clock Cycle Time	300	-	-	ns
t_{AS}	Address Setup Time	10	-	-	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) Chip Select Low Pulse Width (write)	120 60	-	-	ns
PW_{CSH}	Chip Select High Pulse Width (read) Chip Select High Pulse Width (write)	60 60	-	-	ns
t_R	Rise Time	-	-	15	ns
t_F	Fall Time	-	-	15	ns

6800-Series MCU Parallel Interface Timing Characteristics

6800-Series MCU Parallel Interface Timing Characteristics

6800-Series MCU Parallel Interface Characteristics



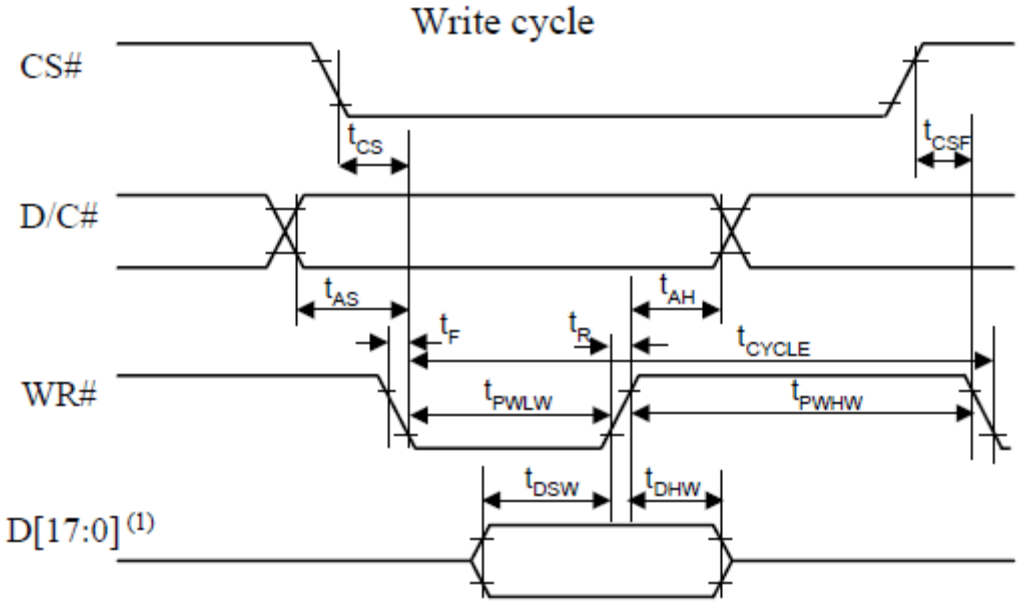
Note: (1) When 8 bit used: D [7:0] instead;
(2) When 16 bit used: D [15:0] instead;
(3) When 18 bit used: D [17:0] instead.

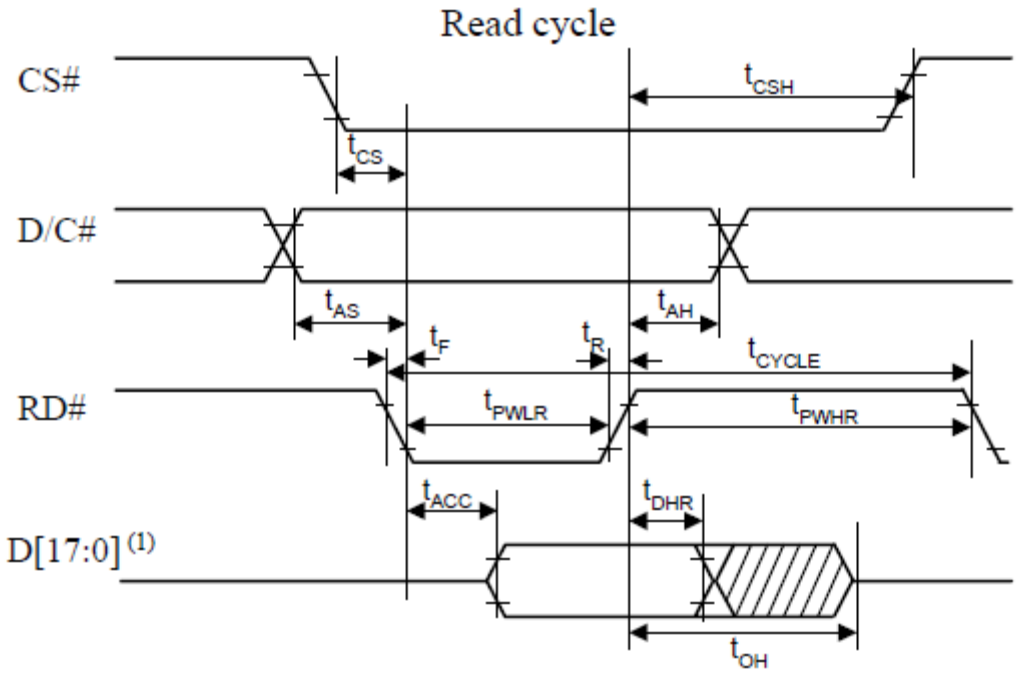
8080-Series MCU Parallel Interface Timing Characteristics

(V_{DD} - V_{SS} = 2.4 to 2.6V, V_{DDIO}=1.6V, V_{CI} = 2.8V, T_A = 25°C)

Symbol	Parameter	Min	Typ	Max	Unit
t_{CYCLE}	Clock Cycle Time	300	-	-	ns
t_{AS}	Address Setup Time	10	-	-	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
t_{PWLR}	Read Low Time	150	-	-	ns
t_{PWLW}	Write Low Time	60	-	-	ns
t_{PWHR}	Read High Time	60	-	-	ns
t_{PWHW}	Write High Time	60	-	-	ns
t_R	Rise Time	-	-	15	ns
t_F	Fall Time	-	-	15	ns
t_{CS}	Chip select setup time	0	-	-	ns
t_{CSH}	Chip select hold time to read signal	0	-	-	ns
t_{CSF}	Chip select hold time	20	-	-	ns

8080-Series MCU Parallel Interface Characteristics





Note:

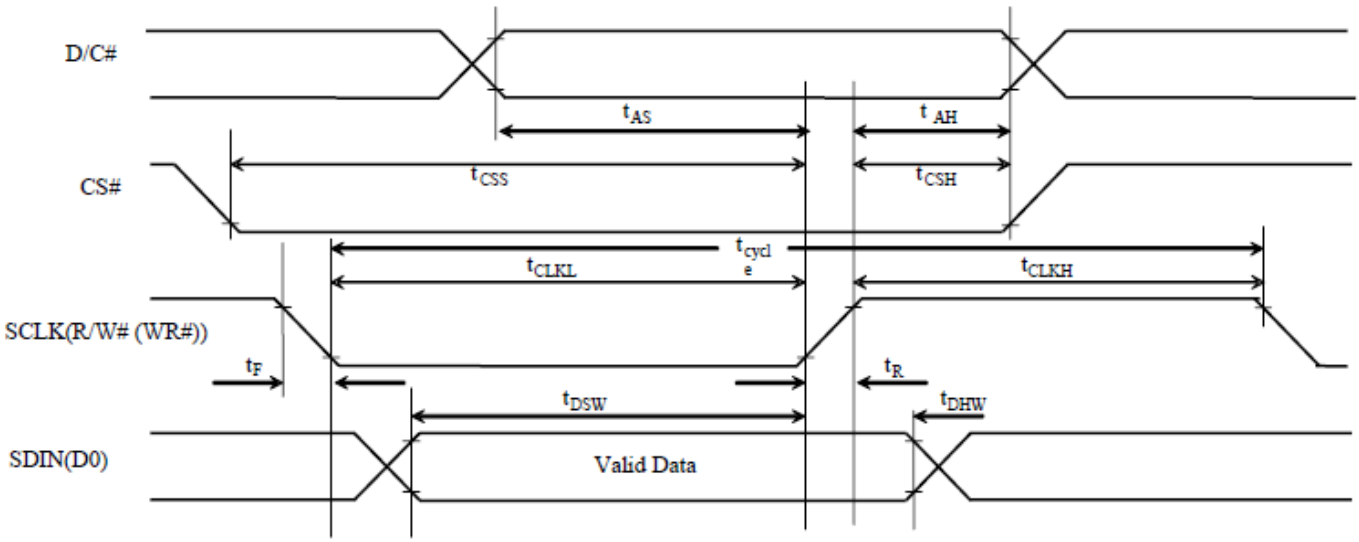
(1) when 8 bit used: D [7:0] instead;
(2) When 16 bit used: D [15:0] instead;
(3) When 18 bit used: D [17:0] instead.

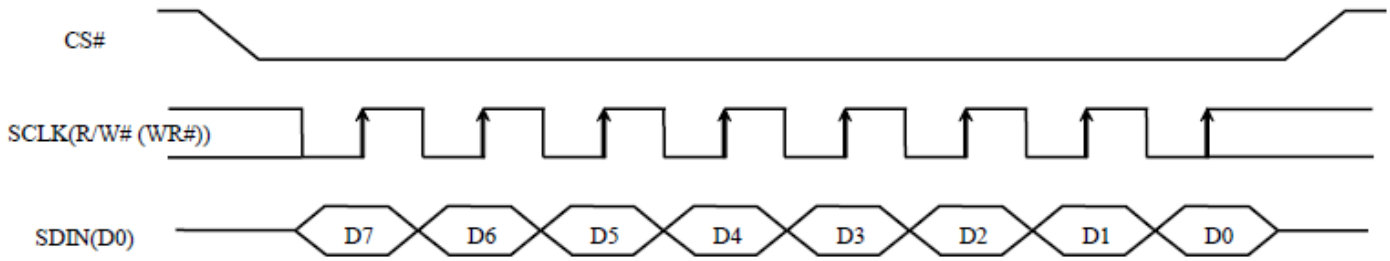
Series Interface Timing Characteristics (4-wire SPI)

(V_{DD} - V_{SS} = 2.4 to 2.6V, V_{DDIO}=1.6V, V_{CI} = 2.8V, T_A = 25°C)

Symbol	Parameter	Min	Typ	Max	Unit
t_{cycle}	Clock Cycle Time	50	-	-	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	-	-	15	ns
t_F	Fall Time	-	-	15	ns

Series Interface Characteristics (4-wire SPI)



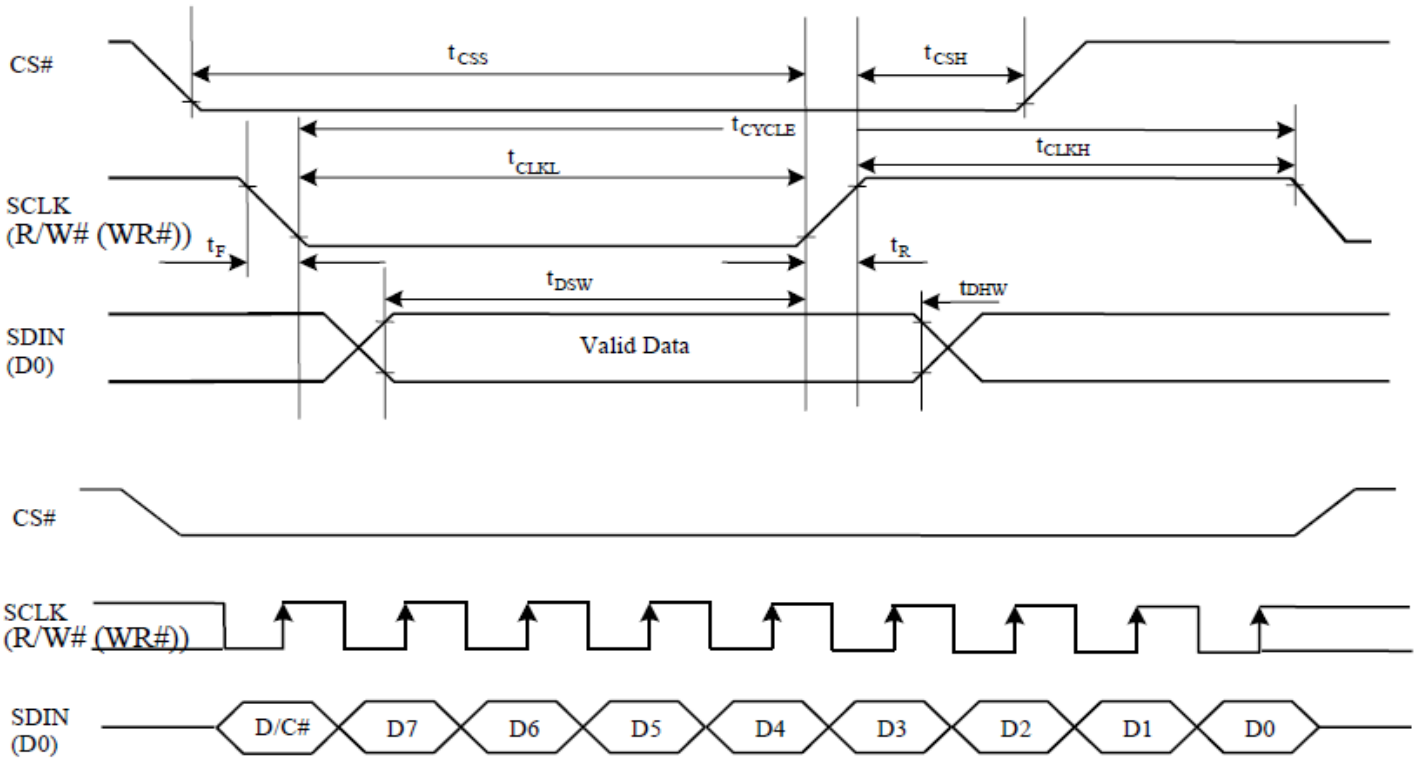


Series Interface Timing Characteristics (3-wire SPI)

(V_{DD} - V_{SS} = 2.4 to 2.6V, V_{DDIO}=1.6V, V_{CI} = 2.8V, T_A = 25°C)

Symbol	Parameter	Min	Typ	Max	Unit
t_{cycle}	Clock Cycle Time	50	-	-	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	-	-	15	ns
t_F	Fall Time	-	-	15	ns

Series Interface Characteristics (3-wire SPI)



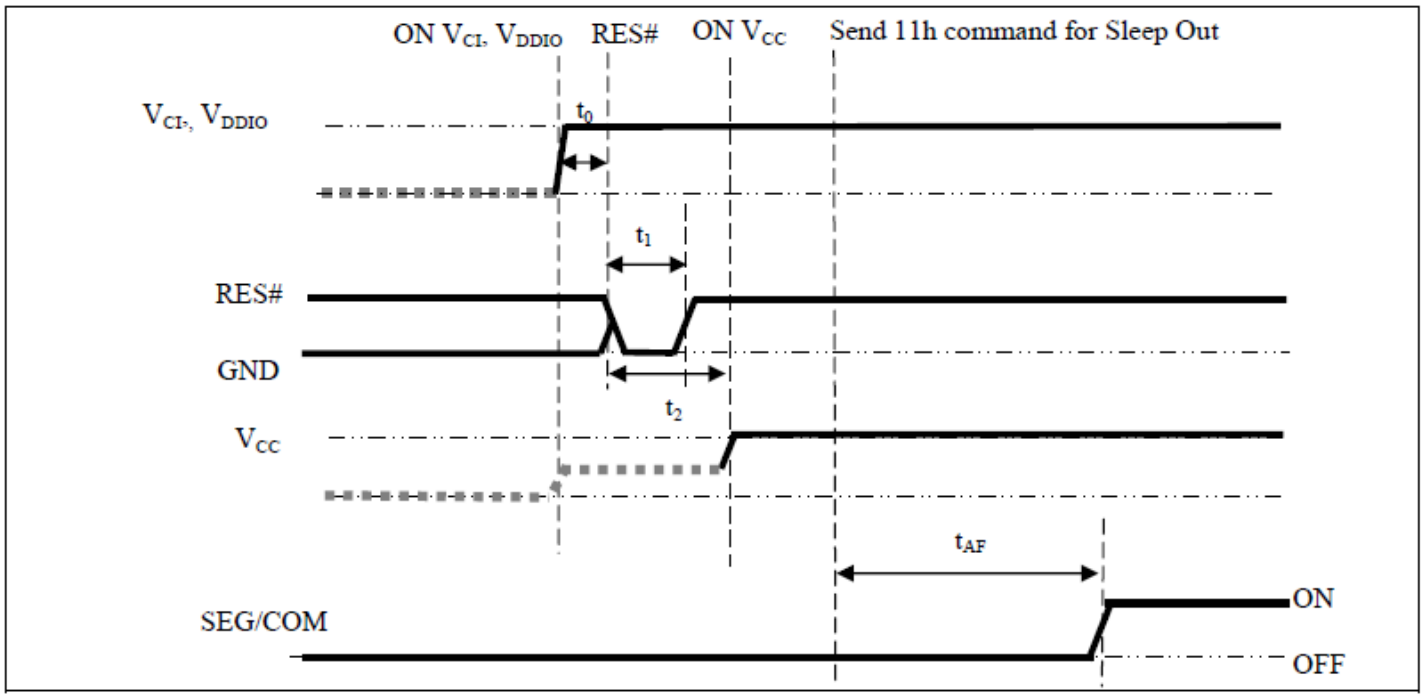
n TIMING OF POWER SUPPLY

The following figures illustrate the recommended power ON and power OFF sequence of SSD1355 (assume V_{CI} and V_{DDIO} are at the same voltage level and internal V_{DD} is used).

Power ON sequence:

1. Power ON V_{CI}, V_{DDIO}.
2. After V_{CI}, V_{DDIO} become stable, set wait time at least 1ms (t_0) for internal V_{DD} become stable. Then set RES# pin LOW (logic low) for at least 2us (t_1)[4] and then HIGH (logic high).
3. After set RES# pin LOW (logic low), wait for at least 2us (t_2). Then Power ON V_{CC}.[1]
4. After V_{CC} become stable, send command 11h for Sleep Out. SEG/COM will be ON after 200ms (t_{AF}).

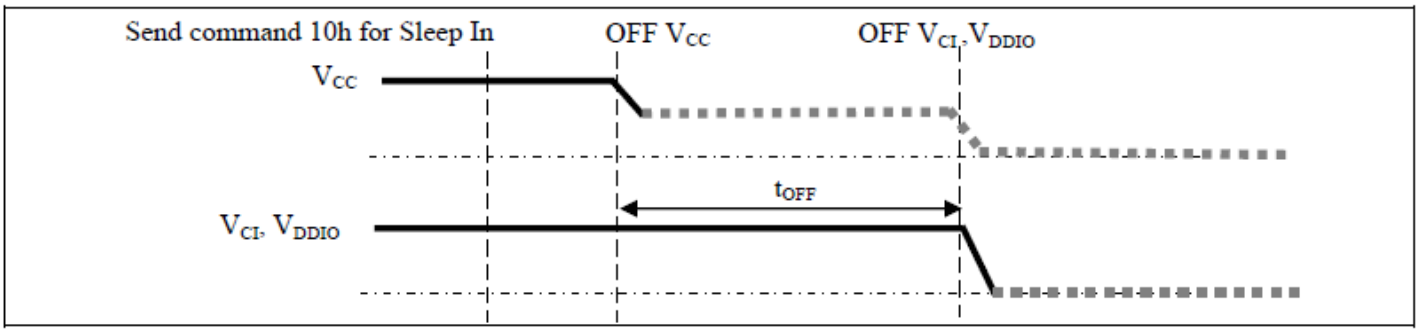
The Power ON sequence



Power OFF sequence:

1. Send command 10h for Sleep In.
2. Power OFF V_{CC}.[1], [2],,[3]
3. Wait for t_{OFF}. Power OFF V_{CI}, V_{DDIO}. (where Minimum t_{OFF}=0ms [5], Typical t_{OFF}=100ms)

The power OFF sequence



Note:

(1) Since an ESD protection circuit is connected between V_{CI}, V_{DDIO} and V_{CC}, V_{CC} becomes lower than V_{CI} whenever V_{CI}, V_{DDIO} is ON and V_{CC} is OFF as shown in the dotted line of V_{CC} in Figure 8-14 and Figure 8-15.

(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) The register values are reset after t_1.

(5) V_{CI}, V_{DDIO} should not be Power OFF before V_{CC} Power OFF.

n ELECTRO-OPTICAL CHARACTERISTICS (Ta=25℃)

Items		Symbol	Min.	Typ.	Max.	Unit	Remark
Luminance		L	60	80	-	cd /m^2	With Polarizer All pixels on
Power Consumption		P	-	250		mW	30% pixels On
Frame Frequency		Fr	-	100	-	Hz	-
Color Coordinate		CIE x CIE y	0.25 0.30	0.29 0.34	0.33 0.38	CIE1931	White
		CIE x CIE y	0.59 0.31	0.63 0.35	0.67 0.39		Red
		CIE x CIE y	0.26 0.57	0.30 0.61	0.34 0.65		Green
		CIE x CIE y	0.11 0.12	0.15 0.16	0.19 0.20		Blue
Response Time	Rise	Tr	-	-	0.02	ms	-
	Decay	Td	-	-	0.02	ms	-
Contrast Ratio*		Cr	5000:1	-	-	-	With Polarizer
Viewing Angle		△ θ	170	-	-	Degree	-
Operating Life Time*		Top	6,000	-	-	Hours	-

Note:

1. **80cd/m^2** is base on V_{CI} =3.0V, V_{CC}=15.0V,
   Contrast command setting: Red contrast: 0x95;
   Green contrast: 0x85;
   Blue contrast: 0xF0;
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.).

n INTERFACE PIN CONNECTIONS

No	Symbol	Description
1	NC (GND)	No connection or connect with GND.
2	V_{LSS}	Analog system ground pin.
3	V_{CC}	Power supply for panel driving voltage. This is also the most positive power voltage supply pin. It is supplied by external high voltage source.
4	V_{COMH}	COM signal deselected voltage level. A capacitor should be connected between this pin and VSS.
5	I_{REF}	This pin is the segment output current reference pin. IREF can be supplied externally or regulated internally. When external IREF is selected, a resistor should be connected between this pin and VSS. When internal IREF is selected, this pin should be floated.
6	V_{SS}	Ground pin.
7~22	D15~D0	These pins are bi-directional data bus connecting to the MCU data bus. Unused pins are recommended to tie LOW. (Except for D1 pin in SPI mode)
23	V_{DD}	Power supply pin for core logic operation. VDD can be supplied externally (within the range of 2.4V to 2.6V) or regulated internally from VCI. A capacitor should be connected between VDD and VSS under all circumstances. Refer to Section 8.11 for details.
24	V_{PP}	Power supply for programming OTP. In OTP programming, this pin is powered up to 7.5V. Refer to Section 9.3.32 OTP Write (B1h) for details. In operation mode (without programming OTP), this pin must be connected to VDD.
25	E/RD#	This pin is MCU interface input. When 6800 interface mode is selected, this pin will be used as the Enable (E) signal. Read/write operation is initiated when this pin is pulled HIGH and the chip is selected. When 8080 interface mode is selected, this pin receives the Read (RD#) signal. Read operation is initiated when this pin is pulled LOW and the chip is selected. When serial interface is selected, this pin E(RD#) must be connected to VSS.

<table>
<tr><td>26</td><td>R/W#</td><td>This pin is read / write control input pin connecting to the MCU interface.
When 6800 interface mode is selected, this pin will be used as Read/Write (R/W#) selection input. Read mode will be carried out when this pin is pulled HIGH and write mode when LOW.
When 8080 interface mode is selected, this pin will be the Write (WR#) input. Data write operation is initiated when this pin is pulled LOW and the chip is selected.</td></tr>
<tr><td>27</td><td>D/C#</td><td>This pin is Data/Command control pin connecting to the MCU.
When the pin is pulled HIGH, the data at D[17:0] will be interpreted as data.
When the pin is pulled LOW, the data at D[17:0] will be interpreted as command.</td></tr>
<tr><td>28</td><td>RES#</td><td>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.</td></tr>
<tr><td>29</td><td>CS#</td><td>This pin is the chip select input connecting to the MCU.
The chip is enabled for MCU communication only when CS# is pulled LOW.</td></tr>
<tr><td>30~31</td><td>BS[1:0]</td><td>MCU bus interface selection pins. Select appropriate logic setting as described in the following table. BS3 and BS2 are command programmable (by command 36h).
[reset = 00]. BS1 and BS0 is pin select.
Table 7-2 : Bus Interface selection
<table>
<tr><td>BS[3:0]</td><td>Interface</td></tr>
<tr><td>0000</td><td>4 line SPI</td></tr>
<tr><td>0001</td><td>3 line SPI</td></tr>
<tr><td>0011</td><td>8-bit 6800 parallel</td></tr>
<tr><td>0010</td><td>8-bit 8080 parallel</td></tr>
<tr><td>0111</td><td>16-bit 6800 parallel</td></tr>
<tr><td>0110</td><td>16-bit 8080 parallel</td></tr>
</table>
Note:
(1) 0 is connected to VSS
(2) 1 is connected to VDDIO</td></tr>
<tr><td>32</td><td>V_{DDIO}</td><td>Power supply for interface logic level. It should match with the MCU interface voltage level and must be connected to external source.</td></tr>
</table>

33	V_{CI}	Low voltage power supply VCI must always be equal to or higher than VDD and VDDIO. Refer to Section 8.11 for details.
34	VSL	This is segment voltage reference pin. When external VSL is not used, this pin should be left open. When external VSL is used, connect with resistor and diode to ground. (Details depend on application).
35	V_{CC}	Power supply for panel driving voltage. This is also the most positive power voltage supply pin. It is supplied by external high voltage source.
36	V_{LSS}	Analog system ground pin
37	NC(GND)	No connection or connect with GND.

n COMMAND TABLE

Operational Code (Hex)	Function	Bytes of Parameter
00	No Operation (NOP)	0
01	Software Reset (SWRESET)	0
04	Read Display Identification Information (RDDIDIF)	2
0A	Read Display Power Mode (RDDPM)	2
0B	Read Display MADCTL (RDDMADCTL)	2
0C	Read Display Pixel Format (RDDCOLMOD)	2
0D	Read Display Image Mode (RDDIM)	2
0E	Read Display Signal Mode (RDDSM)	2
10	Sleep In (SLPIN)	0
11	Sleep Out (SLPOUT)	0
12	Enable Partial Display (PTLON)	0
13	Normal Display Mode ON (NORON)	0
20	Display Inversion OFF (INVOFF)	0
21	Display Inversion ON (INVON)	0
23	All Pixels ON (ALLPON)	0
28	All Pixels OFF(ALLPOFF)	0
29	Disable All Pixels ON/OFF (DISPON)	0
2A	Set Column Address (CASET)	2
2B	Set Row Address (RASET)	2
2C	Memory Write (RAMWR)	Any length
2E	Memory Read (RAMRD)	Any length
30	Set Partial Display Area (PLTAR)	2
33	Set Vertical Scrolling Areas (VSCRDEF)	3
34	Disable Tearing Effect (TEOFF)	0
35	Enable Tearing Effect (TEON)	1
36	Memory Access Control (MADCTL)	2
37	Vertical Scrolling Start Address(VSCRSADD)	1
3A	Interface Pixel Format (COLMOD)	1
51	Write Luminance (SETLUM)	1
52	Read Luminance (RDLUM)	2
DA	Read Display Identification Information (RDDIDIF)	2

Command Table (Continued)

Operational Code (Hex)	Function	Bytes of Parameter
B1	OTP Write (OTPWR)	3
B2	OTP MCU Read (OTPRD)	3
B3	Function Selection (FUSEL)	1
B9	Linear Gamma Look Up Table (LINGLUT)	0
BA	Set Contrast for Color A,B,C (ISEGABC)	5
BD	Set First Pre-Charge Voltage (VPSET)	1
BE	Gamma Look Up Table (GLUT)	96
C8	Set Display Offset (SETDO)	1
C9	Horizontal Scrolling (HORSCR)	1
CA	Set MUX ratio (SETMUX)	1
CD	Set Phase Length (PHLEN)	1
CE	Set Second Precharge Period (SECPLEN)	1
CF	Set Second Precharge Speed (SSPS)	1
D2	Set Display Clock Divider / Oscillator Frequency (SDCOSCF)	1
D3	Set V_{COMH} (SETVCOMH)	1
D7	GPIO (GPIO)	1
FD	Command Lock (COMLCK)	1

Note: Issue command FDh → B3h to access the above supplementary commands.

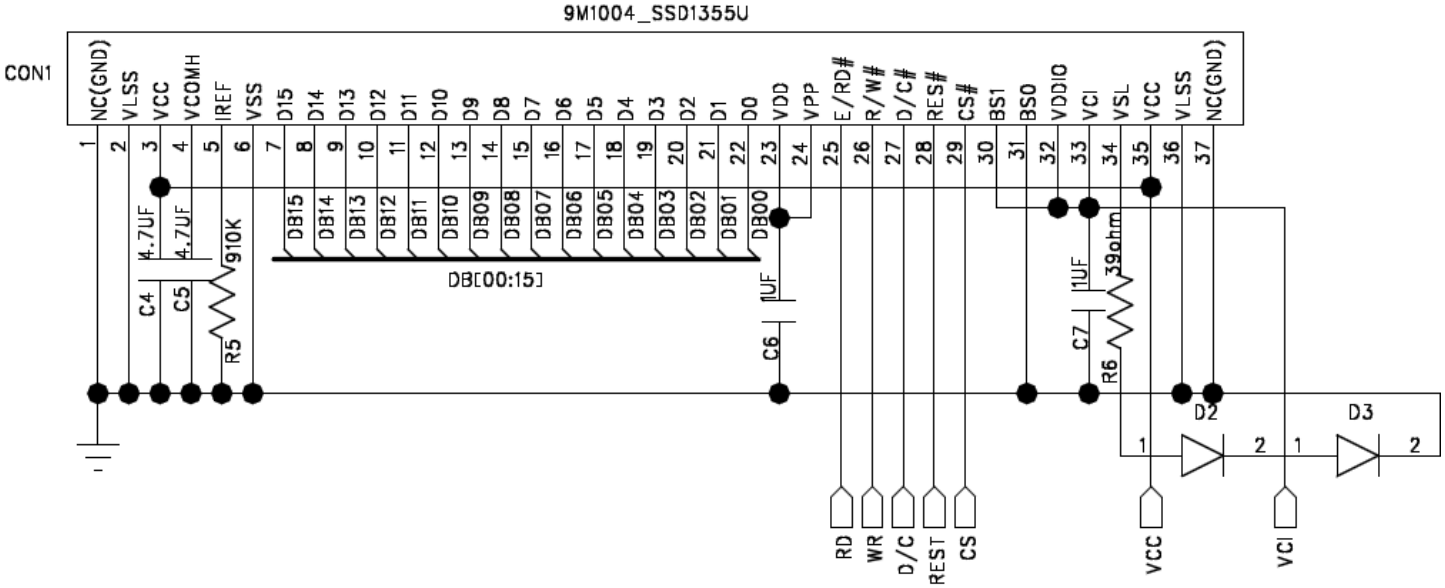
n INTIALIZATION CODE

```
void InitOLED_SSD1355()
{
  WMLCDCOM(0xFD); //Command Lock
  WMLCDDATA(0xB3);

  WMLCDCOM(0xB3); //High Power Protection Selection
  WMLCDDATA(0x01);

  WMLCDCOM(0xD6); //High Power Protection
  WMLCDDATA(0x07);

  WMLCDCOM(0xCC); //Enable External VSL
  WMLCDDATA(0xB0);
  WMLCDDATA(0x16);

  WMLCDCOM(0x35); //
  WMLCDDATA(0x00);

  WMLCDCOM(0xCA); //Set MUX ratio
  WMLCDDATA(0x7F);

  WMLCDCOM(0xBA); //Set contrast for all color R
  WMLCDDATA(0x95);
  WMLCDCOM(0xBB); //Set contrast for all color G
  WMLCDDATA(0x85);
  WMLCDCOM(0xBC); //Set contrast for all color B
  WMLCDDATA(0xF0);


  WMLCDCOM(0xCF); //Set Second Precharge speed
  WMLCDDATA(0x01); //slowest:00 slow:01 normal:02 Fast:03

  WMLCDCOM(0xCD); //Set Phase Length
  WMLCDDATA(0x47);

  WMLCDCOM(0xD2); //Set Display Clock Divider / Oscillator Frequency
  WMLCDDATA(0x30);

  WMLCDCOM(0xCE); //Set Second Precharge Period
  WMLCDDATA(0x05); //00~0F

  WMLCDCOM(0xBD); //Set First Pre-Charge Voltage
  WMLCDDATA(0x06); //Set First Pre-Charge Voltage(00~1F)

  WMLCDCOM(0xE3);
  WMLCDDATA(0x35);

  WMLCDCOM(0x51);  //Write Luminance
  WMLCDDATA(0xF0);

  WMLCDCOM(0xD3); //Set VCOMH
```

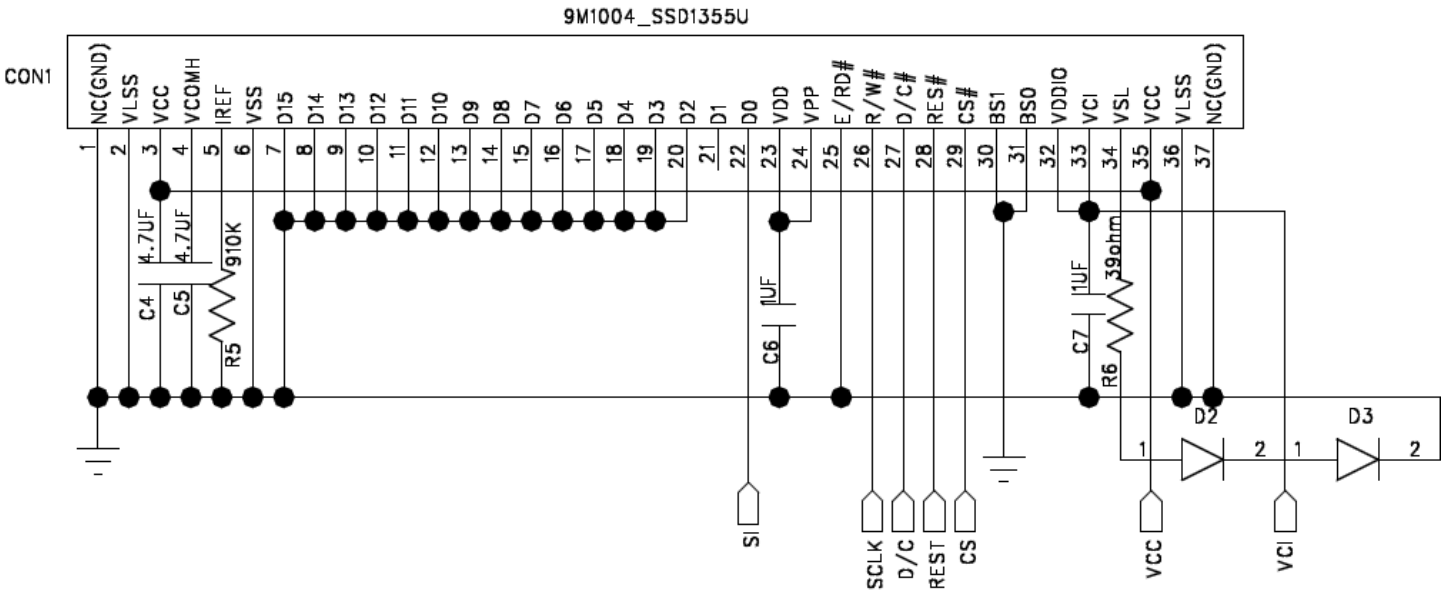
```
  WMLCDDATA(0x05);

  WMLCDCOM(0xD1);
  WMLCDDATA(0x00);
  WMLCDDATA(0x00);

  WMLCDCOM(0xD0);
  WMLCDDATA(0x00);
  WMLCDDATA(0x3F);

  WMLCDCOM(0x36); //Memory Access Control
  WMLCDDATA(0x88);
  WMLCDDATA(0x11);

  WMLCDCOM(0x13); //Normal Display Mode ON

  WMLCDCOM(0x20); //Display Inversion OFF

  WMLCDCOM(0x29); //Disable All Pixels ON/OFF

  WMLCDCOM(0x34); //Disable Tearing Effect

  WMLCDCOM(0x3A); //Interface Pixel Format
  WMLCDDATA(0x05);

  WMLCDCOM(0xC8); //Set Display Offset
  WMLCDDATA(0x00);
  WMLCDCOM(0xC9); //Horizontal Scrolling
  WMLCDDATA(0x00);

  //WMLCDCOM(0xB9); //Linear Gamma Look Up Table
  WMLCDCOM(0xBE);//Gamma Setting
  Write_Gamma_Table(Gamma_Table);
  WMLCDCOM(0x11);//Sleep Out
}
```

n SCHEMATIC EXAMPLE

◆8080 Parallel Interface Application Circuit:



◆4-wire SPI Serial Interface Application Circuit:



n RELIABILITY TESTS

Item		Condition	Criterion
High Temperature Storage (HTS)		80±2℃, 200 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)		70±2℃, 96 hours	
Low Temperature Storage (LTS)		-30±2℃, 200 hours	
Low Temperature Operating (LTO)		-20±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.

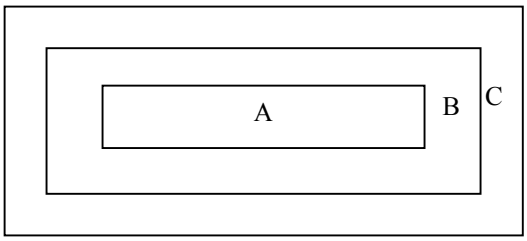
n OUTGOING QUALITY CONTROL SPECIFICATION

◆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

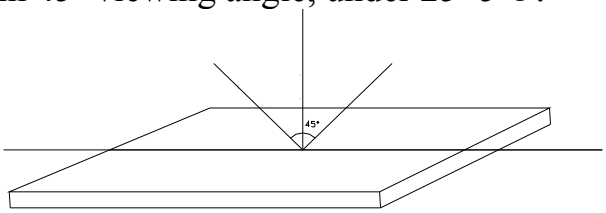
Zone B: Viewing Area except Zone A

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 45º viewing angle, under 25±5℃.



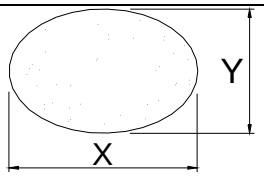
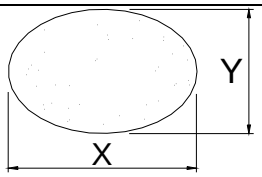
2 The luminance and color coordinate inspection: By PR705 or BM-7 or the equal equipments, in the dark room, under 25±5℃.

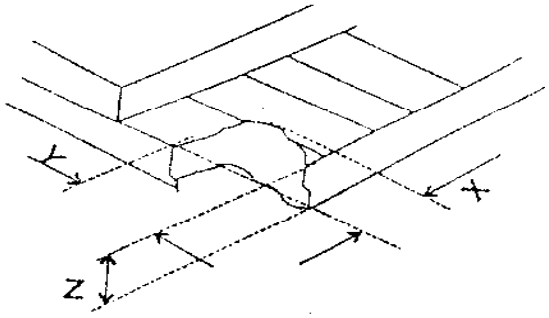
◆Inspection Criteria

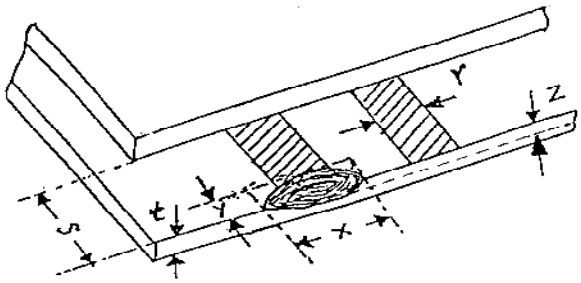
1 Major defect: AQL= 0.65

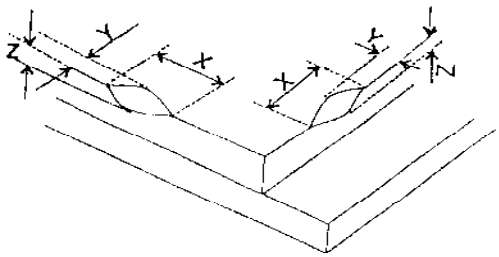
Item	Criterion
Function Defect	1. No display or abnormal display is not accepted
	2. Open or short is not accepted.
	3. Power consumption exceeding the spec is not accepted.
Outline Dimension	Outline dimension exceeding the spec is not accepted.
Glass Crack	Glass crack tends to enlarge is not accepted.

2 Minor Defect: AQL= 1.5

<table>
<tr><td>Item</td><td colspan="4">Criterion</td></tr>
<tr><td rowspan="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≦0.07</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 colspan="4">Note : Φ= (x + y) / 2</td><td>0.15＜Φ</td><td>0</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>

n 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 polarizes 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 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%.

◆ 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.