# SPECIFICATION

## PART NO. : OEL9M1003-L3-E

OLED
Display
96RGBX96
1.1"

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 designing for this product or releasing the order.

# PRODUCT CONTENTS



| TRULY®信利 | | Customer | |
|---|---|---|---|
| Written by | WangGui | Approved by | |
| Checked by | YangXueyu | | |
| Approved by | ZhangWeicang | | |

# REVISION HISTORY

| Rev. | Contents | Date |
|---|---|---|
| 1.0 | First release. | 2012-12-15 |
| | | |

## ■ PHYSICAL DATA

| No. | Items: | Specification: | Unit |
|---|---|---|---|
| 1 | Diagonal Size | 1.1 | Inch |
| 2 | Resolution | 96RGB * 96 | Dots |
| 3 | Active Area | 19.85(W) x 19.85(H) | $mm^2$ |
| 4 | Outline Dimension (Panel) | 25.49(W) x 29.10 (H) | $mm^2$ |
| 5 | Pixel Pitch | 0.207(W) x 0.207(H) | $mm^2$ |
| 6 | Pixel Size | 0.177(W) x 0.182(H) | $mm^2$ |
| 7 | Driver IC | LD7134 | - |
| 8 | Display Color | 65K | - |
| 9 | Interface | 6/8/16bit Parallel / SPI | - |
| 10 | IC package type | COG | - |
| 11 | Thickness | $1.45 \pm 0.1$ | mm |
| 12 | Weight | TBD | g |
| 13 | Duty | 1/96 | - |

## ■ ABSOLUTE MAXIMUM RATINGS

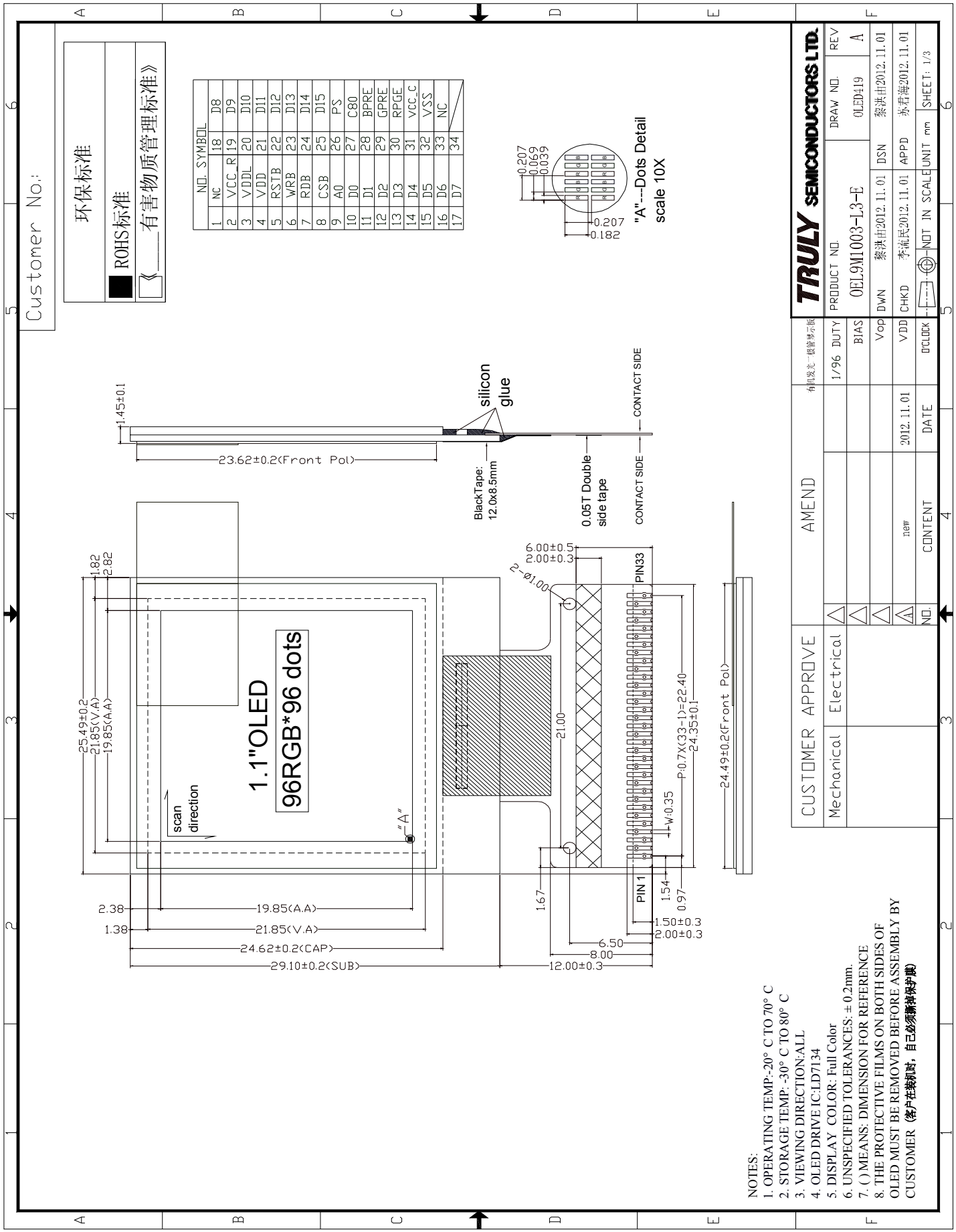
Voltage Referenced to VSS

| Items | | Symbol | Min | Typ. | Max | Unit |
|---|---|---|---|---|---|---|
| Supply Voltage | I/O Power | VDD | -0.3 | - | 3.6 | V |
| | Driving | VCC_C | -0.3 | - | 18.3 | 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.

# ■ EXTERNAL DIMENSIONS



# ■ ELECTRICAL CHARACTERISTICS

## ◆ DC Characteristics

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

| Items | | Symbol | Min | Typ. | Max | Unit |
|---|---|---|---|---|---|---|
| Supply Voltage | Operating | VCC_C | 8 | 15.0 | 18.0 | V |
| | I/O Power | VDD | 1.65 | 2.8 | 3.3 | V |
| Input Voltage | High Voltage | $V_{IH}$ | 0.8 x VDD | - | VDD | V |
| | Low Voltage | $V_{IL}$ | VSS | - | 0.2 x VDD | V |
| Output Voltage | High Voltage | $V_{OH}$ | 0.9 x VDD | - | VDD | V |
| | Low Voltage | $V_{OL}$ | VSS | - | 0.1 x VDD | V |

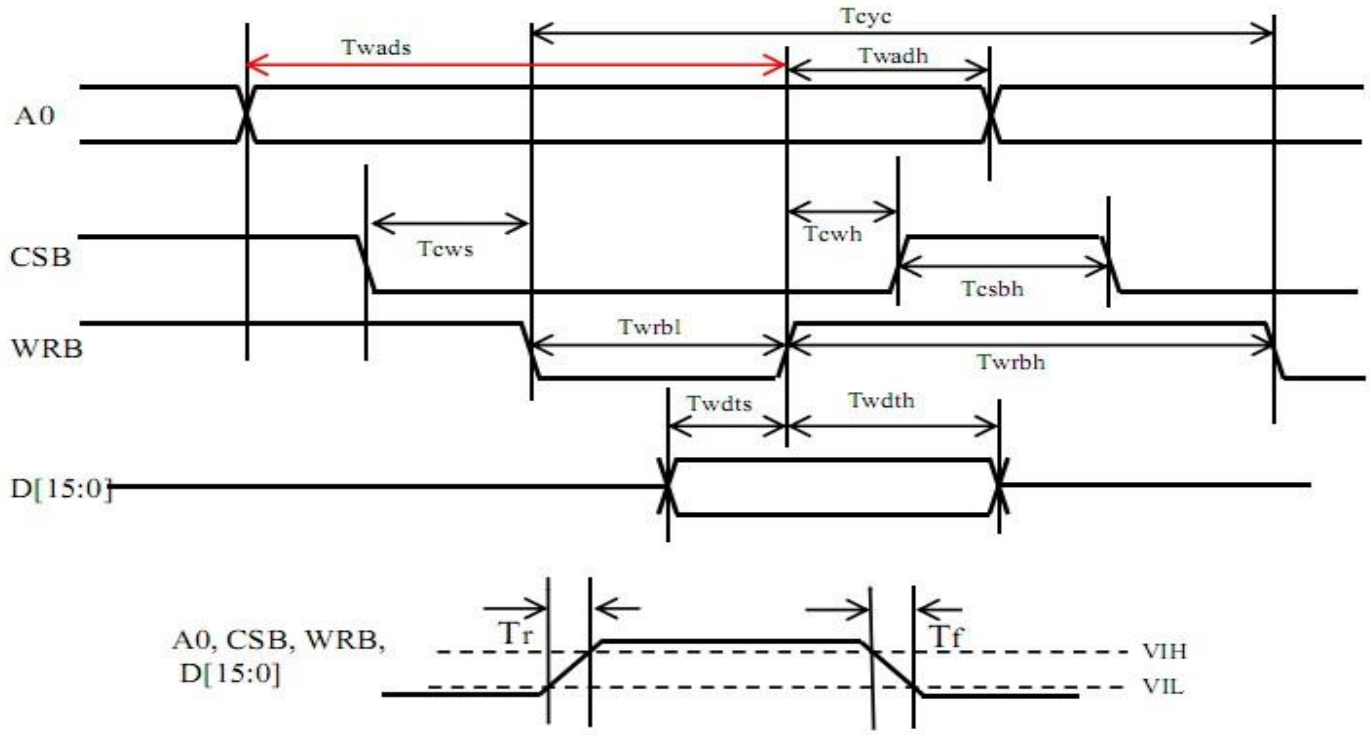
## ◆AC Characteristics

### ◆ 8080-Series MCU Parallel Interface Timing Characteristics

Writing Timing for 80Series CPU

(Ta = -40 ~ +85℃, VSSA=VSSD=0V, VDD=2.8V, VCC_C=VCC_R=18V, R/G/BPRE=0V, CL=100pF)

| Parameter | Symbol | Related Pins | Specification | | Unit |
|---|---|---|---|---|---|
| | | | MIN | MAX | |
| Write Cycle Time | Tcyc | WRB | 100 | - | ns |
| Address Setup Time | Twads | A0 | 50 | | ns |
| Address Hold Time | Twadh | A0 | 20 | | ns |
| Select Setup Time | Tcws | CSB | 10 | | ns |
| Select Hold Time | Tcwh | CSB | 20 | | ns |
| Write Low Pulse Width | Twrbl | WRB | 30 | | ns |
| Write High Pulse Width | Twrbh | WRB | 40 | | ns |
| Select High Pulse Width | Tcsbh | CSB | 10 | | ns |
| Data Setup Time | Twdts | D15 ~ D0 | 10 | | ns |
| Data Hold Time | Twdth | D15 ~ D0 | 30 | | ns |
| Rising Time | Tr | A0, CSB, WRB, D15 ~ D0 | - | 30 | ns |
| Falling Time | Tf | A0, CSB, WRB, D15 ~ D0 | - | 30 | ns |

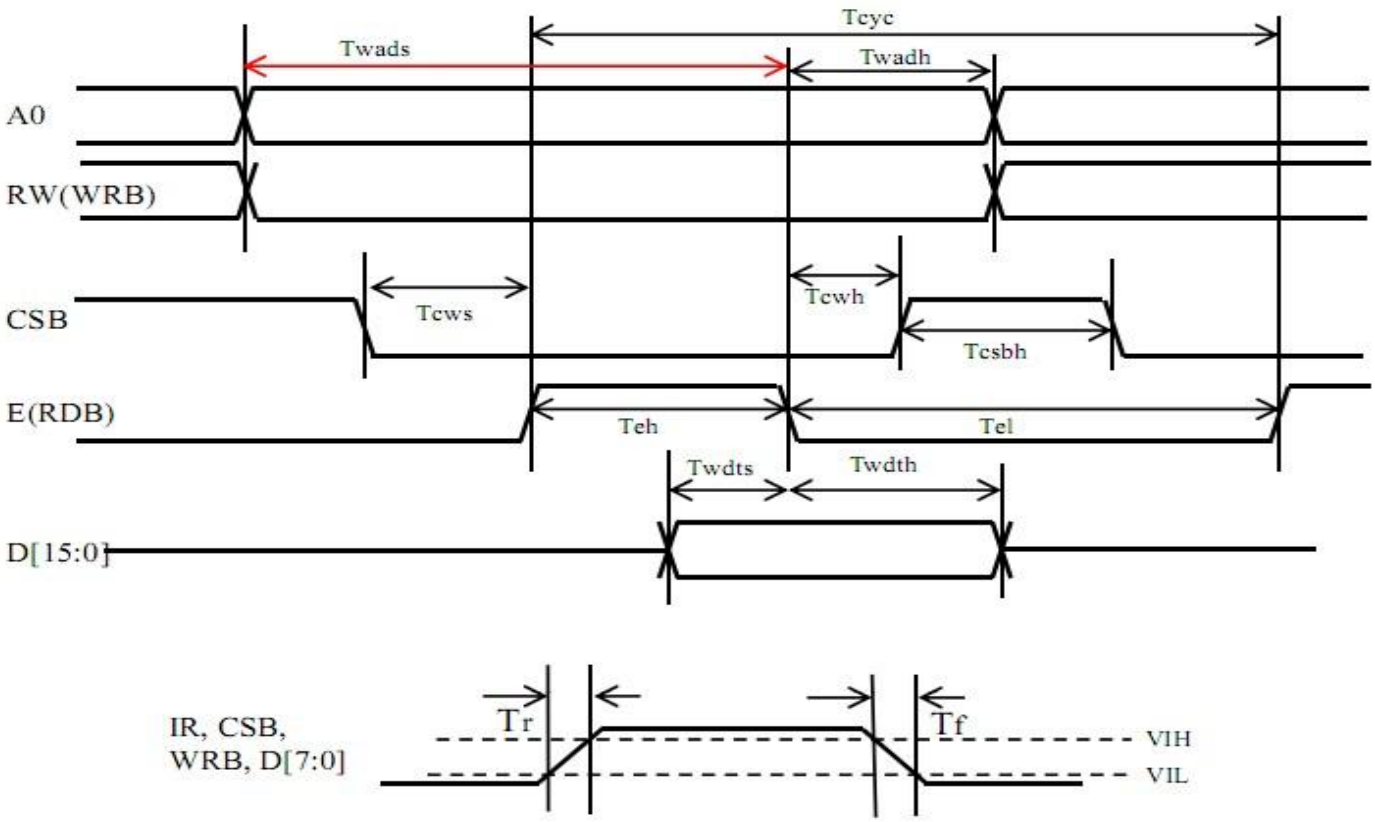



## 6800-series parallel interface characteristics

Writing Timing for 68 Series CPU

(Ta = -40 ~ +85℃, VSSA=VSSD=0V, VDD=2.8V, VCC_C=VCC_R=18V, R/G/BPRE=0V, CL=100pF)

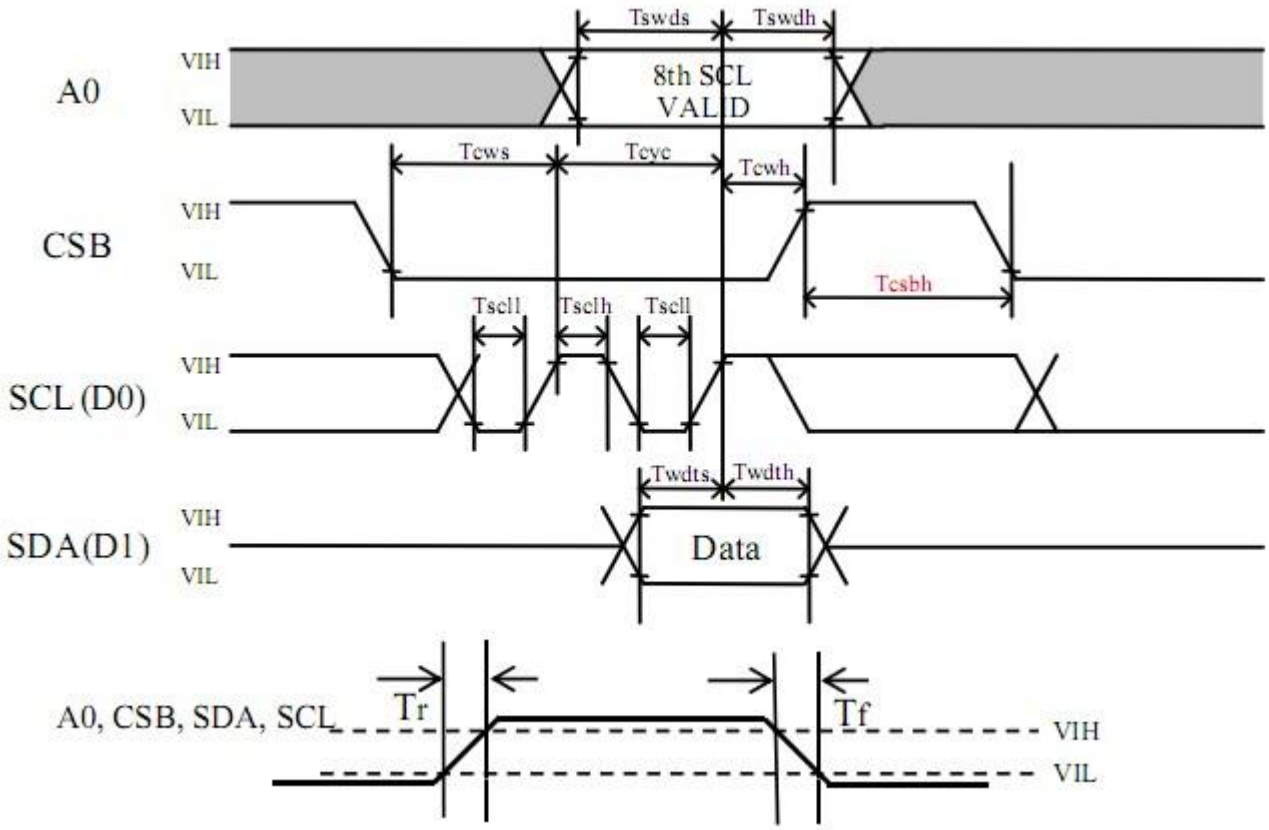
| Parameter | Symbol | Related Pins | Specification | | Unit |
|---|---|---|---|---|---|
| | | | MIN | MAX | |
| Write Cycle Time | Tcyc | E | 100 | - | ns |
| Address Setup Time | Twads | A0, RW | 50 | | ns |
| Address Hold Time | Twadh | A0, RW | 20 | | ns |
| Select Setup Time | Tcws | CSB | 10 | | ns |
| Select Hold Time | Tcwh | CSB | 20 | | ns |
| Write Low Pulse Width | Tel | E | 40 | | ns |
| Write High Pulse Width | Teh | E | 30 | | ns |
| Select High Pulse Width | Tcsbh | CSB | 10 | | ns |
| Data Setup Time | Twdts | D15 ~ D0 | 10 | | ns |
| Data Hold Time | Twdth | D15 ~ D0 | 30 | | ns |
| Rising Time | Tr | A0, CSB, RW, E, D15 ~ D0 | - | 30 | ns |
| Falling Time | Tf | A0, CSB, RW, E, D15 ~ D0 | - | 30 | ns |




## ◆Serial Interface Timing Characteristics

(Ta = -40 ~ +85℃, VSSA=VSSD=0V, VDD=2.8V, VCC_C=VCC_R=18V, R/G/BPRE=0V, CL=100pF)

| Parameter | Symbol | Related Pins | Specification | | Unit |
|---|---|---|---|---|---|
| | | | MIN | MAX | |
| Write Cycle Time | Tcyc | SCL(D0) | 100 | - | ns |
| Address Setup Time | Tswds | A0 | 65 | | ns |
| Address Hold Time | Tswdh | A0 | 35 | | ns |
| Select Setup Time | Tcws | CSB | 65 | | ns |
| Select Hold Time | Tcwh | CSB | 35 | | ns |
| SCL Low Pulse Width | Tscll | SCL(D0) | 45 | | ns |
| Write High Pulse Width | Tsclh | SCL(D0) | 45 | | ns |
| Select High Pulse Width | Tcsbh | CSB | 30 | | ns |
| Data Setup Time | Twdts | SDA(D1) | 20 | | ns |
| Data Hold Time | Twdth | SDA(D1) | 30 | | ns |
| Rising Time | Tr | A0, CSB, SDA, SCL | - | 30 | ns |
| Falling Time | Tf | A0, CSB, SDA, SCL | - | 30 | ns |

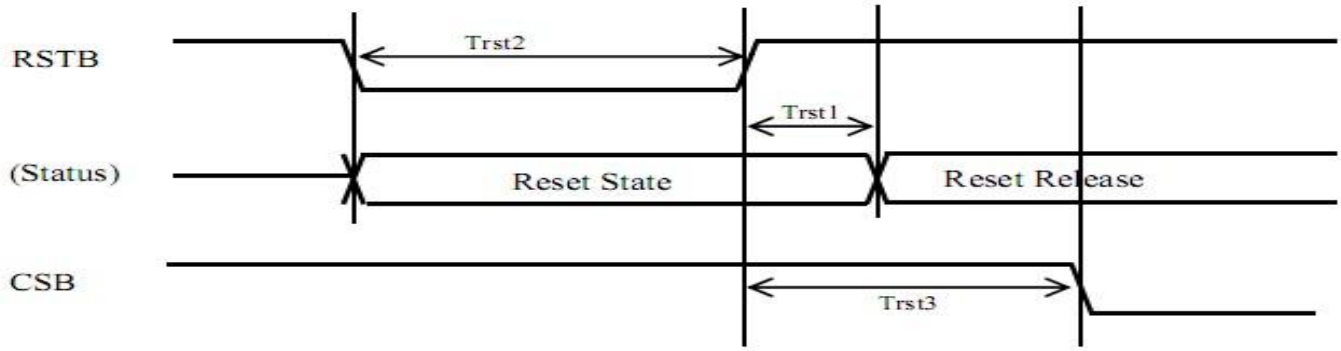


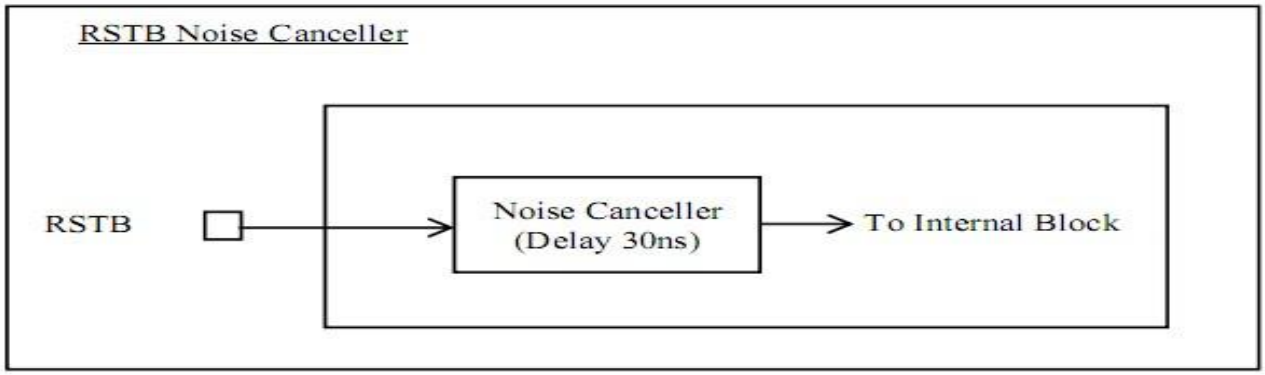

## ◆Reset Timing

(Ta = -40 ~ +85℃, VSSA=VSSD=0V, VDD=2.8V, VCC_C=VCC_R=18V, R/G/BPRE=0V, CL=100pF)

| Parameter | Symbol | Related Pins | Specification | | Unit |
|---|---|---|---|---|---|
| | | | MIN | MAX | |
| The completion Time of Reset | Trst1 | RSTB | 30 (Typ.) | | ns |
| Reset Low Pulse Width | Trst2 | RSTB | 1000 | | ns |
| RSTB non-overlap to CSB | Trst3 | RSTB, CSB | 100 | | ns |

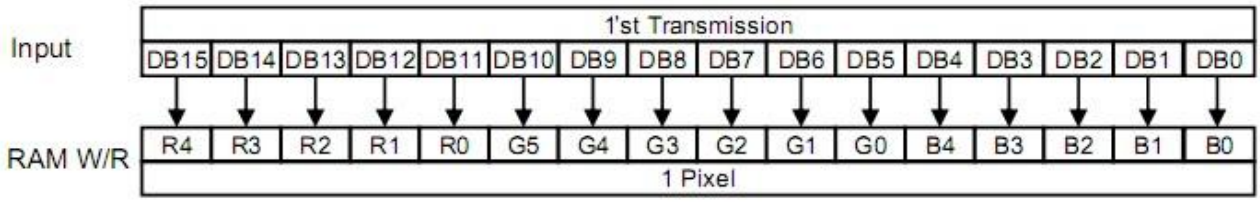
* RSTB pad ignores typically the pulse width less than 30ns.



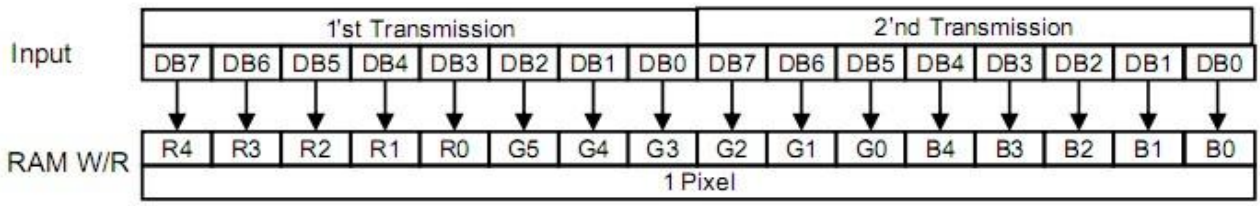




## ◆Read/Write Dot matrix Display Data

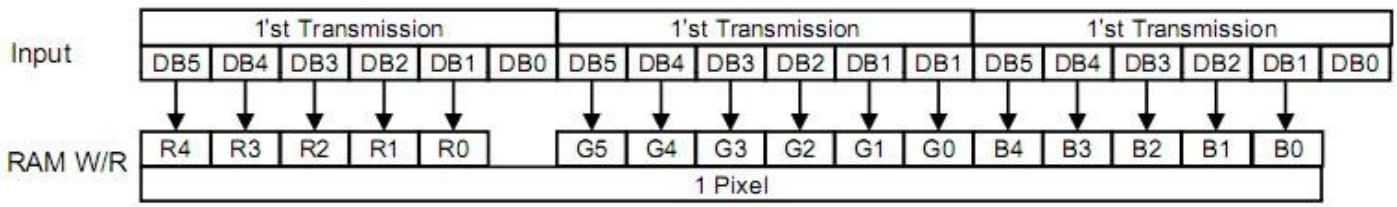
### 16-Bit I/F(65K color)



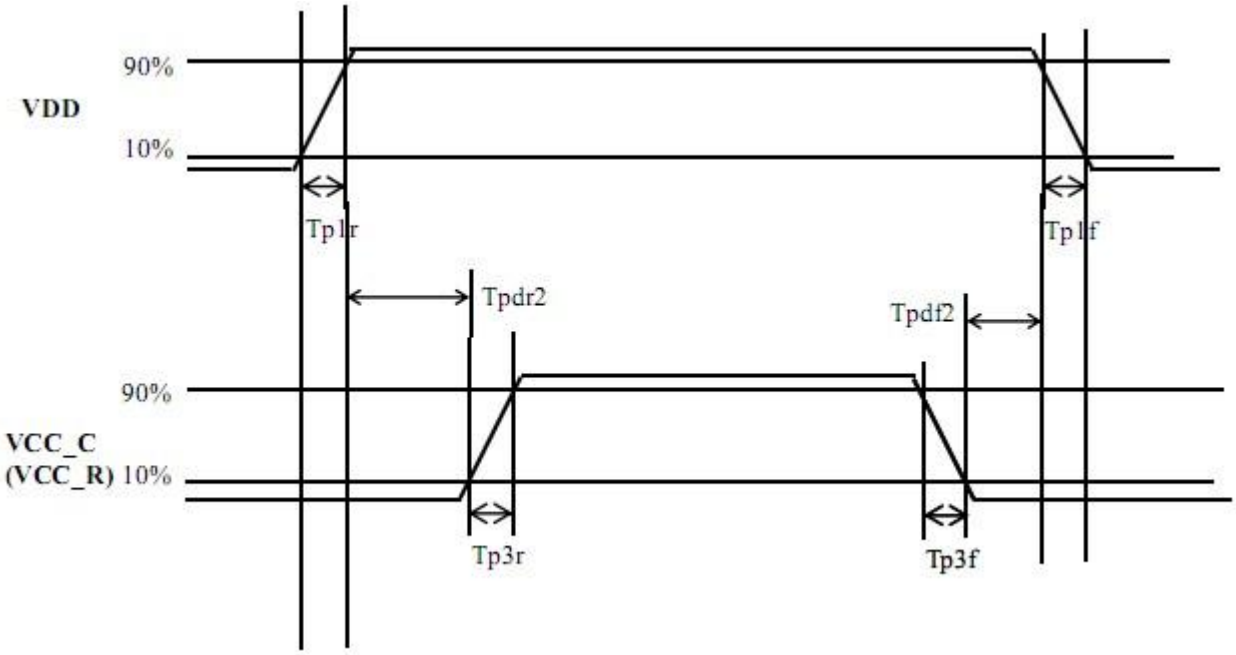

### 8-Bit I/F(65K color)




### 6-Bit I/F(65K color)



## ■ TIMING OF POWER SUPPLY




(Ta = -40 ~ +85℃, VSSA=VSSD=0V, VDD=2.8V, VCC_C=VCC_R=18V, R/G/BPRE=0V, CL=100pF)

| Parameter | Symbol | Related Pins | Specification | | | Unit |
|---|---|---|---|---|---|---|
| | | | MIN | TYP | MAX | |
| VDD On Slope<br>VDD Off Slope | Tp1r<br>Tp1f | VDD | 0.2 | 1 | 5 | ms/V |
| VCC_C(VCC_R) On Slope<br>VCC_C(VCC_R) Off Slope | Tp3r<br>Tp3f | VCC_C(VCC_R) | 0.2 | 1 | 5 | ms/V |
| From VDD to<br>VCC_C(VCC_R) Delay | Tpdr2 | VDD,<br>VCC_C(VCC_R) | 2 | - | - | ms |
| From VCC_C(VCC_R)<br>to VDD Delay | Tpdf2 | VDD,<br>VCC_C(VCC_R) | 2 | - | - | ms |

## ■ ELECTRO-OPTICAL CHARACTERISTICS (Ta=25℃)

| Items | | Symbol | Min. | Typ. | Max. | Unit | Remark |
|---|---|---|---|---|---|---|---|
| Luminance | | L | 80 | 100 | - | cd /m$^2$ | With Polarizer All pixels on |
| Power Consumption | | P | - | 375 | 490 | mW | 30% pixels On |
| Frame Frequency | | Fr | - | 105 | - | Hz | - |
| Color Coordinate | | CIE x<br>CIE y | 0.26<br>0.29 | 0.30<br>0.33 | 0.34<br>0.37 | CIE1931 | White |
| | | CIE x<br>CIE y | 0.60<br>0.31 | 0.64<br>0.35 | 0.68<br>0.39 | | Red |
| | | CIE x<br>CIE y | 0.26<br>0.57 | 0.30<br>0.61 | 0.34<br>0.65 | | Green |
| | | CIE x<br>CIE y | 0.11<br>0.11 | 0.15<br>0.15 | 0.19<br>0.19 | | 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 | 10,000 | - | - | Hours | - |

**Note:**

1. 100 **cd/m$^2$** test condition:
   **Voltage driving:** VDD= 3V, VCC_C= 15V;
   **Contrast Setting:**
   Red contrast : 0X60;
   Green contrast : 0X54;
   Blue contrast : 0X68;
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 alternatively displayed)
(The initial value should be closed to the typical value after adjusting.)

## ■ INTERFACE PIN CONNECTIONS

| No | Symbol | Description |
|---|---|---|
| 1 | NC | No connection |
| 2 | VCC_R | This pin is the power output pin of internal row power regulator. A 4.7uF capacitor is recommended to connect between VCC_R and GND. If internal row power regulator is disabled, It must be connected to the external high voltage source. |
| 3 | VDDL | Internal Logic Power. Capacitor is connected between VDDL and VSSD |
| 4 | VDD | Interface Power & Analog Power |
| 5 | RSTB | Reset (Active Low) |
| 6 | WRB | Write (Active Low) for 80 Series, H : Read, L : Write for 68 Series |
| 7 | RDB | Read (Active Low) for 80 Series, Read or Write Enable for 68 Series |
| 8 | CSB | Chip Select (Active Low) |
| 9 | A0 | Address ( L: command, H: Parameter) |
| 10-25 | D0-D15 | Data Bus;D0 isData Bus or Clock Input for Serial Interface, D1 is Data Bus or Data Input for Serial Interface. |
| 26 | PS | H: Parallel L: Serial |
| 27 | C80 | H: 68CPU L: 80CPU |
| 28 | BPRE | Column Driver Pre-Charge Power for Red |
| 29 | GPRE | Column Driver Pre-Charge Power for Green |
| 30 | RRE | Column Driver Pre-Charge Power for Blue |
| 31 | VCC_C | Column Driver Power |
| 32 | VSS | Gound |
| 33 | NC | No connection |

**MCU Bus Interface Pin Selection:**
Select appropriate logic setting as described in the following table.

| | C80 | PS |
|---|---|---|
| **8080** | **0** | **1** |
| **6800** | **1** | **1** |
| **sesial** | **0** | **0** |

**Note**
(1) 0 is connected to VSS
(2) 1 is connected to VDD

## ■ COMMAND TABLE

| Address | Register Name | Bit7 | Bit6 | Bit5 | Bit4 | Bit3 | Bit2 | Bit1 | Bit0 | Default |
|---|---|---|---|---|---|---|---|---|---|---|
| 01h | SOFTRES | - | - | - | - | - | - | - | - | - |
| 02h | DDISPON/OFF | - | - | - | - | - | - | - | D0 | 00h |
| 03h | DSTBYON/OFF | - | - | - | - | - | - | - | D0 | 01h |
| 04h | DFRAME | - | - | - | - | M | F2 | F1 | F0 | 02h |
| 05h | WriteDirection | - | - | - | - | D3 | D2 | D1 | D0 | 00h |
| 06h | ScanDirection | - | - | - | - | - | - | - | D0 | 00h |
| 07h | DispSize | - | - | - | - | - | FX8 | FX7 | FX6 | 00h |
| | | - | - | FX5 | FX4 | FX3 | FX2 | FX1 | FX0 | 00h |
| | | - | - | - | - | - | TX8 | TX7 | TX6 | 04h |
| | | - | - | TX5 | TX4 | TX3 | TX2 | TX1 | TX0 | 1Fh |
| | | - | - | - | - | - | FY6 | FY5 | FY4 | 00h |
| | | - | - | - | - | FY3 | FY2 | FY1 | FY0 | 00h |
| | | - | - | - | - | - | TY6 | TY5 | TY4 | 05h |
| | | - | - | - | - | TY3 | TY2 | TY1 | TY0 | 0Fh |
| 08h | IF_BUS_SEL | - | - | - | - | - | - | D1 | I0 | 00h |
| 09h | Data_Masking | - | - | - | RV | - | R | G | B | 07h |
| 0Ah | MBoxSize | - | - | - | - | - | XS6 | XS5 | XS4 | 00h |
| | | - | - | - | - | XS3 | XS2 | XS1 | XS0 | 00h |
| | | - | - | - | - | - | XE6 | XE5 | XE4 | 05h |
| | | - | - | - | - | XE3 | XE2 | XE1 | XE0 | 0Fh |
| | | - | - | - | - | - | YS6 | YS5 | YS4 | 00h |
| | | - | - | - | - | YS3 | YS2 | YS1 | YS0 | 00h |
| | | - | - | - | - | - | YE6 | YE5 | YE4 | 05h |
| | | - | - | - | - | YE3 | YE2 | YE1 | YE0 | 0Fh |
| 0Bh | DISPStart | - | - | - | - | - | DX8 | DX7 | DX6 | 00h |
| | | - | - | DX5 | DX4 | DX3 | DX2 | DX1 | DX0 | 00h |
| | | - | - | - | - | - | DY6 | DY5 | DY4 | 00h |
| | | - | - | - | - | DY3 | DY2 | DY1 | DY0 | 00h |

| Address | Register Name | Bit7 | Bit6 | Bit5 | Bit4 | Bit3 | Bit2 | Bit1 | Bit0 | Default |
|---|---|---|---|---|---|---|---|---|---|---|
| 0Ch | DataWrite/Read | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 | - |
| 0Dh | READREG | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 | - |
| 0Eh | DotCurrent | - | - | - | - | IR7 | IR6 | IR5 | IR4 | 00h |
| | | - | - | - | - | IR3 | IR2 | IR1 | IR0 | 00h |
| | | - | - | - | - | IG7 | IG6 | IG5 | IG4 | 00h |
| | | - | - | - | - | IG3 | IG2 | IG1 | IG0 | 00h |
| | | - | - | - | - | IB7 | IB6 | IB5 | IB4 | 00h |
| | | - | - | - | - | IB3 | IB2 | IB1 | IB0 | 00h |
| 0Fh | PeakCurrent | - | - | PR5 | PR4 | PR3 | PR2 | PR1 | PR0 | 00h |
| | | - | - | PG5 | PG4 | PG3 | PG2 | PG1 | PG0 | 00h |
| | | - | - | PB5 | PB4 | PB3 | PB2 | PB1 | PB0 | 00h |
| 1Ch | PreC_Width | - | - | D5 | D4 | D3 | D2 | D1 | D0 | 08h |
| 1Dh | PeakWidth | - | - | D5 | D4 | D3 | D2 | D1 | D0 | 05h |
| | | - | - | D5 | D4 | D3 | D2 | D1 | D0 | 05h |
| | | - | - | D5 | D4 | D3 | D2 | D1 | D0 | 05h |
| 1Eh | PeakDelay | - | - | - | | D3 | D2 | D1 | D0 | 05h |
| 1Fh | Row_Scan | - | - | D5 | D4 | D3 | - | D1 | D0 | 00h |
| 30h | VCC_R_SEL | - | - | - | EN | - | D2 | D1 | D0 | 04h |
| 3Ah | Gamma_Tune | - | - | - | - | I3 | I2 | I1 | I0 | 00h |
| 3Bh | Gamma_Init | - | - | - | - | - | - | - | - | - |
| 3Dh | DMODE | - | - | - | - | - | - | D1 | D0 | 00h |
| 3Eh | TEST | - | - | - | - | - | - | D1 | D0 | 00h |
| | | | | | | | | | | |

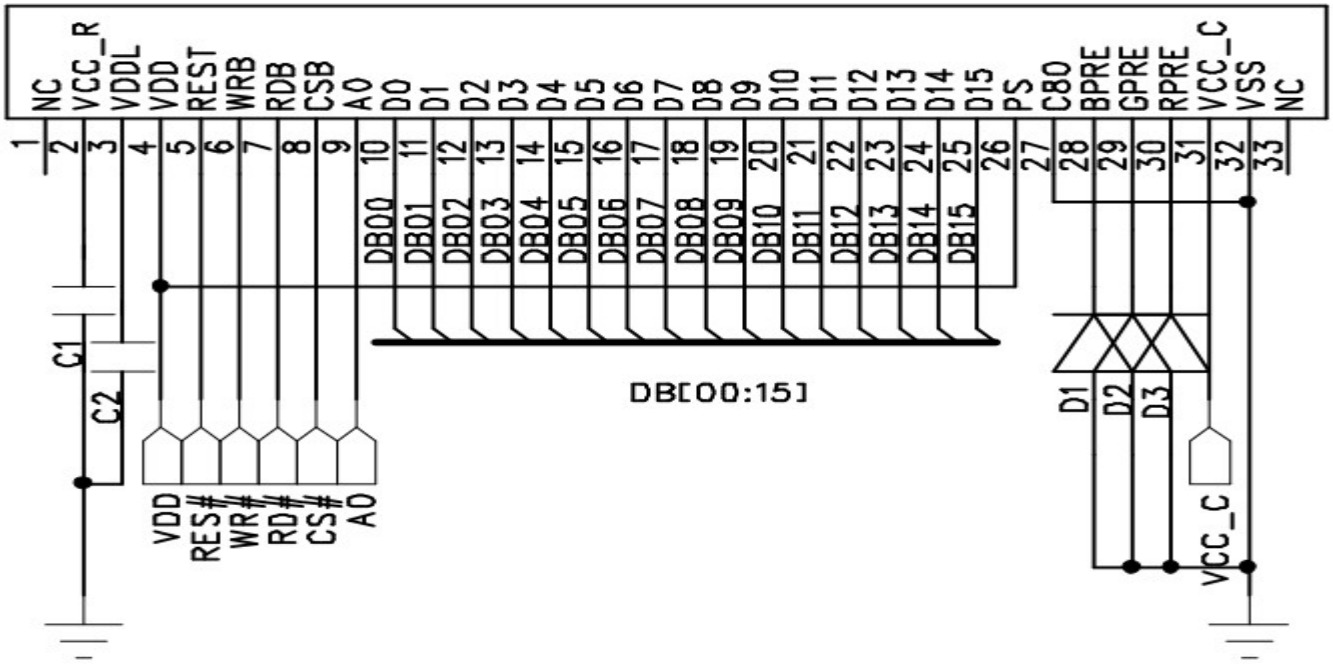
## ■ INITIALIZATION CODE

```
void InitOLED_LD7134()
{
WMOLED_COM(0x02);//display off
WMOLED_DATA(0x00);

WMOLED_COM(0x01);  //software reset The OSC.is stopped.

WMOLED_COM(0x03);
WMOLED_DATA(0x00);

WMOLED_COM(0x04);// Set OSC Control
WMOLED_DATA(0x03);

WMOLED_COM(0x05);// Set Graphic RAM Writing Direction
WMOLED_DATA(0x00);

WMOLED_COM(0x06);// Set Row Scan Direction
WMOLED_DATA(0x00);

WMOLED_COM(0x07);// Set Display Size
WMOLED_DATA(0x00);
WMOLED_DATA(0x00);
WMOLED_DATA(0x04);
WMOLED_DATA(0x1F);
WMOLED_DATA(0x00);
WMOLED_DATA(0x00);
WMOLED_DATA(0x05);
WMOLED_DATA(0x0F);

WMOLED_COM(0x08);// Set Interface Bus Type
WMOLED_DATA(0x03);


WMOLED_COM(0x09);// Set Masking Data
WMOLED_DATA(0x07);

WMOLED_COM(0x0A);// Set Read/Write Box Data
WMOLED_DATA(0x00);
WMOLED_DATA(0x00);
WMOLED_DATA(0x05);
WMOLED_DATA(0x0F);
WMOLED_DATA(0x00);
WMOLED_DATA(0x00);
WMOLED_DATA(0x05);
WMOLED_DATA(0x0F);

WMOLED_COM(0x0B);// Set Display Start Address
WMOLED_DATA(0x00);
WMOLED_DATA(0x00);
WMOLED_DATA(0x00);
WMOLED_DATA(0x00);
```

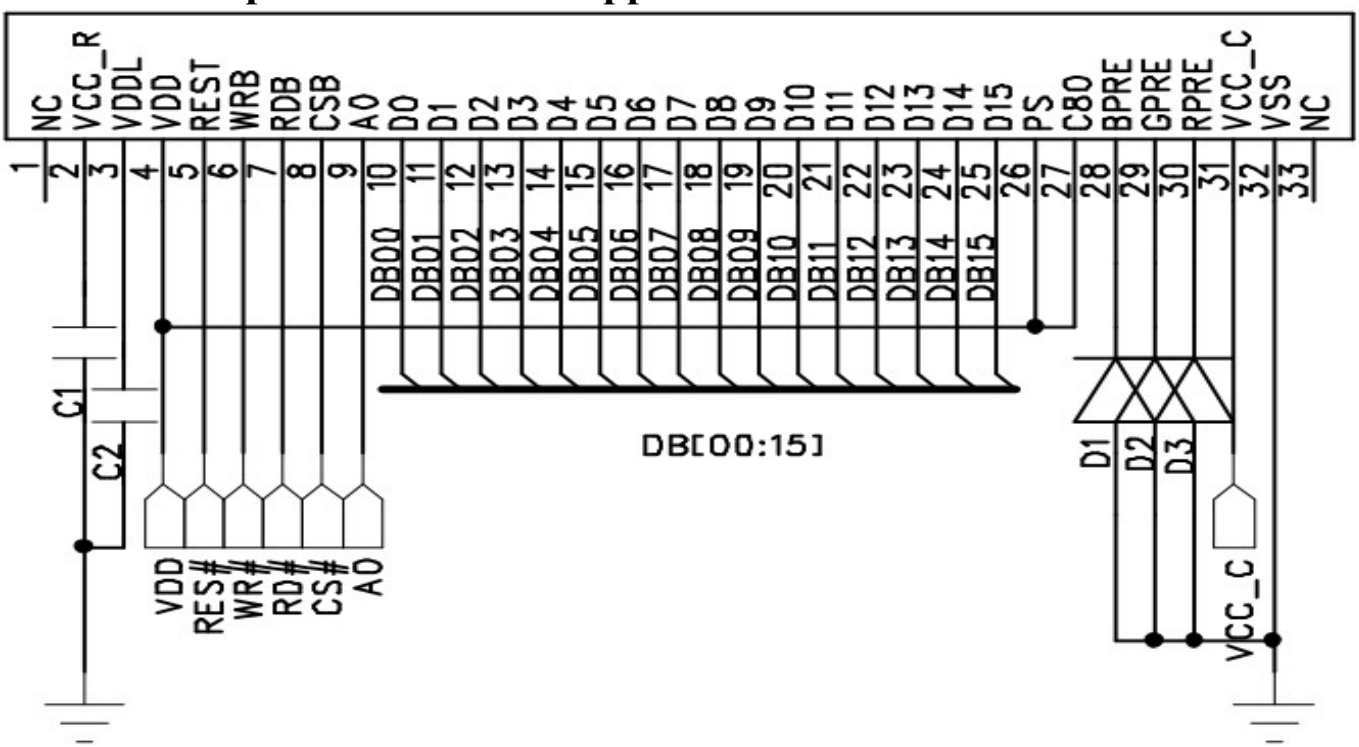
```
WMOLED_COM(0x0E);  //Set Dot Matrix Current Level
WMOLED_DATA(0x06);
WMOLED_DATA(0x00);
WMOLED_DATA(0x05);
WMOLED_DATA(0x04);
WMOLED_DATA(0x06);
WMOLED_DATA(0x08);

WMOLED_COM(0x0F);  //Set Dot Matrix Peak Current Level
WMOLED_DATA(0x00);
WMOLED_DATA(0x00);
WMOLED_DATA(0x00);

WMOLED_COM(0x1C);  //Set Pre-Charge Width
WMOLED_DATA(0x08);

WMOLED_COM(0x1D);   //Set Peak Pulse Width;Parameter Range :01h-3fh
WMOLED_DATA(0x05);  //for Red
WMOLED_DATA(0x05);  //for Green
WMOLED_DATA(0x05);  //for Blue

WMOLED_COM(0x1E); //Set Peak Pulse Delay
WMOLED_DATA(0x01);  //01h-0fh

WMOLED_COM(0x1F);//Set Row Scan Operation
WMOLED_DATA(0x00);

WMOLED_COM(0x30);//Set Internal Regulator for Row Scan
WMOLED_DATA(0x10);

WMOLED_COM(0x3B); //Set Gamma Correction Table Initialize

WMOLED_COM(0x3C);//Set VDD Selection
WMOLED_DATA(0x00);

WMOLED_COM(0x3D);//Set DMODE Selection
WMOLED_DATA(0x00);

WMOLED_COM(0x02);//display on
WMOLED_DATA(0x01);
}
```

## ■ SCHEMATIC EXAMPLE

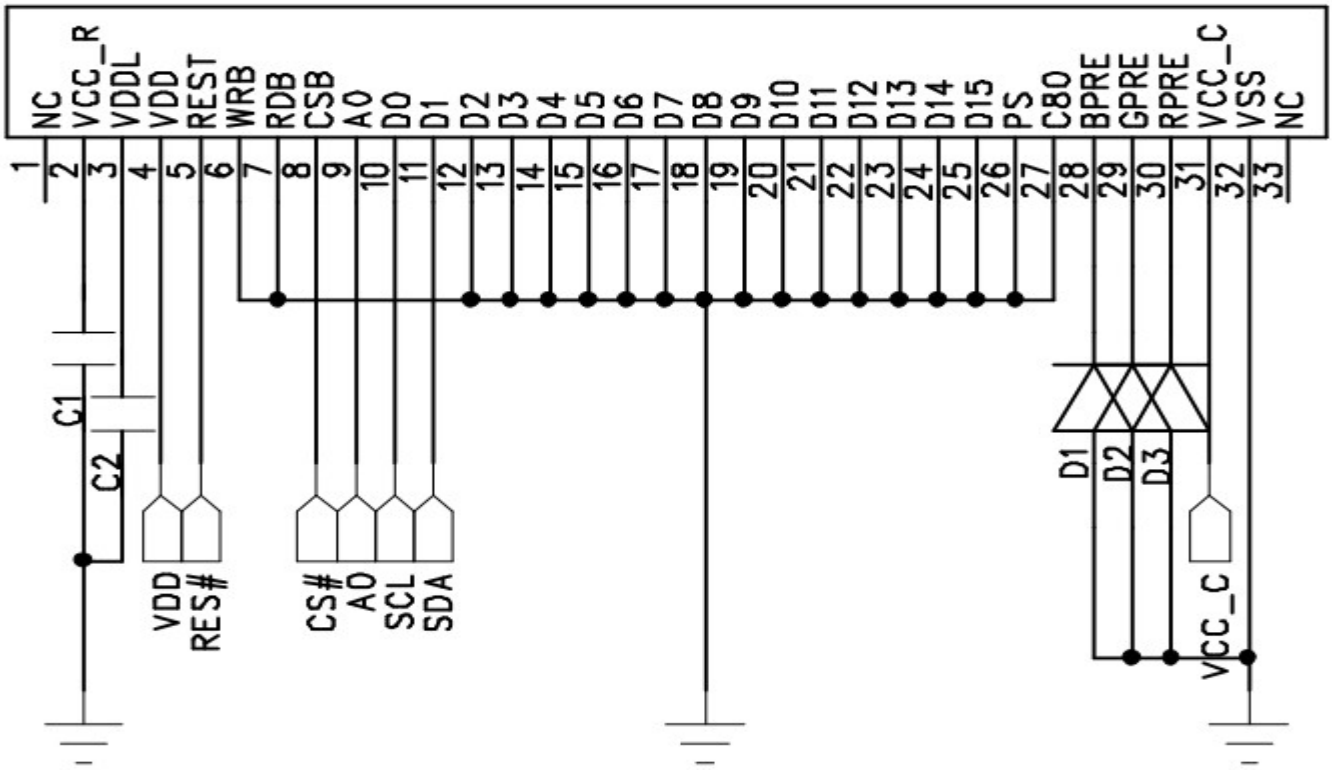
### ◆16-bit 8080 parallel Interface Application Circuit:




### ◆16-bit 6800 parallel Interface Application Circuit:



## ◆SPI Application Circuit:




C1=C2=4.7uF;
D1=D2=D3=Vz=3V(Zener diode)

## ■ RELIABILITY TESTS

| Item | | Condition | Criterion |
|---|---|---|---|
| High Temperature Storage (HTS) | | 80±2℃, 200 hours | 1. After testing, the function test is ok.<br>2. After testing, no addition to the defect.<br>3. After testing, the change of luminance should be within +/- 50% of initial value.<br>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.<br>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.<br>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.<br>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.

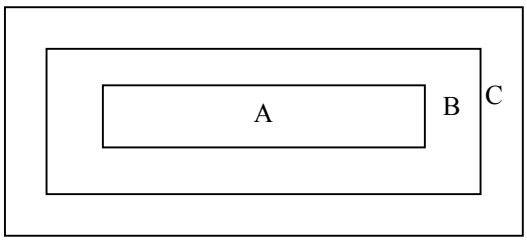
# ■ OUTGOING QUALITY CONTROL SPECIFICATION

## ◆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

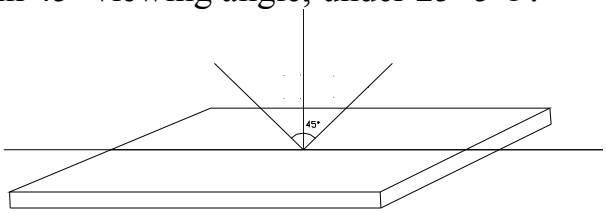
Zone B: Viewing Area except Zone A

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 45º viewing angle, under 25±5℃.



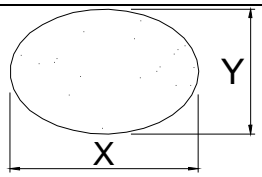
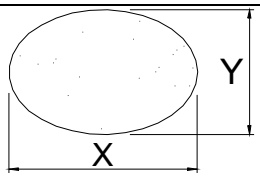

2 The luminance and color coordinate inspection : By PR705 or BM-7 or the equal equipments, in the dark room, under 25±5℃.

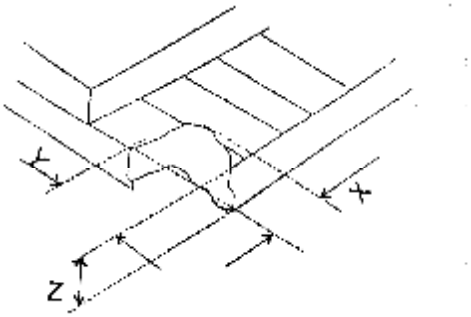
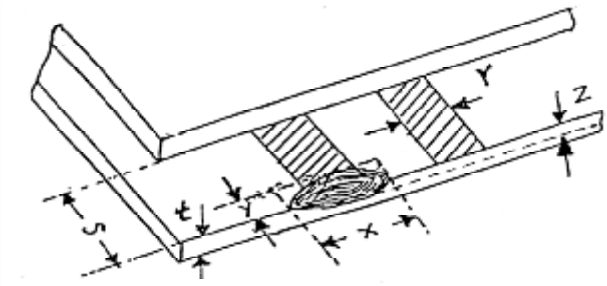
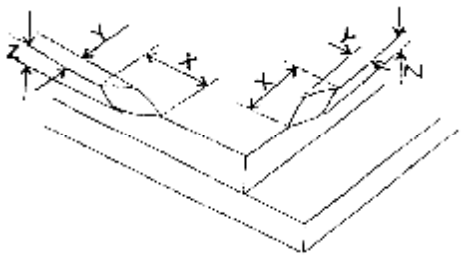
## ◆Inspection Criteria

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="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<br>(mm)<br>  <br><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<br>(mm)<br>  <br><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<br>(mm)<br>  <br><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 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.