Product Specification

(Preliminary)

Part Name: OLED Display Module

Part ID: LY120-096096

PREPARED BY	CHECKED BY	APPROVED BY

LI YUAN ELECTRONICS CO., LTD.

Notes:

1. Please contact Li Yuan Electronics Co., Ltd. before assigning your product based on this module specification.
2. The information contained herein is presented merely to indicate the characteristics and performance of our products. No responsibility is assumed by Li Yuan Electronics Co., Ltd. . For any intellectual property claims or other problems that may result from application baesd on the module described

CONTENT

1 Overview

LY120-096096 is an OLED grayscale 96×96 dot matrix display module. The characteristics of this display module are high brightness, self-emission, high contrast ratio, slim/thin outline, wide viewing angle, wide temperature range, and low power consumption.

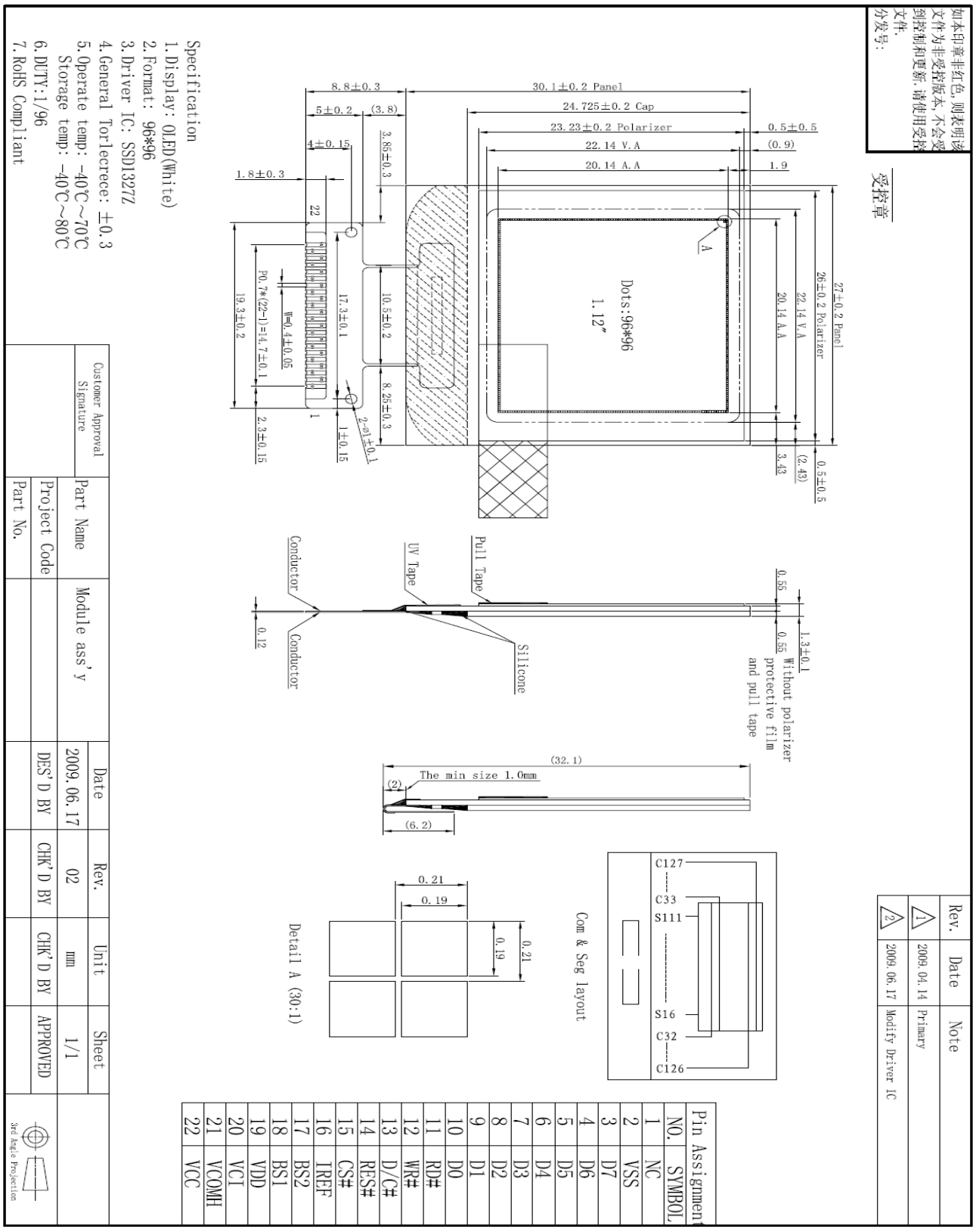
2 Features

- Display Color: White (16 gray scale)
- Dot Matrix:96×96
- Driver IC: SSD1327Z
- Interface:8-bit 8080,8-bit 6800, 4-line SPI, I^2C
- Wide range of operating temperature: -40℃-70℃

3 Mechanical Data

NO.	ITEM	SPECIFICATION	UNIT
1	Dot Matrix	96(W)×96(H)	-
2	Dot Size	0.19(W)×0.19(H)	mm^2
3	Dot Pitch	0.21(W)×0.21(H)	mm^2
4	Aperture Rate	82	%
5	Active Area	20.14(W)×20.14(H)	mm^2
6	Panel Size	27.0(W)×30.1(H)	mm^2
7	Module Size	According to the annexed mechanical drawing	mm^3
8	Diagonal A/A Size	1.12	inch
9	Module Weight	2.01±10%	gram

4 Mechanical Drawing



5 Module Interface

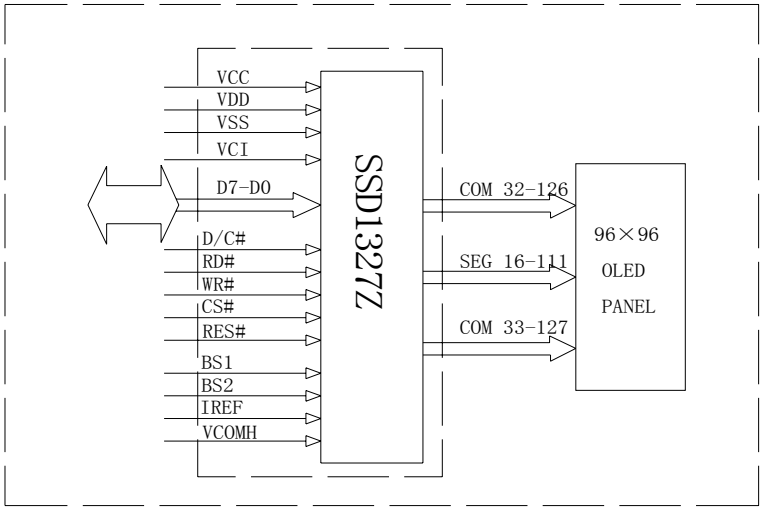
PIN NO.	PIN NAME	DESCRIPTION
1	NC	No Connection.
2	VSS	Ground.
3~10	D7~D0	Data bus.
11	RD#	This pin is MCU interface input.
12	WR#	This pin is read / write control input connecting to the MCU interface.
13	D/C#	Data/Command Select. H: Data; L: Command.
14	RES#	Reset, active low.
15	CS#	Chip Select, active low.
16	IREF	This is a segment current reference pin.
17~18	BS2~BS1	Table:5-1
19	VDD	Power supply pin for core logic operation.
20	VCI	Low voltage power supply and power supply for interface logic level.
21	VCOMH	This is an input pin for the voltage output high level for COM signals.
22	VCC	OLED drive voltage, it should be supplied externally.

Table:5-1

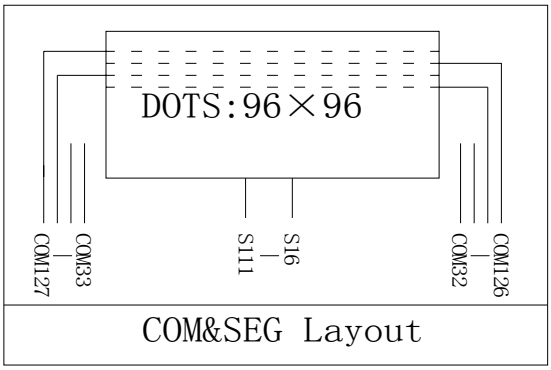
BS[2:1]	Interface
00	4-line SPI
01	I^2C
11	8-bit 8080
10	8-bit 6800

6 Function Block Diagram

6.1 Function Block Diagram



6.2 Panel Layout Diagram



7 Absolute Maximum Ratings

ITEM	SYMBOL	MIN	MAX	UNIT	REMARK
Supply Voltage	V_{DD}	-0.5	+2.75	V	IC maximum rating
	V_{CC}	-0.5	+19	V	IC maximum rating
	V_{CI}	-0.3	4.0	V	
Operating Temp.	Top	-40	+70	℃	-
Storage Temp	Tstg	-40	+80	℃	-

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

Note (2): Permanent breakage of module may occur if the module is used beyond the maximum rating. The module can be normal operated under the conditions according to Section 8 "Electrical Characteristics". Malfunctioning of the module may occur and the reliability of the module may deteriorate if the module is used beyond the conditions.

8 Electrical Characteristics

8.1 DC Electrical Characteristics

ITEM	SYMBOL	TEST CONDITION	MIN	TYPE	MAX	UNIT
Logic Supply Voltage	V_{DD}	22±3°C, 55±15%R.H	1.65	-	2.6	V
OLED Driver Supply Voltage	V_{CC}	22±3°C, 55±15%R.H	14.5	15	15.5	V
Low voltage power supply for I/O pins	V_{CI}	22±3°C, 55±15%R.H	1.65	-	3.5	V
High-level Input Voltage	V_{IH}	-	0.8×V_{DD}	-	-	V
Low-level Input Voltage	V_{IL}	-	0	-	0.2×V_{DD}	V
High-level Output Voltage	V_{OH}	-	0.9×V_{DD}	-	-	V
Low-level Output Voltage	V_{OL}	-	0	-	0.1×V_{DD}	V

Note : The V_{CC} input must be kept in a stable value; ripple and noise are not allowed.

8.2 Electro-optical Characteristics

ITEM	SYMBOL	TEST CONDITION	MIN	TYPE	MAX	UNIT
Normal Mode Brightness	L_{br}	All pixels ON(1)	80	100	-	cd/m^2
Standby Mode Brightness		Standby Mode 10% pixels ON(2)	-	21	-	cd/m^2
Normal Mode Power Consumption	Pt	All pixels ON(1)	-	265.5	330	mW
Standby Mode Power Consumption		Standby Mode 10% pixels ON(2)	-	32	-	mW
C.I.E(White)	(x)	x,y(CIE1931)	0.25	0.29	0.33	-
	(y)		0.28	0.32	0.36	-
Dark Room Contrast	CR	-	≥2000:1	-	-	-
Response Time	-	-	---	10	-	μs
View Angle	-	-	≥160	-	-	Degree

Note(1): Normal Mode test conditions are as follows:

- Driving voltage : 15V
- Contrast setting : 0x53
- Frame rate : 105HZ
- Duty setting : 1/96

Note(2): Standby Mode test conditions are as follows:

- Driving voltage : 15V
- Contrast setting : 0x53
- Frame rate : 105HZ
- Duty setting : 1/96

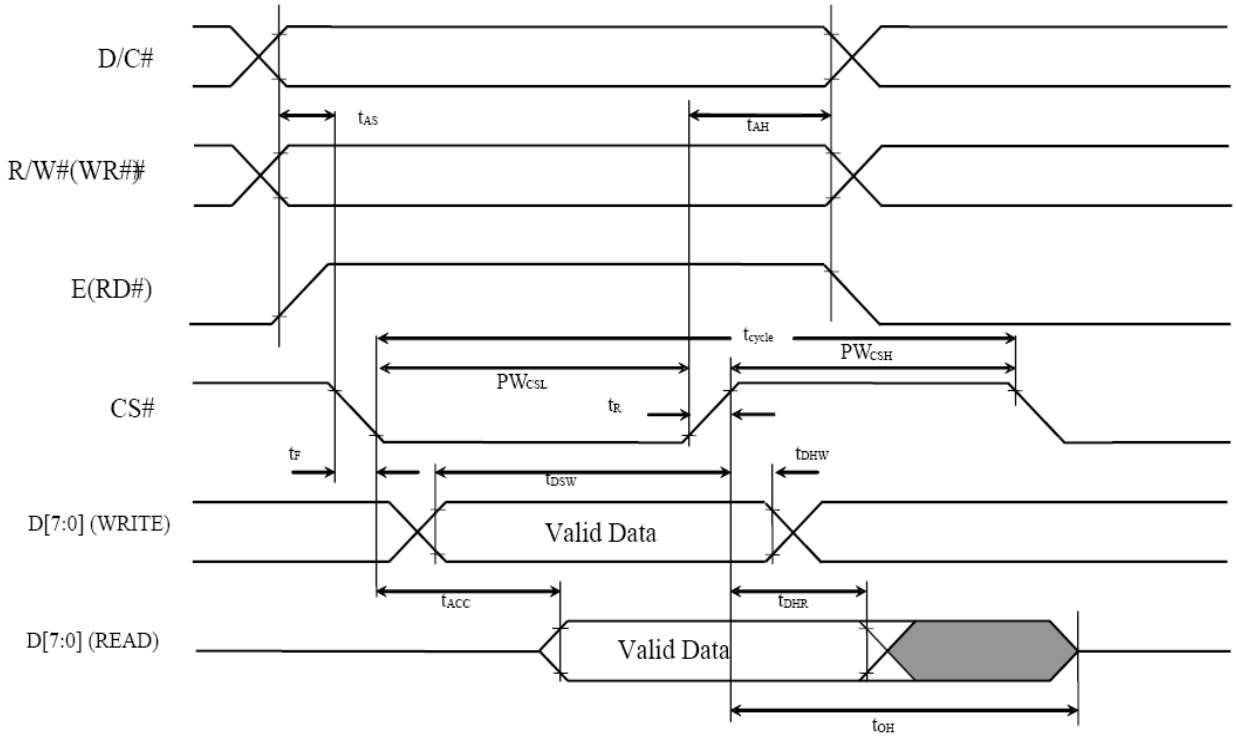
8.3 AC Electrical Characteristics

(1)6800-Series MPU Parallel Interface Timing Characteristics

(V_{CI} - V_{SS} = 1.65V to 3.5V, 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

Figure 13-1 : 6800-series MCU parallel interface characteristics

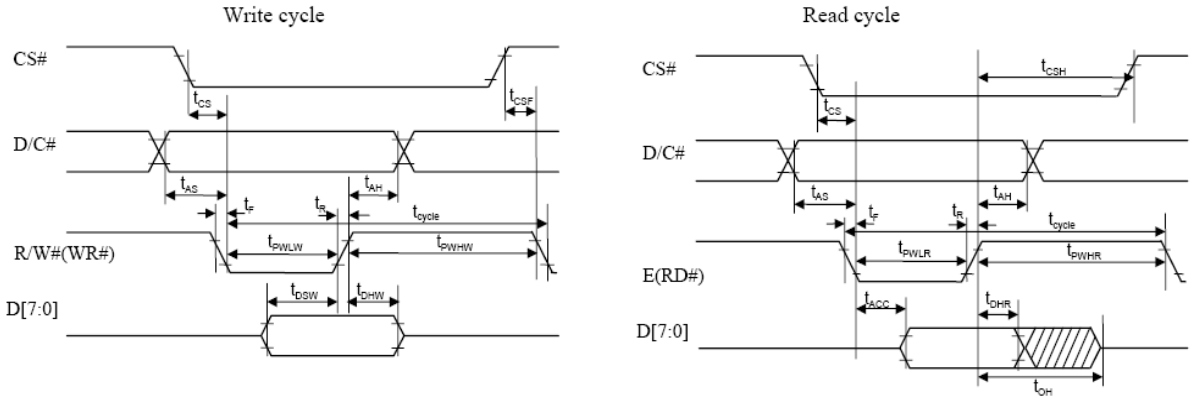


(2)8080-Series MPU Parallel Interface Timing Characteristics

(V_{CI} - V_{SS} = 1.65V to 3.5V, 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

Figure 13-2 : 8080-series MCU parallel interface characteristics

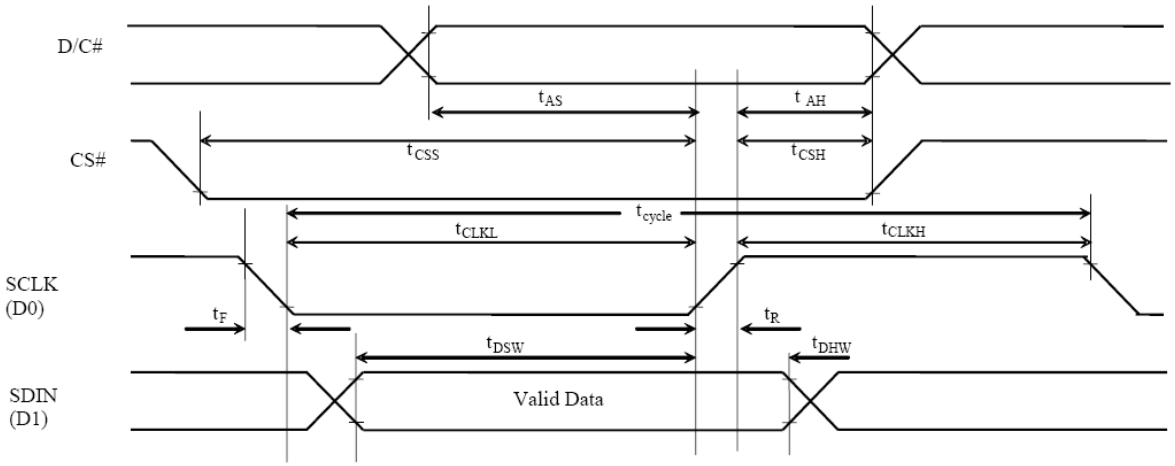


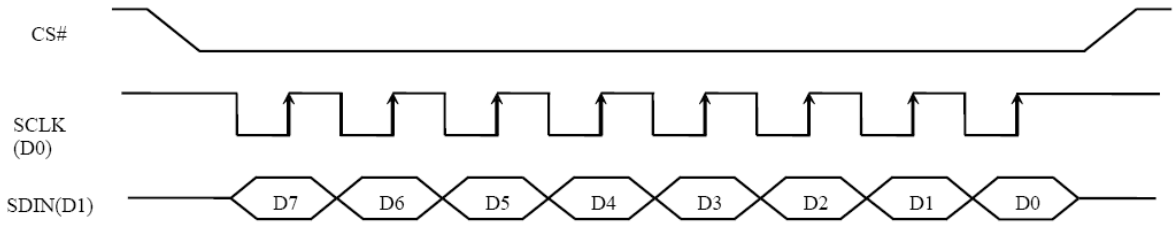
(3)Serial Interface Timing Characteristics

(V_{CI} - V_{SS} = 1.65V to 3.5V, T_A = 25°C)

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	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

Figure 13-3 : Serial interface characteristics (4-wire SPI)



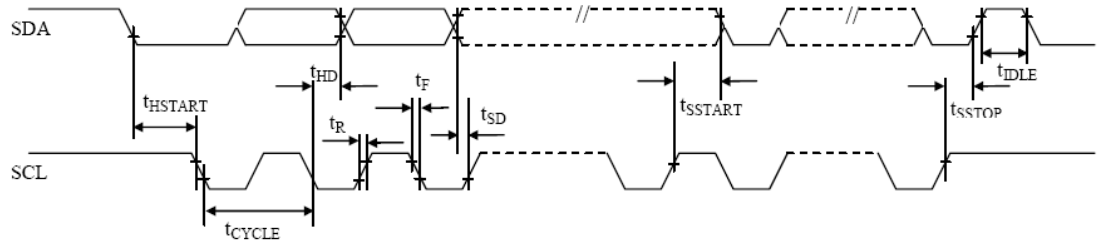


(4) I2C Interface Timing Characteristics

(V_{CI} - 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 "SDA_{OUT}" pin)	0	-	-	ns
	Data Hold Time (for "SDA_{IN}" pin)	300	-	-	ns
t_{SD}	Data Setup Time	100	-	-	ns
t_{SSTART}	Start condition Setup Time (Only relevant for a repeated Start condition)	0.6	-	-	us
t_{SSTOP}	Stop condition Setup Time	0.6	-	-	us
t_R	Rise Time for data and clock pin	-	-	300	ns
t_F	Fall Time for data and clock pin	-	-	300	ns
t_{IDLE}	Idle Time before a new transmission can start	1.3	-	-	us

Figure 13-5: I^2C interface Timing characteristics



9 Functional Specification and Application Circuit

9.1 Power ON and Power OFF Sequence

Power ON Sequence:

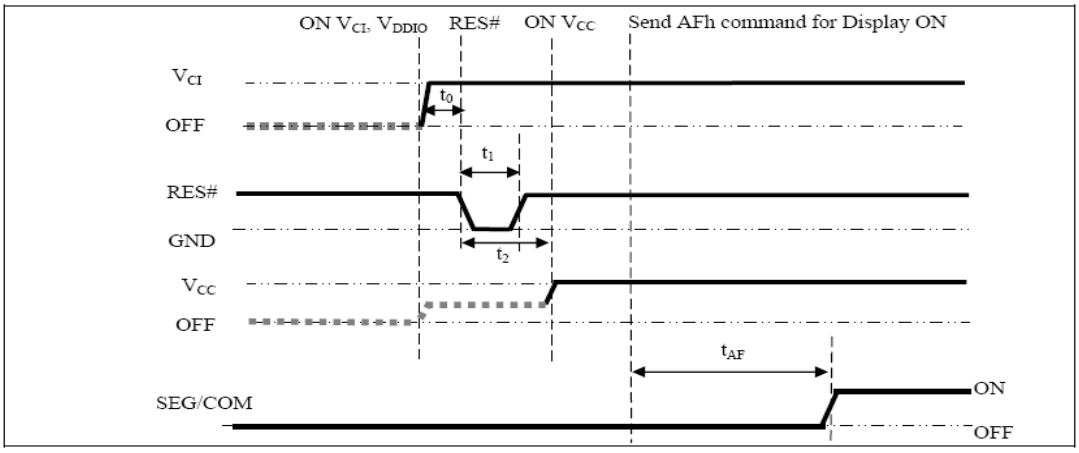
1. Power ON $V_{CI.}$

2. After V_{CI} 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 100us (t_1) and then HIGH (logic high).

3. After set RES# pin LOW (logic low), wait for at least 100us (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}).

Figure 8-17 : The Power ON sequence.



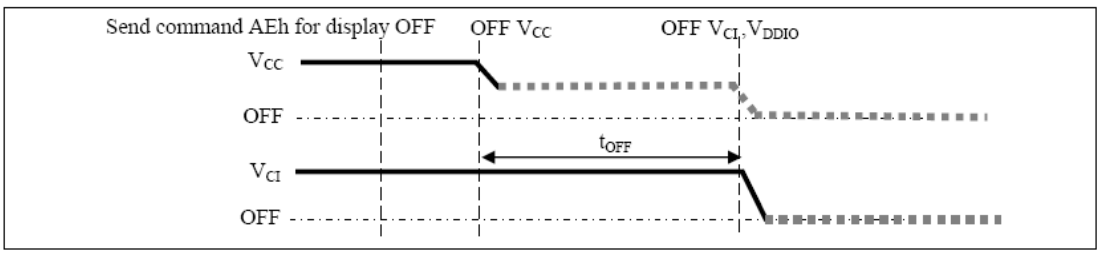
Power OFF Sequence:

1. Send command AEh for display OFF.

2. Power OFF V_{CC}.(1), (2),(3).

3. Wait for t_{OFF}. Power OFF VDD. (where Minimum t_{OFF}=0ms, Typical t_{OFF}=100ms)

Figure 8-18 : The Power OFF sequence



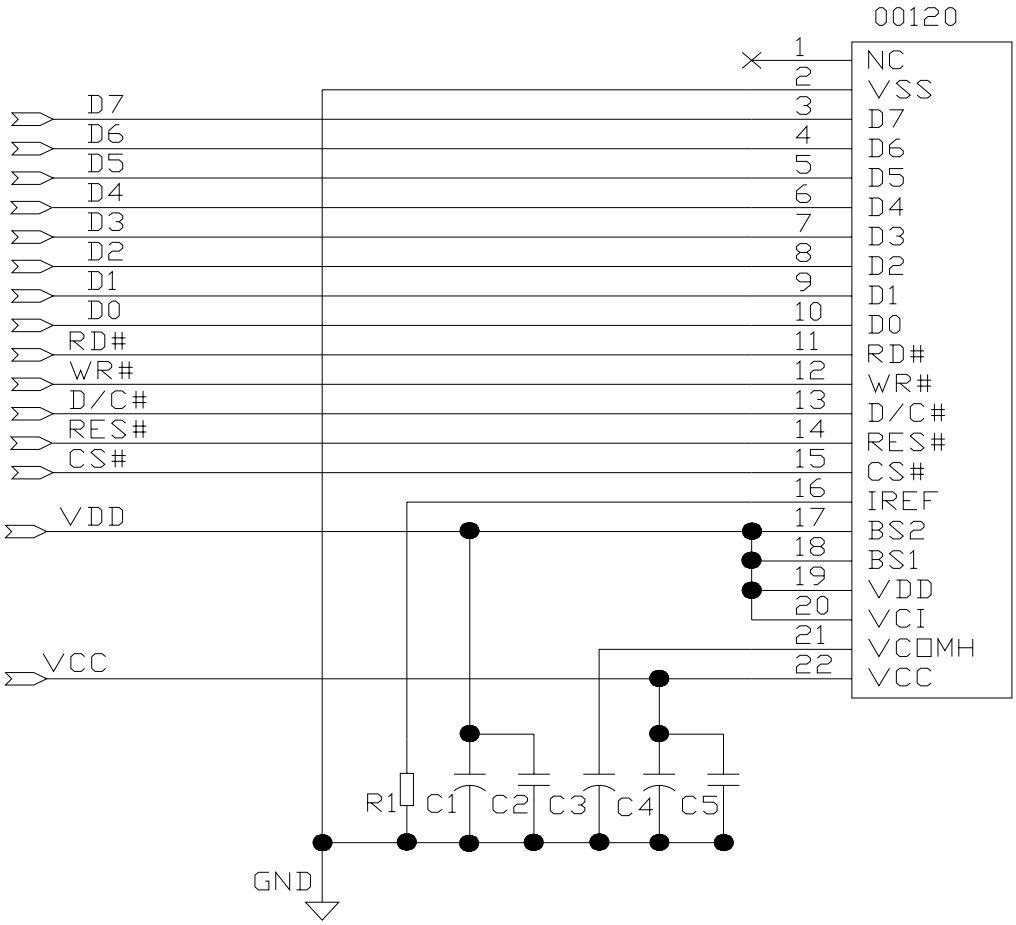
Note:

(1) Since an ESD protection circuit is connected between VDD and VCC, VCC becomes lower than VDD whenever VDD is ON and VCC is OFF as shown in the dotted line of VCC in above figures.

(2). VCC should be kept float (disable) when it is OFF.

9.2 Application Circuit

The configuration for 8080-parallel interface mode, external VCC is shown in the following diagram:



Pin connected to MCU interface: D[7:0], RD#, WR#, D/C#, CS#, RES#

Recommended components

C1,C3,C4: 4.7μF/25V.ROHS (Tantalum Capacitors)

C2,C5: 0.1uF-0603-X7R±10%.ROHS

R1: 0603 1/10W +/-5% 1.2Mohm.ROHS

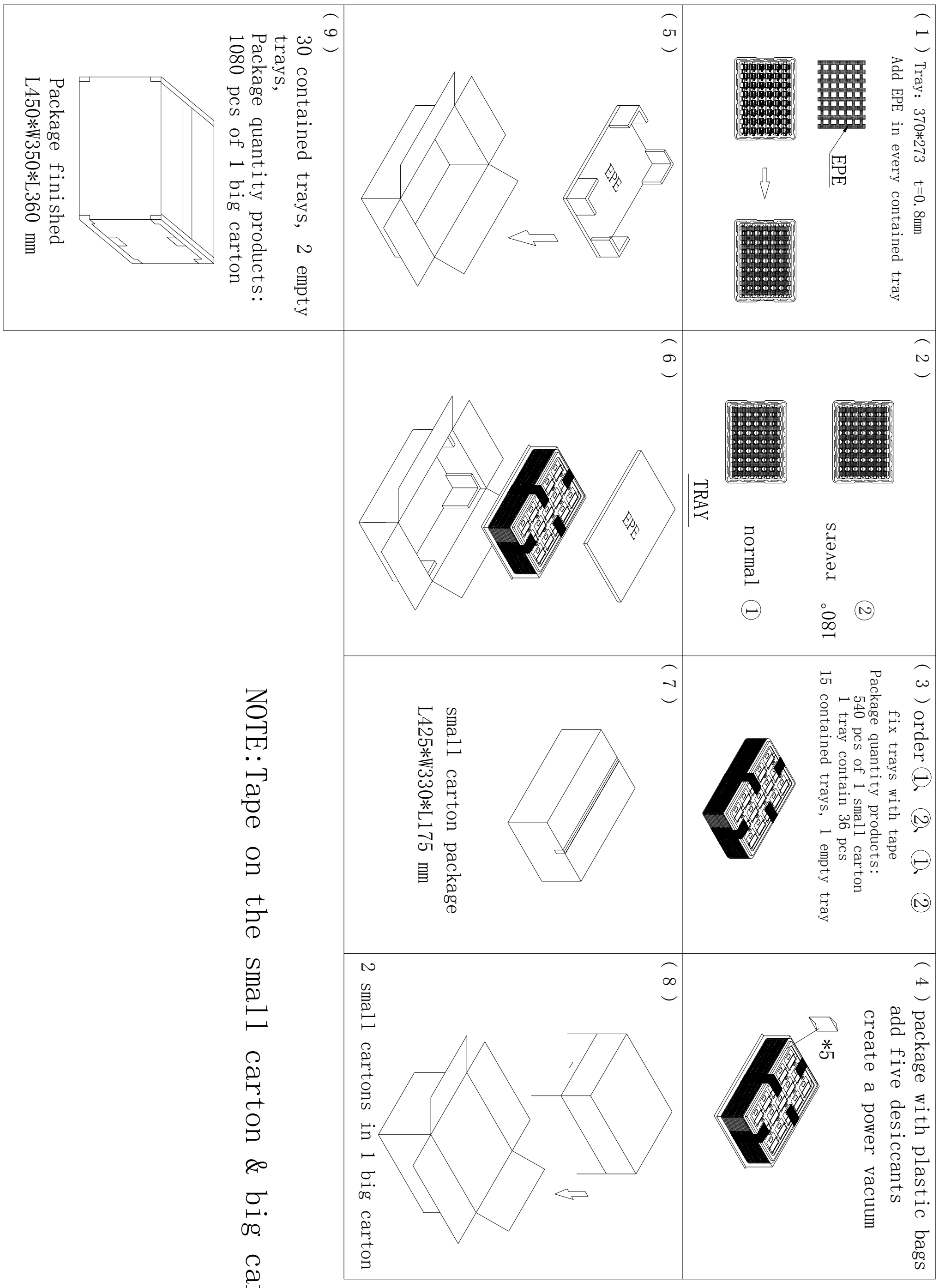
9.3 Display Control Instruction

Refer to SSD1327 IC Specification.

9.4 Recommended Software Initialization

```
void Init_SSD1327( )
{
    Write_Command(0xfd);    // set command unlock
    Write_Command(0x12);
    Write_Command(0xae);    //display off
    Write_Command(0xa8);    //set multiplex ratio
    Write_Command(0x5f);    //96
    Write_Command(0xa1);    //set display start line
    Write_Command(0x00);
    Write_Command(0xa2);    //set display offset
    Write_Command(0x60);
    Write_Command(0xa0);    //set remap
    Write_Command(0x42);
    Write_Command(0xab);    // set vdd internal
    Write_Command(0x01);    //
    Write_Command(0x81);    // set contrasr
    Write_Command(0x53);    // 100 nit
    Write_Command(0xb1);    // Set Phase Length
    Write_Command(0X51);     //
    Write_Command(0xb3);    // Set Display Clock Divide Ratio/Oscillator Frequency
    Write_Command(0x01);
    Write_Command(0xb9);    //
    Write_Command(0xbc);    // set pre_charge voltage/VCOMH
    Write_Command(0x08);     //(0x08);
    Write_Command(0xbe);    // set VCOMH
    Write_Command(0X07) ;    //(0x07);
    Write_Command(0xb6);    // Set second pre-charge period
    Write_Command(0x01);    //
    Write_Command(0xd5);    // enable second precharge and enternal vsl
    Write_Command(0X62);      //(0x62);
    Write_Command(0xa4);    // Set Display Mode
    Write_Command(0xaf);    // display on
}
```

10 Package Specification



NOTE:Tape on the small carton & big carton

11 Reliability

11.1 Reliability Test

NO.	ITEM	CONDITION	QUANTITY
1	High Temperature (Non-operation)	80℃,240hrs	4
2	Low Temperature (Non-operation)	-30℃,240hrs	4
3	High Temperature (Operation)	70℃,240hrs	4
4	Low Temperature (Operation)	-30℃,240hrs	4
5	High Temperature / High Humidity (Operation)	60℃,90%RH,240hrs	4
6	Thermal shock (Non-operation)	-30℃~80℃(-30℃/30min;transit/3min;80℃/30min;transit/3min) 1cycle: 66min,30cycles	4
7	Vibration	Frequency: 5~50Hz,0.5G Scan rate: 1 oct/min Time: 2 hrs/axis Test axis: X,Y, Z	1 Carton
8	Drop	Height: 100 cm Sequence: 1 angle, 3 edges and 6 faces	1 Carton

Test and measurement conditions

1. All measurements shall not be started until the specimens attain to temperature stability, the stable time is at least 15 minutes.
2. The degradation of polarizer is ignored for item 5.
3. The tolerance of temperature is ±3℃, and the tolerance of relative humidity is ±5%.

Evaluation criteria

1. The function test is OK.
2. No observable defects.
3. Luminance:≥50% of initial value.
4. Current consumption: within ± 50% of initial value.

11.2 Lifetime

End of lifetime is specified as 50% of initial brightness and the test pattern at operating condition is 50% alternating checkerboard.

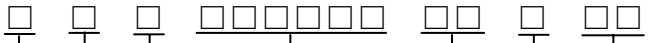
ITEM	MIN	MAX	UNIT	CONDITION
Operation Life Time	35000	-	hrs	100 cd/m^2,50% Checkerboard

An average operating lifetime of more than 10,000 hrs (checkerboard) at room temperature is approached by 240 hrs @ 80°C operating.

11.3 Failure Check Standard

After the completion of the described reliability test, the samples were left at room temperature for 2 hrs prior to conducting the failure test at 22±3°C; 55±15% RH.

12 Illustration of OLED Product Name



Flow No. :

01~99

Display Color :

R—red

G—green

B—blue

Y—yellow

W—white

A—area color

F—full color

Panel Flow No. :

A0~A9, B0~B9…Z0~Z9

Display Format :

Graphic—columns and rows

Character—characters and line number

Segment—segment number

Icon—pixel number

Product Type :

P—panel

M—module

Display Type :

G—graphic

C—character

S—segment

I—Icon

M—mixed

Company :

L —Li Yuan

13 Outgoing Quality Control Specifications

13.1 Sampling Method

(1) GB/T 2828.1-2003/ISO2859-1：1999, inspection level Ⅱ, normal inspection, single sample inspection

(2) AQL: Major 0.65; Minor 1.0

13.2 Inspection Conditions

The environmental conditions for test and measurement are performed as follows.

Temperature: 22±3°C

Humidity: 55±15%R.H

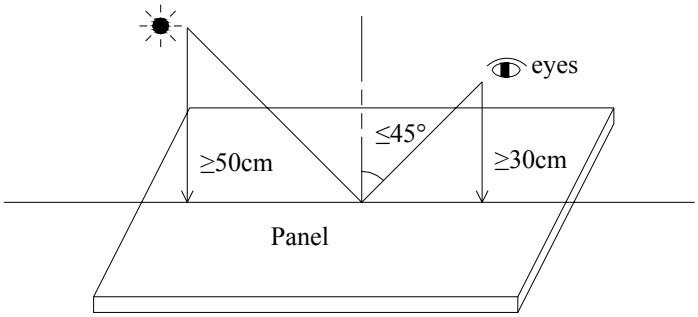
Fluorescent Lamp: 30W

Distance between the Panel & Lamp: ≥50cm

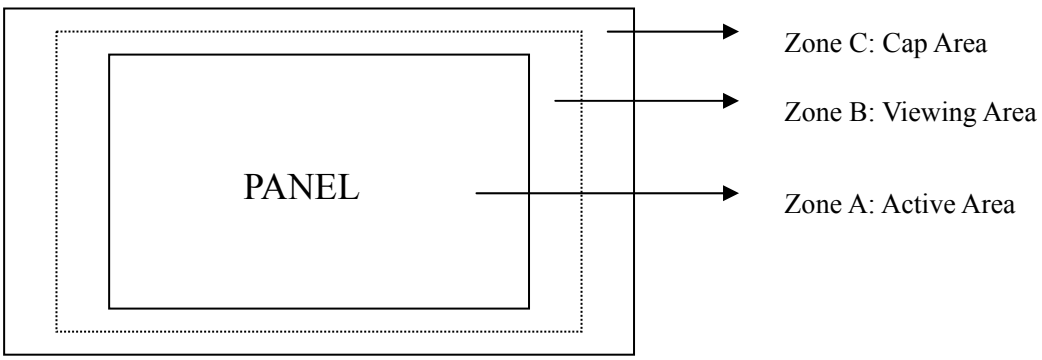
Distance between the Panel & Eyes: ≥30cm

Viewing angle from the vertical in each direction: ≤45°

(See the sketch below)

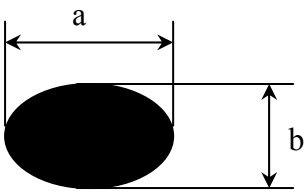


13.3 Quality Assurance Zones

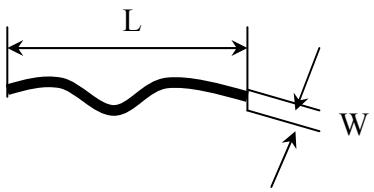


13.4 Inspection Standard

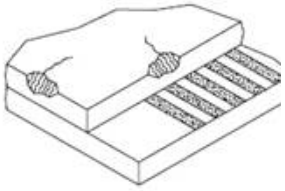
Definition of Φ&L&W (Unit: mm)

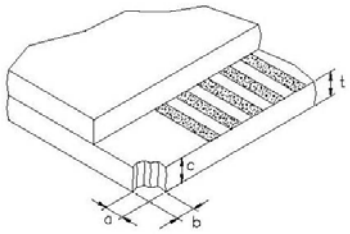
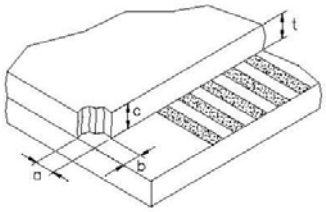
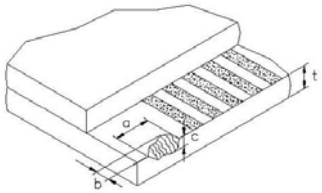
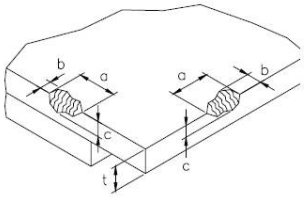
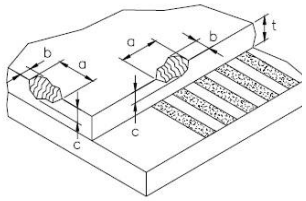


Φ=(a+b)/2



Ⅰ. Appearance Defects

<table>
<tr><th>NO.</th><th>ITEM</th><th>CRITERIA</th><th>CLASSIFICATION</th></tr>
<tr><td>1</td><td>Polarizer Black or White spot, Dirty spot, Foreign matter, Dent on the polarizer</td><td>
<table>
<tr><td rowspan="2">Average Diameter (mm)</td><td colspan="2">Acceptable Number</td></tr>
<tr><td>Zone A,B</td><td>Zone C</td></tr>
<tr><td>Φ≤0.15</td><td>Ignore</td><td rowspan="3">Ignore</td></tr>
<tr><td>0.15＜Φ≤0.30</td><td>3</td></tr>
<tr><td>Φ＞0.30</td><td>0</td></tr>
</table>
</td><td>Minor</td></tr>
<tr><td>2</td><td>Scratch/line on the glass/Polarizer</td><td>
<table>
<tr><td rowspan="2">Width (mm)</td><td rowspan="2">Length (mm)</td><td colspan="2">Acceptable Number</td></tr>
<tr><td>Zone A,B</td><td>Zone C</td></tr>
<tr><td>W≤0.03</td><td>---</td><td>Ignore</td><td rowspan="3">Ignore</td></tr>
<tr><td>0.03＜W≤0.08</td><td>L≤5.0</td><td>3</td></tr>
<tr><td>W＞0.08</td><td>---</td><td>0</td></tr>
</table>
</td><td>Minor</td></tr>
<tr><td>3</td><td>Polarizer Bubble</td><td>
<table>
<tr><td rowspan="2">Average Diameter (mm)</td><td colspan="2">Acceptable Number</td></tr>
<tr><td>Zone A,B</td><td>Zone C</td></tr>
<tr><td>Φ>0.5</td><td>0</td><td rowspan="3">Ignore</td></tr>
<tr><td>0.2＜Φ≤0.5</td><td>3</td></tr>
<tr><td>Φ≤0.2</td><td>Ignore</td></tr>
</table>
</td><td>Minor</td></tr>
<tr><td>4</td><td>Any Dirt & Scratch on Polarizer’s Protective Film</td><td>Ignore for not affect the polarizer.</td><td>Acceptable</td></tr>
<tr><td>5</td><td>Glass Crack</td><td>  Propagation crack is not acceptable.</td><td>Major</td></tr>
</table>

6	Corner Chip	 t= Glass thickness Accept a≤2.0mm or b≤2.0mm, c≤t	Minor
7	Corner Chip on Cap Glass	 t= Glass thickness Accept a≤1.5mm or b≤1.5mm, c≤t	Minor
8	Chip on Contact Pad	 t= Glass thickness Accept a≤3.0mm or b≤0.8mm, c≤t (on the contact pin) a≤3.0mm or b≤1.5mm, c≤t (outside of the contact pin)	Minor
9	Chip on Face of Display	 t= Glass thickness Accept a≤1.5mm or b≤1.5mm, c≤t	Minor
10	Chip on Cap Glass	 t= Glass thickness Accept a≤3.0mm or b≤3.0mm, c≤t/2 a≤1.5mm or b≤1.5mm, t/2≤c≤t	Minor
11	Stain on Surface	Stain removable by soft cloth or air blow is acceptable.	Minor
12	TCP/FPC Damage	(1) Crack, deep scratch, deep hole and deep pressure mark on the TCP/FPC are not acceptable. (2) Terminal lead twisted or broken is not allowable. (3) Copper exposed is not allowed by naked eye inspection.	Minor
13	Dimension Unconformity	Checking by mechanical drawing.	Major

Ⅱ. Displaying Defects

<table>
<tr><th>NO.</th><th>Items</th><th>Criteria</th><th>Classification</th></tr>
<tr><td>1</td><td>Black/White spot
Dirty spot
Foreign matter</td><td>
<table>
<tr><td rowspan="2">Average Diameter (mm)</td><td colspan="2">Pieces Permitted</td></tr>
<tr><td>Zone A,B</td><td>Zone C</td></tr>
<tr><td>Φ≤0.10</td><td>Ignore</td><td rowspan="3">Ignore</td></tr>
<tr><td>0.10＜Φ≤0.20</td><td>3</td></tr>
<tr><td>Φ＞0.20</td><td>0</td></tr>
</table>
</td><td>Minor</td></tr>
<tr><td>2</td><td>No Display</td><td>Not allowable.</td><td>Major</td></tr>
<tr><td>3</td><td>Irregular Display</td><td>Not allowable.</td><td>Major</td></tr>
<tr><td>4</td><td>Missing Line
(row or column)</td><td>Not allowable.</td><td>Major</td></tr>
<tr><td>5</td><td>Short</td><td>Not allowable.</td><td>Major</td></tr>
<tr><td>6</td><td>Flicker</td><td>Not allowable.</td><td>Major</td></tr>
<tr><td>7</td><td>Abnormal Color</td><td>Refer to the SPEC.</td><td>Major</td></tr>
<tr><td>8</td><td>Luminance NG</td><td>Refer to the SPEC.</td><td>Major</td></tr>
<tr><td>9</td><td>Over Current</td><td>Refer to the SPEC.</td><td>Major</td></tr>
</table>

14 Precautions for operation and Storage

14.1 Precautions for Operation

(1) Since OLED panel is made of glass, do not apply any mechanical shock or impact or excessive force to it when installing the OLED module. Any strong mechanical impact due to falling dropping etc. may cause damage (breakage or cracking).

(2) The polarizer on the OLED surface is made of soft material and is easily scratched. Please take most care when handing. When the surface of the polarizer of OLED Module is contaminated, please wipe it off gently by using moisten soft cloth with isopropyl alcohol, do not use water, ketone or aromatics. If there is saliva or water on the OLED surface, please wipe it off immediately.

(3) When handling OLED module, please be sure that the body and the tools are properly grounded. And do not touch I/O pins with bare hands or contaminate I/O pins, it will cause disconnection or defective insulation of terminals.

(4) Do not attempt to disassemble or process the OLED module.

(5) OLED module should be used under recommended operating conditions shown in the specification. Since the higher voltage leads to the shorter lifetime, be sure to use the specified operating voltage.

(6) Foggy dew, moisture condensation or water droplets deposited on surface and contact terminals will cause polarizer stain or damage, the deteriorated display quality and electrochemical reaction then leads to shorter life time and permanent damage to the module probably. Please pay attention to the environmental temperature and humidity.

(7) An afterimage is created by the difference in brightness between unused dot and the fixed dot, according to the decrease of brightness of the emitting time. Therefore, to avoid having an afterimage, the full set should be thoroughly used instead of using a fixed dot. When the fixed dot emits, an afterimage can be created.

(8) Flicker could be come out at full on display. And it disappears when frame frequency increase, but brightness decreases too.

14.2 Soldering

(1) Soldering should be performed only on the I/O terminals.

(2) Use soldering irons with proper grounding and no leakage.

(3) Iron: no higher than 300℃ and 3~4 sec during soldering.

14.3 Precautions for Storage

(1) Please store OLED module in a dark place. Avoid exposure to sunlight, the light of fluorescent lamp or any ultraviolet ray.

(2) Keep the environment temperature between 10℃ and 35℃ and the relative humidity less than 60%. Avoid high temperature and high humidity.

(3) Keep the OLED modules stored in the container when shipped from supplier before using them is recommended.

(4) Do not leave any article on the OLED module surface for an extended period of time.