Product Specification

Product Name: VGM128064A1A01

Product Code: M00020

Customer
Approved by Customer
Approved Date:

Designed By	Checked by	Approved By	
		R&D	QA

CONTENT

REVISION RECORD

REV.	REVISION DESCRIPTION	REV. DATE	REMARK
Y01	Initial Release	2008-11-05	
A01	Modify the mechanical drawing. Modify the package specification. Modify the storage temperature. Add the information of module weight. Add the information of operating conditions. Add the information of electro-optical characteristics. Add the information of recommended software initialization.	2009-02-17	Page 5 Page 16 Page 5,8,17 Page 4 Page 8,9,14 Page 9 Page 15
A02	Change “Product Number” to “Product Code”	2009-02-26	Page 1

1 Overview

VGM128064A1A01 is an OLED area color 128×64 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.

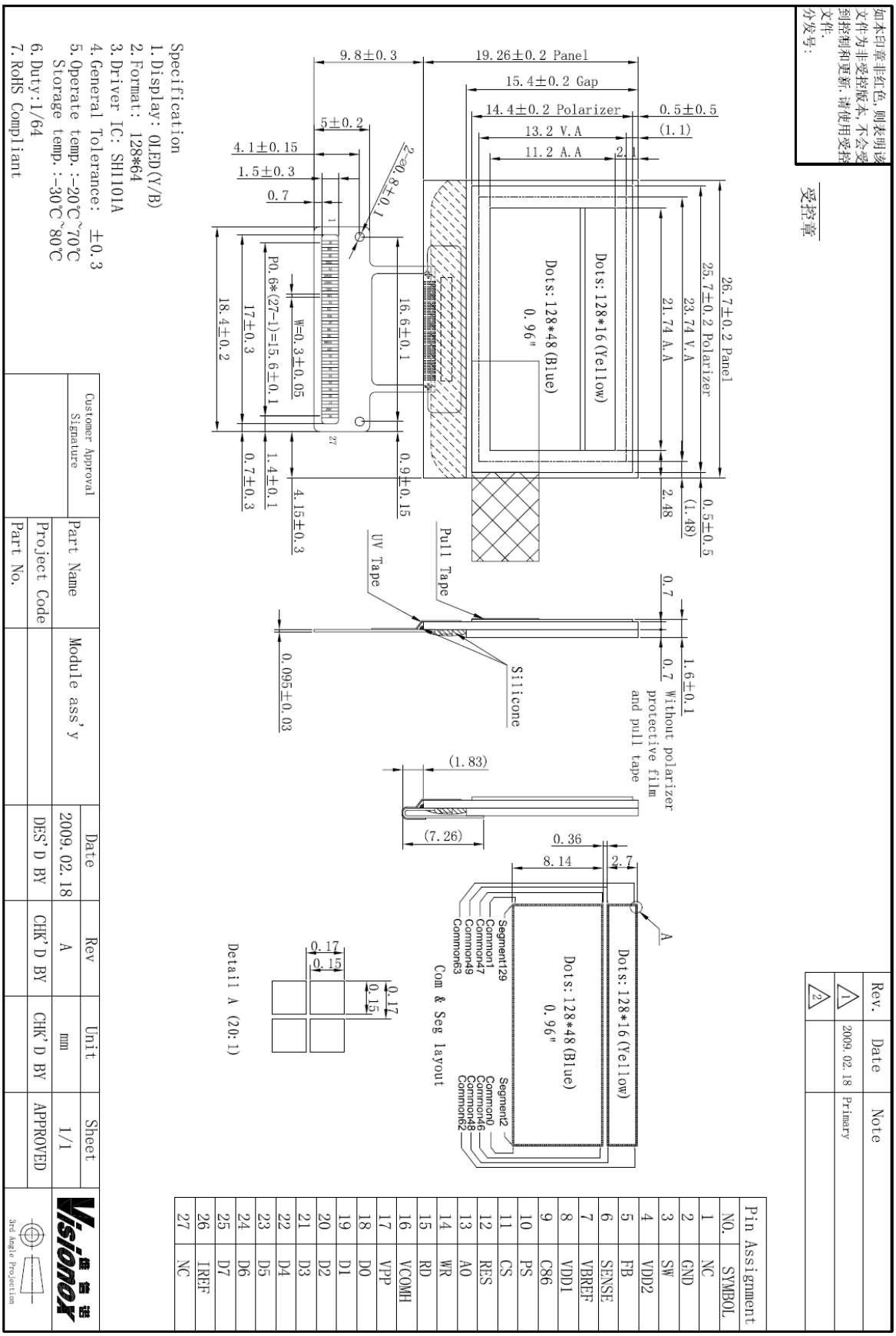
2 Features

- Display Color: Yellow & Blue
- Dot Matrix:128×64
- Driver IC: SH1101A
- Interface:8-bit 8080,8-bit 6800, SPI
- Wide range of operating temperature: -20℃-70℃

3 Mechanical Data

NO.	ITEM	SPECIFICATION	UNIT
1	Dot Matrix	128(W)×64(H)	-
2	Dot Size	0.15(W)×0.15(H)	mm^2
3	Dot Pitch	0.17(W)×0.17(H)	mm^2
4	Aperture Rate	77.85	%
5	Active Area	21.74(W)×11.2 (H)	mm^2
6	Panel Size	26.7(W)×19.26 (H)	mm^2
7	Module Size	According to the annexed mechanical drawing	mm^3
8	Diagonal A/A Size	0.96	inch
9	Module Weight	1.67±10%	gram

4 Mechanical Drawing



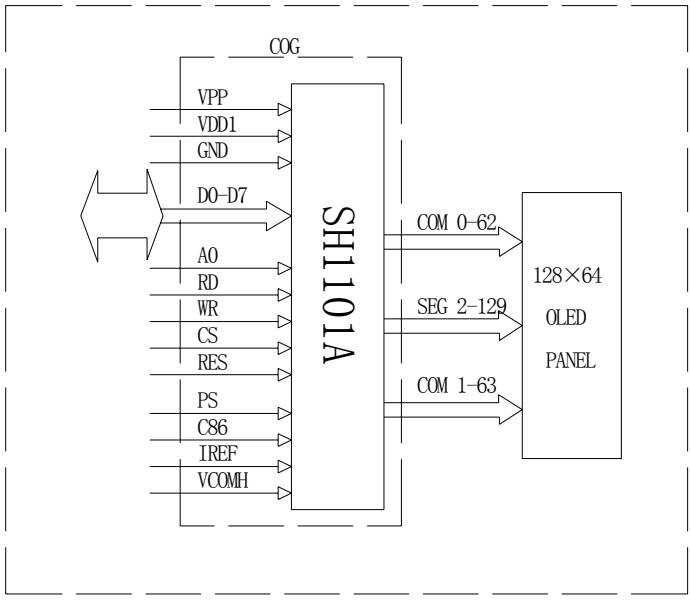
Pin Assignment		
NO.	SYMBOL	
1	NC	
2	GND	
3	SW	
4	VDD2	
5	FB	
6	SENSE	
7	VBREF	
8	VDD1	
9	C86	
10	PS	
11	CS	
12	RES	
13	A0	
14	WR	
15	RD	
16	VCOMH	
17	VPP	
18	D0	
19	D1	
20	D2	
21	D3	
22	D4	
23	D5	
24	D6	
25	D7	
26	IREF	
27	NC	

5 Module Interface

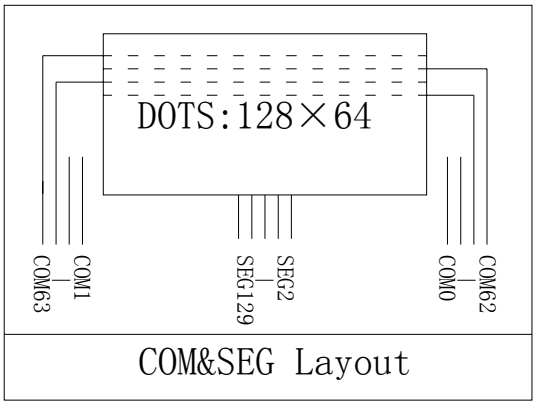
PIN NO.	PIN NAME	DESCRIPTION
1	NC	No Connection.
2	GND	Ground.
3	SW	An output pad driving the gate of the external NMOS of the booster circuit.
4	VDD2	Power supply pad for the internal buffer of the DC-DC voltage converter.
5	FB	This is a feedback resistor input pad for the booster circuit. It is used to adjust the booster output voltage level, VPP.
6	SENSE	This is a source current pad of the external NMOS of the booster circuit.
7	VBREF	This is a voltage reference pad for pre-charge voltage in driving OLED device. Voltage should be set to match with the OLED driving voltage in current drive phase. It can either be supplied externally or by connecting to VPP.
8	VDD1	2.4 - 3.5V power supply input.
9	C86	C86 = “H”: 8080 series,C86 = “L”: 6800 series.
10	PS	PS = “H”: Parallel data input. PS = “L”: Serial data input.
11	CS	Chip select, active low.
12	RES	Reset, active low.
13	A0	H: Data; L :Instruction code.
14	WR	6800: Read or Write ; 8080: Write.
15	RD	6800: Enable (E); 8080:Read.
16	VCOMH	This is a pad for the voltage output high level for common signals. A capacitor should be connected between this pad and GND.
17	VPP	This is the most positive voltage supply pad of the chip. It should be supplied externally.
18	D0	This is an 8-bit bi-directional data bus that connects to an 8-bit or 16-bit standard MPU data bus. When the serial interface is selected, then D0 serves as the serial clock input pad (SCL) and D1 serves as the serial data input pad (SI). At this time, D2 to D7 are set to high impedance. When the chip select is inactive, D0 to D7 are set to high impedance.
19	D1	
20	D2	
21	D3	
22	D4	
23	D5	
24	D6	
25	D7	
26	IREF	This is a segment current reference pad. A resistor should be connected between this pad and GND. Set the current at 10μA.
27	NC	No Connection.

6 Function Block Diagram

6.1 Function Block Diagram



6.2 Panel Layout Diagram



7 Absolute Maximum Ratings

ITEM	SYMBOL	MIN	MAX	UNIT	REMARK
Logic supply voltage	V_{DD1}	-0.3	+3.6	V	IC maximum rating
OLED Operating voltage	V_{PP}	0	+18	V	IC maximum rating
Operating Temp.	Top	-20	+70	℃	-
Storage Temp	Tstg	-30	+80	℃	-

Note (1): All of the voltages are on the basis of "GND = 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_{DD1}	22±3°C, 55±15%R.H	2.4	3.0	3.5	V
OLED Driver Supply Voltage	V_{PP}	22±3°C, 55±15%R.H	8.5	9.0	9.5	V
High-level Input Voltage	V_{IH}	-	$0.8\times V_{DD1}$	-	-	V
Low-level Input Voltage	V_{IL}	-	0	-	$0.2\times V_{DD1}$	V
High-level Output Voltage	V_{OH}	-	$0.8\times V_{DD1}$	-	-	V
Low-level Output Voltage	V_{OL}	-	0	-	$0.2\times V_{DD1}$	V

Note : The V_{PP} 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)	40	60	-	cd/m^2
Standby Mode Brightness		Standby Mode 10% pixels ON(2)	-	30	-	cd/m^2
Normal Mode Power Consumption	Pt	All pixels ON(1)	-	63	79.2	mW
Standby Mode Power Consumption		Standby Mode 10% pixels ON(2)	-	7.2	9	mW
C.I.E(Blue)	(x)	x,y(CIE1931)	0.13	0.17	0.21	-
	(y)		0.20	0.24	0.28	-
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 : 9V
- Contrast setting : 0x64
- Frame rate : 105Hz
- Duty setting : 1/64

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

- Driving voltage : 9V
- Contrast setting : 0x02
- Frame rate : 105Hz
- Duty setting : 1/64

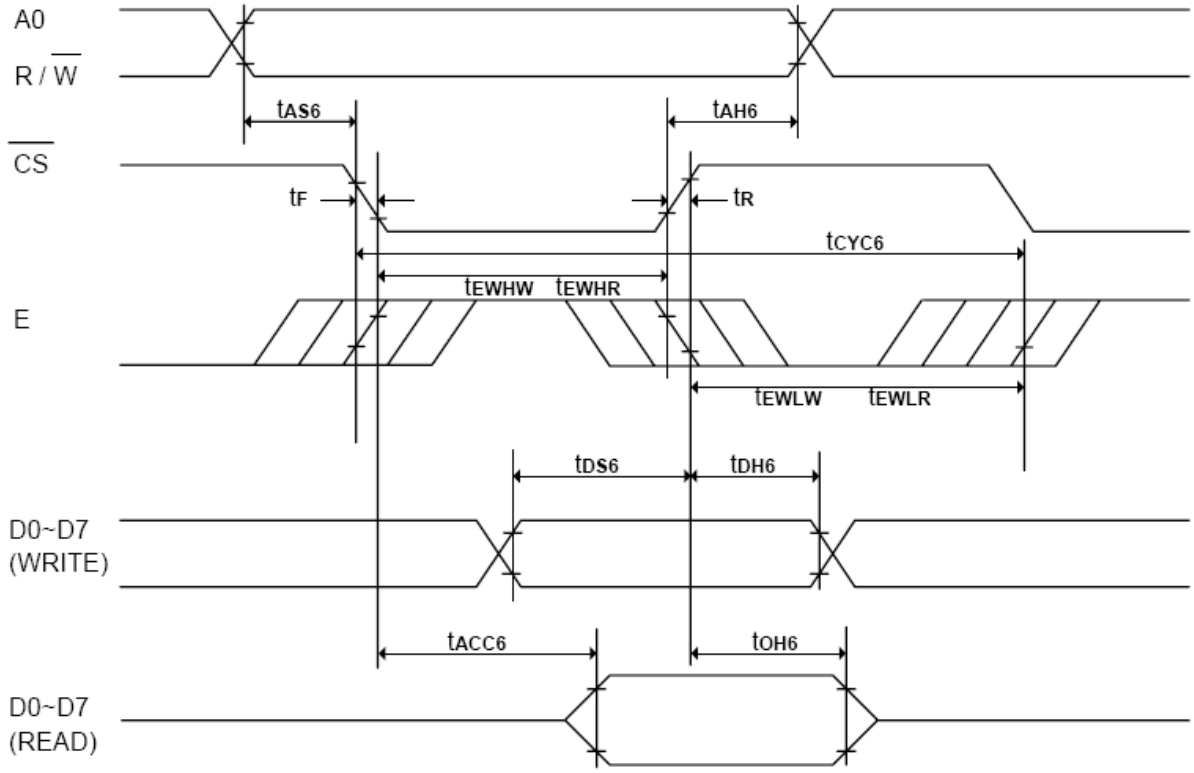
8.3 AC Electrical Characteristics

(1)6800-Series MPU Parallel Interface Timing Characteristics

(VDD1 = 2.4V to 3.5V, TA = 25°C)

Symbol	Parameter	Min.	Typ.	Max.	Unit	Condition
t_{CYC6}	System cycle time	300	-	-	ns	
t_{AS6}	Address setup time	0	-	-	ns	
t_{AH6}	Address hold time	0	-	-	ns	
t_{DS6}	Data setup time	40	-	-	ns	
t_{DH6}	Data hold time	15	-	-	ns	
t_{OH6}	Output disable time	10	-	70	ns	C_L = 100pF
t_{ACC6}	Access time	-	-	140	ns	C_L = 100pF
t_{EWHW}	Enable H pulse width (Write)	100	-	-	ns	
t_{EWHR}	Enable H pulse width (Read)	120	-	-	ns	
t_{EWLW}	Enable L pulse width (Write)	100	-	-	ns	
t_{EWLR}	Enable L pulse width (Read)	100	-	-	ns	
t_R	Rise time	-	-	15	ns	
t_F	Fall time	-	-	15	ns	

6800-series MCU parallel interface characteristics

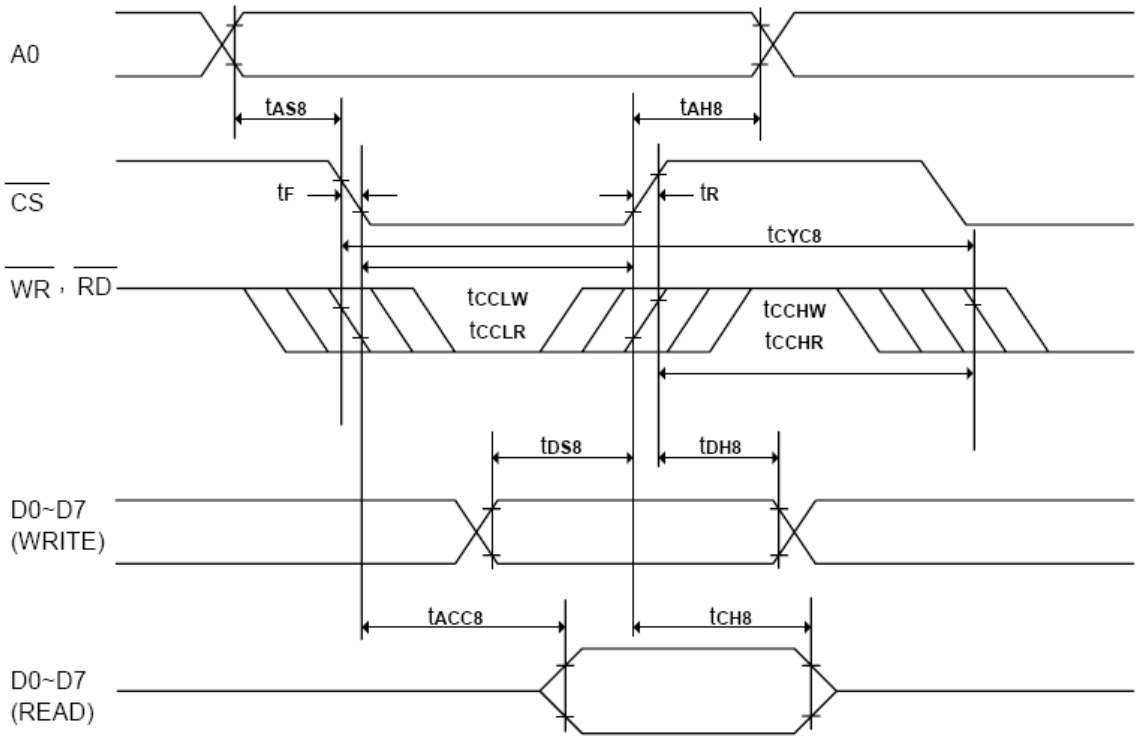


(2)8080-Series MPU Parallel Interface Timing Characteristics

(VDD1 = 2.4V to 3.5V, TA = 25°C)

Symbol	Parameter	Min.	Typ.	Max.	Unit	Condition
t_{CYC8}	System cycle time	300	-	-	ns	
t_{AS8}	Address setup time	0	-	-	ns	
t_{AH8}	Address hold time	0	-	-	ns	
t_{DS8}	Data setup time	40	-	-	ns	
t_{DH8}	Data hold time	15	-	-	ns	
t_{CH8}	Output disable time	10	-	70	ns	C_L = 100pF
t_{ACC8}	$\overline{RD}$ access time	-	-	140	ns	C_L = 100pF
t_{CCLW}	Control L pulse width (WR)	100	-	-	ns	
t_{CCLR}	Control L pulse width (RD)	120	-	-	ns	
t_{CCHW}	Control H pulse width (WR)	100	-	-	ns	
t_{CCHR}	Control H pulse width (RD)	100	-	-	ns	
t_R	Rise time	-	-	15	ns	
t_F	Fall time	-	-	15	ns	

8080-series parallel interface characteristics

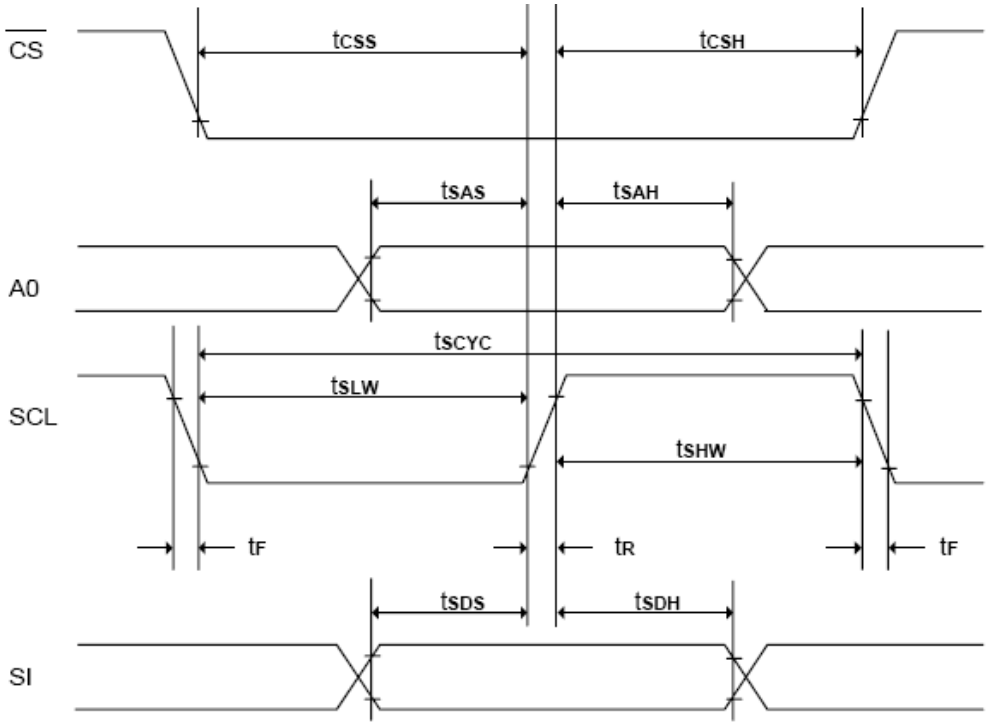


(3)Serial Interface Timing Characteristics

(VDD1= 2.4V to 3.5V, TA = 25°C)

Symbol	Parameter	Min.	Typ.	Max.	Unit	Condition
tSCYC	Serial clock cycle	250	-	-	ns	
tSAS	Address setup time	150	-	-	ns	
tSAH	Address hold time	150	-	-	ns	
tSDS	Data setup time	100	-	-	ns	
tSDH	Data hold time	100	-	-	ns	
tCSS	$\overline{CS}$ setup time	120	-	-	ns	
tCSH	$\overline{CS}$ hold time time	60	-	-	ns	
tSHW	Serial clock H pulse width	100	-	-	ns	
tSLW	Serial clock L pulse width	100	-	-	ns	
tR	Rise time	-	-	15	ns	
tF	Fall time	-	-	15	ns	

Serial interface characteristics

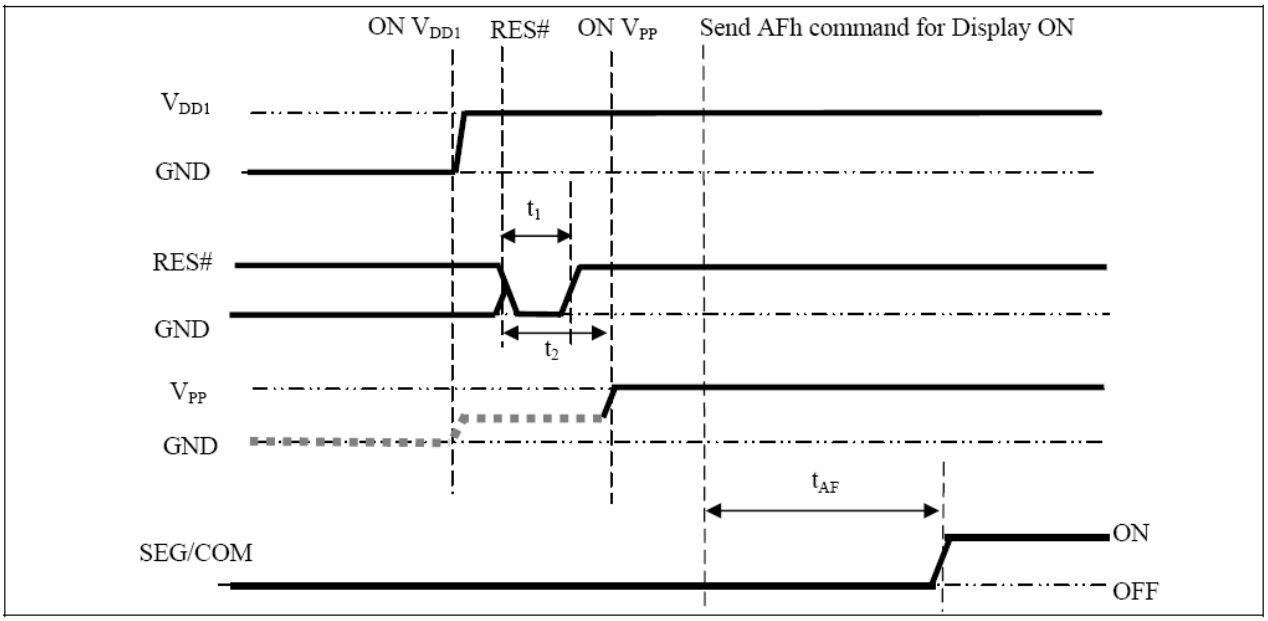


9 Functional Specification and Application Circuit

9.1 Power ON and Power OFF Sequence

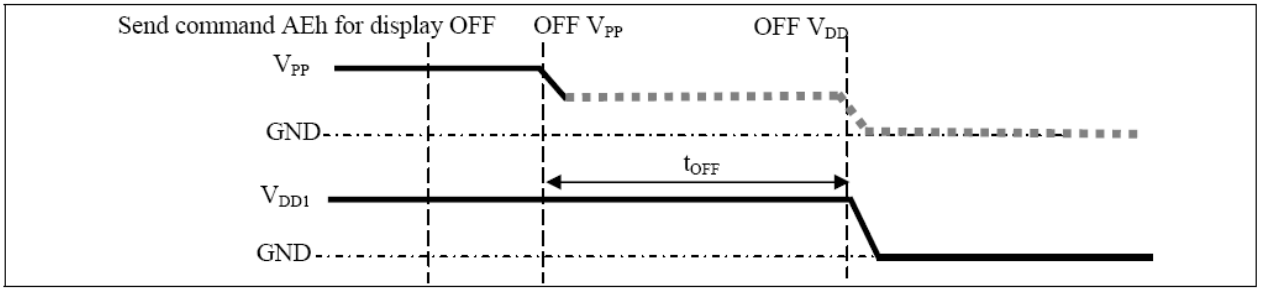
Power ON Sequence:

1. Power ON V_{DD1}.
2. After V_{DD1} become stable, set RES pin LOW (logic low) for at least 5us (t_1) and then HIGH (logic high).
3. After set RES# pin LOW (logic low), wait for at least 5us (t_2). Then Power ON V_{PP}. (1)
4. After V_{PP} become stable, send command AFh for display ON. SEG/COM will be ON after 100ms(t_{AF}).



Power OFF Sequence:

1. Send command AEh for display OFF.
2. Power OFF V_{PP}.(1), (2)
3. Wait for t_{OFF}. Power OFF V_{DD1}. (where Minimum t_{OFF}=0ms, Typical t_{OFF}=100ms)



Note:

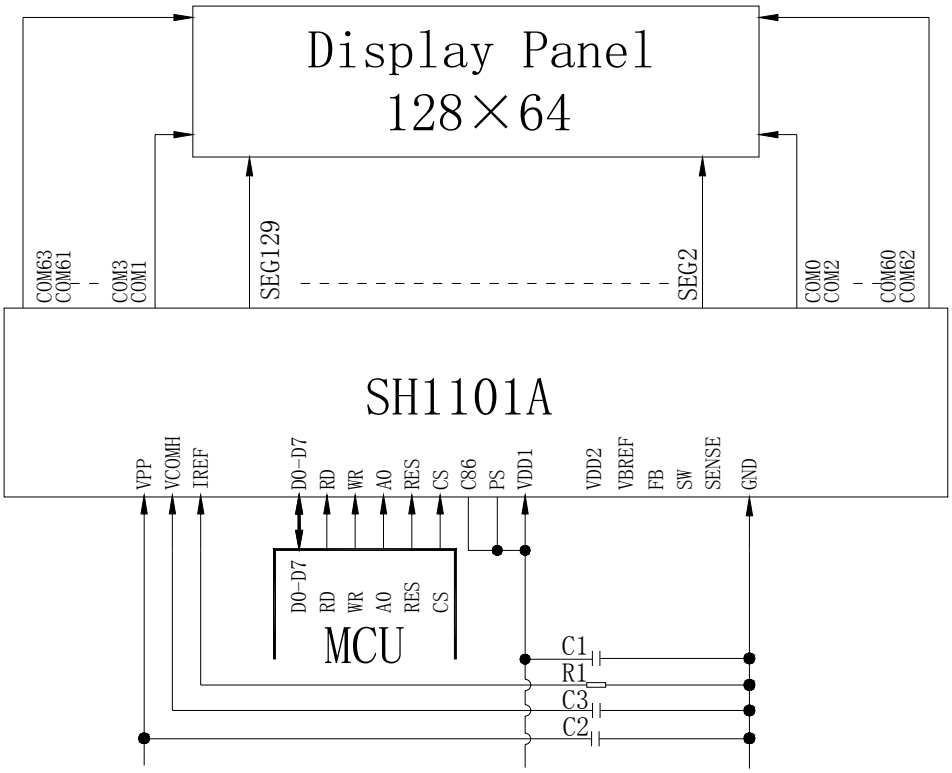
(1) Since an ESD protection circuit is connected between V_{DD1} and V_{PP}, V_{PP} becomes lower than V_{DD1} whenever V_{DD1} is ON and V_{PP} is OFF as shown in the dotted line of V_{PP} in above figures.

(2). V_{PP} should be kept float (disable) when it is OFF.

9.2 Application Circuit

The configuration for 8080-parallel interface mode, external V_{PP} is shown in the following diagram:

(V_{DD1}=3.0V, V_{PP} =9.0V, IREF=10uA)



Pin connected to MCU interface: D[7:0], RD, WR, A0, RES, A0

VDD2, SW, VBREF, FB, SENSE should be left open.

Recommended components

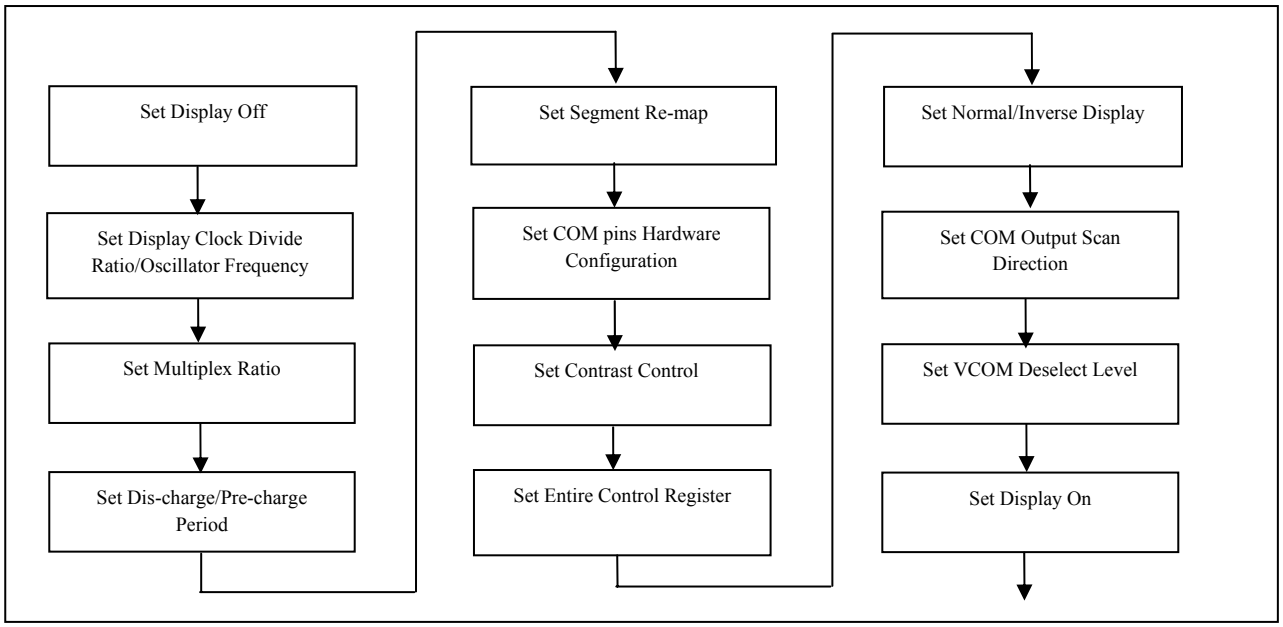
C1, C2, C3: 4.7µF

R1: 910kΩ, R1 = (Voltage at IREF - GND) / IREF

9.3 Display Control Instruction

Refer to SH1101A IC Specification.

9.4 Recommended Software Initialization




```
Void Initialization Code ( )
  {write_c(0xAE);       // 0xAE=Display OFF,    0xAF=Display ON
   write_c(0xAD);       //Set DC/DC
     write_c(0x8B);       // 0x8A=OFF,    0x8B=ON
   write_c(0xD5);       //Set Display Clock Divide Ratio/Oscillator Frequency
     write_c(0xF0);
   write_c(0xA8);       //Set Multipex Ration
     write_c(0x3F);       // 64 Mux
   write_c(0xD9);       //Set Pre-charge Period
     write_c(0x1C);
   write_c(0xA1);       //Set Segment Re-map (0xA0=Normal,0xA1=Reverse)
   write_c(0xDA);       //Set COM Pins Hardware Configuration
   write_c(0x12);
   write_c(0x81);       //Set Contrast Control
     write_c(0x64);
   write_c(0xA4);       //Set Entire Control Register (0xA4=Normal, 0xA5=Entire Display On)
   write_c(0xA6);       //Set Normal/Inverse Display (0xa6=Normal,0xa7=Inverse)
   write_c(0xC8);       //Set COM Output Scan Direction (0xc0=Normal,0xc8=Reverse)
   write_c(0xDB);       //Set VCOMH Deselect Level
   write_c(0x40);
   write_c(0xAF);       //0xAE=Display OFF,    0xAF=Display ON
   }
```

10 Package Specification

Package order(1)~(9)

(1) Tray: 370*273 t=0.8mm
Add EPE in every contained tray

(2)

(3) order ①、②、①、②
fix trays with tape
Package quantity products:
672 pcs of 1 small carton
1 tray contain 48 pcs
14 contained trays, 1 empty tray

(4) package with plastic bags
add five desiccants
create a power vacuum

(5)

(6)

(7)

small carton package
L425*W330*L175 mm

(8)

2 small cartons in 1 big carton

(9)
28 contained trays, 2 empty trays,
Package quantity products:
1344 pcs of 1 big carton

Package finished
L450*W350*L360 mm

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)	-20℃,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.

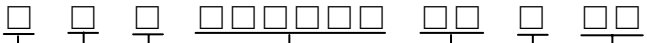
ITEM	MIN	MAX	UNIT	CONDITION
Operation Life Time	20000	-	hrs	60cd/m^2,50% Checkerboard

An average operating lifetime of more than 10,000 hrs (50% 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 :

V—Visionox

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

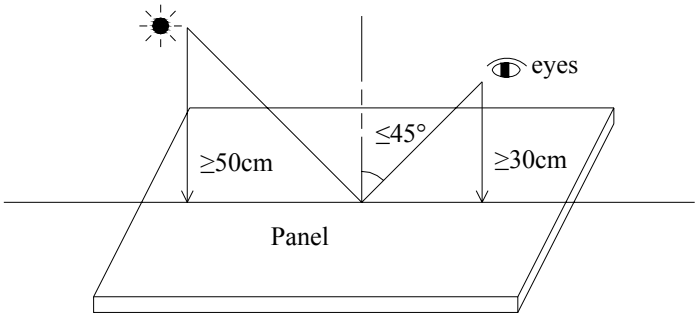
Fluorescent Lamp: 30W

Distance between the Panel & Lamp: ≥50cm

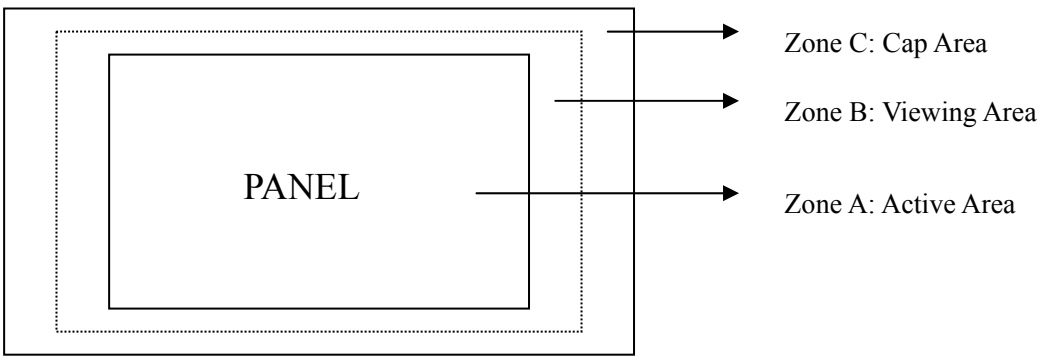
Distance between the Panel & Eyes: ≥30cm

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

(See the sketch below)

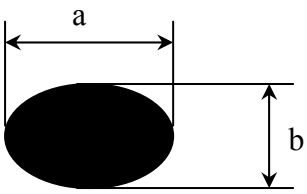


13.3 Quality Assurance Zones

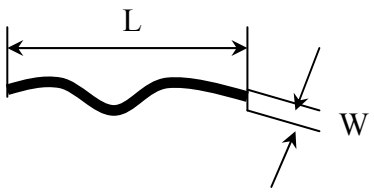


13.4 Inspection Standard

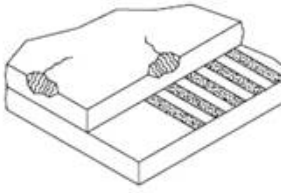
Definition of Φ&L&W (Unit: mm)

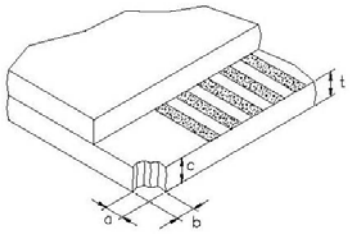
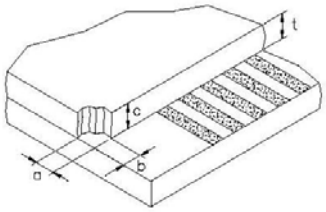
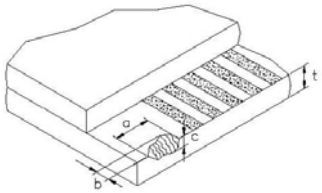
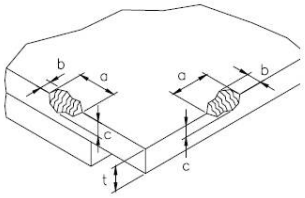
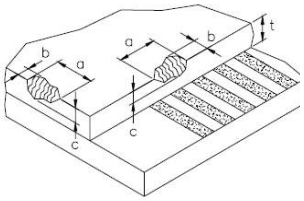


Φ=(a+b)/2



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>ITEM</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.

14.4 Warranty period

Visionox Display Co., Ltd. warrants for a period of 12 months from the shipping date when stored or used under normal condition.