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ET023VGH02 Series
Silicon OLED Micro Display

Data Sheet

BV0.1

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Record of Revision

Version No.	Revise Date	Content
BV0.0	2025/04/21	First released
BV0.1	2025/07/29	Updated PIN definition and Vcom circuits

CONTENTS

1 Product description

The ET023VGH02 series of products are AMOLED micro-displays prepared using top-emitter, high-efficiency, silicon-based active OLED technology. This series includes full-color (C), monochromatic white light (W), monochromatic red light (R), and monochromatic green light (G) specifications. They feature high brightness, high contrast, narrow bezels, wide viewing angles, wide temperature ranges, and low power consumption. When paired with appropriate optical systems, they can achievehigh -quality large-screen display effects. These displays can be used in near-eye display systems such as head-mounted displays and AR glasses.

1.1 Important features

- Display color: full color, Monochromatic white, Monochromatic red, Monochromatic green
- Small size high resolution: 0.23" 3255PPI
- High refresh rate: up to 90Hz
- MIPI (1lanes) + I²C interface
- It can work from-40℃ to 65℃

1.2 Natural parameter

parameter		Characteristic parameter values			
TYPE		/	/	/	Mono red (R)
Resolution ratio		640(×3)×400			
Pixel size ①		7.8μm×7.8μm			
Pixel arrangement		RGB Irregular Hexagon			
Display area size		5.06 mm x 3.29 mm / 0.23 "diagonal			
Structural dimensions (FPC)		54.33mm × 6.02mm × 1.09mm			
Power Supply	VDD	DC 1.8V@Max15mA			
	VCC	DC 5.0V@ Max150mA			
Grey scale		256 levels			
Interface type		MIPI (1lanes) + I² C interface			
Refresh rate		25Hz~ 90 Hz			
Weight		0.2 g			
Operating temperature		- 40℃ ~+65℃			
Operating humidity Range		≤85%RH (no condensation)			
Storage temperature		-55°C to +90°C			
Contrast ratio		>10000:1			
Brightness uniformity		>90%			
Typical brightness ②		/	/	/	10000cd/㎡
Work color coordinates	CIE-x	/	/	/	0.14±0.03
	CIE-y	/	/	/	0.08±0.03
Typical power consumption ③		/	/	/	＜100mW
Life (T50) @Typ. Brightness		/	/	/	1000h

Note：

①Pixel size: each pixel consists of three sub-pixels (RGB), which is the length and width of the pixel;

②Typical brightness: the most representative working brightness in the process of display application, which is not fixed;

③Typical power consumption: the power consumption of the display measured at a specific picture and typical brightness.

2 Function overview and interface

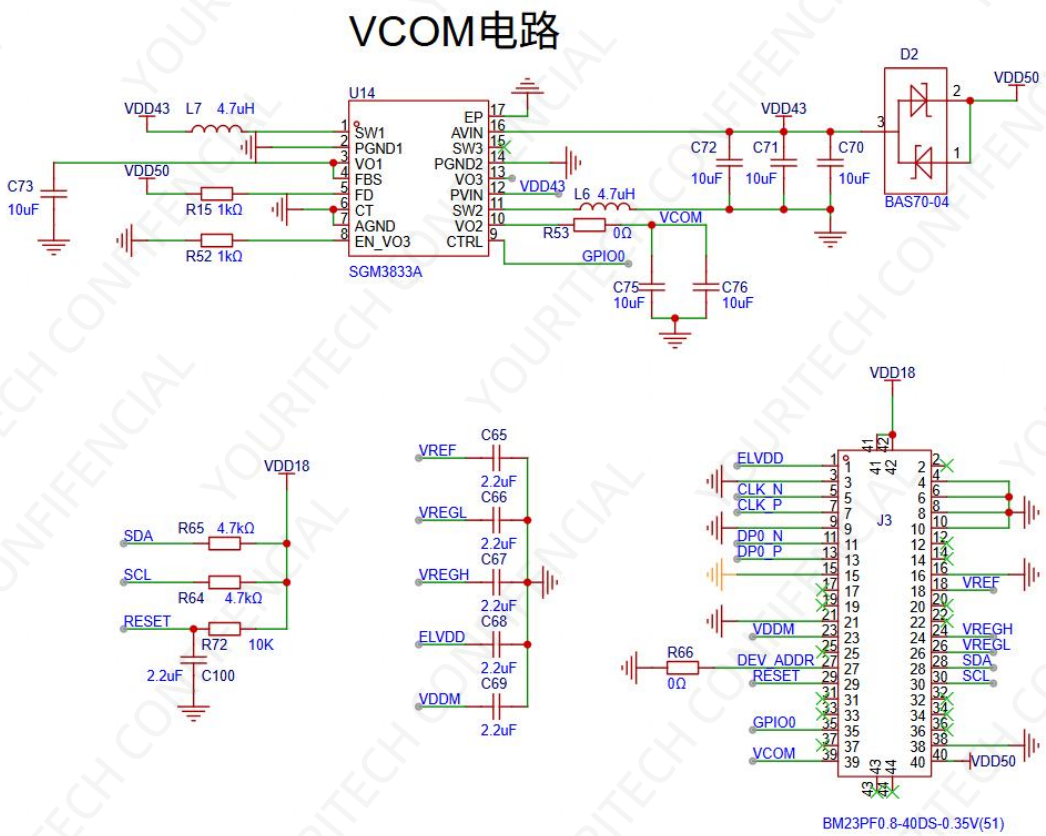
2.1 Pin definition

The product interface uses the " BM23PF0.8-40DP-0.35V(51)" connector, and the electrical interface pin is defined as follows:

Pin No.	Symbol	I/O	Functional description
1	ELVDD	Power	Pixel reference voltage, connected to 2.2uF capacitor
2	NC	/	No connect, floating
3	GND	GND	Ground
4	GND	GND	Ground
5	MIPIC-	I	DPHY clock channel negative signal
6	TEST	/	Ground
7	MIPIC+	I	DPHY clock channel positive signal
8	TEST	/	Ground
9	GND	GND	Ground
10	GND	GND	Ground
11	MIPID0-	I/O	DPHY, negative signal on data channel 0
12	NC	/	No connect, floating
13	MIPID0+	I/O	DPHY, positive signal of data channel 0
14	NC	/	No connect, floating
15	GND	GND	Ground
16	GND	GND	Ground
17	NC	/	No connect, floating

18	VERF	Power	Connected to 2.2uF capacitor
19	NC	/	No connect, floating
20	NC	/	No connect, floating
21	GND	GND	Ground
22	NC	/	No connect, floating
23	MVDD	Power	MIPI DPHY Power supply (1.2v), connect 2.2uF capacitor
24	VERFH	Power	Refer to high voltage and connect to 2.2uF capacitor
25	NC	/	No connect, floating
26	VERFL	Power	Refer to low voltage and connect to a 2.2uF capacitor
27	ADDR	I	I²C Slave Address PIN： 0: I²C Slave Address 8'ha0 1: I²C Slave Address 8'ha8
28	SDA	I/O	I²C Configures interface data signal
29	RESET	I	Reset, low level is valid
30	SCL	I/O	I²C Configuration interface clock signal
31	NC	/	No connect, floating
32	NC	/	No connect, floating
33	NC	/	No connect, floating
34	NC	/	No connect, floating
35	GPIO0	O	The wire signal of the PMIC power chip must be connected.
36	NC	/	No connect, floating
37	OTP—PER	Power	OTP programming voltage input， No connect, floating
38	GND	GND	Ground
39	VCOM	Power	All oled cathode power supplies have a range from-0.8 V to-4 V, with a typical value of-2 V
40	AVDD	Power	5.0 V power supply

2.2 Application circuit



3 Electrical characteristics

3.1 Limit operating range

Function	Symbol	MIN.	MAX.	Unit	Remarks
Positive power	VDD50	-0.3	7.1	V	Maximum range value of IC
Negative power supply	VCOM	-4	-0.8	V	Maximum range value of IC
Internal logic power supply	VDD18	-0.3	2.1	V	Maximum range value of IC
Working temperature	Top	-40	65	℃	-
Storage temperature	Tstg	-55	80	℃	-

Note: The maximum range value (except VI/O) is the limit that cannot be exceeded in an instant. Using or exceeding these ratings may affect the life and reliability of the product, but it may also damage the product. It is recommended that the product be operated under typical operating conditions.

3.2 Rated operating range

Function	Symbol	Test condition	MIN.	TYP.	MAX.	Unit
Working voltage	VDD50	-	-	5	-	V
	VCOM	-	-	-2	-	V
	VDD18	-	-	1.8	-	V
High level input voltage	VIH	VDD18=1.65V ~ 1.95V	0.7*VDD1 8	-	VDD18	V
Low level input voltage	VIL	VDD18=1.65V ~ 1.95V	0	-	0.3*VDD18	V
High level output voltage	VOH	Iout =-1mA	0.8*VDD1 8	-	VDD18	V
Low level output voltage	VOL	Iout = +1mA	0	-	0.2*VDD18	V

Note: All digital logic pin levels support the 1.8V logic level standard.

3.3 Power consumption

The temperature test condition is +25℃±2℃, and the test picture is all white.

Parameter	Functional description		MIN.	TYP.	MAX.	Unit
Power dissipation	Working (60Hz)	Color 3000Cd/㎡	-	145	-	mW
		Color 5000Cd/㎡	-	250	-	
		Monochromatic white 8000Cd/㎡	-	130	-	
		Monochromatic red 10000Cd/㎡	-	100	-	
		Monochromatic green 10000Cd/㎡	-	120	-	
	When closed (Display Off)		-	TBD	--	
	Dormancy (Power Down)		-	TBD	--	

3.4 Power sequence constraints

The normal up and down power operation sequence is shown in Figure 3-1.

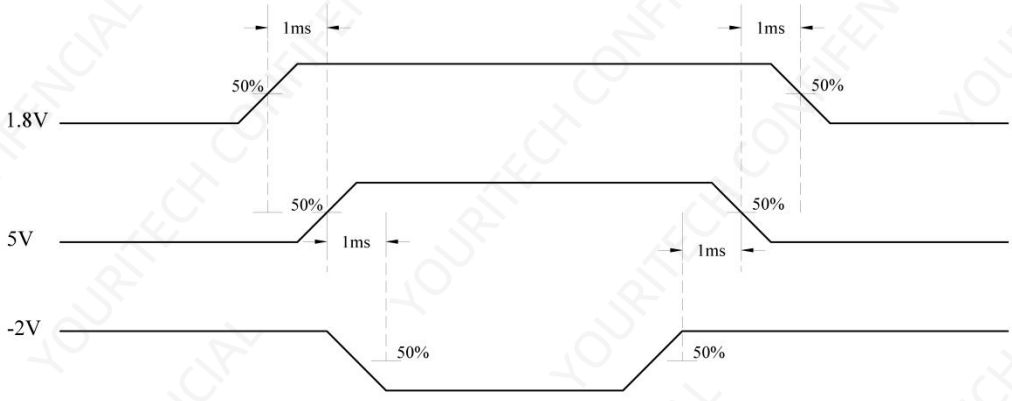


Figure 3-1, power-on sequence

4 List of optical characteristics

4.1 Pixel arrangement form

The pixel diagram of the micro display is shown in Figure 4-1, where each three sub-pixel points form a pixel, and the pixel size is 7.8μm× 7.8 μm.

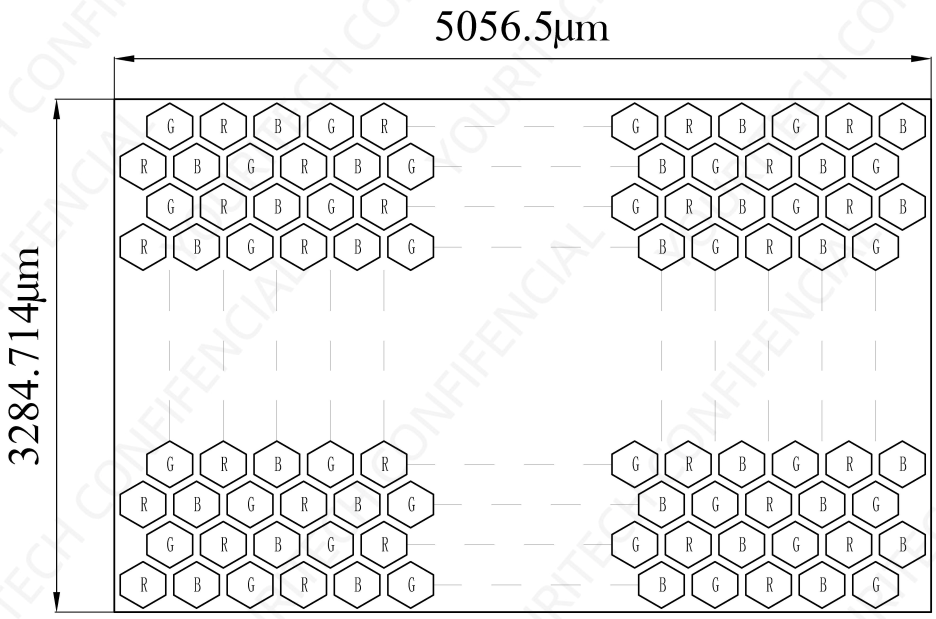


Figure 4-1 Schematic diagram of pixel arrangement of micro display screen

4.2 Photoelectric characteristics

Table 4-1 Optical properties Table 1

Project	Explain	MIN.	TYP.	MAX.
Brightness uniformity	3 point uniformity = 1-(maximum measured brightness-minimum brightness)/3 average brightness	90%	95%	100%

Table 4-2 Optical properties Table 2

Project	Color	CIE	Explain	Test condition	MIN.	TYP.	MAX.
Full color	White	x	All pixels are fully on	Maximum grayscale	0.26	0.31	0.36
		y			0.28	0.33	0.38
	Red	x	All red sub-pixels are fully on		0.55	0.65	0.66
		y			0.29	0.33	0.36
	Green	x	All green sub-pixels are fully on		0.18	0.23	0.26
		y			0.61	0.67	0.69
	Blue	x	All blue sub-pixels are fully on		0.1	0.14	0.18
		y			0.06	0.11	0.14
Mono white	White	x	All pixels are fully on		0.26	0.31	0.36
		y			0.28	0.33	0.38
Mono green	Green	x	All pixels are fully on		0.23	0.27	0.31
		y			0.65	0.7	0.75

Table 4-3 Optical properties Table 3

Project	Explain	MIN.	TYP.	MAX.
Color gamut	NTSC %	53%	60%	75%

5 Function description

5.1 Functional modules

5.1.1 MIPI DPHY/DSI receiver module

The MIPI receiver complies with the DPHY1.1 and DSI1.1 standards. In high-speed mode, it supports up to 800Mbps per data channel, while in low-power mode, it supports 10Mbps data transmission. It also features a low-power mode turn-around function. The device supports clock stop on the D-PHY clock channel to save power and achieve ultra-low power consumption mode, where all data and clock channels are powered down. It includes ECC and CRC header and payload protection. It can be configured with 1 or 2 data channels. It supports RGB888 and RGB101010 video formats.

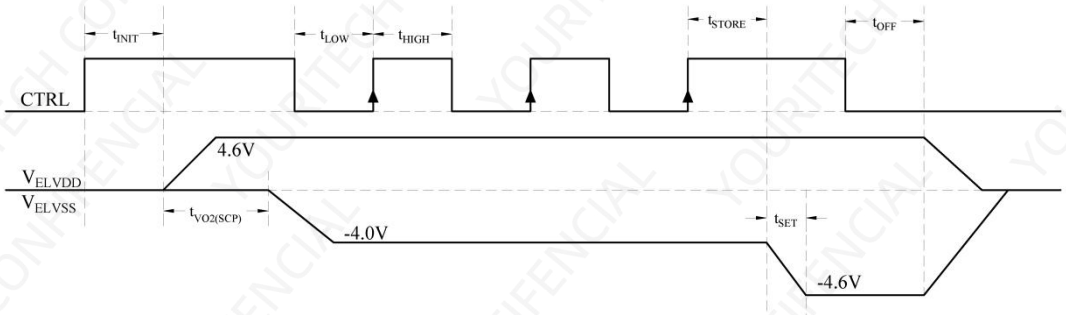
5.1.2 ABP Bus Matrix

APB bus address mapping, the APB bus address signal is 14 bits, there are 2 APB master nodes, 1 is an I^2 C slave event converter, and the other is an OTP loader. When the OTP loader loads data, the I^2 C slave cannot receive any data, by pausing the SCL to low, the I^2 C slave can only receive data from the I^2 C master after the OTP load is completed. There are 5 APB slaves: OTP Slave (Slave ID is 4 B0XXX), MipiAPB Slave (Slave ID is 4 B1000), System APB Slave (Slave ID is 4 B1001), Video Process APB Slave (Slave ID is 4 B1010), TCON APB Slave (Slave ID is 4B1011). The 4 highest bits of the APB bus address ([13:10]) are the APB slave id, and its 10 lowest bits ([9:0]) are the register address of the slave.

5.1.3 VCOM regulation

This product uses the SWIRE protocol to set the Vcom voltage, which is shared with GPIO0. The SWIRE timing diagram is shown below. CTRL is controlled by SWIRE and VELVSS is Vcom.

Address	Byte	Name	W/R	Windows default	description
0x240c	5:00	soft_swire_value	W/R	0x1	swire pulse count



Swire sequence

5.1.4 Video Bist mode

This product has an internal video generation module, which can generate pure color images and color bar patterns, and the width of the color bar can be configured.

Video bist Control Register:

Register	Bits	Name	W/R	Windows default	Description
0x2850	7	r_video_bist_en	W/R	0x0	0: normalmode; 1: enable video bist module
	6:04	r_video_bist_pattern	W/R	0x0	3'h0: the 1 st color bar is white;3'h1: the 1 st color bar isblack;3'h2: the 1st color bar isred; 3'h3: the 1st color bar isgreen; 3'h4: the 1st color bar is blue; Other value arereserved;
	3:02	Reserved		0x0	
	1:00	r_color_bar_width[9:8]	W/R	0x0	The high 2 bits of r_color_bar_width
0x2851	7:00	r_color_bar_width[7:0]	W/R	0x40	The low 8 bits of r_color_bar_width , default value of each color bar's width is 64 pixels

5.1.5 I²C slave interface module

The I² C slave address is 8b1010x00y, the X bit value is determined by the pin dev_addr_in, and the Y bit is the read/write flag. The I² C slave module supports speeds up to 400 kpbs. It supports single-byte or multi-byte (up to 256 bytes, including a 2-byte reg address) transfers, with the first transfer byte being the lower half of the register address (reg_addr[7:0]), and the second transfer byte being the upper half of the register address (reg_addr[13:8], reg_addr[15:14] reserved). Reg_addr [13:10] areapb slave id. The I² C slave interface converts I² C events into APB master events, then connects to the APB master 1 interface of the APB bus matrix.

S	Slave address	R/W	Reg addr[7:0]	A	Reg addr[15:8]	A	Data[7:0]	A	Data[7:0]	A/A	P
		0(write)					N bytes Data				

S	Slave address	R/W	Reg addr[7:0]	A	Reg addr[15:8]	A	Sr	Slave address	R/W	Data [7:0]	A	Data [7:0]	A	P
		1(write)							1(read)		N bytes Data			

Note：S=START; P=STOP; A=Acknowledge; A=Not acknowledge; Sr=Restart.

6 Structure and packaging

6.1 Product Structure

The shape size of the micro display is 54.33mm×6.02mm, and other dimensions are shown in below.

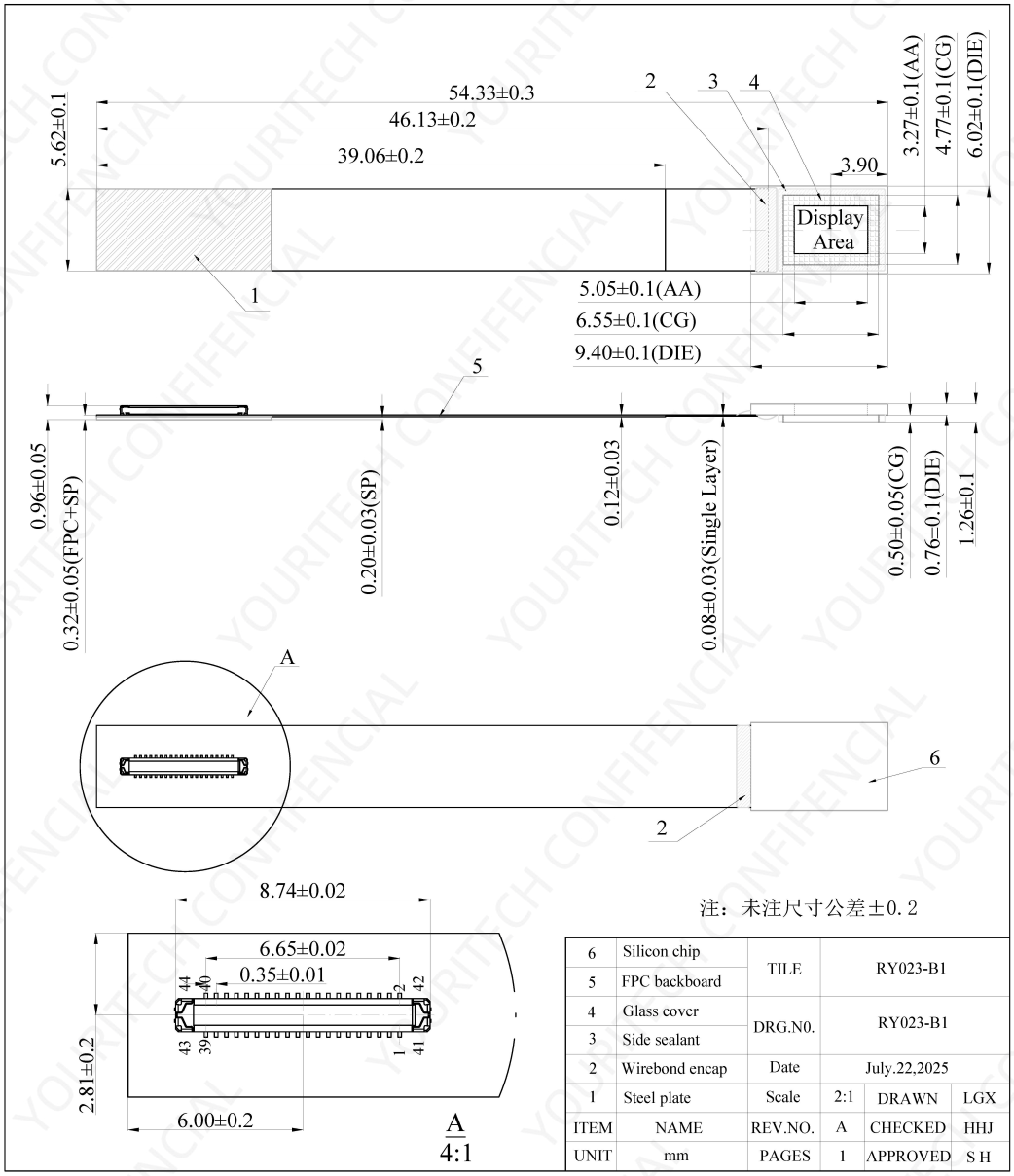


Figure 6-1 Overall Dimension Structure

7 Product Precautions

7.1 Cautions

1. The micro display should be powered and connected to signal cables strictly in accordance with the electrical interface definition in this manual, and keep the power supply stable. Do not use illegal power supply.

2. In the process of use, if you find short circuit, hot and other abnormal phenomena, Do not repeatedly power test, should find the problem in time or contact Rayvision technology maintenance.

3. In order to improve the service life of the product and avoid the aggravation of the residual shadow, the time of displaying the fixed picture under high temperature or brightness conditions should be minimized

4. The edges of the glass and silicon wafer on which the silicon-based OLED micro display is installed are easily damaged and cannot be squeezed by external forces.

5. The integrated CMOS circuit inside the product is sensitive to static electricity. It is recommended to operate in the area with anti-static devices (such as ion fans) during use, or the operator should wear anti-static devices to prevent and reduce electrostatic damage.

7.2 Cleaning Precautions

1. Do not use any acid, base, organic solvents and other chemicals to scrub or touch the product.

2. The surface of the screen can be dipped in a small amount of water or organic solvent with lens paper or dust-free cloth, wring it out and wipe it, but can not be wiped directly with a wet cloth.

3. Avoid wiping the edges of the screen with organic solvents, otherwise it may destroy the glue layer.

4. Do not touch the glass cover of the display screen with hard or sharp objects.

7.3 Storage Requirements

(1) Short-term Storage Requirement: Silicon-based OLED microdisplays allow short-term storage in a dry environment between -55 ° C and 90 ° C (≤100 hours).

(2) Long-term Storage Requirement:

1. Room temperature 25℃±5℃
2. Dry nitrogen or vacuum sealed container
3. Avoid violent vibration
4. Do not immerse the product in liquid

7.4 Others

1. No exposure to ultraviolet and ionizing radiation;
2. No External Force Bending;
3. Keep away from heat;
4. No high-level falling.