国兆光电
GUO ZHAO OPTOELECTRONICS

GZ060PEC01

Silicon-based OLED Microdisplay

Datasheet

Version V1.0

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Revision

Version	Date	Page No.	Description
1.0	2024-08-20		Release official version

Contents

1 Overview / Applications

The GZ060PEC01 microdisplay is a top-emitting, high-efficiency, active-matrix-driven silicon-based OLED microdisplay independently developed by Nanjing Guozhao Optoelectronics Technology Co., Ltd. Its silicon substrate is manufactured by 0.18μm CMOS technology. This product integrates some modules like signal enhancement circuit, row and column drive circuit, logic control circuit, etc. It supports the 8/16/24bit digital video signal. Through the I^2C-bus interface, it can realize the control and adjustment of display mode, display position, brightness, contrast and other functions. This product has the characteristics of low power consumption, high-resolution, high-integration, miniaturization, etc., and it can be widely used in various near-eye display systems with miniaturization, high-resolution, low power consumption, and wide-temperature range.

1.1 Key Features

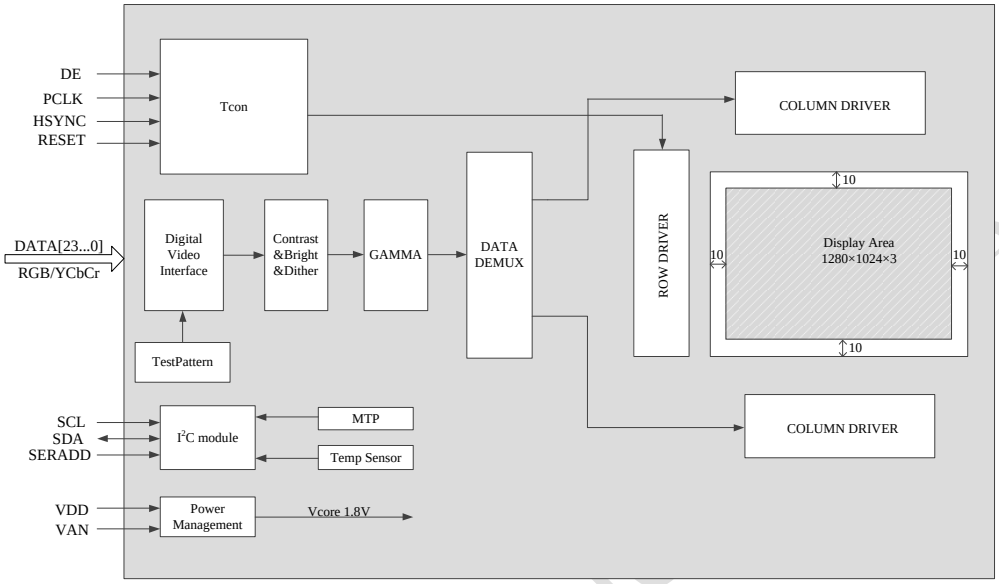
- High contrast
- The communication interface supports I^2C
- The video interface supports RGB, YCbCr, ITU-R BT.656, BT.1120
- Embedded temperature sensor
- Support the PWM-mode brightness adjustment function
- Support automatic brightness-temperature compensation function
- Support the image brightness and contrast digital signal enhancement function
- Support horizontal / vertical inverse display of video images
- Support image display position adjustment
- Support low-resolution partial display and full-screen stretching display
- Support the low power consumption mode

1.2 **General Features**

Parameter	Specification
Product category	Color
Maximum display resolution	1280×1024
Reserved physical pixels	1300×1044
Pixel arrangement	RGB vertical stripe
Pixel dimension	9.3μm×9.3μm
Display area	11.9mm×9.5mm (0.60 inches diagonally)
Structure dimension	19.8mm×15.2mm×4.7mm
Gray level	256 levels
Uniformity@150cd/m^2	≥ 90%
Contrast	>10000:1
Refresh rate	25Hz～75Hz
Video interface	24bit-RGB, 16bit-YCbCr, ITU-R BT.656, BT.1120
Typical brightness	150 cd/m^2
Recommended brightness range	40 cd/m^2 ～ 300 cd/m^2
Supply voltage	1.8V, 5.0V
Weight	≤1.5g
Operating temperature	-20℃ ～ +65℃
Storage temperature	-55℃ ～ +70℃

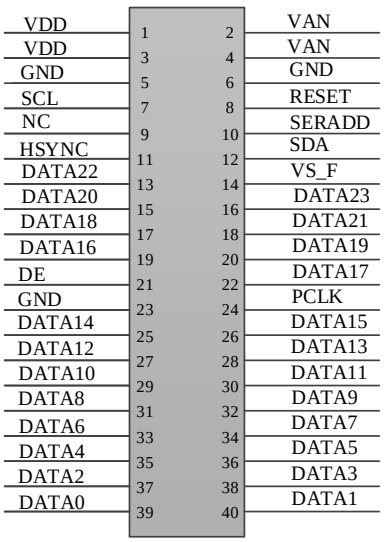
2 Function Overview and Interfaces

2.1 System Block Diagram



2.2 Pin Description

The electrical interface of the microdisplay adopts a 40pin in-line connector with a spacing of 0.5mm. It is recommended that users use the DF12NB(3.0)-40DS-0.5V(51) connector from HRS company or the same specification connector to connect to the Guozhao company's microdisplay.



Note:

Please refer to Chapter 6 for detailed dimensions of the connector.

The electrical interface pins of the microdisplay are defined as follows.

Pin No.	Symbol	Description
1	VDD	Digital circuit power supply
2	VAN	Analog circuit power supply
3	VDD	Digital circuit power supply
4	VAN	Analog circuit power supply
5	GND	Power GND
6	GND	Power GND
7	SCL	I^2C clock
8	$\overline{\text{RESET}}$	Reset signal, active low
9	NC	Not used, recommended to connect to GND
10	SERADD	I^2C slave address selection
11	HSYNC	Video horizontal synchronization
12	SDA	I^2C data
13	DATA 22	Data signal R[6]
14	VS_F	External parity recognition signal
15	DATA20	Data signal R[4]
16	DATA23	Data signal R[7]
17	DATA18	Data signal R[2]
18	DATA21	Data signal R[5]
19	DATA16	Data signal R[0]
20	DATA19	Data signal R[3]
21	DE	Video data enable
22	DATA17	Data signal R[1]
23	GND	Power GND
24	PCLK	Video point clock
25	DATA14	Data signal G[6]
26	DATA15	Data signal G[7]
27	DATA12	Data signal G[4]
28	DATA13	Data signal G[5]
29	DATA10	Data signal G[2]

Pin No.	Symbol	Description
30	DATA11	Data signal G[3]
31	DATA8	Data signal G[0]
32	DATA9	Data signal G[1]
33	DATA6	Data signal B[6]
34	DATA7	Data signal B[7]
35	DATA4	Data signal B[4]
36	DATA5	Data signal B[5]
37	DATA2	Data signal B[2]
38	DATA3	Data signal B[3]
39	DATA0	Data signal B[0]
40	DATA1	Data signal B[1]

Note:

The signal $\overline{\text{RESET}}$ is active at a low level. In order to ensure that the screen is in an effective reset state when starting, a pull-down resistor should be designed at the pin. The recommended resistance value is 10K.

3 Electrical Characteristics

3.1 Absolute Maximum Ratings

Symbol	Description	Min.	Max.	Unit
VDD	Digital circuit power supply	-0.3	2.2	V
VAN	Analog circuit power supply	-0.3	5.5	V
V_I	Input digital signal level	-0.3	VAN-0.3	V
Tst	Storage temperature	-55	+70	℃
Top	Operating temperature	-20	+65	℃

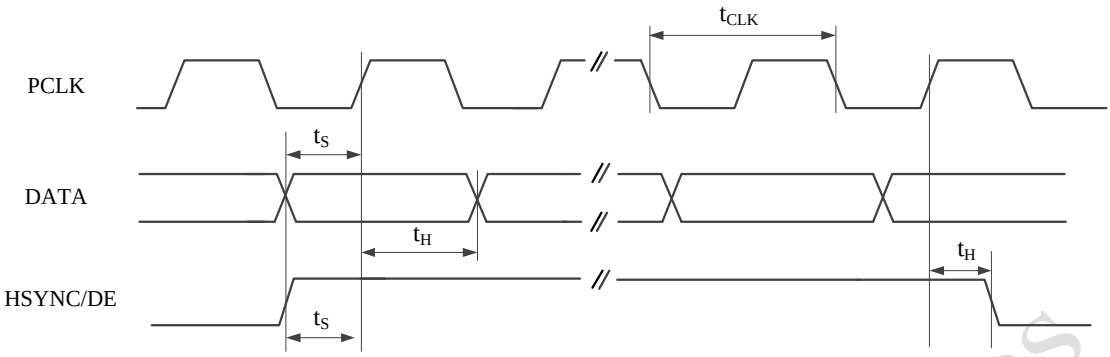
3.2 DC Characteristics

Symbol	Description	Min.	Typ.	Max.	Unit
V_D	VDD voltage	1.75	1.80	1.85	V
I_D	VDD current	—	—	45	mA
V_A	VAN voltage	4.90	5.00	5.10	V
I_A	VAN current	—	—	25	mA
V_{IL}	Valid low level of digital signal	-0.3	—	0.5	V
V_{IH}	Valid high level of digital signal	1.2	—	3.6	V

Note:

Digital input signals are compatible with level standards such as 1.8V, 2.5V, 3.3V, etc., but must meet the electrical standards in the table above.

3.3 AC Characteristics



Symbol	Description	Min.	Typ.	Max.	Unit
t_S	Setup time	4	—	—	ns
t_H	Hold time	1.5	—	—	ns
t_{CLK}	Clock cycle	—	15.4	—	ns
d_{CLK}	Duty cycle	45	50	55	%

3.4 Power Consumption

Power consumption of the microdisplay at different refresh rates

Symbol	Description	Typ.		Unit
		60Hz	25Hz	
P_{VDD}	VDD power consumption	52	28	mW
P_{VAN}	VAN power consumption	58	50	mW
P_{POWER}	Total power consumption	110	78	mW

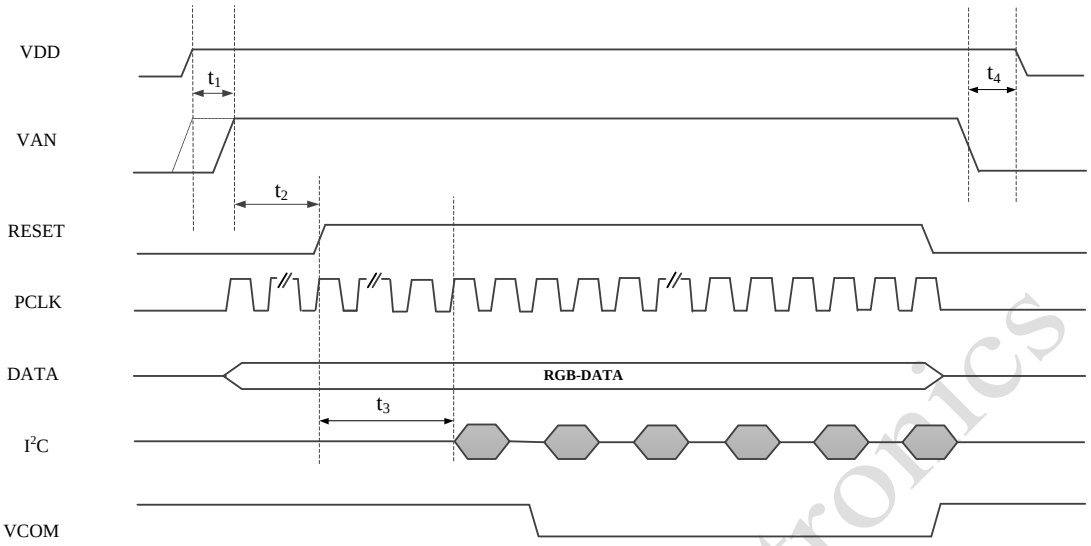
Power consumption of the microdisplay in low power consumption mode

Symbol	Description	Refresh rate	Unit
		25Hz	
P_{VDD}	VDD power consumption	21	mW
P_{VAN}	VAN power consumption	49	mW
P_{POWER}	Total power consumption	70	mW

Note:

All white display, brightness = 150cd/m^2, temperature = +25°C ± 2°C.

3.5 **Power Sequence**



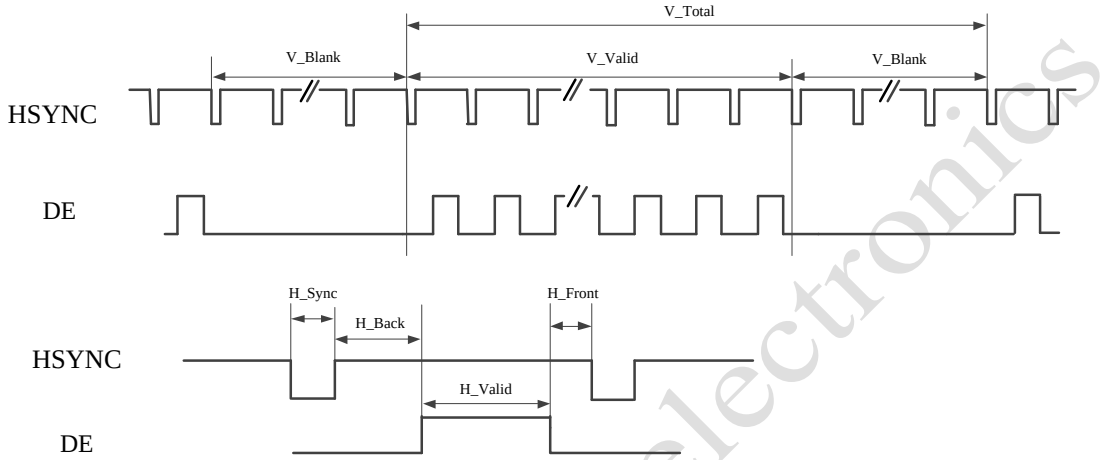
Symbol	Description	Min.	Typ.	Max.	Unit
t_1	Power on time between VDD and VAN	0	—	—	ms
t_2	Reset time	5	—	—	ms
t_3	MTP reload time	5 frames time	—	—	—
t_4	Power-off interval time	0	—	—	ms

Note:

1. In order to avoid display errors when the screen is powered on, it is necessary to ensure that the video data is accurate and at least one frame time later, then configure the 92H register with 0x22, configure the F6H register with 0x40 and configure the AFH register with 0x09, turn on the VCOM voltage and light up the screen.
2. Before powering off, to avoid unstable graphics during shutdown, it is recommended to turn off the VCOM voltage first and set the AFH register to 0x01. During the power-off process, as long as the VDD voltage is not lower than the VAN voltage, the two power supplies can be turned off at the same time.
3. PCLK needs to be in a stable state before RESET is pulled high.
4. Set the 92H register to 0xA3, the microdisplay enters sleep mode and presents a black screen state.

3.6 **Video Sequence**

The timing of the video signal input to the microdisplay shall be in accordance with VESA Standard. When the timing of the video signal is not in accordance with VESA Standard, the parameters below can be configured according to the timing requirements as shown in figure.



Symbol	Min.	Typ.	Max.	Unit
V_Front	1	1	100	HSYNC
V_Sync	3	3	100	HSYNC
V_Back	18	38	100	HSYNC
V_Valid	—	1024	—	HSYNC
H_Front	18	48	500	PCLK
H_Sync	6	112	500	PCLK
H_Back	12	248	500	PCLK
H_Valid	—	1280	—	PCLK

4 Function Description

4.1 Register Map

Address	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0	Default
01H	0	0	Test pattern selection			Input video format selection			0x03
02H	Set 256-level red gray of test pattern								0x00
03H	Set 256-level green gray of test pattern								0x00
04H	Set 256-level blue gray of test pattern								0x00
05H	0	1	0	0	Scanning method		Vertical scanning	Horizontal scanning	0x40
06H	0	Count selection 9bit/10bit	1	0	0	1	1	0	0x66
0CH	0	0	0	0	0	0	BT.656 enable		0x00
0EH	Half of horizontal total pixels H_Total/2 [7:0]								0x4C
0FH	0	0	0	0	Half of horizontal total pixels H_Total/2[11:8]				0x03
11H	Half of horizontal valid pixels H_act/2 [7:0]								0x80
12H	0	0	0	0	Half of horizontal valid pixels H_act/2				0x02
14H	Number of valid rows per frame V_act [7:0]								0x00
15H	0	0	0	0	Number of valid rows per frame V_act				0x04
18H	Number of total rows per frame V_total [7:0]								0x2A
19H	0	0	0	0	Number of total rows per frame				0x04
1BH	Image contrast digital adjustment								0x55
1CH									0xAA
1DH									0x55
1EH									0xAA
1FH	Vertical position control								0x0A
20H									0x0A
21H	Horizontal position control								0x0A
22H									0x0A
91H	Image brightness digital adjustment								0x80
92H	Sleep mode enable	YCbCr to RGB formula selection	Contrast adjustment enable	0	BT.1120 enable	FRC enable	1	Update gamma curve enable	0x23
9AH	Column replication enable	BT.1120 enable	0	Automatic brightness-temperature compensation function enable	0	1	0	0	0x04

9CH	PWM value								0xC0
9EH	BT.656 enable		1	1	0	0	0	0	0x30
A0H	0	0	0	Image stretching enable	1	0	0	0	0x18
A2H	Temperature reading								read only
A7H	BT.656 data format image stretching related								0x00
A9H	Low power consumption mode configuration								0x08
AAH	Low power consumption mode configuration								0xC1
AFH	VCOM voltage enable control								0x01
DBH	0	0	0	0	1	1	VPG_PWM scanning mode selection		0x0C
DCH	Low power consumption mode configuration								0x40
DDH	Low power consumption mode configuration								0x02
EAH	1	1	0	1	0	0	0	Data mode	0xD1
F5H	Image stretching configuration								0x00
F6H	Low power consumption mode configuration								0x00
FAH	BT.656 enable	YCbCr enable	0	0	0	0	0	0	0xC0
FBH	YCbCr enable	0	0	0	0	0	0	0	0x80

4.2 **Test Pattern Selection**

The microdisplay is equipped with various test patterns, and when used, only a stable clock signal PCLK needs to be provided.

Address	Bit	Description
01H	bit5 – bit3	000: With registers 02H, 03H, 04H, 0~255 grayscale of R, G, B signals can be set respectively 001: White field 010: Red field 011: Green field 100: Blue field 101: Transition grayscale pattern from left to right 110: Color bar 111: Checkerboard

4.3 Video Signal Transfer Format

4.3.1 Selection of Video Signal Format

The microdisplay supports various video signal formats, the details are as follows.

Address	Bit	Description
01H	bit2 - bit0	000: BT.656 001: 16bit - YCbCr, 4:2:2 mode / BT.1120 011: 24bit - RGB, 4:4:4 mode 101: Test pattern

Interfaces	BT.656	BT.1120/ YCbCr 4:2:2	RGB 4:4:4
DATA23	GND	GND	R[7]
DATA22			R[6]
DATA21			R[5]
DATA20			R[4]
DATA19			R[3]
DATA18			R[2]
DATA17			R[1]
DATA16			R[0]
DATA15	Y/Cb/Cr[7]	Y[7]	G[7]
DATA14	Y/Cb/Cr[6]	Y[6]	G[6]
DATA13	Y/Cb/Cr[5]	Y[5]	G[5]
DATA12	Y/Cb/Cr[4]	Y[4]	G[4]
DATA11	Y/Cb/Cr[3]	Y[3]	G[3]
DATA10	Y/Cb/Cr[2]	Y[2]	G[2]
DATA9	Y/Cb/Cr[1]	Y[1]	G[1]
DATA8	Y/Cb/Cr[0]	Y[0]	G[0]
DATA7	GND	Cb/Cr[7]	B[7]
DATA6		Cb/Cr[6]	B[6]
DATA5		Cb/Cr[5]	B[5]
DATA4		Cb/Cr[4]	B[4]
DATA3		Cb/Cr[3]	B[3]
DATA2		Cb/Cr[2]	B[2]
DATA1		Cb/Cr[1]	B[1]

Interfaces	BT.656	BT.1120/ YCbCr 4:2:2	RGB 4:4:4
DATA0		Cb/Cr[0]	B[0]

4.3.2 16bit-YCbCr Format Signal Description

The two color conversion formulas are as follows:

Formula 1: (default)

R = Y×149/128 + Cr×204/128 − 223

G = Y×149/128 − Cb×50/128 – Cr×104/128 + 135

B = Y×149/128 + Cb×258/128 – 277

Formula 2: (reserved)

R = Y + Cr×179/128 − 179

G = Y − Cb×44/128 – Cr×91/128 + 135

B = Y + Cb×227/128 – 227

Address	Value	Description
FAH	0x00	YCbCr enable
FBH	0x00	YCbCr enable
01H	0x01	16bit - YCbCr, 4:2:2 mode
92H	0x23	YCbCr to RGB formula 1
	0x63	YCbCr to RGB formula 2

Note:

Configure the registers in the order listed in the table.

4.3.3 ITU-R BT.656 Configuration Instructions

The microdisplay supports ITU-R BT.656 signals in embedded synchronous format. Take the standard PAL-D video as an example, the register settings when the image is centered are shown below.

Address	Value	Description
FAH	0x00	BT.656 enable, YCbCr enable
FBH	0x00	YCbCr enable
01H	0x00	0x00: BT.656 format
05H	0x04	Embedded synchronization, interlaced scanning
06H	0x26	Switch BT.656 8bit to 9bit
0CH	0x01	BT.656 enable
0EH	0x60	Horizontal total pixels, that is 864; H_total = 0x360
0FH	0x03	
11H	0xD0	Horizontal valid pixels, that is 720; H_act = 0x2D0
12H	0x02	
14H	0x20	Number of valid rows per frame, that is 288; V_act = 0x120
15H	0x01	
18H	0x38	Number of total rows per frame, that is 312; V_total = 0x138
19H	0x01	
1FH	0xEA	Redundant rows (top), (1044 – vertical valid pixels)/ 2, (1044 - 576)/ 2 = 234
20H	0xEA	Redundant rows (down), to ensure centered display, keep the same value as the top redundant rows
21H	0x22	Redundant pixels (left), (1300 - horizontal valid pixels)/ 2, (1300 - 720)/ 2=290
22H	0x22	Redundant pixels (right), to ensure centered display, keep the same value as the left redundant rows
92H	0x27	Select YCbCr to RGB formula 1; FRC off
	0x67	Select YCbCr to RGB formula 2; FRC off
9EH	0xF0	BT.656 enable
DBH	0x0F	VPG_ PWM scanning mode selection
EAH	0xD0	Switch BT.656 8bit to 9bit

Note:

1. Configure the registers in the order listed in the table.

2. This configuration is based on default values and it can be changed by users when functions are superimposed.

4.3.4 ITU-R BT.1120 Configuration Instructions

When the input digital video signal is in ITU-R BT.1120 format, the conversion relationship is as follows.

R = Y × 149/128 + Cr × 230/128 – 248

G = Y × 149/128 – Cr × 68/128 – Cb × 27/128 + 77

B = Y × 149/128 + Cb × 270/128 – 289

When inputting the BT.1120 signal, the register settings are shown in the table below.

Address	Value	Description
FAH	0x00	YCbCr enable
FBH	0x00	YCbCr enable
92H	0x2B	BT.1120 enable
9AH	0x44	BT.1120 enable
01H	0x01	0x01: BT.1120 format

Note:

1. Configure the registers in the order listed in the table.

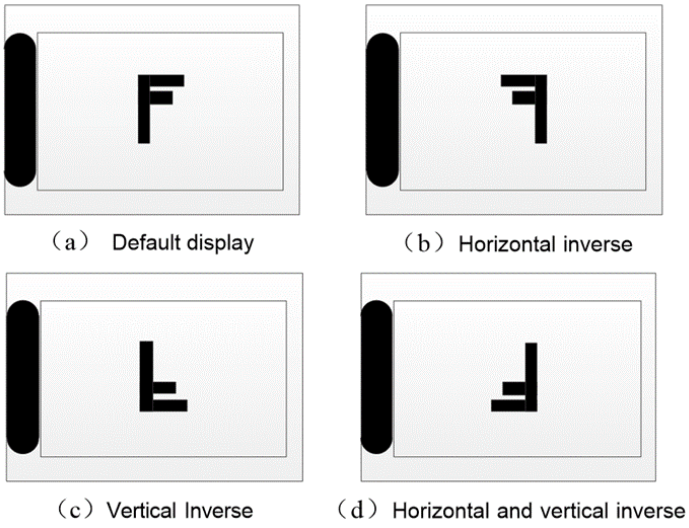
2. This configuration is based on default values and it can be changed by users when functions are superimposed.

4.4 Up / Down and Left / Right Inverse Display

The microdisplay supports inverse display of video images in horizontal and vertical directions.

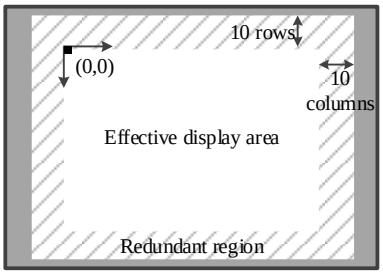
Address	Bit	Description
05H	bit1	Vertical display settings 0: Vertical normal display 1: Vertical inverse display
	bit0	Horizontal display settings 0: Horizontal normal display 1: Horizontal inverse display

The schematic diagram of inverse display in horizontal and vertical directions is as follows.



4.5 **Image Display Position Movement**

The microdisplay supports the movement of the full-screen image at any position within the display area and the offset position value can be set separately. Taking an image with a resolution of 1280×1024 as an example, the maximum horizontal and vertical movement values are both 0x0A.



The image movement can be completed by configuring the register values with addresses ranging from 1FH to 22H. Please refer to the table below for the movement configuration.

Address	Value	Description
1FH	0x0A+Y	The Y value is the vertical movement adjustment amount, and its range is [-10,+10]. The specific description is as follows. $\begin{cases} Y > 0, The\ image\ moves\ down \\ Y = 0, The\ image\ is\ centered\ vertically \\ Y < 0, The\ image\ moves\ up \end{cases}$
20H	0x0A-Y	
21H	0x0A+X	The X value is the horizontal movement adjustment amount, and its range is [-10,+10]. The specific description is as follows. $\begin{cases} X > 0, The\ image\ moves\ right \\ X = 0, The\ image\ is\ centered\ horizontally \\ X < 0, The\ image\ moves\ left \end{cases}$
22H	0x0A-X	

Note:

When moving low-resolution images, the moving range can be greater than 10 rows/columns, and the specific value is calculated according to the actual resolution.

4.6 **Image Stretching**

Image stretching is independent of the input signal format, only related to the input resolution and stretched to 1280×1024 full-screen display. The supported typical resolutions and configurations are shown in the table below.

Address / Resolution	A0H	F5H	9AH	05H	DBH
640×480	0x08	0xC3	/	/	/
640×512	/	/	0x84	0x4C	0x0F
800×600	0x08	0xC6	/	/	/
1024×768	0x08	0xF3	/	/	/

When inputting the BT.656 signal, the register settings of image stretching display are shown in the table below.

No.	Address	Value	No.	Address	Value
1	FAH	0x00	14	19H	0x01
2	FBH	0x00	15	1FH	0x0A
3	01H	0x00	16	20H	0x0A
4	05H	0x04	17	21H	0x0A
5	06H	0x26	18	22H	0x0A
6	0CH	0x01	19	92H	0x27
7	0EH	0x60	20	9EH	0x30
8	0FH	0x03	21	A0H	0x08
9	11H	0xD0	22	A7H	0xB5
10	12H	0x02	23	DBH	0x0F
11	14H	0x20	24	EAH	0xD0
12	15H	0x01	25	F5H	0xE7
13	18H	0x38			

Note:

1. When the BT.656 signal is input and the image is stretched to display, configure the registers according to the order in the table.
2. This configuration is based on default values and it can be changed by users when functions are superimposed.
3. Support other non-standard resolution stretching. If necessary, contact Guozhao Optoelectronics

Company to provide technical support.

4.7 **Temperature Detection**

Register A2H stores the value of the temperature detection module, which can be read at any time through I^2C, and the real-time temperature inside the chip can be obtained after conversion. The conversion relationship is:

$$T = 0.47 \times Reg(A2H) - 47$$

Since the reading of the temperature detection register is related to the environment temperature rise, it is recommended that users check the status and draw the characteristic curve in actual use.

Note:

During normal operation, the temperature reading update cycle is a four-frame image cycle.

4.8 **Brightness Adjustment**

The factory default brightness of the microdisplay is about 150cd/m^2, and the recommended brightness range is 40cd/m^2 ~ 300cd/m^2. The user can adjust the brightness appropriately according to the needs of the use. The brightness adjustment method is the PWM method, the corresponding configuration register address is 9CH, and the brightness adjustment can be realized only by changing the value of the register. Under the standard VESA timing, the adjustment range of the 9CH register is 0x78 ~ 0xFF, the adjustment step is 0x01, and the factory default value is 0xC0. The larger the PWM value, the higher the brightness.

Under different refresh rates, the usable brightness range of the microdisplay is different. The following table shows the adjustable brightness range under typical refresh rates. If this range is exceeded, the image display will be abnormal.

	Typical refresh rate (Hz)				
	60	**50**	**40**	**30**	**25**
Recommended brightness range (cd/m^2)	1~300	1~300	5~300	25~300	40~300

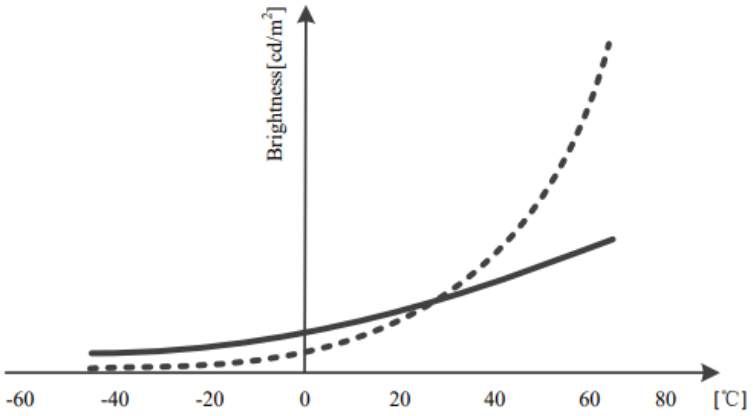
The PWM value of the register is proportional to the brightness of the screen and the relationship formula is as follows.

$$L = 300 \times （8 \times M - 2048 + N）/N$$

In the formula: M represents the value of the PWM register converted to decimal, N represents the number of V_Total, and L represents the brightness value. The value of PWM cannot exceed the value of the number of total rows V_Total, which needs to be restricted.

4.9 **Automatic Brightness-Temperature Compensation**

Due to the inconsistent full temperature characteristics of the silicon-based OLED microdisplay, the brightness increases at high temperatures and decreases at low temperatures. In order to improve the consistency of brightness at different temperatures, the microdisplay has a built-in brightness adaptive adjustment mechanism, which automatically compensates for the brightness of the screen at different temperatures. The 9AH register is the enable control register, and its default value is 0x04, which is in the off state. To enable this function, the configuration value is set to 0x14.



In the figure above, the dashed line represents the brightness curve at full temperature when the brightness adaptive adjustment is turned off, while the solid line represents the brightness curve at full temperature when the brightness adaptive adjustment function is turned on. By testing, the brightness is effectively compensated in both high and low temperature stages after the brightness adaptive adjustment function is turned on, making the brightness at high and low temperatures as close as possible to the default brightness at room temperature. The image display effect basically meets the observation requirements at full temperature.

4.10 **Image Brightness Digital Adjustment**

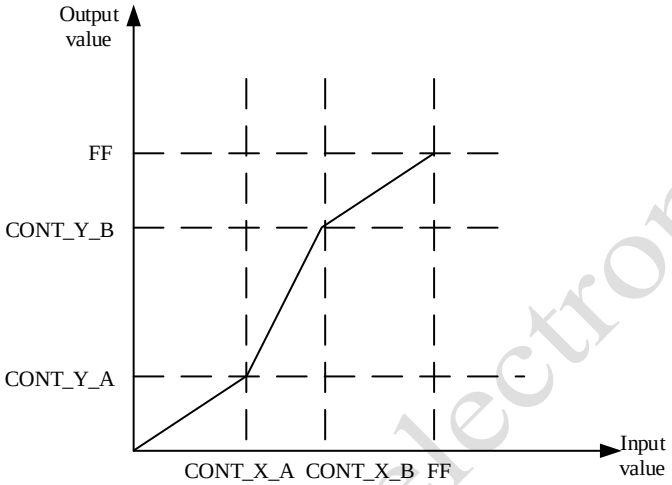
The microdisplay has the image brightness digital adjustment function, and the brightness adjustment formula is as follows:

$$Y = Y_0 + (BRT - 128) \times 4$$

Y is the adjusted data value, Y_0 is the input image data value, and BRT is the configuration value of the 91H register. Data overflow may occur in the low gray stage and high gray stage after adjustment, resulting in image distortion. It is recommended to configure it appropriately.

4.11 **Image Contrast Adjustment**

The microdisplay has the image contrast adjustment function, which divides the contrast adjustment into three sections for adjustment. The mapping curves of the three sections are shown in the figure below:



CONT_X represents the input gray scale value, CONT_Y represents the corresponding output gray scale value. By modifying the values of A and B segment points through the register, the proportional relationship between output and input gray scale is adjusted, so as to realize the function of contrast segment adjustment. The image contrast adjustment register addresses are 1BH, 1CH, 1DH, 1EH, and the adjustment range is 0x00～0xFF.

Address	Bit	Description
92H	bit5	0x23: contrast adjustment on 0x03: contrast adjustment off
1BH	bit7- bit0	Image contrast digital adjustment point A output value
1CH	bit7- bit0	Image contrast digital adjustment point B output value
1DH	bit7- bit0	Image contrast digital adjustment point A input value
1EH	bit7- bit0	Image contrast digital adjustment point B input value

4.12 Low Power Consumption Mode

The register settings for the low power consumption mode are shown in the table below. In the low power consumption mode, the temperature reading fails.

Address	Value
DCH	0xCC
DDH	0x03

4.13 I^2C Interface

The user can write or read the values of the register inside the screen through the I^2C interface. The I^2C interface communication mode conforms to the standard communication protocol. The host can realize functions of test pattern selection, brightness adjustment, contrast adjustment, temperature reading and so on by reading and writing internal registers of the microdisplay.

The communication rate supports 10KHz~400KHz.

Note:

1. SDA and SCL signals must be pulled up with resistors to V_{IH};
2. When the transmission distance of I^2C communication signal is long, please pay attention to the signal integrity and anti-interference measures of SDA and SCL;
3. When the I^2C communication signal is seriously disturbed, I^2C communication can be carried out during the vertical blanking interval, or the communication frequency can be appropriately reduced.

4.13.1 Slave Address Selection

The microdisplay is used as a slave device. Its address can be selected by the SERADD pin, which is 0x54 when the SERADD pin is low and 0x55 when the SERADD pin is high. The specific slave address and read / write instructions are as follows.

Slave address	Instructions	Bit7 (MSB)	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1 (SERADD)	Bit0 (R/W)	Valid bytes
0x54	Write	1	0	1	0	1	0	0	0	0xA8
	Read	1	0	1	0	1	0	0	1	0xA9

0x55	Write	1	0	1	0	1	0	1	0	0xAA
	Read	1	0	1	0	1	0	1	1	0xAB

4.13.2 Data Transfer Format

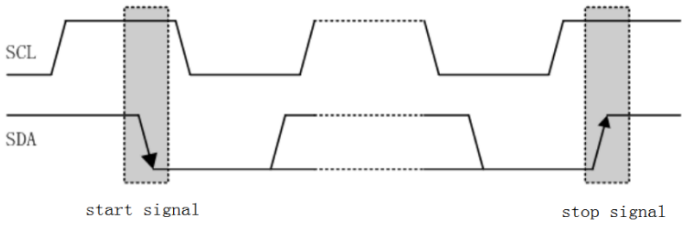
4.13.2.1 Flag Bit Description

Start signal(S): the change of SDA line from high level to low level when the SCL line is high level;

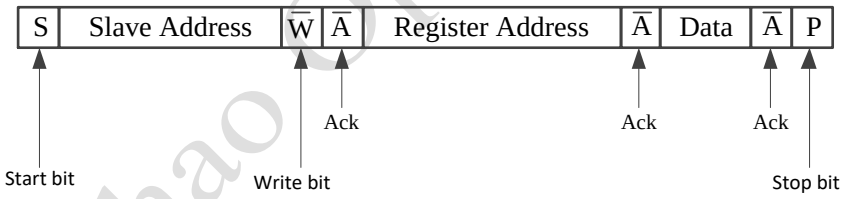
Pause signal (P): the change of SDA line from low level to high level when the SCL line is high level;

Active answer (ACK): SDA at low level indicates active answer;

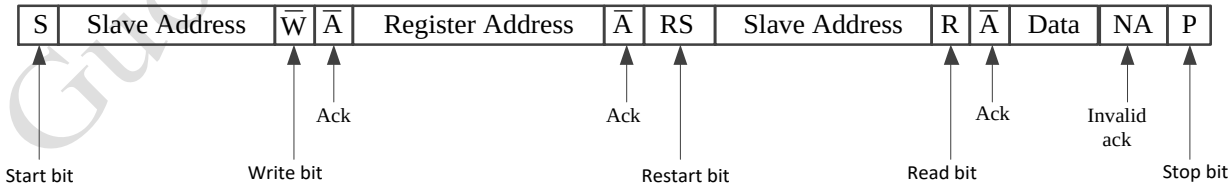
Negative answer (NAK): SDA at high level indicates negative answer;



4.13.2.2 Write Sequence

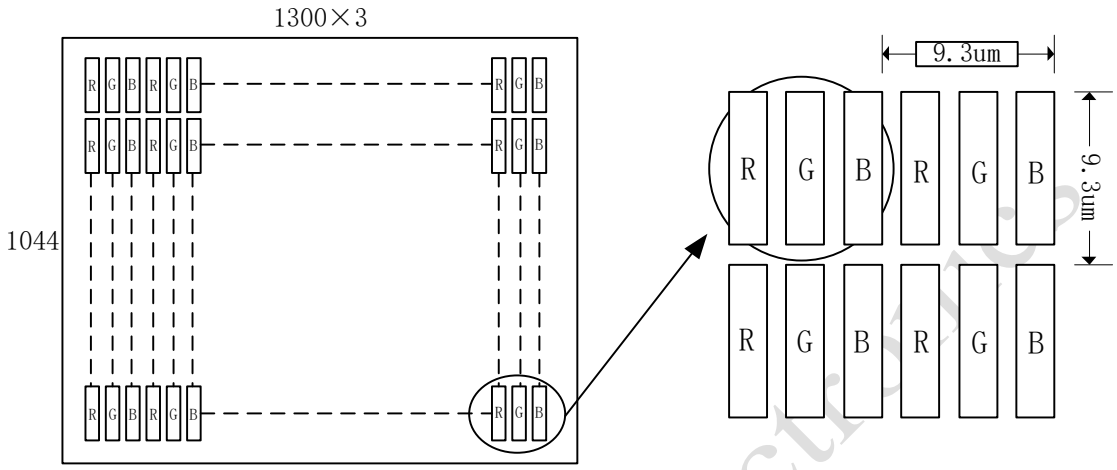


4.13.2.3 Read Sequence



5 Optical Features

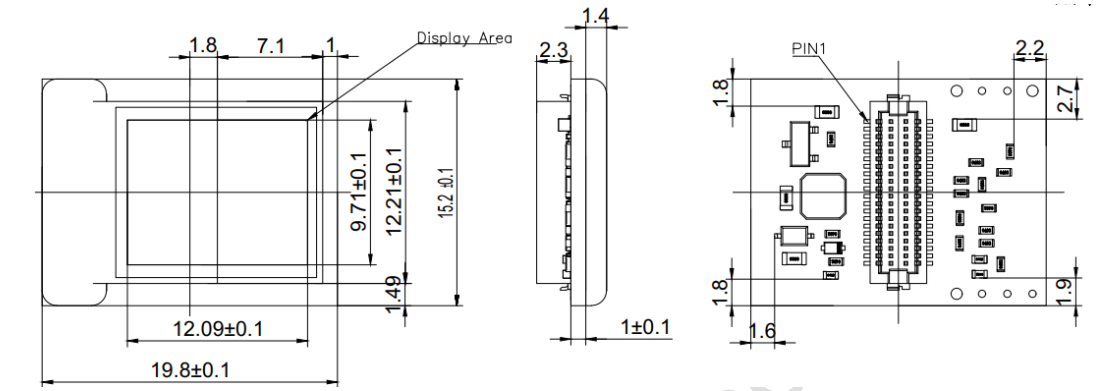
The pixel arrangement of the GZ060PEC01 silicon-based OLED microdisplay is shown below, where every three sub-pixels form a pixel. The pixel size is 9.3μm×9.3μm.

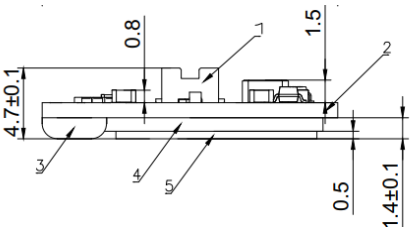


6 Structure and Package

6.1 Product Structure

The overall size of the microdisplay is 19.8mm×15.2mm, and other dimensions are shown below.

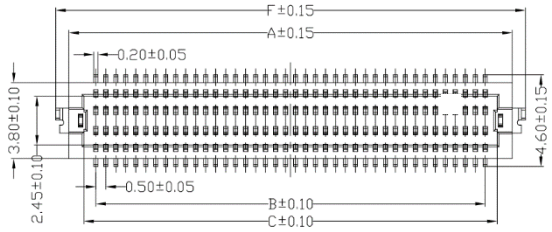




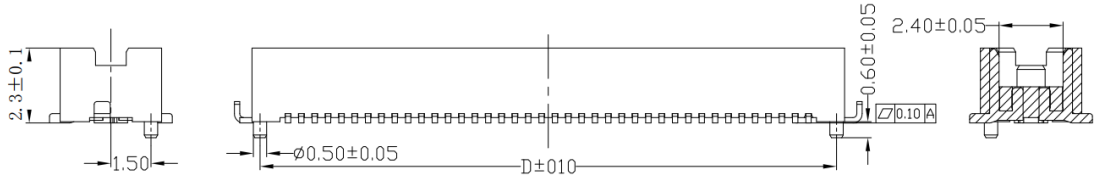
No.	Description
1	Connector
2	PCB substrate
3	Sealant between the silicon substrate and the PCB substrate
4	Silicon substrate
5	Glass

6.2 Connector Dimension and Design Recommendations

Unit: mm



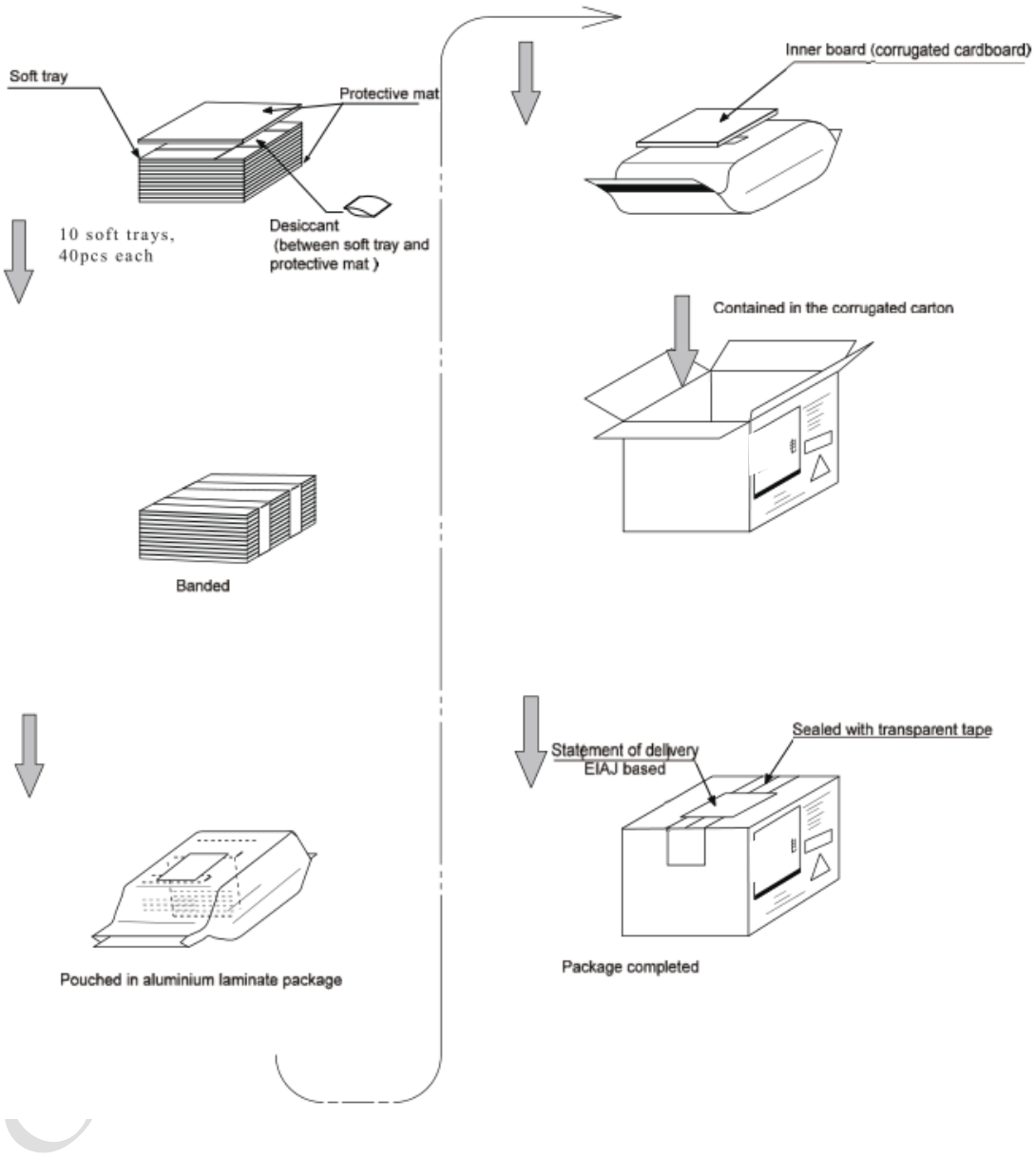
Number of Contacts	Dimension(mm)				
	A	B	C	D.	f
40	12.20	9.50	10.70	11.60	13.52



6.3 **Product Packing Specification**

Packaging composition: Soft tray (capacity: 40 pcs)

Packing quantity: 400 pcs (10×40, 10 soft trays, 40 pcs per tray)



7 Product Precautions

7.1 Use Precautions

1. The GZ060PEC01 silicon-based OLED microdisplay shall be strictly in accordance with the definition of the electrical interface in this datasheet for power supply and signal lines connection. Maintain the stability of the power supply, and illegal power supply is not allowed;
2. During the use of the microdisplay, if abnormal phenomena such as short circuit or overheating are found, it is prohibited to repeatedly power on to test. Please timely find the problem or contact Guozhao Optoelectronics Company for maintenance;
3. In order to improve the service life of the product and avoid the aggravation of residual images affecting use, it is necessary to minimize the time for the product to display a fixed image under high temperature or high brightness conditions;
4. The glass and silicon edges of the silicon-based OLED microdisplay are easily damaged and shall not be subject to physical stress;

7.2 Cleaning Precautions

1. It is prohibited to use any acid, alkali, organic solvent/reagent and other chemicals to scrub or come into contact with the product;
2. Use lens paper or a clean cloth to dip a small amount of water or organic solvent, wring dry and then wipe the silicon-based OLED microdisplay surface. Do not wipe it directly with a wet cloth;
3. When wiping the screen with organic solvents, try to avoid wiping the edge of the screen, otherwise it may damage the rubber layer.

7.3 Storage Requirements

1. Short-term storage requirements: the silicon-based OLED microdisplay allows short-term storage in a dry environment between -55 °C ~ 70 °C (≤ 100 hours);
2. Long-term storage requirements:

1) Room temperature of 25 °C ± 5 °C;
2) The dry nitrogen or vacuum sealed container;
3) Avoid violent shaking.

7.4 **Others**

1. Keep the silicon-based OLED microdisplay away from ultraviolet rays and ionizing radiation;
2. Do not bend the silicon-based OLED microdisplay by external force;
3. Keep the silicon-based OLED microdisplay away from heat sources during storage or use;
4. Avoid falling of the silicon-based OLED microdisplay at high altitude.
