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ET023VGH01-G

Silicon-based OLED Microdisplay

Datasheet

Version Pre Spec V1.0

Revision

Version	Date	Page No.	Description
1.0	2025-09-12		Release preview version

Contents

1 Overview / Applications

The ET023VGH01-G microdisplay is a top-emitting, high-efficiency, active-matrix-driven silicon-based OLED microdisplay independently developed by YOURITECH TECHNOLOGY. This product integrates some modules like signal enhancement circuit, row and column drive circuit, logic control circuit, etc. It supports the MIPI signal. Through the I2C-bus interface, it can realize the control and adjustment of display mode, display position, brightness, contrast and other functions. This productthas 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

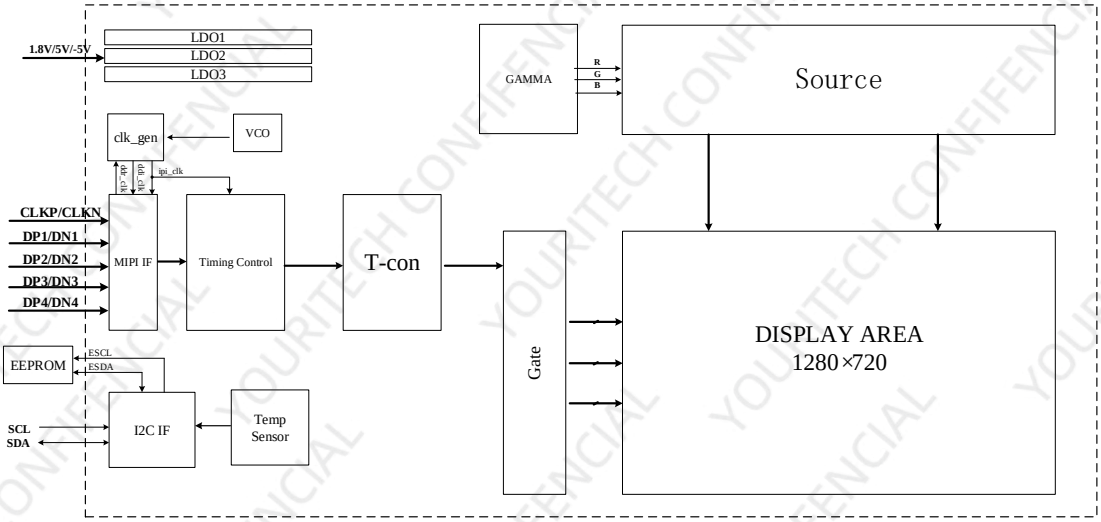
- Low power consumption
- high contrast
- The communication interface supports I2C
- Single MIPI signal (4 lane) input, supporting D-PHY v1.1 1.0Gbps/lane
- built-in temperature sensor
- Built-in PWM mode dimming function
- Support brightness adaptive adjustment function
- Support the image brightness and contrast digital signal enhancement function
- Support horizontal / vertical inverse display of video images
- Support image timed movement
- Support image display position adjustment

1.2 General Features

Parameter	Specification
Product category	Color
Maximum display resolution	1280×720
Reserved physical pixels	1296×736
Pixel arrangement	Hexagon
Pixel dimension	5.22μm×5.22μm
Display area	6.68mm×3.76mm (0.3 inches diagonally)
Gray level	256 levels
Uniformity@10000cd/m^2	≥ 90%
Contrast	>10000:1
Refresh rate	60Hz
Video interface	MIPI
Maximum brightness	10000 cd/m^2
Recommended brightness range	80 cd/m^2 ～ 10000 cd/m^2
Supply voltage	+1.8V、+5V、-5V
Operating temperature	-20℃ ～ +65℃
Storage temperature	-55℃ ～ +70℃

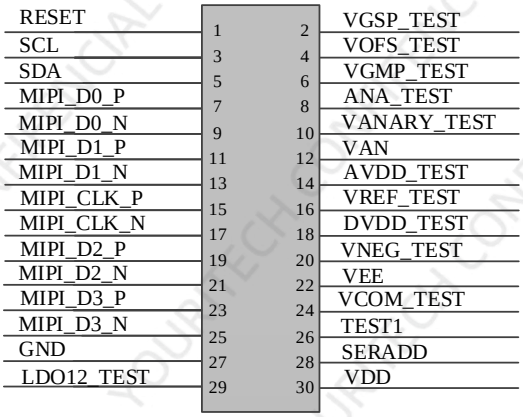
2 Function Overview and Interfaces

2.1 System Block Diagram



2.2 Pin Description

The microdisplay electrical interface uses a 30-pin in-line connector with a pitch of 0.4mm, as shown in Figure.



Note:

Refer to Section 5 for connector detail size.

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

Pin No.	Symbol	Description
1	$\overline{\text{RESET}}$	Reset signal, active low
2	VGSP_TEST	Internal analog power supply, external 0.1μF capacitor to ground
3	SCL	I2C clock
4	VOFS_TEST	Internal analog power supply, external 0.1μF capacitor to ground
5	SDA	I2C data
6	VGMP_TEST	Internal analog power supply, external 0.1μF capacitor to ground
7	MIPI_D0_P	MIPI data input
8	ANA_TEST	Test point, floating
9	MIPI_D0_N	MIPI data input
10	VANARY_TEST	Internal analog power supply, external 2.2μF capacitor to ground
11	MIPI_D1_P	MIPI data input
12	VAN	Analog circuit power supply (+5V)
13	MIPI_D1_N	MIPI data input
14	AVDD_TEST	Internal analog power supply, external 2.2μF capacitor to ground
15	MIPI_CLK_P	MIPI clock input
16	VREF_TEST	Internal analog power supply, external 1μF capacitor to ground
17	MIPI_CLK_N	MIPI clock input
18	DVDD_TEST	Internal analog power supply, external 2.2μF capacitor to ground
19	MIPI_D2_P	MIPI data input
20	VNEG_TEST	Internal analog power supply, external 2.2μF capacitor to ground
21	MIPI_D2_N	MIPI data input
22	VEE	Negative voltage circuit power supply (-5V)
23	MIPI_D3_P	MIPI data input
24	VCOM_TEST	Internal analog power supply, external 2.2μF capacitor to ground
25	MIPI_D3_N	MIPI data input
26	TEST1	Test point, floating
27	GND	Power ground
28	SERADD	I2C slave address selection
29	LDO12_TEST	Internal analog power supply, external 2.2μF capacitor to ground
30	VDD	Digital circuit power supply (+1.8V)

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
VEE	Negative voltage circuit power supply	-5.5	0.3	V
Top	Operating ambient temperature	-20	+65	℃
Tst	Storage temperature	-55	+70	℃

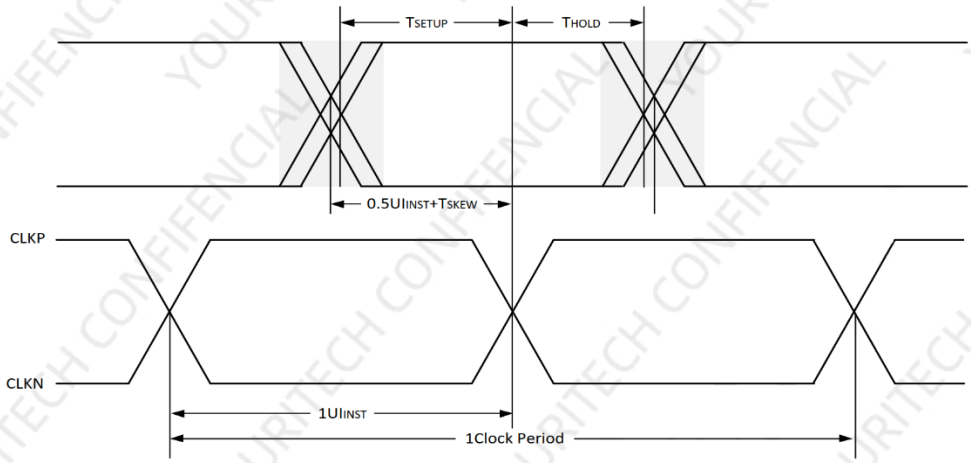
3.2 DC Characteristics

Symbol	Description	Min.	Typ.	Max.	Unit
V_D	VDD voltage	1.75	1.80	1.85	V
I_D	VDD current	—	—	100	mA
V_A	VAN voltage	4.9	5	5.1	V
I_A	VAN current	—	—	200	mA
V_E	VEE voltage	-5.5	-5	-4.9	V
I_E	VEE voltage			200	mA
V_{IL}	Valid low level of digital signal	0	—	0.3* V_D	V
V_{IH}	Valid high level of digital signal	0.7* V_D	—	V_D	V

3.3 AC Characteristics

Table of Mipi high-speed mode characteristics:

Symbol	Description	Min.	Typ.	Max.	Unit
UI_{INST}	UI instantaneous	1	—	3	ns
T_{SKEW}	T Data to Clock Skew	-0.15	—	0.15	UIHS
T_{SETUP}	RX Data to Clock Setup Time Tolerance	0.15	—	—	UIHS
T_{HOLD}	RX Data to Clock Hold Time Tolerance	0.15	—	—	UIHS



3.4 Power Consumption

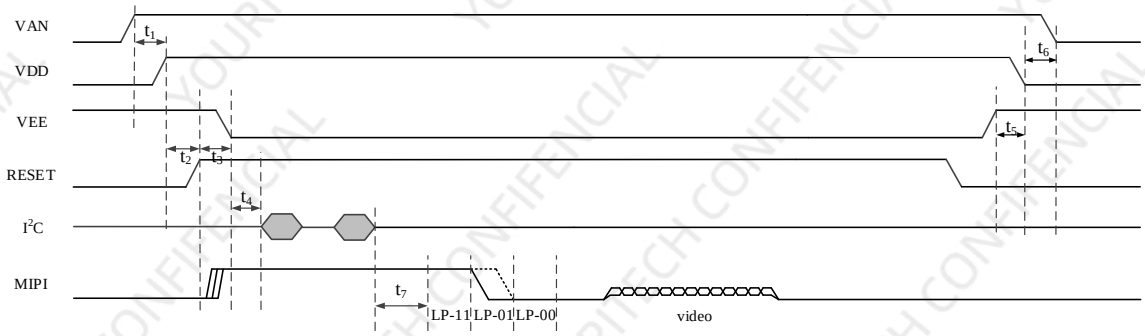
Power consumption of microdisplay at different refresh rates are as follows:

Symbol	Description	6000cd/m²@60Hz	10000cd/m²@60Hz	Unit
P_{VDD}	VDD power consumption	47	47	mW
P_{VAN}	VAN power consumption	43	63	mW
P_{VEE}	VEE power consumption	27	47	mW
P_{POWER}	Total power consumption	117	157	mW

Note:

Temperature test condition is +25℃±2℃, test picture is full white field.

3.5 **Power Sequence**



Symbol	Description	Min.	Typ.	Max.	Unit
t_1	VDD power-on delay	0	—	—	ms
t_2	Power settling time	10	—	—	ms
t_3	VEE power-on delay	10	—	—	ms
t_4	Initialization time	100	—	—	ms
t_5	Power-off interval time	0			ms
t_6	Power-off interval time	0			ms
t_7	MIPI signal input time	0			ms

Note:

Please strictly follow the power-on sequence, otherwise there may be abnormal display and screen damage risk.

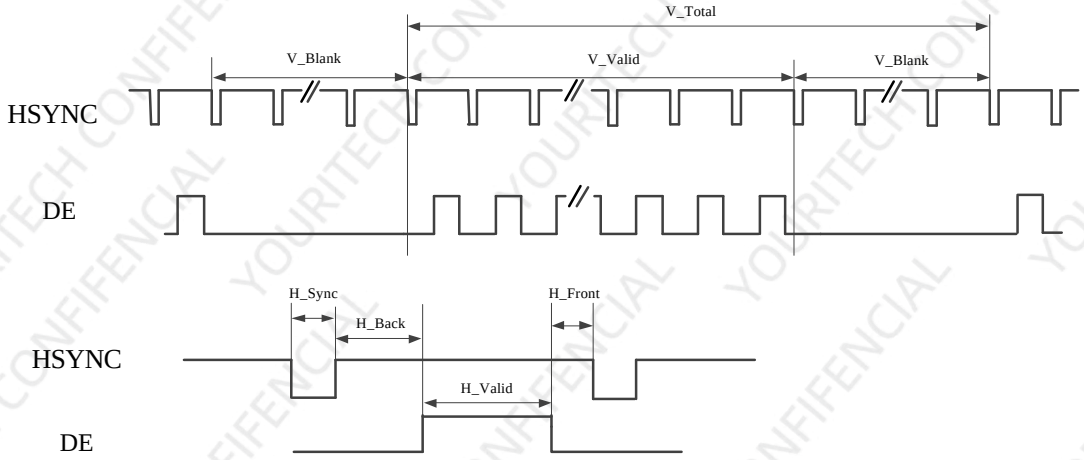
3.6 **Power-up Register Configuration**

I2C Address	Data
6c00H	0x00
6900H	0x08
6901H	0x00
6800H	0x03
6801H	0x00
6802H	0x00
6803H	0x00
6c00H	0x70
6c00H	0x00
6900H	0x10
6901H	0x00
6800H	0x07
6801H	0x00
6802H	0x00
6803H	0x00
6c00H	0x70
6c00H	0x00
6900H	0x10
6901H	0x03
6800H	0x0f
6801H	0x00
6802H	0x00
6803H	0x00
6c00H	0x70
6c00H	0x00
6900H	0x14
6901H	0x03
6800H	0x02
6801H	0x00
6802H	0x00
6803H	0x00
6c00H	0x70
6c00H	0x00
6900H	0x00
6901H	0x04
6800H	0x01
6801H	0x00
6802H	0x00
6803H	0x00
6c00H	0x70

6c00H	0x00
6900H	0x04
6901H	0x04
6800H	0x00
6801H	0x00
6802H	0x00
6803H	0x00
6c00H	0x70
6c00H	0x00
6900H	0x08
6901H	0x04
6800H	0x11
6801H	0x00
6802H	0x00
6803H	0x00
6c00H	0x70
6c00H	0x00
6900H	0x04
6901H	0x00
6800H	0x00
6801H	0x00
6802H	0x00
6803H	0x00
6c00H	0x70
6c00H	0x00
6900H	0x04
6901H	0x00
6800H	0x01
6801H	0x00
6802H	0x00
6803H	0x00
6c00H	0x70
6c00H	0x00
7d02H	0xc0
7e03H	0x01
6f00H	0x30
7402H	0x0d
9f01H	0x10

3.7 **Video Signal Timing Constraint**

The input video signal timing of microdisplay screen shall comply with VESA standard. When the video signal timing does not comply with VESA standard, please refer to the timing requirements shown in Figure below and configure according to the parameters in Table below.



Symbol	Min.	Typ.	Max.	Unit
V_Sync	3	5	80	HSYNC
V_Back	18	20	80	HSYNC
V_Front	3	5	80	HSYNC
V_Valid	—	720	—	HSYNC
H_Sync	20	40	500	PCLK
H_Back	20	220	500	PCLK
H_Front	20	110	500	PCLK
H_Valid	—	1280	—	PCLK

4 Function Description

4.1 Register Map

Address	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0	Default
0001H	Test pattern selection			0		Image display selection			0x03
0002H	0	0	0	0	0		Vertical scanning	Horizontal scanning	0x00
0200H	0	Left / right movement enable	Up / down movement enable	Timed movement distance (number of rows / columns)					0x05
0201H	Time interval for timed movement STICK_TIME [7:0], the unit is 64 frames. At a frame rate of 60Hz, this corresponds to approximately 1 second.								0x01
0202H	Time interval for timed movement STICK_TIME [15:8], the unit is 64 frames. At a frame rate of 60Hz, this corresponds to approximately 1 second.								0x00
0300H	Set 256-level red gray of test pattern								0x00
0301H	Set 256-level green gray of test pattern								0x00
0302H	Set 256-level blue gray of test pattern								0x00
0400H	Top display starting point selection								0x08
0401H	Bottom display starting point selection								0x08
0402H	Left side display starting point selection								0x05
0403H	Right side display starting point selection								0x05
0600H	Global image contrast digital adjustment								0x55
0601H									0xAA
0602H									0x55
0603H									0xAA
0800H	Global image brightness digital adjustment								0x80
3000H	0	1	1	Global contrast update enable	1	1	1	1	0x7F
3001H	Temperature detection readings								Read only
5800H	PWM value								0xFF
7402H	0	0	0	0	1	VCOM voltage enable control	0	1	0x09

4.2 Test Pattern Selection

The microdisplay is equipped with various test patterns, and different test images can be output by setting the values of bit7-bit5 of register 0001H.

Address	Bit	Description
0001H	Bit7 – bit5	000: With registers 0300H, 0301H, 0302H, 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

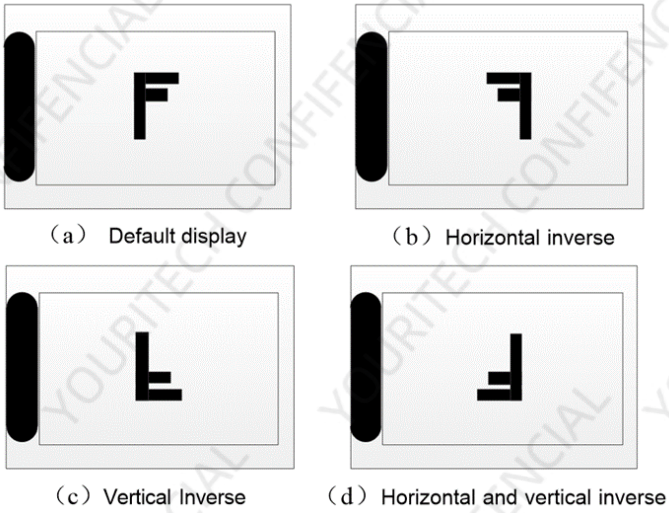
Address	Bit	Description
0001H	bit2 - bit0	011: 24bit - RGB, 8:8:8 mode 101: Test pattern

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
0002H	bit1	Vertical display settings 0: Scan from top to bottom 1: Scan from bottom to top
	bit0	Horizontal display settings 0: Scan from left to right 1: Scan from right to left

The horizontal and vertical mirror images are shown as follows.



4.5 Image Timed Movement

The microdisplay supports timed dynamic movement of the entire screen image in the horizontal or vertical direction.

Address	Bit	Description
0200H	bit6	Horizontal timed movement control 0: Dynamic movement function is turned off; 1: Dynamic movement function is turned on;
	bit5	Vertically timed movement control 0: Dynamic movement function is turned off; 1: Dynamic movement function is turned on;
	bit4-bit0	Number of rows/columns to move, range from 0x00 to 0x05
0201H	bit7-bit0	Time interval of movement STICK_TIME, the unit is 64 frames. At a frame rate of 60Hz, this corresponds to approximately 1 second. Register 0201H value is STICK_TIME[7:0]; Register 0202H value is STICK_TIME[15:8];
0202H	bit7-bit0	

Note:

The display has 8 redundant pixels on the top and bottom, and 5 redundant pixels on the left and right. When the dynamic movement function is enabled, the movement range must not exceed the range of redundant pixels.

4.6 Temperature Measurement

Register 3001H stores the value of the temperature detection module, which can be read at any time through I2C. The real-time internal temperature of the chip can be obtained after conversion, and the conversion relationship is:

$$T = 0.51 \times Reg(3001H) - 63$$

Since the temperature reading of the temperature detection register is related to the temperature rise of the use environment, it is recommended that users conduct state investigation and draw characteristic curves in actual use.

Note:

1. The temperature reading changes greatly during the power-on initialization of the product. It is recommended to read it after a few seconds of stability;
2. The temperature reading update cycle is four frames of image cycle.

4.7 Brightness Adjustment

The default brightness of the microdisplay is about 10000cd/m^2 when it is shipped from the factory. The recommended brightness range is 80cd/m^2~10000cd/m^2. The user can adjust the brightness appropriately according to the use requirements. The brightness adjustment mode is the built-in PWM mode, and the corresponding configuration register address is 5800H , brightness adjustment can be realized only by changing the value of the register. The factory default value of PWM is 0xFF, the adjustment step is 0x01, the larger the PWM value, the greater the brightness. The PWM value corresponding to the minimum brightness is 0x46, and the PWM value corresponding to the maximum brightness is 0xFF.

PWM value is linearly proportional to brightness, and the relationship formula is as follows.

$$L = \frac{M}{N} \times 42649 - 3901$$

M represents PWM register value converted to decimal value, N represents V_Total number, L represents brightness value.

4.8 Image Brightness Digital Adjustment

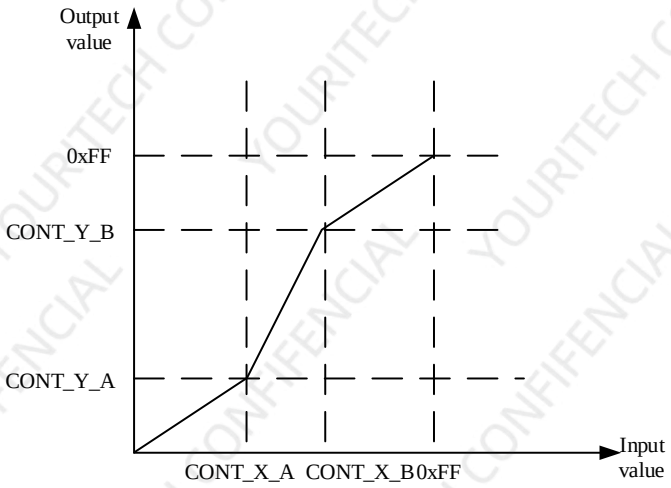
The microdisplay has the image brightness digital adjustment function, and the brightness adjustment formula is as follows:

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

Y is the adjusted data value, Y_0 is the input image data value, and BRT is the configuration value of the 0800H 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.

4.9 Image Contrast Adjustment

The contrast adjustment is divided into three segments, and the horizontal and vertical coordinates of the two segmentation points can be set by registers. The image contrast is adjusted by multiplying the image data segmentation in equal proportions. 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 0600H, 0601H, 0602H, 0603H, and the adjustment range is 0x00～0xFF.

Address	Bit	Detailed Description
3000H	-	Set to 0x6F before contrast configuration, and set to 0x7F after contrast configuration
0600H	bit7-bit0	Image contrast digital adjustment point A output value
0601H	bit7-bit0	Image contrast digital adjustment point B output value
0602H	bit7-bit0	Image contrast digital adjustment point A intput value
0603H	bit7-bit0	Image contrast digital adjustment point B intput value

4.10 I²C Interface

Users can set or read the values of the internal registers of the screen through the I2C serial interface. The I2C address is 16 bits, consisting of two parts: the high 8 bits range from 00 to 9F, representing the main address; the low 8 bits range from 00 to 03, representing the sub-address. 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 I2C communication signal is long, please pay attention to the signal integrity and anti-interference measures of SDA and SCL;
3. When the I2C communication signal is seriously disturbed, I2C communication can be carried out during the vertical blanking interval, or the communication frequency can be appropriately reduced.

4.10.1 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

4.10.2 Data Transfer Format

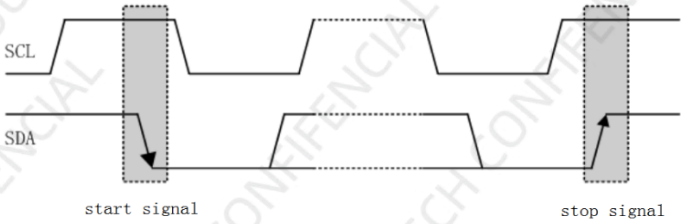
4.10.2.1 Flag Bit Description

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

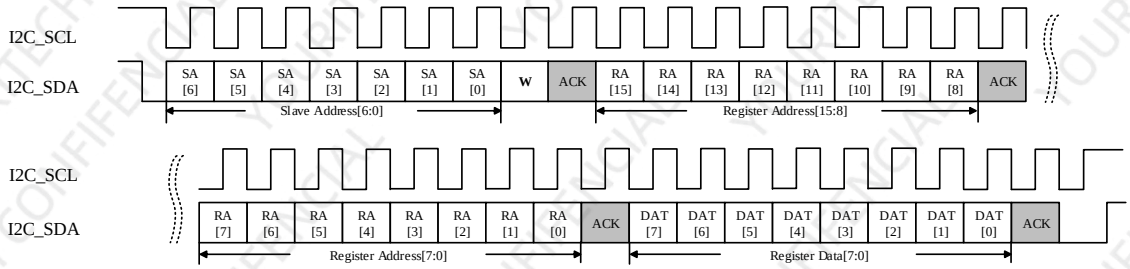
Pause signal (P): the change of SDA line from low level to high level when the SCL line is high level;

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

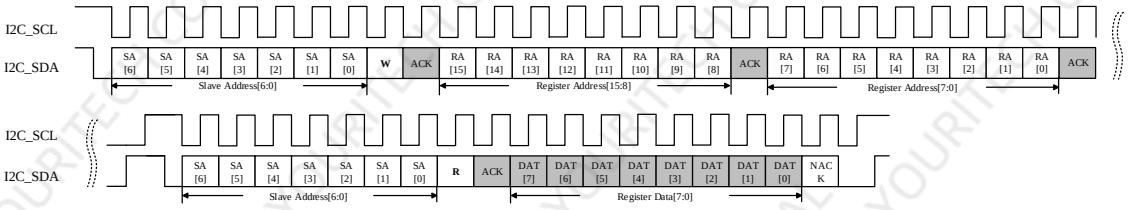
Negative answer (NAK): SDA at high level indicates negative answer;



4.10.2.2 Write Sequence

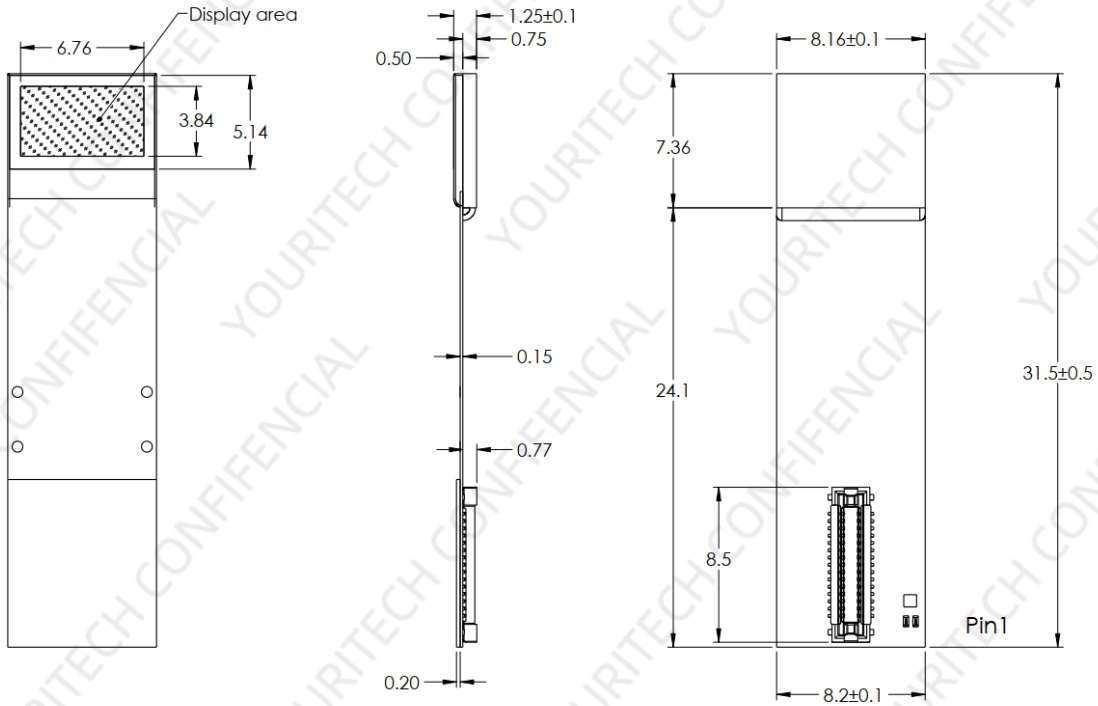


4.10.2.3 Read Sequence

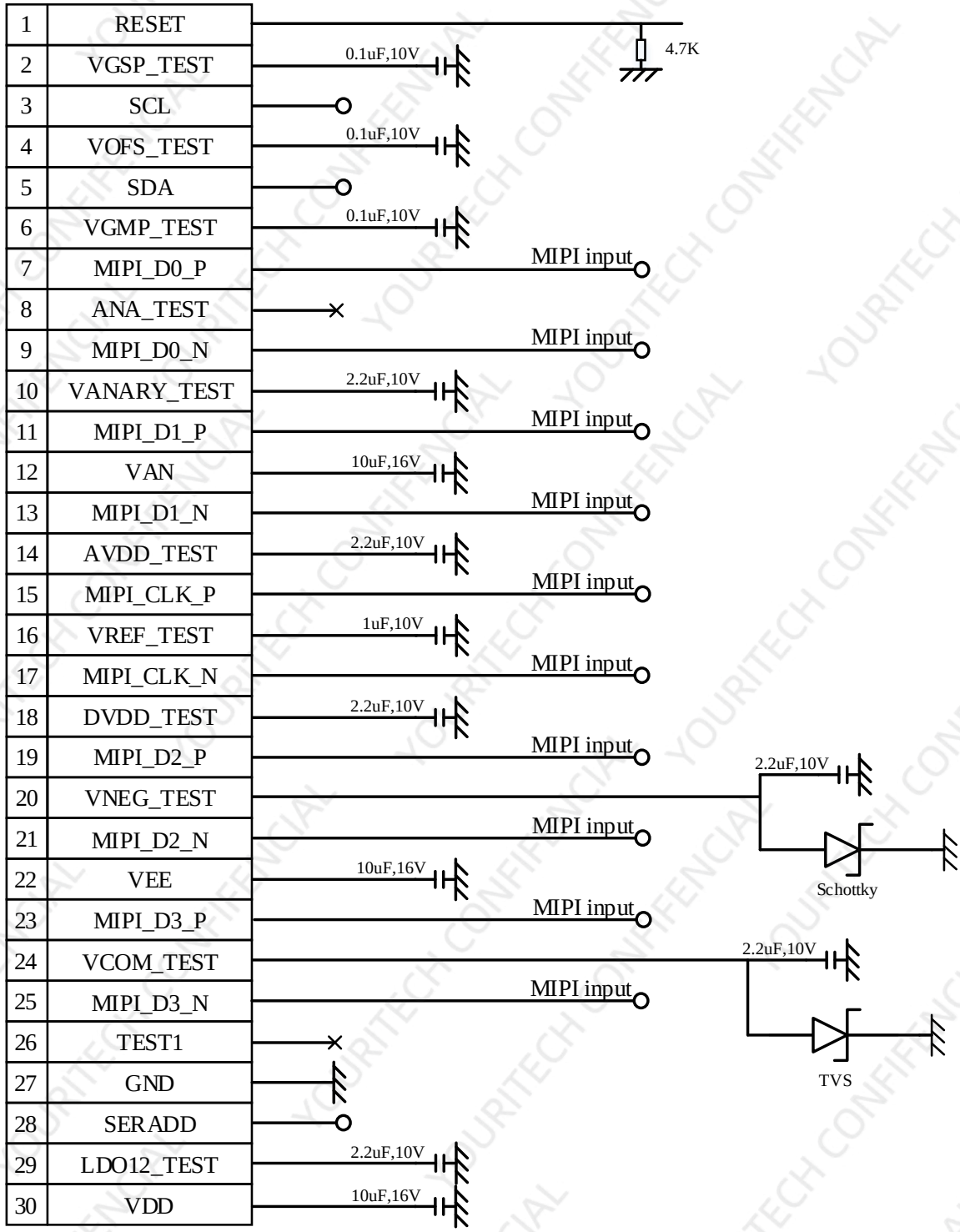


5 Structure and Packaging

5.1 Structure and Packaging



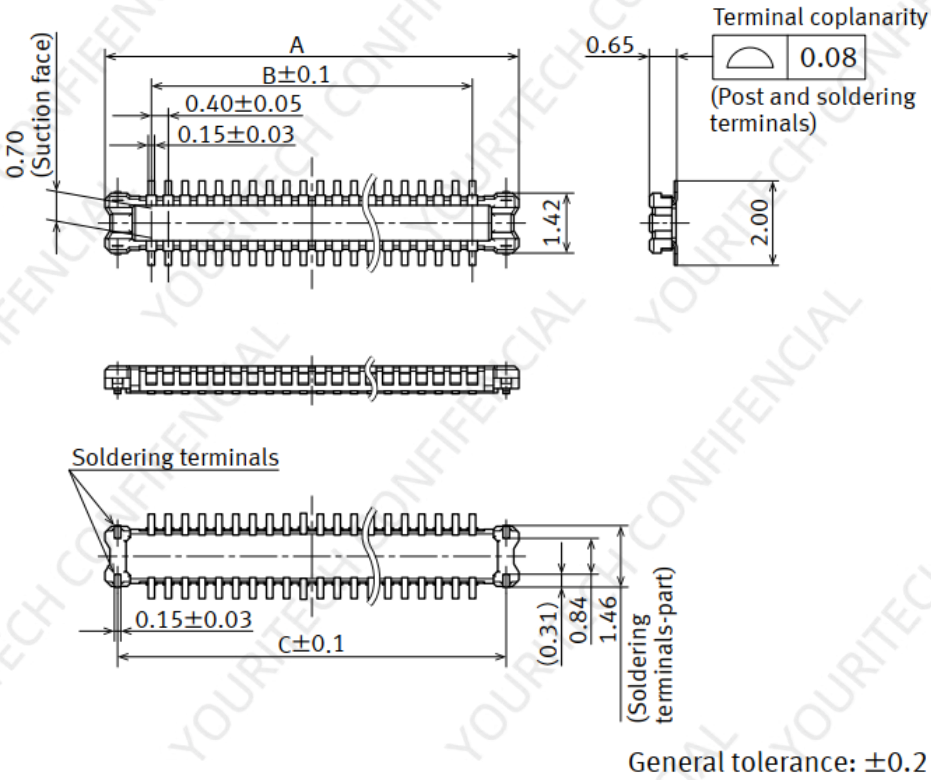
5.2 **Recommended Circuit Design**



5.3 **Connector Size and Design Recommendations**

Unit：mm

External dimensions



General tolerance: ±0.2

Number of Contacts	Dimension(mm)		
	A	B	C
30	7.80	5.60	7.20

Note:

Recommended connector model is AXE630124D, and the manufacturer is Panasonic.

6 Product Precautions

6.1 Use Precautions

1. The ET023VGH01-G 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 YOURITECH TECHNOLOGY for maintenance;In order
3. 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
4. a fixed image under high temperature or high brightness conditions;

   The glass and silicon edges of the silicon-based OLED microdisplay are easily damaged and shall not be subject to physical stress;

6.2 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.

6.3 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 ℃ ±5 ℃;
2) The dry nitrogen or vacuum sealed container;
3) Avoid violent shaking.

6.4 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.