

AMS3XXX Datasheet

Gas flow meter

- Integrated mass flow and temperature measurement
- Good repeatability
- Supports multiple gas measurements
- Standard Modbus RTU communication
- 2 NPN open collector outputs (for upper and lower limit alarms)
- TFT screen display (supports four display direction settings: up, down, left, and right)
- 9~28V DC power supply

Product Summary

The AMS3 series of gas mass flow meters are based on the principle of thermal measurement, combined with the MEMS flow sensor chip independently developed by Aosong, to create a gas mass flow meter with excellent performance, stability and reliability. This product calculates the mass flow of the measured gas by measuring the change in resistance. It has the advantages of accuracy, stability, high and low temperature resistance, good linearity and fast response. The product has an internal alarm function and is equipped with a TFT display for reading display, which makes the detection status clear at a glance. It has multiple output modes such as RS485, NPN open collector, 1~5V linear voltage and 4~20mA linear current, which can meet the personalized needs of different users.

This series has multiple models, covering a variety of ranges, and is suitable for a wide range of scenarios.

Applications

AMS3 series is suitable for mass flow monitoring of dry, clean and non-corrosive gases such as air and nitrogen (except flammable and explosive gases). It has been widely used in university scientific research, fire protection, environmental monitoring, tobacco, smart agriculture, food, medicine and other industries.



Figure 1. AMS3 series products

1. Appearance structure and interface definition

1.1 Appearance structure

Figure 2 shows the appearance structure and working interface of the AMS3 series, including the sensor air duct and working interface. The working interface includes a TFT display and operation buttons. The TFT displays the flow meter Modbus communication address, cumulative flow and instantaneous flow. The buttons include up, down, DISP and MODE. The sensor air duct is below the working interface, including the air inlet and outlet.

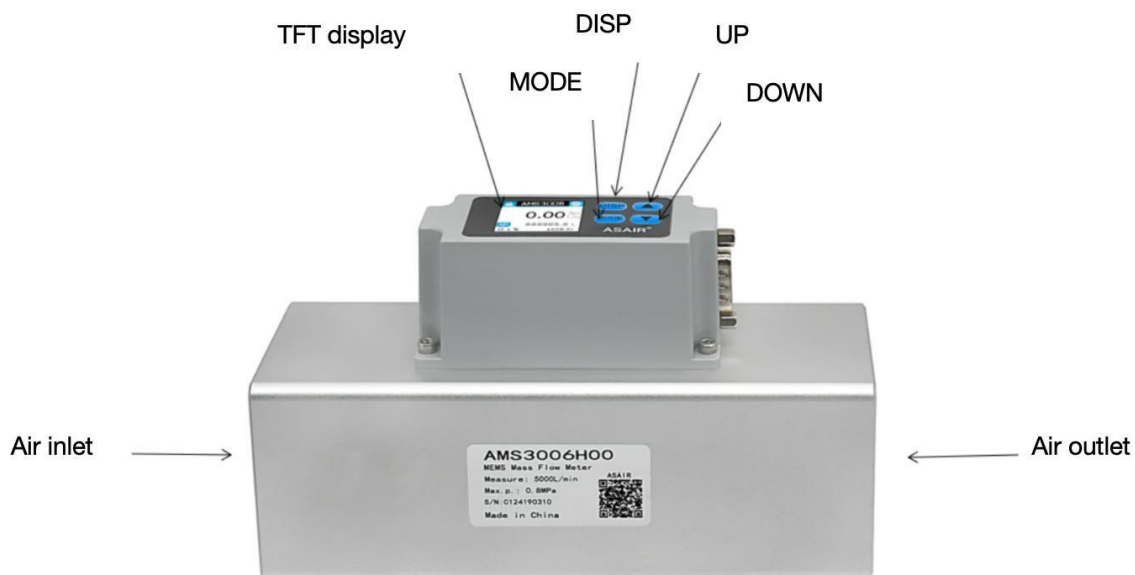


Figure 2. AMS3 series outlook

1.2 Definition of DB9 male connector of the product

The interface of the AMS3 series is a standard DB9 male connector. The DB9 connector pin diagram and pin definition are shown in Figure 3 and Table 1.

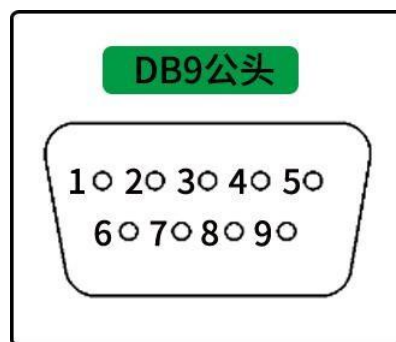


Figure 3. DB9 male header pinout

Table 1. Pin Definition

Pin	Definition
1	External output 1
2	Analog Output
3	RS485B
4	RS485A
5	Power
6	GND
7	GND
8	GND
9	External output 2

1.3 AMS3 series pinout definition

The AMS3 series pinout is a DB9 female pinout, with a length of about 430mm and a material of UL2464. There are 10 wires in total, as defined in Table 2 and in Figure 4.

Table 2. AMS3 series pinout definition

Cable color	Definition
Orange	External output 1
Brown	Analog Output
Green	RS485B
Yellow	RS485A
Red	Power
Black	GND
Blue	GND
Purple	GND
Grey	External output 2
Transparent heat shrink sleeve	Shielded wire

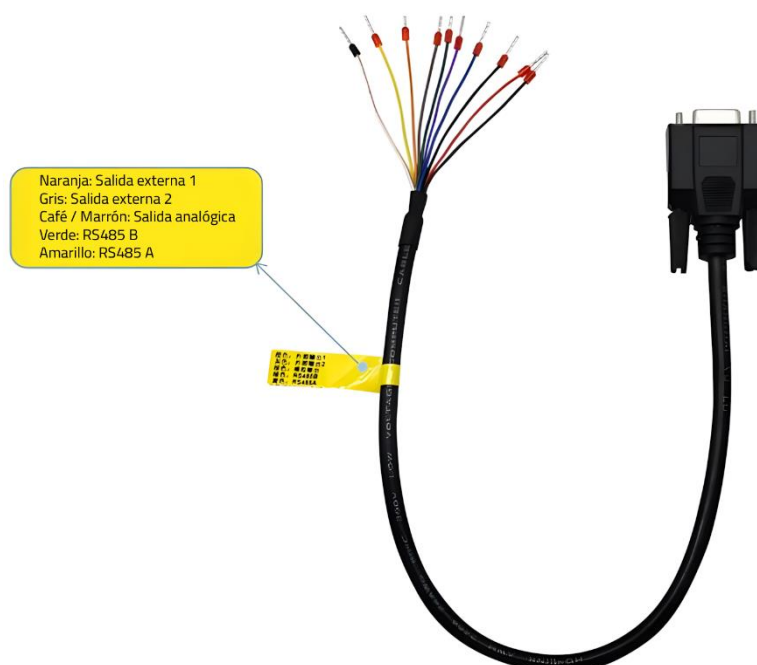


Figure 4. AMS3 series pinout diagram

2. AMS3 series technical indicators and basic information

Table 3. AMS3 series model and range comparison table

Modle	Range	Accuracy	Output	Interface
AMS3001H00	10~1000L/min	$\pm 3\%$ F.S. (100~1000L/min)	RS485, NPN open collector output, 1~5V linear voltage output	2-RC 1/2
AMS3002H00	20~2000L/min	$\pm 3\%$ F.S. (200~2000L/min)	RS485, NPN open collector output, 1~5V linear voltage output	2-RC 3/4
AMS3003H00	30~3000L/min	$\pm 3\%$ F.S. (300~3000L/min)	RS485, NPN open collector output, 1~5V linear voltage output	2-RC1
AMS3006H00	60~6000L/min	$\pm 3\%$ F.S. (600~6000L/min)	RS485, NPN open collector output, 1~5V linear voltage output	2-RC1 1/2

Table 4. AMS3 series technical indicators and basic information

Parameters	Description
Repeatability	$\pm 1\%$ F.S.
Response time	1s
Power supply	external power 9~28V DC
Display	TFT screen
Work pressure	0.1~1.5MPa
Max pressure	2.25MPa
Standard calibration gas	Air (25° C, 1 standard atmosphere)
Operating temperature	0~+50°C
Power consumption	<0.85W
Housing Material	PC
Duct material	6061 Aluminum Alloy
Installation	Horizontal installation is the best installation method. Zero point calibration is recommended for vertical installation

3. Main product dimensions and piping method

3.1 Main dimensions of AMS3 series products

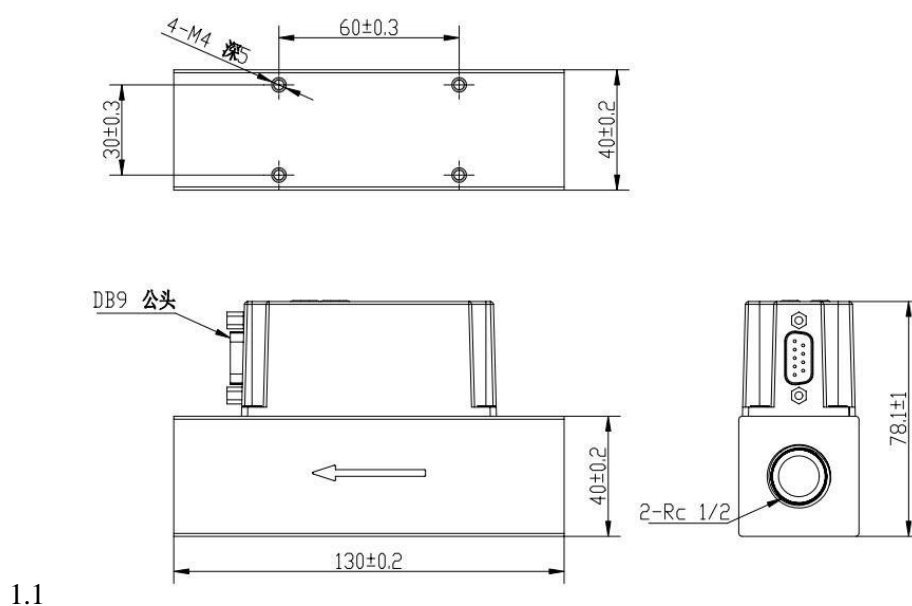


Figure 5. AMS3001 dimension (unit: mm)

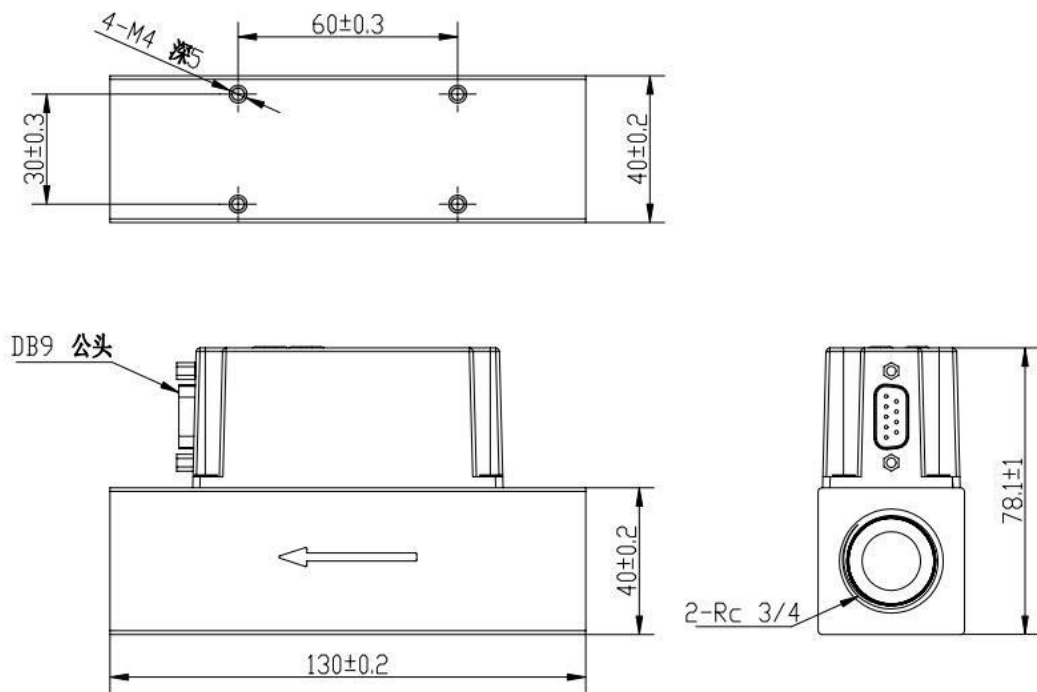


Figure 6. AMS3002 Dimensions (Unit: mm)

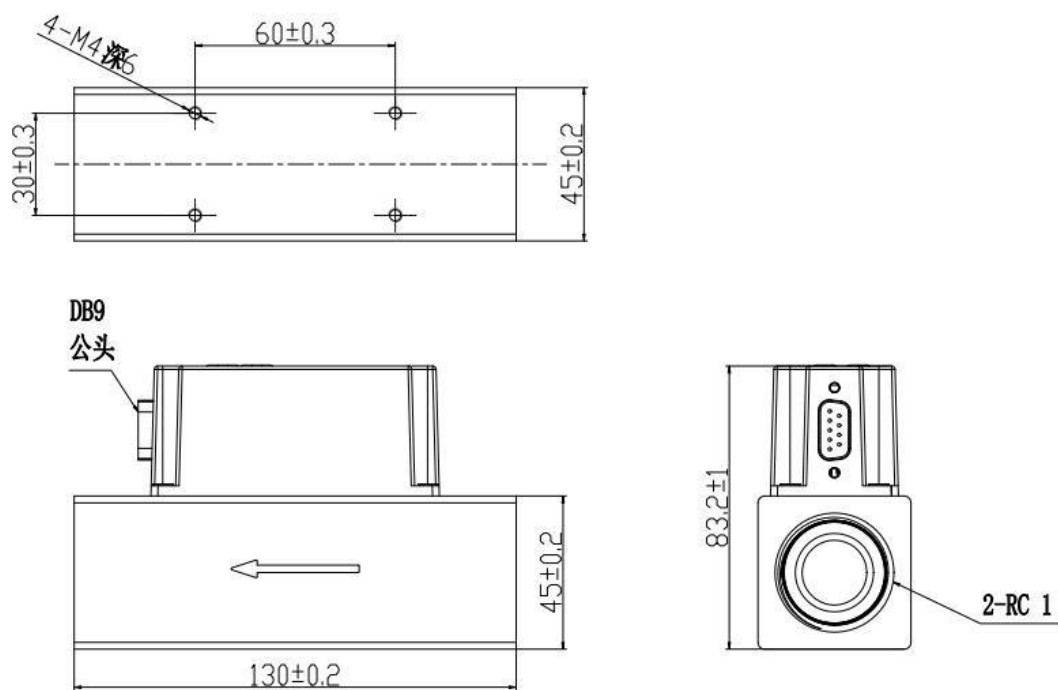


Figure 7. AMS3003 dimensions (unit: mm)

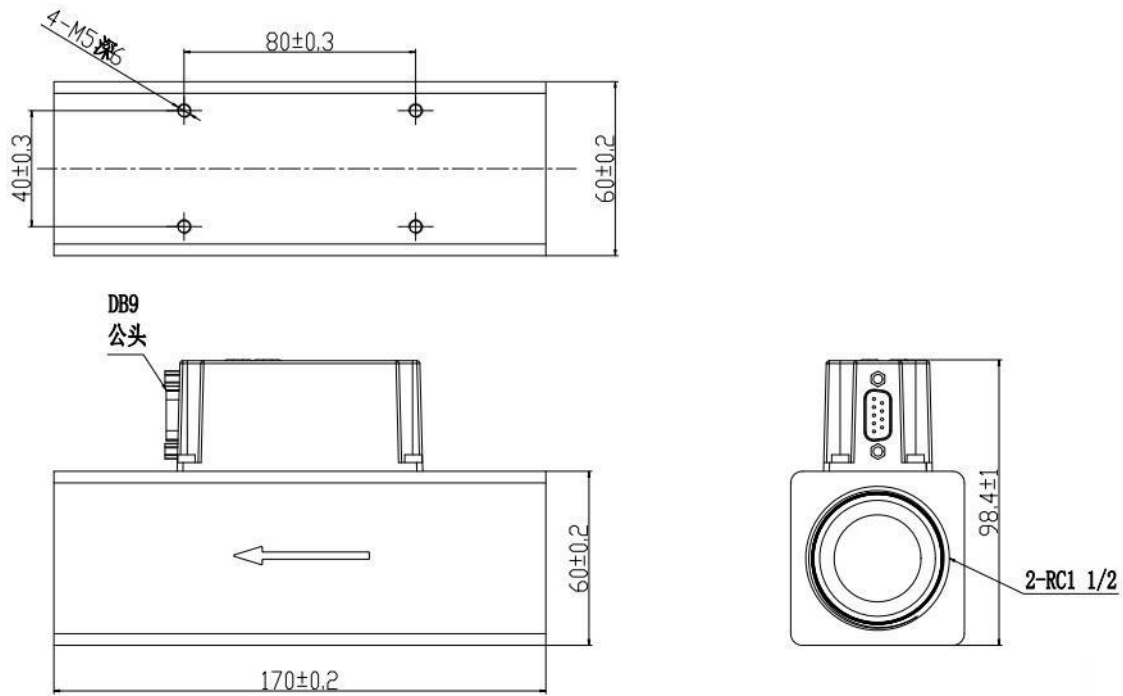


Figure 7. AMS3006 Dimensions (Unit: mm)

3.2 Piping method

The piping method of AMS3 series products is shown in Figure 7.

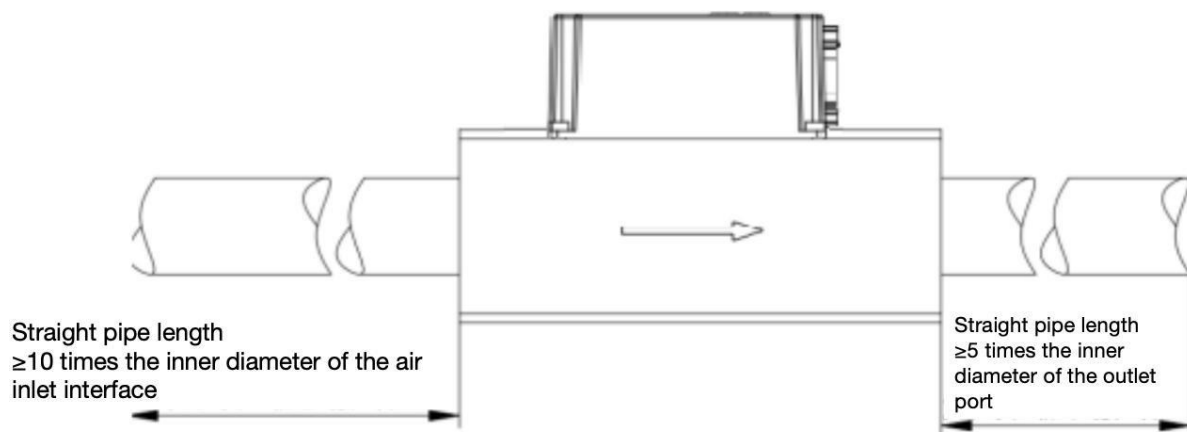


Figure 7. Piping diagram

(1) For the air pipe connected to the air inlet of the AMS3 series product, please reserve a straight pipe section with a length greater than or equal to 10 times the inner diameter of the air inlet, and the inner diameter of the straight pipe must be greater than or equal to the inner diameter of the air inlet. Otherwise, the accuracy may deviate by 2% F.S. or more.

(2) For the air pipe connected to the air outlet of the AMS3 series product, please reserve a straight pipe section with a length greater than or equal to 5 times the inner diameter of the air outlet, and the inner diameter of the straight pipe must be greater than or equal to the inner diameter of the air outlet.

Otherwise, the accuracy may deviate by 2% F.S. or more.

(3) It is recommended that the sensor air duct of the AMS3 series product be installed parallel or perpendicular to the horizontal plane. When the sensor is installed parallel to the horizontal plane, the sensor interface must be above the sensor air duct and parallel to the horizontal plane. For other installation angles, please consult customer service.

(4) If using a quick-connect plug, use an air pipe with an inner diameter of more than 8 mm outside the air inlet and air outlet of the AMS3 series product, and keep the straight pipe according to the requirements of (1) and (2). Otherwise, the accuracy may deviate by more than 2% F.S.

4. Product communication protocol and output

4.1 RS485 communication

The digital output communication method of the AMS3 series gas mass flow meter is RS485 communication, and the communication parameters are shown in Table 5.

Table 5. RS485 communication parameters

Communication parameters	Description
Protocol Format	Modbus RTU
Communication rate	4800/9600/19200/115200bps
Start bit	1
Data bits	8
Stop bits	1
Parity	No

The communication protocol is standard Modbus RTU. The host can be a computer, RS485 receiver, MCU controller, etc. The AMS3 series is a slave, the default address is 0x01, supports address modification, and can be connected to the bus of multiple slaves.

The Modbus RTU communication register definition of the AMS3 series is shown in Table 6.

Table 6. Modbus RTU communication register definition

Register Address	Value range	Read and write	Function code	Multiple	Register Information	Mark
0x0000	0~65535	Read only	03	10	Instantaneous flow	Eg: 157.8L/min 0x062a
0x0001	0~65535	Read only	03	10	Cumulative flow (high 16 bits)	Eg: 123456789.5L High byte: 0x4996 Low byte: 0x02d7
0x0002	0~65535	Read only	03	10	Cumulative flow (lower 16 bits)	
0x0003	0~65535	Read only	03	10	Temperature	Eg: 27.7°C 0x0115
0x0004	0~3	Read only	03	1	Device status information	0: Flow meter is normal 1: Sensor is abnormal 2: EEPROM is abnormal 3: Both sensor and EEPROM are abnormal
0x0005	0~1	Read only	03	1	Upper limit alarm	0: No alarm for upper limit 1: Alarm for upper limit
0x0006	0~1	Read only	03	1	Lower limit alarm	0: No alarm at lower limit 1: Alarm at lower limit
0x0030	0~65535	Read only	03	1	model	The model number is directly converted to hexadecimal number eg AMS30006 —> 0x0BBE
0x0031	0~9999	Read only	03	1	Software version	eg. V0001 —> 0x0001
0x0032	0~1	Read& write	03/06	1	Flow unit	0: L/min 1 : CFM × 10 ⁻¹
0x0033	/	/	/	/	/	/
0x0034	0~1	Read& write	03/06	1	Language	0: Chinese 1: Reserve
0x0035	1~32	Read& write	03/06	1	Slave Address	Slave address, only supports 1-32
0x0036	480,960, 1920,11520	Read& write	03/06	1/10	Baud rate	4800、9600、19200、115200 Eg: baud rate 115200 —> 0x2d00
0x0037	0~1	Read& write	03/06	1	Accumulated flow reset	0: The accumulated flow remains unchanged 1: The accumulated flow is reset to zero
0x0038	1~5	Read& write	03/06	1	Gas type	1: AIR 2: N ₂

0x0039	0~1	Read& write	03/06	1	Alarm switch	0: Alarm off 1: Alarm on
0x003A	0~2000	Read& write	03/06	10	Alarm upper limit value	Eg, set 2500L/min —>0x09C4
0x003B	0~2000	Read& write	03/06	10	Alarm lower limit (L/min)	For example: set 5000L/min —>0x1388

Take the operation of AMS3006H00 as an example, as follows.

When the host reads the instantaneous flow value of AMS3006H00 (the default slave address of the device is 0x01), the host sends a command to AMS3006H00, the data is 01 03 00 00 00 01 84 0A, the format is shown in Table 7.

Table 7. Format of the host sending a read register command

Host sends information	Number of bytes	Sending message example (Hex)	Information meaning
Slave Address	1	01	Communication slave address
Function code	1	03	Read multiplexer registers
Register start address	2	0000	Register 0x0000 stores the instantaneous flow value
Read the number of registers	2	0001	Read 1 register
CRC code	2	840A	CRC code is used for verification

When the host receives the data returned by AMS3006H00, the data is 01 03 02 06 2A B8 4B, and the format is shown in Table 8.

Table 8. Format of the host receiving the AMS3006H00 register data

Slave sends information	Number of bytes	Example of sending information (Hex)	Information meaning
Slave Address	1	01	Communication slave address
Function code	1	03	Read multiplexer registers
Number of received data bytes	1	02	Number of received data bytes = number of registers read \times 2
Register data	2	062A	1 register read The decimal value here is 1578. According to the communication register definition in Table 6, the instantaneous flow rate is 157.8L/min
CRC code	2	B84B	CRC code is used for verification

When the host needs to change the slave address of AMS3006H00 to 0x02, the value of the 0x0035 register needs to be rewritten. The host writes the register value command, the data is 01 06 00 35 00 02 18 05, the format is shown in Table 9.

Table 9. The format of the host sending the write register command

Host sends information	Number of bytes	Sending message example (Hex)	Information meaning
Slave Address	1	01	Communication slave address
Function code	1	06	Writing a single register
Register Address	2	0035	Register 0x0035 stores the slave address
Writing Data	2	0002	Write data 0002
CRC code	2	1805	CRC code is used for verification

The C language code for calculating the CRC code is as follows:

```
// *ptr Communication sends or receives data byte array,
// len Send or receive data byte length (excluding CRC code)
// Returns the calculation result of the CRC code, with the high byte first
unsigned int CRC16(unsigned char * ptr,unsigned char len)
{
    unsigned int crc= 0xFFFF;//Initialization
    unsigned char i;
    while(len--)
    {
        crc ^=*ptr++;
        for(i=0;i<8;i++){
            if(crc & 0x1){
                crc>>=1;
                crc^=0xA001;
            }
            else crc>>=1;
        }
    }
    return crc;
}
```

4.2 NPN open collector output

The AMS3 series has 2 NPN open collector output ports, which correspond to external output 1 and external output 2 respectively. External output 1 controls the upper limit alarm, and external output 2 controls the lower limit alarm. If you purchase the AMS3 series lead wire, external output 1 (NPN1) corresponds to orange, external output 2 (NPN2) corresponds to gray, and GND corresponds to black, blue or purple. The wiring diagram is shown in Figure 8.

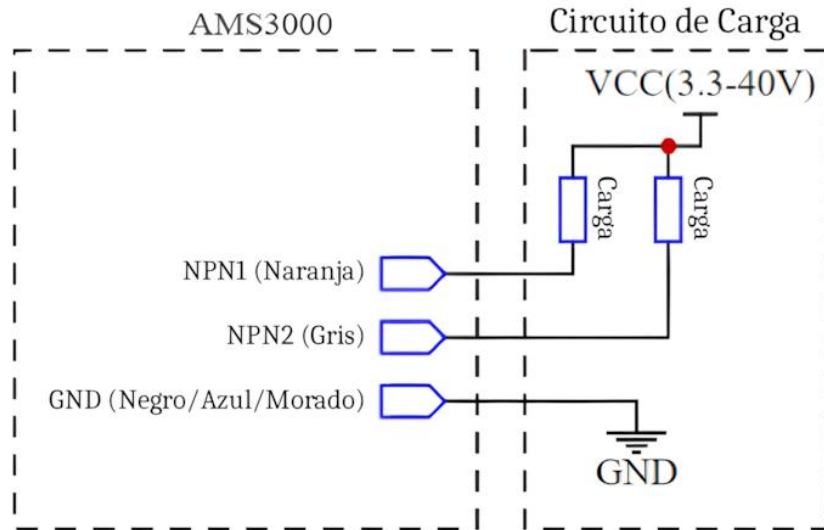


Figure 8 Schematic diagram of upper and lower limits of NPN control

The load in Figure 8 can be an alarm device, such as an alarm light. By default, the alarm function is turned off, there is no upper and lower limit alarm, the two NPNs (equivalent to switches) are in the open state, the load circuit is open, and no current flows. After turning on the alarm function and setting the upper and lower limits of the flow rate, when the flow rate value is higher than the upper limit or lower than the lower limit, the corresponding NPN collector open output port is closed, the current flows through the load, and then the alarm device can start working.

When the upper and lower limit alarms are turned on, an alarm will be triggered when the instantaneous flow value is higher than the upper limit of the flow rate or lower than the lower limit of the flow rate. If the upper limit is set to 20 and the lower limit is set to 5, when the instantaneous flow value is lower than 5L/min, the NPN collector open output port corresponding to external output 2 is closed, and when it is higher than 20L/min, the NPN collector open output port corresponding to external output 1 is closed, and an alarm is triggered.

4.3 Voltage output

The relationship between the output voltage and instantaneous flow of the AMS3 series is:

$$\text{Instantaneous flow} = \frac{\text{Instantaneous output voltage} - \text{Zero flow output voltage}}{\text{Full flow output voltage} - \text{Zero flow output voltage}} \times \text{Full flow}$$

For example: the full-scale 2000L gas mass flow meter has an output voltage of 3V, a zero-flow voltage of 1V, and a full-scale voltage of 5V, then:

$$\text{Instantaneous flow} = \frac{(3 - 1)}{(5 - 1)} \times 2000 = 1000 \text{ L/min}$$

5. Introduction to the main screen interface and setting menu functions

The icons of the main screen interface of the AMS3 series are shown in Figure 9.

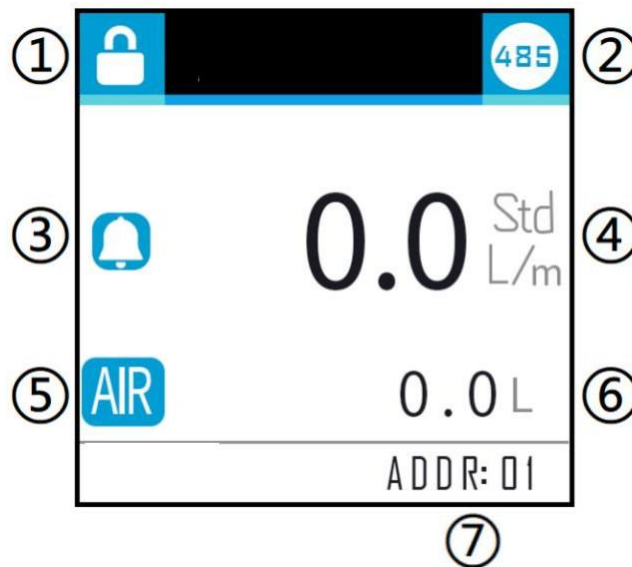


Figure 9. Screen icon description

①: Lock screen icon; ②: 485 communication logo; ③: Flow alarm status; ④: Instantaneous flow; ⑤: Gas type; ⑥: Cumulative flow; ⑦: 485 communication address

If the sensor is not operated within 30 seconds, the system will automatically enter the lock screen state and display the lock screen icon shown in Figure ① on the screen. Press and hold the MODE button (see Figure 2) for 5 seconds to unlock and enter the setting menu page, and press the up and down buttons to select the parameters to be set.

There are four levels in the setting menu page, and the function description of each level is shown in Table 10.

Table 10.Function specification

1 st level menu	2 nd level menu	3 rd level menu	4 th level menu	Function
Parameter setting	Optional gas	AIR、N ₂	/	Select the gas type to be measured
	Alarm setting	Alarm switch	On/off	Alarm function switch on or switch off
		Flow rate upper limit	Set upper limit value	Set the upper limit of flow. When alarm function is enabled, the alarm will be activated when upper limit of flow is exceeded
		Flow rate lower limit	Set lower limit value	Set the lower limit of flow, when alarm function is enabled, the alarm will be activated when less than lower limit of flow.
		Exit	/	Return to 2 nd level menu
	Cumulative zeroing	Yes or No	/	Cumulative flow cleared to zero
	Exit	/	/	Return to 1 st level menu
Communication setting	Baud rate	4800、9600、19200、115200	/	Set baud rate of data transmission
	485 address	1~32 RS485 address	/	Select 485 communication address
	Exit	/	/	Return to 1 st level menu
System setting	Language Setting	Chinese	/	Reserved, Chinese by default
	Flow rate unit	Optional units: L/min and CFM	/	L/min or CFM
	Screen direction	Turn right, turn left or exit	/	Set screen display direction
	Screen brightness	Low, middle, high or exit	/	Set screen display brightness
	Factory reset	Yes or No	/	Reset to factory default status
	Equipment info	Model, range, version and SN codes of devices are	/	Check equipment information
	Zero calibration	The gases of AIR、N ₂ are applicable for zero calibration	/	Zero calibration of flow meter
	Exit	/	/	Return to 1 st level menu
Exit	/	/	/	Return to main interface

6. Packing List

Table 11. Packing List

Product	Qty
AMS3XXX mass flow meter	1
AMS3XXX cable	1
Certificate	1

7. Exception handling

Table 14. Exception handling

Fault description	Fault causes	Trouble shooting/handling measures
No display in main screen	1、 Power cables and ground cables are not connected as required 2、 Power supply is not +9~+24V 3、 Display screen fault	1、 Correct cable connection as required. 2、 Correct +9~+24V power supply 3、 Check any damage to the screen
The display of instantanenous flow is not zero prior to measurement	1、 The valves of installed pipes are not tightly closed 2、 There is the leak in the installed pipes.	1、 Check the valves of installed pipes to be tightly closed or not. 2、 Check the pipes leaky or not.
No flow rate records	1、 The installed pipes are blocked 2、 No gas flow in the installed pipes	1、 Check whether there are abnormal objects blocked in the installed pipeline 2、 Check that the valves of installed pipes are open and that gas flow is passing through the pipes
Flow rate reduction	1、 Blockage 2、 Sensor is polluted	1、 Check whether the inlet and outlet is blocked or there are other objects 2、 Clean or alternate sensor
Communication anomaly	1、 Wiring connection is wrong 2、 Baud rate setting is wrong 3、 RS485 communication in failure 4、 Modbus RTU address setting is wrong	1、 Correct wiring connection as datasheet 2、 Correctly set baud rate of upper computer to 9600bps 3、 Check RS485-RS232 converter working in normal status 4、 Set the correct address according to application requirement

Warning and personal injury

Do not use this product on safety protecting devices or emergency stop devices, or in any other application where the failure of this product may result in personal injury, unless there is a specific purpose or authorized use. Refer to the product data sheet and manual before installing, handling, using or maintaining the product. Failure to comply with the recommendations may result in death or serious injury. The Company will not be liable for any compensation for personal injury or death resulting therefrom, and will waive any claims that may be made against the Company's officers and employees and affiliated agents and distributors, including costs, claims, attorneys' fees, etc.

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Warranty specification

Product category	Warranty period
AMS3XXX gas mass flow meter	12 months
Cables & accessories	6 months

The company is only responsible for products that are defective when used in applications that meet the technical conditions of the product. The company does not make any guarantees or written statements about the application of its products in those special situations other than recommended. The company also does not make any promises about the reliability of its products when applied to products or circuits not provided by Aosong Electronic Co., Ltd.

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