# 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.
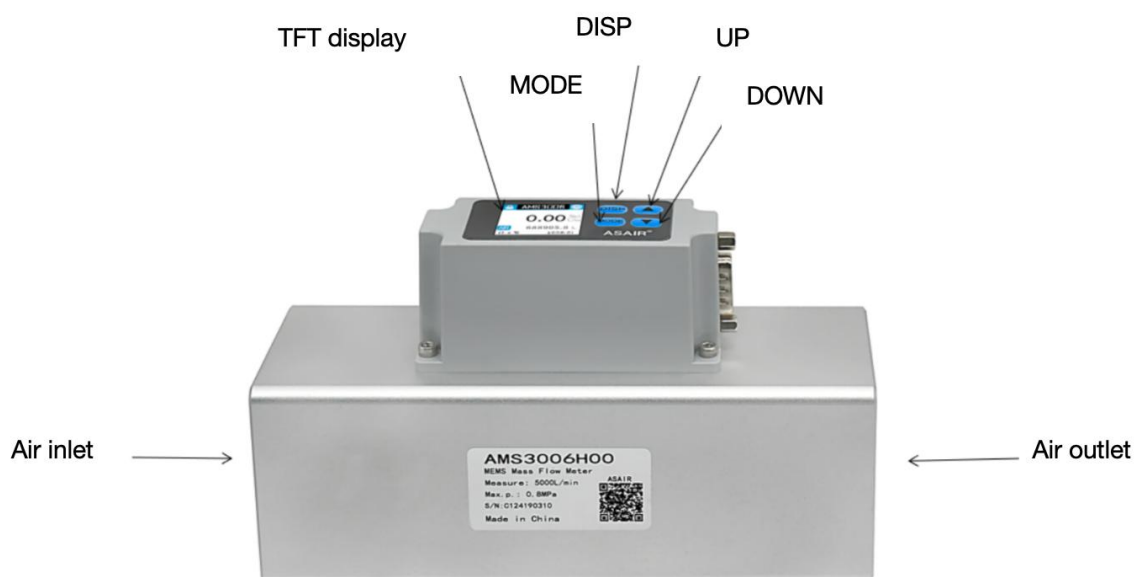


Figure 2. AMS3 series outlook

## 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.
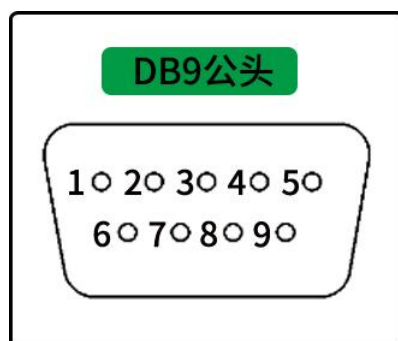


Figure 3. DB9 male header pinout

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

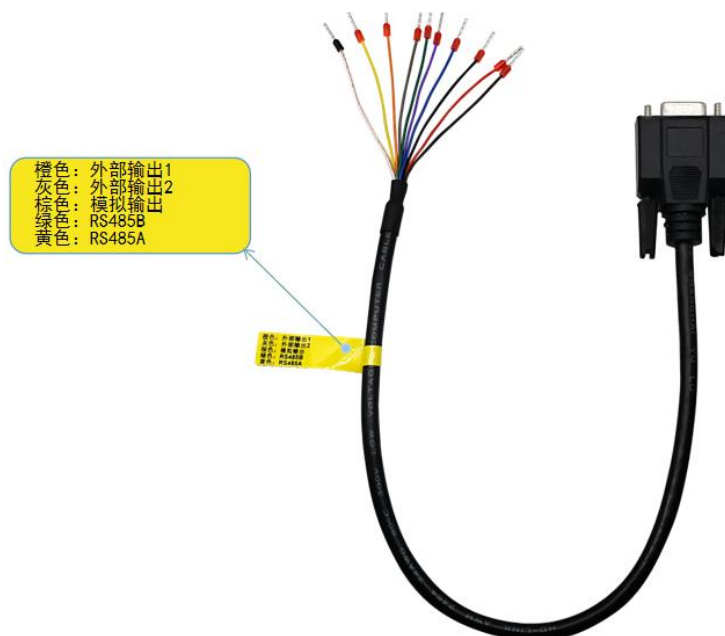| Cable color | Definition |
|---|---|
| Orange | External output 1 |
| Brown | Analog Output |
| Green | RS485B |
| Yellow | RS485A |
| Red | Power |
| Black | GND |
| Blue | GND |
| Purple | GND |
| Grey | External output 2 |
| Transparent heat shrink sleeve | Shielded wire |

橙色：外部输出1
灰色：外部输出2
棕色：模拟输出
绿色：RS485B
黄色：RS485A

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 | ±3%F.S. (100 ~ 1000L/min) | RS485, NPN open collector output, 1~5V linear voltage output | 2-RC 1/2 |
| AMS3002H00 | 20 ~ 2000L/min | ±3%F.S. (200 ~ 2000L/min) | RS485, NPN open collector output, 1~5V linear voltage output | 2-RC 3/4 |
| AMS3003H00 | 30 ~ 3000L/min | ±3%F.S. (300 ~ 3000L/min) | RS485, NPN open collector output, 1~5V linear voltage output | 2-RC1 |
| AMS3006H00 | 60 ~ 6000L/min | ± 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 | ±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℃ |
| 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
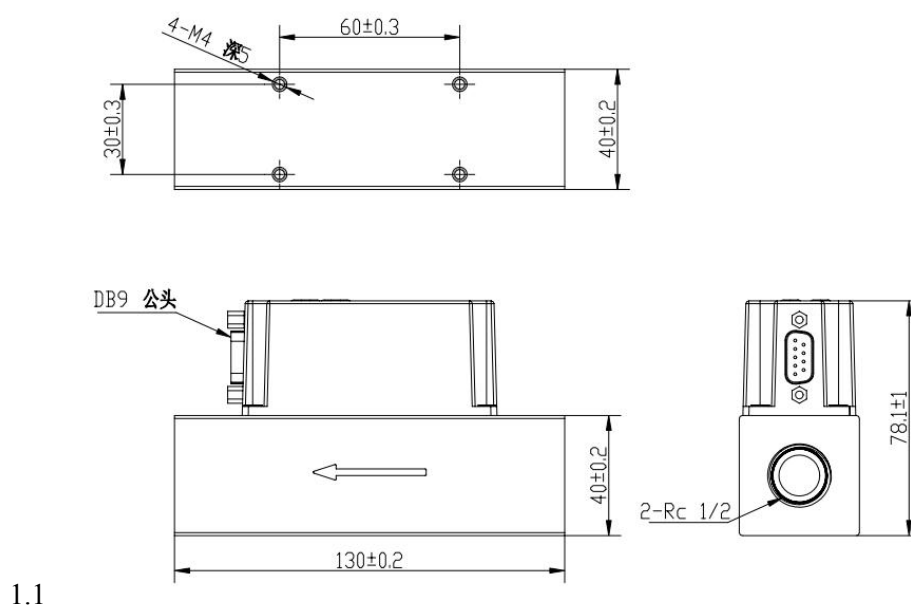
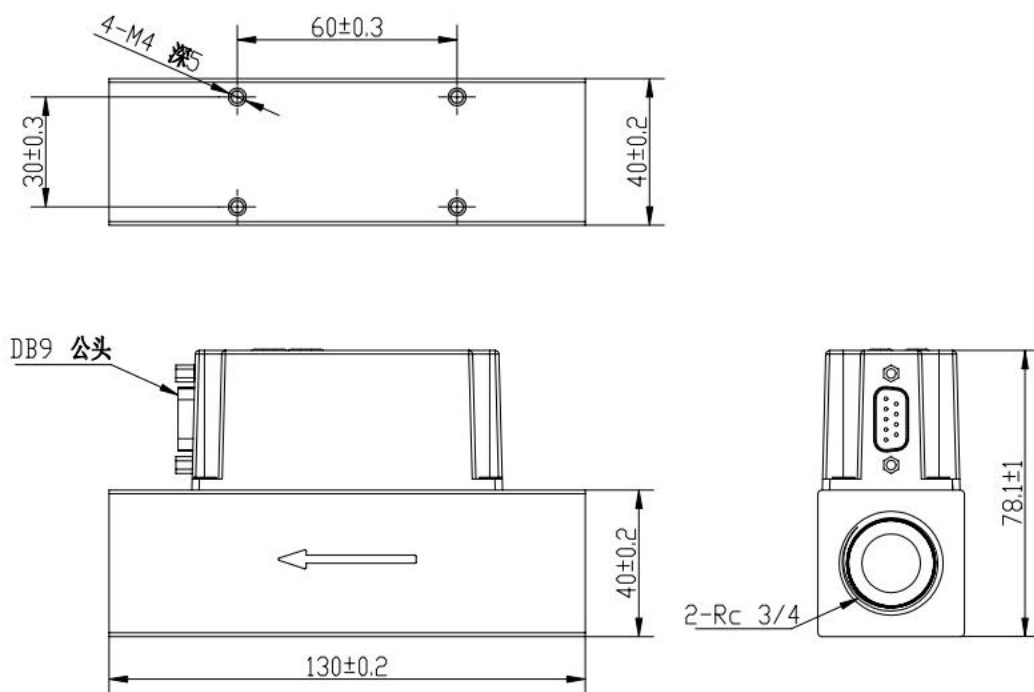

1.1

Figure 5. AMS3001 dimension (unit: mm)

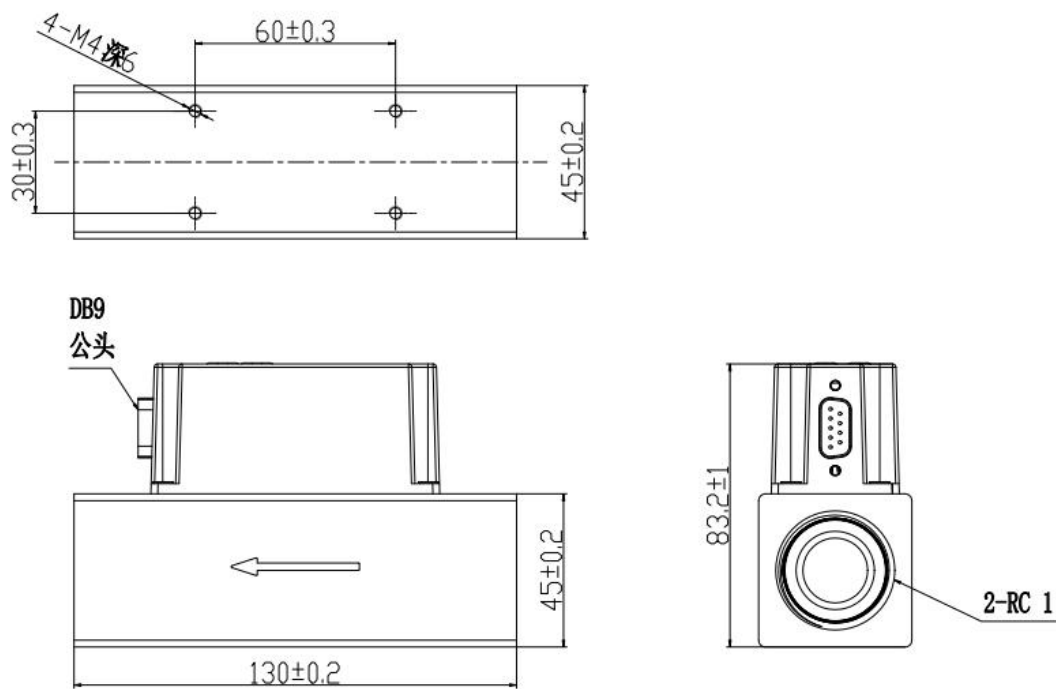Figure 6. AMS3002 Dimensions (Unit: mm)

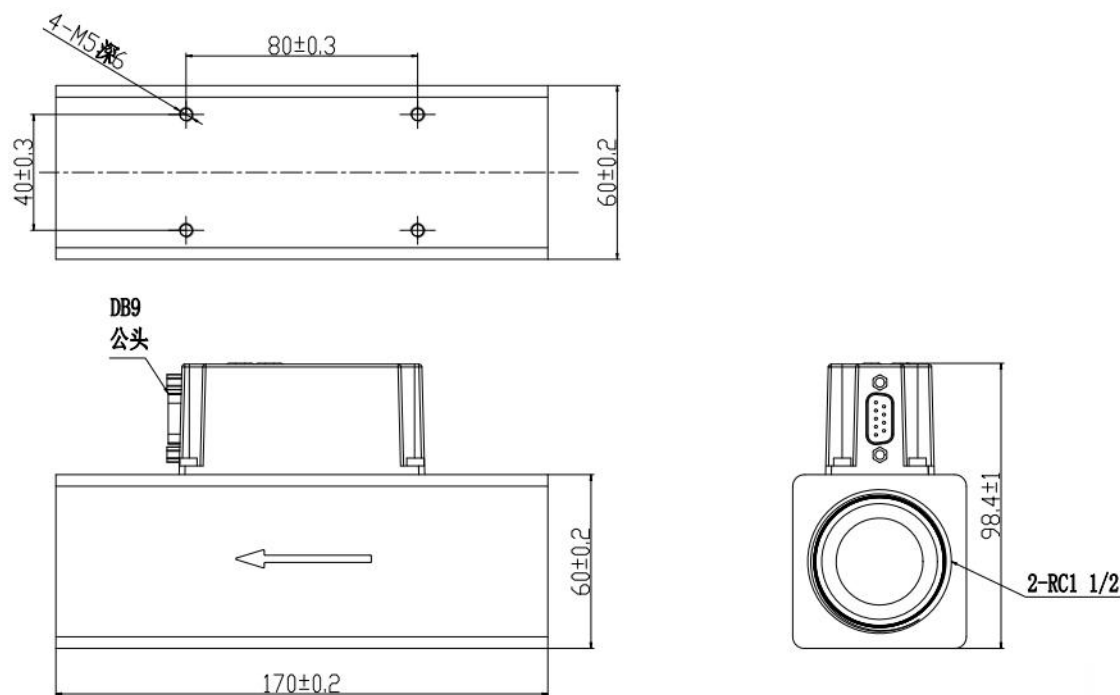Figure 7. AMS3003 dimensions (unit: mm)

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.
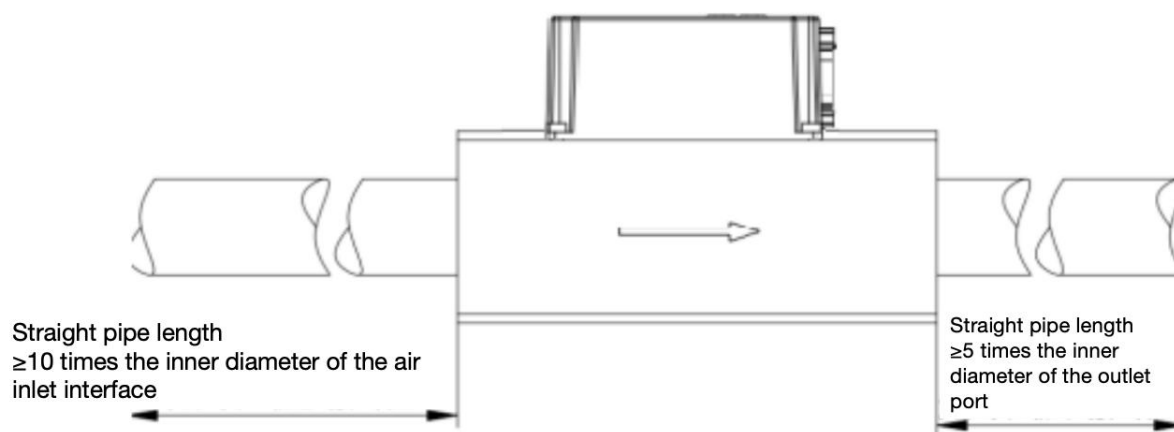
(2) For the air pipe connected to the air outlet of the AMS3 series product, please reserve a straight pipe section with a length greater than or equal to 5 times the inner diameter of the air outlet, and the inner diameter of the straight pipe must be greater than or equal to the inner diameter of the 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 | Descrition |
|---|---|
| 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℃ 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: $CFM \times 10^{-1}$ |
| 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<br>1: Alarm on |
|---|---|---|---|---|---|---|
| 0x003A | 0~2000 | Read& write | 03/06 | 10 | Alarm upper limit value (L/min) | 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 × 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:

```c
// *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.
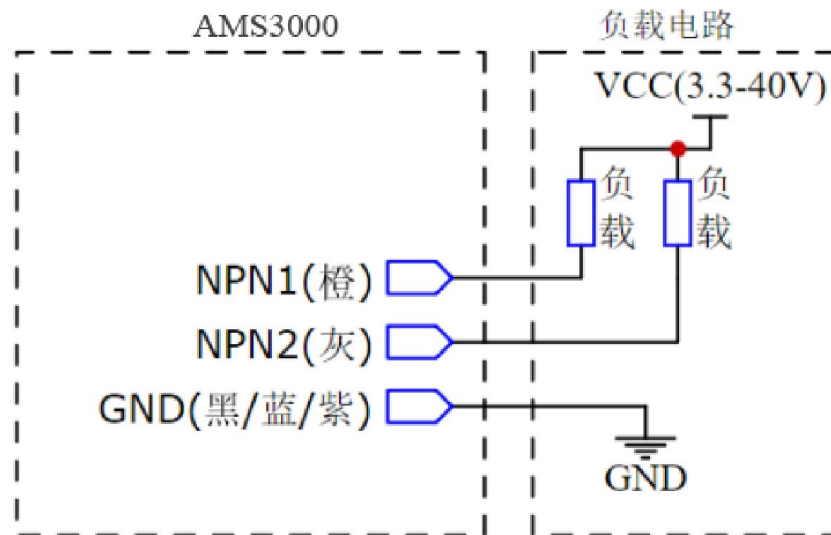
Figure 8 Schematic diagram of upper and lower limits of NPN control

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:

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

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:

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

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

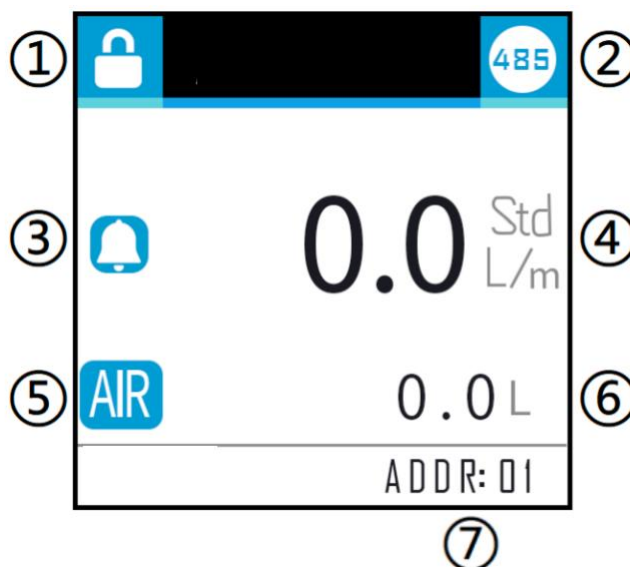The icons of the main screen interface of the AMS3 series are shown in Figure 9.



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

| 1st level menu | 2nd level menu | 3rd level menu | 4th 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 2nd level menu |
| | Cumulative zeroing | Yes or No | / | Cumulative flow cleared to zero |
| | Exit | / | / | Return to 1st 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 1st 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 1st 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/handing measures |
|---|---|---|
| No display in main screen | 1、 Power cables and ground cables are not connected as required<br>2、 Power supply is not +9~+24V<br>3、 Display screen fault | 1、 Correct cable connection as required.<br>2、 Correct +9~+24V power supply<br>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<br>2、 There is the leak in the installed pipes. | 1、 Check the valves of installed pipes to be tightly closed or not.<br>2、 Check the pipes leaky or not. |
| No flow rate records | 1、 The installed pipes are blocked<br>2、 No gas flow in the installed pipes | 1、 Check whether there are abnormal objects blocked in the installed pipeline<br>2、 Check that the valves of installed pipes are open and that gas flow is passing through the pipes |
| Flow rate reduction | 1、 Blockage<br>2、 Sensor is polluted | 1、 Check whether the inlet and outlet is blocked or there are other objects<br>2、 Clean or alternate sensor |
| Communication anomaly | 1、 Wiring connection is wrong<br>2、 Baud rate setting is wrong<br>3、 RS485 communication in failure<br>4、 Modbus RTU address setting is wrong | 1、 Correct wiring connection as datasheet<br>2、 Correctly set baud rate of upper computer to 9600bps<br>3、 Check RS485-RS232 converter working in normal status<br>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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