Datasheet ATO-AMS1000

Gas mass flow meter

- Measure mass flow and temperature simultaneously
- Good repeatability
- Various gas measurements
- Standard Modbus-RTU communication
- Open collector output with two NPN (Used for upper and lower limit alarm）
- 1~5V linear voltage output or 4~20mA linear current output
- LCD display
- 9～24V DC power supply

Summary

ATO-AMS1000 is a thermal mass flow meter that calculates the mass flow of the gas by measuring the change in resistance. It adopts the self-developed MEMS mass flow chip. It has advantages such as simple to use, high accuracy, high stability, high and low temperature resistance, good linearity, and short response time.

The measuring range, accuracy, repeatability, response time, etc. of ATO-AMS1000 are all calibrated before leaving the factory.

Application

ATO-AMS1000 can be used to monitor the mass flow of air, nitrogen, argon, carbon dioxide, helium, oxygen and other dry, clean and non-corrosive gases (except for flammable and explosive gases). It can be widely used in fields, such as university scientific research, fire protection, environmental monitoring, and industries of tobacco, smart agriculture, food and medicine.

Figure 1. ATO-AMS1000

1. Structure and user interface

1.1 Structure

Figure 2 shows the structure including user interface of ATO-AMS1000 and air duct. The user interface consists of an LCD display screen and operation buttons. The parameters displayed on the LCD include the Modbus communication address of the flowmeter, gas temperature, cumulative flow and instantaneous flow. The buttons of "Up" , "Down" , "DISP" and "MODE" are designed on the interface. The air duct is below the user interface, including the inlet and outlet.
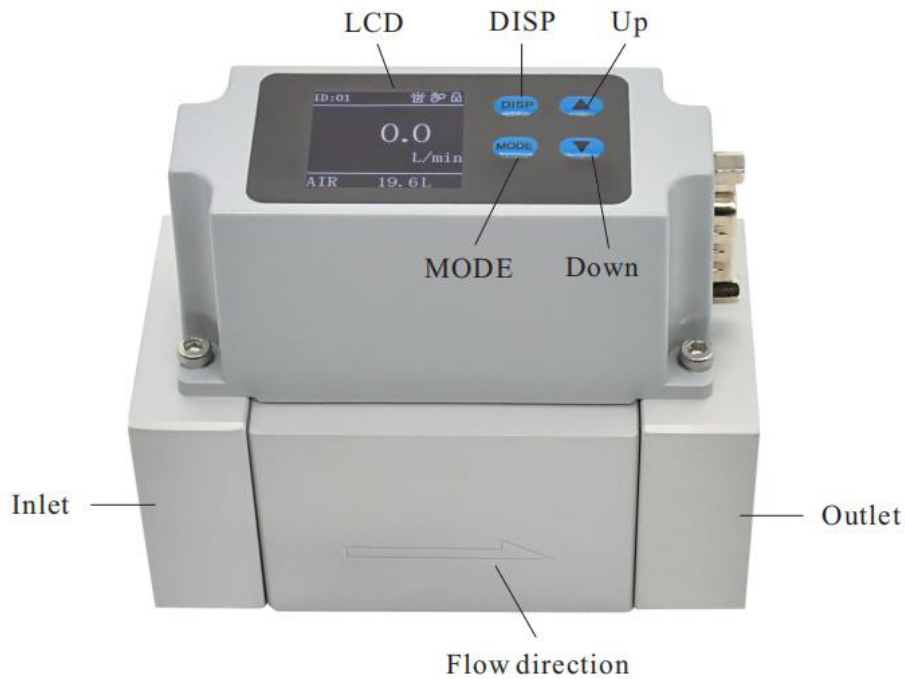

Figure 2. ATO-AMS1000 structure

1.2 DB9 male

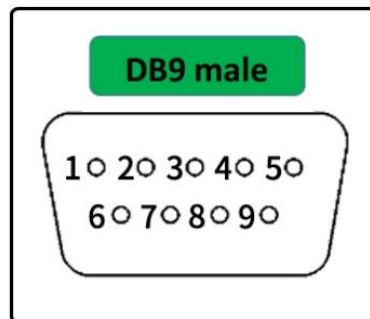The pin definitions are shown in Figure 3 and Table 1.

Figure 3. DB9 male pin diagram

Table 1. DB9 male pin definition

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

1.3 ATO-AMS1000 pinout (DB9 female)

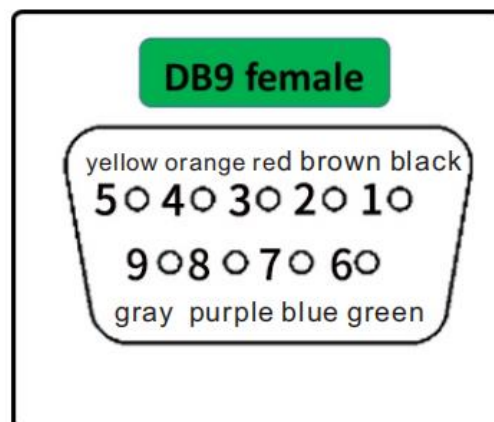If you purchase ATO-AMS1000 pinout cable, the relationship between the pinout and pins is shown in Figure 4.

Figure 4. DB9 pinout

2. Technical and mechanical specifications

Table 2. Technical and mechanical specifications

Parameter	Description					
Model	AMS1000H00	AMS1000H01	AMS1000H02	AMS1000A00	AMS1000A01	AMS1000A02
Measurement range	0~200 L/min	0~20 L/min	0~2 L/min	0~200 L/min	0~20 L/min	0~2 L/min
Accuracy	±4%RD ($2 \leq x \leq 50$L/min) ±2%RD ($50 < x \leq 200$L/min)	±4%RD ($0.2 \leq x \leq 5$L/min) ±2%RD ($5 < x \leq 20$L/min)	±4%RD ($0.02 \leq x \leq 0.5$L/min) ±2%RD ($0.5 < x \leq 2$L/min)	±4%RD ($2 \leq x \leq 50$L/min) ±2%RD ($50 < x \leq 200$L/min)	±4%RD ($0.2 \leq x \leq 5$L/min) ±2%RD ($5 < x \leq 20$L/min)	±4%RD ($0.02 \leq x \leq 0.5$L/min) ±2%RD ($0.5 < x \leq 2$L/min)
Weight	565g	330g		565g	330g	
Output	RS485, open collector output with NPN, 1~5V linear voltage output			RS485, open collector output with NPN, 4~20mA linear current output		
Repeatability	±1% F.S.					
Response time	50 ms					
Power supply	9～24V DC external power supply					
Display	LCD					
Displayed unit	Accumulated flow: L (ft^3×10^{-1}); Instantaneous flow: L/min (CFM×10^{-2})					
Maximum working pressure	0.8 MPa					
Standard calibrated gas	Air (25℃, a standard atmosphere)					
Working temperature	-10 ~ +60 ℃					
Pinout	DB9 female data wire (optional)					
Power consumption	0.85 W (typical)					
Shell material	PC					
Duct material	6061 aluminum alloy					

3. Dimension

The dimensions of AMS1000H00 and AMS1000A00 are shown in Figure 5.
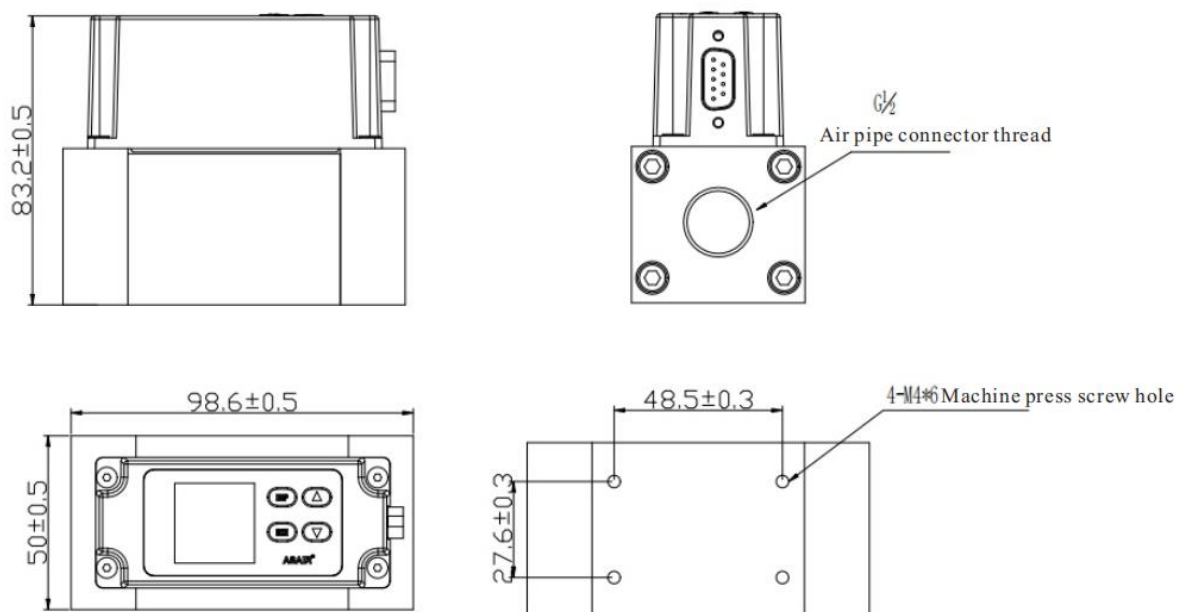

Figure 5. ATO-AMS1000 200L/min (unit: mm)

The dimensions of AMS1000H01, AMS1000H02, AMS1000A01, and AMS1000A02 are shown in Figure 6.
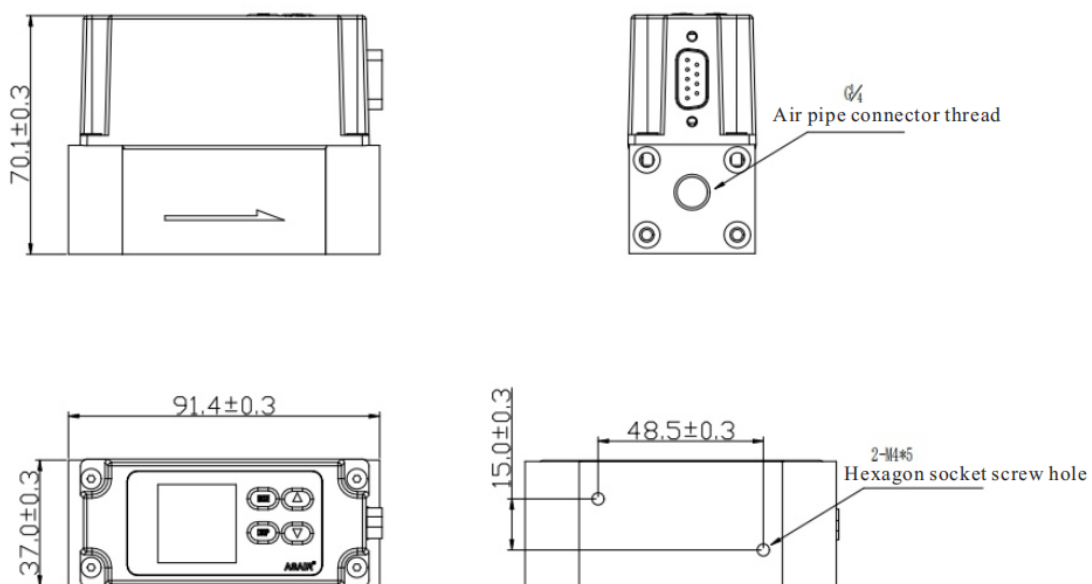

Figure 6. ATO-AMS1000 20L/min and 2L/min (unit: mm)

4. Communication protocol and output

4.1 Communication interface

The digital output communication interface of ATO-AMS1000 is RS485, and the communication parameters are shown in Table 3.

Table 3. RS485 communication parameter

Parameter	Description
Protocol format	RTU
Communication rate	4800/9600/19200/115200 bps
Start bit	1 bit
Data bit	8 bits
Stop bit	1 bit
Parity	None

The communication protocol is standard Modbus-RTU. The host can be a computer, RS485 receiver and MCU controller, etc. ATO-AMS1000 is used as a slave, and the default address is 0x01. ATO-AMS1000 supports address modification, and multiple ATO-AMS1000 can be connected to one bus.

The Modbus RTU communication register definition of ATO-AMS1000 is shown in Table 4.

Table 4. Definition of Modbus-RTU communication register

Register address	Value	Read/Write	Function code	Magnification	Register information	Remark
0x0000	0~65535	Read only	03	10	Instantaneous flow	Example: 157.8 L/min 0x062a
0x0001	0~65535	Read only	03	10	Accumulated flow (higher 16 bits)	Example: 123456789.5 L Higher bits: 0x4996 Lower bits: 0x02d7
0x0002	0~-65535	Read only	03	10	Accumulated flow (lower 16 bits)	
0x0003	0~65535	Read only	03	10	Temperature	Example: 27.7°C 0x0115
0x0004	0~3	Read only	03	1	Device status information	0: normal; 1: sensor errors; 2: EEPROM errors; 3: Sensor and EEPROM error
0x0005	0~1	Read only	03	1	Upper limit alarm sign	0: Close upper limit alarm; 1: Open upper limit alarm
0x0006	0~1	Read only	03	1	Lower limit alarm sign	0: Close lower limit alarm, 1: Open lower limit alarm
0x0030	0~65535	Read only	03	1	Model	Hex of model number Example: ATO-AMS1000 --> 0x02d5
0x0031	0~9999	Read only	03	1	Software version	Example:V0001—＞0x0001
0x0032	0~1	Read and write	03/06	1	Flow units	0: L/min 1: CFM×10⁻¹
0x0033	/	/	/	/	/	/
0x0034	0~1	Read and write	03/06	1	Language selected	0: Chinese 1: Reserved
0x0035	1~32	Read and write	03/06	1	Slave address	Slave address, only support 1-32
0x0036	480 or 960 or 1920 or 11520	Read and write	03/06	1/10	Baud rate	4800、9600、19200、115200 Example: 115200 -->0x2d00
0x0037	0~1	Read and write	03/06	1	Clear accumulated flow	0: no action 1: Clear accumulated flow
0x0038	1~6	Read and write	03/06	1	Gas	1: AIR, 2: N_2 ,3: Ar, 4: CO_2 ,5: He, 6: O_2
0x0039	0~1	Read and write	03/06	1	Alarm switch	0: Close alarm, 1: Open alarm
0x003A	0~2000	Read and write	03/06	10	Upper limits (L/min)	Example: set 25 L/min --＞0x00Fa
0x003B	0~2000	Read and write	03/06	10	Lower limits (L/min)	Example: set 5L/min --＞0x0032

A command has to be sent by host to the ATO-AMS1000 to read the value of the instantaneous flow of the ATO-AMS1000 (the default slave address of the device is 0x01). The data format of the command is shown in Table 5.

Table 5. Data format of command sent by host to read register

Data sent by host	Bytes	Example（Hex）	Remark
Slave address	1	01	Slave address
Function code	1	03	Read multiple register
Start address of register	2	0000	Instantaneous flow value is restored in register 0x0000
Quantity of reading register	2	0001	Read a register
CRC code	2	840A	Used for check

The host will receive the data returned by ATO-AMS1000, and the data format is shown in Table 6.

Table 6. Data format of the received data from ATO-AMS1000

Data sent by slave	Bytes	Example (Hex)	Remark
Slave address	1	01	Slave address
Function code	1	03	Read multiple register
Quantity of receive bytes	1	02	Quantity of receive bytes = quantity of read register $\times$ 2
Register data	2	062A	A register read; Instantaneous flow = Register data (decimal) /10
CRC code	2	B84B	Used for check

When the slave address of ATO-AMS1000 is required to be changed to 0x02, the value of the 0x0035 register has to be rewritten. The data format for the host to rewrite the register value is shown in Table 7.

Table 7. Data format to write register

Message sent by host	bytes	Example (Hex)	Remark
Slave address	1	01	Slave address
Function code	1	06	Write a register
Register address	2	0035	Slave address is restored in register 0x0035
Writing data	2	0002	Write data 0002
CRC code	2	1805	Used for check

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

```c
// *ptr: data byte array of sending or receiving.
// len: length of data bytes sending or receiving. (except for CRC code)
// return the result of CRC code, higher bytes first.
unsigned int CRC16(unsigned char * ptr,unsigned char len)
{
    unsigned int crc= 0xFFFF;//Initialize
    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 Open collector output with NPN transistor

There are two open collector outputs with NPN transistor on ATO-AMS1000, which are corresponding to external output 1 and external output 2. External output 1 controls the upper limit alarm, and external output 2 controls the lower limit alarm. For the ATO-AMS1000 pinout cable, external output 1 (NPN1) corresponds to the black wire, external output 2 (NPN2) corresponds to the gray wire, and GND corresponds to the green wire, blue wire or purple wire. The wiring diagram is shown in Figure 7.
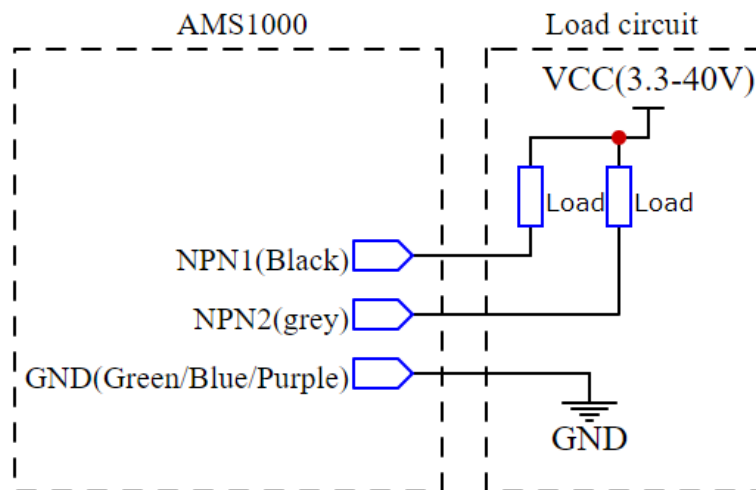

Figure 7. Wiring diagram of upper and lower limit alarms control

The load in Figure 7 can be an alarm device, such as a warning light. By default, the alarm function is off, so there is no upper and lower limit alarm, and the two NPN transistors (equivalent to switches) are in the open state, which means the load circuit is open. To turn on the alarm function, the upper limit and lower limit of flow are set. When the flow value is higher than the upper limit or lower than the lower limit, the corresponding NPN transistor is closed and the current flows through the load, then, the alarm device starts working.

With the alarms function for upper and lower flow limit, alarm will be on when the instantaneous flow value is higher than the upper flow limit value or lower than the flow lower limit value. For example, 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

external output 2 is closed to have alarm on. When it is higher than 20L/min, the external output 1 is closed to have alarm on.

4.3 Voltage/current output

ATO-AMS1000 has two output modes of voltage output or current output for customers to choose. Both voltage output and current output are linear output. The relationship between voltage/current and flow is:

Voltage (V)   = 1+instantaneous flow (L/min) ×voltage coefficient
Current (mA) = 4+ instantaneous flow (L/min) ×current coefficient

The voltage coefficient and current coefficient of product models with different ranges are shown in Table 8.

Table 8. Flow and analog coefficient comparison

Factor\measurement range	200L	20L	2L
Voltage	0.02	0.2	2
Current	0.08	0.8	8

5. User interface and operation

Figure 8. Introduction to screen icons

1: 485-communication address; 2: status for alarm switch; 3: 485 status for communication; 4: lock screen icon; 5: fluid type; 6: accumulated flow; 7: instantaneous flow

When the lock icon (④ in Figure 8) is on, press and hold the setting button for 5 seconds to unlock the screen and enter the menu page, then, press up and down buttons to select the parameter to be set and press the switch button to select the parameter. The interface will enter the lock screen state without any operation within 30 seconds. When the alarm switch status icon (② in Figure 5) is on, it means the alarm function is on, and when there is no icon, it means the alarm is turned off. The page menu has 4 levels, and the function introduction is shown in Table 9.

Table 9. Function instruction of menu

First menu	Secondary menu	Tertiary menu	Function
Parameter setting	Select gas	/	Select measured gas (Air, N_2, Ar, CO_2, He, O_2)
	Set alarm	Alarm switch	Open/close alarm.
		Upper flow limit	Set the upper limit of flow, when the alarm function is turned on, the upper limit of flow will be alarmed.
		Lower flow limit	Set the flow lower limit value, when the alarm function is turned on, the lower flow limit value will be alarmed.
		Quit	Return to secondary menu.
	Reset flow	/	Clear accumulated flow.
	Quit	/	Return to first menu.
Communication setting	Baud rate	/	Set the baud rate of the transmitted data (there are four baud rates of 4800, 9600, 19200, 115200 to choose from)
	Select 485 address	/	Select the communication address of RS485 (1-32)
	Quit	/	Return to first menu.
System setting	Set language	/	Reserved, Chinese by default
	Set unit	/	Unit switching between L/min and CFM.
	Reset	/	Reset the product.
	Device information	/	Check the model and version of the device.
	Quit	/	Return to first menu.
Quit	/	/	Return to main menu.

6. Packing list

Packing list

Parts	Quantity
ATO-AMS1000	1
ATO-AMS1000 pinout wire (optional)	1
Datasheet	1
Certificate	1

Warning and personal injury

Do not apply this product to safety protection devices or emergency stop equipment, and any other applications that may cause personal injury due to the product's failure. Do not use this product unless there is a special purpose or use authorization. Refer to the product data sheet and application guide before installing, handling, using or maintaining the product. Failure to follow this recommendation may result in death and serious personal injury.

The Company will not bear any compensation for personal injury and death arising therefrom, and will exempt the company's managers and employees, affiliated agents, distributors and any other claims that may arise therefrom, including: various costs, claims, lawyer fees, etc.

Description of warranty period

Accessories category	Shelf life
ATO-AMS1000 Gas mass flow meter	12 months
Wiring or other parts	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 applications. At the same time, the company does not make any promises about the reliability of its products when applied to products or circuits not provided by ATO.

This manual may be changed at any time without notice.