Air Flow Sensor

FR_n03H Series

Manual

Version：1.1

Date：2025.09.30

Zhengzhou Winsen Electronic Technology Co., Ltd

Statement

Thanks for purchasing our product. In order to let customers use it better and reduce the faults caused by misuse, please read the manual carefully and operate it correctly in accordance with the instructions. If users disobey the terms or remove, disassemble, change the components inside of the sensor, we shall not be responsible for the loss.

The specific such as color, appearance, sizes &etc, please in kind prevail.

We are devoting ourselves to products development and technical innovation, so we reserve the right to improve the products without notice. Please confirm it is the valid version before using this manual. At the same time, users' comments on optimized using way are welcome.

Please keep the manual properly, in order to get help if you have questions during the usage in the future.

Zhengzhou Winsen Electronics Technology CO., LTD.

1. Product Description

The FRn03H series micro-flow gas mass flow sensor is specifically designed for various micro-flow process control applications. This product is an upgrade based on the FR03H, featuring significantly improved zero-point stability and full-scale signal stability. It is widely used for various gas measurements, offering low cost, easy installation, and low pressure loss, making it a suitable replacement for traditional flow sensors.

2. Product Features

- ✧ High sensor sensitivity with extremely low start-up flow
- ✧ Multiple signal output options
- ✧ High stability and repeatability across the entire range

3. Product Selection：

FR$_n$03H-H0□-□□-□

- 连接器类型——可选端子或插针
- 流量单位——SCCM（SCCM-0℃标况mL/min）
- 最大流量——可选100/200/300/400/500、1000/2000
- 输出方式——可选D或A（D-I²C信号，A-模拟电压信号）

4. Technical Specifications

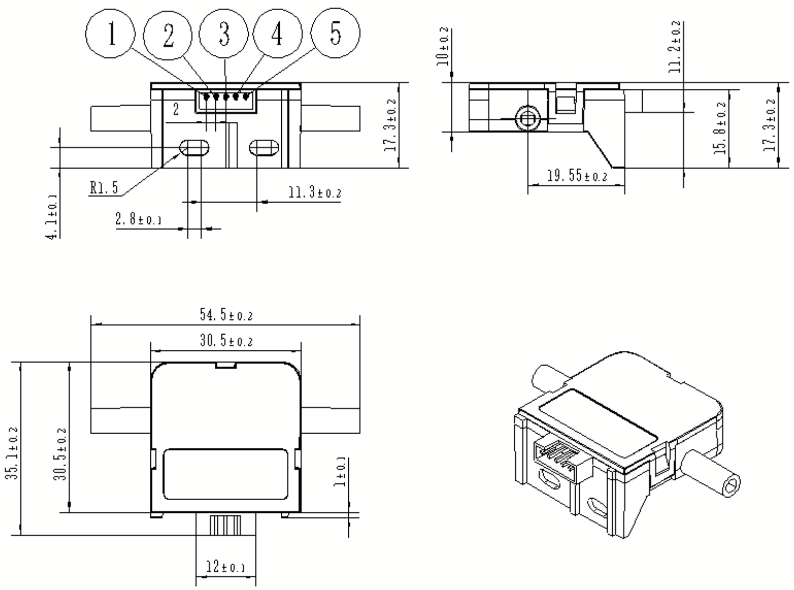
4.1 Technical Parameters

	Parameter	Value	Unit
Flow Measurement	Max. Flow	50/100/200/300/400/500 1000/2000	SCCM
	Accuracy	±（2+0.5FS）	%
	Repeatability	0.5	%
	Maximum working pressure	200	kPa
	Maximum flow pressure loss	≤110	Pa
		≤150	
	Working Temperature	0～50	℃
Output SIgnal	Output Method	Digital I²C & Analog 0.5V～4.5VDC	
	I²C communication rate	100	kHz
	Signal response time	≤50	ms
Electrical Parameters	Operating voltage	5～15	VDC
	Operating current	≤30	mA
	Electrical interface	PH2.0-5P plug-in connector or 2.54-5pin pin header optional	
Other	Storage temperature	-20～65	℃
	Mechanical interface	Removable hose connector	
	Measurement medium	Dry, clean non-corrosive gases	

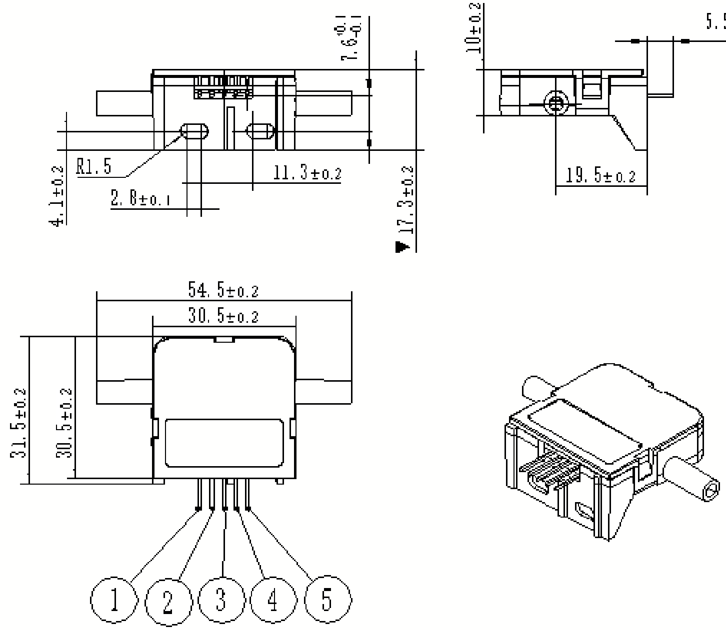
* Our company's flow sensors are calibrated by default under conditions of 20°C, 101.325 kPa, and using air as the reference. The production environment is maintained at a temperature of 22±2°C, in a cleanroom setting with 30%–35% relative humidity. If special requirements exist, calibration will be performed according to the customer's specifications.

4.2 Structural Parameters

4.2.1 Terminal Board



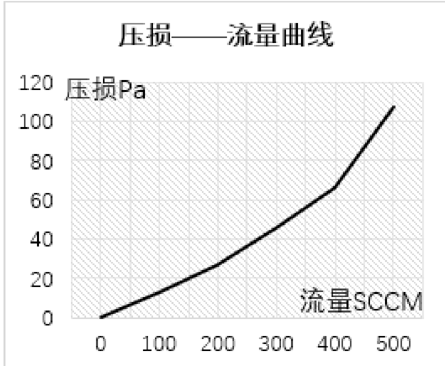
4.2.2 Pin Version



4.3 Flow-Pressure Loss Curve

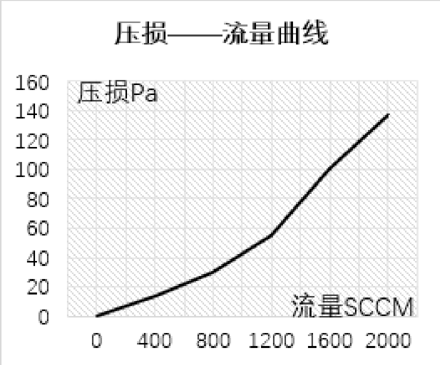
100/200/300/400/500SCCM

流量 SCCM	压损 Pa
0	0
100	13
200	27
300	46
400	66
500	107



1000/2000SCCM

流量 SCCM	压损 Pa
0	0
400	14
800	30
1200	55
1600	100
2000	134



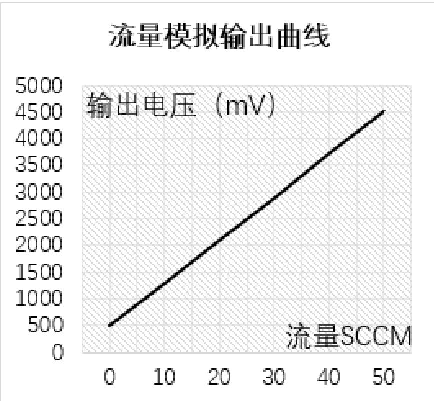
4.4 Interface Definition

引脚	端子版	插针版
PIN1	SDA	SCL
PIN2	SCL	Vout
PIN3	GND	VCC
PIN4	VCC	GND
PIN5	Vout	SDA

4.5 Analog Signal Output Curve

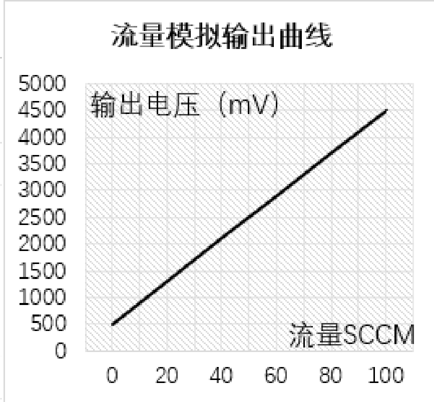
FRn03H-H0D-50SCCM

流量 SCCM	模拟电压 mV
0	500
10	1300
20	2100
30	2900
40	3700
50	4500



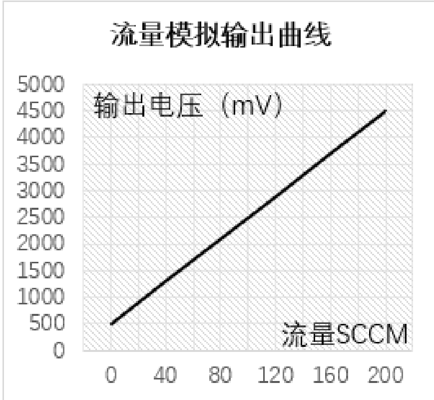
FRn03H-H0D-100SCCM

流量 SCCM	模拟电压 mV
0	500
20	1300
40	2100
60	2900
80	3700
100	4500



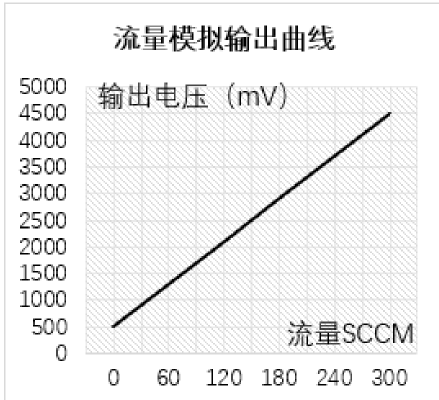
FRn03H-H0D-200SCCM

流量 SCCM	模拟电压 mV
0	500
40	1300
80	2100
120	2900
160	3700
200	4500



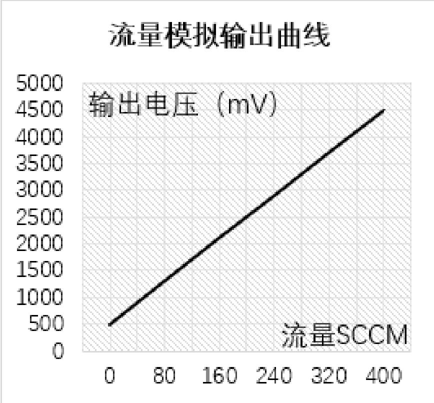
FRn03H-H0D-300SCCM

流量 SCCM	模拟电压 mV
0	500
60	1300
120	2100
180	2900
240	3700
300	4500



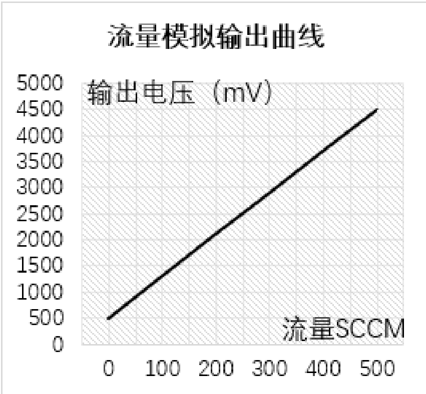
FRn03H-H0D-400SCCM

流量 SCCM	模拟电压 mV
0	500
80	1300
160	2100
240	2900
320	3700
400	4500



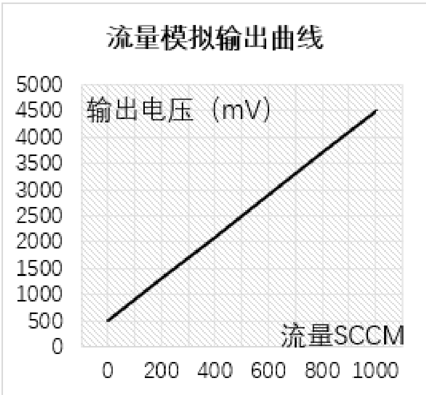
FRn03H-H0D-500SCCM

流量 SCCM	模拟电压 mV
0	500
100	1300
200	2100
300	2900
400	3700
500	4500



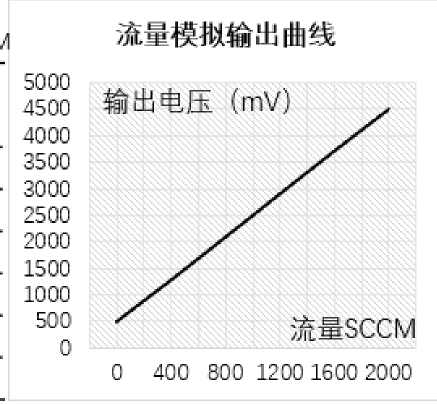
FRn03H-H0D-1000SCCM

流量 SCCM	模拟电压 mV
0	500
200	1300
400	2100
600	2900
800	3700
1000	4500



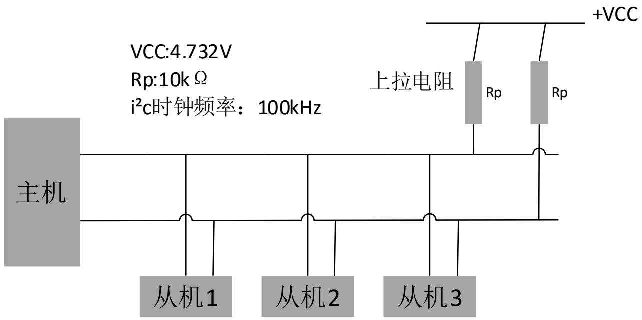
FRn03H-H0D-2000SCCM

流量 SCCM	模拟电压 mV
0	500
400	1300
800	2100
1200	2900
1600	3700
2000	4500



5 I²C Communication

5.1 I²C Connection



5.2 I²C Address

The default address is 0x40, followed immediately by 1 bit for read (1) or write (0).

5.3 I²C Communication

- **Start Condition (S)**: A high-to-low transition on the SDA line while SCL is high.
- **Stop Condition (P)**: A low-to-high transition on the SDA line while SCL is high.
- **Acknowledge (ACK)**: A low level on SDA while SCL generates a positive pulse.

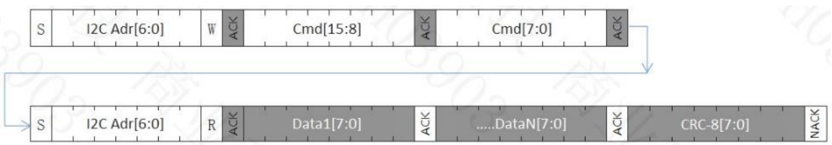
- **Non-Acknowledge (NACK)**: A high level on SDA while SCL generates a positive pulse.

5.4 I²C Command Codes

Command Code	Return Bytes (bytes)	Command Description	Remarks
0x1000	5	Read Flow Value	Reads instantaneous flow value
0xCCDD	41	Read Sensor Parameters	Reads sensor configuration parameters

5.5 I²C Communication Timing and Parsing

5.5.1 I²C Timing



5.5.2 Read Flow Data List:

Data1 Data2	Current Flow Measurement Value	HEX High Byte First
Data3 Data4	/	/-
Data5	CRC-8	Check Value

5.5.3 Read Sensor Parameter Data List:

Data1- Data4	/	/
Data5 Data6	Unit	HEX High Byte First 0x15--mL/min 0x16--L/min
Data7 Data8	Unit	HEX High Byte First
Data9 Data10	Offset	HEX High byte first
Data11 Data12	Conversion Factor	
Data13- Data16	/	/
Data17- Data20	Output Voltage Lower Limit—mV	HEX High byte first
Data21- Data24	Output Voltage Upper Limit—mV	
Data25- Data29	/	/
Data30- Data33	Product ID	ASCII format
Data34- Data40	/	/
Data41	CRC-8	Checksum

5.5.4 Offset and Medium Coefficient Table:

Max Flow Rate	Unit	Offset	Medium Coefficient
50～1000	SCCM	30000	25000
2000	SCCM	30000	2500

5.6 Digital Flow Calculation

Mass Flow = (Flow Measurement Value - Offset) / Medium Coefficient

5.7 CRC Check

The CRC check uses CRC-8 with an initial value of 0x00 and a polynomial of 0x131 ($x^8 + x^5 + x^4 + 1$). Example code is as follows:

```
// Function name: Calc_CRC8
// Function: CRC8 calculation with initial value 0x00, polynomial 0x131 (x8 + x5 +
```

```
x^4 + 1)
        // Parameters: unsigned char *data: pointer to the CRC check array
        //                    unsigned char num: length of CRC check data
        // Return: crc: calculated CRC8 value
        unsigned char Calc_CRC8(unsigned char *data, unsigned char num)
        {
          unsigned char bit,byte,crc = 0x00;
            for(byte = 0; byte < num; byte++)
          {
            crc ^= data[byte];
            for(bit = 8; bit > 0; --bit)
            {
              if(crc & 0x80)
                   crc = (crc << 1)^0x131;
                  else
                   crc = (crc << 1);
        }
        }
        return crc;
        }
```

6 Installation and Usage

Due to the low pressure drop of the sensor, the flow cannot be entirely regulated by the sensor itself. The piping leading to the sensor also affects the distribution of airflow through the sensor, which in turn influences the measurement results. To achieve optimal measurement performance, it is recommended to configure for laminar flow as much as possible. Specific guidelines are as follows:

6.1 The gas used must be purified, free from dust, liquids, and oil contamination. If necessary, a filtration device can be installed at the inlet of the gas path.

6.2 The pressure of the medium used should not exceed 1.6 times the product's maximum operating pressure.

6.3 To ensure measurement accuracy in application scenarios, it is recommended to use silicone tubing with an inner diameter of Ø3 mm for both the inlet and outlet piping. Additionally, a straight pipe section of at least 5 times the nominal diameter should be installed at the sensor inlet, and at least 3 times the nominal diameter at the outlet.

6.4 In principle, thermal flow sensors are not suitable for pulsating airflow measurements. However, this sensor features an extremely fast signal update frequency and response rate, making it suitable for reproducing the pulsating state of the gas source. If flow measurement in a pulsating flow scenario is absolutely necessary, the following steps can be taken to output an accurate and stable signal:

6.4.1 Install the sensor as far away from the pulsation source as possible.

6.4.2 Attempt to add adjustment devices (such as regulating valves, buffer containers, or pulsation dampers) in the piping between the pulsation source and the sensor to isolate pulsations.

6.4.3 The application end can adjust the sampling rate and filtering depth based on actual requirements.

7. Troubleshooting

7.1 Preliminary Checks

7.1.1 Check that the gas source and inlet gas path are open.

7.1.2 Ensure the communication lines are correctly connected.

7.1.3 Verify that the medium pressure and ambient temperature comply with the product's technical specifications.

7.2 Fault Diagnosis

No.	Fault Phenomenon	Possible Causes	Solution
1	No signal output or non-zero fixed value output when no gas flow	Sensor damaged	Return to factory for repair
		Incorrect wiring sequence	Check if the terminal connections are correct

2	No signal change when gas is flowing	Sensor installed in reverse	Change the installation direction
		Incorrect wiring sequence	Check if the terminal connections are correct
		Sensor damaged	Return to factory for repair
3	Sensor responds normally during gas flow but shows a specific patterned deviation compared to the reference instrument	Inconsistent reference standards	Check the measurement units used by the reference instrument and the sensor, and perform necessary conversions
	Sensor responds normally during gas flow, but the signal exhibits significant irregular fluctuations, while the average sampled signal over a period is close to the reference instrument	Turbulent flow in the installation pipeline	Refer to section 6.4 to increase signal integration time
	Sensor responds normally during gas flow, but exhibits a large negative deviation	Jet flow in the pipeline leading to the sensor	Refer to section 6.3 to optimize the pipeline, or consult the manufacturer for joint analysis and solution
	Sensor responds normally during gas flow, but the signal exhibits specific patterned fluctuations, while the average sampled signal over a period is close to the reference instrument	Periodic pulsation characteristics in the airflow	Refer to section 5.4 to increase signal integration time

8 Disclaimer

Our company shall not be held liable for damages caused under the following circumstances:

(1) Force majeure, including natural disasters, etc.

(2) Failure to install, use, or operate the product in accordance with the instruction manual.

(3) Operation or storage in unsuitable or harsh environments.

(4) Unauthorized modifications, alterations, disassembly, reassembly, or repairs by the user or any third party, resulting in product damage, personal injury, property loss, infringement of intellectual property rights, or other harmful consequences.

(5) Our company reserves the final right to interpret this disclaimer.

(6) This disclaimer shall be interpreted in accordance with the laws of Mainland China.

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