Flow Sensor

FR20

User's Manual

Version：1.5

Issue Date：2023.11.10

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

FR20 gas flow sensor uses MEMS thermal principle to monitor the flow of pipeline gas medium, which is suitable for ventilator/anesthesia machine use in medical field/industrial process detection.

2. Feather

- ✧ High sensitivity, very low starting flow;
- ✧ High response speed;
- ✧ High accuracy and repeatability;
- ✧ Low pressure loss;
- ✧ Modular structure design.

3. Technical details

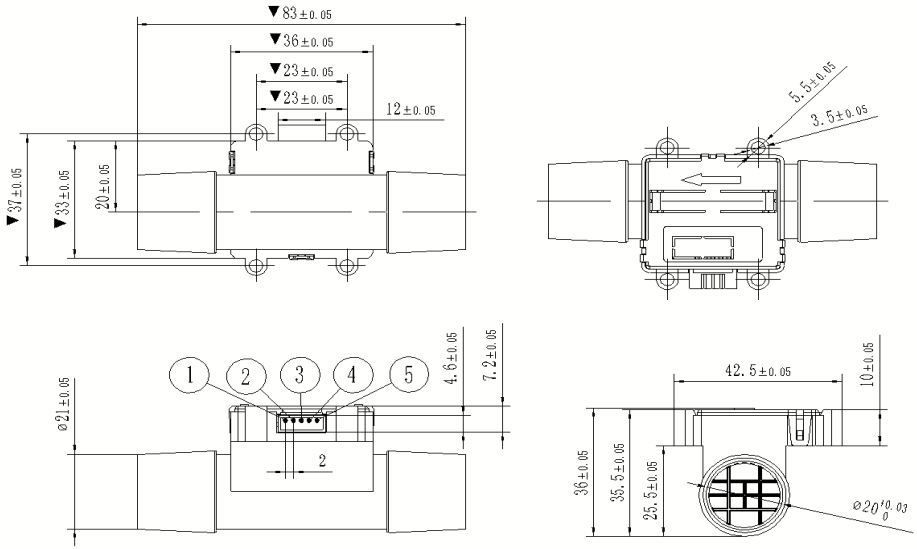
3.1 Technical data

Model No.		FR20
Channel Diameter		Ø20mm
Flow measurement	Maximum Flow Rate	200L/min @20℃ 101.325kPa
	Measurement Accuracy	9L/min ~ 200L/min ±2.5% 0 ~ 9L/min ±0.5%FS
	Repeatability	0.5%
	Working Pressure	≤200kPa
	Burst Pressure	≤0.7MPa
	Woking Temperature	0℃ ~ 50℃
Electrical parameter	Output Mode	Digital IIC or linear analog voltage
	Simulated Flow	Linerarity 0.5V ~ 4.5V
	IIC Communication Rate	100kHz
	Signal Refresh Time	≤1ms
	Signal Response Time	≤3ms
	Working Voltage	DC4.9V ~ 14V
	Working Current	≤30mA
	Electrical Interface	PH2.0-5P Plug - in connector
Others	Storage Temperature	-20℃ ~ 80℃
	□Pmax	≤1000Pa
	Measuring Medium	Dry and clean non-corrosive gas

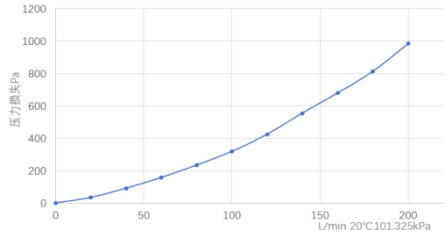
* The company's flow sensor adopts the default 20□ 101.325kPa air for calibration, production temperature is 22±2□, humidity is (30%-35%) RH. If the user has special requirements, it will be calibrated according to customer requirements.

* FS refers to full scale accuracy, and % is the reading accuracy.

3.2 Structure

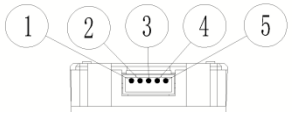


3.3 Flow pressure loss curve



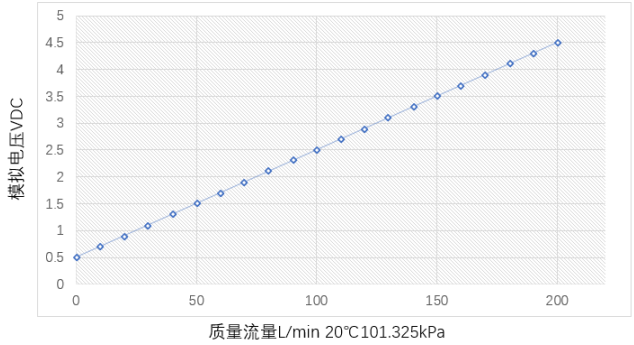
3.4 Interface definition

The sensor built-in connector model is PH2.0-5P, and the specific signal is defined in the following table:



PIN1	SDA
PIN2	SCL
PIN3	GND
PIN4	VCC
PIN5	Vout

3.5 Analog signal output and flow calculation



$$\text{Flow（L/min）} = \frac{\text{output voltage} - \text{zero voltage}}{\text{Full point voltage} - \text{zero voltage}} \times \text{Max flow}$$

4. IIC Communication

4.1 IIC Connectioin

This sensor uses the standard IIC communication protocols, serial Data bus (SDA) and serial time bus (SCL) with a recommended pull-up resistance of 10kΩ.

4.2 IIC address

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

4.3 IIC communication

Transmission start signal (S) - When the clock line SCL is high, the data line SDA appears a falling edge from high to low.

Transmission stop signal (P) - When the clock line SCL is high, the data line SDA appears a rising edge from low to high.

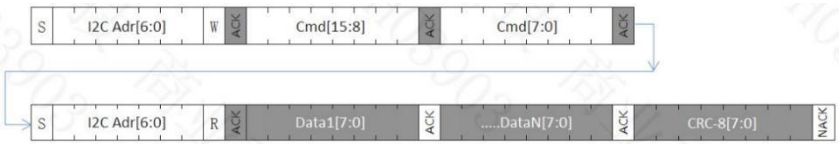
Response (ACK) - The SCL sends a positive pulse during a low SDA level.Non-response (NACK) - The SCL sends a positive pulse when the SDA is high.

4.4 Command set and data transmission sequence

Command code	Return / write (bytes)	**Command description**	**Note**
0x1000	5	**Flow collection**	Read the instantaneous flow value

4.5 Communication timing

Flow collection



Data list:

Data1	Current flow value	HEX, High byte first
Data2		
Data3	reserve	-
Data4		
Data5	CRC-8	Calibration value

Conversion coefficient table:

Medium type	Conversion coefficient	offset
Air	140	20000
Oxygen	142	20000
Other gas		

4.6 Digital flow calculation

$$\text{Flow (L/min)} = \frac{\text{Flow measurement value} - \text{offset value}}{\text{Conversion coefficient}}$$

4.7 CRC verification

CRC verification uses CRC-8, the initial value is 0x00, and the polynomial is 0x131(x8 + x5 + x4 + 1). The example code is as follows:/ / *

```
// Function name: Calc_CRC8
// Function: CRC8 calculation, initial value: 0x00, polynomial: 0x131(x8 + x5 + x4 + 1)
// Parameters: unsigned char *data: indicates the CRC array pointer
// unsigned char num: indicates the length of the CRC check data
// Return: crc: The calculated value of CRC8unsigned 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;
}
```

5. Installation and use

Due to the low pressure drop, flow of sensor is not entirely by the sensor itself. The pipe leading to the sensor also affects the distribution of air flow through the sensor, and the measurement results. To achieve the best measurement performance, laminar flow configuration is recommended as far as possible. The details are as follows:

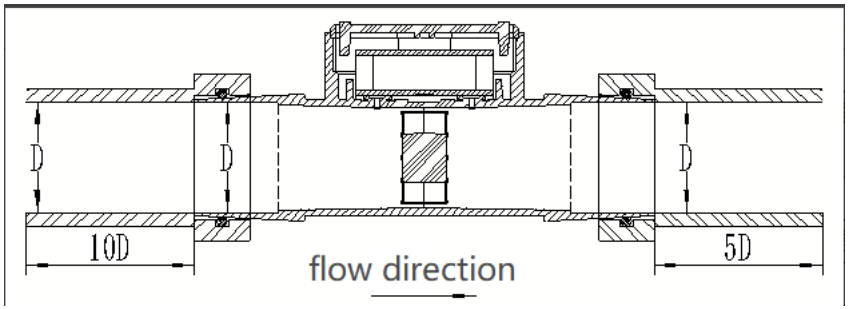
5.1 The gas must be purified to avoid dust, liquid and oil pollution. If necessary, a filter device can be installed in the air inlet end of the gas path.

5.2 The pressure of the medium should not exceed 2 times the maximum

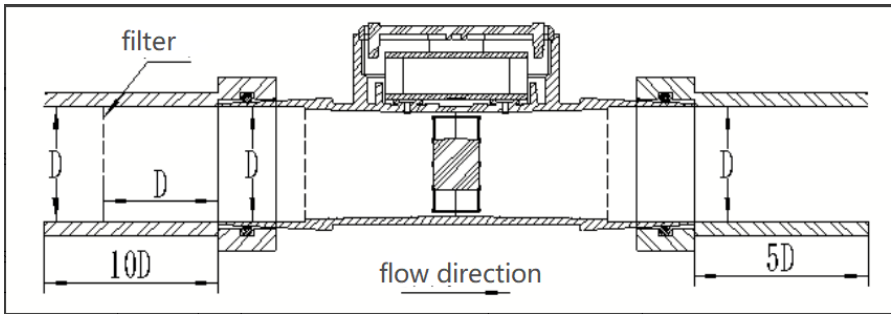
pressure of the product.

5.3 To ensure the measurement accuracy of the sensor in the application scenario, it is recommended to implement the installation as follows.

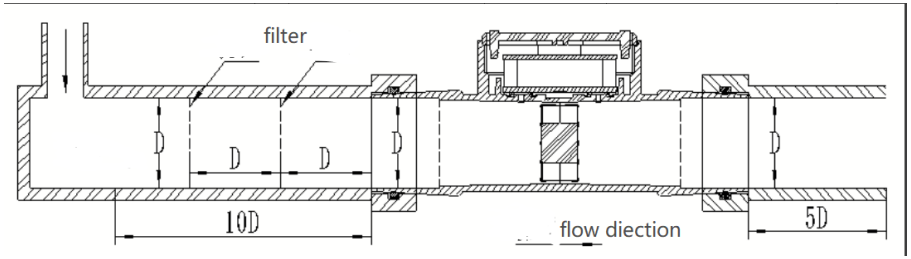
5.3.1 For silicone hose connection: It is suitable for silicone hose with inner diameter □20mm. We recommend you to connect the rigid adapter by pressing the intake end as shown in the diagram



5.3.2 For the occasion of insufficient installation space, rectification measures or filters can be added inside the rigid pipe at the intake end by pressing the figure to adjust the airflow distribution, which is suitable for the pipe network driven by the fan.



5.3.3 For situations with compact space such as ventilators, you can press the figure to adjust the air path structure at the intake end and adjust the air distribution.



6. Fault diagnosis

6.1 Preliminary Inspection

6.1.1 Check the gas source and the entrance to the open road

6.1.2 Ensure that communication cables are properly connected.

6.1.3 Check whether the medium pressure and ambient temperature meet the technical specifications of the product.

6.2 Fault Checking

NO.	Symptoms	Possible Causes	Solution
1	No signal output or output non-zero fixed value during nonventilation	Sensor is failure	Return to factory for repair
		Line sequence error	Check whether the terminal is correctly inserted
2	No signal change during ventilation	Sensor inversion	Change the mounting direction
		Line sequence error	Check whether the terminal is correctly inserted
		Sensor is failure	Return to factory for repair
3	During ventilation, the sensor responded normally, but showed a specific regular deviation from the reference instrument	The reference standards are inconsistent	Check the units of measurement used by reference meters and sensors and convert them

4	The sensor responds normally during ventilation, and the signal has a large irregular pulsation, but the average value of the sampled signal is close to the reference instrument within a period of time	There is turbulence in the pipe	Increase the signal integration duration or refer to 5.3 Optimizing Pipes
5	The sensor responds normally during ventilation, but there is a large negative deviation	There is a jet flow in the pipeline of the inlet sensor	Refer to 5.3.3 to optimize the pipeline or consult the manufacturer for a solution
6	During ventilation, the sensor responds normally, and the signal has a specific rule of pulsation, but the average value of the sampled signal is close to the reference instrument in a period of time	The air flow fluctuates periodically	Increase the signal integration time or refer to 5.3 to adjust the rectification (such as increasing the number of filter layers or mesh)

7. Product selection

Model	Instructions
FR20-H0D	Digital signal output
FR20-H0A	Linear analog signal output

8. Disclaimer of Liability

We are not responsible for any damage caused by:

(1) Natural disasters.

(2) Misoperation or unreasonable use.

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

(4) Modify or disassemble the product without authorization.

(5) Damage caused by violent means.

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