

HORIBASTEC

Gas Mass Flow Controller (Meter)

S500 Instructions (Ver.1.6)

HORIBA Precision Instruments (Beijing) Co.,Ltd.

CSMS50002

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1. Overview

The S500 thermal mass flow controller is able to control gas mass flow rate within a large range in real time accurately. Gas goes through a stainless steel capillary, to change the capillary temperature distribution, resulting in upstream and downstream temperature difference, therefore the flow rate can be measured. Unlike flow controllers or meters that measure gas pressure or volume, this product's accuracy won't be affected by gas pressure or ambient temperature. The electrical signal that represents upstream and downstream temperature difference is always a real-time reflect of instantaneous flow rate. The PID circuit is used to control a proportional solenoid valve constantly, thus control the flow rate precisely. It is particularly applicable for gas precise measurement and control in control processes .

1.1 Range

The mass flow controller is widely used for flow measurement and control in the semiconductor, vacuum coating, chemical, environmental and other industries.

1.2 Mass Flow Controller (Meter)

The mass flow controller (meter) is abbreviated as MFC (MFM). There are two functions in it: flow measurement and control.

1.3 Features of S500 MFC (MFM)

- ☆ **High accuracy, fine linearity, small zero drift, fast gas flow response, small overshoot, and so on.**
- ☆ Applicable to high pressure and vacuum. Small gas resistance, wide operating pressure range. The measured flow rate won't be effected by gas temperature and pressure.
- ☆ All wetted parts have strong corrosion resistance. The valve body is made of stainless steel (316L), and the gas-tight parts are made of fluorine rubber. The important parts, such as PCB, valve body, spring and sensor, undergo strict factory inspection.
- ☆ Can be mounted in any position.
- ☆ Easy to use. It is easy to work together with an electrical or automatic control system. With MT-52 or MT-51 series of Digital Readout and Control Unit, the instantaneous flow rate can be measured and displayed accurately.

2. Terms

2.1 Mass Flow Rate

Mass flow rate is the flow rate that represents the mass of fluid flowing through a cross-section per unit time. Gas mass flow rate is generally converted into volume/time in standard conditions. For example: mL/min (SCCM industry standard), L/min (SLM industry standard).

Standard Condition: Gas Temperature: 273.15K (0°C);

Pressure: 101325Pa (1atm)

Table 2-1 Gas Mass Flow Rate Units

International Unit	Industry Unit	Gas Temperature	Pressure
mL/min	SCCM	0°C (273.15K)	101325Pa(1atm)
L/min	SLM	0°C (273.15K)	101325Pa(1atm)
mL/min	CCM	25°C (298.15K)	101325Pa(1atm)
L/min	LM	25°C (298.15K)	101325Pa(1atm)

2.2 F.S.

F.S. represents for full scale.

2.3 Accuracy

Full-scale accuracy: the ratio of the difference between controller indication and actual value measured by a standard instrument to full scale (F.S). Such as: $\pm 1.0\%$ F.S. (with suffix F.S.).

2.4 Calibration Conditions

Usually we we calibrate a MFC (MFM) on nitrogen (N₂) in standard conditions. If a MFC (MFM) is calibrated on other types of gas, the mass flow rate is a calculated result (volume/time) through the conversion in standard conditions.

2.5 Response Time

When the set value step change (for example: from 0 to 100%) , the gas flow rate will follow the change and reach a final stable value within a error range after a period of time, which is called response time. T98 represents the specified time when the final stable flow rate equals to $\pm 2\%$ F.S .

2.6 Operating Pressure Range and Pressure Resistance

Operating pressure range is the range of pressure difference between inlet and outlet. The MFC (MFM) will work stably in the full range.

Pressure resistance is the maximum line pressure (gauge pressure) that a MFC (MFM) can tolerate and will not leak.

2.7 Flow Direction

The direction of gas flows in the MFC (MFM).

Due to the structural characteristics of the thermal MFC (MFM), gas can only flow in the direction that consistent with the arrow on the valve body and cannot flow opposite, otherwise the MFC (MFM) will not work or even be damaged.

2.8 "Valve Override" Options

Impose a high level, for example +15VDC (take socket pin assignment as the criterion) in the "valve override" pin, the valve will close.

When the "valve override" pin is vacant, the valve will be under control state. Valve opening can be controlled according to the set value.

Impose a low level, for example -15VDC (take socket pin assignment as the criterion) in the "valve override" pin, the valve will open.

The "Open" or "Close" command of S500 MFC (MFM) takes precedence over the implementation of the set value, no matter what input set value is.

2.9 Auto Shut-off

When the set value is less than 1-2% of F.S., the valve will shut off automatically. Therefore, the flow rate control range is from 2% F.S. to 100% F.S.

2.10 Auto-zero

Zero of MFC (MFM) may drift due to environment changes and prolonged use. In order to get a higher flow control accuracy, the zero point should be corrected when necessary. The S500 MFC (MFM) has a auto-zero function. When zero point changes, the MFC can automatically adjust it. When the set value is less than 1-2% F.S., or apply +15V to the "Valve override" pin ("close" state), and maintain the state for more than 4 minutes, the auto-zero circuit will work automatically.

2.11 Zero Temperature Compensation

The zero point may drift as ambient temperature changes. We will test the S500 MFC (MFM) zero drift in different temperatures and compensate zero drift at the factory, in order to minimize the effect of ambient temperature changes.

3. Principle

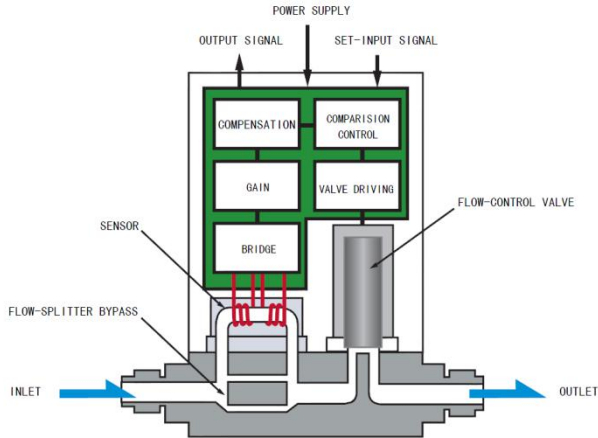


Figure 3-1 Principle of Thermal MFC

The MFC (MFM) consists of sensor, bypass channel, proportional valve, amplification control circuit and so on.

The S500 MFC (MFM) works according to the effect of heat-conduction distribution, that flowing fluid delivers heat to change the capillary wall temperature distribution, namely thermal profile flow meter.

According to thermoelectric calorimetry, the mass flow rate will not be affected by gas temperature and pressure. The flow signal measured by the sensor is amplified and compared with the presetting voltage, and then the differential signal is amplified to control the valve. Through real-time flow detection closed loop, the flow rate through the channel is equal to the set flow rate.

The bypass generates laminar flow between the main passage and the capillary wall, and makes the detected voltage proportional to the flow rate through the channel.

The control valve used in the MFC is a proportional solenoid valve, and it will change the valve opening according to the current applied on the electromagnetic coil.

The $\pm 15\text{V}$ MFC (MFM) can be connected with MT-51 or MT-52 series of Digital Readout and Control Unit generally. The functions of MT-51 and MT-52 are as follows: $\pm 15\text{VDC}$ power supply, flow signal display, flow setting operating and so on. The MFC (MFM) and MT-51 or MT-52 are connected with a cable.

4. Specifications

Table 4-1 S500 MFC Specifications

No.	Item	S500 MFC
1	Full Scale Flow Rate	(10,20,30,50,100,200,300,500) mL/min (1,2,3,5,10,30) L/min
2	Valve Type	Solenoid valve
3	Valve Rest Position	Normally closed
4	Mounting Orientation	Free
5	Flow Rate Control Range	2% - 100% F.S.
6	Flow Rate Measuring Range	0% - 100% F.S.
7	Response Time	1.5 Sec (T98) * (2.5 Sec if F.S. \leq 50mL/min)
8	Operating Temperature	5 - 45 °C
9	Accuracy Guaranteed Temperature	15 - 35 °C
10	Accuracy	\pm 1.0% F.S.
11	Linearity	\pm 0.5% F.S.
12	Repeatability	\pm 0.2% F.S.

No.	Item	S500 MFC
13	Operating Pressure Difference	10 mL/min - 5 L/min (50-300) kPa (D) 10 L/min - 30 L/min (100-300) kPa (D)
14	Max. Operating pressure	300kPa(G)
15	Pressure Resistance	1 MPa (G)
16	Leak Rate	1×10^{-8} Pa•m ³ /s (He)
17	Wetted Materials	316L, Fluorine rubber
18	Fittings	Swagelok: 1/4"Φ6 Φ10 VCR:1/4"3/8"
19	Power Supply	±15 VDC (±5%) +15 V ≤ 100 mA -15 V ≤ 150 mA
20	Flow Rate Setting Signal	0 - 5 VDC Input impedance > 2MΩ
21	Flow Rate Output Signal	0-5 VDC Load output current capability ≤ 3mA
22	Electrical Connector	D - sub15
23	Weight (kg)	0.9

Order Specification:

When ordering, please specify whether it is a MFC or MFM, specify the product model, flow rate, power supply and customized signal types as follows:

【Analog MFC】

Model	Type				
	Body	Seal	Connector	Power	Signal
S500	A:Small	R:Fluorine Rubber (FKM)	1:D-sub15/Male	1:±15V	1:0-5V

Please also specify flow rate, gas species, and fitting type.

For example: MFC (or MFM) - S500 (product model and signal type) ± 15VDC
0-5V

500SCCM (flow rate) N2 (gas species) Φ6 (fitting type)

In the storage and transportation process, do not open the product packaging, and keep the product way from rain, dust and bump.

Do not store the product in extremely cold/ hot or humid environment for a long time.

5. Installation and Connection

5.1 Installation Environment

The product is for indoor use, that operation temperature is 5-45°C and relative humidity is 60% maximum.

The installation environment should be away from vibration, dust, electromagnetic interference, and so on.

The product is required to use clean gas without water vapor and condensation. If a corrosive gas is used, please specify the gas type when ordering.

5.2 External Dimensions

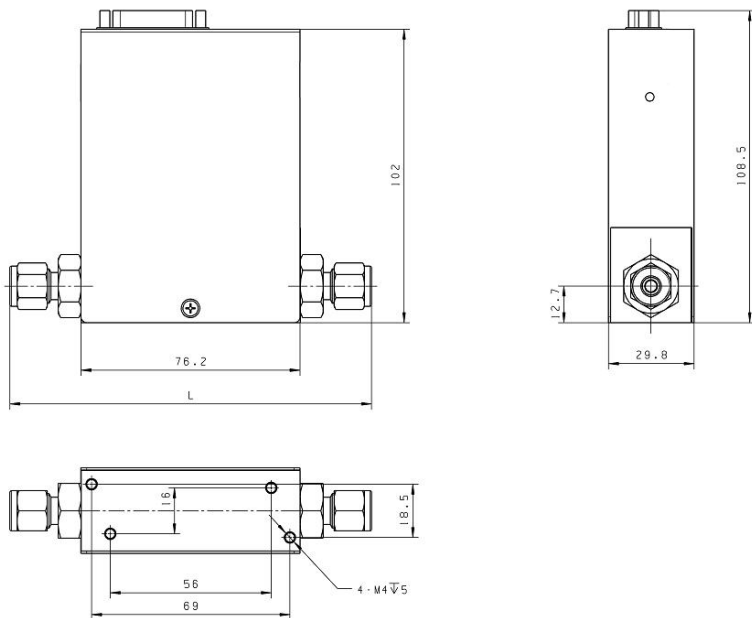


Figure 5-1 S500 Series MFC (MFM) Shape and Installation Dimensions

Table 5-1 Fittings and Dimensions

Fittings	L	W	T	H	D
4HM:1/4inch HPI SWL Fitting	127	76.2	29.8	102	12.7
4IS:1/4inch SWAGELOK Fitting	127	76.2	29.8	102	12.7
6MHM:Φ6mm HPI SWL Fitting	127	76.2	29.8	102	12.7
6MS:Φ6mm SWAGELOK Fitting	127	76.2	29.8	102	12.7
4CR:1/4inch VCR	124	76.2	29.8	102	12.7

Note: the height indicated in the figure does not include the cable plug.

5.3 Fittings

According to different needs, users can choose:

1. Swagelok: a. $\Phi 6\text{mm}$, b. $\Phi 10\text{mm}$, c. $\Phi 1/4''$, d. others.

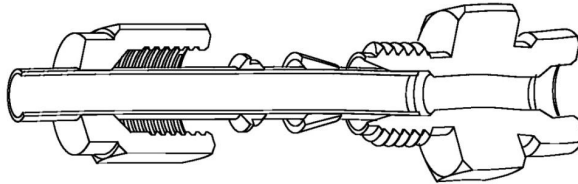


Figure 5-2 Swagelok Connection

2. VCR: a. $\Phi 1/4''$, b. $\Phi 3/8''$.

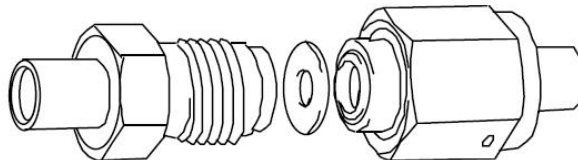


Figure 5-3 VCR Connection

5.4 Circuit Connection

5.4.1 Electric Connectors' Pin Assignment of $\pm 15\text{VDC}$ Power Supply (D-sub15/Male)

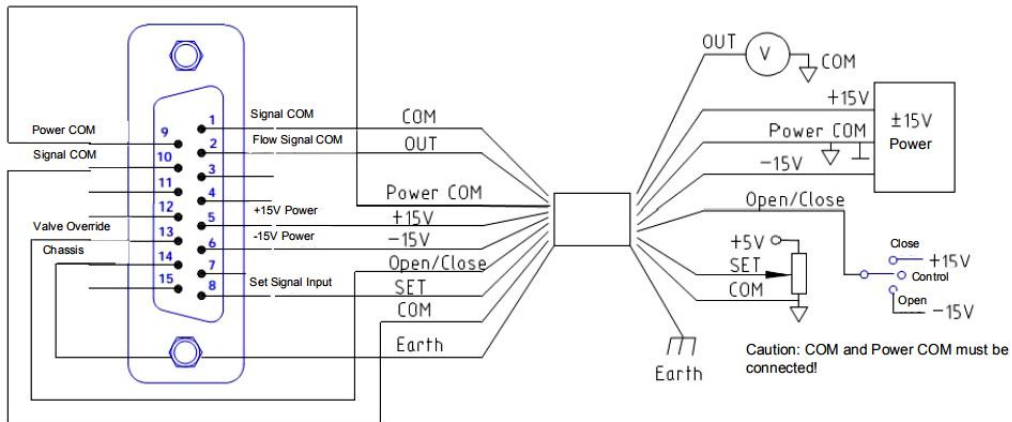


Figure 5-4 Pin Assignment and Wiring Diagram of $\pm 15\text{VDC}$ Power Supply (D-sub15/Male)

Table 5-2 Pin Assignment of ±15VDC Power Supply (D-sub15/Male)

Pin	Function
1	Signal COM
2	Flow Signal Output (0-5V OUT, load capability $\leq 3\text{mA}$)
3	Not Connected
4	Not Connected
5	+15V Power ($\leq 100\text{mA}$)
6	-15V Power ($\leq 150\text{mA}$)
7	Not Connected
8	Set Signal Input (0-5V IN, input impedance $> 1\text{M}\Omega$)
9	Power COM
10	Signal COM
11	Not Connected
12	Not Connected
13	Valve override (N.C. \rightarrow control, +15V \rightarrow close, -15V \rightarrow open)
14	Chassis (Earth)
15	Not Connected

connected with each other to ensure proper operations.

"Chassis" at 14 pin on a male socket and 8pin on a female socket are grounding lines that connect to the metal base of flow meter by the in-house series-wound capacitance, and also should be connected to the control cable shielding mesh to achieve shield. Users should take effective measures to shield and separate the DC power, and thus prevent the interference signal getting into MFC (MFM) system.

The " Chassis" and the "Power COM" should be connected directly with each other or through a large capacitor to achieve point grounding (the existence of multiple ground should be avoided to prevent the formation of ground loops). Thus zero and earth achieve equipotential, and this is also one of the effective methods to resist interference.

6. Operation

The S500 MFC (MFM) needs to work coordinate with a Flow Display Instrument, computer or PLC. When coordinate with MT-51 and MT-52 series Digital Readout and Control Unit, the S500 MFC (MFM) operating methods and steps are as follows:

6.1 Preparation before Power On

6.1.1 Connect the MFC(MFM) and the Flow Display Instrument using cable lines provided by our company.

6.1.2 Choose the source of the setting signal. The signal source interface locates at the back plank of the Flow Display Instrument. If the interface is connected with the Flow Display Instrument, we can obtain the setting signal from the Flow Display Instrument. If we want to get the setting signal from other equipment, the interface needs to connect with corresponding equipment. (For more detail, please see Flow Display Instrument manuals)

6.1.3 Connect to gas circuit according to the direction indicated on the MFC (MFM) case. Please ensure the pressure difference of inlet and outlet is within the working pressure range.

6.2 Power On

In order to ensure the accuracy of measurement, please warm up for 30 minutes before turning on gas supply.

For example, when power is on, switch the valve override to "Close" and set the Flow Display Instrument to zero. When the zero is stable, transfer to "Control", and then adjust flow rate, so that actual flow rate will track and change with the set value.

6.3 Open and Close

When switch to the “open” state, the valve opening will be maximum. If there exists pressure difference between upstream and downstream, there will be a lot of gas going through the pipeline. “Open” function can be used to purge or clean residual gas in the pipeline.

After purging, the MFC should be switched to "Close" before normal "Control" operation can be carried out. The "Control" state cannot be directly transferred to, because thus it will not guarantee the normal valve control function.

When switch to "Close" state, the valve will shut off, and no gas will flow through the MFC.

6.4 Valve Control

When switch to “control” state, users could control gas flow rate by changing the set value.

6.5 External Valve Override

“Valve override” connects to + 15V high level can make valve “close”;

“Valve override” connects to - 15V low level can make valve “open”;

“Valve override” suspends, the valve is in the “control” state.

(For more detail, please see Flow Display Instrument manuals)

6.6 Shut off

After shutting off the power supply, flow will be cut off automatically. It is recommended to shut off the gas supply before power off.

7. Caution

7.1 Gas Flow Direction

Gas should flow in the direction indicated by the direction arrow on the MFC (MFM) case, and cannot hold against. Otherwise the MFC (MFM) will not work or be damaged.

7.2 Working Medium

This product must be guarded against liquid and oil, and cannot be used in the liquid medium. The working medium can only be gas.

The gas must be clean and dry, free of particles and moisture. Otherwise, filters and dryers should be installed in the pipeline to meet the requirements. Keep the pipeline clean, once polluted, it will seriously affect the accuracy.

The type of gas used must be consistent with the gas specified on the nameplate of the MFC (MFM). If the type of gas is changed, it may cause corrosion, inaccuracy and the controller may work improperly.

7.3 Pressure Resistance and Operating Pressure Range

Excessive pressure beyond the controller's specification will lead to serious consequence of leakage and even burst!

It is necessary to keep the working pressure difference between the inlet and outlet of the MFC (MFM) within the specified range. Otherwise, controlling and measuring may be inaccurate or even fail. Excessive pressure difference may result in excessive actual gas flow or valve failing to close. Under too low pressure difference, the actual gas flow rate may be smaller.

Pay attention to the influence of internal resistance of pipeline and gas source on working pressure difference. Especially take pipeline diameter and gas source pressure into consideration when using MFC (MFM) with large flow rate.

When connecting pipelines, avoid air pollution and obstruction. The connection should be compact, and has no gas escaping. The nozzle fasteners must be tightened with tools to prevent bursting and leakage.

7.4 Mounting Orientation

The MFC (MFM) can be installed in any position with little effect on gas flow rate. It breaks the limitation that the traditional MFC (MFM) must be installed in horizontal.

7.5 Valve Sealing

The control valve is an electromagnetic regulating valve, which can not be used as a cut-off valve, because the cut-off sealing function is not guaranteed.

If the user has the requirement of cut-off seal, the cut-off valve should be configured separately.

7.6 Corrosive Gas and Organic Solvent Gas

This controller can be used to control general corrosive gases, but it requires users to ensure that the system has low leakage, no condensation reaction, no particles and no water vapor, the MFC (MFM) is cleaned timely and used properly.

The material of MFC (MFM) channel is 316L (022Cr17Ni12Mo2), which is a kind of corrosion resistant stainless steel, and the sealing material is fluorine rubber and other corrosion resistant materials.

If users use the MFC (MFM) for strong corrosive gases and organic solvent gases, please declare at the time of ordering, so that sealing materials can be changed accordingly.

7.7 “Open” State Flow Rate

In “open” state, the flow rate could reach up to several or even more than ten times of the full scale flow rate. In this state, and the output display is not accurate. It can also occur that output flow rate decreases while the real flow rate increases. This

phenomena is due to the characteristics of the thermal mass flow controller and it is natural. Users can choose not to switch to “open” state if they do not expect it.

It is not recommended to set a MFC in "Open" state for a long time, or use it as a MFM or normally open valve. In “open” state, the valve opening is the maximum and there will be a large current flowing through the solenoid valve, electrical circuit and so on, so the thermal aging damage is accelerated.

7.8 Flow Control

Do not use $\pm 15V$ power Off / On to control the valve Off / On. Be sure to warm up for 30 minutes by power supply and turn on gas supply before setting input control signal to control the flow rate. Only in this operating condition can the accuracy of measurement and response characteristics be guaranteed.

7.9 Non-professionals Cannot Open the Case

If the MFC (MFM) occurs internal faults, it should be repaired by professional maintenance personnel or sent back to our factory for repair.

To avoid accidental damage, live plug-and-pull connections are prohibited.

8. Trouble Shooting

8.1 General Inspection:

When the product is newly installed or malfunction occurs, general inspection should be carried out.

- (1) Check the gas supply pressure, check if the gas line is obstructed, and check the pressure difference.
- (2) Check whether the wiring is correct before power on, including whether all ground wires are connected properly. Warning: Wrong power connection will burn the product .
- (3) Turn on power, open the plug cover, and check the following point voltages: power voltage, set voltage , output signal voltage, zero-voltage, valve voltage, and all ground voltages.

8.2 Typical Trouble

No.	TROUBLE	CAUSE	TREATMENT
1	There is no gas flow and output voltage is 0V.	1.1 The MFC is switched to "Close".	Turn the MFC to "Control" or "Open" state.
		1.2 No setting signal.	Check "In/Out" switch and set potentiometer. Measure the set voltage.
		1.3 Pipeline is blocked or the pressure difference is small.	Check gas supply pressure, make sure that gas line is not blocked or leaking.
		1.4 The filter is blocked	Replace the filter.
		1.5 Internal failure.	Check valve voltage. If there is no valve voltage, repair circuit board. If there exists valve voltage, replace the valve.
		1.6 Internal channel trouble.	Check the channel.
2	There is no gas flow and output voltage is not 0V.	2.1 Zero offset.	Cut off "External Zero Adjustment", and adjust the zero potentiometer.
		2.2 Power supply fails.	Check input / output voltages ($\pm 15\text{VDC}$, $+5\text{VDC}$).
		2.3 Abnormal cable connection.	Check whether the cable connection is open or short.
		2.4 Internal circuit fails.	Replace sensor or circuit board.

No.	TROUBLE	CAUSE	TREATMENT
3	There is flow to control, but there is no output voltage.	3.1 Flow signal line is cut off.	Check the flow signal relative to zero-voltage.
		3.2 Flow Display Instrument fails.	Measure the flow signal to zero-voltage at the plug of the display device. If there exists voltage, the Flow Display Instrument is defective.
		3.3 Internal circuit fails.	Measure the flow signal to zero-voltage at the plug of the product. If there is no voltage, the circuit is defective.
4	There is gas flowing in the MFC, and there is out display, but the flow cannot be controlled.	4.1 Earth wire is abnormal.	Check if all of the earth wires are connected right and whether the circuit is open.
		4.2 The set signal can not be adjusted.	Check if the set signal can be adjusted, and check whether wires are connected right.
		4.3 Zero point is grossly out of calibration .	Cut off "External Zero Adjustment" and turn off zero adjusting.
		4.4 Strong electromagnetic interference.	Decrease electromagnetic interference.
		4.5 Internal circuit fails.	Replace circuit board.

No.	TROUBLE	CAUSE	TREATMENT
5	Valve leaks greatly.	5.1 Zero offset.	Cut off "External Zero Adjustment", Adjust the zero potentiometer to zero or slightly positive bias.
		5.2 Set voltage cannot be adjusted to zero.	The Setting potentiometer may be damaged.
		5.3 Closing signal is abnormal.	Switch to "Control" and "Close" separately, and check if the voltages are normal.
		5.4 The pressure difference between inlet and outlet is beyond rating.	Reduce pressure difference.
		5.5 Valve is contaminated.	Clean valve and replace sealing parts.
		5.6 Internal failure.	Replace circuit board or re-adjust the valve.
6	Gas control is unstable.	6.1 Gas source's pressure is unstable.	Steady the pressure of the gas source, and make the pressure difference between the inlet and outlet within the prescribed pressure range.
		6.2 Large internal resistance.	Lessen internal resistance. Products with large flow rate need pipelines with larger diameters to assure gas supply capacity.

No.	TROUBLE	CAUSE	TREATMENT
		6.3 Setting signal is unsteady.	Measure setting signal stability with an oscilloscope. Measure the stability of power supply value and the relative value to zero-voltage.
		6.4 External zero signal is unsteady.	Cut off "External Zero Adjustment".
		6.5 Internal failure.	Replace the circuit board, clean channel, and repair the valve.
7	There is flow but no out display, and the flow cannot be controlled.	7.1 Sensor fails.	Repair sensor and circuit, clean sensor channels.
8	Flow control is disturbed by high frequency interference.	8.1 Problems with earth wires, zero wires or chassis grounding.	Check grounding or insulation isolation, and ensure one point grounding.
		8.2 Signal lines fail.	Check signal lines and zero-voltage, and prevent interference.
		8.3 Space electromagnetic field interference.	Keep the product away from interference sources. Shield and isolate the product.

No.	TROUBLE	CAUSE	TREATMENT
9	Abnormal flow control.	9.1 Zero offset.	Cut off "External Zero Adjustment", and adjust the zero potentiometer.
		9.2 Power supply trouble.	Measure the voltage of "power" pin to zero-voltage at the plug.
		9.3 Pipeline or the pressure difference is abnormal.	Check gas supply pressure and pressure difference. Check whether the gas line is plugged, polluted, or leaking.
		9.4 Setting signal is abnormal.	Measure setting signal voltage.
		9.5 Internal failure.	Replace sensor and circuit.
10	The actual flow rate deviates too much from the displayed value.	10.1 The product and the Flow Display Instrument have different ranges or units.	Match the product with the Flow Display Instrument. Make sure the setting and display are in the right range (4~20mA, 1~5V, 0~5V).
		10.2 Zero offset	Adjust zero potentiometer.
		10.3 Gas source or pressure difference is abnormal.	Check gas supply pressure and the pressure difference between inlet and outlet.
		10.4 The product is contaminated.	Clean sensor channels.

No.	TROUBLE	CAUSE	TREATMENT
11	There is no gas flow, and zero is unstable or slowly drifting.	11.1 "External Zero Adjustment" is unstable.	Cut off "External Zero Adjustment".
		11.2 Internal failure.	Repair or replace sensor and circuit.

[Warning] Products with internal failure should be repaired by professional maintenance personnel or sent back to our factory for repair.

Appendix I: Calibration and Conversion

Products are calibrated with nitrogen (N₂) before leaving the factory.

Mass flow rate units: mL/ min (SCCM industry standard) ;

L/ min (SLM industry standard).

Standard state: Gas Temperature: 273.15K (0°C);

Pressure: 101325Pa (1atm)

When leaving the factory, the designated gas is marked on the product. Indicated flow rate represents the designated gas flow rate in standard conditions. The formula for calibration with nitrogen (N₂) when leaving the factory is:

Indicated flow rate = calibrated nitrogen (N₂) flow rate × conversion coefficient of the designated gas.

When users use other gases, they can also convert through the conversion coefficient in the appendix by themselves.

S500 Conversion Factor

No.	Gas Name	Formula	Molecular Weight	Conversion Factor (C.F.)
1	Air	Mixture	28.96	1.000
2	Argon	Ar	39.95	1.389

3	Hexafluoroethane	C ₂ F ₆	138.00	0.250
4	Acetylene	C ₂ H ₂	26.04	0.628
5	Ethylene	C ₂ H ₄	28.05	0.633
6	Ethane	C ₂ H ₆	30.07	0.516
7	Octafluoropropane	C ₃ F ₈	188.00	0.179
8	Propylene	C ₃ H ₆	42.08	0.417
9	Propane	C ₃ H ₈	44.10	0.362
10	Octafluorocyclobutane	C ₄ F ₈	200.00	0.170
11	Carbon Tetrafluoride	CF ₄	88.00	0.439
12	Methane	CH ₄	16.04	0.797
13	Chlorine	Cl ₂	70.91	0.830
14	Carbon Monoxide	CO	28.01	0.998
15	Carbon Dioxide	CO ₂	44.01	0.749
16	Hydrogen	H ₂	2.02	1.050
17	Hydrogen Chloride	HCl	36.46	0.993
18	Helium	He	4.00	1.447


19	I-Isobutane	i-C ₄ H ₁₀	58.12	0.273
20	I-Isobutene	i-C ₄ H ₈	56.11	0.303
21	Krypton	Kr	83.80	1.370
22	Nitrogen	N ₂	28.01	1.000
23	Nitrous Oxide	N ₂ O	44.01	0.722
24	N-butane	n-C ₄ H ₁₀	58.12	0.270
25	Neon	Ne	20.18	1.406
26	Nitrogen Trifluoride	NF ₃	71.00	0.508
27	Ammonia	NH ₃	17.03	0.803
28	Nitric Oxide	NO	30.01	0.975
29	Oxygen	O ₂	32.00	0.981
30	Sulfur Hexafluoride	SF ₆	146.10	0.272
31	Silicon Tetrafluoride	SiF ₄	104.10	0.369
32	Silane	SiH ₄	32.12	0.638
33	Sulfur Dioxide	SO ₂	64.06	0.698
34	Xenon	Xe	131.30	1.359

Appendix II: RoHS

标记的意义

Meaning of Marking

マークの意味

	<p>本标记适用在中华人民共和国销售电器电子产品，标记中央的数字表示环境保护使用期限的年数。（不是表示产品质量保证期间。）只要遵守这个产品有关的安全和使用注意事项，从制造日开始算起在这个年限内，不会给环境污染、人体和财产带来严重的影响。请不要随意废弃本电器电子产品。</p>
	<p>This marking is applied to electric and electronic products sold in the People's Republic of China. The figure at the center of the marking indicates the environmental protection use period in years. (It does not indicate a product guarantee period.) It guarantees that the product will not cause environment pollution nor serious influence on human body and property within the period of the indicated years which is counted from the date of manufacture as far as the safety and usage precautions for the product are observed. Do not throw away this product without any good reason.</p>
	<p>本マークは、中華人民共和国で販売される電気電子製品に適用され、マークの中央の数字は環境保護使用期限の年数を意味します（製品の品質保証期間を示すものではありません）。この製品に関する安全や使用上の注意をお守り頂く限り、製造日から起算するこの年限内では、環境汚染や人体や財産に深刻な影響を及ぼすことはありません。本製品をみだりに廃棄しないでください。</p>

产品中有害物质的名称及含量

Name and amount of hazardous substance used in a product

部件名称 Unit name	有害物质 Hazardous substance					
	铅 Lead (Pb)	汞 Mercury (Hg)	镉 Cadmium (Cd)	六价铬 Hexavalent chromium (Cr (VI))	多溴联苯 Polybromo- biphenyl (PBB)	多溴二苯醚 Polybromo- diphenyl ether (PBDE)
外壳 Case	○	○	○	○	○	○
机械零部件 Machine parts	×	×	×	×	×	×
电路板 Printed board	×	×	×	×	×	×

本表格依据 SJ/T 11364 的规定编制。

This form is prepared in accordance with SJ / T 11364.

○：表示该有害物质在该部件所有均质材料中的含量均在 GB/T 26572 规定的限量要求以下。

Denotes that the amount of the hazardous substance contained in all of the homogeneous materials used in the component is below the limit on the acceptable amount stipulated in the GB/T 26572.

×：表示该有害物质至少在该部件的某一均质材料中的含量超出 GB/T 26572 规定的限量要求。

Denotes that the amount of the hazardous substance contained in any of the homogeneous materials used in the component is above the limit on the acceptable amount stipulated in the GB/T 26572.

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HORIBA Precision Instruments (Beijing) Co.,Ltd.

Address: No.40 Beiyuan Road,Chaoyang district,Beijing China

Postcode: 100012

Tel: +86 10 84929402/04/52/53

Fax: +86 10 84927216

E-Mail: sales@horibaprecision.com

Website: <http://www.horibaprecision.com>