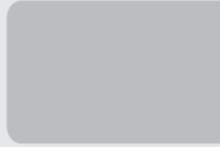
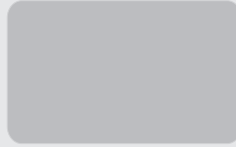
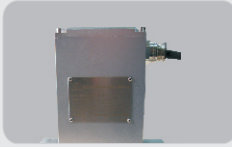
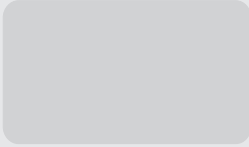
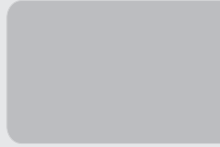
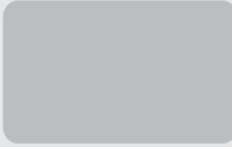
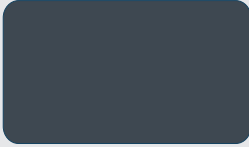




Siargo Ltd.



# Model MF5000

SIARGO MEMS FLOW SENSOR PRODUCTS

**MEMS Mass Flow Meter**

VB.5

## **RESTRICTION ON USE**

---

1. This meter is manufactured for general purpose industrial applications for flow measurements. Do not alter any hardware and software of the product. Any modifications might cause damage and unexpected events.
2. All practices for electronic device safety should apply.
3. Do not use this product in any environments where human safety may be at risk.
4. Only a qualified person from Siargo or a person who is accredited by Siargo can perform troubleshooting services to the product, Siargo is otherwise not liable for any consequences thereafter.

## **SAFETY PRECAUTION**

---

1. The product can be utilized to measure and/or monitor in-line mass flow rate of any clean, dry and preferably constant concentration gases in industrial applications. For other special gases or variable concentration gases, the product may not function properly or even can be damaged. Please contact Siargo for further information.
2. The operational environments of the product are illustrated in the section of product specifications. If the product is used for other circumstances, the product may not function properly or even can be damaged.
3. Operation, installation, storage, and maintenance of the product must strictly follow the instructions illustrated in this user manual. Otherwise, unpredicted damage and even injuries or other severe situations could be induced. All the installation, storage, and maintenance of the product must be performed by skilled workers. This user manual should be placed near the product for easy access.
4. Before using the product, the user should read this user manual completely and in details so that the user is well understand all the important instructions.  
It is recommended that the product should be re - calibrated and serviced in every two years or at a time of desire.

## Contents

---

|                                                             |   |
|-------------------------------------------------------------|---|
| RESTRICTION ON USE .....                                    | 1 |
| SAFETY PRECAUTION .....                                     | 1 |
| Contents .....                                              | 2 |
| 1 Overview .....                                            | 3 |
| 1.1 Siargo's MEMS Thermal Mass Flow Sensor Technology ..... | 3 |
| 1.2 Working Principle .....                                 | 3 |
| 1.3 Volume Flow vs. Mass Flow .....                         | 3 |
| 2 Models and Selection .....                                | 4 |
| 2.1 Product Selection .....                                 | 4 |
| 2.2 Physical Dimensions .....                               | 4 |
| 2.3 Specifications .....                                    | 4 |
| 2.4 Flow Range .....                                        | 5 |
| 3 Installation .....                                        | 5 |
| 3.1 Description of Parts in Package .....                   | 5 |
| 3.2 Installation and User Interface .....                   | 5 |
| 3.3 Cautions for the Installation .....                     | 6 |
| 3.4 RS485 Data Communication Protocol .....                 | 6 |
| 3.5 4~20mA output .....                                     | 7 |
| 3.6 Pulse output .....                                      | 7 |
| 3.7 Automatic stored data .....                             | 7 |
| 4 Safety and Maintenance .....                              | 7 |
| 4.1 Wetted Materials and Compatibility .....                | 7 |
| 4.2 Safety Precautions .....                                | 7 |
| 4.3 Maintenance .....                                       | 7 |
| 5 Warranty .....                                            | 8 |
| 6 Customer Service and Order information .....              | 8 |

## **1. Overview**

### **1.1 Siargo's MEMS Thermal Mass Flow Sensor Technology**

Siargo's proprietary MF series MEMS mass flow sensor technology provides accurate in-line flow measurement with the availability of customer-specified packages. The sensor is manufactured using Siargo's unique MEMS process that ensures high reliability. The sensors can measure air flow as low as 0.01m/sec and as high as 75m/sec. Depending on the applications, the sensors can be used to measure mass flow, volume flow or media flow speed. The specially designed circuit provides amplification as well as small signal processing capability that yields a high accuracy.

Siargo's flow sensors utilize the same thermal mass flow technology using energy balance design. But unlike the other MEMS flow sensing technologies, Siargo's flow sensors have multiple sensors integrated on a single silicon chip. The surface of the chip is passivated by ceramic materials with high thermal conductivity to ensure the sensor's sensitivity. It also enhances the reliability by avoiding the direct contact among the sensors and the flow media. Also, Siargo's sensor design makes it easy to package the sensor in a variety of ways, which significantly expands the applications of the technology.

### **1.2 Working Principle**

Siargo's proprietary flow meter can measure gas flow in large pipes. The MEMS flow sensors are integrated with a micro heater, local temperature sensors and environmental temperature sensor onto a single chip. If no flow media passes through the MEMS sensor chip, a stable temperature field (distribution) around the micro heater is maintained. When the flow media passes through the sensor chip, the temperature field will be forced to change as the flow media will carry away the heat causing the redistribution and variation of local temperature. Such a change of the local temperature will depend on the media's mass as well as the media's flow speed. The sensors integrated on the silicon chip will then measure such temperature redistribution, and the carefully designed signal process circuits and the algorithm provided by the smart control software can then precisely measure the actual media mass flow speed. This mass flow speed can then be translated into volume speed as well as accumulated volume media consumption.

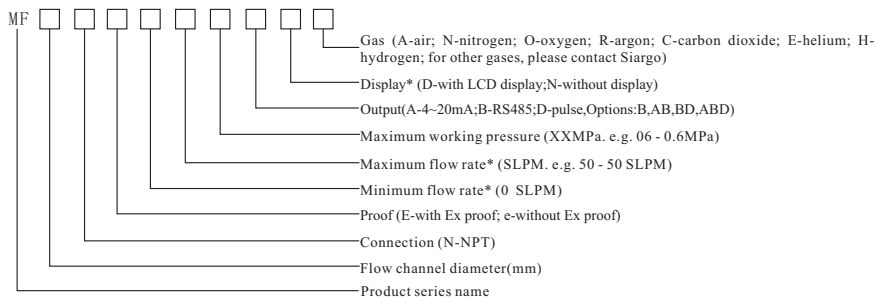
### **1.3 Volume Flow vs. Mass Flow**

For the gas metrology using mechanical meters, the volume flow rate is adopted. The volume rate nevertheless may not be a good indicator at industrial processing technology as the processing gas quality depends vastly on the mass, not on the volume. In addition, the volume of gas will change with different environment temperature and pressure. With the MEMS thermal mass flow meter, it is possible to measure the "quality" (mass) of the gas directly, and at real time. The mass flow rate will not depend on temperature and pressure. Therefore an accurate measurement of the actual mass consumption becomes a reality. In addition, the conversion of the mass rate to the volume rate is readily available by referencing a standard condition such as 20°C and 101.325 kPa.

## 2. Models and Selection

### 2.1 Product Selection

In addition to the models listed, we can also provide customized products that will be tailored to customers' very needs. For further information, please contact manufacturer. The meters are made by referencing to: ISO14511;



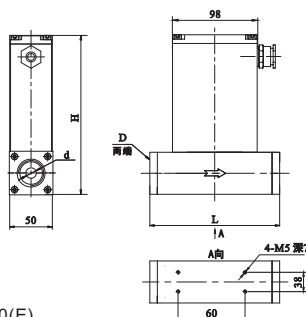
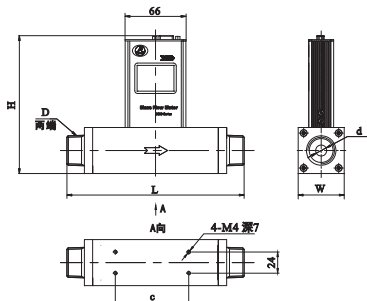
\* There is flow rate number only for unit SLPM. If other unit is selected, there must be flow rate number with unit together.

\*\* Only N can be selected for with Ex proof model, that means, there is no display for with Ex proof model.

### 2.2 Physical Dimensions

| Model     | DN (mm) | Connection (NPT-M) | L     | H   | W  | d   | c  |
|-----------|---------|--------------------|-------|-----|----|-----|----|
| MF5003(e) | 3.0     | 1/8"               | 96    | 125 | 35 | Φ3  | 36 |
| MF5006(e) | 6.0     | 1/4"               | 104   | 127 | 35 | Φ6  | 36 |
| MF5008(e) | 8.0     | 3/8"               | 106   | 134 | 35 | Φ8  | 50 |
| MF5012(e) | 12.0    | 1/2"               | 142   | 137 | 40 | Φ12 | 50 |
| MF5019(e) | 19.0    | 3/4"               | 182.5 | 150 | 40 | Φ19 | 70 |

| Model     | DN (mm) | Connection (NPT-F) | L   | H   | d   |
|-----------|---------|--------------------|-----|-----|-----|
| MF5003(E) | 3.0     | 1/8"               | 152 | 181 | Φ3  |
| MF5006(E) | 6.0     | 1/4"               | 152 | 181 | Φ6  |
| MF5008(E) | 8.0     | 3/8"               | 152 | 181 | Φ8  |
| MF5012(E) | 12.0    | 1/2"               | 162 | 185 | Φ12 |
| MF5019(E) | 19.0    | 3/4"               | 187 | 185 | Φ19 |



### 2.3 Specifications

|                     |                  |
|---------------------|------------------|
| Accuracy            | ± (1.5+0.5FS)%;  |
| Working Temperature | -20~65°C;        |
| Working Pressure    | <1.5 MPa;        |
| Humidity            | ≤95%RH;          |
| Power supply        | 12~24 VDC, 50mA; |

|                       |                                               |
|-----------------------|-----------------------------------------------|
| Communication         | 4~20mA/RS485/Pulse                            |
| Mechanical Connection | NPT;                                          |
| Display               | Mass flow, accumulated mass flow;             |
| Calibration Air       | 20°C, 101.325 kPa (other gases upon request); |

## 2.4 Flow Range

| Model  | DN   | Connection | Flow Range* |         |           |           |
|--------|------|------------|-------------|---------|-----------|-----------|
|        |      |            | sccm        | SLPM    | SCFM      | SCMH      |
| MF5003 | 3.0  | 1/8"       | 150~15000   | 0.15~15 |           |           |
| MF5006 | 6.0  | 1/4"       |             | 0.5~50  | 0.02~2    | 0.03~3    |
| MF5008 | 8.0  | 3/8"       |             | 1.2~120 | 0.042~4.2 | 0.072~7.2 |
| MF5012 | 12.0 | 1/2"       |             | 3~300   | 0.1~10    | 0.18~18   |
| MF5019 | 19.0 | 3/4"       |             | 8~800   | 0.28~28   | 0.48~48   |

\*: Customer specified flow range and flow unit can be accommodated.  
For CO<sub>2</sub>, flow range are 0.15~10, 0.5~40, 1.2~80, 3~200 and 8~600 SLPM.

## 3. Installation

### 3.1 Description of Parts in Package

When unpacking your meter from the shipping container, three items should be found in the package:

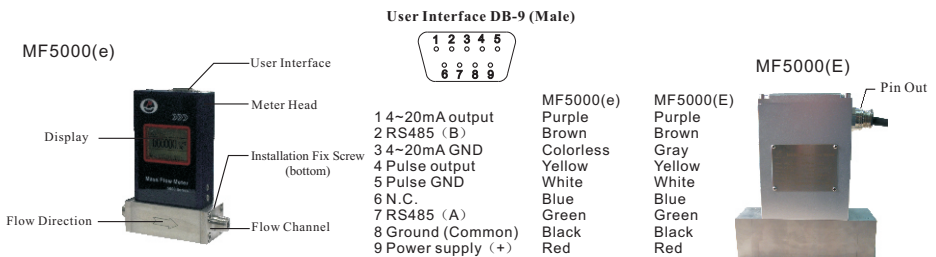
- The flow meter product
- This user manual
- Quality certificate and Warranty

Upon opening the package, the product physical integrity should be inspected to ensure no visual damage. If any items are missing or any physical damages are observed, please contact the meter manufacturer and/or the shipping agents to place a return/exchange or to identify the cause during the transit. If you are uncertain of the installation or have any questions about the shipment, please also contact the manufacturer or the shipping agents before further process.

### 3.2 Installation and User Interface

The product at the time of shipment is fully inspected for product quality and meets all safety requirements. Additional safety measures during the installation should be applied. This includes, but is not limited to leakage verification procedures, standard EDS (electrostatic discharge) precautions, DC voltage precautions, and heavy duty precautions. Other tasks such as calibration, part replacement, repair, and maintenance must only be performed by trained personnel. Upon requests, manufacturer will provide necessary technical support and/or training of the personnel.

Do not open the product cover or alter any part of the product. Any such actions will forfeit the terms of the warranty and cause the liability to any damages thereafter.



**Notice:** Upon open the package, if any component listed above is missing or any visible mechanical damage is found, please contact supplier or distributors immediately. For additional assistance of installation, please contact supplier or customer service.



The installation must observe the following steps:

1. Make sure there are no any foreign materials in the pipeline.
2. Make sure there the seal gaskets are properly placed without interfering with the flow channel.
3. Connect the meter/sensor to the pipeline using proper tools to fasten the screws.
4. Initialization after power on, the display should show: Only for MF5000(e)

#### AUTO CHECKING

- 1) CRYSTAL OK
- 2) ADC OK
- 3) EEPROM OK
- 4) RTC OK

5. After initialization, the LCD will display Mass flow in the upper row and accumulated mass flow (ACC.) in the lower row. Only for MF5000(e)

**Note:** because this flow meter is highly sensitive, only when the pipeline has absolutely no flow, the display will be zero. To ensure the offset is working properly, make sure the pipeline has NO flow.

6. Offset detection.

For certain models, when apply to gases different from the calibration gas, proper reset of the offset is necessary for the meter to work. In this case, Open upstream and downstream valves, make sure the gas (to be measured) is fully filled into the meter and any other gases have been completely replaced. Wait for about 30 sec, close all of the valves, initializing the meter using the Siargo Gas Meter User Interface software or the handheld device (provided separately, please contact manufacturer for details), to reset the offset.

### 3.3 Cautions for the Installation

- a). Welding the pipe while the meter is installed is prohibited;
- b). Any foreign materials in the pipeline after installation may cause irreversible damage;
- c). Seal gaskets must not block flow channel otherwise accuracy cannot be maintained;
- d). The meter should be properly grounded via the electrical connection;
- e). After installation, severe force applied to the meter may cause damage;
- f). Severe vibration or very strong magnetic field may cause malfunction;

### 3.4 RS485 Data Communication Protocol

For purposes of computer control and networking, the RS485 is used for communication with the following preferred settings:

Baud rate (Bits per second): 9600  
 Date bits: 8  
 Stop bits: 1  
 Parity: None  
 Flow control: None

#### Operation Mode:

- i). Send 0x9d to the meter and return with 0x9d;
- ii). Send 0x54 to the meter and return with 0x54;

The interval time between two bytes sent to the sensor must be longer than 5ms;

The sensor will be at Operation Mode at which the data from the meter will be sent via RS485 in an interval of one second.

The data are in the following format:

**S=vvvvv\nF=ffffff\nA=aaaaaaa\n;\n**

V=vvvvv Voltage code;

F=ffffff Mass flow rate (Equal to fff.fff SLPM);

A=aaaaaaaaa Accumulated flow (Equal to aaaaaaa.aaa SL).

#### User Mode:

- i). Send 0x9d to the meter and return with 0x9d;
- ii). Send 0x00 to the meter and return with 0x00;

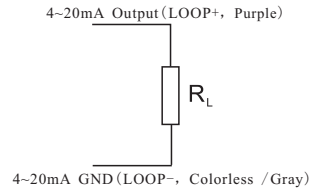
The interval time between two bytes sent to the sensor must be longer than 5ms;

Then the sensor will be at User Mode at which the data will not be sent via RS485 by the meter.

### 3.5 4~20mA output

The resistance loop should follow the relationship:

$$R_L (\text{max}) = 450\Omega$$



### 3.6 Pulse output

The meter supply pulse output in form of even square wave. The even square wave is composed of 3.3V signal high and 0V signal low, and every pulse equal to 1SL.

### 3.7 Automatic stored data

The meter can automatically record mass flow rate, accumulated flow rate and time. To retrieve these data, please contact manufacturer for the necessary user interface software. The data store interval can be customized and please contact manufacturer for further information.

## 4. Safety and Maintenance

### 4.1 Wetted Materials and Compatibility

The meter body and pipe are made of 304 stainless steel. Sensors comprise of silicon, silicon nitride and silicon dioxide and the sensor surfaces are passivated with silicon nitride and silicon dioxide. The electronic sealing is provided by RTV (room temperature vulcanizing) silicone sealant WR-704 composed of  $\text{HOCH}_3(\text{SiO})_n\text{CH}_3\text{H}$ .

### 4.2 Compliance Statement

All components of this product are RoHS compliant. The product fully complies with CE norm EN61000-6-1 through 61000-6-4, EN50081-2 through 50082-2 and EMC directive 89/336/EEC.

### 4.3 Safety Precautions

The product is designed for use with general purpose gases such as air and nitrogen. It is advised that the products are best used for non-explosive clean gases. The meter cannot be used for gas metrology of fluoride or fluoride containing gases. For updates of the product certification information, please contact manufacturer or visit [www.Siargo.com](http://www.Siargo.com). Use for other gases such as extreme corrosive and toxic may cause the product malfunctioning or even severe damages. The product sealing is ensured to work under working pressure of 1.5MPa and is leakage proof before the shipment. But cautions and further leakage test are important at installation as well since any leakage could cause severe safety issue. The power supply for this product is 12~24 VDC, all precautions and measures for electrical voltage handling must apply.

**Attention:** any alternation and/or improper use of the product without the permission of the manufacturer can cause unpredicted damages and even injuries or other severe situations. Siargo Ltd. or any of its employees, subsidiaries shall not be hold and indemnified against such consequences due to such circumstances via improper use of the product.

### 4.4 Maintenance

**Attention:** without prior permission of the manufacturer, please do not attempt to alter any parts of the product as it may cause unrecoverable damages. If there are questions or doubts, please contact manufacturer immediately before further actions. Please ensure the DC power is off before disassembling the meter.

All maintenance of the meter should be done by trained and certified personnel by Siargo Ltd.



Siargo Ltd.

## MF5000 Series User Manual (VB.5)

### 5. Warranty

Siargo warrants the products sold hereunder, properly used and properly installed under normal circumstances and service as described in the user's manual, shall be free from faulty materials or workmanship for 180 days for OEM products, and 365 days for non-OEM products from the date of shipment. This warranty period is inclusive of any statutory warranty. Any repair or replacement serviced product shall bear the same terms in this warranty.

Siargo makes no other warranty, expressed or implied and assumes no liability for any special or incidental damage or charges, including but not limited to any damages or charges due to installation, dismantling, reinstallation or any other consequential or indirect damages of any kind. To the extent permitted by Law, the exclusive remedy of the user or purchaser, and the limit of Siargo's liability for any and all losses, injuries or damages concerning the products including claims based on contract, negligence, tort, strictly liability or otherwise shall be the return of products to Siargo, and upon verification by Siargo to prove to be defective, at its sole option, to refund, repair or replacement of the products. No Action, regardless of form, may be brought against Siargo more than 365 days after a cause of action has accrued. The products returned under warranty to Siargo shall be at user or purchaser's risk of loss, and will be returned, if at all, at Siargo's risk of loss. Purchasers or users are deemed to have accepted this limitation of warranty and liability, which contains the complete and exclusive limited warranty of Siargo, and it shall not be amended, modified or its terms waived except by Siargo's sole action.

This warranty is subject to the following exclusions:

- a). Products that have been altered, modified or have been subject to unusual physical or electrical circumstances indicated but not limited to those stated in the user's manual or any other actions which cannot be deemed as proper use of the products
- b). Siargo does not provide any warranty on finished goods manufactured by others. Only the original manufacturer's warranty applies.

### 6. Customer Service and Order information

Siargo Ltd. is making every effort to ensure the quality of the products. In case of questions, and or product supports, please contact customer service at the address listed below. We will respond your request in a timely fashion and will work with you toward your complete satisfaction.

Customer service and all orders should be addressed to

**Siargo Ltd.**

2041 Mission College Blvd, Suite 250

Santa Clara, CA 95054.

Tel: 01-(408)969-0368

Fax: 01-(408)777-8091

Email: [info@Siargo.com](mailto:info@Siargo.com)

For orders, please provide accurate and full post address. Siargo will not ship to P.O. Boxes or via a third party.

For further information and updates, please visit **[www.Siargo.com](http://www.Siargo.com)**.



## **Siargo Ltd.**

2041 Mission College Blvd, Ste 250

Santa Clara, CA 95054 USA

Tel: +1(408)969-0368

Email: [Info@Siargo.com](mailto:Info@Siargo.com)

[Http: //www.Siargo.com](http://www.Siargo.com)

