

MEMS Mass flow Meter

MF/FS4700 series

User manual (VB.1)



Please read this manual for ensuring correct use of this product. Make the manual available for easy access.

SIARGO LTD.

Introduction

MF/FS4700 series mass flow meters are made with Siargo's proprietary MEMS sensing technology. It applies for clean and dry gas metering and control. The meter is designed with the structure of a rotameter but with the full capability of a digital gas mass flow metrology and LED display. Both instant and accumulated flowrate can be read and displayed. The front buttons let user to access and adjust the parameters as well as stored data. The standard RS485 Modbus enables the remote access and integration.

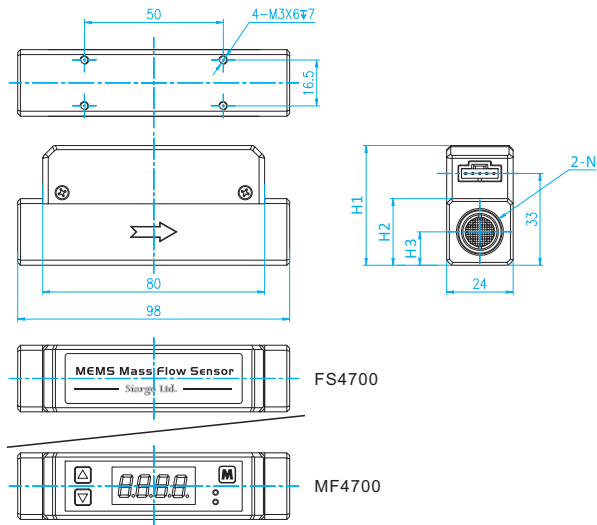
Features

- Direct mass flow measurement with high accuracy
- Multiple sensing elements for extended rangeability over 100:1
- Easy remote accessible user interface with RS485 Modbus and/or linearized analog data
- Bright LED display for instant and accumulated flowrate with on-site access via front buttons
- Record flowrate patterns with over range indication
- Easy for remote communication and integration
- Compatible with traditional rotameter mechanical connections
- Flow range and mechanical dimensions can be fully customized

Specifications

Parameters	MF/FS4701	MF/FS4703	MF/FS4708	Units
Flow Range	0 ~ 100, 200, 500			sccm
		0 ~ 1, 2, 5	0~10, 20, 50	SLPM
Rangeability	50:1			
Accuracy	$\pm(2.5+0.5FS)$			%
Repeatability	± 0.8			%
Offset stability	0.1			%FS
Span stability	± 0.12			%/°C
Response time	10 (default, can be changed via button)			msec
Power supply	8~24Vdc, 50mA max.			
Output	Analog, RS232/RS485 (Modbus)			
Display	LED with 2 indicators			
Display units				
- Instant flow:	sccm	SLPM	SLPM	
- Accumulated flow:	SL	Nm3	Nm3	
Resolution	0.1 or 1sccm,	0.001, 0.01,	0.01, 0.1	
Selectable		0.1 or 1SLPM	or 1SLPM	
(Default)	1sccm	0.01SLPM	0.1SLPM	
Pressure loss	100			Pa
Max pressure	0.5			MPa
Temperature	-10 ~ +55			°C
Storage	-20 ~ +65			°C
Humidity	<95%RH, no condensation			
Mechanical	NPT or BSPT			
Key board	3 keys			
Electrical	5 pins, CD R-5			
Calibration	Air (20°C, 101.325 kPa)			
Maximum overflow	3	30	200	SLPM
Maximum flow change	0.5	4	30	SLPM/sec

Dimensions



Model	H1	H2	H3	2-N
FS4701/FS4703	39	20	10	2-NPT 1/8, 2-BSPT 1/8
MF4701/MF4703	43	20	10	
FS4708	43	24	12	2-NPT 3/8, 2-BSPT 3/8
MF4708	47	24	12	

Description

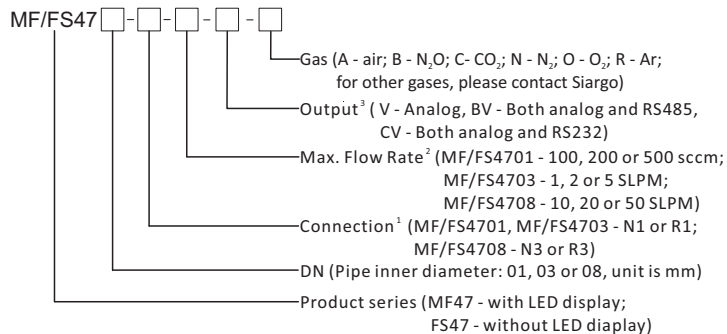


Pin definition

Pin	Color	Definition
1	Blue	RS485B
2	Green	Analog output
3	Red	VCC, Power + (8 ~ 24Vdc)
4	Black	GND, ground - (power/signal)
5	Yellow	RS485A



Product selection



1, N1 - NPT 1/8, N3 - NPT 3/8, R1 - BSPT 1/8, R3 - BSPT 3/8;

2, Max. flow rate number only, for example, 100 meaning full scale flow rate of 100 sccm. 5 meaning full scale flow rate of 5 SLPM);

3, The sensor shipped with standard analog output. RS232/RS485 is optional.

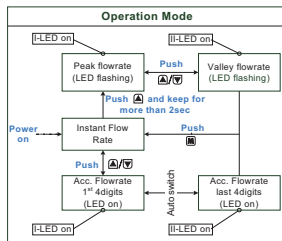
Installation

Please check the items in the package upon opening the box:

- 1) The package should contain the followings
 - a) MF/FS4700 mass flow meter 1
 - b) Electrical cable 1
 - c) QC certificate
- 2) Make sure no mechanical damages or visual damages;
- 3) Connect the electrical cable according to the pin definition;
- 4) Connect power supply and warm up for 2 minutes before use.

Operation

The meter shall display instant, accumulated and peak-valley flowrate. The indication light shall be lighted accordingly. Please see the detailed description below.



Instant flowrate display

1. Instant flowrate is a default display mode, both LED (I and II) will be off.
2. Instant flowrate is displayed by 4 LED digit with a decimal, the unit is SLPM
3. When the instant flowrate is over the allowed range, I-LED (over max) or II-LED (below min) will be flashing.
4. If I-LED and II-LED flash at the same time, it indicates that the actual flowrate is over the calibrated range or the display value is incorrect.

Accumulated flowrate display

1. The accumulated flowrate is displayed by 8 digits that is separated with two 4 digit display where I-LED indicates the first 4 digits and II-LED indicates the last 4 digits. The units is SL.
2. The accumulated flowrate can be reset via the keyboard.

NOTE: The flow accumulation will be saved every 3 minutes. For instance:

- The flow accumulation will not be saved if power off @ 2 minutes.
- The flow accumulation will be the value of 33 minutes if power off @ 34 minutes.

Peak-Valley flowrate retrieval

1. The data of the last registered peak-valley flowrate can be retrieved via the keyboard.
2. When the peak flowrate value is displayed and flashed, the I-LED will light.
3. When the valley flowrate value is displayed and flashed, the II-LED will light.

Menu settings

The Menu Settings will allow the user to execute keyboard lock/unlock, reset accumulated flowrate, reset offset, set time, response time, instant flow decimal point etc.

Keyboard lock

This function shall prevent unintended changes of the parameters by press the keyboard. When keyboard is locked, the menu function is disabled.

Accumulated flowrate reset

This function shall reset the accumulated flowrate, and the meter will re-start from null.

Offset reset

This function shall reset the offset which may be due to drift after a certain period of performance. It shall help for improving accuracy. **Note:** When performing offset reset, make sure there is no flow in the meter otherwise it will have impact to the accuracy.

Sampling time

This function allows user to set the sampling time between analog output and digital output via the serial port. Once the setting is done, it will be immediately effective but the settings will only be saved into the EEPROM after switch to another function.

Display	4.001	4.002	4.005	4.010	4.020	4.050	4.100
Sampling	10ms	20ms	50ms	100ms	200ms	500ms	1000ms

Display update time

This function allows the user to set the display update time of the meter. Once the setting is done, it will be immediately effective but the settings will only be saved into the EEPROM after switch to another function.

Display	5.025	5.050	5.100	5.200
Update	250ms	500ms	1000ms	2000ms

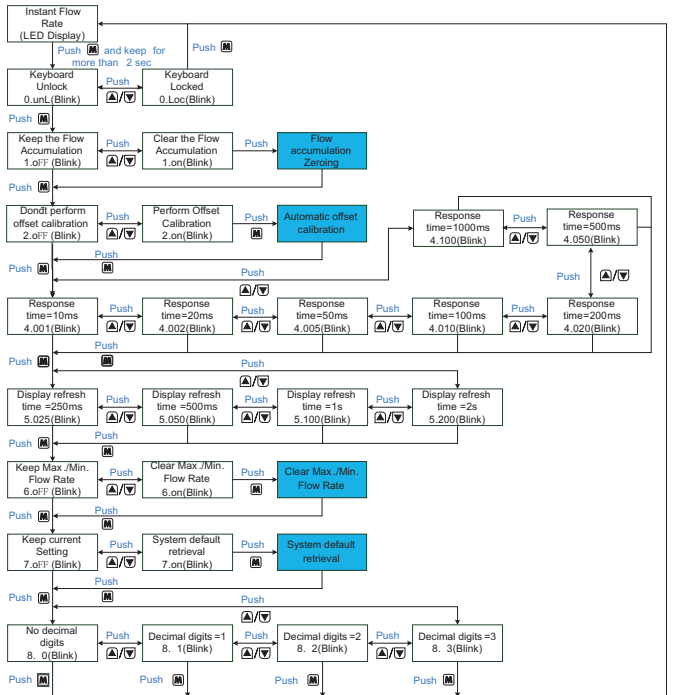
Peak-valley values reset

This function allows user to reset the peak value to null.

Reset to factory default value

This function allows user to reset all parameters to factory default values.

MENU SETTING MODE



Decimal setting for instant flowrate

This function allows user to set the decimal point of instant flowrate.

Note: (1) When full scale flowrate is 100, 200 or 500 sccm, 0 or 1 decimal can be set.

e.g. 123 or 123.4 sccm, default setting is 0 decimal;

(2) When full scale flowrate is 1, 2 or 5 SLPM, 0, 1, 2 or 3 decimals can be set.

e.g. 1 SLPM, 1.2 SLPM, 1.23 SLPM or 1.234 SLPM, default setting is 2 decimals;

(3) When full scale flowrate is 10, 20 or 50 SLPM, 0, 1 or 2 decimals can be set,

e.g. 12 SLPM, 12.3 SLPM or 12.34 SLPM, default setting is 1 decimals.

RS232/RS485 communication

For purposes of computer control and networking, the RS232/RS485 is used for communication with the following settings:

Baud rate (Bits per second): 38400

Date bits: 8; Stop bits: 1;

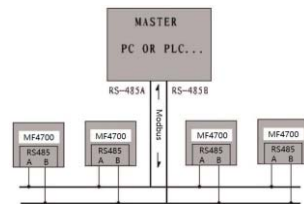
Parity: None; Flow control: None.

The protocol is based on the standard Modbus communication protocol. RS232 model supports single meter communication, and RS485 model supports either single meter communication or multi-meter networking.

1. Hardware connection

MF/FS4700 protocol is based on standard Modbus RTU mode. A master (PC or PLC) can communicate with several slaves (MF/FS4700), setting parameter or getting data.

The hardware layer is TIA/EIA-485-A. The connection is as below:



2. Communication parameter

The UART parameter is shown as below table:

Communication parameter	Protocol
	RTU
Baud rate(Bits per second)	38400 bps
Start bits	1
Data bits	8
Stop bits	1
Even/Odd parity	None
Bits period	104.2 μs
Bytes period	1.1458 ms
Maximum data length	20
Maximum Node	255

3. Frame

The framing function is accord with The Standard Modbus RTU framing, which is shown as below:

Start_bits	Address	Function code	Data	CRC	Stop_bits
T1-T2-T3-T4	8Bit	8Bit	N 8Bit (20≥N≥0)	16Bit	T1-T2-T3-T4

Start_bits: 4 periods bit time, to indicate a new frame.

Address: The address, can be set as 1 to 255, 0 is broadcast address.

Function code: Define the action that MF/FS4700 should takes, or indicate that which code the MF/FS4700 is responding.

Data: Including the address of register, length of data and the data.

CRC : CRC verify code, the low byte is flowed by high byte. For example, the 16bit CRC code is divide as BYTE_H BYTE_L, in the frame, the BYTE_L goes first, then the BYTE_H, at last, is the stop signal.

Stop_bits: 4 periods bit time, to indicate that the current framing is over.

4. Function code

MF/FS4700 Modbus Function-code is a subclass of Standard Modbus Function-code. By using these function-code, We can set or read the registers of MF/FS4700.

They are shown as below table:

Code	Name	Action
0x03	Read register	Read register (one or more)
0x06	Set single register	Write one single 16 bit register
0x10	Set multi registers	Write multi registers

5. Registers

MF/FS4700 has several registers. We can get the information (such as “address”, “flow rate” and so on) form reading these registers, or we can write into some of the registers for setting parameters of MF/FS4700.

The registers are shown as below table:

Name	Description	Register	Modbus
Address	The address of MF/FS4700 (W/R)	0x0001	40002
Flow Rate	The current flow rate (R)	0x0002~0x0003	40003
Total	The accumulative total of flow rate (W/R)	0x0004~0x0006	40005
Baud Rate	The communication band rate (W/R)	0x0015	40022
GCF	Gas correction factor (W/R)	0x0016	40023
Response time	Response time setting (W/R)	0x0017	40024
Filter depth	Filter depth (W/R)	0x0018	40025
Offset Calibration	Calibrate the offset (W)	0x0027	40040
Write-protect	Write-protect for some parameters setting (W)	0x0014	40021

* R-read only, W/R-write and read.

Flow meter Address	0x0001	WRITE	A
		READ	A
Description	The address of MF/FS4700 in modbus protocol		
Value type	UINT16		
Detail	Value from 1 to 255 except 157 (0x9d). 0 is broadcast address.		
Flow Rate	0x0002 ~ 0x0003	WRITE	N
		READ	A
Description	The current flow rate		
Value type	UINT16 Note: sccm for MF/FS4701, SLPM for MF/FS4703/08.		
Detail	Flowrate=[value(0x0002) * 65536+value(0x0003)]/1000 Example: When we get "0" from register 0x0002 and "20340" from register 0x0003. Flowrate = (0*65536+20340)/1000= 20.340		
Total	0x0004 ~ 0x0006	WRITE	A
		READ	A
Description	The accumulative total of flow		
Value type	UINT32 + UINT16 Note: SL for MF/FS4701, Nm³ for MF/FS4703/08.		
Detail	V1 = value (0x0004) * 65536 +value (0x0005); V2 = value (0x0006) Total = (V1 *1000 + V2)/1000; Example: When the LCD shows 3452.245NCM, we can get "0" from register 0x0004, "3452" from register 0x0005, "245" from register 0x0006. Then, V1 = 0*65536 + 3452; V2= 245; Total =(3452*1000 + 245) /1000=3452.245		
Baud Rate	0x0015	WRITE	A
		READ	A
Description	The communication baud rate		
Value type	UINT16		
Detail	0: 4800, 1: 9600, 2: 19200, 3: 38400. The default value is 3. Example: When you get "3" from register 0x0015, the baud rate is 38400.		

GCF	0x0016	WRITE	A
		READ	A
Description	The gas correction factor. Note: Need to set write-protect.		
Value type	UINT16		
Detail	The value is 1000 time of the gas correction factor. The default value is 1000. Example: The GCF of air is 1.0, you can get "1000" from register 0x0016.		
Response time	0x0017	WRITE	A
		READ	A
Description	Response time. Note: Need to set write-protect.		
Value type	UINT16		
Detail	10, 20, 50, 100, 200, 500 or 1000 ms. The default value is 10. Example: When you get "10" from register 0x0017, the response time is 10 ms.		
Filter depth	0x0018	WRITE	A
		READ	A
Description	Filter depth. Note: Need to set write-protect.		
Value type	UINT16		
Detail	0 and 4~255. The default value is 0. Example: When you get "8" from register 0x0018, the filter depth is 8.		
Offset Calibration	0x0027	WRITE	A
		READ	N
Description	Calibrate the offset		
Value type	UINT16, Fixed value 0XAA55		
Detail	Set the fixed value 0XAA55 to register 0x0027. Note: Please ensure there is NO flow in the pipeline.		
Write-protect	0x0014	WRITE	A
		READ	N
Description	Write-protect for GCF, response time and filter depth. Single effective.		
Value type	UINT16, Fixed value 0XAA55		
Detail	Example: When you want to set response time, you need to set fixed value 0xAA55 to register 0x0014.		

Safety and Warranty**Wetted Materials and Compatibility**

The meter body is made of polycarbonate and 316 stainless steel. The sensor chip comprises of silicon, silicon nitride and silicon dioxide and the sensor chip surfaces are passivated with silicon nitride and silicon dioxide. The electronic sealing is provided by 201-A/B-90 epoxy. Other wetted materials may be exposed are 84-3J wire sealant and FR-4 fiber glass.

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 meters 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. 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 60 psi 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 requires a voltage supply of 8-24 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.

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

For further information, please contact the manufacturer.

Environmental compliance

Siargo commits to be in compliance with the environmental regulations. This includes all package materials. Please dispose the corresponding materials by it categories, such as wood, paper, plastics. For the disposal of the entire product, please follow the electronics disposal regulations and laws.

Customer service and Contact

Siargo shall guarantee its product quality and ensure the quality assurance in its entire manufacture process. For any questions or technical support, please contact at the following address and we shall response timely.

Headquarters

Siargo Ltd.
3100 De La Cruz Boulevard, Suite 210,
Santa Clara, California 95054, USA
Phone: +01(408)969-0368
Email: info@Siargo.com

Representative in US

Servoflo Corporation
75 Allen Street,
Lexington, MA 02421, USA
Phone: +1-781-862-9572
Email: info@servoflo.com

Representative in Europe

IDENTIC GmbH
In der Siedlerruh 24
69123 Heidelberg / Germany
Phone: +49-(0)6221-7509777
Fax: +49-(0)6221-7509779
Email: info@identic.de

Representative in Japan

Marubeni Information Systems Co., Ltd.
Device Solutions Department
14th Floor, Shinjuku Garden Tower,
3-8-2, Okubo, Shinjuku-ku, Tokyo 169-0072, Japan
Phone: +81-3-4243-4160
Fax: +81-3-4243-4198
Email: siargo@marubeni-sys.com