

MEMS Mass Flow Meter MF5806 Series

User Manual

(VC.1)



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

SIARGO LTD.



Siargo Ltd.

MEMS MEMS Flow Meters

MF5806 Series

User Manual

Document No. 07-2019-M13 EN

Issue date: 2019.07

Revision: VC.1

Siargo Ltd.

3100 De La Cruz Boulevard,
Suite 210,
Santa Clara, CA 95054
USA

Tel: +1(408)969.0368

Email: info@siargo.com

© Copyright 2019 by Siargo Ltd.

Siargo Ltd. and its subsidiaries reserve the rights to change the specifications and/or descriptions without prior notice. For further information and updates, please visit:

www.Siargo.com

RESTRICTION ON USE

1. This meter is designed and manufactured specially for hospital individual oxygen therapy applications that will delivery a better and controllable precious dosage. 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 safety may be a concern.
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 PRECAUSION

1. The product can be utilized to measure and/or monitor in-line oxygen mass flow rate. 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 described 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 well understands all the important instructions.

Contents

RESTRICTION ON USE	1
SAFETY PRECAUTION	1
Content	2
Overview	3
Features	3
Working Principle	4
Control Schematics	4
Specifications	5
Dimensions	6
Description	6
Product Selection	7
Menu Illustration	7
RS485 Communication Protocol	11
Parts in Package	14
Safety and Maintenance	14
Customer Service	15
Warranty and Liability.....	16
Appendix: Revision History.....	17

Siargo designs, develops and manufactures the world leading MEMS mass flow sensing products for various applications in gas flow monitor, measurement and control. This manual provides the instructions for proper use of the MF5806 series of products, including installation, maintenance and troubleshooting. For further customization or other product related questions, please contact the manufacture or visit www.Siargo.com

Overview

MF5806 mass flow meters are specially designed for hospital individual oxygen therapy applications. It provides precise measurement of instant oxygen intake rate and accumulated oxygen dosage for the individual oxygen delivery system. The design provides low power consumption that make it possible for operation on battery when power is an concern. The meter can be directly connected to the central station via RS485 that can provide remote monitoring and control which will reduce the risk of oxygen over dosing.

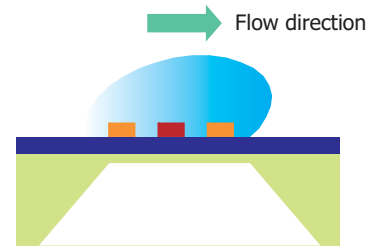
The meters are operated with the Siargo's proprietary MEMS thermal mass flow sensors together with the smart control electronics. The sensor probe surface is passivated with silicon nitride ceramic materials together with a water/oil proof nano-coating for performance and reliability. The current models provide plug-and-play connectors for hospital oxygen systems. The meter can be directly plug into the oxygen supply system outlet located at the hospital bedside.

Features

- ◆ Plug-and-paly hospital oxygen deliver design for easy usage
- ◆ Mass flow technology provide precise instant rate and accumulated dosage
- ◆ Historical data storage and retrieval
- ◆ Password protected access
- ◆ Excellent repeatability and accuracy
- ◆ Low power design with stand-alone operation by battery
- ◆ 2 AA Battery powered for continuous operation over 2000 hours
- ◆ Bluetooth LE with smart APP
- ◆ GPRS or WIFI data transmission with location service
- ◆ Gas consumption/mass flowrate high/low alarm
- ◆ Interlock of in/out connector for prevention of wrong mechanical
- ◆ Manual adjustable valve for instant rate
- ◆ Standard RS485 Modbus interface for remote monitor and control

Working Principle

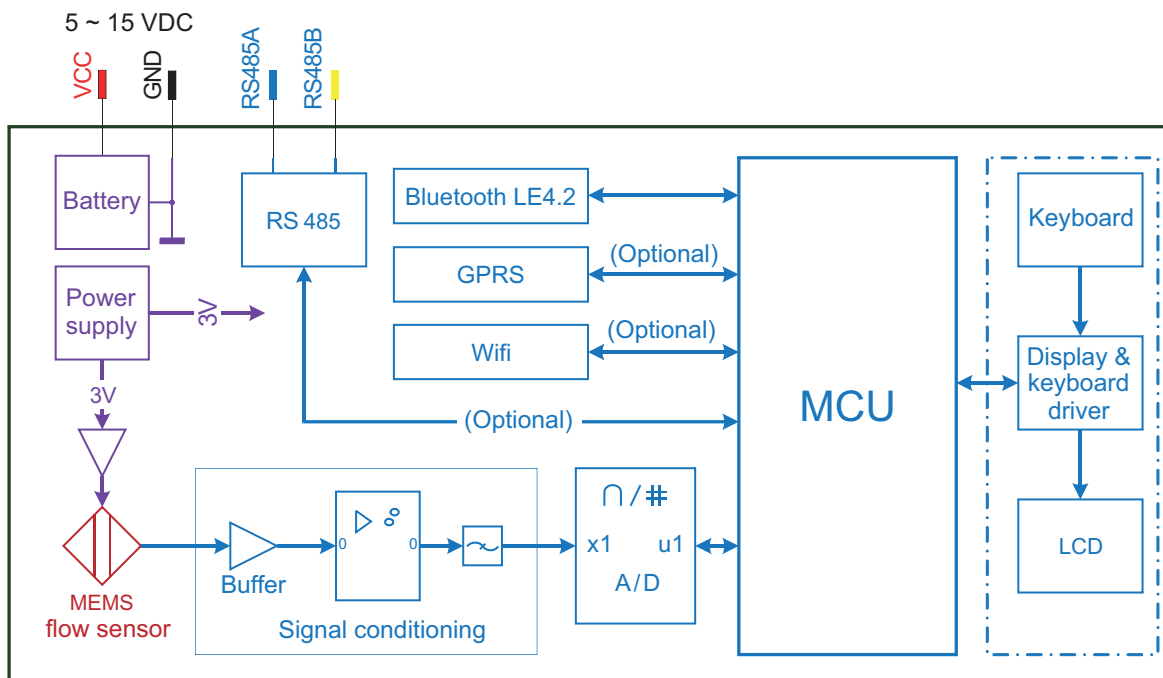
The MF5806 series flow meters measure flow using Siargo’s proprietary MEMS calorimetric mass flow sensor that is installed in the flow channel forming a plate which serves as an additional flow conditioner from the boundary layer configuration resulting in a laminar flow. The mass flow measurement is established as the fluid carries heat away from the heater causing the redistribution of the temperature field. Accurate flow rate is obtained by calibration with the standard fluid at the preset conditions.



The wetted materials of the MEMS sensor is silicon nitride and the flow channel of the meter is made of polycarbonate that are compatible with the most common gases. As each of a specific gas has a unique specific heat, the MEMS sensor can also measure such values and hence provide the gas identification capability which could be critical in applications where mixed or incorrect gas flow may lead to unrecoverable damage.

The data are readily transmitted via the Bluetooth LE embedded inside the meter head to a smart device with the manufacturer provided APP and further the information can be relied to the cloud for data processing. Alternatively, GPRS or WIFI option can be requested. A land line option with RS485 Modbus can also be requested.

Control Schematics



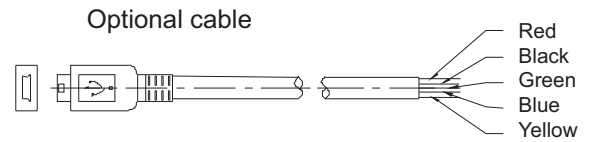
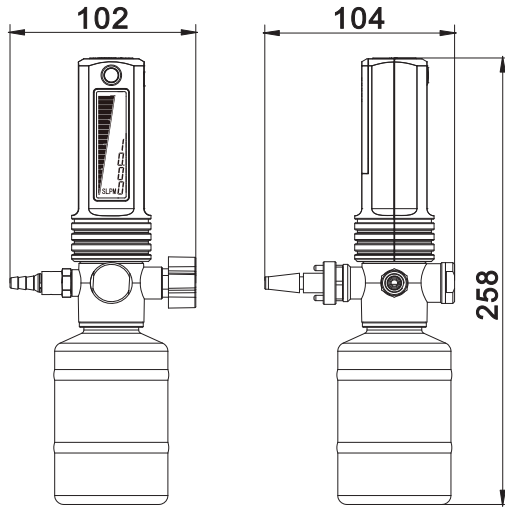
Specifications

Model	Value	Unit
Flow range	0 ~ 10	SLPM
Accuracy	$\pm(1.5+0.5FS)$	%
Repeatability	0.5	%
Response time	≤ 2	sec
Power supply	2 x AA batteries(LR6) or AC adapter (5 ~ 15 Vdc)	
Power consumption	≤ 5	mW
Digital output	Linear, RS485 (Modbus)	
Wireless output	Bluetooth LE 4.2	
Display	LCD	
Display information	Instant flow: SLPM; Totalized flow: m ³ ; Time: hhHmm	
Flow resolution	Instant flow: 0.01 SLPM; Totalized flow: 0.001 m ³ ; Time: 00H00	
Keyboard	1 key	
User function	Password; alarm limit; totalized flow; offset reset	
Max. pressure	0.6	MPa
Working temperature	-10 ~ +55	°C
Pressure loss	≤ 500	Pa
Battery life	800 hrs - continuous operation; 2300 hrs - meter continuous operation with BT off	
Calibration	Air @ 20°C, 101.325 kPa	
Pin out	miniUSB (optional)	
Mech. connection	Medical oxygen nozzle (customizable)	
Weight	~350	g

Notes: * The above parameters are applicable at 20°C and 101.325kPa.

** Meter head can be rotated 180 degree for convenience at installation and reading.

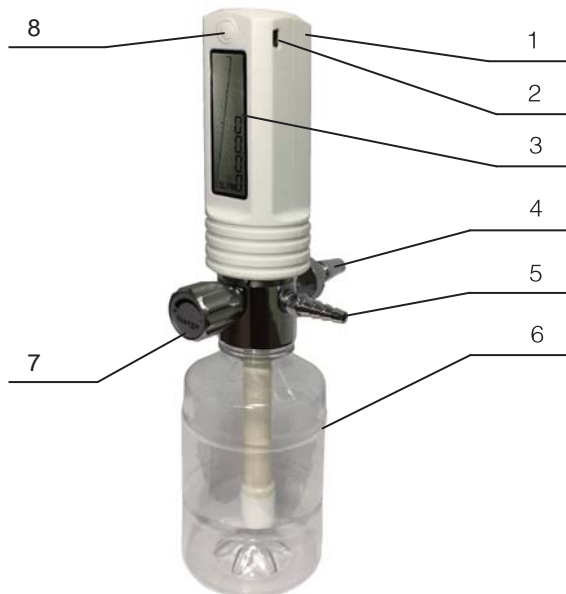
Dimensions



Note:

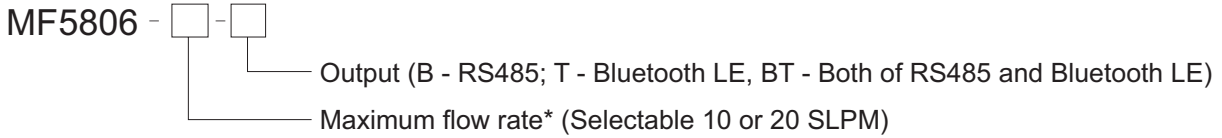
- 1) Please note the inlet would be from the medical connector. If the inlet is connected to the other one, the reading will be null.
- 2) The optional miniUSB cable will provide connections to external power supply as well as the RS485 communication. For connection definitions, see the corresponding descriptions.

Description



- 1 - Meter head
- 2 - User interface
- 3 - LCD display
- 4 - Oxygen inlet
- 5 - Oxygen outlet
- 6 - Humidifier bottle
- 7 - Manual adjustable valve
- 8 - Function key

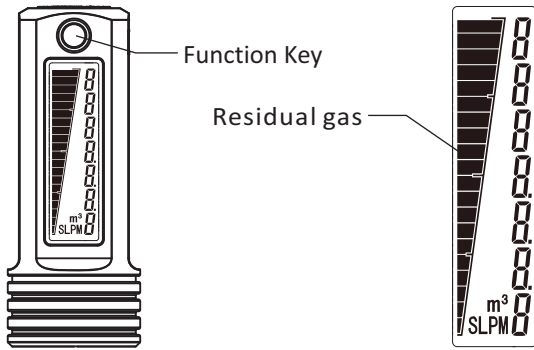
Product Selection



* There is flow rate number only.

Menu Illustration

1. Interface illustration



Interface includes *instant flow, totalized flow, time counter, bar-chart indicates instant flow rate (cylinder gas remaining volume optional), menu and other process data for Setup*. See the graph at the left for details.

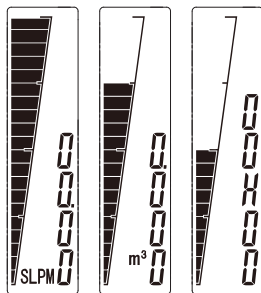
One function key located on the upper front of the meter head.

2. Operation

The followings describe the details for each menu step. Please read carefully before use.

2.1 Display at normal operation

Upon power on, the meter will go through a self-check, and the meter then will display the normal operation menu: instant flow mode, totalized mode or time counter mode. Press the *function key* (for less than 0.5sec), one can switch the mode from one to another.



- a. Instant flow: SLPM;
- b. Totalized or accumulated flow: m³;
- c. Time counter: hhHmm (for instance, 03H25 means 3 hours and 25 minutes);
- d. Bar-chart: instant flow.

2.2 Password verification

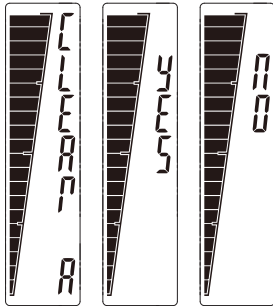
At the normal operation display, press & hold *the function key* (press for more than 1 sec), it will enter into the password interface. Input the correct password, then the *Setup Menu* will display. If the password is incorrect, the display will return to normal operation modes. The default password is 1111.



To enter the password, **briefly press (less than 1 sec) *the function key*** to change the digit. When it flashes, then **press & hold *the function key* (press for more than 3 sec)** to confirm the entry. Repeat this process for all 4 digits and the meter will proceed to the menu interface.

Note: while performing the password input, the flow measurement will not be interrupted.

2.3 Reset the totalized flow

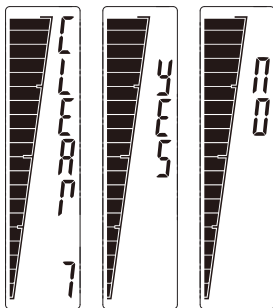


When the meter completed the “password verification”, the following menu can be accessed: **CLEAR A, CLEAR T, OFFSET, ACC dIS, EXIT**.

For the “**CLEAR A**” mode, press & hold the *function key*, the screen will show “**YES**” or “**nO**”, briefly press the *function key* to choose “**YES**”, press & hold *function key*, the totalized flow will be reset or be cleared.

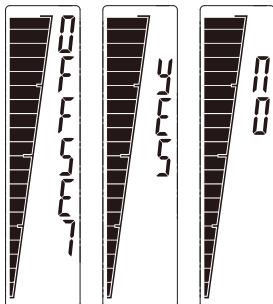
Note: while “**UnUSED**” is chosen in the “**ACC dIS**”, there is no “**CLEAR A**”.

2.4 Reset the time counter



For the “**CLEAR T**” mode, press & hold the *function key*, the screen will show “**YES**” or “**nO**”, briefly press the *function key* to choose “**YES**”, press & hold *function key*, the time counter will be reset or be cleared.

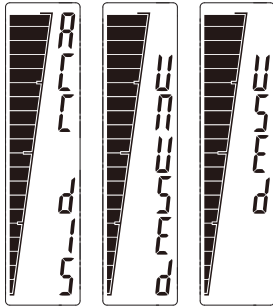
2.5 Offset calibration



For the “**OFFSET**” mode, press & hold the *function key*, the screen will show “**YES**” or “**nO**”, briefly press the *function key* to choose “**YES**”, press & hold *function key*, the meter will calibration offset.

Note: Please ensure that there is **NO FLOW** in the offset calibration.

2.6 Accumulated flow modes (increasing/decreasing)



For the “ACC dIS” mode, press & hold the *function key*, the screen will show “UnUSED” or “USED”, briefly press the *function key* to choose “UnUSED” or “USED”, press & hold *function key*, the mode will be chosen.

“UnUSED” means of decreasing, while “USED” means of increasing.

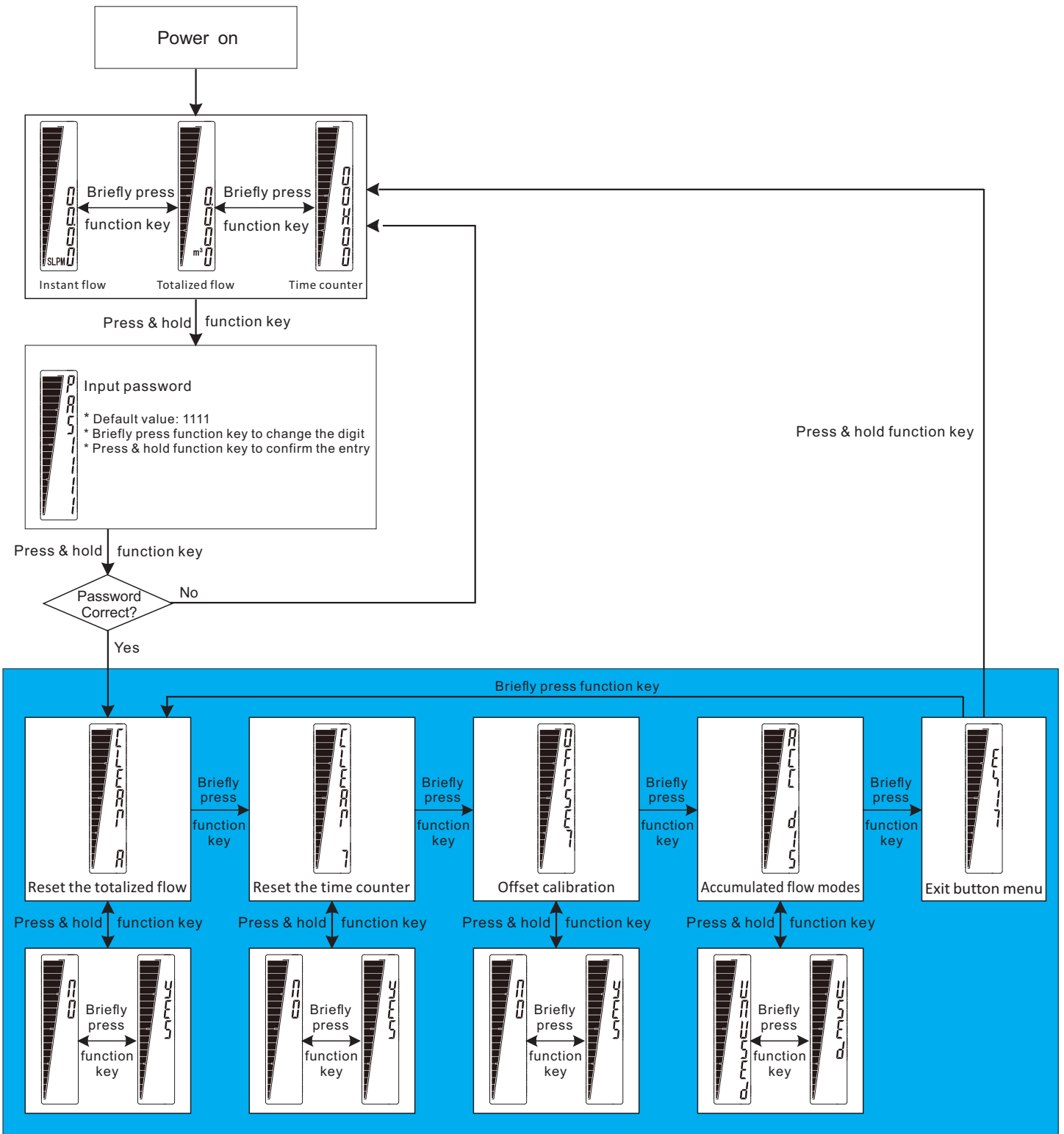
Note: In “UnUSED” mode, there is no “CLEAR A” option.

2.7 Exit



Briefly press the *function key*, the screen will switch to “EXIT” mode.

At “EXIT” mode, press & hold the *function key*, the meter will return to normal operation mode.

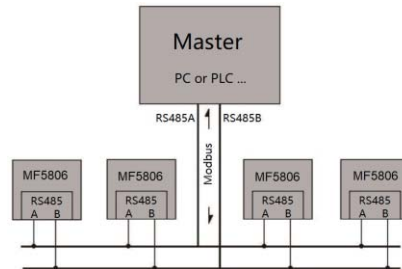


RS485 Modbus Protocol

RS485 is based on the standard Modbus communication protocol. It supports either single meter communication or multi-meter networking.

1. Interface illustration

Based on standard Modbus RTU mode, a master (PC or PLC) can communicate with several slaves (MF5806), 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)	9600 bps
Start bits	1
Data bits	8
Stop bits	1
Even/Odd parity	None
Bits period	104.2μs
Bytes period	1.1458ms
Maximum data length	20
Maximum Nodes	247

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 Modbus address, can be set as 0 to 255 except 157. 0 is broadcast address.
- Function code :** Define the action that MF5806 should takes, or indicate that which code the MF5806 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

MF5806 Modbus Function-code is a subclass of Standard Modbus Function-code. By using these function-code, We can set or read the registers of MF5806.

They are shown as below table:

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

5. Registers

MF5806 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 MF5806.

Name	Description	Register	Modbus
Address	The modbus address (RW)	0x0001	40002(0x0001)
Flow Rate	The Instant flow (R)	0x0002 ~ 0x0003	40003(0x0002)
Total	The totalized flow (RW)	0x0004 ~ 0x0006	40005(0x0004)
Time Counter	The time counter (RW)	0x0017 ~ 0x0018	40024(0x0017)
Leakage Alarm	The leakage alarm flow rate (RW)	0x0019	40026(0x0019)
GCF	The gas correction factor (RW)	0x001A	40027(0x001A)

* R-read only, RW-read and write.

Flow meter Address	0x0001	WRITE	A
		READ	A
Description	The modbus address		
Value type	UINT16		
Detail	Value from 1 to 255 except 157 (0x9d). Default value is 255.		
Flow Rate	0x0002 ~ 0x0003	WRITE	N
		READ	A
Description	The instant flow		
Value type	UINT32		
Detail	Flowrate = [value(0x0002) * 65536 + value(0x0003)] /1000 Example: When the LCD shows 2.34 SLPM, we can get “0” form register 0x0002 and “2340” form register 0x0003. Thus, flowrate = (0*65536 + 2340)/1000= 20.340		

Total	0x0004 ~ 0x0006	WRITE	A
		READ	A
Description	The totalized flow		
Value type	UINT32 + UINT16		
Detail	<p>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</p>		
Time Counter	0x0017 ~ 0x0018	WRITE	A
		READ	A
Description	The time counter		
Value type	UINT32		
Detail	<p>The time counter (Minutes) = value(0x0017). The time counter (Hours) = value(0x0018). Example: When the LCD shows 3:25 (3 hours and 25 minutes), we can get “3” from register 0x0017 and “25” from register 0x0018.</p>		
Leakage Alarm	0x0019	WRITE	A
		READ	A
Description	The leakage alarm flow rate		
Value type	UINT16		
Detail	<p>The leakage alarm flow rate = value(0x0019) /1000. Example: When the leakage alarm is 0.1 SLPM, we can get “100” from register 0x0019.</p>		
GCF	0x001A	WRITE	A
		READ	A
Description	The gas correction factor		
Value type	UINT16		
Detail	<p>GCF = value(0x001A) /1000. Example: When GCF is 0.67, we can get “670” from register 0x001A.</p>		

Parts in Package

MF5806 gas flow meter	1
User manual	1
QC certificate	1

Safety and Maintenance

1. 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 agents may cause the product malfunctioning or even severe damages. The product sealing is ensured to work under working pressure of 0.8MPa 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 4-AA batteries or external adapter, 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 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.

2. Cautions for change of batteries

When the while blink, batteries should be changed immediately or switch to AC power. Do not allow battery leakage inside the meter.

3. 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.

All maintenance of the sensor should be performed by trained and certified personnel by Siargo.

Customer Service

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

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 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

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

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.

Warranty and Liability

(Effective January 2010)

Siargo warrants the products sold hereunder, properly used and properly installed under normal circumstances and service as described in this user 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 warranty, representation, or guarantee and shall not assume any liability regarding the suitability of the products described in this manual for any purposes that are not specified in this manual. The users shall be held for full responsibility for validating the performance and suitability of the products for their particular design and applications. For any of the misuse of the products out of the scope described herein, the user shall indemnify and hold Siargo and its officers, employees, subsidiaries, affiliates and sales channels harmless against all claims, costs, damages, and expense or reasonable attorney fee from direct or indirect sources.

Siargo makes no other warranty, express 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 of 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.

The product information provided in this manual is believed to be accurate and reliable at the time of release to or made available to the users. However, Siargo shall assume no responsibility for any inaccuracies and/or errors and reserves the rights to make changes without further notice for the relevant information herein.

This warranty is subject to the following exclusions:

- (1) Products that have been altered, modified or have been subject to unusual physical or electrical circumstances indicated but not limited to those stated in this document or any other actions which cannot be deemed as proper use of the products;
- (2) Siargo does not provide any warranty on finished goods manufactured by others. Only the original manufacturer's warranty applies;
- (3) Products re-sold to the third parties.

Appendix: Revision History

Revision C.1 (July 2019):

- ✎ Added the production selection;
- ✎ Added RS485 Modbus Protocol.

Revision C.0 (November 2017):

- ✎ First released.