Siargo Ltd.



Gas Mass Flow Meter VE.2.08

Model MF5000

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Gas Mass Flow Meter

with MEMS calorimetric sensing technology

MF5000 Series

User Manual

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Attention!

- Please carefully read this manual before operating this product.
- Do not open or modify any hardware that may lead to irrecoverable damage.
- Do not use this product if you suspect any malfunctions or defects.
- Do not use this product for corrosive media or in an environment with strong vibrations.
- Use this product according to the specified parameters.
- Only the trained or qualified personnel shall be allowed to perform product services.

Use with caution!

- Be cautious of electrical safety, even if it operates at a low voltage; any electrical shock might lead to unexpected damage.
- The gas to be measured should be clean and free of particles. Do not apply this meter to a liquid medium.
- Do not apply for any unknown or non-specified gases that may damage the product.
- For remote data, please be sure the meter is properly configured.

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1. Overview

All contact information can be found at the end of this manual.

This manual provides essential information for the third generation of the MF5000 series of gas mass flow meters for general-purpose gas metrology. The performance, maintenance, troubleshooting, ordering information, technical support, and repair are also included.

MF5000 mass flow meters are designed for general-purpose, industrial gas flow measurement, monitoring, or control. The meter series offers a wide dynamic flow range with a working pressure rating of up to 1.5 MPa, and a temperature range of -20 to 60°C.

The meters are operated with Siargo's proprietary MEMS calorimetric mass flow sensors together with smart control electronics. The sensor surface is passivated with silicon nitride ceramic materials and a water/oilproof nano-coating for performance and reliability. The meter body is made of stainless steel SUS 304, which is ready for applications in most gases.

This new release offers applications in a hazardous zone (Ex ia IIC T4 Gb, equivalent to Class I, Div. 1, Zone 0, Group A, T4). It also boosts the protection class to IP66 and offers additional mechanical connection flexibility with both male and female connectors, which can be further adapted with any other threaded ones. The electrical interface is an M12 connector.

2. Receipt / unpack of the products

Upon receipt of the products, please check the packing box before dismantling the packing materials. Ensure no damage during shipping. If any abnormality is observed, please contact and notify the carrier who shipped the product, and inform the distributors or sales representatives if the order is not placed directly with the manufacturer. Otherwise, the manufacturer should be informed. For any further actions, please refer to the return and repair section in this manual.

If the packing box is intact, open it to find the product inside. It is (either the meter or the meter with the valve on the actual purchase order. The power adapter and/or data cable, as shown below, may also be found if the order includes them.



Flow meter



data cable

Figure 2.1: MF5000 flow meter and data cable

Please immediately check the integrity of the product as well as the power and data cable. If any abnormality is identified, please notify the distributor/sales representative or manufacturer as soon as you can. If any defects are confirmed, an exchange shall be arranged immediately via the original sales channel. (Note: the LCD screen shall not be lighted until the power cable is plugged in.) This user manual will either be included in the packing box, or an electronic version can be requested online. In most cases, this manual will be made available to the customer before the actual order.

The cable is a standard one with an M12 connector.

3. Knowing the products

3.1. Product description

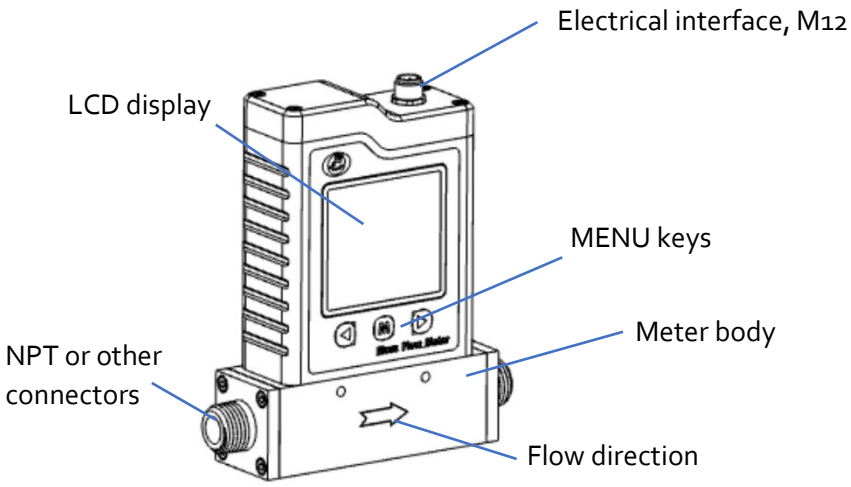


Figure 3.1: MF5000 parts description

3.2. LCD description

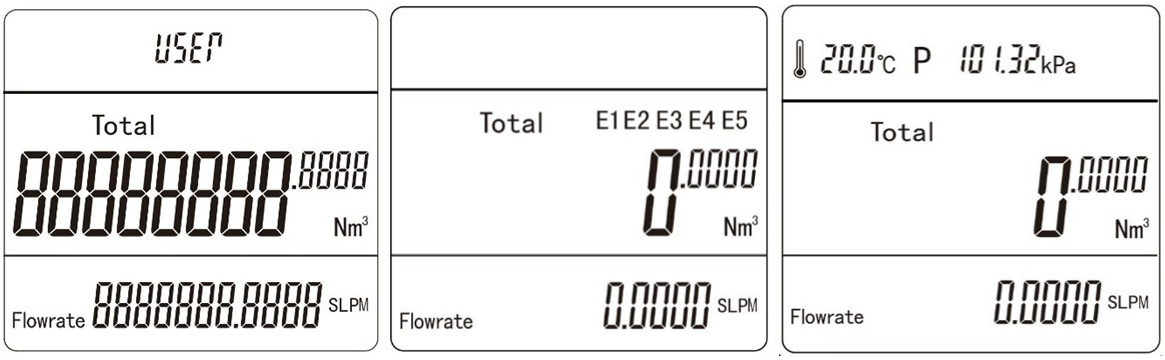


Figure 3.2: LCD symbol illustration.

The LCD displays all the information measured by the product. Some symbols are reserved for future upgrades and will not be lit during the operation. The following table explains each symbol.

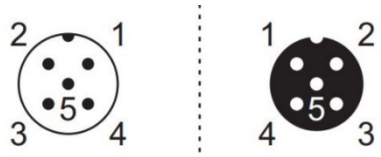
Table 3.1: Symbol descriptions

USER	The top row shows only when communication or another user-defined function is in process.
Total	The middle row displays the accumulated or totalized flow rate in Nm^3 (Normalized cubic meters) or SCF (Standard cubic feet). Here, the standard (normalized) conditions refer to 20°C, 101.325kPa.
Flowrate	The bottom row displays the instant flow rate in SLPM (Standard liters per minute), Nm^3/h (Normalized cubic meters per hour), or SCFM (Standard cubic feet per minute)
E1	Error 1 – Sensor error
E2	Error 2 – ADC error
E3	Error 3 – RTC error
E4	Error 4 – EEPROM error
E5	Error 5 – Oscillator (crystal) error
	Temperature, for models with the temperature option
P	Pressure, for models with the pressure option

***Note:** Both the pressure and temperature sensors can be integrated with the current product, but not with the default models. Contact the manufacturer for further information.

3.3. Power and data cable description

Table 3.2: MF5000 wire (M12) assignments.



Socket Cable

Figure 3.3: MF5000 socket and cable

Wire	Color	Definition
1	Brown	12 ~ 24 Vdc
2	White	RS485 B (-)
3	Blue	GND, common ground
4	Black	RS485 A (+)
5	Gray	4 ~ 20 mA output

3.4. Mechanical dimensions

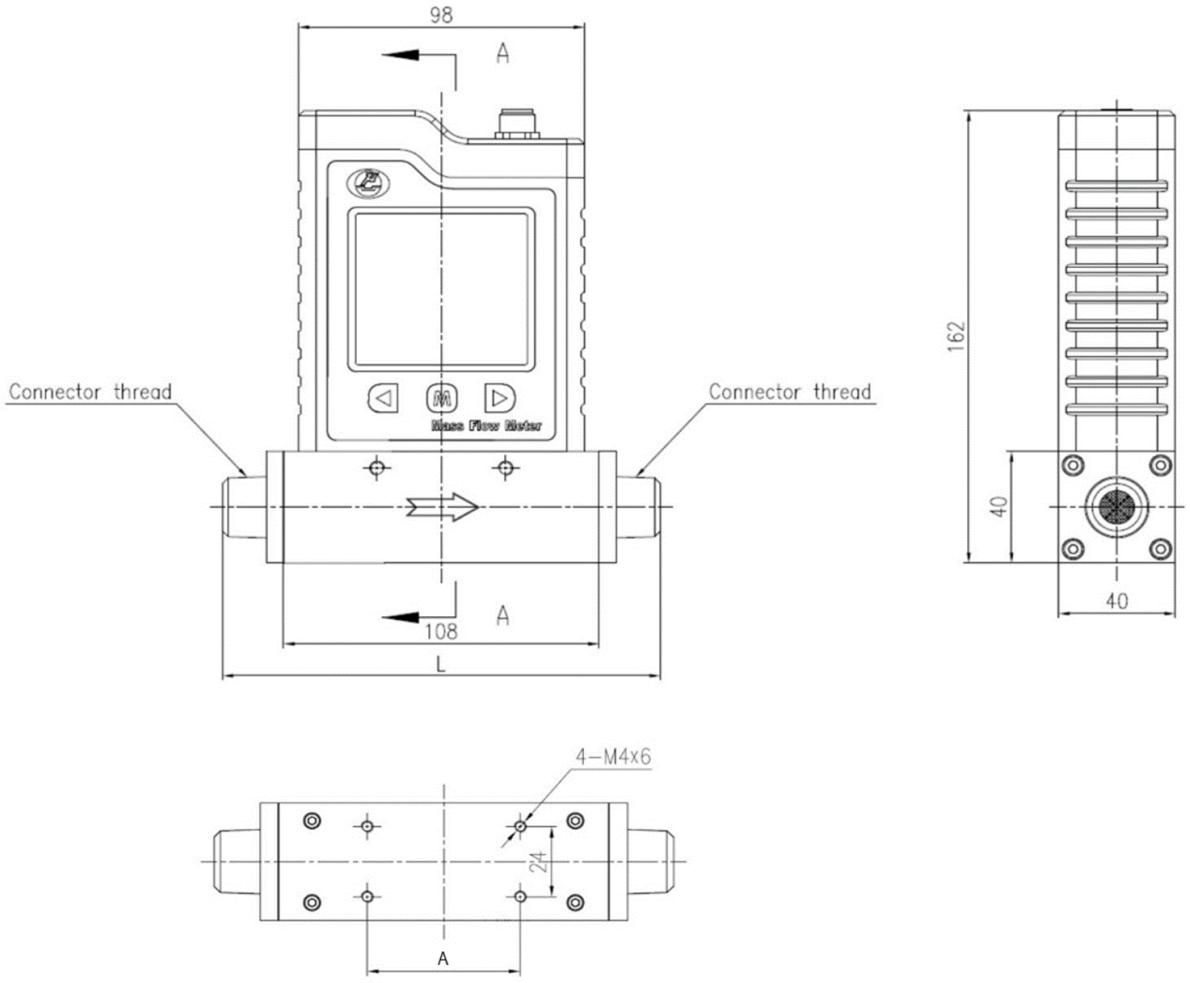


Figure 3.4: MF5000 meter dimensions.

Model	DN (mm)	D (NPTM)	L	A
MF5003	3	1/8″	138	50
MF5006	6	1/4″	144	50
MF5008	8	3/8″	144	50
MF5012	12	1/2″	150	50
MF5019	19	3/4″	182.5	70

4. Installation

Do not open or alter any part of the product that would lead to malfunction and irrecoverable damage. It will forfeit the terms of the warranty and expose the party to liability.

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

The product is preferably installed horizontally. The flow direction should be aligned with the arrow mark on the meter body. If the flowing fluid may have particles or debris, a filter is strongly recommended to be installed upstream of the meter.

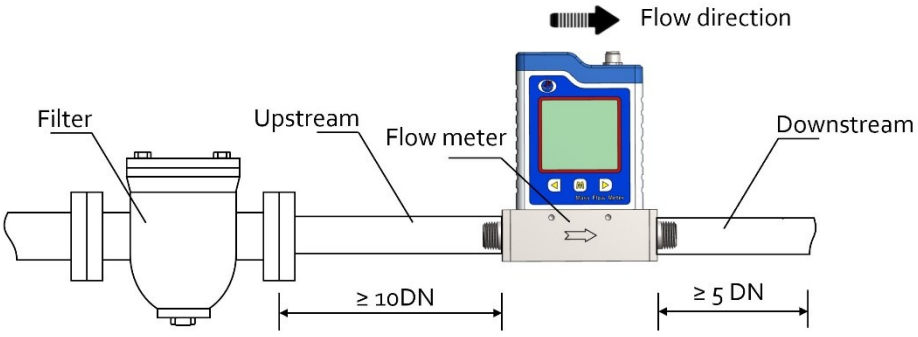


Figure 4.1: MF5000 meter installation

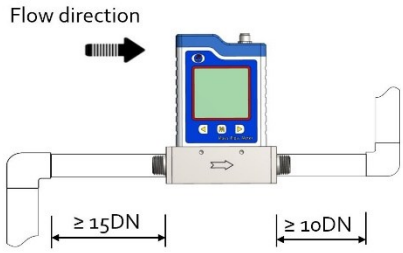
Please follow the following steps to complete the installation:

a) Upon opening the package, the product's physical integrity should be inspected to ensure no visual damage.

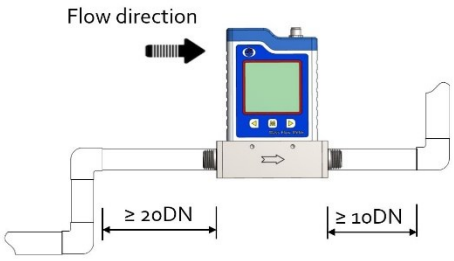
b) Before installation of the product, please ensure that the pipe debris or particles, or any other foreign materials, are completely removed.

c) Cautions during installation:

i) It is preferable to install/connect the meter inlet first and then the outlet end of the meter. To ensure measurement accuracy, an upstream straight pipe of length no less than 10DN and a downstream straight pipe of length no less than 5DN should be in place. Please refer to the recommended installation configuration below.



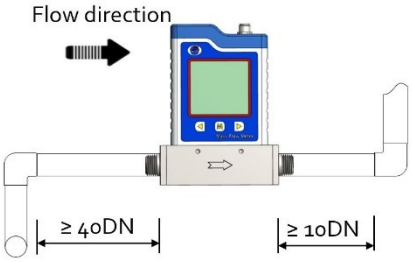
(a) 90-degree elbow or T-piece



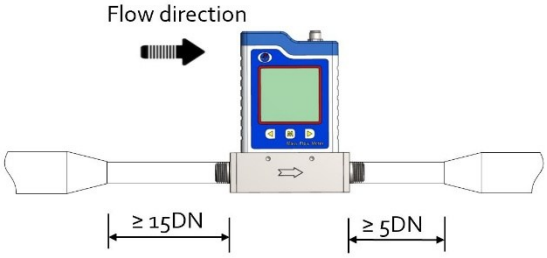
(b) 2x90-degree elbow

Figure 4.2: MF5000 meter installation

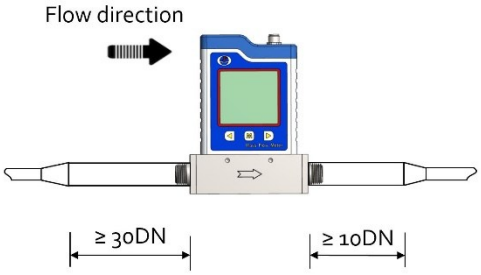
(ii) If the upstream or downstream pipe size is different from that of the product, the size of the installation line pipe diameter(s) should be larger than the flow channel (pipe) size of the meters to be installed. For some typical situations, please follow the installation recommendations detailed in the following sketches.



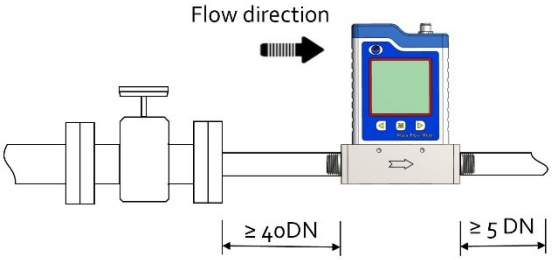
(c) 2x90-degree elbow, 3D



(d) Pipe size-reduction



(e) Pipe size expansion



(f) Control valve at upstream or downstream

Figure 4.3: MF5000 meter installation

(iii) During installation, please make sure no foreign materials (such as water, oil, dirt, particles, etc.) enter the installation pipeline.

d) Connect electrical wires per the wire definition in Table 3.3. Please be sure of the power supply range (i.e., 12~24 Vdc) and power supply polarization. Any third-party adapter must meet industrial standards and have all safety certifications.

e) For the data communication wire connection, please follow the description in Table 3.3 and make sure that the wires are correctly connected to the proper ports on your data device/equipment. The data cable must meet industrial standards with shielding.

f) Once the external power is successfully connected, the LCD should be lit up with the proper information displayed to work correctly.

g) Slowly open the valve(s) if any, upstream or downstream, or both of the pipeline, and the meter should then start to measure the flow in the pipeline. Note: The meter has an extensive dynamic measurement range. It would be normal for a tiny instant flow rate to exist before you open the valve. It could be from leakage. However, before use, the meter should read null when there is no flow present in the pipeline.

h) This will conclude the installation.



Cautions:

a) Don't alter any parts of the product.

b) Ensure the electrical connection is done correctly per the instructions.

c) Make sure no mechanical stresses in the connections.

d) The strong electromagnetic interference sources close by or any mechanical shocks at the pipeline may also create malfunctioning of the product.

e) Slowly open/close valves to prevent abrupt pulse flow impact.

5. Operation and MENU description

5.1 Check the product specifications

Before using this product, verify the product specifications in this manual or the basic information in the datasheet on the company's website www.Siargo.com.

The detailed product technical specifications can be found in Section 7. For a specific application, the pressure rating must be lower than the system pressure. The flow range should also be within the specified range. The gas medium for the controller must also be consistent with that specified by the product. Be particularly cautious about the supplied voltage indicated in the specification. A higher voltage may lead to irreparable damage. A lower voltage will not power the product for any desired functions.

For the product's optimal performance, the gas to be applied must be clean and free of particles or other foreign materials.

5.2 Check the leakage

Check gas leakage in the pipe system before the operation. Pressurized nitrogen or air can be used for the leakage check.

5.3 Power the meter and digital data connection

Although this product complies with the CE-required EMC regulations, it also requires that the product usage follows standard electrical device practice. Before connecting the product to external DC power, make sure the supply voltage is within the range specified in Section 7. Be cautious of standard electrical device precautions, such as ESD(electrostatic discharge) and DC voltage, which are observed. Excessive electrostatic discharge may damage the product.

The manufacturer-supplied power and data cable has a locking fixture. Fasten the cable until it is properly engaged and will not be accidentally unplugged.

Half-duplex RS485 Modbus is used for digital data communication. Make sure the wires are correctly connected to the receiver side.

5.4 Meter MENU descriptions

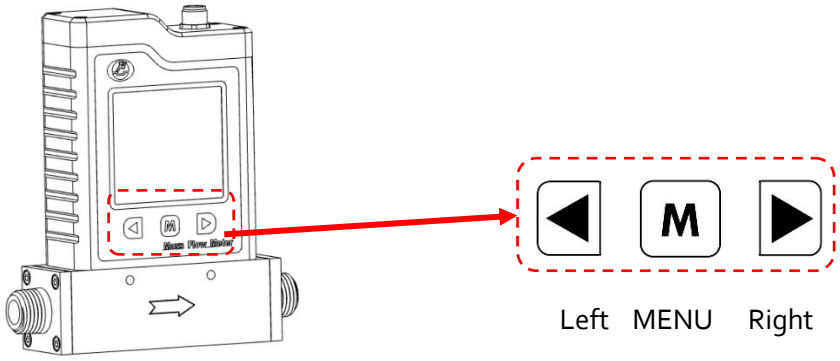


Figure 5.1: MF5000 keyboard

A front 3-key board is used to program the desired functions, access data, and check the status. The Menu key (M) is in the central position. It is used to select and confirm a function, or other related actions that will be detailed below. Two keys ("Left" and "Right") are used to select the menu and submenu.

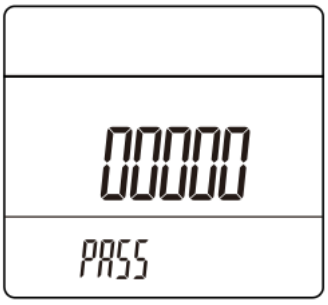
5.4.1 Starting the measurement

Once the power is supplied and no abnormal issues are observed, the meter is ready to perform the measurements. The default display is for the mass flow measurement, having two numerical lines on the LCD. The middle line displays the accumulated or totalized flow rate, and the instant flow rate is displayed on the lower line. The upper line will light up when the pressure or temperature option is selected.

The characters displayed are limited by the LCD capability. The following table lists the corresponding characters.

A/a	B/b	C/c	D/d	E/e	F/f	G/g	H/h	I/i	J/j	K/k	L/l	M/m	N/n	O/o	P/p	Q/q	R/r
S/s	T/t	U/u	V/v	W/w	X/x	Y/y	Z/z	1	2	3	4	5	6	7	8	9	0

5.4.2 MENU entry with a verified password



At the flow measurement (primary) display, press the central "M" MENU key, which will enter the password setting and verification MENU. The default password is "11111". If the password is incorrect, the display will return to the main display.

To enter a new password, press the "Up" or "Down" key to change the digit that flashes, and press the "M" key to confirm. Repeat this process for all five digits, and the meter will enter the menu setting interface/screen.

Subsequently, the MENU allows the user to:

➢ Set Modbus address	F2 - Addr
➢ Change communication baud rate	F3 - bPS
➢ Reset or calibrate the offset	F11 - oFFST
➢ Enter the gas conversion factor (GCF)	F12 - GCF
➢ Set the 2nd-correction factor	F14 - Corr
➢ Change the response time	F16 - rESPS
➢ Set the unit for the accumulated or totalized flow rate	F31 - UnT-A
➢ Set the unit for the instant flow rate	F32 - UnT-F
➢ Change the default password	F91 - PASS
➢ Clear or reset the accumulated or totalized flow rate	F92 - CLr-A
➢ Reset the 2nd-correction factor	F94 - rS2nd
➢ Exit from the MENU	F99 - qUIT

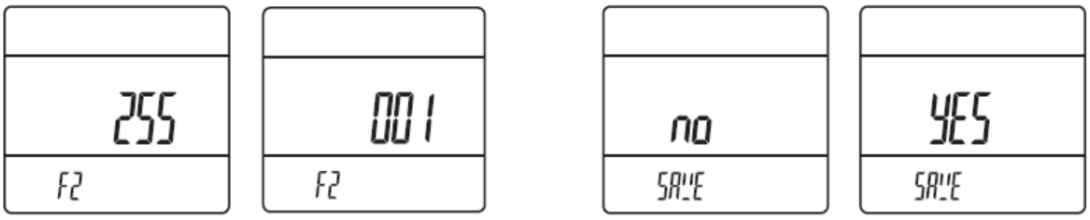
Note: During this process, the meter will continue to measure the flow without being interrupted.

5.4.3 Set the RS485 Modbus address

After the password is verified and entered into the MENU settings, press the "Up" or "Down" key until the screen shows the F2-Addr as indicated to the left.

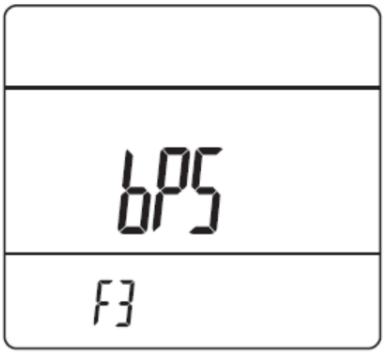


The Modbus address has three digits, which can be any number between 001 and 255. Press the "M" key to enter the change address screen. Press the "Up" or "Down" key to change the flashing digits, and then press the "M" key to confirm. After the address is set, the display will return to F2 - Addr, which indicates the task is completed. Press the "Up" or "Down" key to select F99 - qUIT and the "M" key to exit the MENU and return to the Main Display screen.

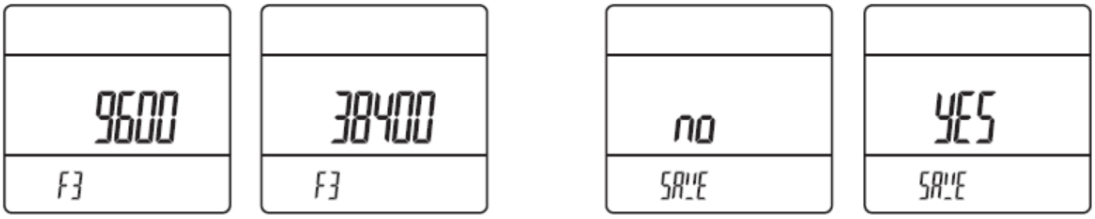


5.4.4 Set the RS485 communication baud rate

Following the above steps, at the MENU setting screen, use the "Up" or "Down" key to select F3-bPS and then press the "M" key to set the RS485 communication baud rate.

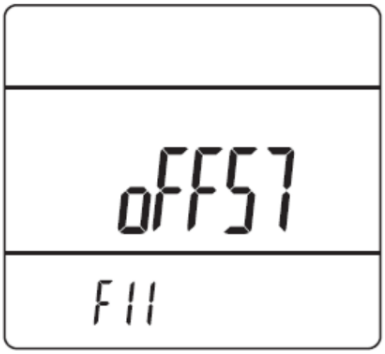


There are 6 baud rates selectable, depending on your system requirements: 4800, 9600, 19200, 38400, 57600, and 115200. The default baud rate is 9600. Use the "Up" or "Down" key to select the desired one and press the "M" key to confirm. The display will then return to the F3-bPS screen, which indicates the task is completed. Use the "Up" or "Down" key to select F99 - qUIT and the "M" key to exit the MENU and return to the Main Display screen.



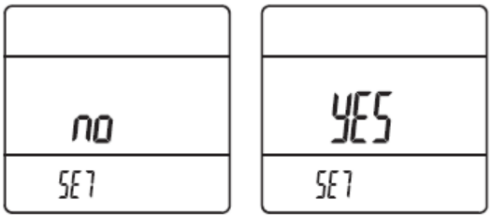
5.4.5 Reset or calibrate the offset

After a certain usage, the meter's offset (zero flow rate) might have a small shift. Or when you apply the meter for different gases, the offset might be shifted. To ensure measurement accuracy, it is necessary to reset or calibrate the offset. Following the above steps, at the MENU setting screen, use the "Up" or "Down" key to select F11 - oFFST. Before performing the task, ensure there is no flow in the flow channel; otherwise, it will lead to even bigger erroneous measurement results.



Press the "M" key to confirm the task, and it will open the sub-MENU asking you to confirm. Use the "Up" or "Down" key to select the desired one and press the "M" key to confirm. The display will then return to the F11 - oFFST screen, which indicates the task is

completed. Use the "Up" or "Down" key to select F99 - qUIT and the "M" key to exit the MENU and return to the Main Display screen.

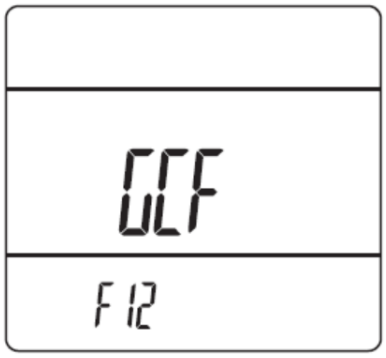


5.4.6 Gas conversion factor (GCF) for different gas measurements

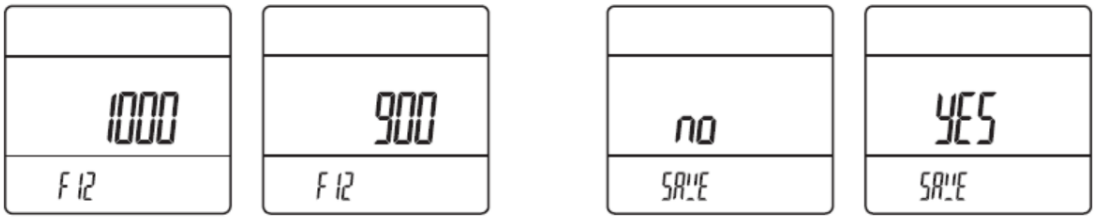
For the general purpose of the application, a gas conversion factor (GCF) can be applied to gases differently from the default one or the one used for calibration. The GCF is determined by the thermal calorimetric sensing principle, as well as the meter fluidic dynamic design and the control circuitry. Contact the manufacturer for the GCF.

The GCF for air is 1000.

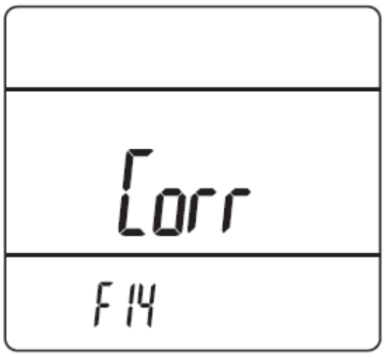
Note: If the meter is ordered for a special real gas calibration, contact the manufacturer before proceeding further.



Following the above steps, at the MENU setting screen, use the "Up" or "Down" key to select F12 - GCF. Press the "M" key to confirm, and it will open the sub-MENU showing the current gas conversion value. Use the "Up" or "Down" and the "M" key to input the desired value. Press the "M" key again to complete the task. The display will then return to the F12 - GCF screen, which indicates the task is completed. Use the "Up" or "Down" key to select F99 - qUIT and the "M" key to exit the MENU and return to the Main Display screen.



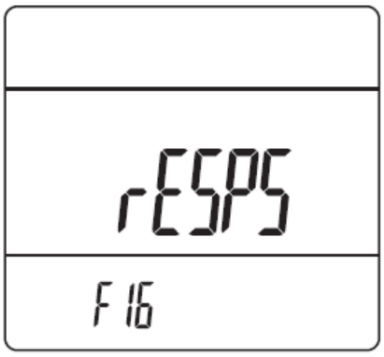
5.4.7 Set the 2nd-correction factor



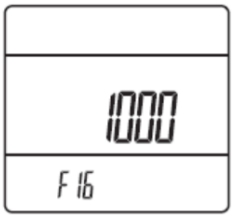
Following the above steps, at the MENU setting screen, use the "Up" or "Down" key to select F14 - Corr and then press the "M" key to set the 2nd correction factor.

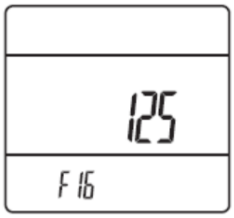
5.4.8 Set the Response Time

Following the above steps, at the MENU setting screen, use the "Up" or "Down" key to select F16 - rESPS and then press the "M" key to set the response time.



There are six response times selectable: 125, 250, 500, 1000, 2000, and 5000. The unit is in milliseconds. The default response time is 125 msec. Use the "Up" or "Down" key to select the desired one and press the "M" key to confirm. The display will then return to the F16 - rESPS screen, which indicates the task is completed. Use the "Up" or "Down" key to select F99 - qUIT and the "M" key to exit the MENU and return to the Main Display screen.



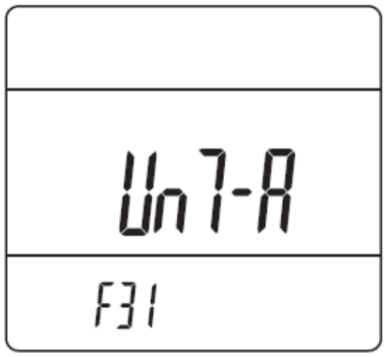


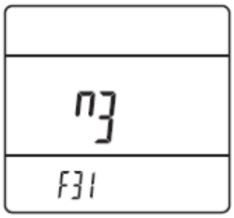


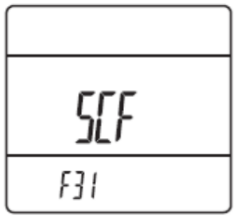


5.4.9 Set the unit for the accumulated or totalized flow rate

This function is used to set the unit of accumulated flow. To switch between m^3 and SCF, at the MENU setting screen, use the "Up" or "Down" key to select F31 - UnT-A. Press the "M" key to confirm, and it will open the sub-MENU showing the current unit of accumulated flow. Use the "Up" or "Down" keys and the "M" key to confirm your selection. Press the "M" key again to complete the task. The display will then return to the F31 – UnT-A screen, which indicates the task is completed. Use the "Up" or "Down" key to select F99 - qUIT and the "M" key to exit the MENU and return to the Main Display screen.





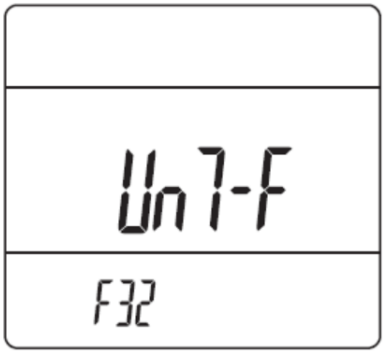


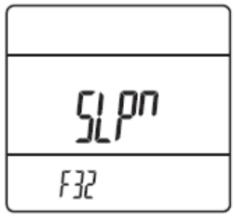




5.4.10 Set the unit for the instant flow rate

This function is used to set the unit for an instant flow rate. To switch between SLPM, m^3/h (m3PH), and SCFM, on the MENU setting screen, use the "Up" or "Down" key to select F32 - UnT-F. Press the "M" key to confirm, and it will open the sub-MENU showing the current unit of accumulated flow. Use the "Up" or "Down" keys and the "M" key to confirm your selection. Press the "M" key again to complete the task. The display will then return to the F32 - UnT-F screen, which indicates the task is completed. Use the "Up" or "Down" key to select F99 - qUIT and the "M" key to exit the MENU and return to the Main Display screen.







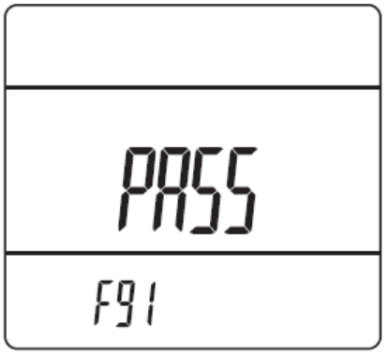






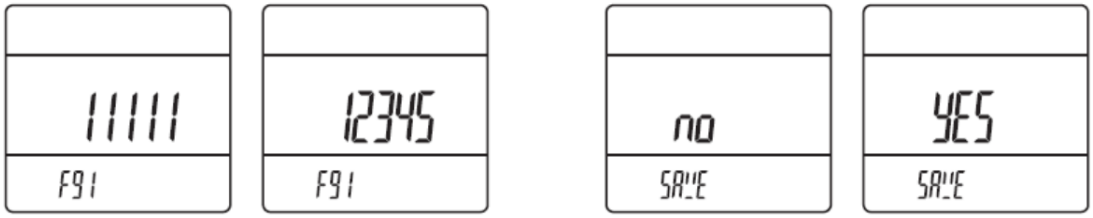
5.4.11 Change the default password

For safety reasons, it is recommended that the user change the default password 11111 before using this product.



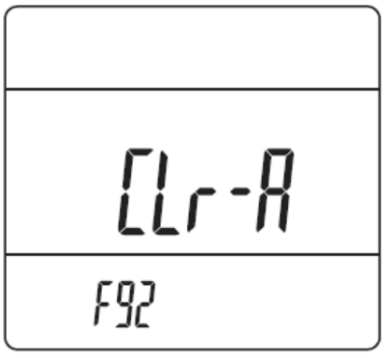
Following the above steps, at the MENU setting screen, use the "Up" or "Down" key to select F91 - PASS. Press the "M" key to confirm, and it will open the sub-MENU showing the default password of 11111. Use the "Up" or "Down" and the "M" confirming key to input the desired value. Press the "M" key again to complete the task. The display will then return to the F91 - PASS screen, which indicates the task is completed. Use the "Up" or "Down" key to select F99 - qUIT and the "M" key to exit the MENU and return to the Main Display screen.

Please keep the changed password in a safe yet accessible place. If it is unrecoverable, contact the manufacturer for a special password to access the meter MENU.



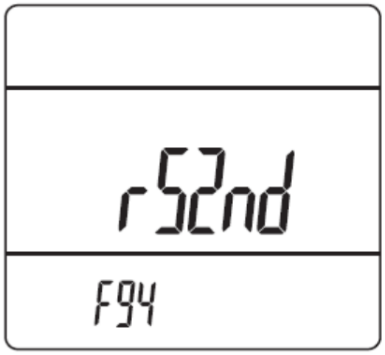
5.4.12 Reset the accumulated or totalized flow rate

The maximum value of the accumulated or totalized flow rate that the internal register can have is 9999999. The register will stop accumulating once the value is reached. At this time, it is necessary to reset this register. Following the above steps, at the MENU setting screen, use the "Up" or "Down" key to select F92 - CLr-A. Press the "M" key to confirm, and it will open the sub-MENU for resetting the value. Use the "Up" or "Down" keys to select, and the "M" key to confirm. Press the "M" key again to complete the task. The display will then return to the F92 - CLr-A screen, which indicates the task is completed. Use the "Up" or "Down" key to select F99 - qUIT and the "M" key to exit the MENU and return to the Main Display screen.



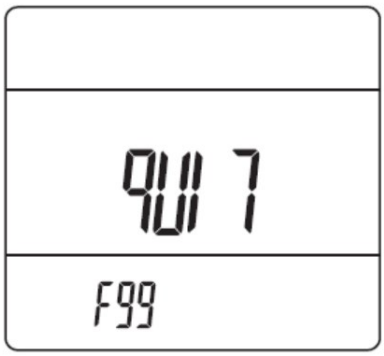


5.4.13 Reset the 2nd-correction factor

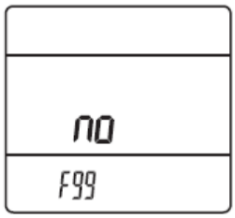


Following the above steps, at the MENU setting screen, use the "Up" or "Down" key to select F14 - Corr and then press the "M" key to set the 2nd correction factor.

5.4.14 Exit the MENU



At the MENU settings, use the "Up" or "Down" key to select the F99 - qUIT option and press the "M" confirming key to exit the MENU settings and return to the Main Display screen.





5.4.15 MENU key sequence for the settings

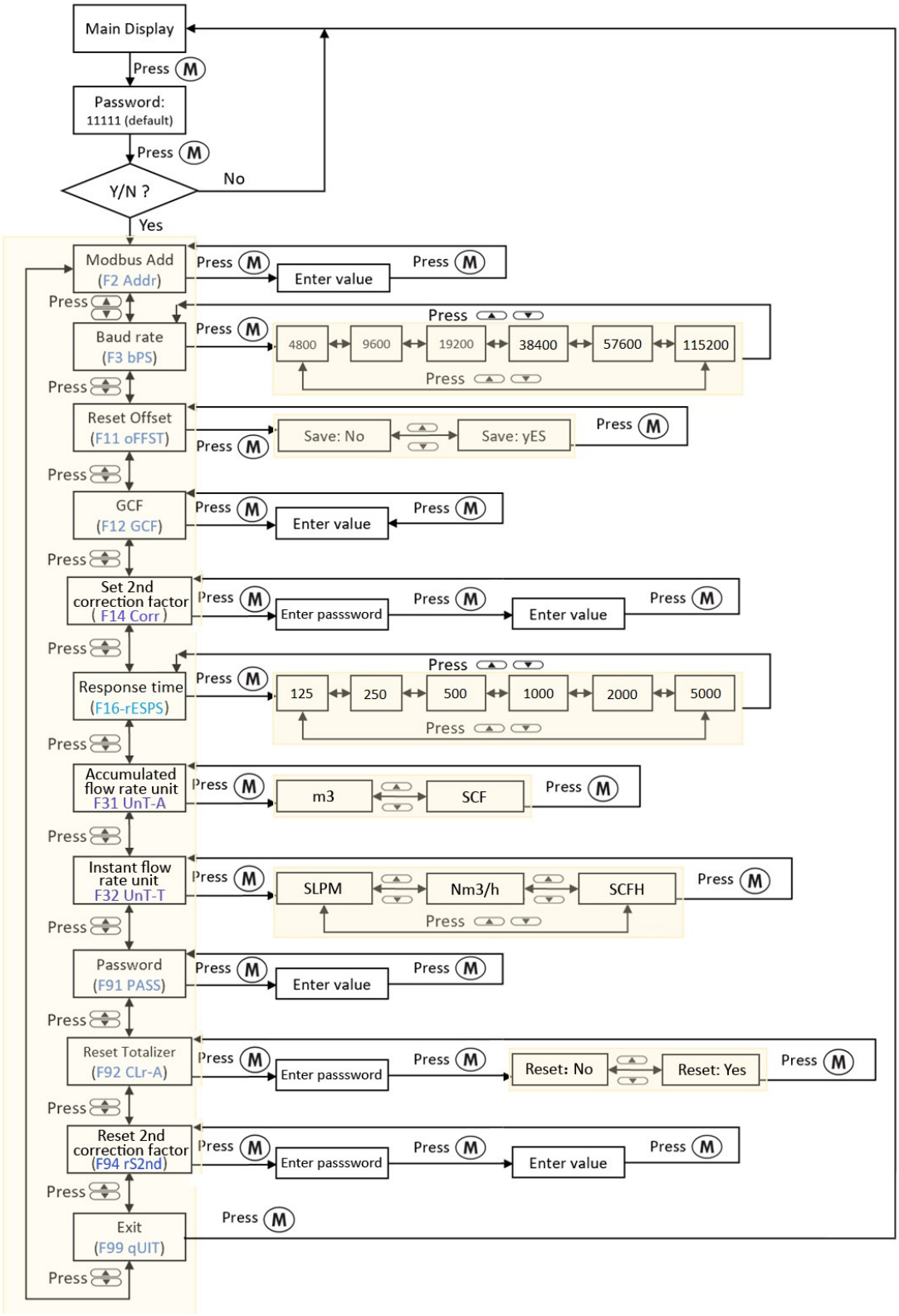


Figure 5.2: MF5000 MENU key sequence.

5.5 RS485 Modbus communication protocol

The digital communication protocol is based on standard Modbus RTU Half-plex mode. A master (PC or PLC) can communicate with multiple slaves (the current product) for data exchange and configure the communication parameters. Refer to Table 3.2 for the cable connection.

5.5.1 Hardware connection

The hardware layer is TIA/EIA-485-A, as illustrated. In this configuration, the product (MF5000) is a slave.

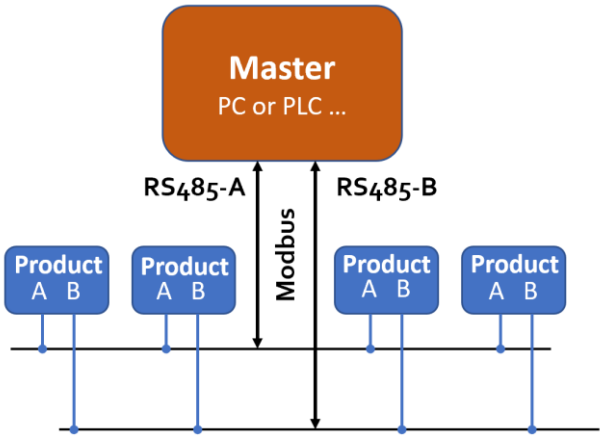


Figure 5.3: RS485 hardware connection

5.5.2 Communication parameters

The PC UART communication parameters are listed in the following table.

Parameters	Protocol
	RTU
Baud rate (Bits per second)	9600 bps
Start bits	1
Data bits	8
Stop bits	1
Even/Odd parity	None
Bits period	104.2 µsec
Bytes period	1.1458 msec
Maximum data length	20
Maximum nodes	247

5.5.3 Frame

The frame function is based on the standard Modbus RTU framing:

Start_bits	Address	Function codes	Data	CRC	Stop_bits
T1-T2-T3-T4	8 bit	8 bit	N 8 bit (20≥n≥0)	16 bit	T1-T2-T3-T4

Start_bits: 4 periods bit time, for a new frame.

Address: The address can be set from 1 to 247, excluding 157 (0x9d). 0 is the broadcast address.

Function codes: Define the product (MF5900)'s functions/actions (slaves), either execution or response.

Data: The address of the register, the length of data, and the data themselves.

CRC: CRC verification code. The low byte is followed by the high byte. For example, a 16-bit CRC is divided into BYTE_H and BYTE_L. In the framing, the BYTE_L will come first, followed by the BYTE_H. The last one is the STOP signal.

Stop_bits: 4 periods bit time, for ending the current frame.

5.5.4 Function codes

The Modbus function codes applied for the product are a subclass of the standard Modbus function codes. These codes are used to set or read the registers of the product:

Code	Name	Functions
0x03	Read register	Read register(s)
0x06	Set a single register	Write one single 16-bit register
0x10	Set multiple registers	Write multiple registers

5.5.5 Registers

The product (MF5000) has multiple registers available for various functions. With these functions, the user can acquire data from the products, such as product address and flow rates from the registers, or set the product functions by writing the corresponding parameters.

The currently available registers are listed in the following table. The registers may be customized upon contacting the manufacturer. Where R: read; W: write-only; W/R: read and write.

Note: At the time of shipping, the write protection function is enabled except for the address and baud rate. Once the user completes the register value change, write protection will be automatically enabled to prevent incidental data loss.

Functions	Description	Register	Modbus reference
Address	Product address (R/W)	0x0081	40130 (0x0081)
Serial number	Serial number of the product	0x0030~0x0035	40049 (0x0030)
Flow rate	Current flow rate (R)	0x003A~0x003B	40059 (0x003A)
Accumulated flow	Accumulated or totalized flow rate (R)	0x003C~0x003E	40061 (0x003C)
Baud rate	Communication (R/W)	0x0082	40131 (0x0082)
GCF*	Gas correction factor (R/W)	0x008B	40140 (0x008B)
Response time*	Set the response time (R/W)	0x008D	40142 (0x008D)
Units*	Instant and accumulated flow rate units (R/W)	0x0090	40145 (0x0090)
Password*	Password change (R/W)	0x00AE~0x00AF	40175 (0x00AE)
Reset offset	Reset or calibrate the offset (W)	0x00F0	40241 (0x00F0)
Reset totalizer*	Reset accumulated or totalized flow rate (W)	0x00F2	40243 (0x00F2)
Write protection	Write protection of selected parameters (W)	0x00FF	40256 (0x00FF)

Notes: 1, R – Read-only, W – Write only, R/W – Read and write.

2. For the * marked functions, you need to disable the write protection before setting.

The detailed information of each register is described below: Y: enabled; N: disabled

Address	**0x0081**	**Write**	Y
		Read	Y
Description	RS485 Modbus address of the flow meter		
Value type	UINT 16		
Notes	Values range from 1 to 247, excluding 157 (0x9d). Broadcast address 0 is not enabled; the default address is 1.		

SN, Serial number	**0x0030 ~ 0x0035**	**Write**	N
		Read	Y
Description	Series Number of the product, SN		
Value type	ASCII		
Notes	SN= value(0x0007), value(0x0008),….,value (0x000C); **e.g.:** Receiving 12 bits as: 0x2A47, 0x3741, 0x4549, 0x3032, 0x3035, 0x382A , the corresponding Serial Number is **G7AEI02058**.		

Instant flow rate	**0x003A ~ 0x003B**	**Write**	N
		Read	Y
Description	Instant flow rate		
Value type	UINT 32		
Notes	Flow rate = [Value (0x003A)*65536 + value (0x003B)]/1000 **e.g.:** For a flow rate of 20.340 L/min, the user will read "0 (0x0000)" from register 0x003A and "20340 (0x4F74)" from register 0x003B, therefore Current flow rate = (0*65536+20340)/1000 = 20.340		

Accumulated flow rate	0x003C ~ 0x003E	Write	N
		Read	Y
Description	Accumulated or totalized flow rate		
Value type	UINT 32 + UNIT 16		
Notes	Accumulated flow rate = Value (0x003C) * 65536 + Value (0x003D) + Value (0x003E)/1000 **e.g.:** For an accumulated flow rate of 3452.245 m^3, the user will read "0 (0x0000)" from register 0x003C; "3452 (0x0D7C)" from register 0x003D, and "245 (0x00F5)" from register 0x003E. Then, the accumulated flow rate = 0 + 3425 + 245/1000=3425.245.		

Baud rate	0x0082	Write	Y
		Read	Y
Description	Communication baud rate with a PC		
Value type	UINT 16		
Notes	0 - 4800; 1 - 9600; 2 - 19200; 3 - 38400; 4 - 57600; 5 - 115200. The default value is 1, and the baud rate is 9600. **e.g.,** when the user reads "2 (0x0002)" from register 0x0082, the baud rate is 19200.		

GCF	0x008B	Write	Y
		Read	Y
Description	The gas conversion factor for a gas is different from the calibration gas.		
Value type	UINT 16		
Notes	The air (default) is 1000, usually read from register 0x008B. **The product will disable this function with write protection once the metering gas is confirmed with the proper GCF.** For a specific GCF value, contact the manufacturer. **Notes: Please disable the write protection before executing this function.**		

Response time	0x008D	Write	Y
		Read	Y
Description	Set response time		
Value type	UINT 16		
Notes	125, 250, 500, 1000, 2000, or 5000, the unit is in milliseconds. The default value is 125 msec. **For example, when** the user reads "2000" from register 0x008D, the response time is 2000 msec. (2 sec). **Notes: Please disable the write protection before executing this function.**		

Units	0x0090	Write	Y
		Read	Y
Description	Set the instant flow rate unit and the accumulated or totalized flow rate unit.		
Value type	UINT 16		

Notes	5 - instant flow rate unit m^3/h, accumulated or totalized flow rate unit m^3; 8 - instant flow rate unit SLPM, accumulated or totalized flow rate unit m^3; 9 - Instant flow rate unit: SCFM, accumulated or totalized flow rate unit: SCF. The default value is 8. **For example, when the user reads "8" from register 0x0090, the instant flow rate unit is SLPM, and** the accumulated or totalized flow rate unit is m^3. **Notes: Please disable the write protection before executing this function.**

Change password	**0x00AE ~ 0x00AF**	**Write**	Y
		Read	Y
Description	Change the default password.		
Value type	UINT 32		
Notes	Password values = Value (0x00AE)*65536 + Value (0x00AF) Available: 00000 ~ 99999 **Notes: Please disable the write protection before executing this function.**		

Offset calibration	**0x00F0**	**Write**	Y
		Read	N
Description	Reset or calibrate the offset.		
Value type	UINT 16, Fixed value 0xAA55		
Notes	To reset or calibrate the offset, write 0xAA55 to register 0x00F0. **Notes: When you execute this function, make sure there is NO flow in the flow channel.**		

Reset the accumulated flow rate	**0x00F2**	**Write**	Y
		Read	N
Description	Reset the accumulated or totalized flow rate value.		
Value type	UINT 16, Fixed value 0x0001		
Notes	To reset the accumulated or totalized flow rate value, write 0x0001 to register 0x00F2. **Notes: Please disable the write protection before executing this function.**		

Write protection	**0x00FF**	**Write**	Y
		Read	N
Description	Write protection disabler for a set value to a specific register.		
Value type	UINT 16, Fixed value 0xAA55		
Notes	This function is enabled at the time of product shipment. To enable the write function of a specific parameter, such as GCF, send 0xAA55 to the register 0x00FF, and then the write function will be enabled (write protection is disabled). After the write execution is completed, the firmware will automatically re-enable the write protection.		

5.6 Analog (4 ~ 20 mA) output

The loop resistor connection is illustrated in the graph below. The current output load depends on the power supply (yellow-colored area in the graph). The maximum load resistor, R_L, with a 24-Vdc supply, will be 450 Ohms.

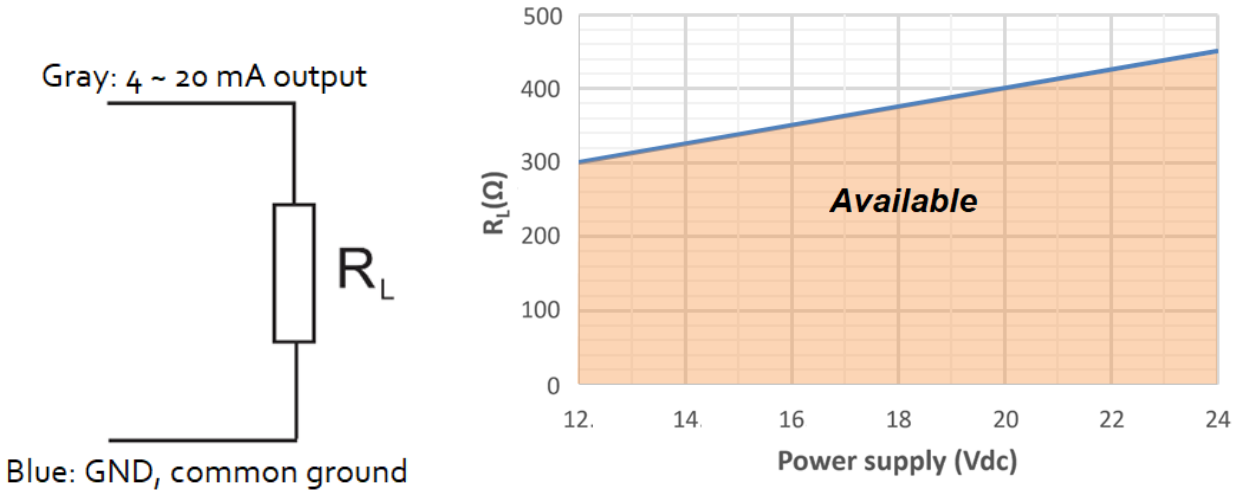
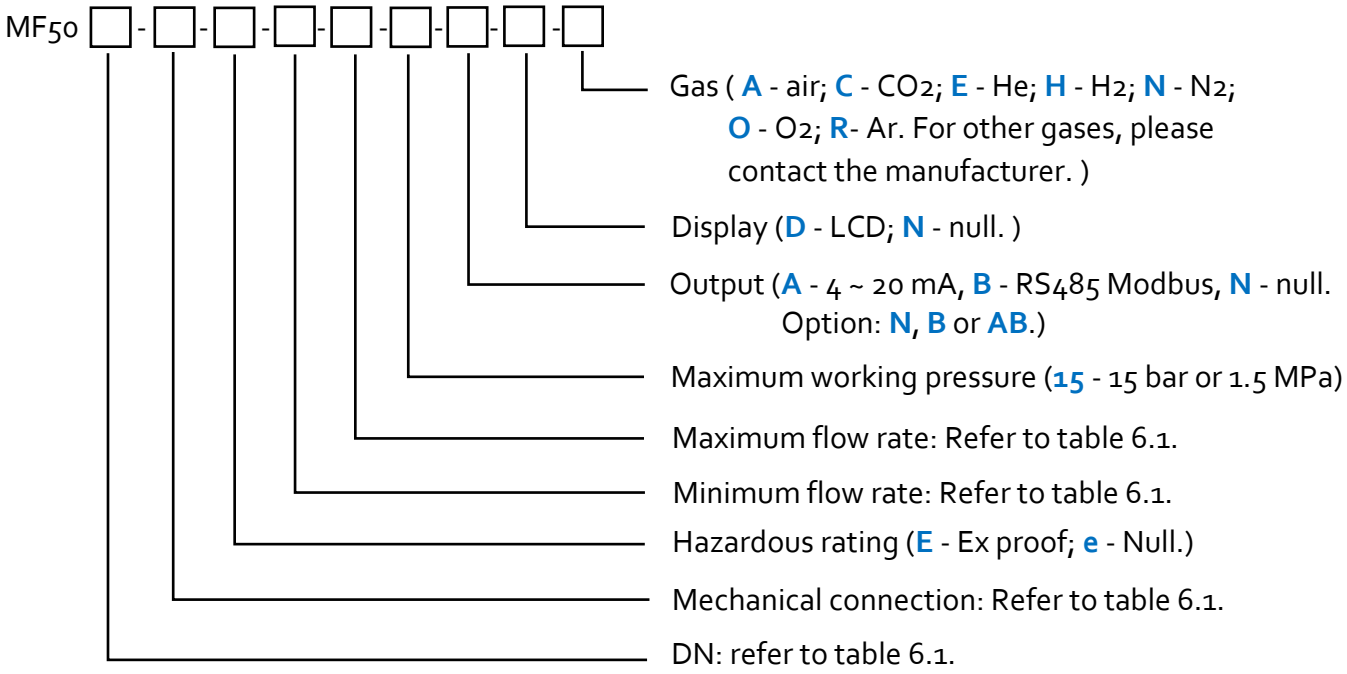


Figure 5.4: Analog output.

6. Product selection

The product part number is composed of the product model number and suffixes indicating the full-scale flow rate, as well as the other parameters. Refer to the following for details.



Note: Explosive proof: Ex ia IIC T4 Gb.

Table 6.1: Mechanical connection and flow range of all models.

Model	DN (mm)	Mechanical connection	Flow range		
			SLPM	m^3/h	SCFM
MF5003	3.0	N1M: NPT 1/8 male N1F: NPT 1/8 female	0.15 ~ 15		-
MF5006	6.0	N2M: NPT 1/4 male N2F: NPT 1/4 female	0.5 ~ 50	0.03 ~ 3	0.02 ~ 2
MF5008	8.0	N3M: NPT 3/8 male N3F: NPT 3/8 female	1.2 ~ 120	0.072 ~ 7.2	0.05 ~ 5
MF5012	12.0	N4M: NPT 1/2 male N4F: NPT 1/2 female	3 ~ 300	0.18 ~ 18	0.1 ~ 10
MF5019	19.0	N6M: NPT 3/4 male N6F: NPT 3/4 female	8 ~ 800	0.48 ~ 48	0.3 ~ 30

e.g., MF5006-N2F-E-0.5-5-15-AB-D-A

7. Technical specifications

7.1 Specifications

All specifications listed in the following table, unless otherwise noted, apply for calibration conditions at 20°C and 101.325 kPa absolute pressure with air. The product is horizontally mounted during calibration.

	Value	Unit
Full-scale flow range	See Table 6.1	SLPM
Accuracy	±(1.5+0.20FS)	%
Repeatability	(0.5+0.05FS)	%
Turn-down ratio	100:1	
Working temperature	-20 ~ +60	°C
Maximum pressure	1.5	MPa
Humidity	<95, no condensation	%RH
Power supply	12 ~ 24 (50 mA)	Vdc
Output*	RS485 Modbus half-duplex / 4 ~ 20 mA	
MENU access	3 key – front face keyboard/digital	
Display	Instant flow rate, Accumulated or totalized flow rate	
Mechanical connection	NPT or customized	
Hazardous rating	Ex ia IIC T4 Gb / Class I, Div. 1, zone 0, Group A, T4	
Protection	IP66	
Storage temperature	-20 ~ +70	°C
Reference conditions	20°C, 101.325 kPa, air	
Fluid compatibility	Non-corrosive	
CE	EN61326-1; -2; -3	

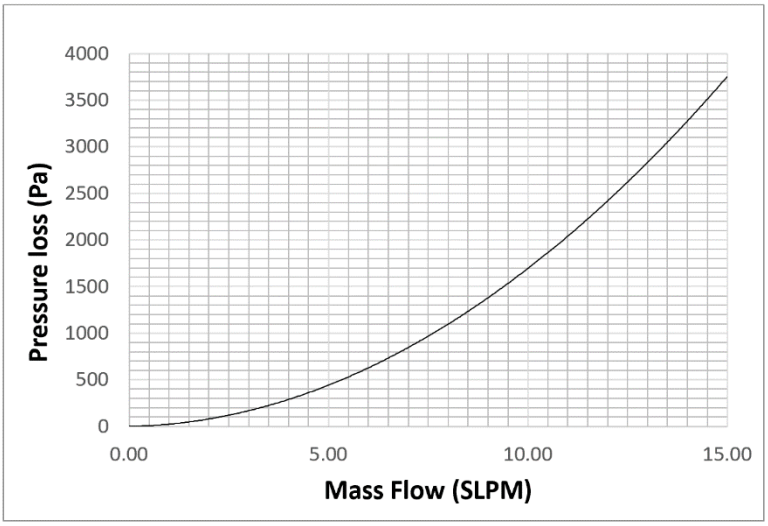
	MF5003	MF5006	MF5008	MF5012	MF5019	
Maximum overflow	30	120	200	450	1200	SLPM
Maximum flow change	4	15	30	60	150	SLPM/sec

Note: For other features or specifications not listed, contact the manufacturer.

7.2 Pressure loss

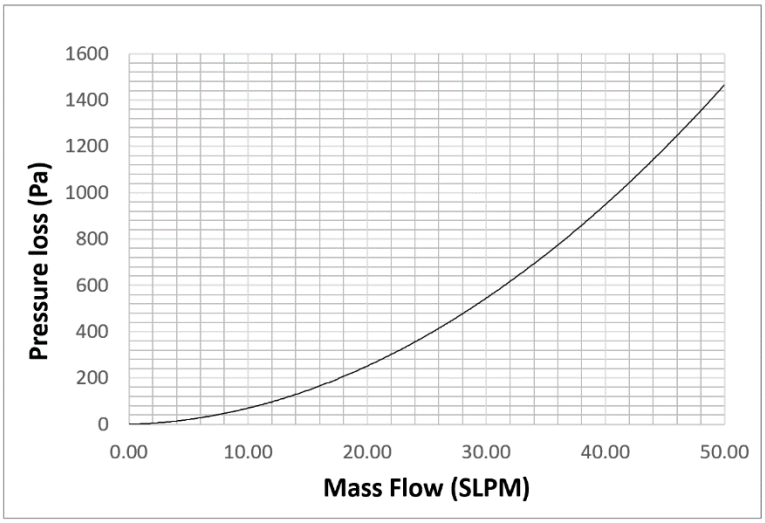
7.2.1 MF5003

Flow rate (SLPM)	Pressure loss (Pa/PSI)
2.0	80 / 0.012
4.0	290 / 0.042
6.0	630 / 0.091
8.0	1100 / 0.159
10.0	1690 / 0.245
12.0	2420 / 0.351
15.0	3750 / 0.544



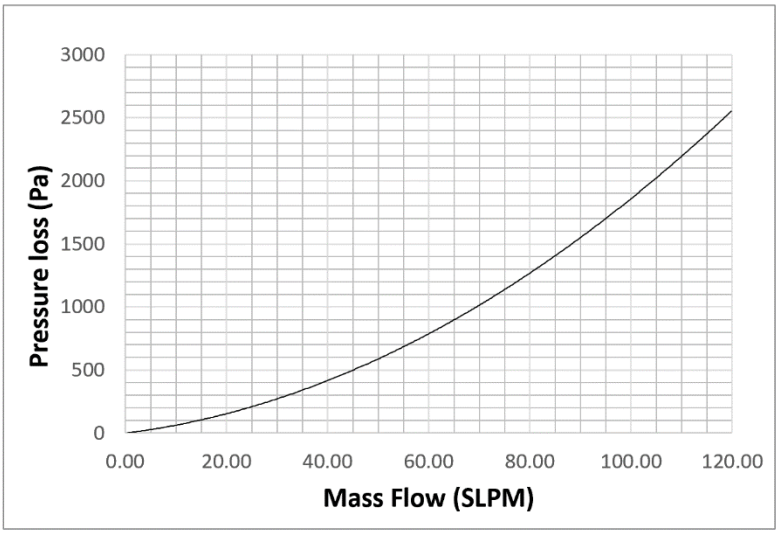
7.2.2 MF5006

Flow rate (SLPM)	Pressure loss (Pa/PSI)
2.0	5 / 0.001
5.0	21 / 0.003
10.0	70 / 0.010
20.0	250 / 0.036
30.0	540 / 0.079
40.0	950 / 0.138
50.0	1460 / 0.213



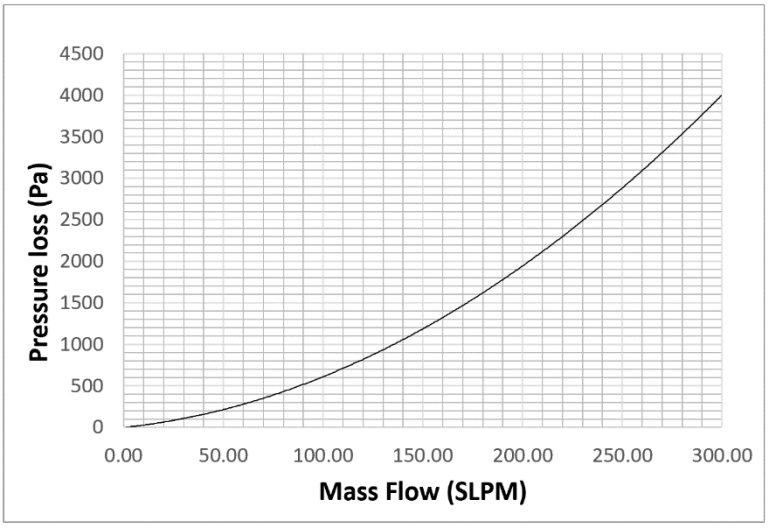
7.2.3 MF5008

Flow rate (SLPM)	Pressure loss (Pa/PSI)
5.0	30 / 0.004
10.0	65 / 0.009
20.0	150 / 0.022
40.0	415 / 0.060
60.0	790 / 0.114
80.0	1270 / 0.184
100.0	1860 / 0.270
120.0	2560 / 0.371



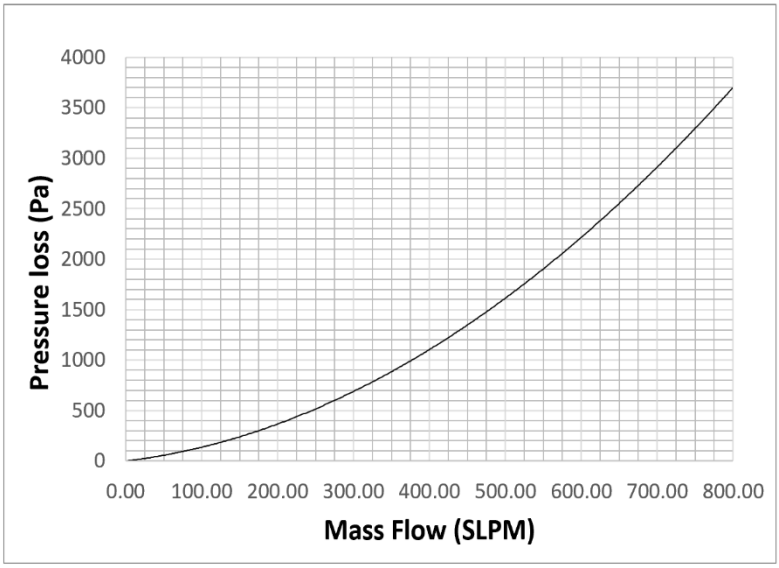
7.2.4 MF5012

Flow rate (SLPM)	Pressure loss (Pa/PSI)
30.0	110 / 0.016
50.0	215 / 0.031
70.0	350 / 0.051
100.0	610 / 0.088
150.0	1185 / 0.173
200.0	1950 / 0.282
250.0	2885 / 0.418
300.0	4000 / 0.581



7.2.5 MF5019

Flow rate (SLPM)	Pressure loss (Pa/PSI)
50.0	60 / 0.008
100.0	140 / 0.020
200.0	370 / 0.053
300.0	695 / 0.100
400.0	1110 / 0.161
500.0	1625 / 0.236
600.0	2230 / 0.324
700.0	2930 / 0.425
800.0	3730 / 0.541



7.3 Wetted materials

The wetted materials include silicon nitride, FR4, and epoxy (Loctite Ablestik 84-3J). The product flow channel is made of 304 stainless steel.

8. Technical notes for the product performance

8.1 Measurement principle

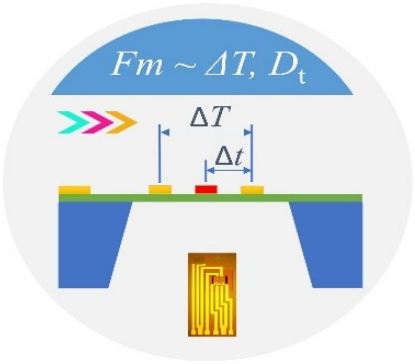


Figure 8.1: Measurement approach illustration.

The products utilize the Company's proprietary micro-machined (MEMS) thermal calorimetric sensing in time-domain data with a data processing algorithm (Thermal-D sensing). A thermal signal generator (microheater) with a pair of sensing elements is precisely manufactured upstream and downstream and separated at predefined micrometer distances on the chip surface under excellent thermal isolation. When a fluid flows through the sensing chip, the fluid carries the thermal signal downstream. The sensing elements register the amplitude, time, and temperature differences. It calculates the thermal diffusivity and further correlates with the fluid mass flow rate during the calibration process.

This unique thermal sensing approach offers an extensive dynamic range with better performance against environmental parameter alternations. It is the first of its kind in the industry, which allows gas property-independent mass flow measurements for gases with similar thermal diffusivities. It significantly simplifies process control with high precision and easy maintenance. Please refer to the company's USA patents and other publications made available for additional information.

8.2 Precautions for the best performance of the product

8.2.1 Comparison with a third-party reference meter

It is a general practice to compare the data from the product with a third-party reference meter, and in many cases, discrepancies can occur.

When performing such a comparison, please note that the reference meter should have a better-specified accuracy (approximately one-third of that specified by the product), and pay special attention to the differences in the reading accuracy and full-scale accuracy.

A full-scale accuracy = reading accuracy x (full-scale flow rate/ set point (current) flow rate)

Another key point to comparing the different flow meters is that as long as the fluidic flow is a continuous flow without pulsation, then the fluid dynamics will have the system following the Bernoulli equation:

$$P_1 + \frac{1}{2}\rho v_1^2 + \rho g h_1 = P_2 + \frac{1}{2}\rho v_2^2 + \rho g h_2$$

Where ρ is the fluid density, g is the acceleration due to gravity, P1 is the pressure of the reference meter, P2 is the pressure at the test meter, v1 is the velocity of the reference meter, and v2 is the velocity of the test meter. h1 and h2 are the corresponding heights for the meters, which are often the same in the system. Therefore, it will be essential to ensure the system has no pressure variation. (This explains our recommendations for the installations in Section 4). In addition, the meter measurement principle is often the key to understanding any discrepancies.

Please note that for comparison with a rotameter, the reading can have large deviations due to differences in measurement principles. Particularly, a rotameter is sensitive to pressure and temperature variations.

8.2.2 Particle contamination and fluidic cleanness

Any contamination, including particles and liquid vapors, would be detrimental to the accuracy of the flow measurement and the meter's functionality. It is critical to ensure that the applied flow medium is clean and dry. If contamination is suspected, please allow experienced technical personnel to check and recondition it. Do not use foreign cleansers or other fluids to clean the flow path, as they could cause irreparable damage.

8.2.3 Apply to a different gas medium

The product is calibrated using a high-precision NIST-traceable metrological standard and clean and dry air. With this unique thermal sensing technology, the product can be applied to meters and control other clean and dry gases with similar thermal diffusivities without losing accuracy. It has effectively resolved the nonlinearity issues when applying to a gas conversion factor in calorimetric sensing, making the measurement highly accurate with an extensive dynamic range. Applicable gases include air, N_2, O_2, Ar, CH_4, and CO.

This innovative product also follows the basic sensing principle described in the international standard for thermal mass flow meters (ISO 14511:2001 - Measurement of fluid flow in closed conduits — Thermal mass flowmeters). For gases with different diffusivities, a gas conversion factor could be applied. For more information, contact your sales representative or manufacturer.

Under normal operation conditions, the wetted materials are fully compatible with common gases, such as air, oxygen, nitrogen, argon, and carbon dioxide. If a special gas is applied, please check the

gas compatibility data with the manufacturer. In some cases, packing materials may need to be changed for gas compatibility, or additional hazardous zone certification will be required before the products can be used.

8.2.4 Recalibration and maintenance

The recalibration of the controller depends on usage and application requirements. Therefore, it is a decision by the applications.

If preferred, Siargo can offer free calibration software or a user application kit to facilitate the customer's calibration requirements. Alternatively, contact your sales representative or contact the manufacturer for assistance. Siargo calibrates all products with NIST (National Institute of Standards and Technology, USA) traceable calibrators.

For maintenance, the services must be performed by trained or certified technicians by Siargo. Any changes to the products will void the product warranty. It could lead to irreparable damage to the products and could result in unexpected injuries.

The products do not require regular maintenance if the specified application conditions are exactly observed. Maintenance is required if indications of contamination or malfunctions are verified. In this case, contact your sales representative or directly contact customer support (information available on the Company's webpage) to obtain an RMA (Return Material Authorization) before shipping the products back to the Company's support center. Siargo commits to responding as fast as possible. Regular service will be performed within five business days if no major parts change is required.

9. Troubleshooting

Phenomena	Possible causes	Actions
No signal/display.	The power is not connected.	Connect the power and then check the cable.
	Cable connection incorrect.	Check the cable.
	No flow or clogging.	Check flow and contamination.
	Power regulator failure.	Return to the factory.
	Sensor failure.	Return to the factory.
Significant errors or unexpected flow rate.	Particles, fluid type.	Check the system.
Erroneous or large noise.	Vibration, unstable flow.	Check the system.
Valve not work.	Wire connection, valve.	Return to the factory.
Offset unstable.	Circuitry instability.	Check the system, power off.
No digital interface.	Wrong address, software.	Check commands, connection.
No wireless, BT cannot pair.	Wrong model, data jam.	Check model, power off/on.
E1 code in LCD display.	Error 1 – Sensor error.	Return to the factory.
E2 code in LCD display.	Error 2 – ADC error.	Return to the factory.
E3 code in LCD display.	Error 3 – RTC error.	Return to the factory.
E4 code in LCD display.	Error 4 – EEPROM error.	Return to the factory.
E5 code in LCD display.	Error 5 – Oscillator (crystal) error.	Return to the factory.

10.Warranty and Liability

(Effective January 2018)

Siargo warrants that the products sold hereunder, when used and installed properly under normal circumstances and services, will be free from defects. As described in this user manual, it 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 repairs or replacement product shall bear the exact terms of 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. Users shall be held fully responsible for validating the performance and suitability of the products for their particular design and applications. For any misuse of the products beyond the scope described herein, the user shall indemnify and hold Siargo, its officers, employees, subsidiaries, affiliates, and sales channels harmless against all claims, costs, damages, expenses, and reasonable attorney fees 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, etc., or 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, strict 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. Regardless of form, no action 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 the 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. It shall not be amended, modified, or its terms waived except by Siargo's sole action.

The product information in this manual is believed to be accurate and reliable at the time of release. They are made available to users. However, Siargo shall assume no responsibility for any inaccuracies and/or errors and reserves the right 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, but not limited to those stated in this document or any other actions that cannot be deemed as proper use of the products;

(2) Products that have been subject to chemical attacks, including exposure to corrosive substances or contaminants. In the case of battery usage, long-term discharge, or leakage-induced damage;
(3) Products that have been opened or dismantled for whatever reason;
(4) Products that have been subject to working conditions beyond the technical specification as described by this manual or related datasheet published by the manufacturer;
(5) Any damages incurred by the incorrect usage of the products;
(6) Siargo does not provide any warranty on finished goods manufactured by others. Only the original manufacturer's warranty applies.
(7) Products resold by unauthorized dealers or any third parties.

11. Service/order contact and other information

Siargo Ltd. is making every effort to ensure the quality of its products. For any questions or product support, contact your direct sales representative. If you require additional assistance, contact the customer service at the address listed below. We will respond quickly to your requests and work with you to your complete satisfaction.

For sales or product orders, contact the local sales representatives or distributors listed on the company's webpage www.Siargo.com.

For any returns, contact your direct sales representative to obtain an RMA. For any further assistance, contact info@siargo.com to obtain additional information or a Return Materials Authorization (RMA) before shipping the product back to the factory for factory services such as calibration. In your email messages, please specify the status of the product you intend to return to the factory, and include your shipping address. Be sure to write the RMA on the returned package or include a letter with the RMA information.

Direct customer service request(s) should be addressed to

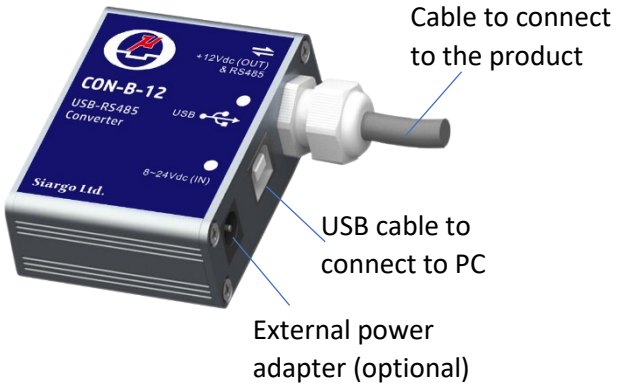
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Email: Info@Siargo.com

For further information and updates, please visit www.Siargo.com.

Appendix I: Product evaluation kit

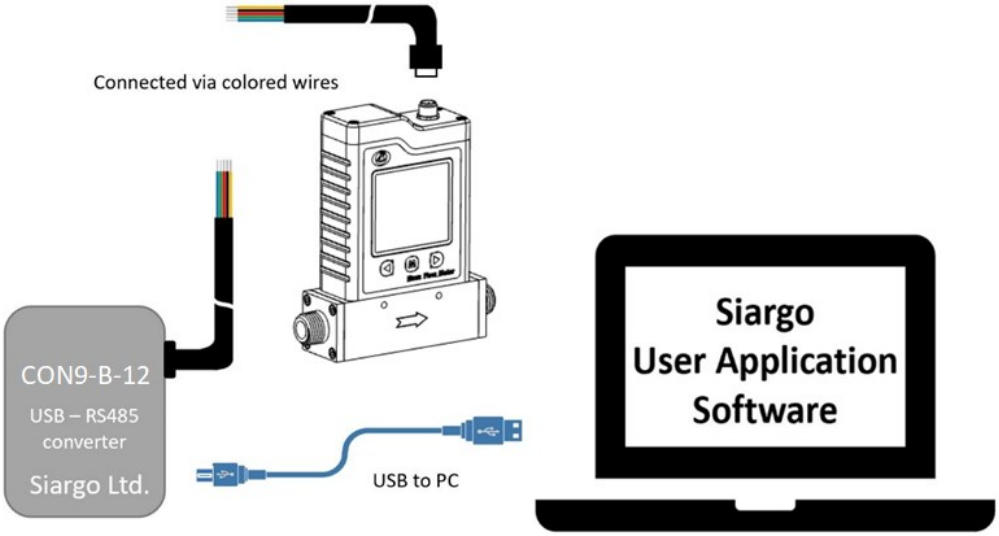
Siargo offers a product evaluation kit. It includes a digital data converter, USB data cable, and User Application software. The kit provides the opportunity to quickly evaluate the product's performance on a Microsoft Windows-based computer. This kit can also be used for simple applications with digital data transfer. The user can read and visualize the flow rate, obtain the totalizer or accumulated flow rate, and save the data for further analysis. It can be connected to up to 128 meters using the RS485 serial interface.

For further information and to purchase the evaluation kit, contact the manufacturer or the sales representative.



Each converter has a fixed cable that can be directly connected to the product. The USB cable to the PC is also included.

For most products, the power from the PC via the USB cable will be sufficient. No external power will be required. However, for multiple products connected in series, the power supplied by the USB cable may not be enough. An external power adapter with an 8-24V DC voltage will be required.



Appendix II: Document history

Revision VE.2.08 (November 2025)

- Revised the troubleshooting.

Revision VE.2.07 (August 2025)

- Correction.

Revision VE.2.06 (October 2024)

- Minor correction.

Revision VE.2.05 (July 2024)

- Minor correction.

Revision VE.2.04 (June 2024)

- Corrected the product selection.

Revision VE.2.03 (January 2024)

- Corrected the mechanical dimensions.

Revision VE.2.02 (June 2023)

- Update contact address.

Revision VE.2.01 (July 2022)

- Update service and contact information.

Revision VE.2 (April 2022)

- Update the MENU description.

Revision VE.1 (April 2022)

- Add the pressure loss data.

Revision VE.0 (February 2022)

- Major upgrade, the 3rd generation. For additional information, please see the overview.

Revision VD.2 (April 2021)

- Corrections.

Revision VD.1 (March 2021)

- Reformat, correct, and add the evaluation kit.

Revision VC.7 (July 2019)

- Update the MENU key functions.

Revision VC.6 (July 2018)

- Add the RS485 Modbus protocol (Mode P1).

Revision VC.5 (November 2017)

- Add the maximum overflow and maximum flow changes.
- Add the revision history (Appendix).

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Revision VA.0 (October 2007)

- First release.