Siargo Ltd.



Gas Mass Flow Meter VE.0.03

Model MF-FD

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Gas Mass Flow Meter

with MEMS calorimetric sensing technology

MF-FD Series

User Manual

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Attention!

- The product can be utilized to measure in-line mass flow rate of any relatively clean, single-element gas or multiple-element gas mixture with a relatively constant concentration profile during gas measurement, monitoring, or flow control in industrial and commercial applications. If the product is used for a special gas condition other than those listed above, the product may not function properly or may even be damaged. Please get in touch with Siargo for special requirements.
- The operational ranges of the product are illustrated in the product specifications section. If the product is used for a special operational condition other than listed in the product specifications, the product may not function properly or may even be damaged. Please get in touch with Siargo for special requirements.
- Operation, installation, storage, and maintenance of the product must closely follow the instructions of this user manual. Otherwise, unpredictable damage and even injuries or other severe situations could be caused. Skilled workers are responsible for performing all installation, storage, and maintenance of the product. This user manual should be placed near the product for easy access.
- Before using the product, the user should read this user manual thoroughly and in detail so that the user can memorize all the important instructions.
- It is recommended that the product should be recalibrated and maintained every two years or at a desired time if required.

Use with caution!

- Do not alter any software and hardware of the product.
- Do not use the product if any suspicion of malfunction or damage.
- Do not use this product in any corrosive gas environment.
- Observe all requirements in accordance with the product specifications.
- Only qualified personnel from Siargo or a person whom Siargo accredits can perform troubleshooting or service to the product.

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1. Overview

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

Siargo's proprietary MEMS mass flow sensor technology provides accurate in-line flow measurement with the availability of customer-specified packages. The sensor is manufactured using Siargo's unique MEMS process that ensures high reliability. The sensors can measure air flow as low as 5 mm/sec and as high as 75m/sec. Depending on the applications, the sensors can be used to measure mass flow, volume flow, or media flow speed. The specially designed circuitry provides amplification as well as small signal processing capability.

Siargo's flow sensors utilize the thermal mass flow technology using an energy balance design. Unlike the other MEMS flow sensing technologies, Siargo's flow sensors have multiple sensors integrated on a single silicon chip. The surface of the chip is passivated with ceramic materials of high thermal conductivity to ensure the sensor's sensitivity. Siargo's sensor package has its flexibility that significantly expands the applications of the technology.

The MF-FD series MEMS mass flow meters are the third-generation products based on Siargo's proprietary sensor technology and control circuit technology. These meters offer a higher standard of intelligent, all-electronic mass flow technology. With the smart software well tested for various applications, the MF-FD series MEMS mass flow meters achieve high sensitivity, extensive dynamic range, and high accuracy. The MF-FD series MEMS mass flow meters incorporate several advanced techniques such as a multiple-compensation scheme, noise reduction solution, multiple signal outputs, and network management features.

The MF-FD series MEMS mass flow meters can be used for general-purpose gas metering in industry or commercial applications. The user shall observe the general guidelines in the meter applications in accordance with the safety and other metrology requirements. It is advised that the user must read this user manual carefully before proceeding to field applications. It is mandatory to follow the instructions for installation and operation requirements to ensure the meter can work properly without malfunctions or damage.

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 notified as well. 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 (either the meter or the meter with the valve, as specified in the actual order). The power adapter and/or data cable, as shown below, may also be found according to your exact order.



Figure 2.1: MF-FD flow meter with data cable

Please check immediately for the integrity of the product, as well as the battery pack assembly parts and the optional 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 battery is installed or the power cable is plugged in.) Due to battery freight restrictions, the user must assemble the battery pack according to the instructions in Section 5.3. This user manual shall also either be included in the packing box or be available via an online request for an electronic version. In most cases, this manual shall be made available to the customer before the actual order.

3. Knowing the products

3.1 Product description

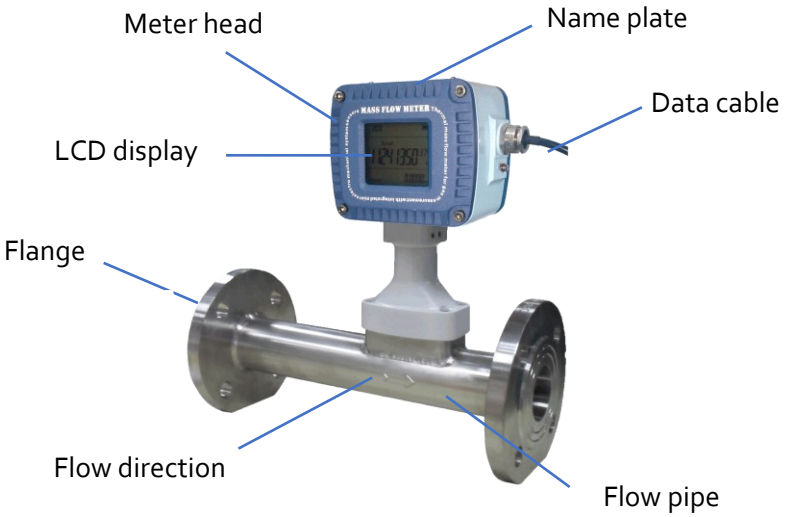
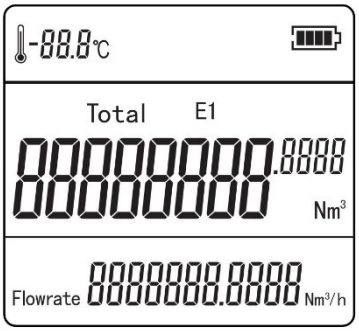


Figure 3.1: MF-FD meter parts description

3.2 LCD description



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 details the meaning of each of the symbols.

Figure 3.2: LCD symbol illustration.

Table 3.1: Symbol descriptions

Total	The middle row. The default displays the totalizer or accumulated flow rate in Nm^3 (cubic meters at the normalized conditions: 20°C, 101.325kPa). The maximum value is 99,999,999.999 Nm^3.
Flowrate	The bottom row. Displays instant flow rate in Nm^3/h (normal cubic meters per hour).
	Battery or power status is displayed in the upper row to the right.
	Temperature is displayed in the upper row to the left.

E1	One of the five error codes (the sign will be flashing): E1 – Sensor error. In most cases, E1 is often an indication of sensor damage.
E2	E2 – Sensor contamination, an indication of surface thermal sensitivity degradation.
E3	E3 – Electronic hardware errors.
E4	E4 – Out-of-flow measurement range.
E5	E5 – Battery low.

3.3 Interface terminal descriptions

For the meters with the external power option, the interface can be accessed by opening the back cover, and the terminal of the interface is inside the meter head. The description of the terminal is as follows:

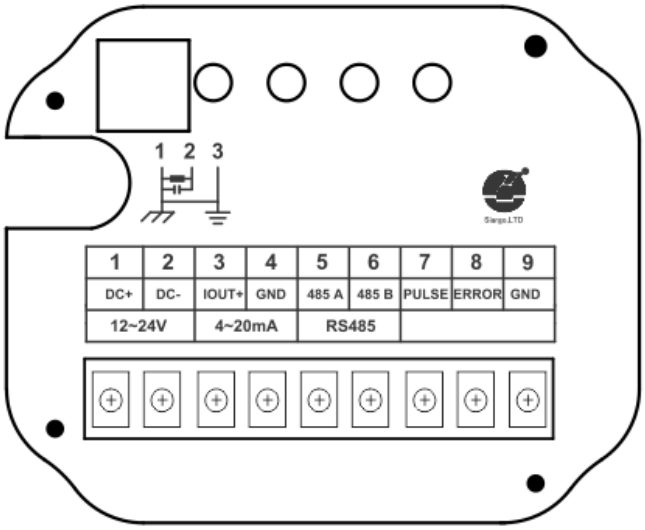
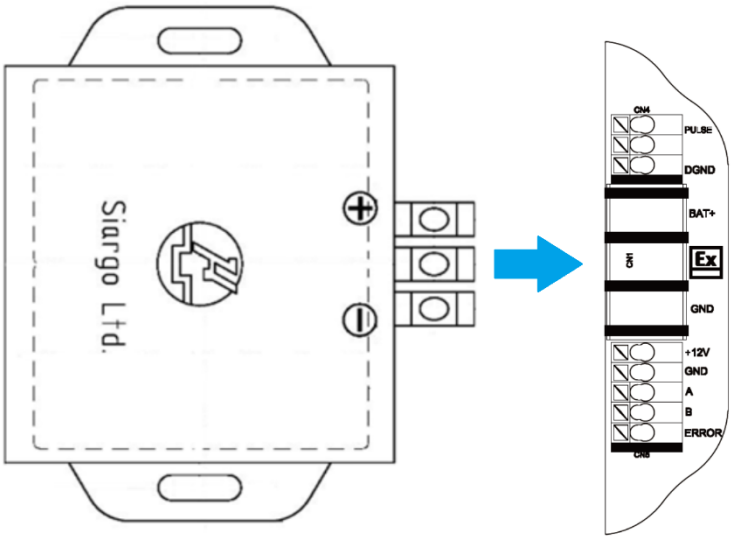


Figure 3.3: MF-FD meter interface terminal

Table 3.2: Interface terminal assignment

Wire	Definition	Description
1	DC+	12 ~ 24 Vdc Power Supply
2	DC-	Power GND
3	IOUT+	4 ~ 20mA Output
4	GND	4 ~ 20mA GND
5	485A	RS485 A (+)
6	485B	RS485 B (-)
7	PULSE	Pulse Signal Output
8	ERROR	Error Signal Output
9	GND	Pulse and Error Signal GND

For the meters with a lithium-ion battery power option, connect the battery as follows.



3.4 External cable descriptions

For the meters with the external power option, a colored cable is attached as shown below.

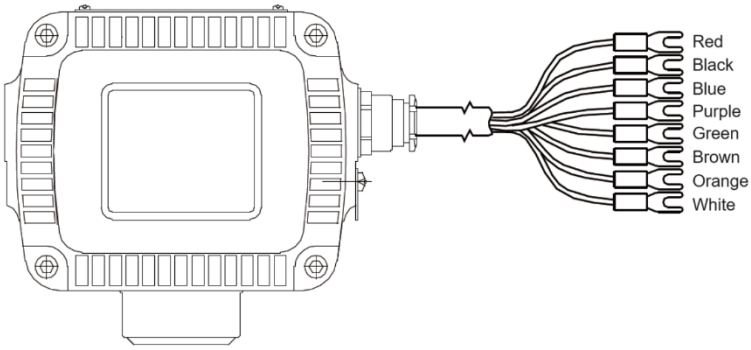


Figure 3.4: MF-FD meter interface terminal

Table 3.3: Interface terminal assignment

Color	Description
Red	12 ~ 24 Vdc Power Supply
Black	Power GND
Blue	4 ~ 20mA Output
Purple	4 ~ 20mA GND
Green	RS485 A (+)
Brown	RS485 B (-)
Orange	Pulse Signal Output
White	Pulse and Error Signal GND

3.5 Mechanical dimensions

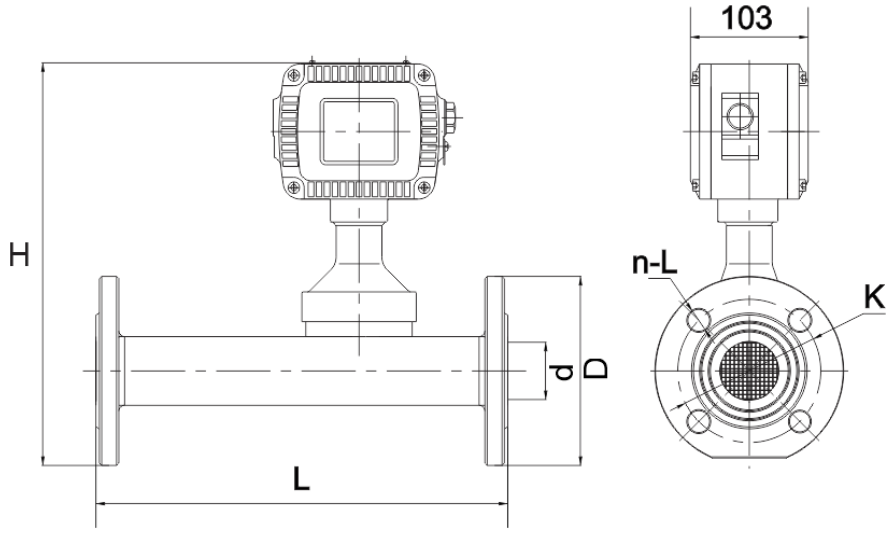


Figure 3.5: MF-FD meter dimensions

Table 3.3: Meter dimensions (mm)

Model	L	H	ΦD	Φd	ΦK	n-L
MF25FD	300	315	115	25	85	4-Φ14
MF32FD	300	326	140	32	100	4-Φ18
MF40FD	300	330	150	40	110	4-Φ18
MF50FD	360	344	165	50	125	4-Φ18
MF65FD	360	362	185	65	145	8-Φ18
MF80FD	400	374	200	80	160	8-Φ18
MF100FD	400	396	220	100	180	8-Φ18

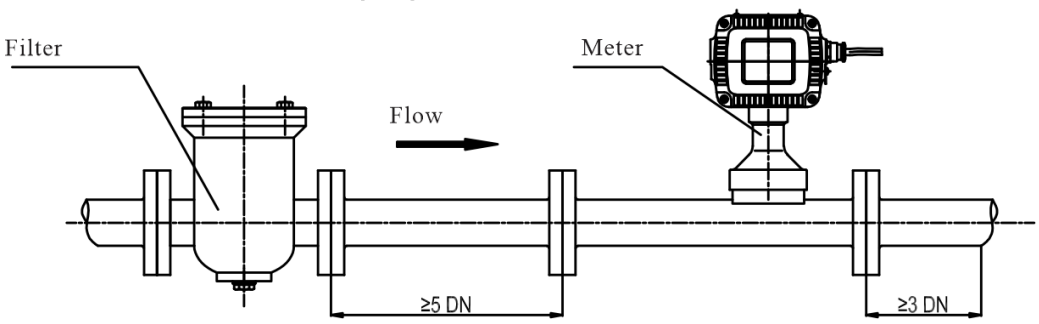
4. Installation

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

The product at the time of shipment is fully inspected for its quality and meets all safety requirements. Additional safety measures during the installation should be applied. 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.

Please follow the following steps to complete the installation:

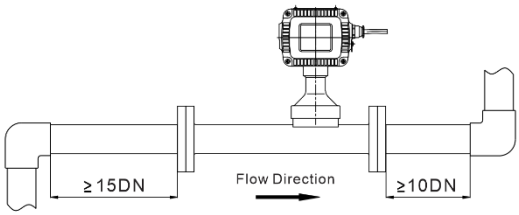


a) Upon opening the package, the product's physical integrity should be inspected to ensure no visual damage.

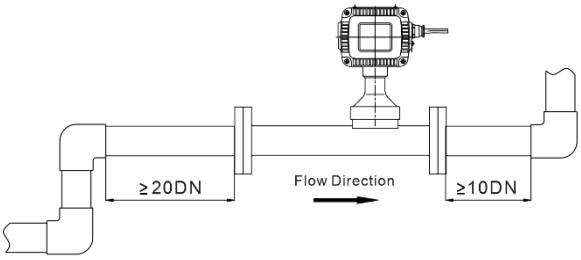
b) Before installation of the product, please ensure that the pipe is free from debris, particles, or any other foreign materials.

c) Cautions during installation:

   i) It is preferable to first install/connect the meter inlet 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 following recommended installation configuration.

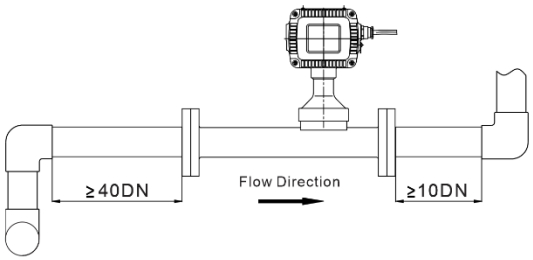


(a) 90-degree elbow or T-piece

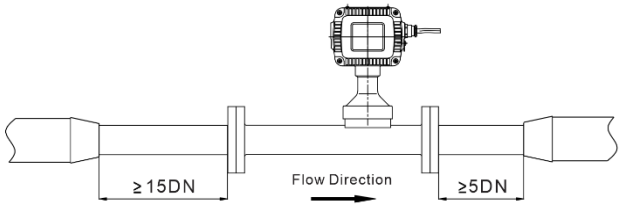


(b) 2x90-degree elbow

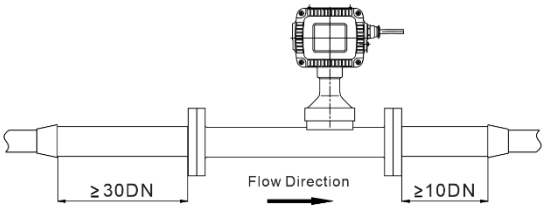
ii) If the upstream or downstream pipe size is different from that of the product, the size of the installation line pipe diameter(s) should be larger than the flow channel (pipe) size of the meters to be installed. For some typical situations, please follow the installation recommendations detailed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



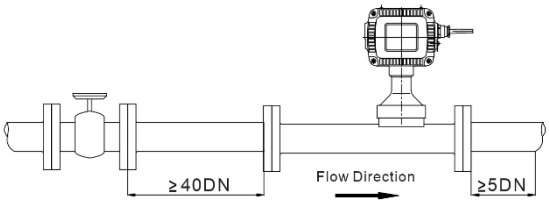
(c) 2x90-degree elbow, 3 D



(d) Pipe size-reduction

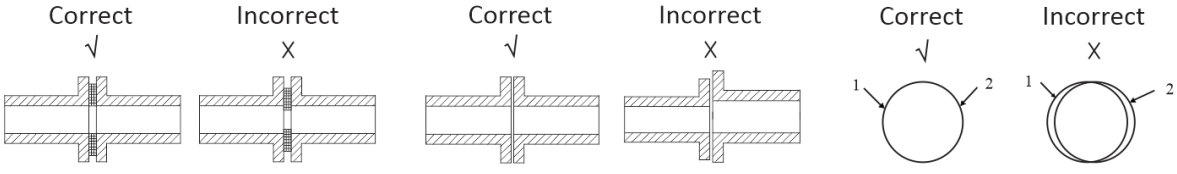


(e) Pipe size expansion



(f) Control valve at upstream or downstream

It is also essential to ensure all mechanical alignment for the connections to the meters. The following illustrations indicate some frequently mistaken connections:



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. If an adapter is other than the one supplied by the manufacturer, make sure the adapter meets industrial standards and has 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. Please make sure the data cable meets industrial standards with adequate protection.

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: Because the meter has an extensive dynamic measurement range, it is normal to see a small instant flow rate before opening the valve, as there may be some leakage. However, make sure the meter reads 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

5.1 Check the product specifications

Before starting to use this product, check the product specifications that can be found in this manual or the basic information located on the back panel of the product.

The detailed product technical specifications can be found in Section 7. For a specific application, the pressure rating must not be higher than the system pressure to be measured, and the flow range should also be within the specified range. In most cases, the use of a high full-scale range meter for the very low flow rate measurement often results in erroneous data. The gas to be measured 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 irrecoverable damage, and a lower voltage will not power the product for any desired functions.

For optimal product performance, it is recommended that the gas to be measured be clean and free of particles or other foreign materials.

5.2 Check the leakage

Check for gas leakage before any measurement. If necessary, pressurized nitrogen or air can be used for the leakage check.

5.3 Power the meter and data connection

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

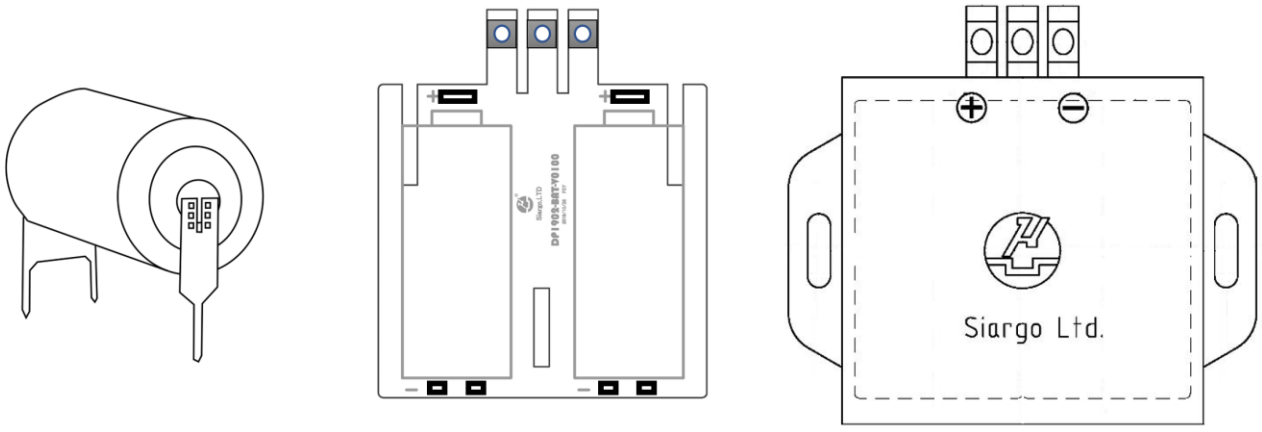
The products offer two power options. The external power option is mainly used when remote data communication is required, while the battery option is favored by users for utility gas metering. Due to transportation restrictions, the user must acquire the batteries and assemble the battery pack for battery power. Please follow the instructions in 5.4 to complete the battery pack assembly. For external power users, refer to Sections 3.3 and 3.4 for the detailed description of the cable wire definition.

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

5.4 Battery power and battery pack

The meter is designed for city utility gas metering powered by lithium-ion batteries. Two 3.6Vdc 19Ah D-Cell lithium-ion batteries at normal usage can offer up to 5+ years of operation. Due to the restriction on battery freight, the user must obtain the proper batteries and perform a simple assembly. For applications of fuel gases, the battery must meet the required safety regulations, and an appropriate certificate of safety of the battery should be ensured before acquiring such a battery pack.

The necessary parts for battery pack assembly are shipped together with the product (see Sec. 2). These are the battery pack box, battery PCB, and cover. Follow the steps below to complete the battery pack assembly.



For simplicity, the D-Cell lithium-ion battery with terminal option TP should be acquired from the local dealer of the user. This terminal option is readily available from the battery suppliers such as Tadiran (www.tadiranbat.com). The pre-installed terminal can be easily fitted into the position on the PCB, and then proceed with soldering. After the two batteries are installed onto the PCB, the PCB can then be placed into the battery pack enclosure and filled with epoxy (for example, Araldite CW 177 CI by Vantico, and finally closed and sealed with the battery pack cover.

5.5 Meter MENU descriptions

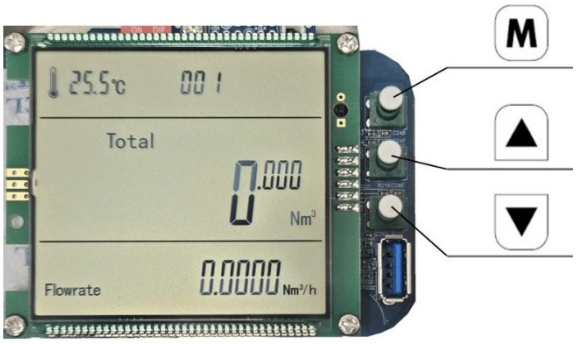


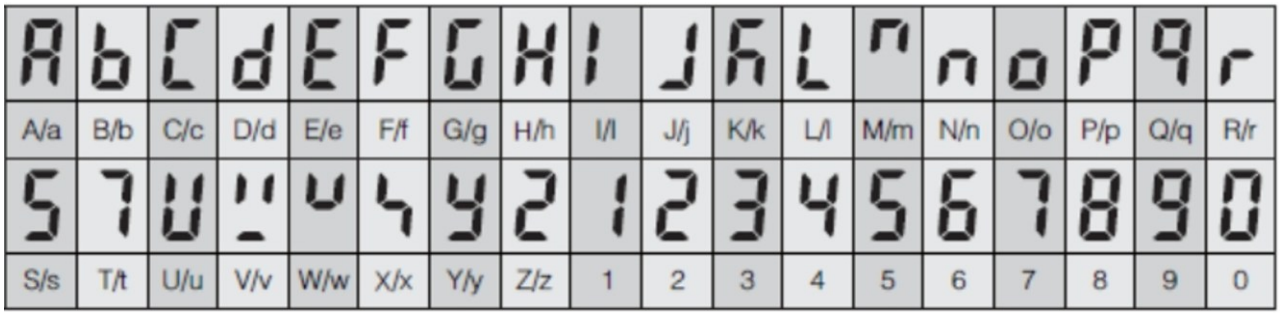
Figure 5.1: MF-FD keys description

The meter features a front 3-key board, allowing users to set desired functions, access data, and check the status. The Menu key (M) is located at the central position, allowing the user to select a function and perform confirmation or other related actions, which will be detailed below. Two keys ("Up" and "Down") are used to select the menu and sub-menu.

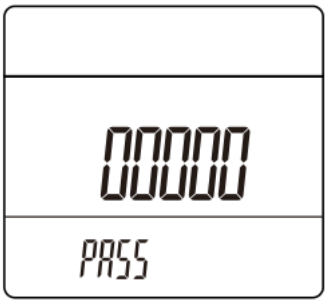
5.5.1 Starting the measurement

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 is the accumulated or totalized flow rate, and the lower line is the instant flow rate. The upper line will light up when the pressure or temperature option is selected.

The LCD capability limits the display characters; the following table is an illustration.



5.5.2 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
➢ Reset or calibrate the offset	F11 - oFFST
➢ Enter the gas conversion factor (GCF)	F12 - GCF
➢ Change the meter factor	F13 - FACTr
➢ Set the 2nd-correction factor	F14 - Corr
➢ Set the full scale	F15 - FS
➢ Change the response time	F16 - rESPS
➢ Set the language	F39 - LAnG
➢ Set the pulse	F41 - PULSE
➢ 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.

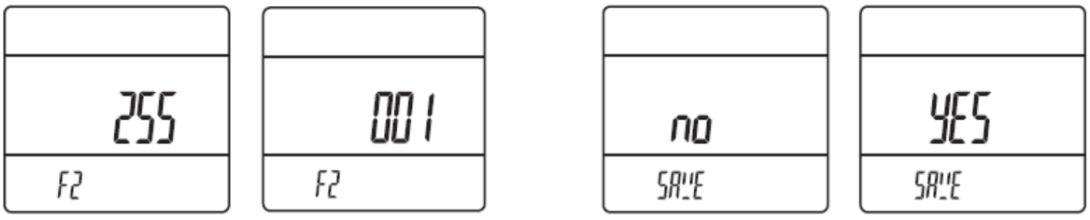
5.5.3 Set the RS485 Modbus address

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.



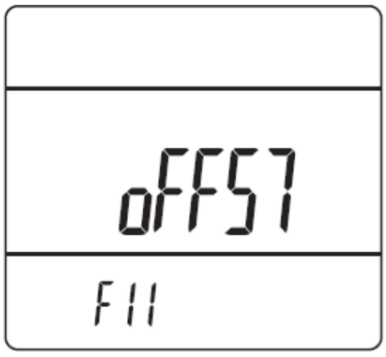
The Modbus address has three digits, which can be any number between 001 and 255. Press the "M" key to enter the change address screen. Press the "Up" or "Down" key to change the flashing digits, and then press the "M" key to confirm. After the address is set, the display will return to F2 - Addr, which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

Note: The default address is 255.



5.5.4 Reset or calibrate the offset

After a specific period of usage, the meter's offset (zero flow rate) may exhibit a slight shift. When applying the meter to different gases, the offset might shift. To ensure measurement accuracy, it is necessary to reset or calibrate the offset. Following the steps mentioned above, 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 more 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.

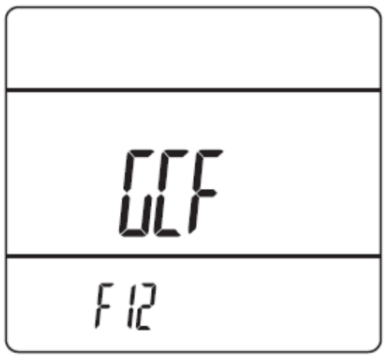


5.5.5 Gas conversion factor (GCF) for different gas measurements

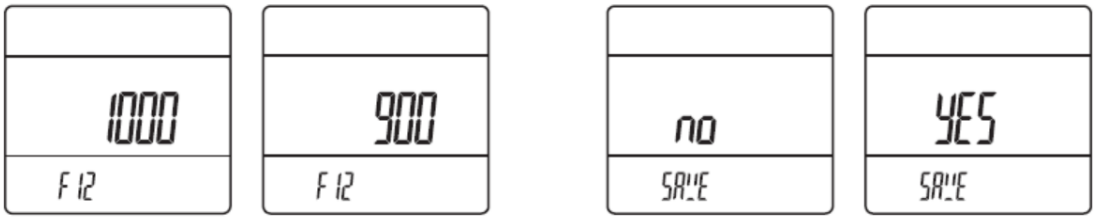
For the general purpose of the application, a gas conversion factor (GCF) can be applied to measure the gas differently from the default one or the one used for calibration. The GCF is determined by the thermal calorimetric sensing principle, as well as the meter fluidic dynamic design and the control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

The GCF for air is 1000.

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

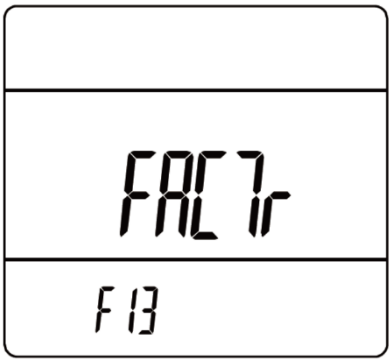


Following the steps mentioned above, at the MENU setting screen, use the "Up" or "Down" key to select F12 - GCF. Press the "M" key to confirm, and it will open the sub-MENU showing the current gas conversion value. Use the "Up" or "Down" and the "M" confirming key to input the desired value, and press 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.

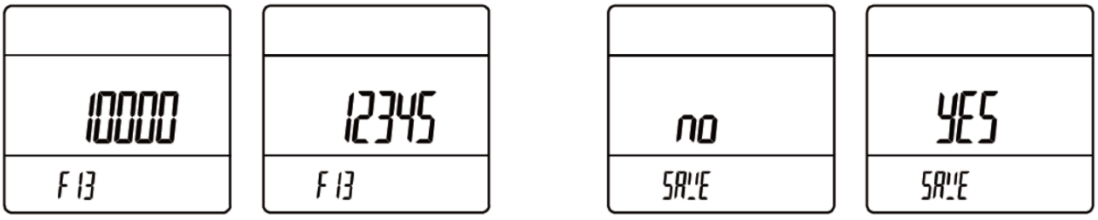


5.5.6 Meter factor

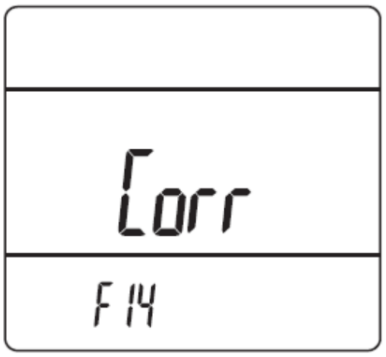
The meter factor is used to correct the systematic deviation in different devices. The default value is 10000.



Following the steps mentioned above, 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" confirming key to input the desired value, and 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.



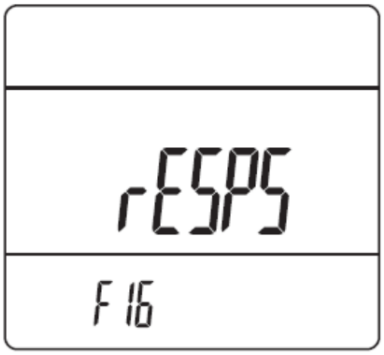
5.5.7 Set the 2nd-correction factor



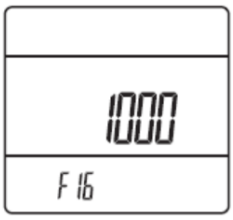
Following the steps mentioned above, at the MENU setting screen, use the "Up" or "Down" key to select F14 - Corr and then press the "M" key to set the 2nd correction factor.

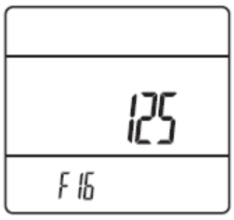
5.5.8 Set the Response time

Following the steps mentioned above, 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 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.

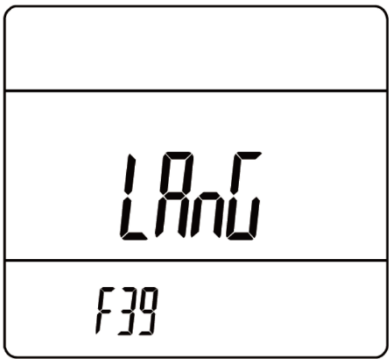




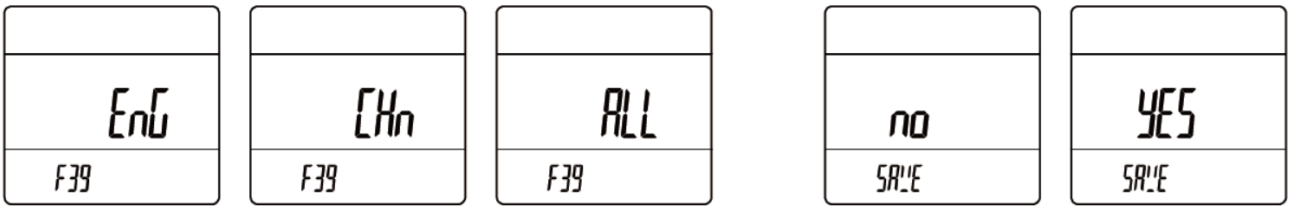




5.5.9 Select the display language

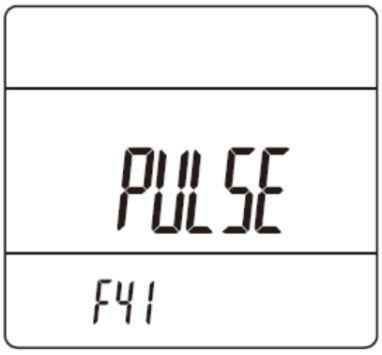


This function is reserved for future upgrades. The current models are configured to be English or Chinese based on the shipping geographic regions. However, if one likes to switch between these two default languages, following the steps mentioned above, at the MENU setting screen, use the "Up" or "Down" key to select F39 - LAnG. Press the "M" key to confirm, and it will open the sub-MENU showing the current language. Use the "Up" or "Down" and the "M" confirming key to select the desired one, and press the "M" key again to complete the task. The display will then return to the F39 - LAnG 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.

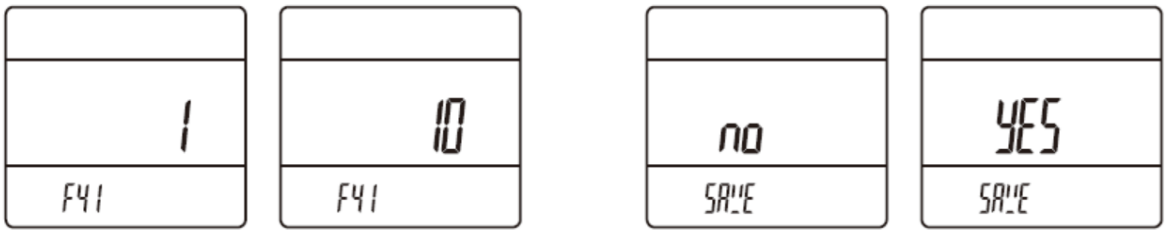


5.5.10 Set the pulse

Following the steps mentioned above, at the MENU setting screen, use the "Up" or "Down" key to select F41 - PULSE and then press the "M" key to set the pulse output for the accumulated or totalized flow rate.

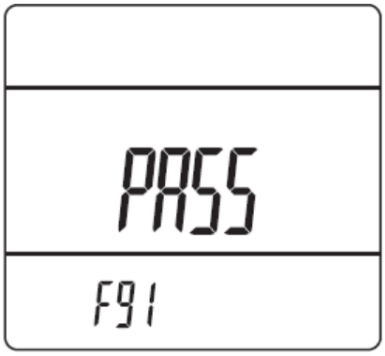


There are five pulse outputs selectable: 0.001 SL/pulse (display shows: 10-3), 0.01 SL/pulse (display shows: 10-2), 0.1 SL/pulse (display shows: 10-1), 1 SL/pulse (display shows: 1) and 10 SL/pulse (display shows: 10). The default pulse output is 1 SL/pulse (display shows: 1). Use the "Up" or "Down" key to select the desired one and press the "M" key to confirm. The display will then return to the F41 - PULSE 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.



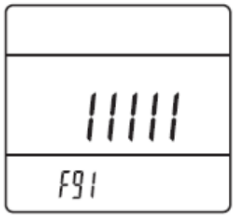
5.5.11 Change the default password

For data safety, it is recommended that the default password of 11111 be changed when using this product for the first time.



Following the steps mentioned above, 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" keys and the "M" confirming key to select the desired option, and 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. In case it is unrecoverable, please get in touch with the manufacturer to obtain a special password to access the meter MENU.



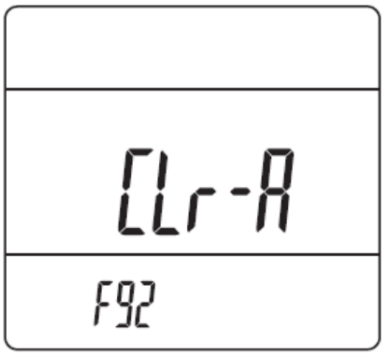


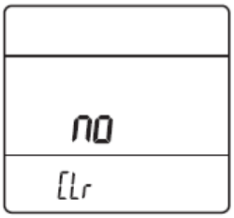




5.5.12 Reset the accumulated or totalized flow rate

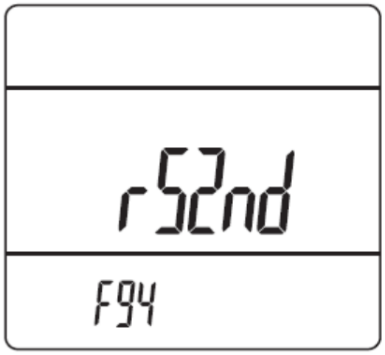
As the maximum value of the accumulated or totalized flow rate that the internal register can have is 9999999, the register will stop accumulating once the value is reached. At this time, it is necessary to reset this register. Following the steps mentioned above, at the MENU setting screen, use the "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 and execute. 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.





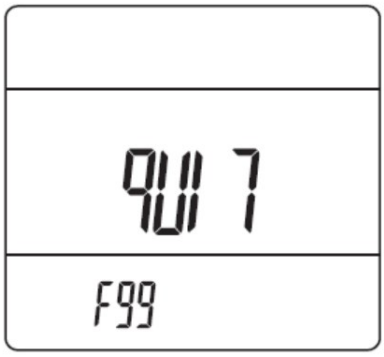


5.5.13 Reset the 2nd-correction factor

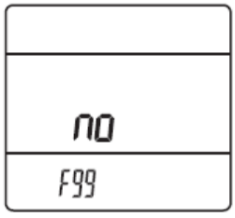


Following the steps mentioned above, at the MENU setting screen, use the "Up" or "Down" key to select F14 - Corr and then press the "M" key to set the 2nd correction factor.

5.5.14 Exit the MENU

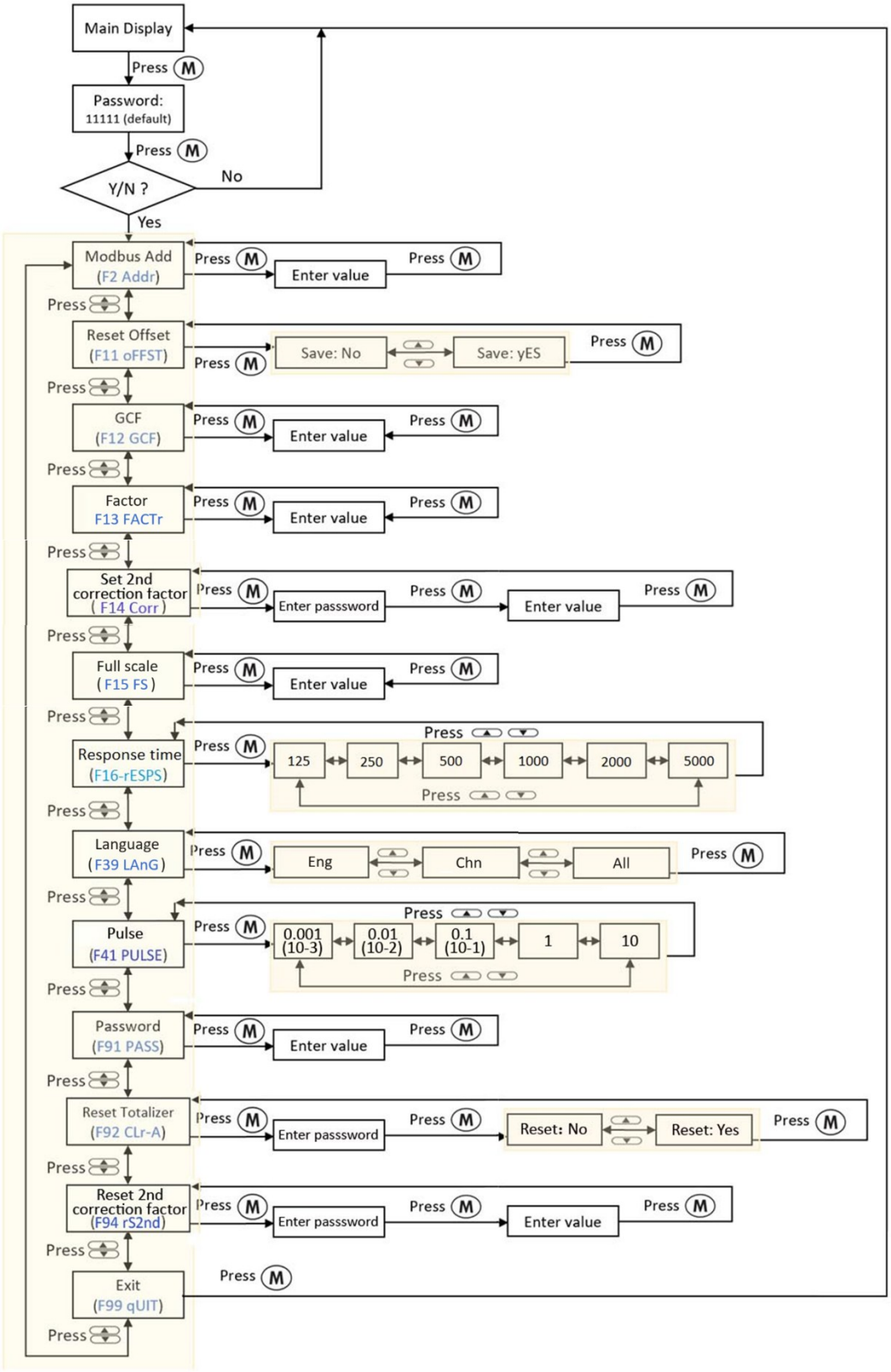


At the MENU settings, use the "Up" or "Down" key to select the F99 - qUIT option and press the "M" confirming key to exit the MENU settings and return to the Main Display screen.



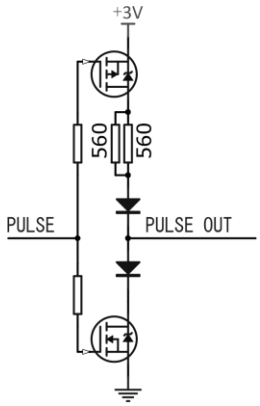


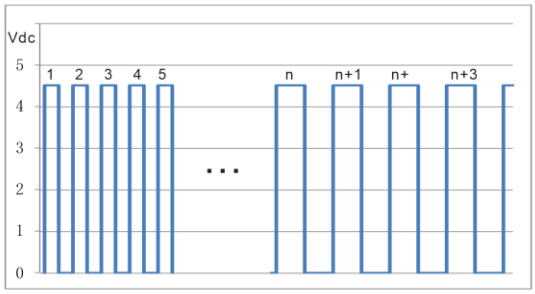
5.5.15 MENU key sequence for the settings



5.6 Analog (pulse) data communication

The pulse outputs are the square waves of a 3Vdc signal high and a 0Vdc signal low. The pulse can be programmed to 1 Nm^3, 0.1 Nm^3, 0.01 Nm^3, 0.001 Nm^3, or 0.0001 Nm^3 (the default is 1 Nm^3). The pulse level can be converted to other values; use the circuitry below as the reference.



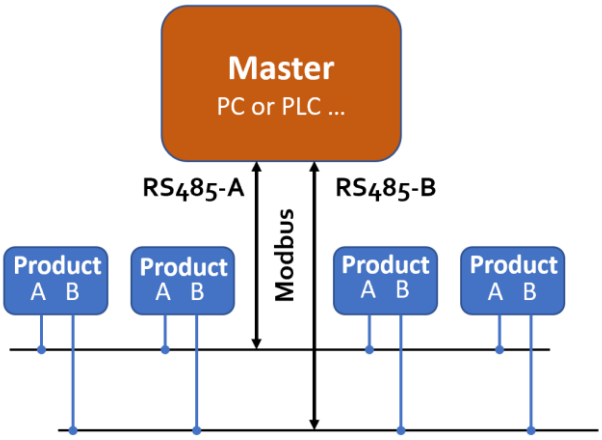


5.7 RS485 Modbus communication protocol

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 configuration of communication parameters. Refer to Table 3.3 for the cable connection.

5.7.1 Hardware connection

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



5.7.2 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

5.7.3 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 except for 157 (0x9d). 0 is the broadcast address.

Function codes: Define the product (MF-FD)'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.

5.7.4 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
0x08	CRC verification	Communication verification
0x10	Set multiple registers	Write multiple registers

5.7.5 Registers

The product (MF-FD) has multiple registers available for the assignment of the various functions. With these functions, the user can obtain data from products, such as product addresses and flow rates from the registers, or set product functions by writing the corresponding parameters.

The currently available registers are listed in the following table, and 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, the write protection will be automatically re-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 (R)	0x0030 ~ 0x0035	40049 (0x0030)
Flow rate	Current flow rate (R)	0x003A ~ 0x003B	40059 (0x003A)
Totalizer	Totalizer or accumulated flow rate (R)	0x003C ~ 0x003E	40061 (0x003C)
Minimal flow rate	Upper flow rate limit alarm (R/W)	0x0083 ~ 0x0084	40132 (0x0083)
Maximum flow rate	Lower flow rate limit alarm (R/W)	0x0085 ~ 0x0086	40134 (0x0085)
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)
Pulse*	Set the pulse output (R/W)	0x0093	40148 (0x0093)
Reset offset	Reset or calibrate the offset (W)	0x00F0	40241 (0x00F0)
Reset totalizer*	Reset totalizer or accumulated 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	Address of the product		
Value type	UINT 16		
Notes	Values range from 1 to 247, excluding 157 (0x9d). 0 is the broadcast address.		

Serial number, SN	0x0030 ~ 0x0035	Write	N
		Read	Y
Description	Series Number of the product, SN		
Value type	ASCII		
Notes	SN= value(0x0030), value(0x0031),….,value (0x0035); Receiving 12 bytes as: 2A 47 37 41 45 49 30 32 30 35 38 2A, the corresponding Serial Number is *G7AEI02058*.		

Flow rate	0x003A ~ 0x003B	Write	N
		Read	Y
Description	Current flow rate		
Value type	UINT 32		
Notes	Flow rate = [Value (0x003A)*65536 + value (0x003B)]/1000 e.g.: for a flow rate of 123.456 Nm^3/h, the user will read "1 (0x0001)" from register 0x003A and "57920 (0xE240)" from register 0x003B, therefore Current flow rate = (1*65536+57920)/1000 = 123.456 Nm^3/h.		

Totalizer	0x003C ~ 0x003E	Write	N
		Read	Y
Description	Totalizer or accumulated flow rate		
Value type	UINT 32 + UNIT 16		
Notes	A1 = Value (0x003C) * 65536 + Value (0x003D); A2 = Value (0x003E) Totalizer or accumulated flow rate = (A1 * 1000 + A2)/1000 For a totalizer or accumulated flow rate of 3452.245 m3, the user will read "0 (0x0000)" from register 0x003C; "3452(0x0D7C)" from register 0x003D, and "245(0x00F5)" from register 0x003E. Then, the totalizer or accumulated flow rate = ((0 + 3452)*1000 + 245)/1000=3452.245.		

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. **The default value is 1, and the baud rate is 9600.** **For example, when** the user reads "2" from register 0x0082, the baud rate is 19200.		

Minimal flow rate	0x0083 ~ 0x0084	Write	Y
		Read	Y
Description	Set the minimal flow rate.		
Value type	UINT 32		
Notes	Minimal flow rate = [Value (0x0083)*65536 + Value (0x0084)]/1000 **Notes: Please disable the write protection before executing this command.**		

Maximum flow rate	0x0085 ~ 0x0086	Write	Y
		Read	Y
Description	Set the maximum flow rate.		
Value type	UINT 32		
Notes	Minimal flow rate = [Value (0x0085)*65536 + Value (0x0086)]/1000 **Notes: Please disable the write protection before executing this command.**		

GCF	0x008B	Write	Y
		Read	Y
Description	The gas conversion factor applies to a gas that differs 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, please get in touch with 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, or 2000, the unit is in milliseconds. The default value is 125 msec. **e.g.,** 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 command.**		

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	1 - Instant flow rate unit SLPM, accumulated or totalized flow rate unit Nm^3; 2 - Instant flow rate unit Nm^3/h, accumulated or totalized flow rate unit Nm^3; 6 - Instant flow rate unit: kg/h, accumulated or totalized flow rate unit: kg. **The default value is 2.** **e.g.:** When the user reads "2 (0x0002)" from register 0x0090, the instant flow rate unit is Nm^3/h, accumulated or totalized flow rate unit is Nm^3. **Notes: Please disable the write protection before executing this function.**		

Pulse	0x0093	Write	Y
		Read	Y
Description	Set the pulse		
Value type	UINT 16		
Notes	Value -1, 0, 1, 2, 3, or 4. -1 (oxFFFF): 0.1 (10^{-1}) SL/pulse; 0 (0x0000): 1 (10^{0}) SL/pulse; 1 (0x0001): 10 (10^{1}) SL/pulse; 2 (0x0002): 100 (10^{2}) SL/pulse (0.1 m^3/pulse) ; 3 (0x0003): 1,000 (10^{3}) SL/pulse (1 m^3/pulse); 4 (0x0004): 10,000 (10^{4}) SL/pulse (10 m^3/pulse). **The default value is 3, the pulse is 1,000 SL/pulse (1 m^3/pulse).** **For example, when** the user reads "2 (0x0003)" from register 0x0093, the pulse is 100 (10^{2}) SL/pulse (0.1 m^3/pulse). **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 totalizer	0x00F2	Write	Y
		Read	N
Description	Reset the totalizer or accumulated flow rate value.		
Value type	UINT 16, Fixed value 0x0001		
Notes	To reset the totalizer or accumulated 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, offset, or totalizer, the user needs to 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. **Only the Address and Baud rate will not be write-protected.**		

6. Product selection

The product part number is defined by the flow pipe diameter (mm) and its flow range as listed in the following table.

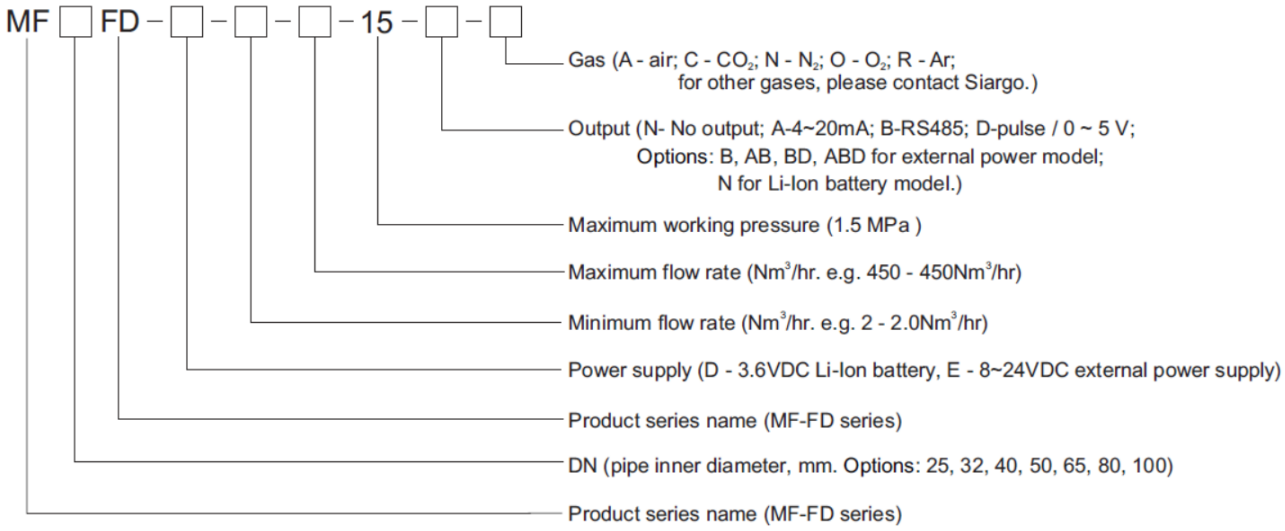


Table 6.1: The Product models and Flow ranges.

Model	Pipe size (mm)	Maximum flow rate (Nm^3/h)	Minimal flow rate (Nm^3/h)
MF25FD	25	100	1.0
MF32FD	32	160	1.6
MF40FD	40	250	2.5
MF50FD	50	400	4.0
MF65FD	65	650	6.5
MF80FD	80	1000	10
MF100FD	100	1500	15

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	
Accuracy	±(1.5+0.5FS)	%
Repeatability	(0.5+0.15FS)	%
Turn-down ratio	100:1	
Working temperature	-20 ~ +55	°C
Maximum pressure	1.5	MPa
Humidity	<95, no condensation	%RH
Power supply	External power model: 12 ~ 24 Vdc Li-Ion battery model: Li-Ion battery L3338B	
Battery life	>36	Months
Real-time clock life	>10	Years
Digital output	RS485 Modbus half-duplex / Pulse	
MENU access	3 key – front face keyboard/digital	
Display	LCD, instant flow rate, totalizer or accumulated flow rate	
Storage temperature	-20 ~ +70	°C
Reference conditions	20°C, 101.325 kPa, air	
Protection	IP66 (NEMA 4x)	
Fluid compatibility	Non-corrosive	
Ex Proof	Ex ia IIC T4 Gb	

Note: For other features or specifications not listed, please get in touch with the manufacturer.

7.2 Wetted materials

The wetted materials are 304 stainless steel. The sensing element comprises silicon, silicon nitride, and silicon dioxide. The sensor chip surfaces are passivated with silicon nitride and silicon dioxide. The electronic sealing is provided by LOCTITE Ablestik 84-3J. Another wetted material that may be exposed is FR-4.

8. Technical notes for the product performance

8.1 Measurement principle

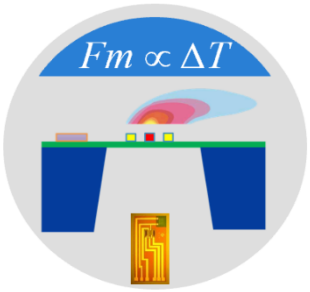


Figure 8.1: Measurement approach illustration.

The products utilize the Company's proprietary micro-machined (MEMS) calorimetric sensing and data processing technology. A thermal signal generator with a pair of sensing elements upstream and downstream of the microheater is precisely manufactured and separated at predefined micrometer distances on a chip surface with excellent thermal isolation. When a fluid is flowing through the sensing chip, the fluid carries the thermal signal downstream. The sensing elements register the temperature differences, which are then correlated with the fluid mass flow rate via the calibration process.

Our proprietary calorimetric sensing technology offers an extensive dynamic range and superior performance against environmental parameter fluctuations. Additionally, it provides a unique gas identification algorithm through direct measurement of the gas's thermal conductivity and capacitance. For any gases with distinct thermal properties and pre-registered, the meter can identify them and make an automatic adjustment to the original calibration values, making the measurement via thermal mass sensing an easy task. Please refer to the company's US patents and other publications made available to the public 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 common for users to compare product data with a third-party reference meter, and in many cases, discrepancies may arise.

When performing such a comparison, please note that the reference meter should have a better-specified accuracy (about 1/3 of 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 generally the same in the system. Therefore, it would be very critical for the system to have no pressure variation. (This explains our recommendations for the installations in Section 4). Also, the meter measurement principle is often very important for the understanding of any discrepancies.

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 also to the meter functionality. It is essential to ensure the applied flow medium will be clean and dry. If any contamination is suspected, please allow experienced technical personnel to have it checked and reconditioned. Do not use a foreign cleanser or other fluids to clean the flow path, which could bring irrecoverable damage.

9. Troubleshooting

Phenomena	Possible causes	Actions
No signal/display.	The power is not connected; The battery is empty.	Connect the power and then check the cable; Replace a new battery.
	Cable connection incorrect.	Check the cable.
	No flow or clogging.	Check flow and contamination.
	LCD error.	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.
Readings without flow rate.	Sensor error.	Return to the factory.
	Power failure.	Check the power status.
Offset unstable.	Circuitry instability.	Check the system, power off.
No digital interface.	Wrong address, software.	Check commands, connection.
	Incorrect baud rate.	Check the settings.
	Pin contact or connection.	Check the hardware.
No pulse output.	Incorrect wiring.	Reconnect the wire.
E1 code in LCD display.	Error 1 – Sensor error. In most cases, E1 is often an indication of sensor damage.	Return to the factory.
E2 code in LCD display.	Error 2 – Sensor contamination, an indication of surface thermal sensitivity degradation.	Return to the factory.
E3 code in LCD display.	Error 3 – Electronic hardware errors.	Return to the factory.
E4 code in LCD display.	Error 4 – Out-of-flow measurement range.	Turn down the flow rate.
E5 code in LCD display.	Error 5 – Battery low.	Replace a new battery.

10.Warranty and Liability

(Effective January 2018)

Siargo warrants that the products sold hereunder will be used appropriately and installed correctly under normal circumstances and service conditions. 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 repair or replacement of a 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 fully responsible for validating the performance and suitability of the products for their particular design and applications. For any 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 expenses or 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 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, 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.

This manual's product information is believed to be accurate and reliable at the time of release or when made available to the 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, as 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) 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 that unauthorized dealers or any third parties resell.

11. Service/order contact and other information

Siargo Ltd. is making every effort to ensure the quality of its products. For questions or product support, please get in touch with your direct sales representative. If you need additional assistance, please reach out to customer service at the address listed below. We will respond to your request in a timely fashion and work with you toward your complete satisfaction.

For sales or product orders, please get in touch with the local sales representatives or distributors listed on the company's webpage: www.Siargo.com.

For any returns, please get in touch with your direct sales representative to obtain an RMA. If you require further assistance, please get in touch with info@siargo.com for additional information or a Return Materials Authorization (RMA) before returning the product to the factory for servicing, including calibration. Please specify in your email message the product's status as clearly as possible, indicating your intention to return it 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

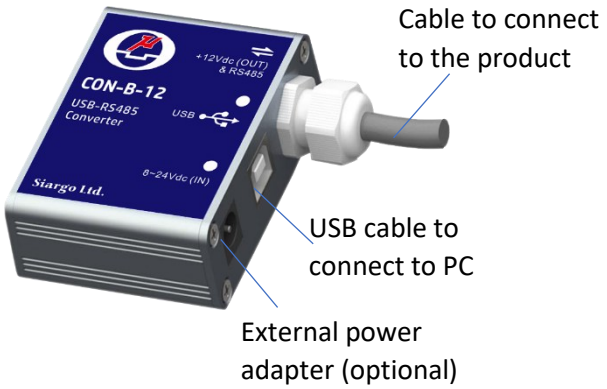
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For further information and updates, please visit www.Siargo.com.

Appendix I: Product evaluation kit

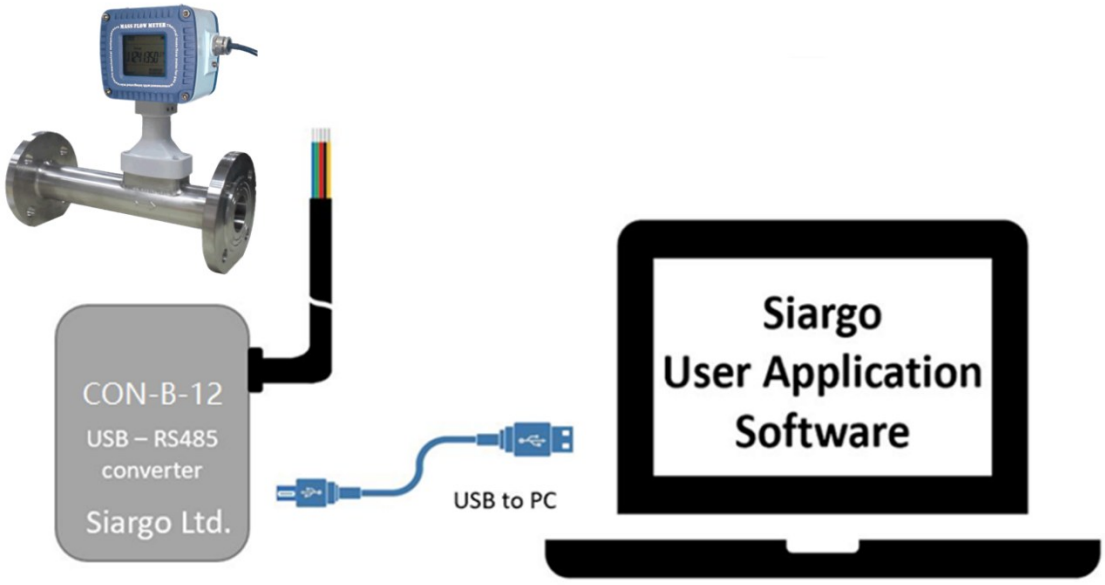
Siargo offers a product evaluation kit, including a digital data converter, USB data cable, and User Application software, that allows the user to evaluate the product performance on a Microsoft Windows-based computer. For some simple applications with digital data transfer, this kit could serve the purpose. The user can read and visualize the flow rate of the product, obtain the totalizer or accumulated flow rate values, and save the data for further analysis. It can read from up to 128 sensors via the RS485 serial interface.

For further information and purchase of the evaluation kit, please get in touch with the manufacturer or the sales representative.



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

For most of the products, the power from the PC via the USB cable will be sufficient to power the sensor product; no external power will be required. However, for multiple sensors in serial, the power via the USB cable may not be enough; an external power adapter with 12~24Vdc will be necessary.



Appendix II: Document history

Revision VE.0.03 (November 2025)

- Revised the troubleshooting.

Revision VE.0.02 (August 2025)

- Corrections.

Revision VE.0.01 (July 2024)

- Minor corrections.

Revision VE.0 (April 2024)

- Format, addition, and modifications.

Revision VD.0 (January 2021)

- Adjust the MF series to the MF-FD series.

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Revision VC.0 (September 2015)

- Gen III meters released.

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Revision VB.0 (March 2013)

- Gen II meters released.

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Revision VA.0 (March 2010)

- First release.