Siargo Ltd.

Gas Mass Flow Meter VA.0

Model MFGD

Gas Mass Flow Meter

with MEMS calorimetric sensing technology

MF-GD Series

User Manual

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Attention!

- This product is designed for low-pressure gas mass flow metering and control with a safety rating of Ex ib IIC T4. All standard hazardous gas handling procedures must be observed during installation and usage.

- This product can be powered with lithium-ion battery or an external DC power. For digital data communication, external power is recommended but the intrinsic device safety procedure must be observed.

- The detailed operational conditions of the product are described in this manual. Please make sure each of the specifications is fully understood, and acquire the full knowledge of the field where the product will be installed. Please do not apply the products out of their applicable working conditions, otherwise, the product may not function properly or would be damaged or cause other irreversible consequences.

- Before the operation, a leakage test must be performed after installation for safety assurance.

- Operation, installation, storage, and maintenance of the product must strictly follow the instructions of this user manual. It is highly recommended that the maintenance should be performed by skilled personnel or trained operators. Unpredicted consequences may otherwise be caused. All the installation, storage, and maintenance of the product must be handled by qualified operators. This user manual should be placed near the product for easy access.

- Before using the product, the user should read this user manual carefully and completely.

- It is recommended that the product should be re-calibrated and maintained every two years or at a time when necessary.

Use with caution!

- Do not apply this product to any gas medium that contains excessive liquid or solid debris, that may lead to malfunction or unrecoverable damages.
- Do not change any software and hardware of the product. All software and hardware of the product have been certified at the time of manufacture.
- Do not use the product if suspect of malfunction.
- Do not use this product in any excessive radiation or vibration environment.
- Only qualified or accredited personnel by Siargo can perform the repair services. Siargo shall not be liable to any products that have been altered or damaged before returning for product verification and services.
- Before digitally communicating with the product, it is highly recommended to carefully read the user interface requirements described in this manual.
- The product body is made of aluminum alloy, do not hammer or use sharp tooling during installation.
- The battery pack must be assembled with safety-certified lithium-ion batteries. Consult manufacturer for battery requirements or obtain the replacement from the manufacturer.
- Read the manual carefully before processing any maintenance or troubleshooting.

Table of Contents

1. Overview

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

This manual provides essential information for the operation of the MF-GD series of gas mass flow meters. The product performance, maintenance, and trouble-shooting as well as the information for product order, technical support, and repair are also included.

The MF-GD series gas flow meters are specially designed for city utility gas metering applications but they can also be used as a general-purpose gas metering at low pressure. Based on Siargo's proprietary MEMS calorimetric flow sensing technology and control technology, the meters can identify gas thermal property at dynamic flowing conditions. Unlike most conventional thermal mass flow metering, the products will not require manual input of gas conversion but can be adjusted automatically between air and natural gases. The product offers a wide dynamic range while maintaining high sensitivity at the low flow for gas tariff and monitor. The product is fully temperature compensated and works with either battery power or external DC power with a safety barrier. The sensing elements are at the center of the flow channel that is designed to a semi-Venturi configuration. The sensors are packaged using the boundary layer technology that ensures a time-averaged velocity profile across the sensing elements, which would force the flow to redistribute at the sensor assembly forming a laminar flow.

The meters have a standard half-duplex RS485 Modbus communication interface that is ready for remote data logging or networking. The enhanced data safety is realized via the storage designed in the control circuitry that allows the user to program the records of the flow status that can be transmitted via the network or downloaded with a handheld or personal computer with the manufacturer-provided software.

The products are best for clean and dry gas flow measurement for gas mass flow applications. Other gases with excessive moisture may cause instability due to condensation. The meters also come with options for GPRS data transmission, pre-paid IC card reader attachment with a shut-off valve. Other convenient features include compact for logistic and well isolated standalone unit for a reduction of foreign tampering.

2. Receipt / unpack of the products

Upon receipt of the products, please check the packing box before the dismantlement of the packing materials. Ensure no damages 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 as well. For any further actions, please refer to the return and repair section in this manual.

If the packing box is intact, proceed to open the packing box, and you shall find the product (either the meter or the meter with valve per the actual order). The power adapter and/or data cable as shown below may also be found according to your actual order.

The product

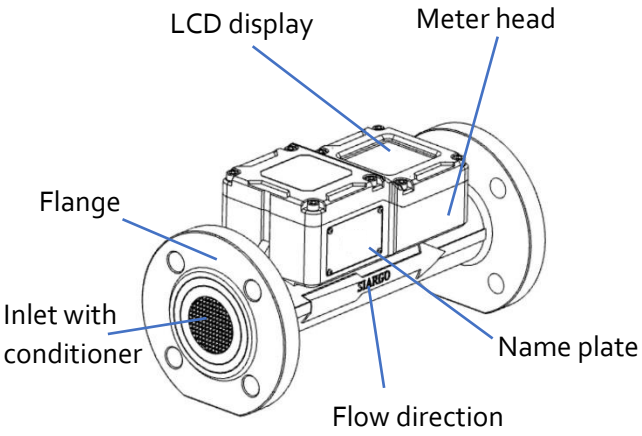
Battery pack assembly

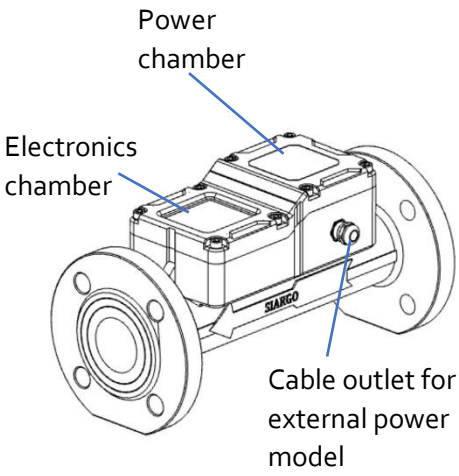
Data cable (optional)

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 abnormal 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). Because of the restriction of battery freight, the user needs to assemble the battery pack following the instruction in Sec 5.3. This user manual shall also either be included in the packing box or via an online request for an electronic version. In most cases, this manual shall be made available to the customer before the actual order.

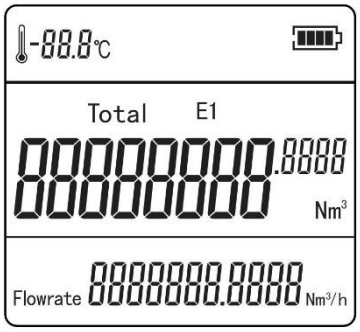
3. Knowing the products

3.1. Product description





3.2. LCD description



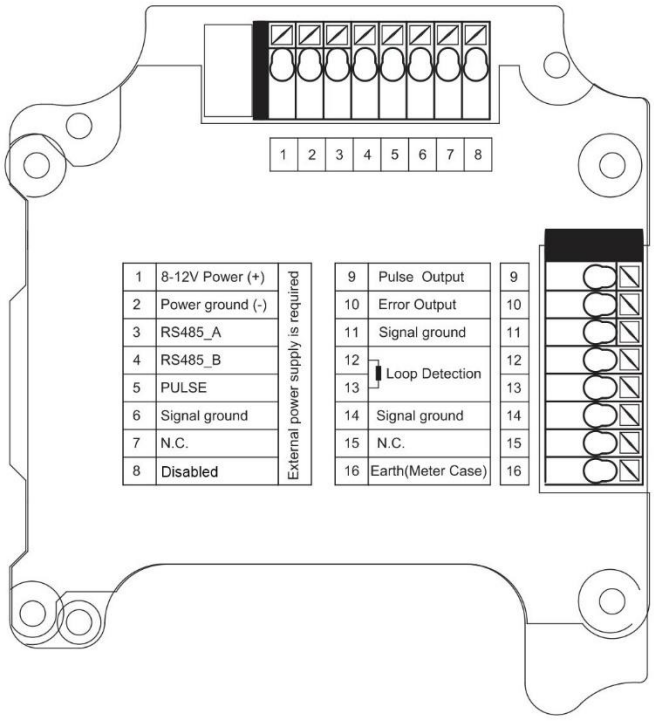
The LCD provides all information that the product measures. Some symbols are reserved for future upgrades, and will not be lighted during the operation. The following table details the meaning of each of the symbols.

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 at the upper row to the right.
	Temperature, displayed at the upper row to the left.

E1	One of the 5 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 battery (power) chamber cover, and the terminal of the interface is inside the chamber. The description of the terminal is as follows:



Note: Terminal 1 through 6 are isolated for use with external power. All communication is strongly recommended with external power supply.

Table 3.3: Interface terminal assignment

Wire	Definition
1	Power supply (8~24 Vdc)
2	Ground, power
3	RS485A
4	RS485B
5	Pulse output, (5.0Vdc)
6	Ground, pulse
7	N.C.
8	Disabled
9	Pulse output (3.0Vdc)
10	Error output
11	Ground, error output
12	Loop detection, fixed
13	Loop detection, fixed
14	Ground, pulse (3.0Vdc)
15	N.C.
16	Earth (to meter case)

3.4 Mechanical dimensions

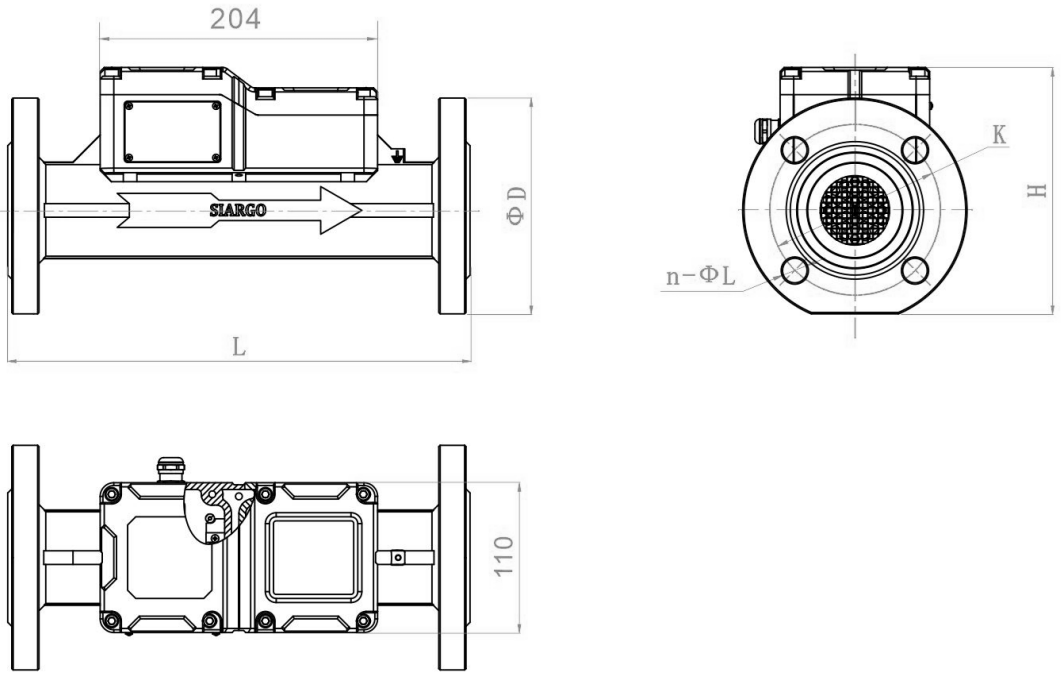


Figure 3.4.1. MF-GD meter dimensions

Table 3.4.1 Meter dimensions (mm)

Model	L	H	ΦD	n-ΦL	ΦK
MF25GD	300.0	156.0	115.0	4-14.0	85.0
MF40GD	320.0	175.0	150.0	4-18.0	110.0
MF50GD	340.0	181.0	165.0	4-18.0	125.0
MF80GD	340.0	215.0	200.0	8-18.0	160.0

4. Installation

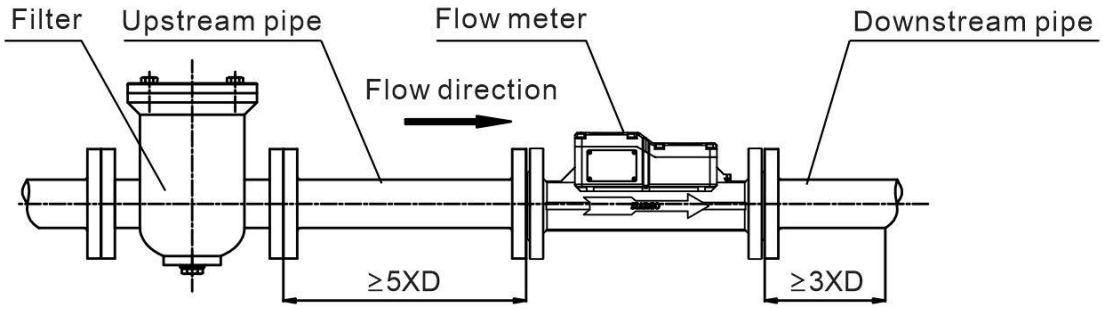
Do not open or alter any part of the product which would lead to malfunction and irrecoverable damage. It will also forfeit the terms of the warranty and cause liability.

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, DC voltage precautions. Other tasks such as calibration, part replacement, repair, and maintenance must only be performed by trained personnel. Upon requests, the manufacturer will provide necessary technical support and/or training of the personnel.

The product is preferable to be installed horizontally. 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:

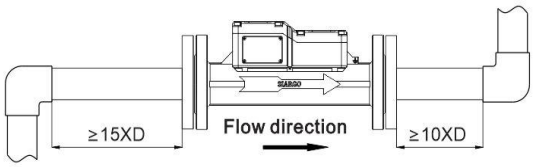


a) Upon opening the package, the product's physical integrity should be inspected to ensure no visual damage.

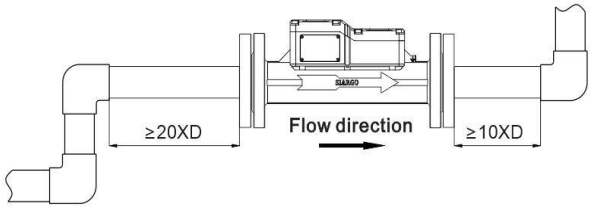
b) Before installation of the product, please ensure that the pipe debris or particles or any other foreign materials are completed removed.

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 the 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.

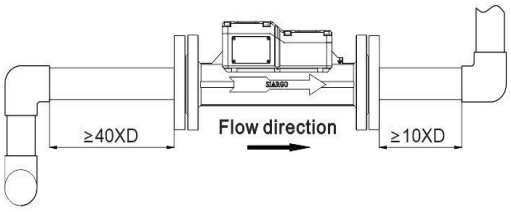


(a) 90-degree elbow or T-piece

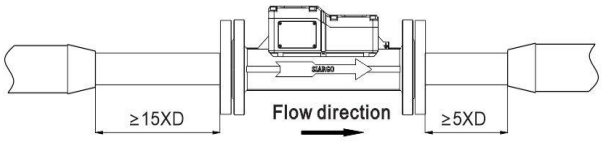


(b) 2x90-degree elbow

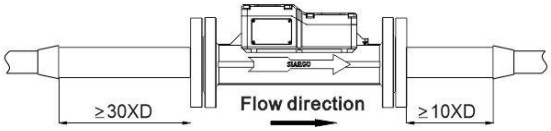
(ii) If the upstream or downstream pipe size is different from that of the product, the size of the installation line pipe diameter(s) should be larger than the flow channel (pipe) size of the meters to be installed. For some typical situations, please follow the installation recommendation detailed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



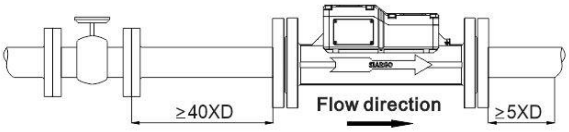
(c) 2x90-degree elbow, 3 D



(d) Pipe size-reduction

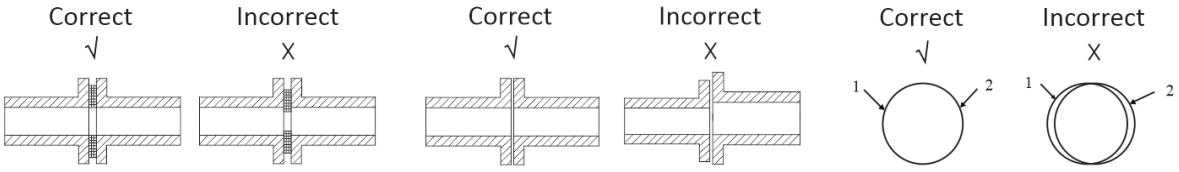


(e) Pipe size expansion



(f) Control valve at upstream or downstream

It is also important 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.) entering into 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., 8 ~ 24 VDC) and power supply polarization. If an adapter 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 proper shielding.

f) Once the external power is successfully connected, the LCD should be lighted up with the proper information displayed works 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 a large dynamical measurement range, it could be normal if you see the small instant flow rate before you open the valve as there could 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 properly done 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 ones. In most cases, the use of a high full-scale ranged 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 the best performance of the product, it is advised that the gas to be measured must be clean and free of particles or other foreign materials.

5.2. Check the leakage

Check gas leakage before any measurement. If it is needed, the 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 of the specified ones in Section 7. Be cautious that the standard electrical device precautions such as EDS (electrostatic discharge) and DC voltage are observed. Excessive electrostatic discharge may damage the product.

The products offer two power options. The battery option is favored by users for utility gas metering, while the external power option is mostly used when a remote date communication is required. For the battery power, due to the transportation restrictions, the user needs to acquire the batteries and assemble the battery pack. Please follow the instructions in 5.3.1 to complete the battery pack

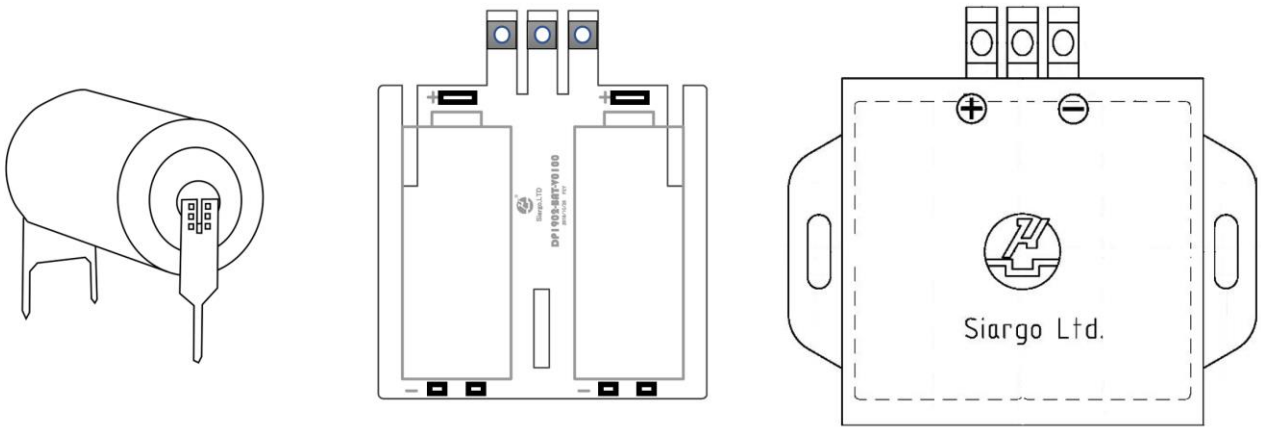
assembly. For the external power users, refer to Sec. 3.3 for the detailed description of the cable wire definition, and 5.3.2 for cable installation and terminal connections.

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

5.3.1 Battery power and battery pack

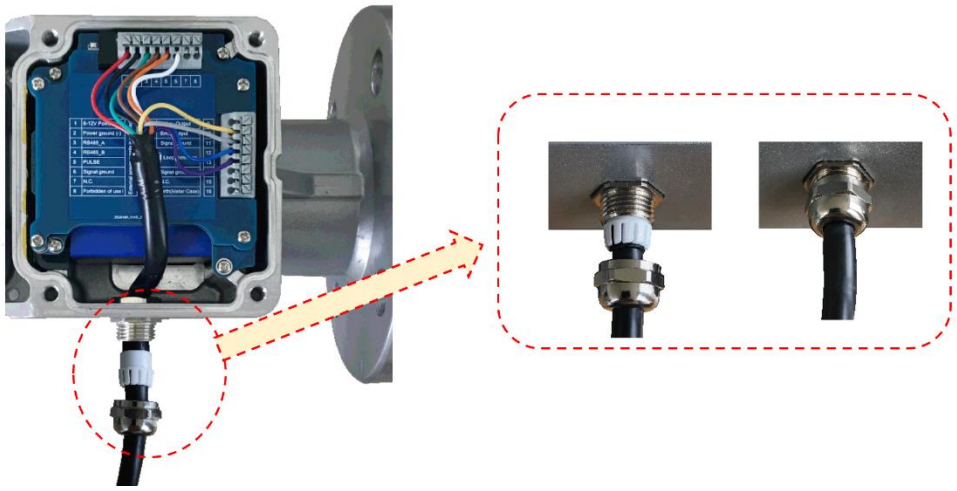
The meter is designed for city utility gas metering powered with lithium-ion batteries. Two 3.6Vdc 19Ah D-Cell lithium-ion batteries at normal usage can offer up to 5+ years of operation. Due to the restriction of battery freight, the user has to acquire the proper batteries and do a simple assembly. For applications of fuel gases, the battery must meet the required safety regulations and a proper safety certificate of the battery should be ensured before acquiring such for the 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. Following 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 at the PCB and then proceed with solder. After the two batteries are installed onto the PCB, the PCB then can 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.

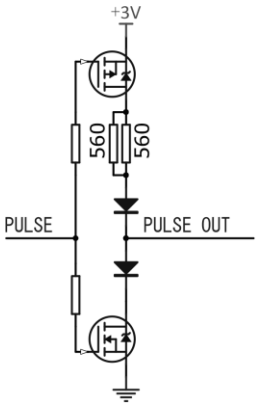
5.3.2 External power option and cable installation

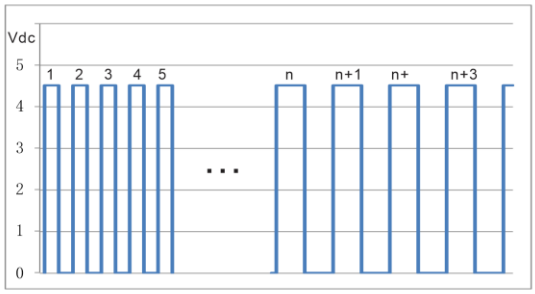


The terminal interface PCB is located inside the battery chamber. Open the battery chamber cover, if the model is external power only, there will be only the terminal PCB. Otherwise, one needs to install the battery pack first before installing the terminal PCB and make the connections. Referring to the above illustration and Table 3.3, connect the wires according to the power source and application requirements. And then make sure the cable is tightly engaged from outside the battery chamber such that the protection can be ensured.

5.4. Analog (pulse) data communication

The pulse outputs are the square waves of 3 Vdc signal high and 0 Vdc 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.



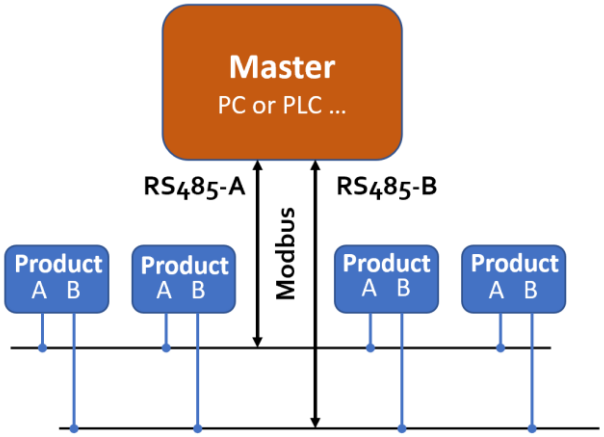


5.5. RS485 Modbus communication protocol

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 communication parameter configuration. Refer to Table 3.3 for cable connection.

5.5.1. Hardware connection

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



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

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

Data: The address of the register, 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, then 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 the sub-class 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 single register	Write one single 16-bit register
0x08	CRC verification	Communication verification
0x10	Set multiple registers	Write multiple registers

5.5.5. Registers

The product (MF-GD) has multiple registers available for the assignment of the various functions. With these functions, the user can obtain the 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, and the registers may be customized upon contact 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 address and baud rate. Once the user completes the register value change, the write protection will be automatically enabled once again 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	40049 (0x0030)
Flow rate	Current flow rate (R)	0x003A~0x003B	40059 (0x003A)
Totalizer	Totalizer or accumulated flow rate (R)	0x003C~0x003E	40061 (0x003C)
Reset totalizer	Reset totalizer or accumulated flow rate (W)	0x00F2	40243 (0x00F2)
Write protection	Write protection of selected parameters (W)	0x00FF	40256 (0x00FF)

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 from 1 to 255 except for 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	UINT8 (12 bits)		
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 16		
Notes	Flow rate = [Value (0x003A)*65536 + value (0x003B)]/1000 e.g.: for a flow rate of 123.456 SLPM, 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		

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 e.g.: for a totalizer or 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 totalizer or accumulated flow rate = ((0 + 3452)*1000 + 245)/1000=3452.245.		

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.		

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 **Address** and **Baud rate** will not be write-protected.		

6. Product selection and order information

6.1. 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 6.1.1. The Product models and flow ranges.

Model	**DN (mm)**	**Max. flowrate (Nm^3/h)**	**Min. flowrate (Nm^3/h)**
MF25GD10/16/25/40	25.0 (1")	10./16./25./40.	0.10/0.16/0.25/0.40
MF40GD25/40/65	40.0 (1-1/2")	25./40./65.	0.25/0.40/0.65
MF50GD40/65/80	50.0 (2")	40./65./80.	0.40/0.65/0.80
MF80GD100/160	80.0 (3")	100./160.	1.00/1.60

6.2. Order contact and customer support

The sales offices and the sales distributors/representatives are listed at the end of this document. For small quantities, the order can be placed either through the Siargo website: www.siargo.com or the sales office. For large quantities, please contact the sales office, distributors, or sales representatives.

Siargo is making every effort to ensure the quality of the products. In case of questions and/or product supports, please contact the customer service listed at the end of the document.

7. Technical specifications

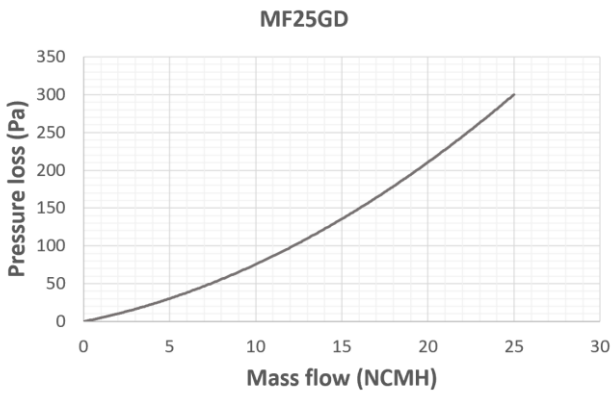
7.1. Technical parameters

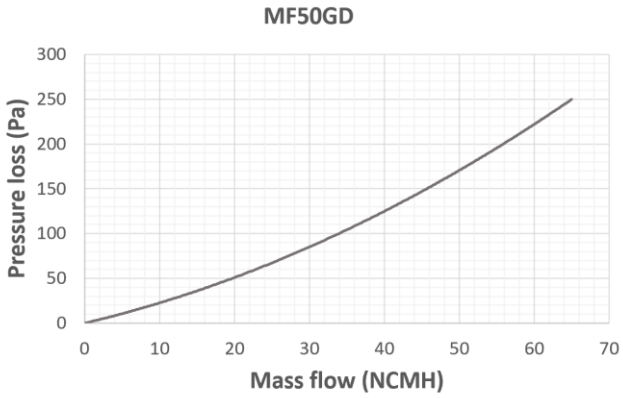
All specifications listed in the following table unless otherwise noted apply for calibration conditions at 20°C and 101.325 kPa absolute pressure with air. The product is horizontally mounted at calibration.

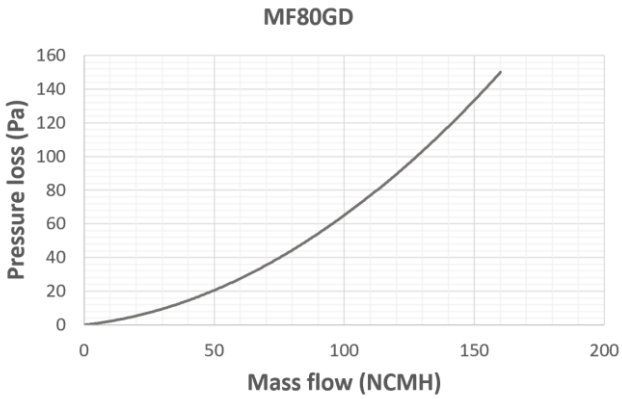
	Value	Unit
Full-scale flow range	See table 6.1.1	
Accuracy	±(1.5+0.25FS)	%
Repeatability	0.5	%
Turn-down ratio	100:1	
Working temperature	-20~55	°C
Maximum pressure	0.6	MPa
Humidity	<95, no condensation	%RH
Power supply	2x D-Cell 19 Ah lithium-ion or 8~24Vdc	
Battery life	>36	Months
Real-time clock life	>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 ib II CT4	

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

7.2. Pressure loss







8. Technical notes for the product performance

8.1. Measurement principle

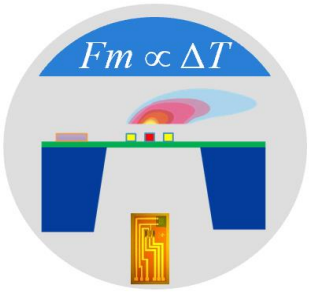


Figure 8.1. Measurement approach illustration.

The products utilize the Company's proprietary micro-machined (MEMS) calorimetric sensing and data process technology. A thermal signal generator with a pair of sensing elements at the up 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, further correlated to the fluid mass flow rate via the calibration process.

Our proprietary calorimetric sensing technology not only offers a large dynamic range with a better performance against the environmental parameter alternations, but it provides a unique gas identification algorithm via the direct measurement of the gas thermal conductivity and capacitance. For any gases with distinct thermal properties and pre-registered, the meter can identify such 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 very common that a user may compare the data from the product with a third-party reference meter, and in many cases, there could be some discrepancies.

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 compare the different flow meter is that as long as the fluidic flow is a continuous flow without pulsation, then the fluidic dynamic 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 height for the meters which in most cases is the same in the system. Therefore, it would be very critical to have the system does not have a 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 important 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 re-conditioned. 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	Power not connected; battery empty	Connect the power, check the cable
	Cable connection incorrect	Check cable
	No flow or clogging	Check flow and contamination
	LCD error	Return to factory
	Sensor failure	Return to factory
Large errors or unexpected flow rate	Particles, fluid type	Check system
Erroneous or large noise	Vibration, unstable flow	Check system
Readings without flowrate	Sensor error	Return to factory
	Power failure	Check power status
Offset unstable	Circuitry instability	Check system, power off
No digital interface	Wrong address, software	Check commands, connection
	Incorrect baud rate	Check the settings
	Pin contact or connection	Check hardware
No pulse output	Incorrect wiring	Reconnect the wire

10. Warranty and Liability

(Effective January 2018)

Siargo warrants the products sold hereunder, properly used, and properly installed under normal circumstances and service. 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 serviced product shall bear the same terms in this warranty.

Siargo makes no warranty, representation, or guarantee and shall not assume any liability regarding the suitability of the products described in this manual for any purposes that are not specified in this manual. The users shall be held for full responsibility for validating the performance and suitability of the products for their particular design and applications. For any of the misusage of the products out of the scope described herein, the user shall indemnify and hold Siargo and its officers, employees, subsidiaries, affiliates, and sales channels harmless against all claims, costs, damages, and expense or reasonable attorney fee from direct or indirect sources.

Siargo makes no other warranty, express or implied, and assumes no liability for any special or incidental damage or charges, including but not limited to any damages or charges due to installation, dismantling, reinstallation, etc. 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 to or 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 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 damages;
(3) Products that have been opened or dismantled for whatever reasons;
(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 are re-sold by unauthorized dealers or any third parties.

11. Service contact

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

Customer service and all orders should be addressed to

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

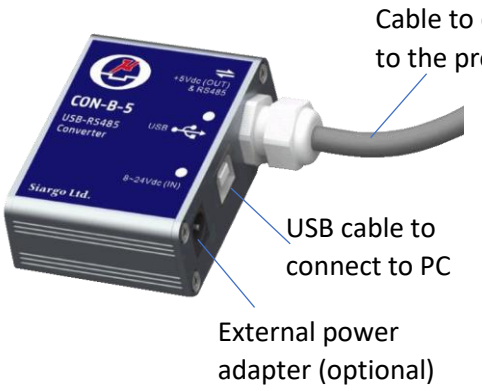
For orders, please provide an accurate and full postal address. Siargo will not ship to P.O. Boxes or via a third party.

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

Appendix I: Product evaluation kit

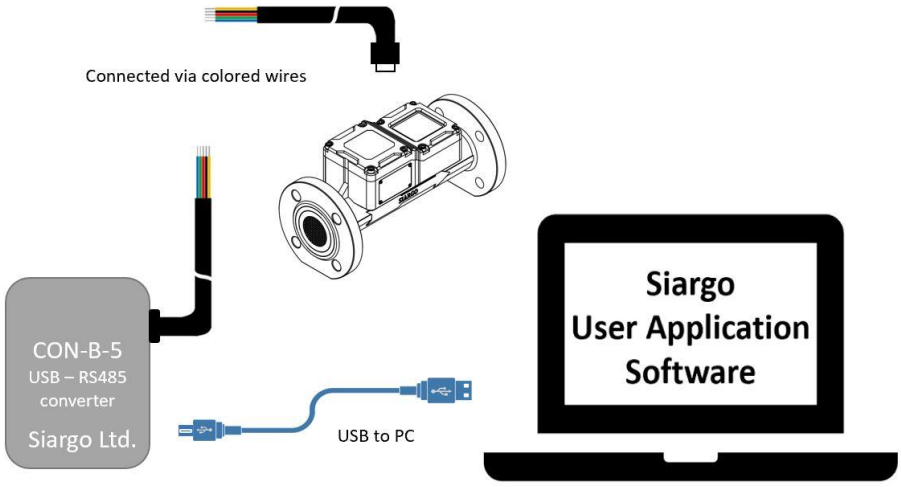
Siargo offers a product evaluation kit, including a digital data converter, USB data cable, and a User Application software, that allows the user to evaluate the product performance on a Microsoft Windows-based computer. For some simple applications with digital data transfer, this kit could serve the 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 with the RS485 interface in serial.

For further information and purchase of the evaluation kit, please contact 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 product, 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 8~24Vdc will be required.



Appendix II: Document history

03.2021	VF.1 – Format, addition, and modifications.
07.2020	VE.1 – Revision for flanged mechanical modification release.
04.2019	VD.5 – Addition of gas recognition function.
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05.2009	VA.0 – First release.