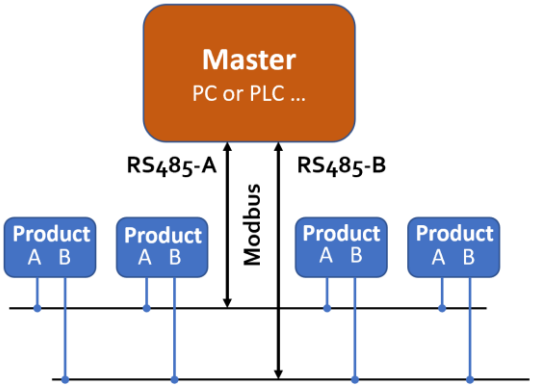
MF-FD serial MEMS mass flow meter

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.

1. Hardware connection

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



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

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-FD)'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.

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. Registers

The product (MF-FD) 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 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 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	0x0030~0x0035	40049 (0x0030)
Flow rate	Current flow rate (R)	0x003A~0x003B	40059 (0x003A)
Totalizer	Totalizer or accumulated flow rate (R)	0x003C~0x003E	40061 (0x003C)
Temperature	Ambient temperature	0x003F	40064 (0x003F)
GCF*	Gas correction factor (R/W)	0x008B	40140 (0x008B)
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, 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 from 1 to 247 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 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	Totalizer or accumulated flow rate A = Value (0x003C) * 65536 + Value (0x003D) + Value (0x003E) /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+ 245/1000=3452.245.		

Temperature	0x003F	Write	N
		Read	Y
Description	Ambient temperature.		
Value type	UINT 16		
Notes	Ambient temperature = Value (0x003F) / 100 **e.g.,** for an ambient temperature of 23.45 °C, the user will read "2345 (0x0929)" from register 0x003F, therefore Ambient temperature = 2345/100 = 23.45		

GCF	0x008B	Write	Y
		Read	Y
Description	The gas conversion factor for a gas that is different from the calibration gas.		
Value type	UINT 16		
Notes	The air (default) is 1000, normally 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 contact the manufacturer. **Notes: please disable the write protection before executing this function.**		

Pulse	0x0093	Write	Y
		Read	Y
Description	Set the pulse		
Value type	INT 16		
Notes	Value -1, 0, 1, 2 or 3. -1 (0xFFFF): 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); **The default value is 3, the pulse is 1,000 SL/pulse (1 m^3/pulse).** **e.g.:** 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.** **Notes: please disable the write protection before executing this function.**		

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