MEMS Mass flow Meter

MF4600 series

User manual

(VA.0)

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

SIARGO LTD.

Introduction

MF4600 series mass flow meters are made with Siargo's proprietary MEMS sensing technology. It applies for clean and dry gas metering and control. The meter is designed with the structure of a rotameter but with the full capability of a digital gas mass flow metrology and LED display. Both instant and accumulated flowrate can be read and displayed. The front buttons let user to access and adjust the parameters as well as stored data. The standard RS485 Modbus enables the remote access and integration.

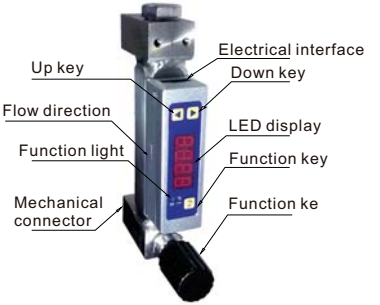
Features

- Direct mass flow measurement with high accuracy
- Multiple sensing elements for extended rangeability over 100:1
- Easy remote accessible user interface with RS485 Modbus and/or linearized analog data
- Bright LED display for instant and accunulated flowrate with on-site access via front buttons
- Record flowrate patterns with over range indication
- Easy for remote communication and integration
- Compatible with traditional rotameter mechanical connections
- Flow range and mechanical dimensions can be fully customized

Specifications

Parameters		Units
Meter DN	3/8	mm
Flow range	0...1/3/5/10/20/30/50	SLPM
Rangeability	50:1	
Accuracy	±(2.5+0.5FS)	%
Repeatability	±0.8	%
Offset stability	0.01	%FS
Span stability	±0.12	%/°C
Response time	10 (default, can be changed via button)	msec
Power supply	8~24Vdc, 50mA max.	
Output	Analog, RS485 Modbus	
Display	LED with 2 indicators	
Display units	Instant flow: SLPM; Accumulated flow: SL	
Resolution	0.001, 0.01. 0.1, selectable	SLPM
Pressure loss	100 (0...5)/600 (0...50)	Pa
Max pressure	0.5	MPa
Temperature	-10 ~ +55	°C
Storage	-20 ~ +65	°C
Humidity	<95%RH, no condensation	
Mechanical	Flexible, soft tubing	
Key board	3 keys	
Electrical	5 pins, CD R-5	
Calibration	Air (20°C, 101.325 kPa)	

Description



Installation

Please check the items in the package upon opening the box:

1) The package should contain the followings
   a) MF4600 mass flow meter 1
   b) Electrical cable .1
   c) User manual
   d) QC certificate

2) Make sure no mechanical damages or visual damages

3) Connect the electrical cable according to the pin description

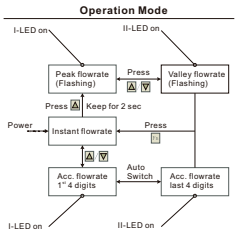
4) Connect power supply and warm up for 2 minutes before use

Pin definition

Pin	Color	Definition
1	Blue	RS485B
2	Green	NC
3	Red	VCC, Power +(8~24Vdc)
4	Black	GND, ground (power/signal)
5	Yellow	RS485A

Operation

The meter shall display instant, accumulated, peak-peak, peak-valley flowerate. The indication light shall be lighted accordingly. Please see the detailed description below.



Instant flowrate display

1. Instant flowrate is a default display mode, both LED (I and II) will be off.
2. Instant flowrate is displayed by 4 LED digit with a decimal, the unit is SLPM
3. When the instant flowrate is over the allowed range, I-LED (over max) or II-LED (below min) will be flashing.

4. If I- and II-LED flash at the same time, it indicates that the actual flowrate is over the calibrated range or the display value is incorrect.

Accumulated flowrate display

1. The accumulated flowrate is displayed by 8 digits that is separated with two 4 digit display where I-LED indicates the first 4 digits and II-LED indicates the last 4 digits. The units is SL.
2. The accumulated flowrate can be reset via the keyboard.

Peak-Valley flowrate retrieval

1. The data of the last registered peak-valley flowrate can be retrieved via the keyboard.
2. When the peak flowrate value is displayed and flashed, the I-LED will light.
3. When the valley flowrate value is displayed and flashed, the II-LED will light.

Menu settings

The Menu Settings will allow the user to execute keyboard lock/unlock, reset accumulated flowrate, reset offset, set time, response time, instant flow decimal point etc.

Keyboard lock

This function shall prevent unintended changes of the parameters by press the keyboard. When keyboard is locked, the menu function is disabled.

Accumulated flowrate reset

This function shall reset the accumulated flowrate, and the meter will re-start from null.

Offset reset

This function shall reset the offset which may be due to drift after a certain period of performance. It shall help for improving accuracy. **Note**: When performing offset reset, make sure there is no flow in the meter otherwise it will have impact to the accuracy.

Sampling time

This function allows user to set the sampling time between analog output and digital output via the serial port. Once the setting is done, it will be immediately effective but the settings will only be saved into the EEPROM after switch to another function.

Display	4.001	4.002	4.005	4.010	4.020	4.050	4.100
Sampling	10ms	20ms	50ms	100ms	200ms	500ms	1000ms

Display update time

This function allows the user to set the display update time of the meter. Once the setting is done, it will be immediately effective but the settings will only be saved into the EEPROM after switch to another function.

Display	5.025	5.050	5.100	5.200
Update	250ms	500ms	1000ms	2000ms

Peak value reset

This function allows user to reset the peak value to null.

Reset to factory default value

This function allows user to reset all parameters to factory default values.

Decimal setting for instant flowrate

This function allows user to set the decimal point of instant flowrate. **Note:** when full scale flowrate is up to 5 SLPM, 3 decimals can be set, e.g. 1.111; when full scale flowrate is up to 50 SLPM, only 2 decimals can be set, e.g. 11.11.

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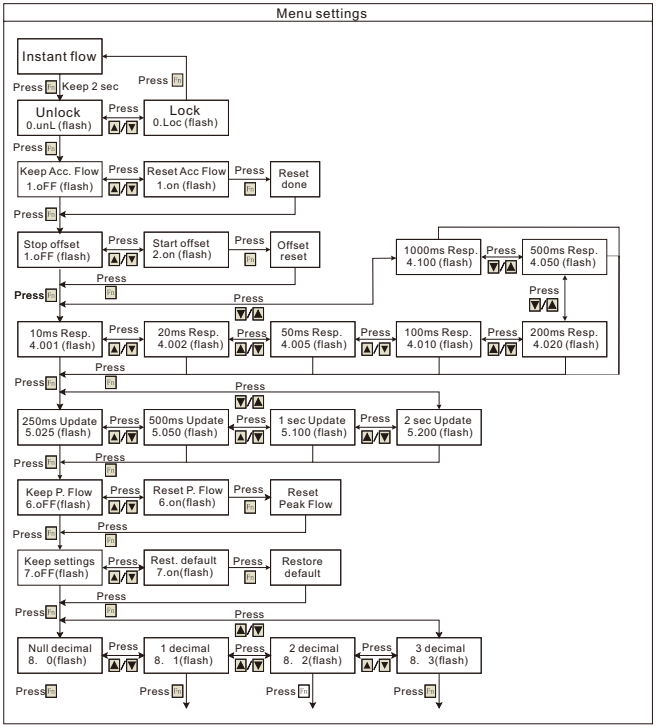

RS232 communication

1. Serial port settings

Item	Protocol
Product	MF4600 mass flow meters with manual valve
Physical class	TIA/EIA - 232 - E
Cable	3 conductor shielded cable
Cable length	~3m (recommended)
Network spec.	Master 1/Slave 1
Data rate	38400 bps
Data exchange	Asynchronous serial, dual half
Data protocol	Point to point
Length	11 bit
Stop length	1 bit
Overtime	1 sec
Frame	Variable, longest from master/slave should not over 107 bytes
Even/Odd Verif.	None. (but should use the bite)
Verification	XOR checksum

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2. Protocol structure

This protocol has 3 layers, physical layer, data link layer and user layer.

2.1. Physical layer

The electrical interface standard is TIA/EIA-232-E, it takes asynchronous serial dual half and point to point communication protocol. The cable is shielded and ground can be independent or make use of the shield layer.

2.1.1. Data format

Data have 11bits and have the following format:

Start D0 D1 D2 D3 D4 D5 D6 D7 D8 stop

Start: 1 bit, expressed by a low level

Data（D0~D7): 8 bits, stands for the data to be transmitted or frame start, from low to high.

Frame marker (D8): 1 bit, indicates the 8 bits are data or frame start. When the master is sending the data, D8=1 indicates the frame start, otherwise the bits are data, including commands, data length, data segment, verification and frame end. When slave is sending the data, D8=0.

Stop: 1 bit, represented by a high level

2.1.2. Baud rate

The Baud rate is fixed to be 38400 bps.

2.2 Data Link Layer

The data link layer defines the data frame format of the protocol. Both the master and slave shall use the same format. Each field in the data frame are expressed in hexadecimal. (Non-ASCII code)

The frame format is as follows,

Header	Command	Length	Segment	Checksum	Tail
1 bit	1 bit	1 bit	Variable	1 bit	1 bit

a) Header: it is the address of the meter (e.g., 0x01), which is the begging of a data frame.

b) Command: it is the execution of the master for slave, such as data read. The value shall be 0~255.

c) Data length: the effective data length is 0~102. If the length is over 102, there will be no responses.

d) Data segment: each segment may contain additional data, such as for revision of certain meter parameters. Some commands may contain no data for which the segment is void when the length is 0.

e) Checksum: it provides the data transmission approach in the presence of interference. It sums up XOR for all bits. If the checksum is incorrect, there shall be no responses. The master can check it with overtime.

f) Tail: it is fixed with 0x0D, that ends the data frame.

g) Overtime interval: In order to prevent interferences or master incident induced slave lock. The overtime check shall be started whenever the salve receives a data. If the next 1 second, no additional valid data is received, it shall be verified as overtime, and a new check starts for the next data. The minimal 10 msec interval shall apply for slave responses to master.

2.3 User Layer

The user layer defines commands that can be used by the master to the meters. The following table lists all currently available commands. (address 01 as an

Commands	F0	Read *instant flowrate*	Applicable	All
Master enq.	01 F0 01 OUT_SEL CRC 0D			
Slave resp.	01 F0 DATA_LEN DATAS CRC 0D			
Description	Read *instant flowrate*, the data length is 3 bits Master enquiry: 01 F0 01 08 CRC 0D (where OUT_SEL=0x8) Slave response: 01 F0 03 FRH FRM FRL CRC 0D Date format: instant flowrate = (FRH * 65536 + FRM * 256 + FRL) / 1000 Note: the unit is SLPM with 3 decimals.			
Commands	FF	Read *meter serial number*	Applicable	All
Master enq.	01 FF 00 CRC 0D			
Slave resp.	01 FF 0C SN1 SN2 SN3 SN4 SN5 SN6 SN7 SN8 SN9 SN10 SN11 SN12 CRC 0D			
Description	This reads the serial number of the meter which is unique assigned at manufacture. The serial contains 12 continuous ASCII characters.			
Commands	02	Change *sampling time*	Applicable	All
Master enq.	01 02 02 RTH RTL CRC 0D			
Slave resp.	01 02 01 STATE CRC 0D			
Description	This command changes the sampling time, unit: msec. Sampling time = RTH * 256 + RTL Available sampling time: 10ms, 20ms, 50ms, 100ms, 500ms, 1000ms. STATE: if change is accepted, STATE=1, otherwise STATE=0			
Commands	03	Change *GDCF, gas factor*	Applicable	All
Master enq.	01 03 02 GDCFH GDCFL CRC 0D			
Slave resp.	01 03 01 STATE CRC 0D			
Description	This command changes the linear revision factor that is due to calibrator inconsistency GDCF = GDCFH * 256 + GDCFL STATE: if change is accepted, STATE=1, otherwise STATE=0			

Commands	72	Reset offset	Applicable	All
Master enq.	01 72 01 55 CRC 0D			
Slave resp.	01 72 02 OFFSETH OFFSETL CRC 0D			
Description	This command shall automatically reset the offset, please ensure that there is no flow in the flow channel. Otherwise the reset will result a larger error. Offset = OFFSETH * 256 + OFFSETL; the value will be from -32767 to +32767			
Commands	78	Restore factory default values	Applicable	All
Master enq.	01 78 01 55 CRC 0D			
Slave resp.	01 78 01 STATE CRC 0D			
Description	This command shall restore factory default values in the meter, including 1. Sampling time (response time), 10 msec; 2. Meter calibration, GDCF, 1000. 3. Offset data at calibration in factory.			
Commands	82	Reset offset	Applicable	All
Master enq.	01 82 00 CRC 0D			
Slave resp.	01 82 02 RTH RTL CRC 0D			
Commands	83	Read GDCF	Applicable	All
Master enq.	01 83 00 CRC 0D			
Slave resp.	01 83 02 GDCFH GDCFL CRC 0D			
Description	This command shall read the GDCF from the meter. GDCF = GDCFH * 256 + GDCFL			

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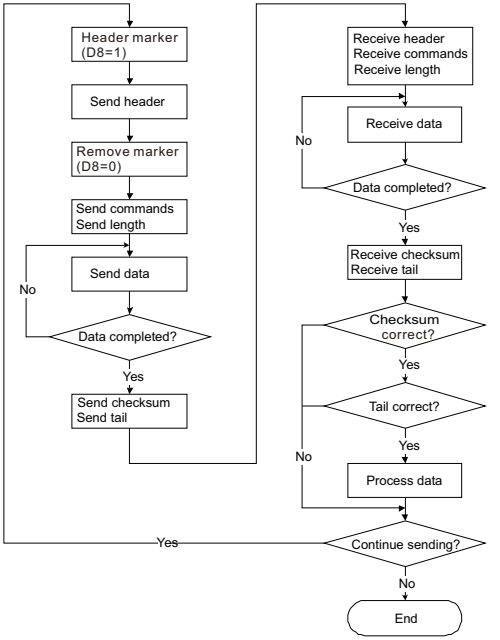
3. Communication flow

The recommended communication flow is indicated in the following chart.



Safety and Warranty

Wetted Materials and Compatibility

The meter body is made of polycarbonate and 316 stainless steel. Sensors comprise of silicon, silicon nitride and silicon dioxide and the sensor surfaces are passivated with silicon nitride and silicon dioxide. The electronic sealing is provided by RTV (room temperature vulcanizing) silicone sealant WR-704 composed of HOCH3(SiO)nCH3H.

Safety Precautions

The product is designed for use with general purpose gases such as air and nitrogen. It is advised that the products are best used for non-explosive clean gases. The meters cannot be used for gas metrology of fluoride or fluoride containing gases. For updates of the product certification information, please contact manufacturer or visit www.Siargo.com. Use for other gases such as extreme corrosive and toxic may cause the product malfunctioning or even severe damages. The product sealing is ensured to work under working pressure of 60 psi and is leakage proof before the shipment. But cautions and further leakage test are important at installation as well since any leakage could cause severe safety issue. The power supply for this product requires a voltage supply of 8-24 Vdc, all precautions and measures for electrical voltage handling must apply.

Attention: Any alternation and/or improper use of the product without the permission of the manufacturer can cause unpredicted damages and even injuries or other severe situations. Siargo Ltd. or any of its employees, subsidiaries shall not be hold and indemnified against such consequences due to such circumstances via improper use of the product.

All maintenance of the product should be done by trained and certified personnel by Siargo Ltd.

For further information, please contact the manufacturer.

Environmental compliance

Siargo commits to be in compliance with the environmental regulations. This includes all package materials. Please dispose the corresponding materials by it categories, such as wood, paper, plastics. For the disposal of the entire product, please follow the electronics disposal regulations and laws.

Customer service and Contact

Siargo shall guarantee its product quality and ensure the quality assurance in its entire manufacture process. For any questions or technical support, please contact at the following address and we shall response timely.

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