F235x

Small Flow Mass Flow Meter

Instruction Manual

Version: 1.00

Experts in Compressed Air & Fluid Measurement

Fast · Accurate · Managing

Preface

- Dear customer, thank you for choosing our products.
- This manual is a description of the use range, functions, installation and operation, trouble-shooting, and maintenance of the product.
- The user must read this manual completely before using the device to properly use product.
- After you have finished reading, please keep it in an easily accessible place for future reference.

Notice

- The company is not responsible for any losses caused by not carefully review this manual or by unauthorized modifications to the equipment. Additionally, such actions will result in automatic voiding of the product's warranty.
- The company is not responsible for indirect losses caused by transportation, equipment performance issues, or improper use.
- The company does not guarantee the suitability of the equipment for any uses not described.
- We strive to ensure the accuracy of this manual. If you find any issues, please feel free to contact us.

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Content

Preface 2

Notice 2

1 Safety Instructions 5

1.1 General Safety Instructions 5

1.2 Storage And Transport Safety 6

2 Product Overview 7

2.1 Product Introduction 7

2.2 Product Advantages 7

2.3 Technical Data 8

2.4 Size and flow range 9

2.5 Order Information 10

3 Product Dimensions and Installation 12

3.1 Dimensions (outline drawing) 12

3.2 Installation 13

3.2.1 Attention 13

3.2.2 Install the flow meter 13

3.3 Cabling 15

4 Digital Signal 16

4.1 MODBUS RS485 communication 16

4.2 Precautions for RS485 bus cabling 16

4.3 Communication failures RS485 16

4.4 Trouble shooting RS485 17

5 Modbus RTU Protocol 18

5.1 Communication Parameters 18

5.2 Holding Register Definition 18

5.3 Process Data Format 18

5.4 Byte Order 18

5.5 Holding Register: Process Data Table 19

6 Locally Button Configure 21

6.1 F235x series one-buttonflow meter local operating instructions 21
6.1.1 Main UI 21
6.1.2 Operation instruction 21
6.2 F235x series three-buttonsflow meter local operating instructions (flow PNP alarm output) 22
6.2.1 Main UI 22
6.2.2 Configuration UI 22
6.2.3 The 1st line of the red LED displays the parameter name and parameter value as the following table: ...24
7 Operation And Maintenance 25
7.1 Attentions 25
7.2 Local indicator 25
7.3 Maintenance 25
7.4 Troubleshooting 26
8 Guarantee Clause 26

1 Safety Instructions

1.1 General Safety Instructions

Warning signs indicate the necessity of special attention when installing or using



Warning!

Compressed Air!

Any contact with rapid air leaks or pressurized parts of the compressed air system can lead to significant injury or even death!

- Use only pressure-resistant installation materials.
- Avoid personal contact with rapid air leaks or parts of the instrument with pressure.
- You must ensure that the system is not under pressure when performing maintenance operations.



Warning!

Power Voltage!

Any contact with the electrical parts of the product can lead to significant injury or even death.

- Consider all electrical installation-related regulations.
- Any power connections must be disconnected when performing repair and maintenance operations.
- Any electrical work on the system is to be performed by authorized personnel only.

Attention signs indicate the necessity of attention when installing or using



Attention!

The permissible range of operating conditions

Please check the permitted operating conditions. Any operation outside these permits may cause equipment failure or even damage to the instrument or the entire system.

- Please check the national regulations, and remarks during the preparation, installation, and use.
- Use of this product is prohibited in explosive areas.
- Do not operate outside the permitted operating range.
- Make sure that the product operates within the permitted conditions.
- Do not exceed or fall below allowable storage/operating temperatures and pressures.
- Do not disassemble the product without permission.
- Use the correct and appropriate tools when the product is in working condition.



Attention!

The product must be properly installed and regularly maintained, otherwise incorrect measurement data will lead to incorrect measurement results.

Please contact the relevant technician for any malfunction

1.2 Storage And Transport Safety

- Ensure that the product is transported at a temperature of -30 ... +70 °C.
- It is recommended to use the product's original packaging for storage and transport.
- Make sure that the product is stored at a temperature of 0 ... +40 °C.
- Avoid exposure to sunlight and UV rays.
- The storage humidity must be < 90% and free of condensation.

2 Product Overview

2.1 Product Introduction

F235x series is used to accurately measure the mass flow of gas medium. The series design bases on the thermal principle, omits intense compensation when pressure and temperature change. The product integrated the technologies of MEMS (Micro-Electro-Mechanical System), Signal processing, Digital Simulations. The principle and technologies bases guarantee the superior performance of the F235x series on gas flow measurement in terms of sensitivity, pressure loss, range ratio, response time, and micro flow measurement. The F235x series presents instant flow rate and cumulative flow with local indicator. Also, it enables the analog and digital output for remote data access.

F235x flow meter series applies to measure and control the gas flow of industrial furnaces, medical and pharmacy gas equipment, laboratory micro reaction devices, gas mixing system, gas chromatograph equipment, semiconductor processing equipment, optical fiber processing equipment, etc.

The F235x series flow meters are used for real-time flow measurement and output of flow related information. Output methods include local display, analog 4~20mA and RS485 digital communication; local display includes instantaneous and cumulative gas flow, gas pressure (optional), gas temperature; these contents can also be remotely transmitted to the upper computer or control system through analog and digital communication.

2.2 Product Advantages

- ✓ **Based on the thermal principle, unaffected by temperature and pressure, Integrated temperature measurement**
- ✓ **Microelectromechanical systems for sensors based on CMOS semiconductor processes, achieve hig h precision measurement of millimeter dimensions**
- ✓ **Extremely wide 1:100 range ratio, lower limit of measurement down to 0.04 SLM (DN3)**
- ✓ **Integrated digital adaptive signal processing technology, effective suppression of random errors**
- ✓ **Fully isolated electrical structure completely filters out interference**
- ✓ **Standard of Modbus RTU (RS485) interface and 4~20 mA current**

2.3 Technical Data

Measuring Medium	
Measuring Medium	Air, Oxygen, Nitrogen, Hydrogen, Argon, Helium, Silane, Ammonia, Phosphorus Oxychloride, Nitrogen trifluoride and other customized gases
Flow Measurement	
Measuring Range	Reference (section 2.4)
Measuring Accuracy	± 1.5% F.S.
Reference Condition	20 °C, 1 bar(a) - ISO 1217
Repeatability	±0.25% FS
Zero Drift	< 0.1% FS
Response Time	< 20 ms
Pressure	1.6 MPa
Pressure Loss	3 kPa（Full scale）
Temperature	
T-Medium	-20 ... +60 ℃
Output	
4 ... 20 mA Output (Standard)	Flow
Digital Output	Modbus RTU RS485（Standard）
Connection	Cable link
Materials	
Flow Runner	SUS304 or SUS316L
Sealing	Viton, EPDM, XX customized
Joints	SUS304 or SUS316L
Mechanical Parameter	
Process Connection	Reference (section 2.4)
Dimensions	Reference (section 2.4)
Weight	< 1.0 kg
Protection	IP54
Power	
Power	24 VDC 0.5W @ 24VDC

2.4 Size and flow range

DN (mm)	Process connection (Inch)	L (mm)	W (mm)	H (mm)	FLOW RANGE (SLM)
40	Female G1$^{1/2}$"	133	58	90	30 ... 3000
32	Female G1$^{1/4}$"	133	54	85	20 ... 2000
25	Female G1"	133	49	78	15 ... 1500
20	Female G3/4"	88	38	72	8 ... 800
15	Female G1/2"	88	38	72	3 ... 300
10	Female G3/8"	88	38	56	1 ... 100
10	Female NPT 3/8"	88	38	56	1 ... 100
10	Male LOK 3/8"	124	38	56	1 ... 100
6	Female NPT 1/4"	88	38	56	0.5 ... 50
6	Male LOK 1/4"	124	38	56	0.5 ... 50
3	Female NPT 1/8"	88	38	56	0.02 ... 2
3	Male LOK 1/8"	124	38	56	0.02 ... 2

2.5 Order Information

F235x Ordering information list

Model	Pressure	Digital Output	Analog Output	Material	Process Connection	Gas type	Accuracy	Description
F235x								Small Flow Mass Flow Meter
	PN16							1.6 MPa
		1						Modbus RTU (RS485)
			1					4...20 mA Output
				M0101 0001				SUS304
				M0101 0001				SUS316L
					LOK-3			Male, LOK 1/8", DN3
					LOK-6			Male, LOK 1/4", DN6
					LOK-10			Male, LOK 3/8", DN10
					NPT-3			Female, NPT 1/8", DN3
					NPT-6			Female, NPT 1/4", DN6
					NPT-10			Female, NPT 3/8", DN10
					G-10			Female, G3/8", DN10
					G-15			Female, G1/2", DN15
					G-20			Female, G3/4", DN20
					G-25			Female, G1", DN25

Model	Pressure	Digital Output	Analog Output	Material	Process Connection	Gas type	Accuracy	Description
					G-32			Female, G1$^{1/4}$", DN32
					G-40			Female, G1$^{1/2}$", DN40
						V0202 0001		Air
						V0202 0002		Oxygen (O2)
						V0202 0003		Nitrogen (N2)
						V0202 0004		Hydrogen (H2), Real Gas Calibration
						V0202 0005		Nitroous Oxide (N2O)
						V0202 0006		Carbon Dioxide (CO2)
						V0202 0007		Natural Gas (NG)
						V0202 0008		Argon (Ar)
						V0202 0009		Helium (He), Real Gas Calibration
						V0202 0010		Other Specified Gases (Specify Gas or Gas Mix)
							V0204 0001	Standard Calibration Accuracy ±1.5% FS

3 Product Dimensions and Installation

3.1 Dimensions (outline drawing)

Please refer to Chapter 2.4 for detailed appearance dimensions.

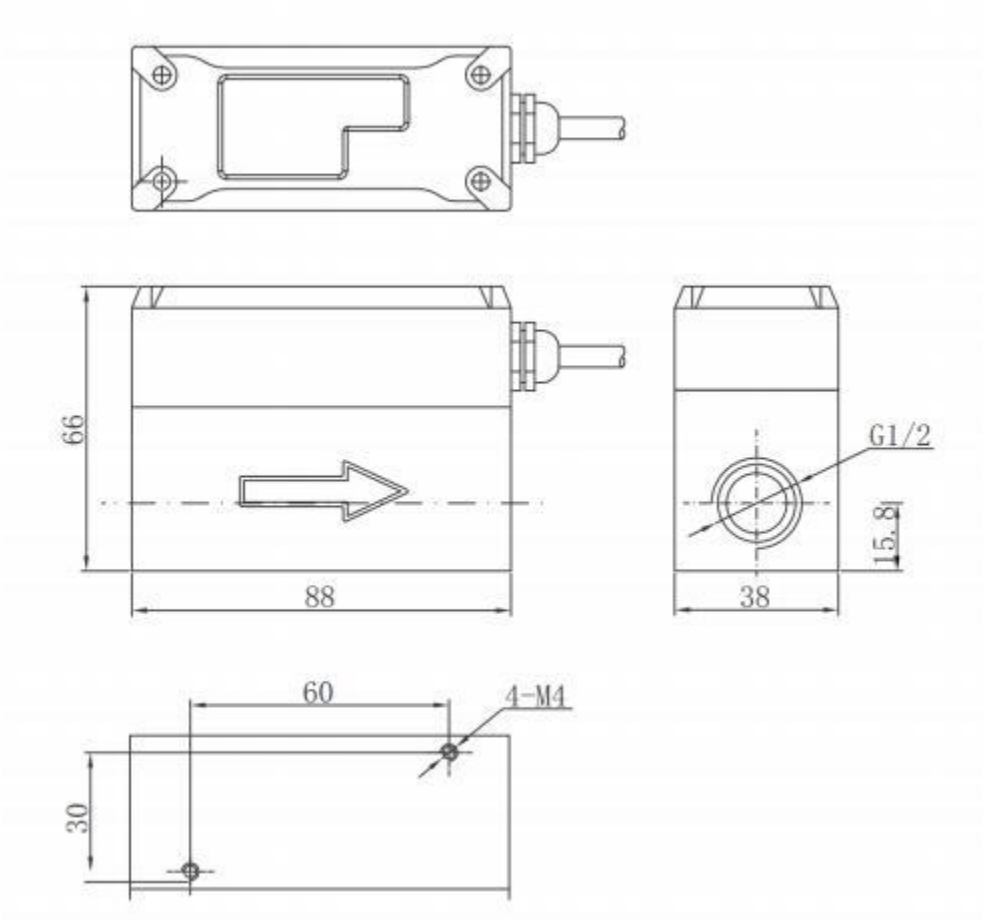


Figure 3.1 F235x product dimensions

3.2 Installation

3.2.1 Attention

(1) The flow meter should be used to measure the clean and dry gas flow, free of dust and oil. A filter of fineness 1μm and a dryer shall be installed in upstream of the flow meter.

(2) The measuring gas should be in line with the specification. The flow meter should not be used to measure the gas flow of corrosive medium or liquid. If the meter is used to measure the corrosive medium, it should be stated before ordering.

(3) The gas flow pressure and flow rate should match the order specified. Overpressure usage of the flow meter is strictly prohibited

(4) When the pipeline is to be pressure tested, the valves located at the upstream and downstream of the flow meter should be switched off to avoid flow meter damage.

(5) If the flow meter is used to measure the flammable gas, measures should be taken to prevent fire and explosion.

(6) If the flow meter is used in a hazardous or corrosive environment, the correct operating procedures should be strictly followed.

(7) The wiring should be arranged properly for safety concern, the distance between wire and the gas pipeline shall be greater than 300mm. The electrical equipment and their wiring shall not be arranged within 500mm around the flow meter.

3.2.2 Install the flow meter

Refer to **Figure 3.2** for the piping design and field engineering

1) The flow meter should be arranged avoiding the environment of strong magnetic field or strong vibration.

2) The pipeline should be purged before installing the flow meter.

3) The joints with correct specification should be selected in consistent with the nominal diameter of the flow meter. It is recommended to connect the threaded pipe with consistent bore to flow meter.

4) The flow meter should be installed horizontally. If it is installed vertically, it shall be specified when place the order.

5) Stable flow field improves the measuring accuracy, the straight pipe sections should be arranged at the upstream and downstream of the flow meter; **refer to Figure 3.3 for more information.**

6) The flow meter direction (indicated by the arrow sign) should be in consistent with gas flow direction.

7) When using a joint connection, the inner diameter of the joint should be consistent with the inner diameter of the flow meter to ensure measurement accuracy and precision.

8) The flow meter should be mounted without generating excessive mechanical stress. The supports should be added on the pipelines on both sides of the flow meter if necessary.

9) The valves located at the upstream and downstream of the flow mete should be softly switched on and off when necessary. Quick operations lead to pressure and flow rate fluctuation, further damage the flow meter.

10) The air tight test should be conducted before the flow meter is put into use.

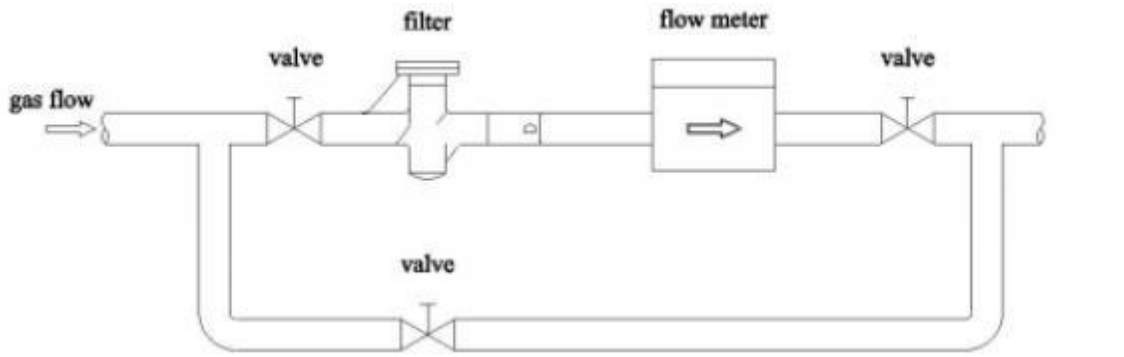


Figure 3.2 outline diagram of flow meter install

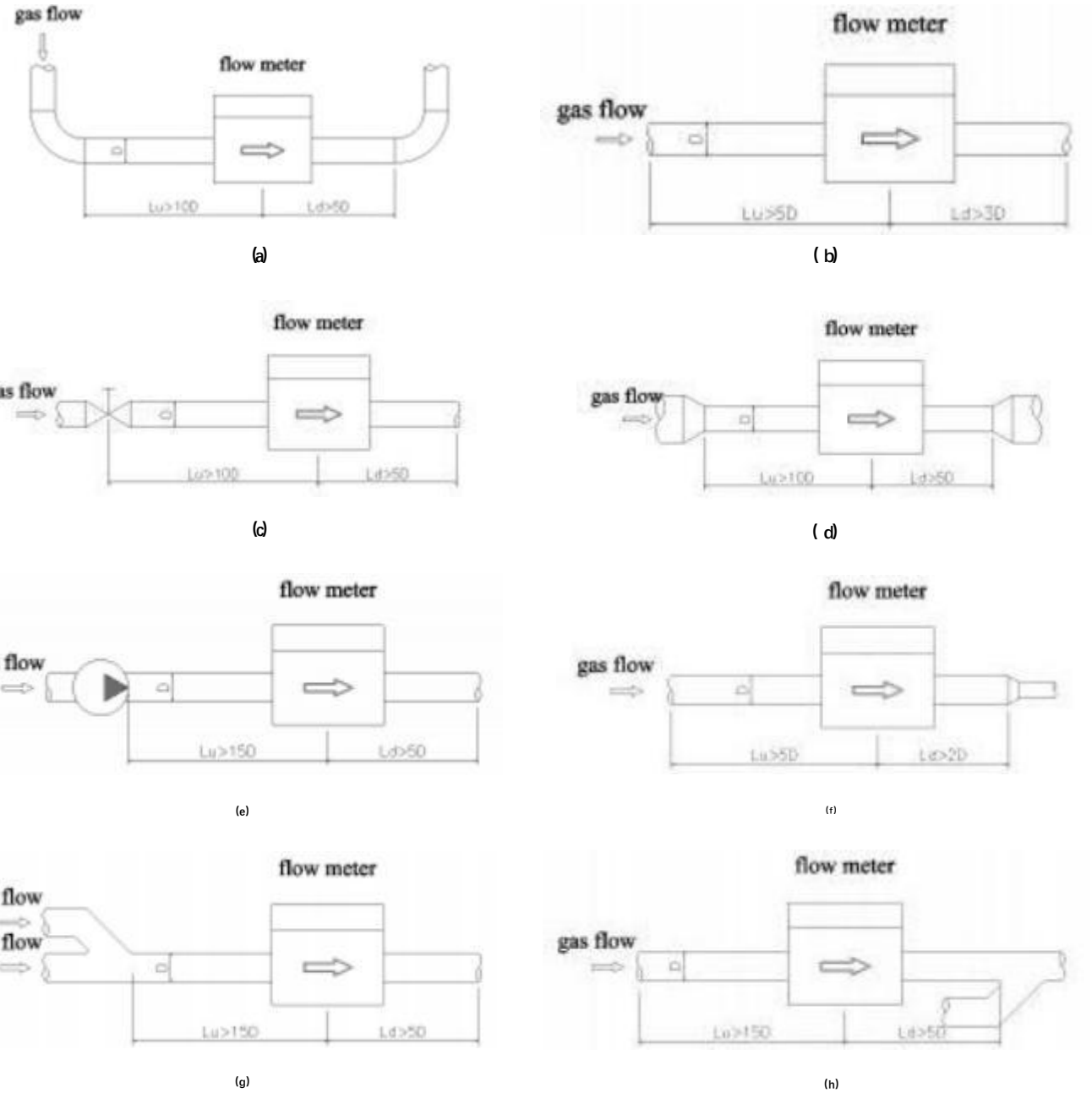


Figure 3.3 outline diagram of flow meter installation

3.3 Cabling

Refer to Table 3.1 and Figure 3.4 to wire the power and the signal. Note: Reversely wiring +/-of the power, power over-voltage, wiring the power supply to the signal output may damage the flow meter. Reversely wiring the signal line results in abnormal signal output.

Table 3.1 Wiring definition

Line code mark (color)	Wiring definition	Notes
+(Red)	24VDC (+)	DC 24V Power
-(Black)	24VDC (-)	
A(Green)	RS485 (A)	MODBUS RTU
B(White)	RS485 (B)	
C(Yellow)	4-20 mA (+)	Optional
D(Blue)	4-20 mA (-)	

passive analog signal output 4-20mA wiring

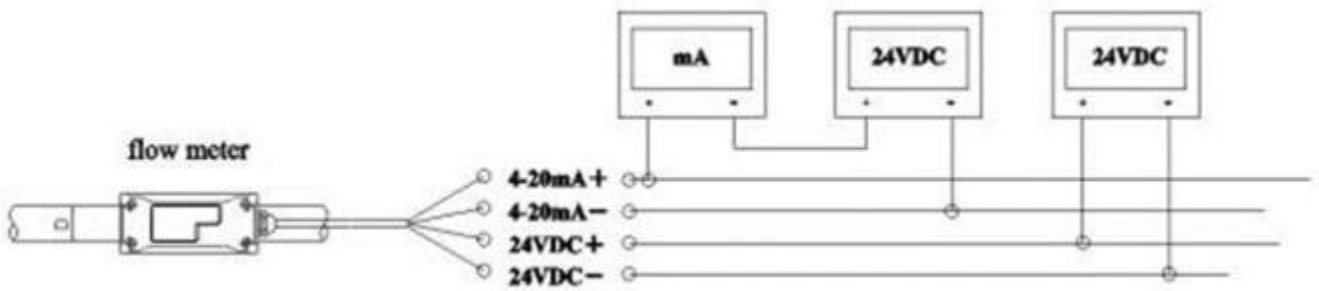


Figure 3.4 wiring 4~20mA

Active analog signal output 4-20mA wiring , Just connect the positive and negative signals directly

4 Digital Signal

4.1 MODBUS RS485 communication

RS485 Interface Definition

1) The theoretical maximum communication distance of RS485 bus is 1200 meters ideally with One single RS485 BUS device, baud rate 9600, and qualified cable. It will shorten the communication distance when presenting multiple RS485 devices, non-standard cable impedance, thin cable diameter, low-quality converters, complex lightning protection measures, and higher baud rates.

2) RS485 BUS supports communication up to 128 devices such as display meters, paperless recorders, and PID controllers. The mentioned factors affecting the communication distance will also reduce the supporting number of devices.

3) RS485 BUS is economical and traditional for industrial device networking. Its communication quality can be through debugging and testing based on engineering experience.

4.2 Precautions for RS485 bus cabling

1) Communication cable requirements: Shielded twisted pair cables should be used to achieve anti-interference performance. Other types of cable harms communication quality and increase debugging time. It is recommended to use multi-strand shielded twisted pair cables, with spare cores and shields available for special situations during debugging.

2) Wiring requirements: RS485 bus must adopt a hand-in-hand bus structure and does not support other types of topologies, such as star connections or branch.

3) Grounding requirements: The AC power supply for devices and the chassis must be properly grounded. Ensuring good grounding can prevent equipment from being struck by lightning or experiencing surge impacts. Good grounding can also help release energy accumulated during static electricity, protecting the RS485 bus devices and related chips from damage.

4) Wiring requirements: RS485 bus should be wired separating from high-voltage lines to prevent interference from strong electrical fields.

4.3 Communication failures RS485

1) No communication or no response.

2) Able to upload data but unable to download data.

3) Interference. The system may indicate interference during communication, or the communication indicator light may keep flashing even when there is no communication.

4) Communication instability. Communication is unstable, and some commands may work while others fail.

4.4 Trouble shooting RS485

It is important check the wiring and compliance of the specifications before commissioning. The following lists the methods for troubleshooting.

1) Common Ground Method: Connect the GND of all RS485 devices with one shielding wire to eliminate potential voltage differences that could affect communication.

2) Terminal Resistor: Connect a 120-ohm terminal resistor between 485+ and 485- of the last RS485 device to improve communication.

3) Intermediate disconnection: Check the equipment load, the communication distance, or the device impacting the entire communication link by disconnecting it.

4) Separate Wiring Method: Wire a separate link to the device to eliminate the possible wiring fault.

5) Replace the Converter: Replace the converter with a reliable one to check if problem is caused by converter quality.

6) Laptop Debugging: Use Laptop to replace the host computer for testing communication. The serial port problem may be identified.

7) Use a Repeater or RS485HUB.

5 Modbus RTU Protocol

5.1 Communication Parameters

Default settings:

Address: 1

Baud rate: 9600

Data Length: 8, Parity: None, Stop Bit: 1

Response Time out: 1 second

Response Delay: 0 ms

Inter-frame spacing: 7 char

5.2 Holding Register Definition

Logical channels, data and related holding registers

- Modbus read command: 0x03
- Modbus write command: 0x06 for single register, 0x10 for multiple register

5.3 Process Data Format

Supports two data types: IEEE 754 float data and unsigned int data

Float format

Value (Decimal)	IEEE 754 float	Register N		Register N + 1	
		High byte	Low byte	High byte	Low byte
123.4	0x42F6CCCD	0x42	0xF6	0xCC	0xCD

Unsigned int format

Value (Decimal)	Unsigned int	Register N		Register N + 1	
		High byte	Low byte	High byte	Low byte
123456789	0x075BCD15	0x07	0x5B	0xCD	0x15

5.4 Byte Order

Data is big-endian, the most significant bit transmitted first

32bit: AB CD

64bit: AB CD EF GH

5.5 Holding Register: Process Data Table

Holding Register Addr. / Hex	Data Type	No. of Byte	Data	Unit	Read / Write
0	FLOAT_B	4	Standard Flow	Nm^3/h NL/min	R
2	UNSIGNED LONG	4	Standard Consumption	Nm^3 NL	R
4	UNSIGNED INT	2	Decimal part of Standard Consumption	0.001 Nm^3	R
5	UNSIGNED INT	2	Medium Pressure	0.1KPa	R
0C	SIGNED INT	4	Medium Temperature	0.1℃	R
12	UNSIGNED LONG LONG	8	Zero Consumption	\	W: write '0' to clear the consumption
9600	UNSIGNED INT	2	Set Device Addr.	\	W: device address (1 … 255)
9602	UNSIGNED INT	2	Set Flow Factor	0.001	W

Example

Read the Standard Flow value from two holding registers with starting holding register address 0.

Device address 1, holding register 0, data type is a 16-bit big-endian floating number.

Send Modbus command: 01 03 00 00 00 02 C4 0B

01: Device address

03: Function code 03 in Hex format

0000: Holding register address 0 in Hex format

0002: Number of holding register

C40B: CRC

Device response: 01 03 04 41 04 CC CD 3B 5B

01: Device address

03: Function code 03 in Hex format

0004: Number of byte

4104CCCD: Floating number 8.3

3B5B: CRC

6 Locally Button Configure

6.1 F235x series one-button flow meter local operating instructions

6.1.1 Main UI

1st line: display 6-digit mass flow consumption;

2nd line: display instantaneous flow (display "----" when the flow sensor reports error);

(1) Configuration UI:

1st line (6-digit red LED): display parameter;

2nd line (4-digit green LED): " xx ⌐┘ "; The first 2-digit of "xx" indicates "parameter code";

The third digit " ⌐" symbol indicates "ESC" and the fourth digit "┘ " symbol indicates "Enter";

6.1.2 Operation instruction

The button has 2 states, long press (approx. 2S) and short press. The button must be used with the LED display to realize the configuration function.

Long press the button to enter the configuration UI. In the configuration UI, the field (position) that can be changed is blinking.

After entering the configuration UI, the 2nd line will display "P S ⌐┘ ", the first two characters will keep blinking, and there are 3 options ,

as following table:

Parameters Code	Parameters Name	Description
PS	Password	Password: '1222', access to modify parameters; Password: '1346', for specific applications
AD	Communication Address	Address: 1-255 (Dec)
od	Operating Mode	Default: 0, other mode alternate
FR	Flow Factor	Default: 1.000

Button Operation: Long press to toggle/move to the modifiable field/position.

Button operation: short press to modify the content/value of the current blinking field.

The symbol" ⌐" is defined as (ESC), a short press to exit the configuration without saving, and return to the main interface.

The symbol "┘ " is defined as (Enter), a short press to exit the configuration and save the modification, return to the normal interface.

(2) Example of modifying the device communication address:

If the password is not entered or is incorrect, the parameters can be viewed but not modified. When "PS" is displayed in the parameter field: long press the key to shift to the 1st line red LED blinking digit; short press to modify the value of the blinking digit, repeat the above operation, and enter "1222" in the 1st line; after completion, long press the key to shift the blinking digit to the 4th digit in the 2nd line, short press to confirm; it will enter the parameter modifiable state, and the green digital tube in the 2nd line will be fully illuminated with its decimal point (indicating that the parameters/address/flow factor can be modified). Enter the AD interface to modify the address, and complete the device address setting by long-pressing to shift and short-pressing to modify the value. Short press "┘ " to confirm and return to the main interface. Short press " ┌" or more than 30s without button action automatically exits the configuration state, the current changes are not saved.

6.2 F235x series three-buttons flow meter local operating instructions (flow PNP alarm output)

6.2.1 Main UI

1st line: display flow setpoint (F.)/ consumption / medium temperature (C.) / medium pressure (P.), the display parameter is switched by a short press of the button (MOV) during normal operation;

2nd line: display instantaneous flow (display "----" when the flow sensor reports error);

Button Definition	Short Press Function	Long Press Function
(INC) Increase Value	Undefined	Undefined
(MOV) Cursor Shift	Switch 1st display line (consumption/temperature/pressure)	Undefined
(SET) Setting/Enter	Undefined	Undefined
(INC)+(MOV), (press at the same time)	Enter the parameter configuration interface	Undefined
(SET)+(MOV), (press at the same time)	Undefined	Change flow unit: L/Min (U=11) < -> m3/h (U=02)

6.2.2 Configuration UI

Button Definition	Short Press Function	Long Press Function
(INC) Increase Value	Increase values/Change parameters	Flow control mode: on/off, quick control valve on/off
(MOV) Cursor Shift	Cursor (blinking digit) Shift	Undefined

(SET) Setting/Enter	Confirm the current operation, exit or save exit, etc	Flow control mode: enter the “flow setpoint” interface
(INC)+(MOV), (press at the same time)	Enter the parameter configuration interface	Undefined

6.2.3 The 1st line of the red LED displays the parameter name and parameter value as the following table:

Parameter Code	Parameter Name	Description
PS	Password	Password: '1222', access to modify parameters; Password: '1346', for specific applications
AD	Communication Address	Address: 1-255 (Dec)
od	Operating Mode	Default: 0, other mode alternate
FR	Flow Factor	Default: 1.000
AH	Upper limit alarm = (Maximum measuring range * 100%)	Example: The maximum measuring range of the meter is 10L/min. To set the alarm value to 2L/min, AH should be set to 20
AL	Low limit alarm = (Maximum measuring range * 100%)	

The 2nd line (4-digit green LED) displays "xx ⌐ ┘";

The first 2-digits of "xx" indicate the "parameter code";

The third digit " ⌐" symbol indicates "ESC", exit settings without saving, and return to the normal interface;

The fourth digit "┘ " symbol indicates "Enter", exit settings and save changes, and return to the normal interface.

In the configuration UI, the field (position) that can be changed is blinking.

(1) Example of modifying the device communication address:

If the password is not entered or is incorrect, the parameters can be viewed but not modified. When "PS" is displayed in the parameter field: long press the key to shift to the 1st line red LED blinking digit; short press to modify the value of the blinking digit, repeat the above operation, and enter "1222" in the 1st line; after completion, long press the key to shift the blinking digit to the 4th digit in the 2nd line, short press to confirm; it will enter the parameter modifiable state, and the green digital tube in the 2nd line will be fully illuminated with its decimal point (indicating that the parameters/address/flow factor/ flow PNP alarm output can be modified). Enter the AD interface to modify the address, and complete the device address setting by long-pressing to shift and short-pressing to modify the value. Short press "┘ " to confirm and return to the main interface. Short press " ⌐" or more than 30s without button action automatically exits the configuration state, the current changes are not saved。

7 Operation And Maintenance

7.1 Attentions

(1) Prohibit to: Disassemble the flow without authorization, leak detection under open fire.

(2) When gas leakage is detected, close the manual valve timely and ventilate the nearby area, do not switch on and off the electrical equipment, report to the management.

(3) Avoid putting any stuff on the flow meter, Avoid water droplets entering into the flow meter.

(4) Clean the flow meter with semi-wet and soft cloth, avoid cleaning the flow meter with water.

(5) Use the flow meter under pressure and flow rate limit. The measuring error increases, the service life decreases if the limit exceeds the limit.

(6) Close the both manual valves at the upstream and downstream of the flow meter before carry out the pipeline pressure test.

(7) Disassemble the flow meter without permission leads to risks, please contact producer if disassembling is necessary.

(8) Backflow, pipeline cleaning, operations causing excessive impurities or liquid entering the flow meter body may damage the flow meter。

7.2 Local indicator

The local indicator displays the instant flow rate and the cumulative flow acquired by the flow mete as shown in Figure 7.1.

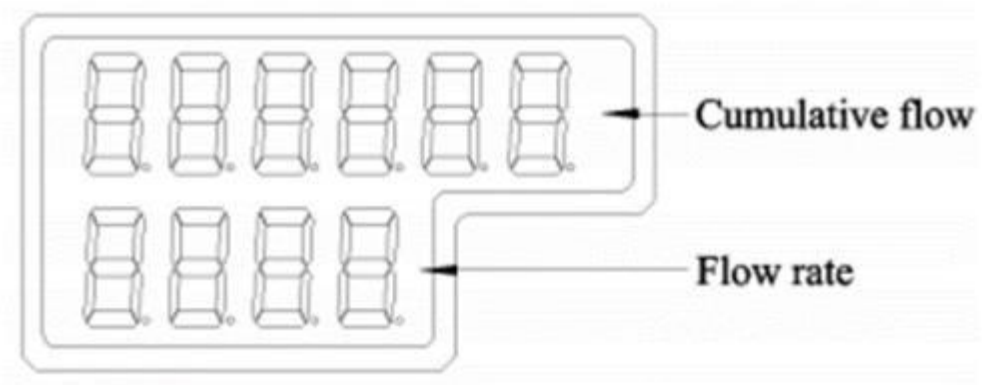


Figure 7.1 Flow display area

7.3 Maintenance

(1) Dry towel with some neutral detergent shall be used regularly to wiping flow meter to sharpen the reading. Do not clean the flow meter using caustic soda, gasoline and other solvents.

(2) It is recommended to mount the flow meter in a well-ventilated place convenient for reading, observation

and maintenance.

(3) Inspection shall be conducted regularly to check any potential leakage or damages.

(4) The flow meter should be factory-checked and repaired to maintain the accuracy.

7.4 Troubleshooting

Phenomenon	Possible causes	Remedy
Wrong flow rate indicated	1. The sensor is damaged 2. Gas is not flowing in the pipeline 3. Reverse installation of flow meter	1. Check the sensor(contact manufacturer for the service) 2. Open the valve 3. Verify the gas flow direction is consistent with the flow direction identification.
Non zero flow rate indicated after flow ceased	1. The valve is not tightly shut off 2. Pipeline leakage	1. Check the valve 2. Check leakage
Flow rate indication decreases	1. The Flow meter is blocked 2. The sensor is contaminated 3. The sensor is damaged	1. Check the filter 2. Clean the sensor (contact manufacturer) 3. replace the sensor (contact manufacturer)
Black indicator	1.Wrong wiring 2. Indicator failure	1.Re-wire according to this manual 2.Replace the indicator
Communication abnormal	1. Wiring error 2. Incorrect device address, baud rate or data format 3. The RS485 converter is faulty	1. Check the wiring 2.Reset address, baud rate and data format 3.Serial communication port test (contact manufacturer)

8 Guarantee Clause

The flow meters are built strictly in accordance with the standard. The manufacturer commits to provide timely service for normal operation of the flow meter. The scope of after sales services includes remote telephone support, site support, product repair, product replacement, etc. Please feel free to contact us for the service.