SENSORS

User Manual

Mini Flow Meter

Model: FLC

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Notices and Warnings

Notices

Please **read this manual** in full and carefully observe the notes and instructions before and during installation, operation and maintenance. The manufacturer cannot be held liable for any damage which occurs as a result of noncompliance with this manual.

Do not tamper with device. Should the device be tampered with in any manner other than a procedure which is described and specified in this manual, the warranty is cancelled and the manufacturer is exempt from liability.

The product is designed exclusively for the described application. Use of this product in conditions not specified in this manual or, contrary to the instructions provided by the manufacturer, is considered improper handling of the product and will void your warranty. The manufacturer will not be held liable for any damages resulting from improper use of the product.

This manual should be read carefully by relevant personnel and the end user**.** This manual should be kept with the product and be made available as needed. **Once you install or use the product, you accept that you have read, understood and complied with this manual**.

CAA Sensors endeavours to make the content of this manual correct,but is not responsible for omissions or errors and the consequences caused. In case of any doubts or questions regarding this manual or the product, please contact CAA Sensors.

Warnings

Ignoring the warnings can lead to serious injury and/or cause damage!

When handling, operating or carrying out maintenance on this product, personnel must employ safe working practices and observe all local health & safety requirements and regulations.

Improper operation or maintenance of this product could be dangerous and result in an accident causing damage to machinery or injury or death.

The manufacturer cannot anticipate every possible circumstance which may represent a potential hazard. The warnings in this manual cover the most common potential hazards and are therefore not all-inclusive. If the user employs an operating procedure, an item of equipment or a method of working which is not specifically recommended by the manufacturer they must ensure that the product will not be damaged or made unsafe and that there is no risk to persons or property.

NEVER CHANGE ORIGINAL COMPONENTS WITH ALTERNATIVES.

Compressed Air Safety

Any contact with quickly escaping air or bursting parts of the compressed air system can lead to serious injuries or even death.

- Do not exceed the maximum permitted pressure.
- Only use pressure rated installation materials and parts.
- Avoid getting hit by escaping air or bursting parts.
- The system must be pressure-less during maintenance work.

Electrical Safety

Any contact with energised parts of the product, may lead to an electrical shock which can lead to serious injuries or even death. The user shall take all measures necessary to protect against electrical shock.

Consider all regulations for electrical installations.

The system must be disconnected from any power supply during maintenance work.

Any electrical work on the system is only allowed by authorised qualified personal.

Storage and transportation

- Make sure that the transportation temperature of the sensor is between -30°C to 70°C (-22°F to 158°F).
- Please make sure that the storage temperature of the sensor is between 0°C to 40°C (32°F to 104°F) and the humidity is <70%, no condensation. Avoid direct UV and solar radiation during storage.

Cleaning

If you need to clean the sensor it is recommended to use a clean, dry cloth. For stubborn marks, use distilled water or isopropyl alcohol only.

Please note: contamination on the sensor tip will affect calibration and accuracy of the sensor. Removal of the contamination may not fix the issue.

Disposal

Electronic devices are recyclable material and do not belong in the household waste. The product, accessories and its packing material must be disposed according to local statutory requirements.

Introduction

Specifications

Intended use

CAA Sensors' flow meters are suitable for use in manufacturing, industrial and base building environments providing the sensor's specifications are met (see below). The flow meter is not used in explosive areas.

The mini flow meter measures instantaneous (real time) flow and cumulative flow.

Specifications

Application	Manufacturing and Industrial	
Gas	Air, Nitrogen (N2), Oxygen (O2), Carbon dioxide (CO2), Carbon monoxide (CO) *Other inert gases available upon request*	
Gas Quality	Clean, dry, dust-free, oil-free gas	
Accuracy	±3% full scale ±1 digit *Accuracy is affected by the installation location and on-site conditions*.	
Repeatability	±1% FS. ±1 digit (±2% FS at 50ms)*2	
Straightness	±3% FS	
Temperature	±5% FS	
Pressure	±5% FS. ±1 digit	
Pressure Resistance	1.5 MPa	
	Measurement Ranges	
Flow Measurement	G1/2" connection	5 – 1000 L/min
	G3/4" connection	10-2000 L/min
	G1" connection	15-3000 L/min
Pressure Measurement	0 to 10 bar (145 psi)	

Gas Temperature Measurement	0°C to +50°C	32°F to +122°F
	Outputs	
Output	RS485 Modbus / RTU	
Output Signals	Instantaneous (real time) flow Cumulative flow	
	Power	
Power Supply	24 vDC ±10%	
Power Consumption	< 50mW	
Electrical Connection	Lead connection	
EMC	According to IEC 61000-6-2, IEC 61000-6-4	
	Other Information	
Display	Colour crystal display	
Bi-directional	No	
Pipe Size	G1/2”, G3/4”, G1”, G1.5”	
Process Connection	G thread, internal	
Weight	< 0.5kg	
Protection Level	IP40	
Installation Type	Permanent or temporary installation	
Warranty Period	12 Months	

Installation

Installation Overview

Mechanical Installation

Step 1 – Find a suitable section of pipe

- The sensor must be installed horizontally, in clean, dry gas
- The sensor must be installed away from bends, edges, seams, changes in pipe size and other obstructions
- Do NOT install the sensor in wet gas, corrosive gas or liquids

Step 2 – Cut pipe to suit flow meter pipe section and install pipe unions

Step 3 – Fit flow meter

Electrical Installation

Step 4 – Wire the sensor for 24vDC power and communication

Step 6 (optional) – Connect the sensor to your SCADA or energy management system

Tools and Equipment needed for installation

(not included with Flow Meter Pack)

Wrench / Spanner

Thread Tape / Sealant

Installation – Mechanical

WARNING! Incorrect installation can damage the sensor or cause it to work incorrectly.

Notes

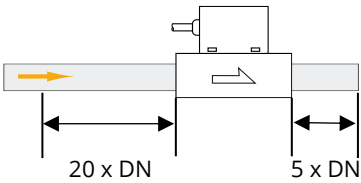
- **Before installing the sensor, make sure it is rated for your system** (refer to the "Specifications" section).
  - Use of the product outside specified ranges or operating parameters can lead to malfunctions and may damage the product or system.
- Do not use this product in explosive areas.
- Pay attention to the installation location and gas contamination levels to ensure accuracy is maintained.
- The flow meter is **not** bidirectional. When installing and using the flow meter, please pay attention to the direction of gas flow and the alignment of the sensor. The direction is indicated on the housing.
- Avoid condensation on the sensor element as this will affect the accuracy.
- The sensor is for indoor use only. If installed in an outdoor installation, the sensor must be protected from sun and rain.
- Only use pressure rated materials and parts when installing and maintaining the product.
- Do not disassemble the product.
- Please follow local and national regulations before/during installation and operation.
- This product must be installed properly and calibrated regularly, otherwise it may lead to inaccurate measurements.

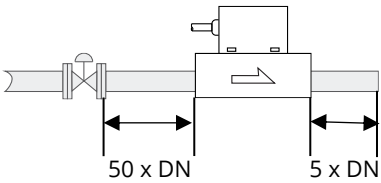
Step 1 – Find a suitable section of pipe

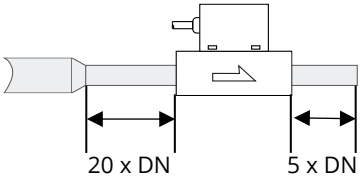
The sensor **must** be installed:

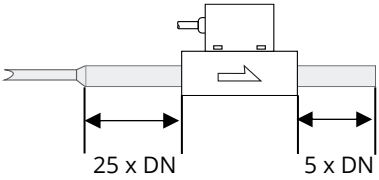
- ✓ horizontally, in dry gas (gas humidity should be less than 80% relative humidity (RH)).
- ✓ in clean gas (dust-free and oil-free). The sensor should be installed after filters and dryers.
- ✓ away from bends, edges, seams, changes in pipe size and other obstructions as these change the velocity of compressed air / gasses and/or create turbulence near the obstruction. Placing the sensor too close to the obstruction will result in inaccurate readings. See diagrams below.
- ✓ away from environments with strong magnetic fields or strong vibrations

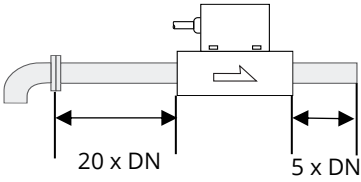
The diagram below shows the minimum allowable distance between the sensor and any bends, changes in pipe size or other obstructions. Distances are shown in multiples of pipe diameters (DNs). For best results, choose a long, absolutely straight, section of pipe that is free of obstructions.

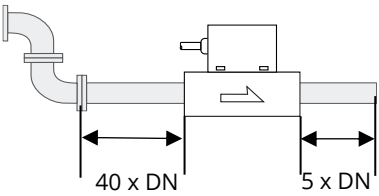












Step 2 - Cut pipe and install pipe unions

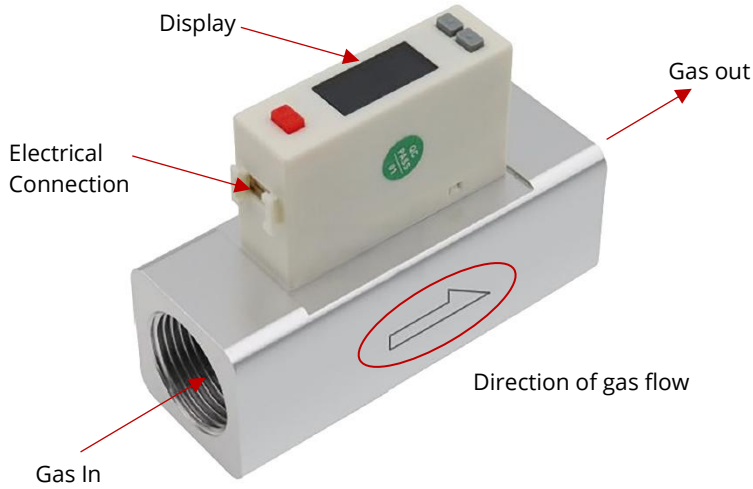
This step will depend on the pipe material and available fittings. Match the thread of the pipe to the flow meter and install pipe unions on both ends.

Do **not** increase or decrease the pipe diameter immediately before or after the flow meter pipe section.

Step 3 – Fit Flow meter

The flow meter is **not** bidirectional. When installing and using the flow meter, please pay attention to the direction of air flow and the alignment of the sensor.

The direction is flow is marked by the arrow on the side of the sensor.



Installation – Electrical

WARNING! Incorrect wiring can damage the sensor or cause it to work incorrectly.

Notes:

- Do **not** force the connector, otherwise it may damage the connections
- Follow all local and national safety requirements and regulations for electrical installations.
- **The system must be disconnected from any power supply during installation and maintenance work.**
- Any electrical work on the system is only allowed by authorised and qualified personal.

Step 4 – Wire the sensor for power and communication

The flow meter comes with a 6 wire cable with a plug on one end and bare wires on the other.

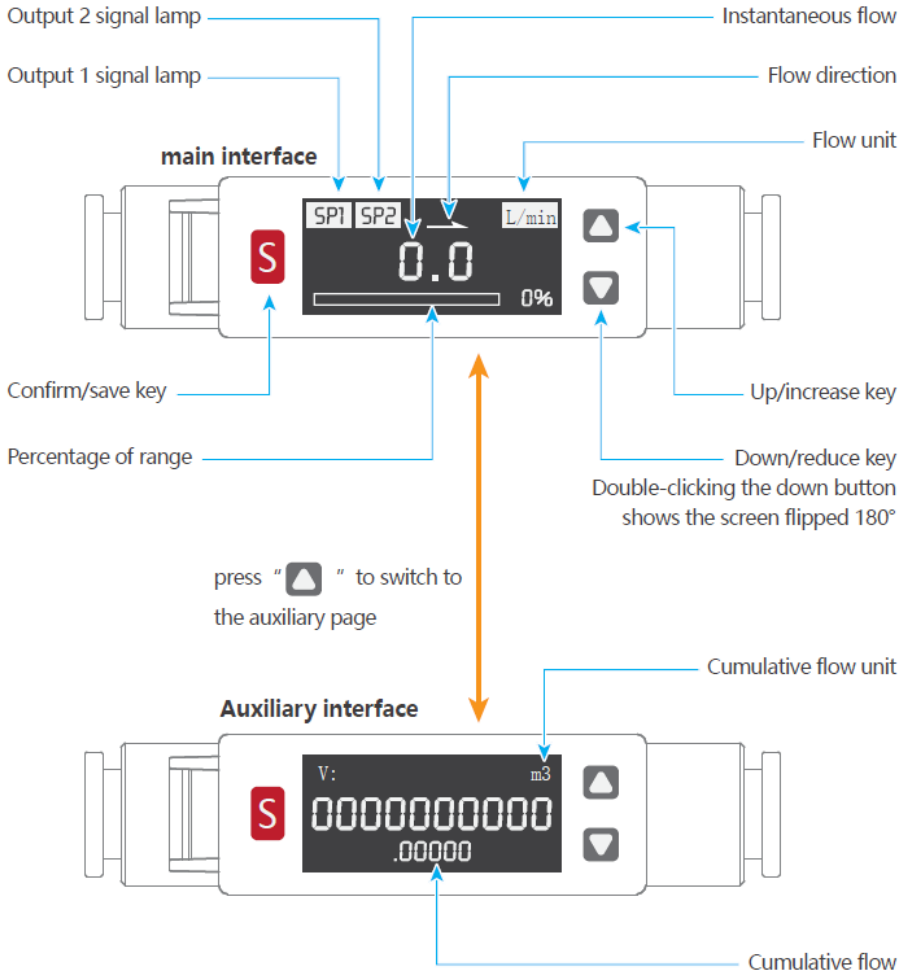
- Insert the plug into the electrical connection on the sensor.
- Connect the bare wires to power and communication

Cable Colour	Stitch	Connection
Red	6	Power Supply +
Orange	1	Power Supply -
Black	5	RS485 (A)
White	4	RS485 (B)
Yellow	3 (Out 1)	SP1 switch PNP (default) SP1 switch NPN
Green	2 (Out 2)	SP2 switch PNP (default) SP2 switch NPN

Using the Flow Meter

Operating the Flow Meter

WARNING! Make sure the sensor is installed and wired correctly before powering up the sensor. Only use 24vDC to power the sensor.



Menu Options

Using the Menu

Press the red button  to:

- open a menu
- save changes
- go back to the previous menu

Press the up  or down  button to:

- move between sub menus
- change values

To exit the menu, keep pressing the up or down arrow until you get to the end of the menu options.

To the **rotate the menu 180 degress**, press and hold the down arrow for 5 seconds. The screen will turn black for a second, then the menu will reappear.

Menu Options

Menu	Options	Options / Comments	Default Value
Main Menu			
SP1 Set	1 to full scale	Switch 1 Set value	20% of full scale
rP1 Set	1 to full scale	Switch 1 Reset value	90% of SP1
SP2 Set	1 to full scale	Switch 2 Set value	80% of full scale
rP2 Set	1 to full scale	Switch 2 Reset value	90% of SP2
F-URV	0-99999	Range	Full scale
RS485 ID	1-255	Modbus Address	1
Baud Set	2400 4800 9600 14400 19200 38400	Modbus Baud Rate	9600

Menu	Options	Options / Comments	Default Value
	56000 115200		
Parity Set	None Even Odd	Modbus Parity	None
Stop Bit Set	1 bit 1.5 bit 2 bit	Modbus Stop bit	1
Menu 2	-	Press the red button to access additional menus	-
Menu 2 options			
Factory Reset	-	Factory reset device	5s
Out1 Set		Output 1 Mode H-NO: Hysteresis normally open Hz OUT: Pulse Output W-NC: Window normally closed W-NO: Window always open H-NC: Hysteresis normally closed	H-NO: Hysteresis normally open
Out2 Set		Output 2 Mode H-NO: Hysteresis normally open W-NC: Window normally closed W-NO: Window always open H-NC: Hysteresis normally closed	H-NO: Hysteresis normally open
ds1 Set	0.0-1000.0	Switch 1 Output delay	0.0 seconds
dR1 Set	0.0-1000.0	Switch 1 Reset delay	0.0 seconds
ds2 Set	0.0-1000.0	Switch 2 Output delay	0.0 seconds
dR2 Set	0.0-1000.0	Switch 2 Reset delay	0.0 seconds
Unit Set	L/min m3/h	Measurement units	L/min

Menu	Options	Options / Comments	Default Value
PNP/NPN Set	PNP NPN	PNP/NPN Settings	PNP
F-C-data	0.01-100.00	Flow Coefficient value for different gas types 1.00 = Air 1.03 = Nitrogen (N2) 0.90 = Oxygen (O2) 0.65 = Carbon dioxide (CO2) 1.03 = Carbon monoxide (CO)	1.00
F-Ofst	-100.0 to 100.0	Flow Offset value	0.0
F-PACE	0.1 – 5.0	Filter damping	0.5
Low Flow Cut	0-20000	Lower flow rate cut off	Lower end of the scale
Fi-C-set	0.1-100.0	Filter coefficient value	10.0
d-P-set	0 0.0 0.00 0.000	Number of decimals	0
Digit Colour		Colour of the digits on the display	White
BG Colour		Background colour	Black

Modbus Registers

Default Modbus Communication settings

Modbus settings can be changed to suit system requirements

Default Modbus RTU (RS485) Settings				
Address	Baud Rate	Frame / Parity / Stop Bit	Response Time	Response Delay
1	9600	8 / N / 1	1 Sec	0 Milliseconds

Data Format

The format of each byte (11 bits) in the pattern is:

- The encoding system is: 8-bit binary
- Bits of each byte: 1 start bit, 8 data bits (least significant bit sent first), no parity bit, and 1 stop bit

Note: When no check is used, you can select 1 stop bit or 2 stop bits.

Start	Address	Function Code	Data	CRC Check	End
≥3.5 character	8 bit	8 bit	N*8 bit	16 bit	≥3.5 character

Note:

- In RTU mode, an idle interval of at least 3. 5 characters separates the packet frames.
- The entire message frame must be sent in a continuous stream of characters.
- The idle interval between two characters should not exceed 1.5 characters time.

Command instructions

The flow meter uses 2 instructions from the MODBUS protocol:

- Command 03 - Read the single hold register
- Command 06 - Write a single hold register

Command 03 format (read register command)

MODBUS request

Instrument address	1 Byte	0-255
Function code	1 Byte	0x03
Origin address	2 Byte	0-FFFF
Read quantity	2 Byte	1-12
CRC low	1 Byte	
CRC High	1 Byte	

M0DBUS respond

Instrument address	1 Byte	0-255
Function code	1 Byte	0x03
Origin address	1 Byte	
Read quantity	N*2 Byte	
CRC low	1 Byte	
CRC High	1 Byte	

Command 06 format (write register command)

Clear the value of the total cumulative flow rate

MODBUS request

Instrument address	1 Byte	0-255
Function code	06	0x06
Byte Count	1 Byte	

M0DBUS respond

Instrument address	1 Byte	0-255
Function code	06	0x06
Byte Count	1 Byte	

Data item definition

03H command

Modbus Address	Register Length	Comment
00	16-bit unsigned integer	Instantaneous flow rate (one decimal, display value *0.l L/min)
01	32-bit unsigned integer	Cumulative flow (m3) integer part
03	32-bit unsigned integer	Cumulative flow (m3) Fractional (read value *0.00001)
05	16-bit unsigned integer	Display the current value in units (0: Umin, 1: m3/h)
06	16-bit unsigned integer	Displays the decimal point of the current value

06H command

Clear cumulative flow: Write register value 1 to register address 1

Warranty

CAA Sensors provides a 12-month warranty for all sensors. The warranty covers materials and workmanship under the stated operating conditions from the date of delivery. Please report any findings immediately and within the warranty time.

If faults occur during the warranty period CAA Sensors will repair or replace the defective unit, without charge for repair labour and material costs but there is a charge for other services such as labour to remove or reinstall the instrument, transport and packing. Warranty repairs do not extend the period of warranty.

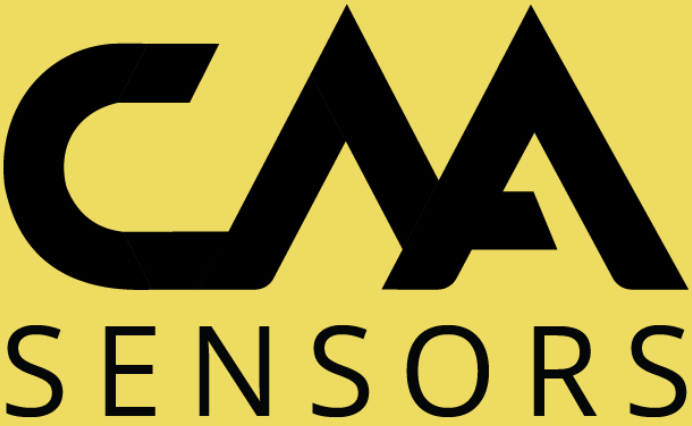
The following damage is excluded from this warranty:

- Improper use and non-adherence to the user manual.
- Use of unsuitable accessories.
- External influences (e.g. damage caused by vibration, damage during transportation, excess heat or moisture).

The warranty is cancelled when one of the following situations occurs:

- The user opens the measurement instrument without a direct request written in this manual.
- Repairs or modifications are undertaken by third parties or unauthorised persons.
- The serial number has been changed, damaged or removed.

Other claims, especially damage occurring on the outside of the instrument (eg dents, marks), are not included unless responsibility is legally binding.



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