Industrial Automation

Mass Flow Controller (MFC)

Breakthrough engineering for a better world

Quick Start Guide

Thank you very much for acquiring one of our products. We hope you will find them to fit your needs.
This document aims at giving a quick introduction to users, to help them setting up their device for the first time and sending the first commands. For the whole document we refer to MFC as device to stay generic and specify one or the other when needed.

Contents

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Installation

To set the device up, please shut the flow source off. Connect the device according to the flow direction arrow drawn on the device.

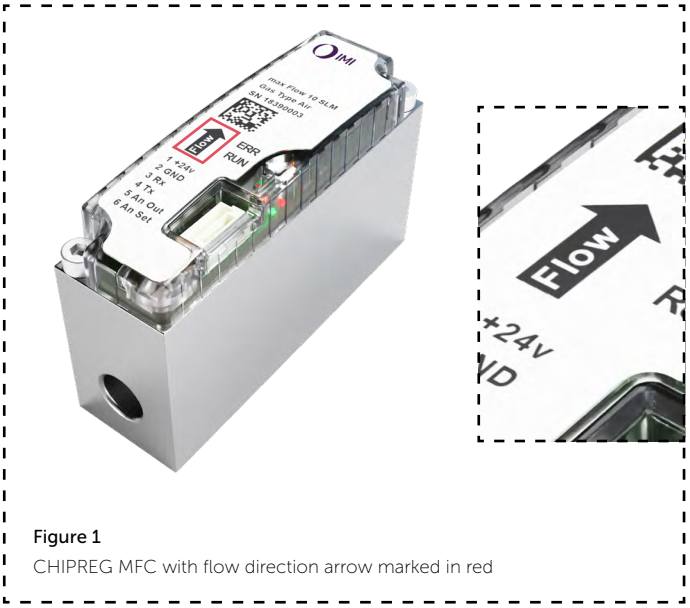


Figure 1
CHIPREG MFC with flow direction arrow marked in red

Once the device linked to the flow tubing, it can be connected to a computer or a power unit with a 6 pins JST connector available for order with **PN: S401.0024**.

Another connection cable is also available for order with **PN: S401.0305**.

It is a RS85-USB converter, with a JST connector end to connect directly the device to a computer.

Electrical connector JST GHR-06V-S with 300 mm flying leads	USB to JST cable (incl. RS485 converter) Power supply, universal input voltage and interchangeable AC blades for global use
	
S401.0024	S401.0305

The device can be controlled either by applying voltage or communicating via RS-485. You will find further on a description of both ways to control our products.

Analog control

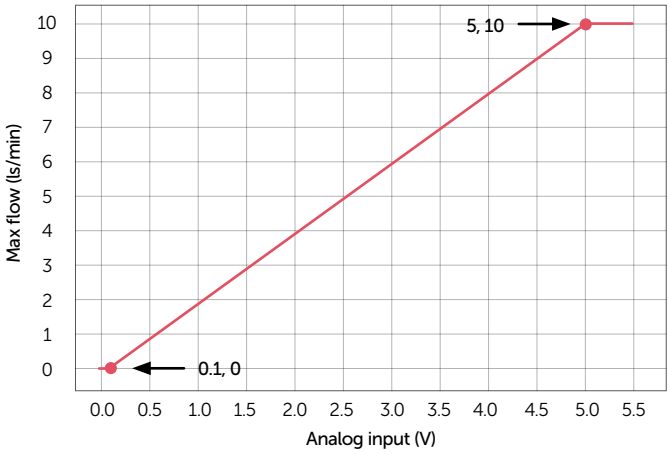
The controls available through analog input are the setpoint setting and the measurement. To set a setpoint on a device, the user can apply a voltage between pin 2 and 6.

To compute the voltage needed for a given setpoint, the following formula is used:

$$V_{Setpoint} = \frac{Q_{desired} \times (V_{Full\text{-}scale} - V_{Offset})}{Q_{Full\text{-}scale}} + V_{Offset} = \frac{Q_{desired} \times (5\text{-}0.1)V}{Q_{Full\text{-}scale}} + 0.1V$$

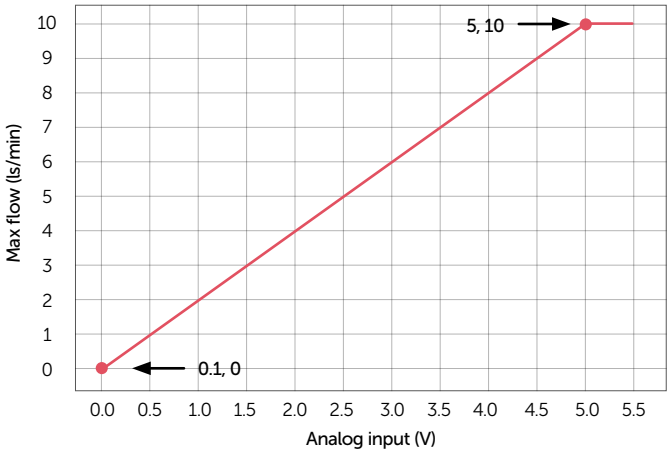
An example for an analog setpoint curve is shown below for a 10 Ls/min MFC. To set a setpoint of 3 Ls/min, the voltage needed to be applied is

$$V_{Setpoint} = \frac{3\,Ls/min \times 4.9\,V}{10\,Ls/min} + 0.1 = 1.57\,V$$



Reading measurement from the device is made by reading the voltage output returned by the device. An example for a 10 Ls/min MFC is shown below. For instance, a measured output of 3V means a flow read of

$$Q_{reading} = \frac{10\,Ls/min \times (3\text{-}0.1)\,V}{4.9\,V} = 5.91\ Ls/min$$



Digital control

To control the device digitally, a connection to the computer can be made using a serial over USB converter. A driver may be needed to allow the computer to detect the device (FTDI).

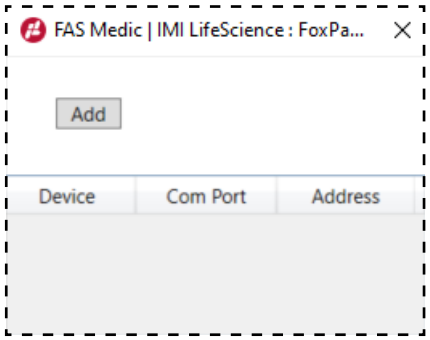
The device can be operated through two means: via command line, or with our software.

Our software is publicly available online and its use is described below.

Fluid Visual Control introduction

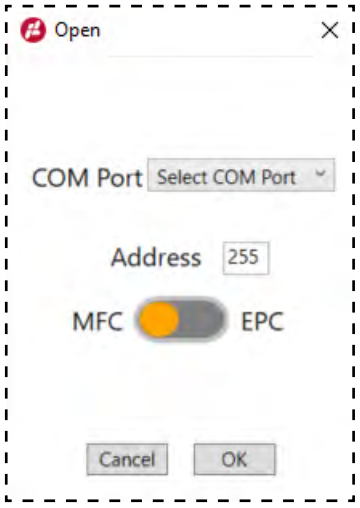
The software installer can be downloaded on from our website on the device page*.

Once the software installed, run the FVC app. The home window allows you to connect a new device with the add button and see the list of connected devices.



Clicking the add button opens a new window, to choose what device you are connecting, on which port.

Nb: To connect two or more devices on the same com port the user needs to specify each address when connecting the device.



Once the device is connected, a new window opens with information about the device, a graph interface, logging option, address change interface, PID selection.

To enter a setpoint, the user must first start the measurement, then enter a setpoint in the text entry and hit enter.

This software is developed to allow the user basic use, and first customization. For more advanced use, please refer to the command line list in user manual, available on the device page*.

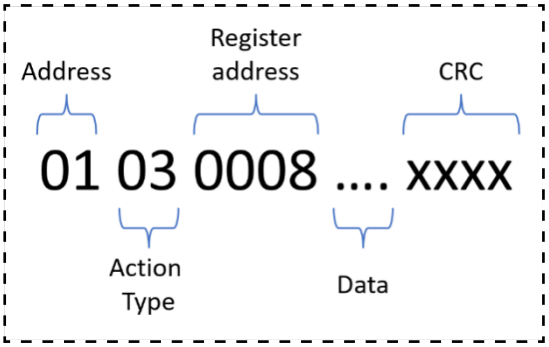
Nb: any setpoint higher than the full-scale is ignored.

Control through command line

Controlling your device can be done through command lines. Two communication protocols have been implemented: Modbus or a FAS protocol.

Modbus (only available for MFC for now)

To use the Modbus protocol the user needs to have access to a software such as Yat, to pass Modbus sequence. A Modbus sequence is built as follow:



The action type describes to the device what kind of command it is facing.

03 is reading a single holding register, 06 is writing on single holding register, 05 is writing a single coil.

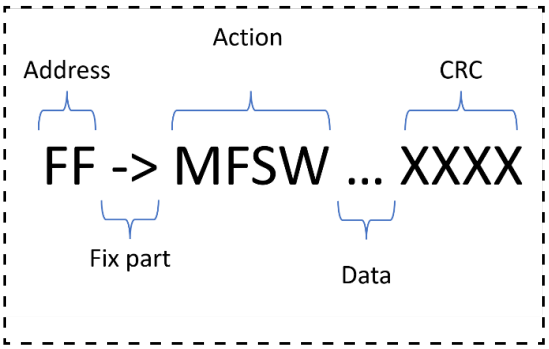
The CRC of Modbus command has to be computed for the command to be complete and interpreted by the device.

A set of most used commands is described in Annex.

Nb: Modbus protocol is only available for MFC

FAS protocol

To send commands to the device, users can pass through third-party software such as Terminal. Once the software connected to the device com port, commands can be built and sent as follow:



For the FAS protocol, the crc can be left out as XXXX if not wanting to compute it.

A set of most common commands is described in Annex.

Annex

Most common commands memo

The following commands are written with the device address 255 (ff in hexadecimal)

	Description	FAS protocol	Modbus
	Both device commands		
Device Address	Read device address	ff->DADRXXXX	FF0300010001C014
	Set device address to 01	ff->DADW01XXXX	FF06000100010C14
	MFC specific commands		
Mass Flow Setpoint	Read mass flow setpoint	ff->MFSRXXXX	FF03000800011016
	Set mass flow setpoint to full-scale	ff->MFSW0FFFXXXX	FF0600080FFF5866
Mass Flow Measure	Read scaled mass flow measure	ff->SMFRXXXX	FF0311100001952D

Process to change device address

To change the device address permanently, the changes need to be stored into the non-volatile memory. To do so, please follow the following procedure:

FF->DADW01XXXX

FF->CTRW00XXXX

FF->NMWMXXXX

Data computation

The MFC has a 4'095 points resolution between 0 and Full-scale mass flow.

To know what data to pass the setpoint via command line, the user must compute

$$\text{Setpoint} = \frac{Q_{desired} \times 4'095}{Q_{Full\text{-}scale}}$$

For instance, if the user wants a 5 Ls/min mass flow, on a 10 Ls/min Full-scale MFC, the setpoint to give the MFC would be:

$$\text{Setpoint} = \frac{5\ \text{Ls/min} \times 4'095}{10\ \text{Ls/min}} = 2'048$$

Finally, the user needs to transform 2'048 in hexadecimal i.e. 0800.

Hence the command to set the mass flow to 5 Ls/min on a 10 Ls/min on address 255 would be:

ff->MFSW0800XXXX

Q&As

Why does the device stop and is in alarm (red LED flashing)?

Scenario 1:

The inlet pressure is too low, or the output pressure (back pressure) is too high. The flow capability of the proportional valve has a given kv (orifice size dependent). The Δp is insufficient, and you may increase the input pressure and/or decrease the back pressure. As a feel, if Δp=0 there is no flow.

Also, you can refer to the device datasheet maximum flow rate, as an example below is the MFC datasheet:

Maximum Flow Rate

Flow rate may be limited by inlet pressure.
Please ensure your inlet pressure is high enough to achieve your desired maximum flow rate as per below curves.

Typical data for air at 20°C

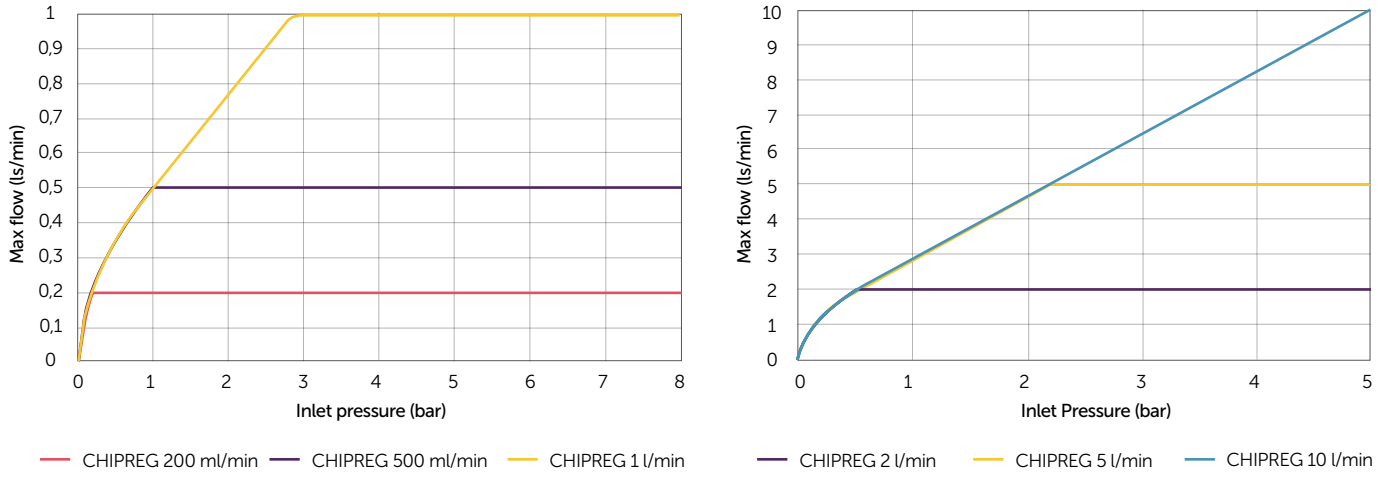


Figure 2

CHIPREG MFC, Maximum Flow Rate curves

Scenario 2:

The flow/pressure control setpoint cannot be reached. You should check for leaks, for low flow devices with backpressure, this can often happen. Some leak could be tricky and unexpected, and you would lose time to debug.

My device reads a different flow rate

The MFC flow measurement is fluid dependent, it will not read the same flow for air or CO_2. MFCs are calibrated with specific medium.

My device doesn't reply

The following process is described using RS232 protocol, but RS485 follows the same troubleshooting process.

- Check the RS232 settings.
- Check the syntax of the sequence, check the address of the CHIPREG. If syntax error, incorrect address, there is no reply, no warning.
- Make sure that the USB-RS232 converters is working properly. User can use two converters connected to different computers. Connect both converters together and try and send some ASCII sequences as simple as "Hello World!". Make sure that the communication between PCs is bidirectional.
- Did RS232 speed setting change? If improper speed, no reply is possible from the CHIPREG.
- Is the CHIPREG properly powered? Remember that the power is 24V ± 10% 100mA and the polarity is correct. If not properly powered, the green LED doesn't flash.

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