



IQ+FLOW®

Micro Fluidic Mass Flow and Pressure Meters/Controllers with high intrinsic quality

> Introduction

Bronkhorst High-Tech B.V, the European market leader in thermal Mass Flow Meters/Controllers and Electronic Pressure Controllers, has over 30 years of experience in designing and manufacturing precise and reliable measurement and control devices. With a wide range of instruments, Bronkhorst High-Tech offers innovative solutions for many different applications in many different markets. The instruments are made to customers' specification, in various styles, suitable for use in laboratory, industrial environment, hazardous areas, semiconductor or analytical installations.

> Micro fluidic concept

The use of micro fluidic devices for research and analytical purposes has some important advantages. Firstly, because the internal volumes within the instruments are very small, the analysis will be faster and the amount of reagents and analytes used can be reduced. The latter is especially significant for expensive reagents. Furthermore, the physical dimensions are much smaller than those of conventional devices. This enables Life Sciences system integrators to downscale the size, inherently reducing the costs of ownership of their equipment. Also, the availability of compact and lightweight instruments could lead to the development of portable systems.



Actual size



> World's smallest Mass Flow / Pressure Controllers

Previously, conventional mass flow and pressure meters and controllers have needed a footprint of 1.5", as for instance specified in the NeSSI™ system. Now, and in close co-operation with the Netherlands organisation for applied scientific research TNO, Bronkhorst High-Tech has developed the IQ+FLOW mass flow sensor. Due to the use of micro system technology (MST), Bronkhorst has been able to halve the footprint dimension to 0.75", thereby realising ultra compact flow controllers for flow rates from 0.2 to 5000 scfm (ml_r/min) and pressure controllers for 0.3 to 150 psi.

> High intrinsic quality, featuring...

- ◆ Compact assembly ensures space efficiency
- ◆ Economical solution, low cost of ownership
- ◆ Analog or digital communication
- ◆ Top-mount modules; easily accessible
- ◆ Pre-tested "Plug and Play" manifold assemblies, reducing custom testing requirements

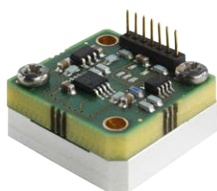
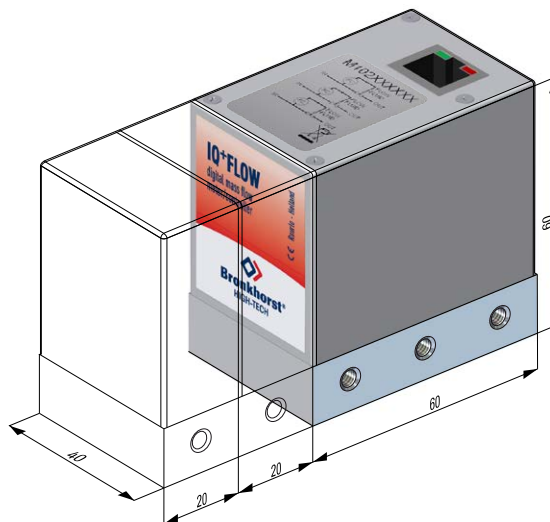
> Multi-channel solutions

Thanks to the modular concept of the IQ+FLOW series, multiple channel arrangements can be realised on one compact manifold, with one multi-channel digital pc-board (per 3 channels) in one housing.

> Customer specific designs

A core philosophy of Bronkhorst High-Tech is to form close working links and collaborations with Original Equipment Manufacturers OEMs to ensure optimised integration of our instruments within their own equipment. Most often this results in a bespoke design in which multiple channels and/or various functions are combined into one micro fluidic system.

The IQ+FLOW concept offers the following functional modules within the 0.75" footprint:



Flow sensor; gas flow ranges from 10 to 5000 sccm (Full Scale values)

Pressure sensor; pressure ranges from 8 to 150 psi abs/gauge (FS)



Control valve

Electrical shut-off valve



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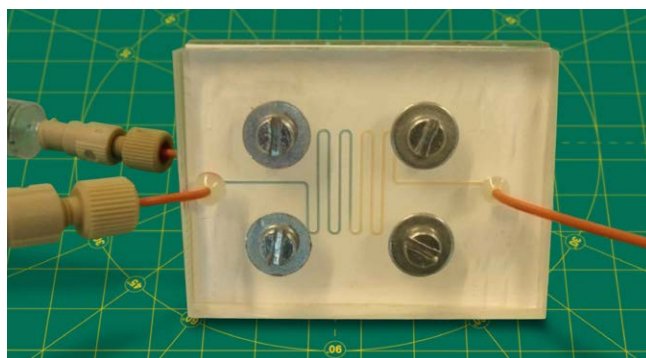


Pneumatic shut-off valve

A combination of these modules can be mounted on a compact manifold, in line with a customers' requirements, and following open design discussions. Further possibilities might include either an aluminium or a stainless steel manifold with perhaps female inlet/outlet ports that could be suitable for either gas or liquid. As there are truly an infinite number of possible solutions we highly recommend you to contact Bronkhorst High-Tech to discuss your application.

> Application: Micro reactor engineering

In the field of micro fluidics, small amounts of fluids are processed or manipulated within a pattern of very small channels. Research on micro scale reactions and separations led to the development of micro reactor engineering. An example of a micro reactor is shown below.



Micro reactor used for testing the CO₂-permeability of membranes (source: University of Twente, NL)

With their unsurpassed expertise in the field of low flow measurement and control of both gases and liquids, Bronkhorst offers precision equipment that is ideally suited to meet the critical requirements of micro fluidic research and system integration.



IQ+FLOW Downported MFC



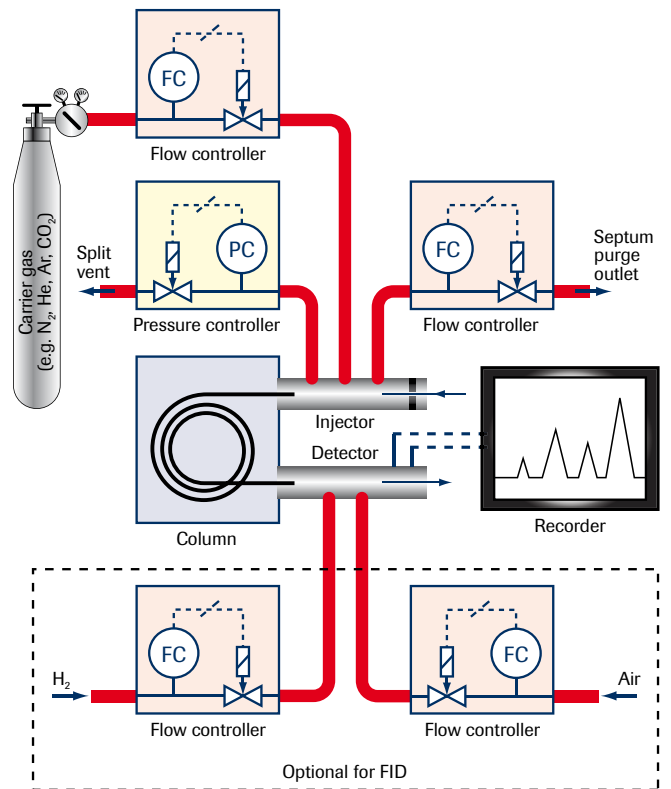
IQ+FLOW Pressure Controller

> Analytical applications

Examples of analytical applications based on the ultra compact modules with a footprint of 0.75" are:

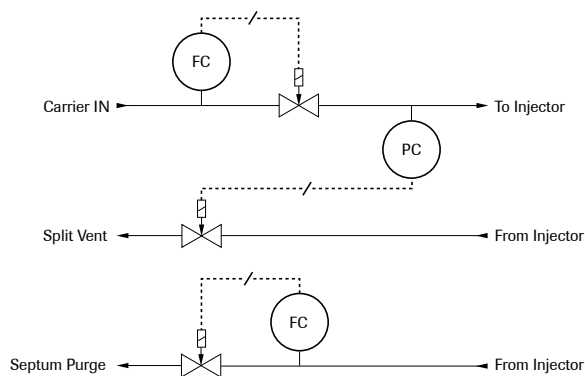
- ◆ Flow – Pressure control at the injector side of a GC
- ◆ Flow control at the detector side of a GC or HPLC
- ◆ Flow control in an FID (Flame Ionisation Detector)

The schematic diagram illustrates the set-up of a typical GC system. Below you will find just two of many solutions for using the modular IQ⁺FLOW concept for analytical applications.



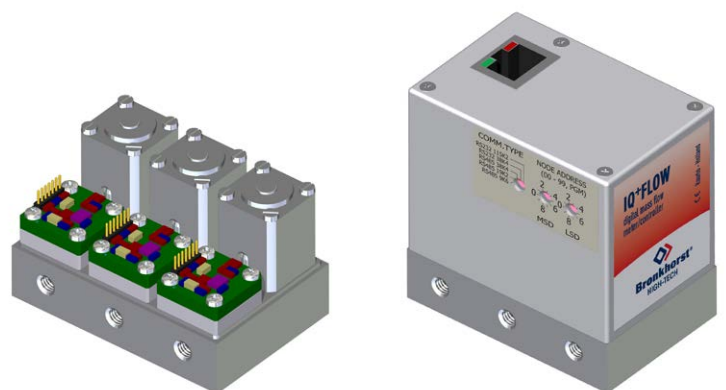
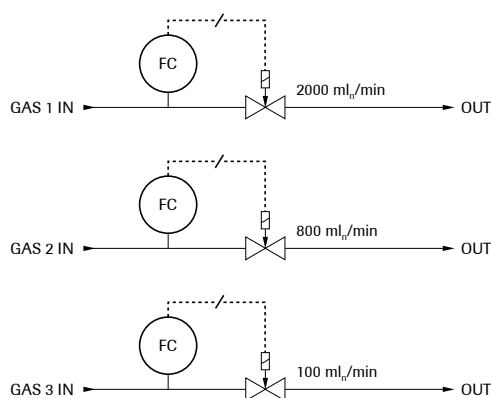
Gas Chromatography (GC)

Gas chromatography involves a sample being vapourised and injected into a chromatographic column. The sample is transported through the column by an inert carrier gas flow and led into a detector. The detector responds to the various chemical compounds of the sample. To optimize GC separations the pressure at the inlet of the column can be programmed, making use of a pressure controller.



Flame Ionisation Detector (FID)

An FID is a highly sensitive detector for the analysis of organic compounds. The effluent from the column is mixed with H₂ and air, and ignited. The sensor measures the current resulting from the pyrolysis (decomposition by the use of heat).



> Technical specifications

Operating conditions

| | |
|-----------------------------|---|
| Flow ranges | : min. 0.2...10 sccm / max. 0.1...5 slm (storage of max. 8 calibration curves) |
| Pressure ranges (abs/gauge) | : min 1.5...8 psi / max. 3...150 psi |
| Media | : dry, clean, non-explosive and non-corrosive gases |
| Operating temperature | : 5...50°C |
| Max. operating pressure | : 150 psig (10 barg) |
| Pressure drop flow meter | : 0.3 psi dif (20 mbard) based on 1 slm Air at 0 psig |

Performance mass flow meter/controller - IQF(D)

| | |
|---|---|
| Accuracy flow sensor (based on actual calibration) | : < ±1.5% RD + ±0.5% FS |
| Repeatability | : for flows < 20 ml _v /min: < ±0.5% FS; for flows > 20 ml _v /min: < ±0.5% RD |
| Settling time (in control) | : τ _{90%} down to 300 msec, 700 msec typical |
| Temperature sensitivity | : span: 0.2% RD/°C; zero: 0.01 ml _v /min/°C |
| Leak integrity (outboard) | : 1 x 10 ⁻⁸ mbar-l/sec He |
| Attitude sensitivity | : max. error at 90° off horizontal 0.5 ml _v /min at 1 bar, typical N ₂ |

Performance pressure meter/controller - IQP(D)

| | |
|---------------------------|---------------------------------------|
| Accuracy pressure sensor | : < ±0.5% FS |
| Repeatability | : < ±0.2% FS |
| Response time sensor | : τ _{95%} 5 msec |
| Temperature sensitivity | : span: 0.1% RD/°C; zero: 0.05% FS/°C |
| Leak integrity (outboard) | : 1 x 10 ⁻⁶ mbar-l/sec He |
| Attitude sensitivity | : negligible |

Mechanical specifications

| | |
|--|---|
| Material of construction (wetted parts) | : aluminium, Si, SiO _x , epoxy; option: stainless steel body |
| Process connections (optional) | : 10-32 UNF threaded internal nut with 1/16" ferrule (SS316 or Peek); 1/16" or 1/8" OD compression type |
| Seals | : Viton®; other on request |
| Weight | : approx. 0.2 kg |

Electrical specifications

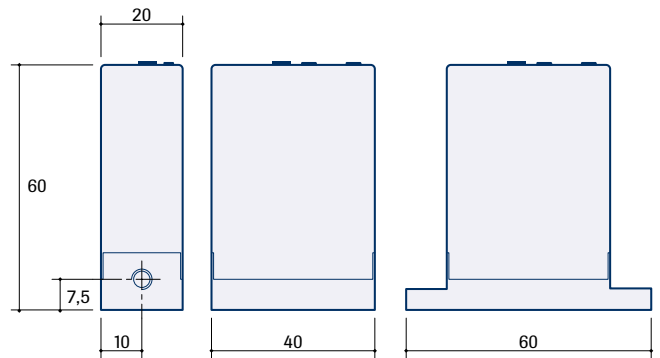
| | |
|---|---|
| Readout sample time | : 2 msec |
| Power supply | : +15...+24 Vdc, 50 mA for meter; add 50 mA for control valve |
| Output/Setpoint | |
| Single-channel | : 0...5 (10) Vdc or 0 (4)...20 mA (sourcing output) and RS232, RS485 (Modbus RTU/ASCII or FLOW-BUS) |
| Multi-channel | : RS232, RS485 (Modbus RTU) |
| Rotary switches (multi-channel only) | : for bus and address selection |
| Electrical connection | : RJ45 modular jack |
| Ingress protection | : IP40 |

Technical specifications and dimensions subject to change without notice.

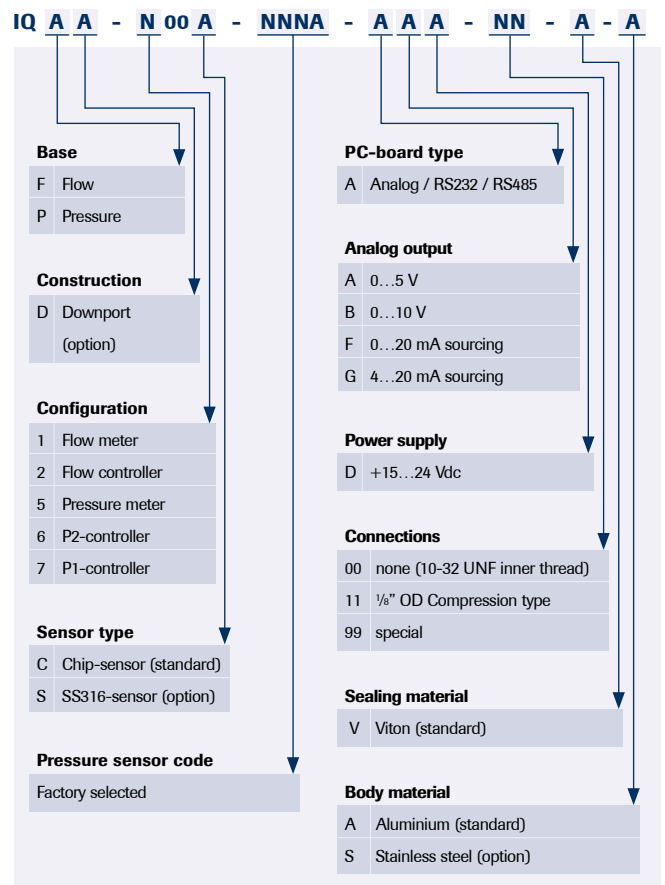
> High accuracy and control performance

IQ⁺FLOW Mass Flow Meters and Controllers are sophisticated microprocessor-based instruments offering high accuracy and repeatability. Up to 8 calibration curves can be stored on the instrument, eliminating the need to recalibrate the device for different gases. The PID controller, integrated on the pc-board, ensures highly stable control and, as an option, allows adjustment of the settling time down to 300 msec, for processes that require fast response times.

> Dimensions (mm)



> Model number identification (1-channel)



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