

# IN-FLOW®

Industrial Style Digital mass Flow meters and controllers for Gases

## > Introduction

Bronkhorst High-Tech B.V., the European market leader in thermal Mass Flow Meters/Controllers and Electronic Pressure Controllers, has 25 years experience in designing and manufacturing precise and reliable measurement and control devices. With a wide range of instruments, Bronkhorst High-Tech is offering 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.

## > IN-FLOW series for Industrial Environments

The Mass Flow Meters of the IN-FLOW series are of rugged design (IP65) for use in pilot and production plants in industrial environments. Mass Flow Meters can be supplied in ranges starting from 0.02...1 sccm up to 6,500 scfm air-equivalent, with pressure rating between vacuum and 10,000 psi. In combination with control valves, either integrated or separate, Mass Flow Controllers can be offered up to 6...300 scfm air-equivalent. The instruments of the IN-FLOW series are now available with ATEX approval for use in Zone 2 hazardous areas.

## > Multi-Bus Technology

Bronkhorst High-Tech developed their latest digital instruments according to the "multi-bus" principle. The basic pc-board on the instrument contains all of the general functions needed for measurement and control. It has analog I/O-signals and also an RS232 connection as a standard feature. In addition to this there is the possibility of integrating an interface board with DeviceNet™, Profibus-DP®, Modbus-RTU or FLOW-BUS protocol. The latter is a fieldbus based RS485, specifically designed by Bronkhorst High-Tech for their mass flow metering and control solutions, and through which the company already has over ten years of experience with digital communication.

## > Mass Flow Controllers for every application

The control valve can be furnished as integral part of an IN-FLOW MFC, or as separate component. It is a proportional, electromagnetic control valve with extremely fast and smooth control characteristics. With reference to the specific field of application there are different series of control valves. There is a standard direct acting valve for common applications, a pilot operated valve for high



flow rates, the so-called Vary-P valve with pressure rating 6,000 or 10,000 psi, that can cope with up to 6,000 psi  $\Delta P$  and a bellows valve for applications with very low differential pressure.

## > General IN-FLOW features

- ◆ weatherproof IP65 housing
- ◆ ATEX approval Cat.3, Zone 2
- ◆ fast response, excellent repeatability
- ◆ flow ranges from 0.02...1 sccm up to 130...6,500 scfm
- ◆ pressure ratings up to 10,000 psi

## > Digital features

- ◆ DeviceNet™, PROFIBUS-DP®, Modbus-RTU or FLOW-BUS slave
- ◆ RS232 interface
- ◆ other fieldbus options on request
- ◆ alarm and counter functions

## > Fields of application

- ◆ Process gas measurement or control in food, pharmaceutical and (petro-) chemical industries, in fermentation installations and in fuel cell technology
- ◆ Sample gas measurement
- ◆ Burner control
- ◆ Gas consumption measurement for internal accounting
- ◆ Making of defined gas mixtures



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## > Technical specifications

### Measurement / control system

Accuracy (incl. linearity)	: standard: $\pm 0.8\%$ Rd plus $\pm 0.2\%$ FS;
(based on actual calibration)	on request: $\pm 0.5\%$ Rd plus $\pm 0.1\%$ FS;
	( $\pm 1\%$ FS for ranges $< 0-10$ sccm
	for flow $> 600$ scfm contact factory)
Turndown	: 1 : 50 (2 ... 100%)
Repeatability	: $< 0.2\%$ Rd
Settling time (controller)	: standard: 1 ... 2 seconds
	option: down to 200 msec
Operating temperature	: $-10 \dots +70^\circ\text{C}$ ; for ATEX Cat.3 max $50^\circ\text{C}$
Temperature sensitivity	: zero: $< 0.05\%$ FS/ $^\circ\text{C}$ ; span: $< 0.05\%$ FS/ $^\circ\text{C}$
Leak integrity	: tested $< 2 \times 10^{-9}$ mpsi l/s He
Attitude sensitivity	: max. error at $90^\circ$ off horizontal $0.2\%$
	at 1 atmosphere, typical N2
Warm-up time	: 30 min. for optimum accuracy
	2 min for accuracy $\pm 2\%$ FS

### Mechanical parts

Material (wetted parts)	: stainless steel 316L or comparable
Surface quality (wetted parts)	: Ra = $0.8 \mu\text{m}$ typical
Process connections	: compression type or face seal
	couplings; wafer type series F-106;
	DIN or ANSI flanges on series F-107
Seals	: standard: Viton
Ingress protection (housing)	: IP65

### Electrical properties

Power supply	: $+15 \dots +24$ Vdc
Power consumption	: meter: 70 mA;
	controller: max. 320 mA;
	add 50 mA for Profibus, if applicable
Analog output/command	: 0...5 (10) Vdc or 0 (4) ... 20 mA
	(sourcing output)
Digital communication	: standard: RS232
	options: Profibus-DP <sup>®</sup> , DeviceNet <sup>™</sup> ,
	Modbus-RTU, FLOW-BUS
Electrical connection	
Analog/RS232	: 8 DIN male;
Profibus-DP <sup>®</sup>	: bus: 5-pin M12 female; power: 8 DIN male;
DeviceNet <sup>™</sup>	: 5-pin M12 male;
Modbus-RTU/FLOW-BUS	: 5-pin M12 male

Technical specifications subject to change without notice.



F-201CI Compact IP65 Mass Flow Controller for low flow ranges

## > Models and flow ranges

### Mass Flow Meters (MFM); PN100 (pressure rating 100 psi)

Model	min. flow	max. flow
F-110CI	0.02...1 sccm	0.24...12 sccm
F-111BI	0.16...8 sccm	0.6...30 slpm
F-111AI	0.4...20 slpm	2...100 slpm
F-112AI	8...40 slpm	7.6...380 slpm
F-113AI	4...200 slpm	36...1800 slpm
F-116AI	0.2...12 scfm	2.5...115 scfm
F-116BI	0.6...30 scfm	6...275 scfm

For ranges of 3,000, 6,000 or 10,000 psi rated MFMs please contact factory.

### High Flow MFMs; PN10 / PN16 / PN25 / PN40 / PN100

Model	min. flow	max. flow
F-106AI/F-107AI/F-117AI	0.2...12 scfm	2...115 scfm
F-106BI/F-107BI/F-117BI	1...30 scfm	5...275 scfm
F-106CI/F-107CI/F-117CI	1...60 scfm	10...600 scfm
F-106DI/F-107DI/F-117DI	2...110 scfm	20...1,100 scfm
F-106EI	5...240 scfm	50...2,400 scfm
F-106FI	8...420 scfm	80...4,200 scfm
F-106GI	13...650 scfm	130...6,500 scfm

### Mass Flow Controllers (MFC); PN64 / PN100

Model	min. flow	max. flow
F-200CI/F-210CI <sup>1)</sup>	0.02...10 sccm	0.24...12 sccm
F-201CI/F-211CI <sup>1)</sup>	0.24...12 sccm	0.6...30 slpm
F-201AI/F-211AI <sup>1)</sup>	0.4...20 slpm	2...100 slpm
F-202AI/F-212AI <sup>2)</sup>	8...40 slpm	7.6...380 slpm
F-203AI/F-213AI <sup>3)</sup>	4...200 slpm	36...1800 slpm
F-206AI/F-216AI <sup>3)</sup>	0.2...12 scfm	2...115 scfm
F-206BI/F-216BI <sup>4)</sup>	0.6...30 scfm	5...275 scfm

<sup>1)</sup>  $K_v\text{-max} = 6.6 \times 10^{-2}$  <sup>2)</sup>  $K_v\text{-max} = 0.4$  <sup>3)</sup>  $K_v\text{-max} = 1.5$  <sup>4)</sup>  $K_v\text{-max} = 6.0$

### MFCs for high-pressure / high- $\Delta P$ applications; PN400

Model	min. flow	max. flow
F-230MI	0.2...10 sccm	14...700 sccm
F-231MI	6...300 sccm	0.26...13 slpm
F-232MI	0.14...7 slpm	2...100 slpm

For ranges of 10,000 psi rated MFMs please contact factory.



F-107BI Mass Flow Meter for high flow ranges



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