

METAL SEALED

Digital Mass Flow / Pressure Meters and Controllers

> Introduction

Bronkhorst High-Tech B.V., European market leader in thermal Mass Flow Meters/Controllers and Electronic Pressure Controllers, has many 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.

> Metal sealed

Since 1989 Bronkhorst High-Tech manufactures metal sealed Mass Flow and Pressure Meters/Controllers, designed especially to meet the requirements of the semicon market as well as other high purity gas applications. The instruments feature high surface quality and are of modular construction with metal-to-metal seals that ensure long-term leak tightness. Metal sealed Mass Flow Meters/Controllers can be supplied in ranges starting from 0.1...5 sccm up to 1...50 slm (based on N₂) or even higher on request. Metal sealed Pressure Meters/Controllers are available in pressure ranges from 0.029...1.43 psi up to 18...900 psi.

> State of the art digital design

Today's instruments are equipped with a digital pc-board, offering high accuracy, excellent temperature stability and fast response (settling time t₉₈ down to 600 msec). The main digital pc-board contains all of the general functions needed for measurement and control. The latest EL-FLOW® design features Multi Gas / Multi Range functionality, providing (OEM-) customers with optimal flexibility and process efficiency. For the convenience of the customer Bronkhorst provides easy-to-use configuration software tools.

In addition to the standard RS232 output the instruments also offer analog I/O. Furthermore, an optionally integrated interface board provides DeviceNet™, PROFIBUS DP, Modbus-RTU/ASCII, EtherCAT® or FLOW-BUS protocols.



> General features

- ◆ patented metal-to-metal seal construction ensures long-term leak tightness (to atmosphere)
- ◆ electropolished wetted parts
- ◆ fast response, excellent repeatability
- ◆ flow ranges from 0.1...5 sccm up to 1...50 slm N₂-equivalent (higher on request)
- ◆ Multi Gas / Multi Range functionality
- ◆ optional solutions for low pressure drop or vacuum applications
- ◆ pressure ranges from 0.029...1.43 up to 18...900 psi
- ◆ optional surface mount constructions
- ◆ compliant with RoHS directives

> Digital features

- ◆ DeviceNet™, PROFIBUS DP, Modbus-RTU/ASCII, EtherCAT® or FLOW-BUS slave; RS232 interface
- ◆ rotary switches for selecting node address and the DeviceNet™ data rate
- ◆ high accuracy, $\pm 0.5\%$ RD + $\pm 0.1\%$ FS
- ◆ storage of max. 8 calibration curves
- ◆ alarm and counter functions
- ◆ single rail power supply: +15 or +24 Vdc

> Technical specifications

MASS FLOW measurement / control system

Accuracy (incl. linearity) (based on actual calibration)	: $\pm 0.5\%$ Rd plus $\pm 0.1\%$ FS
Turndown	: 1 : 50 (in digital mode up to 1 : 150)
Repeatability	: $< 0.2\%$ Rd
Settling time (controller)	: 1 second typical above 5% FS; option: down to 600 msec
Control stability	: $< \pm 0.05\%$ FS (typical for 1 slm N ₂)
Max. operating pressure	: meter: 1500 psig; controller: 1000 psig
Temperature sensitivity	: zero: $< \pm 0.05\%$ FS/°C; span: $< \pm 0.05\%$ Rd/°C
Pressure sensitivity	: 0.1% Rd/bar typical N ₂ , 0.01% Rd/bar typical H ₂
Warm-up time	: 30 min. for optimum accuracy 2 min for accuracy $\pm 2\%$ FS

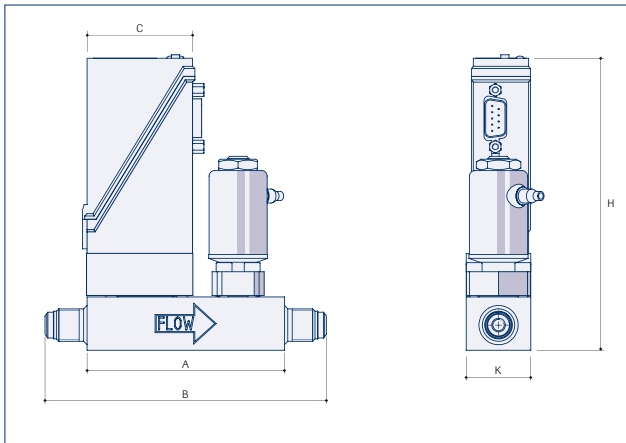
PRESSURE measurement / control system

Accuracy (incl. linearity)	: $\pm 0.5\%$ of full scale (FS)
Pressure rangeability	: Measurement: 1 : 50 (2...100%) Control (with flow range 1 : 50) P-602CM 1 : 20, P-702CM 1 : 5
Repeatability	: $\leq 0,1\%$ RD
Response time sensor	: < 2 msec
Control stability	: $\leq \pm 0,05\%$ FS (typical for 1 slm N ₂ at specified process volume)
Temperature sensitivity	: $< \pm 0.1\%$ FS/°C

General performance

Operating temperature	: -10...+50°C; up to +70°C on request
Leak integrity(outboard)	: $< 2 \times 10^{-11}$ Pa.m ³ /s He
Leak-by through closed valve	: $< 10^{-5}$ Pa.m ³ /s He
Attitude sensitivity	: may be mounted in any position

> Dimensions and weights



Mass Flow and Pressure Meters / Controllers – 1/4" VCR

Model	A	B	C	H	K	Weight (kg)
F-111CM MFM	87	124	47	129	29	0,6
P-502CM EPT	87	124	47	129	29	0,6
F-201CM MFC	87	124	47	129	29	0,7
P-602CM EPC	87	124	47	129	29	0,7
P-702CM EPC	87	124	47	129	29	0,7

Dimensions in mm.

Mechanical parts

Material (wetted parts)	: stainless steel 316L or comparable
Process connections	: 1/4" face seal male
Outer seals	: metal-to-metal (no rings)
Valve seat (controllers)	: Kalrez® (FFKM); options: Viton®, EPDM
Ingress protection (housing)	: IP40

Electrical properties

Power supply	: +15...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, DeviceNet™, Modbus-RTU/ASCII, EtherCAT®, FLOW-BUS
Electrical connection	
Analog/RS232	: 9-pin D-connector (male);
PROFIBUS DP	: bus: 9-pin D-connector (female); power: 9-pin D-connector (male);
DeviceNet™	: 5-pin M12-connector (male);
EtherCAT®	: 2x RJ45 modular jack (in/out)
Modbus/FLOW-BUS	: RJ45 modular jack

Notes:

- Mass flow units sccm and slm refer to 0°C (32°F) and 1013 mbar (14.7 psi)
- Technical specifications subject to change without notice.

> Models and ranges

Mass Flow Meters (MFM); ranges based on N₂

Model	min. flow	max. flow
F-111CM	0.1...5 sccm	1...50 slm

Mass Flow Controllers (MFC)

Model	min. flow	max. flow
F-201CM ¹⁾	0.2...10 sccm	1...50 slm

Electronic Pressure Transducers (EPT)

Model	min. pressure	max. pressure
P-502CM	0.029...1.43 psi ²⁾	18...900 psi ²⁾

Electronic Pressure Controllers (EPC)

Models	min. pressure	max. pressure
P-602CM ¹⁾ (forward pressure control)	0.072...1.43 psi ²⁾	45...900 psi ²⁾
P-702CM ¹⁾ (back pressure control)	0.29...1.43 psi ²⁾	180...900 psi ²⁾

¹⁾ $Kv\text{-max} = 6,6 \times 10^{-2}$

²⁾ Absolute or relative (gauge)

> Fields of application

Both Mass Flow Meters / Controllers and Pressure Meters / Controllers are applied across a huge range of applications e.g. in the fabrication of gas compositions, for CVD and PVD, optical glass coatings, LED production, in vacuum technology and solar power (Photo-Voltaic) element manufacturing and also in semiconductor processes such as ion implantation, etching processes and atomic layer deposition (ALD). Depending on the chemical properties of the process gases and the level of particle cleanliness required, equipment builders often prefer to apply metal sealed equipment over those with elastomeric seals. Bronkhorst High-Tech has many years of experience, supplying precise and reliable instruments for demanding high-purity applications, distinguishing themselves by unique metal-to-metal seals with excellent resealing capability.

> Enhanced performance

Close links with customers and long-standing business partnerships have resulted in a number of new requirements becoming evident, which are now met with the very latest technology from Bronkhorst®.

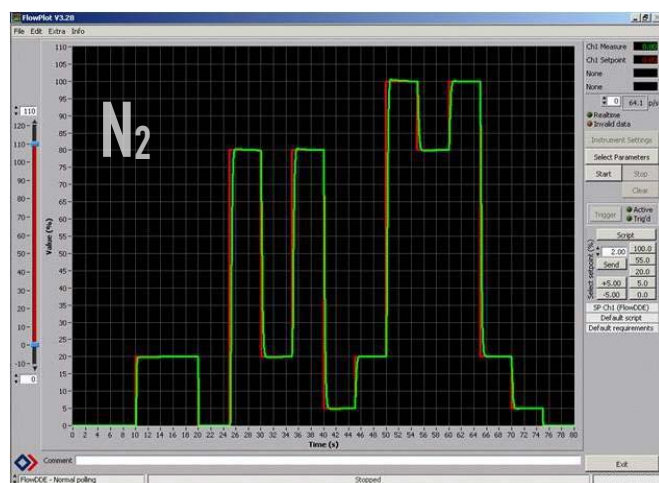
The main benefits are:

- ◆ Faster, more stable and with vastly improved specification
- ◆ User friendly and more forgiving of day-to-day disturbances
- ◆ Configurable for specific uses with wider ranging solutions

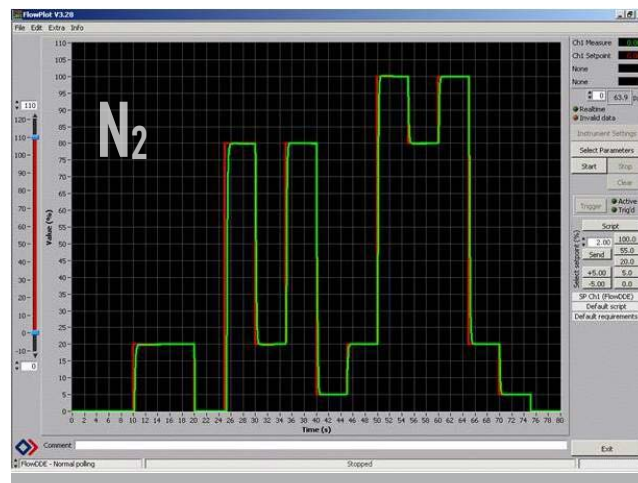


EL-FLOW® model F-201CM Metal Sealed Mass Flow Controller

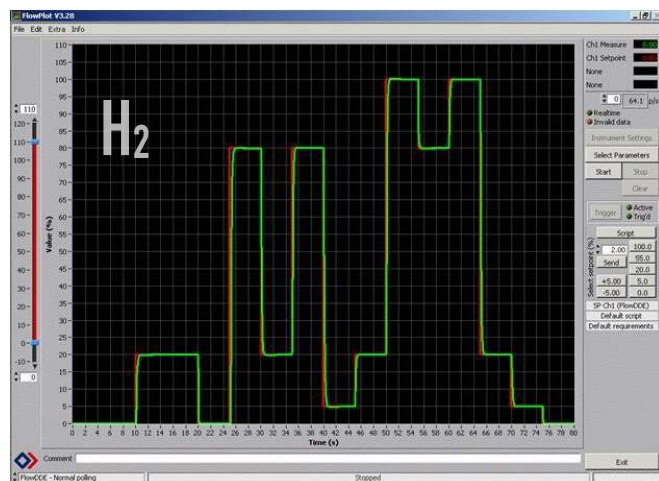
To illustrate the impressive performance of the latest EL-FLOW Metal Sealed series, please refer to the four graphs on this page. These examples show the performance of a Mass Flow Controller, when changing fluid from N₂ to H₂ at both 30 psig and 100 psig input pressure, without changing any of the control parameter settings.



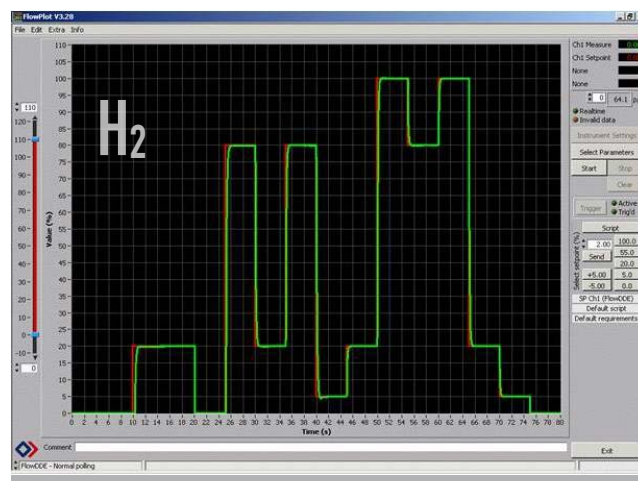
P in = 30 psig; P out = atm



P in = 100 psig; P out = atm



P in = 30 psig; P out = atm



P in = 100 psig; P out = atm

> Model number identification

PRESSURE Meters/Controllers

AA-NNNAA - NNNA - A A A - NN - A

Base model	
P-502CM	Pressure Meter - 1/4" VCR
P-602CM	Forward Pressure Controller - 1/4" VCR
P-702CM	Back Pressure Controller - 1/4" VCR
Sensor code	
Factory selected	
Communication (I/O)	
A	RS232 + analog (n/c control)
B	RS232 + analog (n/o control)
D	RS232 + DeviceNet™ (n/c control)
E	RS232 + DeviceNet™ (n/o control)
M	RS232 + Modbus (n/c control)
N	RS232 + Modbus (n/o control)
P	RS232 + PROFIBUS DP (n/c control)
Q	RS232 + PROFIBUS DP (n/o control)
R	RS232 + FLOW-BUS (n/c control)
S	RS232 + FLOW-BUS (n/o control)
T	RS232 + EtherCAT® (n/c control)
U	RS232 + EtherCAT® (n/o control)
Analog output	
A	0...5 Vdc
B	0...10 Vdc
F	0...20 mA sourcing
G	4...20 mA sourcing
Supply voltage	
D	+15...24 Vdc
Connections (in/out)	
88	1/4" Face Seal male
Valve seals	
V	Viton
E	EPDM
K	Kalrez® (FFKM) (factory standard)



> Model number identification

MASS FLOW Meters/Controllers

AA-NNNAA - NNNA - A A A - NN - A

Base model	
F-111CM	Mass Flow Meter - 1/4" VCR
F-201CM	Mass Flow Controller - 1/4" VCR
Sensor code	
Factory selected	
Communication (I/O)	
A	RS232 + analog (n/c control)
B	RS232 + analog (n/o control)
D	RS232 + DeviceNet™ (n/c control)
E	RS232 + DeviceNet™ (n/o control)
M	RS232 + Modbus (n/c control)
N	RS232 + Modbus (n/o control)
P	RS232 + PROFIBUS DP (n/c control)
Q	RS232 + PROFIBUS DP (n/o control)
R	RS232 + FLOW-BUS (n/c control)
S	RS232 + FLOW-BUS (n/o control)
T	RS232 + EtherCAT® (n/c control)
U	RS232 + EtherCAT® (n/o control)
Analog output	
A	0...5 Vdc
B	0...10 Vdc
F	0...20 mA sourcing
G	4...20 mA sourcing
Supply voltage	
D	+15...24 Vdc
Connections (in/out)	
88	1/4" Face Seal male
Valve seals	
V	Viton
E	EPDM
K	Kalrez® (FFKM) (factory standard)



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