

Datasheet F-111AC

Mass Flow Meter for Gases

> Introduction

Bronkhorst® model F-111AC Mass Flow Meters (MFM) are suited for precise measurement of virtually all conventional process gases. The MFM consists of a thermal mass flow sensor and a microprocessor based pc-board with signal and fieldbus conversion and a PID controller for optional mass flow control by means of a separately mounted control valve. The mass flow, expressed in normal millilitres per minute or per hour, is provided as analog signal or digitally via RS232 or fieldbus. The flow range and wetted materials are determined depending of the type of gas and the process conditions of the application.

Although all specifications in this datasheet are believed to be accurate, the right is reserved to make changes without notice or obligation.



EL-FLOW Mass Flow Meter model F-111AC

> Technical specifications

Measurement / control system

Accuracy (incl. linearity) (Based on actual calibration)	: $\pm 0,5\% \text{ Rd}$ plus $\pm 0,1\% \text{ FS}$
Turndown	: 1 : 50 (in digital mode up to 1:187,5)
Multiple fluid capability	: • storage of max. 8 calibration curves • optional Multi Gas / Multi Range functionality up to 10 bar abs
Repeatability	: $< \pm 0,2\% \text{ Rd}$
Response time (SEMI-E17-00-0600-0307R)	: typical 0,5 sec
Temperature range	: $-10 \dots +70^\circ\text{C}$
Temperature sensitivity (nominal range)	: zero: $< \pm 0,05\% \text{ FS}/^\circ\text{C}$; span: $< \pm 0,05\% \text{ Rd}/^\circ\text{C}$
Leak integrity (outboard)	: $< 2 \times 10^{-9} \text{ mbar l/s He}$
Attitude sensitivity	: max. error at 90° off horizontal $0,2\% \text{ FS}$ at 1 bar, typical N_2
Warm-up time	: 30 min. for optimum accuracy 2 min. for accuracy $\pm 2\% \text{ FS}$

Mechanical parts

Material (wetted parts)	: stainless steel 316L or comparable
Pressure rating	: 100 bar abs
Process connections	: compression type or face seal male
Seals	: standard : Viton; options: EPDM, Kalrez
Ingress protection (housing)	: IP40

Electrical properties

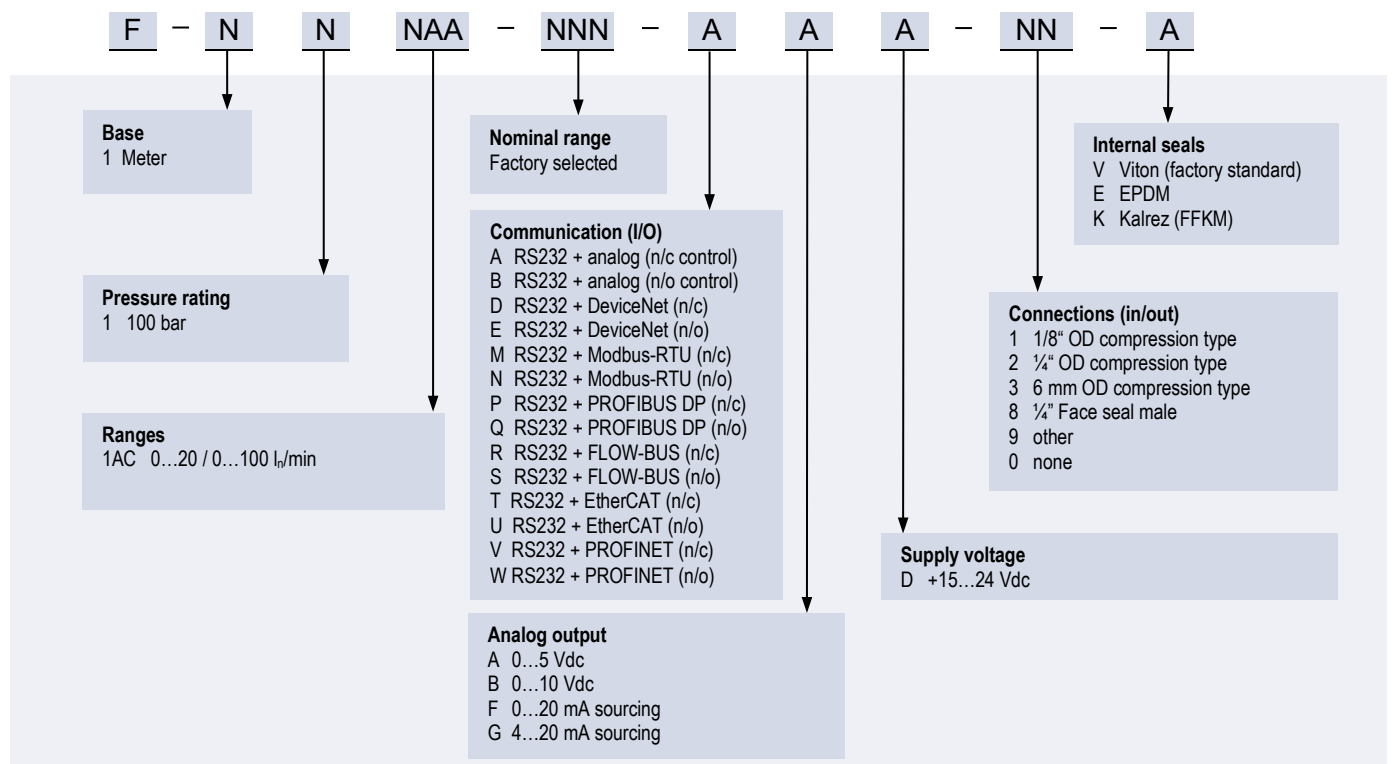
Power supply	: $+15 \dots 24 \text{ Vdc} \pm 10\%$
Power consumption	: Supply at voltage I/O at current I/O
Meter	: 15 V 95 mA 24 V 65 mA
Controller	: 15 V 290 mA (based on N/C valve) 24 V 200 mA
Extra for fieldbus:	PROFIBUS DP: add 53 mA (15 V supply) or 30 mA (24 V supply)
(if applicable)	EtherCAT®: add 66 mA (15 V supply) or 41 mA (24 V supply)
	DeviceNet™: add 48 mA (24 V supply)
	PROFINET: add 77mA (15 V supply) or 48 mA (15 V supply)
Analog output (0...100%)	: 0...5 (10) Vdc, min. load impedance $> 2 \text{ k}\Omega$; 0 (4)...20 mA (sourcing), max. load impedance $< 375 \Omega$
Analog setpoint (0...100%) (for MFM + control valve)	: 0...5 (10) Vdc, min. load impedance $> 100 \text{ k}\Omega$; 0 (4)...20 mA, load impedance $\sim 250 \Omega$
Digital communication	: standard RS232; options: PROFIBUS DP, DeviceNet™, EtherCAT®, Modbus RTU/ASCII, FLOW-BUS, PROFINET

> Ranges (based on Air)

Model	minimum	nominal	maximum
F-111AC-50K	0,4...20 $\text{l}_\text{r}/\text{min}$	0,4...50 $\text{l}_\text{r}/\text{min}$	0,4...75 $\text{l}_\text{r}/\text{min}$
F-111AC-70K	0,6...30 $\text{l}_\text{r}/\text{min}$	0,6...70 $\text{l}_\text{r}/\text{min}$	0,6...100 $\text{l}_\text{r}/\text{min}$

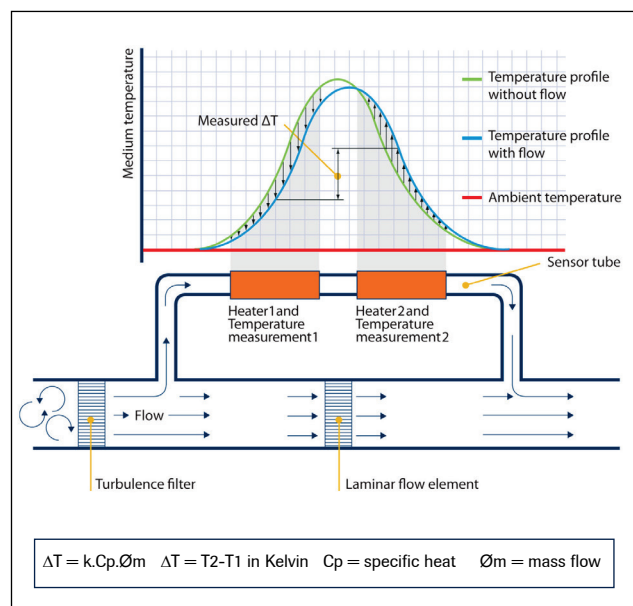
Intermediate ranges are available

> Model number identification



> Thermal mass flow measuring principle

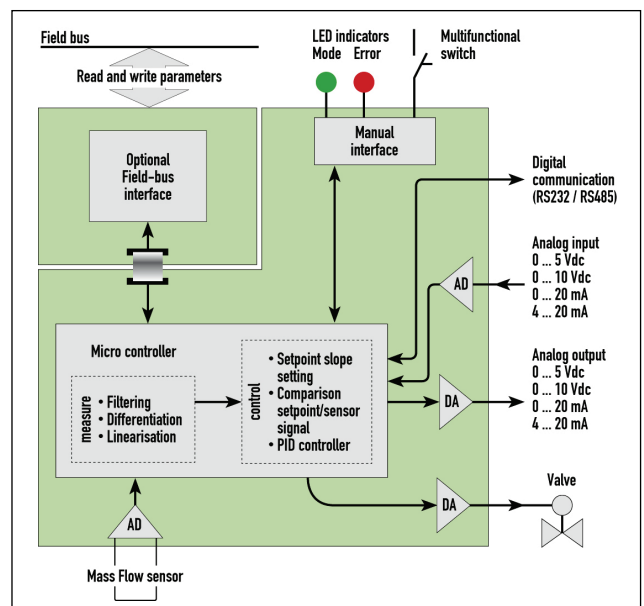
The heart of the thermal mass flow meter/controller is a sensor that consists of a stainless steel capillary tube with resistance thermometer elements. A part of the gas flow is redirected through this bypass style sensor, and is warmed up by heating elements. Consequently the measured temperatures T_1 and T_2 drift apart. The temperature difference is directly proportional to mass flow through the sensor. In the main channel Bronkhorst applies a patented laminar flow element consisting of a stack of stainless steel discs with precision-etched flow channels. Thanks to the perfect flow-split the sensor output is proportional to the total mass flow rate.



Functional scheme of the thermal mass flow sensor

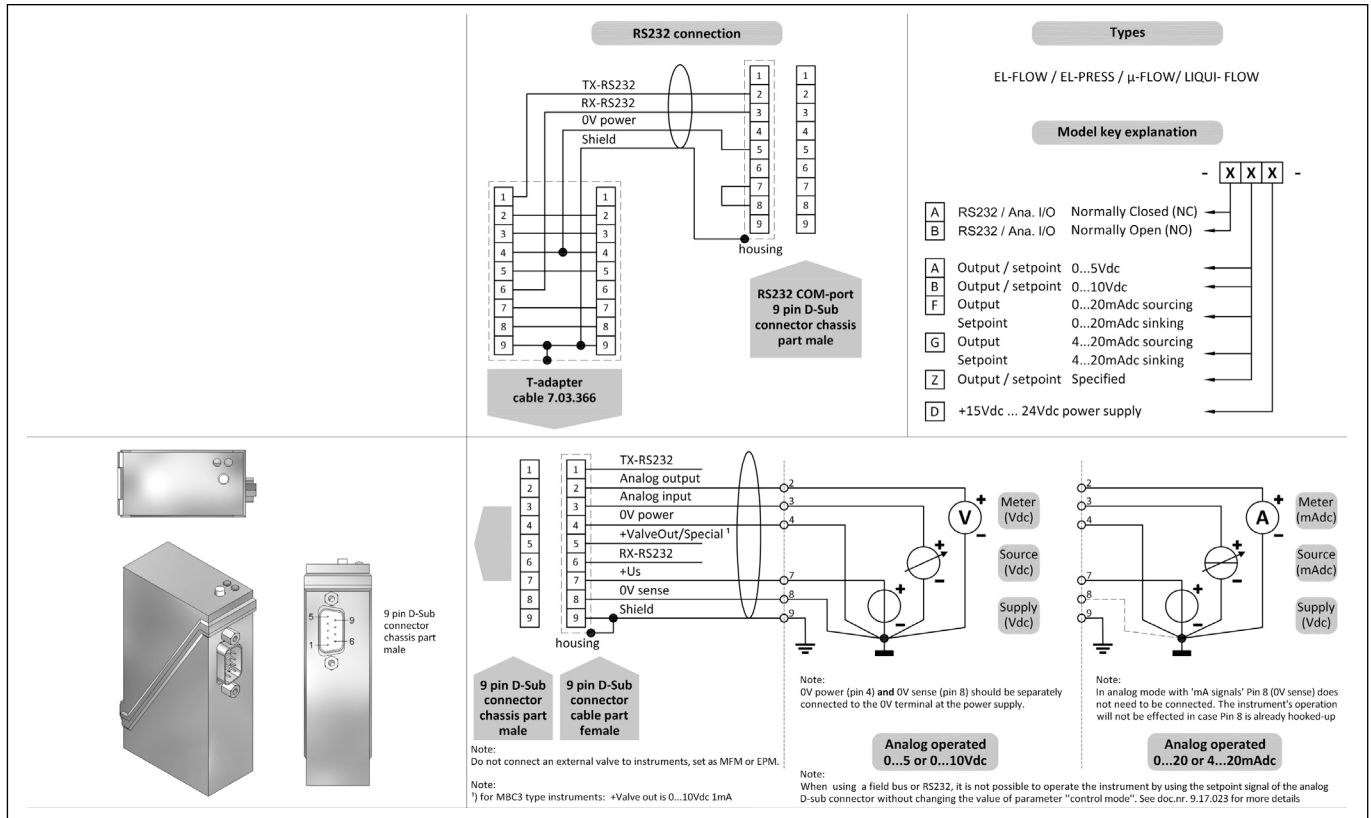
> State of the art digital design

Today's EL-FLOW[®] series are equipped with a digital pc-board, offering high accuracy, excellent temperature stability and fast response. The basic digital pc-board contains all of the general functions needed for measurement and control. In addition to the standard RS232 output the instruments also offer analog I/O. Furthermore, an integrated interface board provides DeviceNet[™], PROFIBUS DP, Modbus RTU/ASCII or FLOW-BUS protocols.



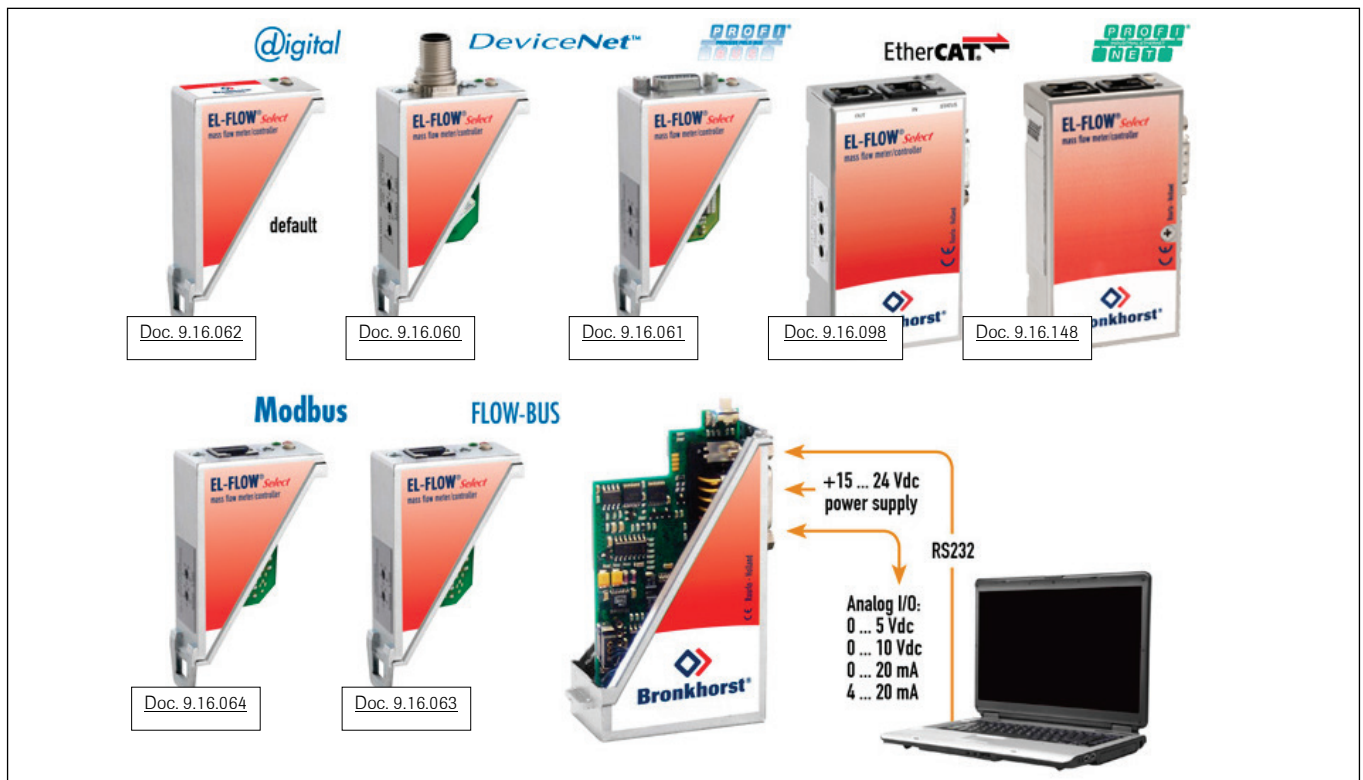
Functional scheme of the digital PC-board

> Hook-up diagram for analog or RS232 communication

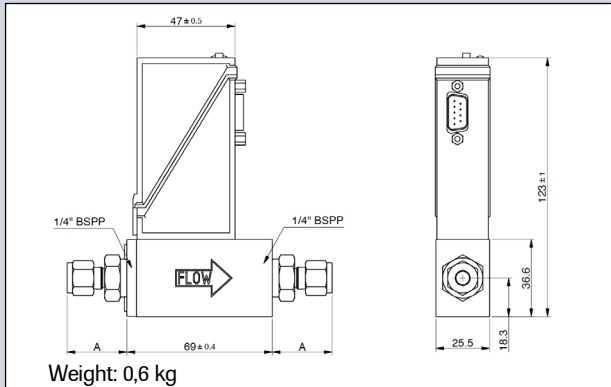


> Hook-up diagrams for fieldbus communication

For the available fieldbus options we refer to the various hook-up diagrams as indicated below. If you are viewing this datasheet in digital format, you may use the hyperlink to each of the drawings. Otherwise please visit the download section on www.bronkhorst.com or contact our local representatives.

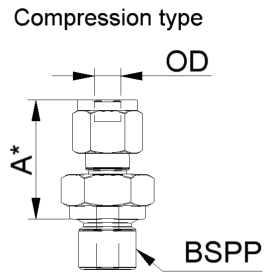


> Dimensions (mm) and weight (kg)



Dimension table adapters (RS-type)

Compression type	1/4\"/>	
	Size A	
adapter 3 mm OD	26.1	
adapter 6 mm OD	28.4	
adapter 8 mm OD	29.4	
adapter 10 mm OD	30.2	
adapter 12 mm OD	32.5	
adapter 1/8\"/>		
adapter 1/4\"/>		
adapter 3/8\"/>		
adapter 1/2\"/>		
Face-seal male	Size A	
adapter 1/4\"/>		



*) Dimension A is typical finger-tight.

> Options and accessories

<ul style="list-style-type: none"> - Multi-Gas / Multi-Range option, with free configuration software. - Free software support for operation, monitoring, optimizing or to interface between digital instruments and windows software. 	
<ul style="list-style-type: none"> - IN-LINE filters for protection against particulates 	
<ul style="list-style-type: none"> - BRIGHT compact local Readout/Control modules - E-8000 Power Supply/Readout systems 	
<ul style="list-style-type: none"> - Interconnecting cables for power and analog/digital communication - PiPS Plug-in Power Supply 	

> Alternatives

<ul style="list-style-type: none"> - IN-FLOW MFM with industrial (IP65) housing 	
<ul style="list-style-type: none"> - IN-FLOW^{CTA} direct (no by-pass), industrial (IP65) Mass Flow Meter 	
<ul style="list-style-type: none"> - LOW-ΔP-FLOW series MFM for low pressure drop applications or corrosive gas service 	
<ul style="list-style-type: none"> - Metal Sealed MFM for Semiconductor or other high purity applications 	

