

# FLEXI-FLOW™ Compact

The new standard in measurement & control of mass flow and pressure



**Status indication**  
NAMUR



**Fast response**  
Due to TCS technology



**Connectivity**  
Bluetooth and USB-C



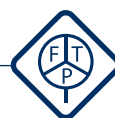
**Compact design**  
35% footprint reduction



**On-board gas database**  
Real-time conversion



**Multi parameter**  
Flow, Pressure, Temperature



Mass Flow Control **#Redefined**  
Swift & Stable, Proven & Precise

DATASHEET

  
**Bronkhorst®**



## > TCS Technology

Bronkhorst has created a completely new concept for measuring mass flow using the thermal measuring principle. The unique **TCS Technology (Through Chip Sensor)** combines the best of two technologies: a fast and stable chip flow sensor applied in Bronkhorst's proven by-pass construction. Due to the TCS Technology, accurate mass flow measurement, virtual independent of variations in temperature and line pressure is established. By measuring the actual process conditions (temperature and line pressure), a real-time correction is made to the measured value. And because all gas properties are available on-board, accurate conversion to other gases is possible.

## > Unique FLEXI-FLOW™ features



### Fast response

Due to the ultra-thin sensor tube, the sensor reacts instantaneously to changes of the gas flow, resulting in very fast flow measurement. Combined with a direct acting control valve, settling times smaller than 150 ms are achieved.



### Multi parameter

Besides mass flow measurement, the instrument has an integrated temperature sensor and 2 pressure sensors (instrument inlet and outlet pressure). These measurement parameters do not only provide information about the instrument but also about the process conditions.



### On-board FLUIDAT® gas database

Select your process gas. With 22 on-board gases, it is very easy to switch to another gas or mixture. Additionally, the on-board gas database is used for real-time corrections on the flow measurement based on the actual process conditions (temperature and line pressure).



### Namur NE107 status indication

The instrument shows the status of self-monitoring and diagnosis by means of a coloured LED. This signal can be easily recognized by the operator. For more details the diagnostic parameters can be used.



### Compact design

We have been able to reduce the footprint by 35% compared to similar instruments up to 20 l<sub>v</sub>/min. Due to this compact size, the instrument is very suitable to be used inside desktop equipment or at places where space is limited.



### Separate USB-C communication interface

For easy setup outside the installation, the USB-C port can be used. Communication can be established with the Bronkhorst FlowSuite software without the need of an additional power supply. During operation, this port can also be used to monitor the instrument without disconnecting the power and data connection.



### Bluetooth communication

To enhance user flexibility, a wireless connection allows monitoring the instrument without disconnecting the regular power and data connection. In case Bluetooth is not desired, this function can be disabled.



### Sustainable and environmentally friendly

Due to the accurate conversion, calibration with valuable or rare gases is no longer necessary. In addition, Bronkhorst's products are known for their low power consumption. The reduced size and weight of the instrument minimizes its environmental impact.



### Predictive maintenance

Prepared for predictive maintenance and diagnostic functions by means of datalogging of several parameters, that can be used to predict the health status of the instrument and condition of the process. With multiple configurable alarms the information can be transferred to the user.

## > The new standard in measurement & control of Mass flow and pressure

- ◆ 3 control types in one compact instrument
  - ◆ Mass flow
  - ◆ Upstream pressure
  - ◆ Downstream pressure
- ◆ Multi parameter output
  - ◆ Actual mass flow
  - ◆ Upstream pressure
  - ◆ Downstream pressure
  - ◆ Temperature (instrument)
- ◆ Simple and secure connection through Bluetooth or USB-C
- ◆ High accuracy through on-board gas database and real-time conversion
- ◆ Easy to configure
- ◆ MTBF 145 years

## > Models and ranges

### Mass Flow and Pressure Meter

Model	Full scale flow (N <sub>2</sub> eq.)
FF-M1x	0,5...20 l <sub>v</sub> /min

### Mass Flow and Pressure Controller

Model	Full scale flow (N <sub>2</sub> eq.)
FF-C1x	0,5...20 l <sub>v</sub> /min

## › Technical specifications

Measurement / control system	
<b>Flow</b>	
Accuracy (N <sub>2</sub> , Air, O <sub>2</sub> ) <i>For other gases see multi gas table</i>	up to ±0,5% Rd plus ±0,1% FS
Repeatability	< ± 0,2% Rd
Typical settling time (T <sub>90</sub> ) in control	<150 ms
Response time (T <sub>63</sub> )	<30 ms
Long term stability	<0,5% FS over period of 3 years, then <0,2% FS per year
Control stability	< ± 0,1% FS (typical for 1 l/min N <sub>2</sub> )
Control range / measurement range	up to 1:1000
Multi Gas / Multi Range	embedded gas data for 22 unique gases plus any mixture of these gases
Operating temperature	0...50 °C (32°F - 122°F)
Storage / transport conditions	-20...70 °C, 95% RH non-condensing
Temperature sensitivity	zero 0,015 % FS/°C span 0,03 % Rd/°C
Pressure sensitivity	standard: < 0,15% Rd/bar typical N <sub>2</sub> ; with pressure correction: < 0,02% Rd typical N <sub>2</sub>
Mounting	any position, attitude sensitivity negligible
<b>Temperature</b>	
Accuracy temperature sensor	±0,2 °C (instrument body temperature)
<b>Pressure</b>	
Accuracy pressure sensors <i>(incl. linearity and hysteresis)</i>	±0,5% FS
Pressure range	0...17 bar(a)
Repeatability pressure sensors	<0,2% FS
Temperature sensitivity	zero: 0,16 mbar/°C span: 0,05% Rd/°C
<b>Mechanical parts</b>	
Material ( <i>wetted parts</i> )	aluminium, stainless steel, silicon nitride, epoxy, aluminiumoxide, glass
Process connections	optional compression type, push-in or face seal couplings
Seals	default: FKM 51415 For other materials contact factory
Pressure rating	16 bar(g) / 250 psi(g)
Leaktightness, outboard <i>(prior to permeation through seals)</i>	typical 2·10 <sup>-9</sup> mbar.l/s He
Leak-by through closed valve	typical 5·10 <sup>-5</sup> mbar.l/s He
Surface roughness body <i>(wetted parts)</i>	<1,6 µm Ra (<0,8 µm Ra for stainless steel body)
Ingress protection ( <i>housing</i> )	IP40
Weight	Aluminium body: 200 g Stainless steel body: 300 g
<b>Electrical properties</b>	
Power supply	24 Vdc ± 10%
Electrical connection	9-pin D-sub male
Power consumption	meter 0,35 Watt controller 2,0 Watt
Digital communication	Modbus RTU FLOW-BUS
Certification	CE / RoHS

Technical specifications and dimensions subject to change without notice.

## › Multi-channel systems

FLEXI-FLOW compact instruments can be combined to build a compact system – ready to use. Multi-channel systems up to 8 channels can be easily created with the help of configuration software.

The use of distribution chambers at the inlet or mixing chambers at the outlet ensures a compact and small build of the system. Communication from the multi-channel system to the PLC can be established with additional gateways.

Since the system is completely assembled and tested at Bronkhorst, the effort required for commissioning is kept to a minimum.



## › Typical markets



### Bioreactors

Increased deployment of a flow instrument by Air, N<sub>2</sub>, O<sub>2</sub>, CO<sub>2</sub> - multi-gas functionality and availability of multiple flow ranges in a single instrument.

Compact for desktop equipment.



### Reactive sputtering

Fast follow-up of setpoints for layer thickness and transparency control.

Large dynamic range for flexibility within the application.



### Fuel cell

Very accurate and repeatable over short-term and long-term for H<sub>2</sub>, Air, O<sub>2</sub> and CO<sub>2</sub> flow measurement and control. Fast response flow measurement and control for accuracy at any time.

Large dynamic range flow measurement and control for accuracy over a wide flow range. Compact for space-restricted mobile applications.



### Analytical equipment

Trace Elemental Analysis (TEA)  
Gas Chromatography (GC)  
Optical Emission Spectroscopy (ICP-OES)  
Mass Spectrometry (MS, ICP-MS)  
Atomic Absorption Spectrometry (AAS)

Excellent repeatability and long-term stability.

Analytical grade; low outgassing. Fast flow control, also at very low flow rates. Compact for desktop equipment.

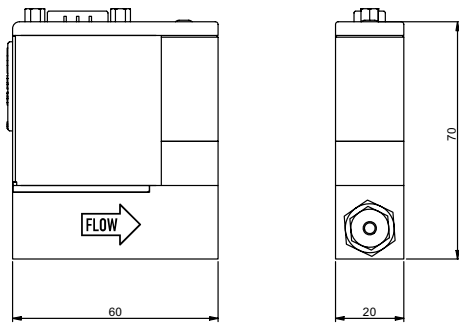
### And many other applications

High-end burners, plasma spray, leak testing, ALD, etc.

DATASHEET

**Bronkhorst**<sup>®</sup>

## Dimensions



## Multi gas table

To determine which model is suitable for process gases other than N<sub>2</sub>, the full-scale flow must be multiplied by the below-mentioned "flow factor".

Note: this factor might be different for a flow meter (MFM) or a flow controller (MFC).

The highly accurate on-board Fluidat gas database ensures best in class conversion from N<sub>2</sub> to the customer gas. When converting one gas to another, a small uncertainty is introduced. Although gas properties and conversion model are very accurate, mechanical tolerances can cause slight deviations from the theoretical conversion values. Therefore an additional uncertainty [%Rd] is applied to the accuracy specification. When the best accuracy performance is needed, calibration on actual process gas can be performed.

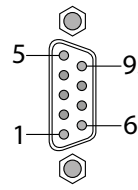
Name	Gas Formula	Full scale factor (MFM)	Full scale factor (MFC)	Conversion uncertainty	Remarks
Acetylene	C <sub>2</sub> H <sub>2</sub>	0,6	0,6	±1,5% Rd	
Air	Air	1	1	none	
Allene	C <sub>3</sub> H <sub>4</sub> #1	0,4	0,4	±1,5% Rd	
Argon	Ar	1,3	0,8	±1,5% Rd	
Carbon dioxide	CO <sub>2</sub>	0,7	0,7	±1,5% Rd	Max. 10 bar
Carbon monoxide	CO	1	1	±1,5% Rd	
Cyclopropane	C <sub>3</sub> H <sub>6</sub> #1	0,4	0,4	±1,5% Rd	
Deuterium	D <sub>2</sub> #1	1	1	±1,5% Rd	
Ethane	C <sub>2</sub> H <sub>6</sub>	0,5	0,5	±1,5% Rd	
Ethylene	C <sub>2</sub> H <sub>4</sub>	0,6	0,6	±1,5% Rd	Max. 10 bar
Helium	He	1,4	1,4	±1,5% Rd	
Propyne	C <sub>3</sub> H <sub>4</sub> #2	0,5	0,5	±1,5% Rd	
Hydrogen	H <sub>2</sub>	1	1	±1,5% Rd	
Krypton	Kr	1	0,6	±1,5% Rd	
Methane	CH <sub>4</sub>	0,8	0,8	±1,5% Rd	
Neon	Ne	1,4	1,2	±1,5% Rd	
Nitrogen	N <sub>2</sub>	1	1	none	
Oxygen	O <sub>2</sub>	1	0,9	none	
Propylene	C <sub>3</sub> H <sub>6</sub> #2	0,4	0,4	±1,5% Rd	Max. 10 bar
Propane	C <sub>3</sub> H <sub>8</sub>	0,3	0,3	±1,5% Rd	
Perfluoropropane	C <sub>3</sub> F <sub>8</sub>	0,2	0,2	±1,5% Rd	Max. 10 bar
Nitrous oxide	N <sub>2</sub> O	0,7	0,7	±1,5% Rd	

## About Bronkhorst

For more than 40 years Bronkhorst has been supplying instruments and solutions for the measurement and control of gas flow and pressure. In that time, our portfolio has grown considerably, as we have responded well to the requirements of our customers by means of our innovative strength. Moreover, we have continuously improved our mass flow and pressure meters and controllers by applying the latest techniques. These market requirements and the availability of high-quality production techniques have again led to the development of a new, revolutionary product line: FLEXI-FLOW Compact.

## Electrical connection

### 9-pin D-sub male



1	RS-485 D0 (A/A')
2	Not connected
3	Not connected
4	0Vs
5	Not connected
6	RS-485 D1 (B/B')
7	+Us
8	0Vs
9	Shield

## FLEXI-FLOW™ Compact preconfigured models

Due to the flexibility and versatility of the instrument, Bronkhorst has defined 4 models to cover the flowrange from 500 ml<sub>r</sub>/min to 20 l<sub>r</sub>/min. Two performance levels (advanced and standard) are available. With the easy-to-use FlowSuite software (available for Windows and iOS), these instruments can be tuned to meet your specific needs.

Part number	FS flow (based on N <sub>2</sub> @ 1 bar abs)	Type	
7.11.785	500 ml <sub>r</sub> /min	FF-A500	
7.11.786	2 l <sub>r</sub> /min	FF-A2K0	advanced functionality
7.11.787	5 l <sub>r</sub> /min	FF-A5K0	
7.11.788	20 l <sub>r</sub> /min*	FF-A20K	
7.11.789	500 ml <sub>r</sub> /min	FF-S500	
7.11.790	2 l <sub>r</sub> /min	FF-S2K0	standard functionality
7.11.791	5 l <sub>r</sub> /min	FF-S5K0	
7.11.792	20 l <sub>r</sub> /min*	FF-S20K	

\* Max. ΔP: 5 bar(d), for higher ΔP refer to FF-C1x model

## Features advanced and standard models

	Advanced	Standard
Multi parameter	Flow, temperature, pressure up- and downstream	Flow, temperature
Accuracy (N <sub>2</sub> , Air, O <sub>2</sub> ) For other gases see multi gas table	±0,8%Rd plus ±0,2%FS	±1,5%Rd plus ±0,5%FS
Control range / measurement range	1:500	1:50
Multi function (selectable)	Flow control, pressure control	Flow control
Diagnostic function	Namur status, data logging	Namur status
Multi Gas / Multi Range	Embedded gas data for 22 unique gases	
Communication (selectable)	Modbus RTU, FLOW-BUS	
Connectivity	USB-C, Bluetooth	
Pressure rating	16 bar(g) / 250 psi(g)	
Body material	Aluminium	
Seals	FKM	
Process connections	None, to be ordered separately	