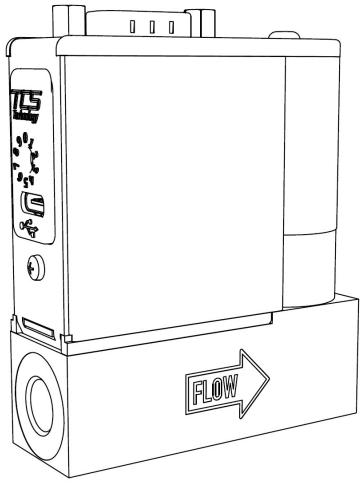
Instruction Manual

FLEXI-FLOW™ Compact

Doc. no.: 9.17.158 rev. D Date: 30-01-2023



ATTENTION
Please read this document carefully before installing and operating the product.
Not following the guidelines could result in personal injury and/or damage to the equipment.
Keep this document for future reference.

Bronkhorst®

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Disclaimer

The illustrations in this document serve to provide general notices regarding correct operation. The illustrations are simplified representations of the actual situation and may differ from the actual product.

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Symbols in this document

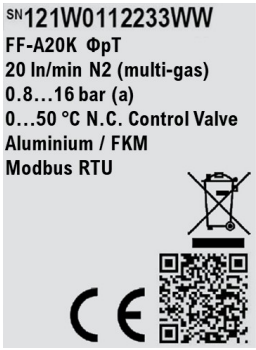
Important information. Disregarding this information could increase the risk of damage to the equipment, or the risk of personal injuries.

Tips, useful information, attention points. This will facilitate the use of the instrument and/or contribute to its optimal performance.

Additional information available in the referenced documentation, on the indicated website(s) or from your Bronkhorst representative.

Service

If you have a question about a product or if you find the product does not meet the specifications as ordered, do not hesitate to contact your Bronkhorst representative. To enable us to help you quickly and effectively, make sure to have the serial number (SN) ready whenever seeking contact with your Bronkhorst representative about a specific item.



For current information about Bronkhorst® and worldwide service addresses, please visit our website:

www.bronkhorst.com

Do you have any questions about our products? Our Sales department will gladly assist you selecting the right product for your application. Contact sales by e-mail:

sales@bronkhorst.com

For after-sales questions, help and guidance, our Customer Care department is available by e-mail:

aftersales@bronkhorst.com

No matter the time zone, our experts within the Customer Care department are available to answer your request immediately or take appropriate further action. Our experts can be reached at:

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NL-7261 AK Ruurlo
The Netherlands

Warranty

Bronkhorst® products are warranted against defects in material and workmanship for a period of three years from the date of shipment, provided they are used in accordance with the ordering specifications and not subject to abuse or physical damage. Products that do not operate properly during this period may be repaired or replaced at no charge. Repairs are normally warranted for one year or the balance of the original warranty, whichever is the longer.

See also section 9 (Guarantee) of the Conditions of sales:
www.bronkhorst.com/int/about/conditions-of-sales/

The warranty includes all initial and latent defects, random failures, and indeterminable internal causes. It excludes failures and damage caused by the customer, such as contamination, improper electrical hook-up, physical shock etc.

Re-conditioning of products primarily returned for warranty service that is partly or wholly judged non-warranty may be charged for.

Bronkhorst High-Tech B.V. or affiliated company prepays outgoing freight charges when any part of the service is performed under warranty, unless otherwise agreed upon beforehand. The costs of unstamped returns are added to the repair invoice. Import and/or export charges as well as costs of foreign shipping methods and/or carriers are paid by the customer.

Receipt of equipment

Check the outside packaging box for damage incurred during shipment. If the box is damaged, the local carrier must be notified at once regarding his liability. At the same time a report should be submitted to your Bronkhorst representative.

Carefully remove the equipment from the box. Verify that the contents of the package was not damaged during shipment. Should the equipment be damaged, the local carrier must be notified at once regarding his liability. At the same time a report should be submitted to your Bronkhorst representative.

- *Check the packing list to ensure that you received all items included in the scope of delivery*
- *Do not discard spare or replacement parts with the packaging material*

Refer to Removal and return instructions 22 about return shipment procedures.

Equipment storage

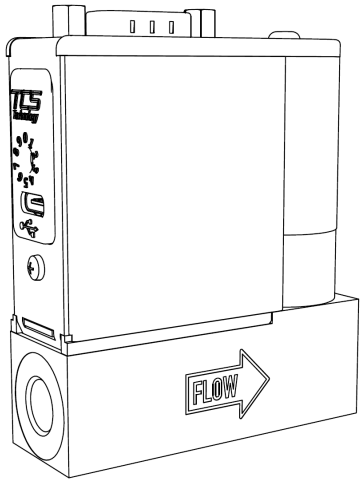
- The equipment should be stored in its original package in a climate controlled storage location.
- Care should be taken not to subject the equipment to excessive temperatures or humidity.
- See technical specifications (data sheet) for information about required storage conditions.

Table of contents

1 General information

1.1 Scope of this document

This document contains general product information, installation and basic operating instructions and troubleshooting tips for the **FLEXI-FLOW™ Compact**.



1.2 Intended use

The FLEXI-FLOW™ has been developed to measure and/or control mass flow rates and pressures of clean, dry, non-corrosive and non-toxic gases in a fluid system.

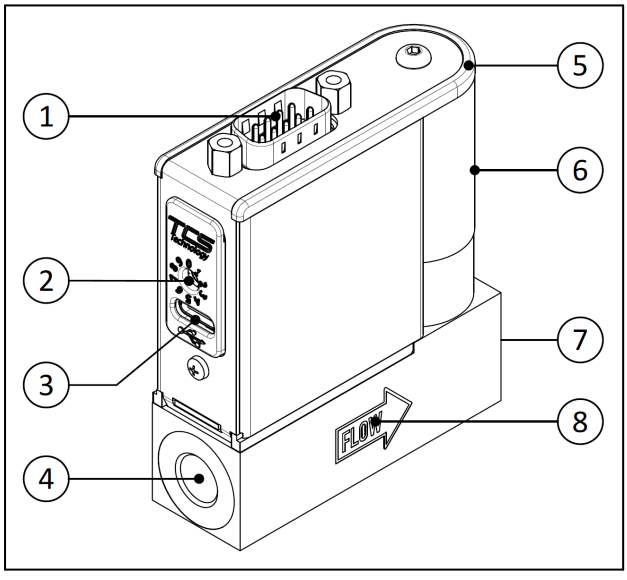
The product is suited for general purpose dry indoor applications, like laboratories and machine enclosures, applying media and operating conditions within the limits as specified in the FLEXI-FLOW™ Compact datasheet[9] .

Any other use is considered as not intended and improper. Improper use might cause damage to the product and/or propose danger to users and/or bystanders and is therefore not permissible.

Responsibility for application of the product in accordance with its intended use, suitability for the intended application, cleaning and compatibility of the used media with the applied materials lies solely with the user.

Bronkhorst High-Tech B.V. cannot be held liable for any damage and/or injury resulting from unintended, improper or unsafe use.

1.3 Product overview



1. Power and signal connector (9-pin D-sub)
2. Address selector (rotary switch)
3. Support interface (USB-C)
4. Fluid inlet
5. Status indication light
6. Control valve (optional)
7. Fluid outlet
8. Flow direction

1.4 Product features

1.4.1 Offline/parallel configuration

The instrument is fitted with a support interface (USB-C) and a *Bluetooth*® wireless connection (optional). Both connections can be used to configure the instrument before process integration. After process integration, both connections can also be used to monitor the instrument without disconnecting the communication connection.

Note: All information in this document regarding the *Bluetooth*® functionality of the FLEXI-FLOW™ does not apply to instruments ordered without this functionality.

1.4.2 Instrument status (NAMUR)

With the status indication light7 , the FLEXI-FLOW™ Compact shows its current status14 , using a color range based on the NAMUR NE 107 standard. The colors provide easily recognizable signals to the operator regarding corrective actions, malfunctions, maintenance indications, etc.

Comprehensive diagnostic information based on the NAMUR status is available in FlowSuite.

1.4.3 Multi-parameter functionality

The FLEXI-FLOW™ Compact works in much the same way as any regular digital Bronkhorst® instrument. Upon delivery, the FLEXI-FLOW™ Compact is configured as a (mass) flow controller or meter. An integrated temperature sensor and 2 pressure sensors provide additional real-time measurement data, allowing the main instrument function to be switched between flow control and pressure control17 .

1.4.4 On-board FLUIDAT® database

A built-in database with properties of 22 commonly used gases provides the basis for up to 8 fluid presets, which can be stored in the instrument using FlowSuite or by direct digital communication (e.g. using a custom-built (PLC) program).

The on-board FLUIDAT® conversion algorithm continuously adjusts the gas flow relative to the calibration gas, based on the measured temperature and pressure and the properties of the selected gas (or mixture)15 .

1.4.5 Multi-modular systems

The FLEXI-FLOW™ Compact can be supplied as a system with up to 8 instruments which are linked fluidically by means of a manifold-like construction. The instruments can be controlled individually on FLOW-BUS or Modbus, or through a gateway42 in other fieldbus systems. The gateway and the instruments behind it are powered through a single cable.

For information about FLEXI-FLOW™ Compact based multi-channel systems and possible applications, contact your Bronkhorst representative.

1.5 Documentation

- *This document contains basic information for installation, commissioning and maintenance of the FLEXI-FLOW™ Compact.*
- *At some points it refers to documentation associated with important components or features. These references are listed in the table below.*
- *All documents listed here can be found on the FLEXI-FLOW™ product page (www.bronkhorst.com/flexi-flow or scan the QR code).*

Type	Document name	Document no.
Manuals	Instruction Manual FLEXI-FLOW™ Compact (this document)	9.17.158
	Quick Start Guide FLEXI-FLOW™ Compact	9.17.157
	Instruction Manual FLOW-BUS interface	9.17.024
	Instruction Manual Modbus interface	9.17.035
	Instruction Manual RS-232 interface*	9.17.027
Technical documentation	Datasheet (technical specifications)	
	Hook-up diagram Modbus RTU / FLOW-BUS	9.16.275
	Dimensional drawing	7.15.225
Compliance	EU Declaration of Conformity FLEXI-FLOW™	9.06.132
	EU Declaration of Conformity RoHS	9.06.124
	Manufacturer Declaration REACH	9.06.056
	Manufacturer Declaration WEEE	9.06.128
	Conflict Minerals Compliance Policy	9.06.065

*) Note that the FLEXI-FLOW™ has no RS-232 communication interface. In this context, the reference to this manual is only to provide information about the ProPar protocol.

1.6 Safety notes

Please read this document entirely and carefully before installing and operating the product. Not following the guidelines could result in personal injury and damage to the product and the system(s) it is incorporated in or connected with.

- *The product(s) described in this document may only be handled by qualified personnel who are familiar with combined fluid and electrical systems and who recognize the associated hazards (e.g. (high) fluid pressure, electric shock).*
- *The user is responsible for taking the necessary safety measures to prevent damage and/or injury while working with the equipment and process media (as described in the associated Material Safety Data Sheets).*
- *Where appropriate, this document recommends or prescribes safety measures to be taken with respect to media or equipment usage under the specified conditions. However, this does not relieve the user of aforementioned responsibility, not even if such is not explicitly recommended or prescribed in this document.*
- *The equipment and its accessories must be used in accordance with their specifications and intended use.*
- *The customer is responsible for conducting a risk analysis for the entire system and take the required safety precautions following applicable laws and regulations. Based on the risk analysis, the customer should describe and adhere to standard operating procedures to ensure safe use of the equipment.*
- *Individual instruments may not be disassembled or modified in any way or for any purpose.*
- *Any unauthorized modification, for any purpose whatsoever, will be considered as unintended and improper use[7] , will void warranty and cancel the manufacturer's liability.*
- *Unauthorized modifications can undo safety features, compromise system specifications (such as ingress protection rating) and cause failure to comply with applicable laws, regulations and directives.*
- *If the product is defective or otherwise does not meet your requirements, please contact your Bronkhorst representative for assistance or advice.*

Product related safety warnings

Before operating the FLEXI-FLOW™, make sure that the equipment has been installed and configured by an authorized engineer and that the installation is approved for use.

To ensure and maintain a safe working area, regularly inspect electrical and fluid lines and connections:
- *Prior to each use, check cabling for proper connection, damage and wear. If necessary, replace cables and/or connectors.*
- *Before, during and after operation, check fluid lines and connections for leaks, damage and wear. Re-tighten fluid connections as necessary, replace connectors as needed.*

During operation, fluid connections may not be loosened or disconnected under any circumstances.

When pressurizing, prevent pressure shocks by gradually bringing the fluid system to the required operating pressure.

Bronkhorst does the utmost to ensure that you receive a clean product. This does not, however, relieve the user of the responsibility to ensure that the equipment and the system in which it is incorporated meet the requirements implied by the intended use of the product. The responsibility for cleaning the equipment to meet such requirements lies exclusively with the user.

- *Depending on the properties of the process medium and the (expected) time until the next use, it is advisable to flush the fluid system with a suitable (cleaning) fluid after use.*
- *If the equipment has been used to process corrosive, reactive or hazardous media (e.g. toxic or flammable), cleaning the fluid system is imperative before it is exposed to air.*
- *If the equipment is not used for an extended period, the fluid system should be dry after use and after cleaning. If not, it should be purged with a dry, inert gas for a minimum period of 30 minutes.*

- *Prior to powering down the FLEXI-FLOW™, the fluid system should be depressurized.*
- *When depressurizing, prevent pressure shocks by shutting off the fluid supply gradually.*

Inexpertly servicing instruments can lead to serious personal injury and/or damage to the instrument or the system it is used in. Servicing must therefore be performed by trained and qualified personnel. Contact your Bronkhorst representative for information about cleaning and calibration. Bronkhorst has trained staff available.

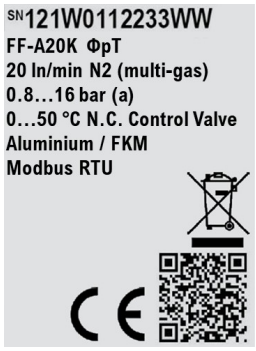
- *Before disconnecting or disassembling any fluid system related parts, always make sure the fluid system is depressurized to atmospheric pressure.*
- *When depressurizing, prevent sudden pressure changes by shutting off the fluid supply gradually.*

2 Installation

2.1 Product specifications

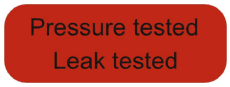
Before installing the FLEXI-FLOW™, check that the functional and technical properties of the product match your requirements (the image on the right is an example; it does not necessarily reflect the actual specifications of your instrument).

If you have a question about the product or if you find the product does not meet the specifications as ordered, do not hesitate to contact your Bronkhorst representative (see the first pages of this document for contact information).



2.1.1 Pressure rating

A red label signifies that the FLEXI-FLOW™ has undergone a pressure test and a test for outboard leakage.



- *If the red label is missing, the device must not be used and should be returned to the factory.*
- *Before installation, make sure that the pressure rating is within the limits of the normal process conditions of your application.*

2.1.2 Bluetooth certification

Connectivity

Bluetooth version	5.2
Frequency range	2402…2480 MHz
Transmitter power	max. +6 dBm
Range	max. 75 m

FCC (USA): YCP-STM32WB5M001

Note: This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

ISED (Canada): 8976A-STM32WB5M01

Notes: This device contains licence-exempt transmitter(s)/receiver(s) that comply with Innovation, Science and Economic Development Canada's licence-exempt RSS(s). Operation is subject to the following two conditions:

1. This device may not cause interference.
2. This device must accept any interference, including interference that may cause undesired operation of the device.

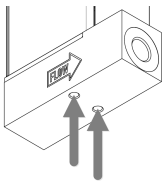
JRF (Japan): 005-102490

NCC (Taiwan): CCAN20LP0740T3

2.2 Mounting

For optimal performance, observe the following guidelines:

- *Avoid installation in close proximity of mechanical vibration and/or heat sources.*
- *Use the equipment in an environment with a stable ambient pressure and temperature.*
- *For stable fixation to a rigid and stable surface or construction, use the threaded mounting holes in the bottom of the instrument base. Consult the dimensional drawing 9 for the exact size and locations.*



2.2.1 Piping requirements

- *For reliable performance, make sure the fluid stream is uncontaminated. If necessary, use an inlet filter to ensure a particle free media stream. Select a filter with a maximum pore size of 20 µm and a surface area that minimizes the pressure drop.*
- *If back flow could occur, the use of a check valve is also recommended.*

Use piping or tubing that is suitable for the operating conditions of the application (media, maximum temperature, maximum operating pressure).

2.2.2 Fluid connection

- If applicable: install the fluid connections according to the manufacturer's instructions.
- Connect the FLEXI-FLOW™ to the fluid system in accordance with the product overview 7 .
- Tighten fluid connections according to the instructions of the manufacturer of the fittings.
- Make sure connector sizes match; do not mix metric (mm) and imperial (inch) sizes.
- Make sure all connectors and tubing are free from dirt and debris.

Do not apply fluid pressure until all required fluid connections and electrical connections have been made.

Check the fluid system for leak tightness after any modification and before applying full operating pressure, especially when using hazardous media (e.g. toxic or flammable).

2.2.3 Preventing pressure shocks

FLEXI-FLOW™ instruments can handle pressure shocks in the system well, but are not insensitive to pressure fluctuations. For optimal control stability, observe the following guidelines:

- *Provide a stable (pressure controlled) upstream pressure; put sufficient buffer volume between a pressure regulator and the instrument. As a rule of thumb, install pressure regulators at a distance of at least 25 times the pipe diameter from the inlet or outlet of the instrument.*
- *When using multiple instruments and/or control valves, prevent interference by putting piping with sufficient buffer volume between components.*

2.3 Electrical connection

- Electrical connections should be made according to the hook-up diagram 9 , using the supplied cables (insofar as included) or compatible, with respect to required supply current, voltage loss, cable length, cable and gland diameters and operating conditions.
- When using self-assembled cables, follow the guidelines provided by the connectors' manufacturer.
- For use in a fieldbus system, follow the instructions of the cable supplier for the according fieldbus system.
- Make sure that the power supply matches the power rating of the instrument (see technical specifications 9) and that double or reinforced insulation is used for the power supply.
- If a surge protection device is used, make sure its specifications match the power consumption of the application.

To prevent damage as a result of reversed polarity, the use of a 2A fuse in the direct +Us line is recommended.

Always turn off electrical power before connecting or disconnecting equipment electrically.

In order to be able to comply with all applicable guidelines and regulations, it is essential that electrical connections be made by or under supervision of a qualified electrician.

- *The equipment described in this document contains electronic components that are susceptible to **electrostatic discharge**.*
- *When working on the electrical installation, take appropriate measures to prevent damage as a result of electrostatic discharge.*

*The **CE mark** on the equipment indicates that it complies with requirements imposed by the European Union, including **electromagnetic compatibility (EMC)**.*

EMC can only be guaranteed by applying appropriate cables and connectors or gland assemblies:
- *Cable wire diameters must be sufficient to carry the supply current and minimize voltage loss.*
- *When connecting the product to other devices, ensure that the integrity of the shielding remains uncompromised; use shielded cables and connectors where possible and/or required.*
- *Preferably use the supplied cables (if applicable) to make electrical (signal) connections to and between the supplied components. These cables are shielded, have the required wire diameter, and loose ends (if applicable) are marked to facilitate correct connection.*

If not all requirements for proper shielding can be met (for example, because a component is not equipped with shielded connectors), take the following measures to ensure the best possible shielding:
- *Keep cable lengths at a minimum.*
- *Route cables as closely as possible alongside metal structures or components.*
- *Ensure all electrical components are grounded to earth.*

When in doubt about the shielding of your cabling and/or electrical connections, contact your Bronkhorst representative.

2.4 Fieldbus connection

The power connector also provides the selected fieldbus interface (FLOW-BUS or Modbus RTU).

Always check the total power consumption of your instruments before connecting them to a fieldbus system. Do not exceed the maximum power of the power supply unit.

- *For fieldbus related wiring details, consult the according hook-up diagram* 9 .
- *For information about setting up a fieldbus network with Bronkhorst® instruments, consult the according fieldbus manual* 9 .
- *If you need assistance with setting up a fieldbus network, contactyour Bronkhorst representative for information.*

3 Operation

3.1 General procedures

Before operating the FLEXI-FLOW™, make sure that the equipment has been installed and configured by an authorized engineer and that the installation is approved for use.

To ensure and maintain a safe working area, regularly inspect electrical and fluid lines and connections:
- *Prior to each use, check cabling for proper connection, damage and wear. If necessary, replace cables and/or connectors.*
- *Before, during and after operation, check fluid lines and connections for leaks, damage and wear. Re-tighten fluid connections as necessary, replace connectors as needed.*

During operation, fluid connections may not be loosened or disconnected under any circumstances.

Gas condensation in the instrument can seriously affect its performance and reliability.
- *If possible, ensure that the ambient temperature is stable and at least equal to the temperature of the process gas.*
- *Always use a clean and dry process gas (preferably with a purity of at least 99.5 %).*

3.1.1 Powering up

To maintain control of the fluid system and ensure a safe situation, it is recommended to turn on power before applying fluid pressure and to switch off power only after the fluid system is depressurized.

When pressurizing, prevent pressure shocks by gradually bringing the fluid system to the required operating pressure.

- When powering up, the instrument needs a couple of seconds to start up the electronics and perform a self-test.
- During initialization, the indication light cycles through all NAMUR status colors[8] .
- After successful initialization, the indication light lights up green to indicate that the instrument is ready to be used.

3.1.2 First use

Bronkhorst does the utmost to ensure that you receive a clean product. This does not, however, relieve the user of the responsibility to ensure that the equipment and the system in which it is incorporated meet the requirements implied by the intended use of the product. The responsibility for cleaning the equipment to meet such requirements lies exclusively with the user.

3.1.3 After use

- *Depending on the properties of the process medium and the (expected) time until the next use, it is advisable to flush the fluid system with a suitable (cleaning) fluid after use.*
- *If the equipment has been used to process corrosive, reactive or hazardous media (e.g. toxic or flammable), cleaning the fluid system is imperative before it is exposed to air.*
- *If the equipment is not used for an extended period, the fluid system should be dry after use and after cleaning. If not, it should be purged with a dry, inert gas for a minimum period of 30 minutes.*

3.1.4 Powering down

- *Prior to powering down the FLEXI-FLOW™, the fluid system should be depressurized.*
- *When depressurizing, prevent pressure shocks by shutting off the fluid supply gradually.*

3.1.5 Instrument status

The status indication light[7] uses different colors to reflect the current status of the instrument:

Green	Normal operation
Red	Failure
Yellow	Out of specification
Blue	Maintenance required
Orange	Check function

- The colors are based on the NAMUR NE 107 standard and are a simplified representation of the instrument's diagnostic data[20].
- After powering up or restarting the instrument, the indication light cycles through all status colors once.
- After the startup cycle, the indication lights assumes the color associated with the current instrument status.

Bluetooth
- When Bluetooth is active, the indication light flashes blue once every 3 seconds.
- If the instrument has a Bluetooth connection, the indication light flashes blue twice every 3 seconds.
- Bluetooth communication is not reflected by the indication light.
- Bluetooth indications are not related to the blue NAMUR indication.

Zeroing
- During zero point adjustment[18], the indication light blinks blue (1 second on, 1 second off).
- The zeroing indication is not related to the blue NAMUR indication.

3.2 Special procedures

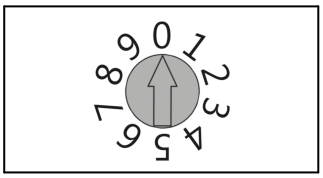
3.2.1 Changing communication settings

Communication interface (power and signal connector)
- Unless specified otherwise at ordering time, the power and signal connector is configured for Modbus RTU communication upon delivery.
- If necessary, use the support interface or a Bluetooth wireless connection to change the communication settings.
- Because selection of the active communication interface is effective immediately, communication will be cut off if the selected interface is changed while communicating through the power and signal connector.
- Preferably use FlowSuite to select the required communication interface and associated parameters (fieldbus address, baud rate, parity).
- Alternatively, use a ProPar-enabled software tool like FlowDDE (support interface only).
- See parameter section Network configuration[30] for digital parameter settings and default values.

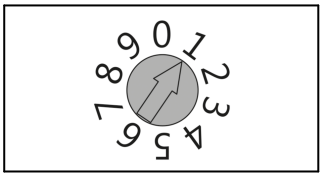
- *A USB connection on the support interface provides sufficient power for instrument configuration only.*
- *Configuration using a Bluetooth wireless connection requires powering the instrument through the power connector or support interface.*

Manual address selection
Assuming the default baud rate and parity match the fieldbus configuration, the fieldbus address can be quickly set using the manual address selector[7] :

- With value 0, the instrument uses the digital address setting



- Values from 1 to 9 override the digital setting



3.2.2 Fluid selection

Fluid sets or mixtures can be stored using FlowSuite or by direct digital communication (e.g. using a custom-built (PLC) program). To define a fluid set or mixture, only the formula of the required gas needs to be entered in the appropriate parameter. The associated conversion parameters are filled in automatically.

Whether carried out in FlowSuite or with direct digital communication, fluid and mixture definition are virtually identical:

To define a fluid set:
1. Select the required *Fluid Set Index*.
2. Enter the formula of the required gas into parameter *Fluid Name* (case-sensitive).

To define a mix component:
1. Select the required *Fluid Set Index*.
2. Select the required *Mix Component Index*.
3. Enter the formula of the required gas into parameter *Mix Component Fluid Name* (case-sensitive).

The following gases can be selected:

Name	Formula
Acetylene	C2H2
Air	Air
Allene	C3H4 #1
Argon	Ar
Carbon dioxide	CO2
Carbon monoxide	CO
Cyclopropane	C3H6 #1
Deuterium	D2 #1
Ethane	C2H6
Ethylene	C2H4
Helium	He
Hydrogen	H2
Krypton	Kr
Methane	CH4
Neon	Ne
Nitrogen	N2
Nitrous oxide	N2O
Oxygen	O2
Perfluoropropane	C3F8
Propane	C3H8
Propylene	C3H6 #2
Propyne	C3H4 #2

- *Note that the FLUIDAT® algorithm is case-sensitive regarding fluid names.*
- *If you need definitions for other gases, contact your Bronkhorst representative.*
- *Also see parameter section Fluid set 31 for a complete reference of all digital fluid set parameters.*

3.2.3 Switching control function

Bronkhorst® software automatically adds additional communication channels to the array as regular instruments.

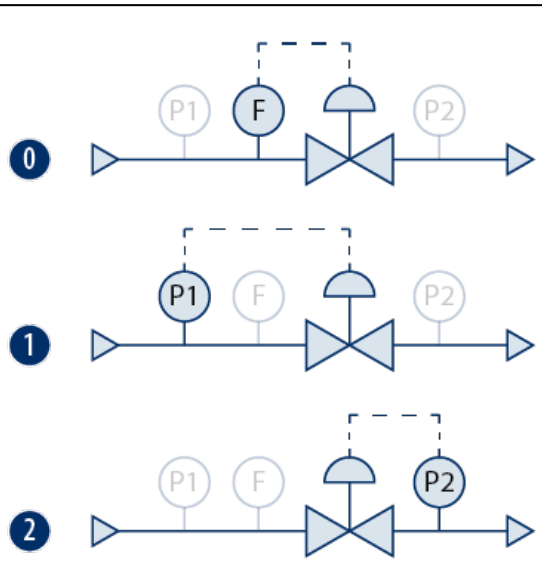
Control functions

The multi-parameter functionality enables simultaneous measurement of flow, upstream pressure and downstream pressure, using 3 different communication channels. The selected control function determines whether the instrument uses 1 or 2 communication channels/sensors for measurement and control.

Single channel control

Using the single channel control functionality, only a single sensor is used:

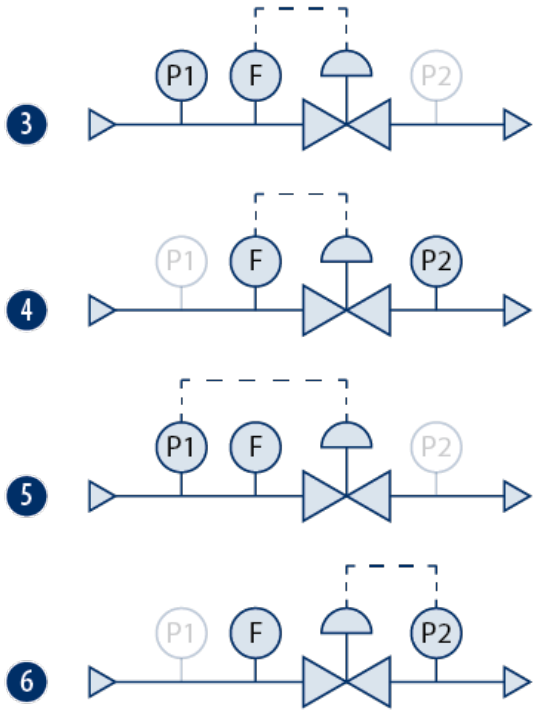
Control Function param.	Communication channel	Instrument function
0	F	Flow control
1	P1	Upstream pressure control
2	P2	Downstream pressure control



Dual channel control

Using the dual channel control functionality, a combination of the flow sensor and 1 of the pressure sensors is used, where either the flow is controlled and the pressure is limited, or vice-versa:

Control Function param.	Communication channel	Instrument function
3	F + P1	Flow control, with upstream pressure limit
4	F + P2	Flow control, with downstream pressure limit
5	P1 + F	Upstream pressure control, with flow limit
6	P2 + F	Downstream pressure control, with flow limit



Switching the control function

- Use parameter *Control Function* 25 to set the instrument function.
- Give a setpoint to the controlled value.
- If dual channel control is selected: give a limit to the limited value, using the setpoint parameter of that communication channel.
- See section Multi-parameter addressing 41 for available parameters.

3.2.4 Bluetooth configuration

- The FLEXI-FLOW™ Compact is delivered with Bluetooth disabled.
- Bluetooth can be enabled using FlowSuite.
- When pairing, the instrument can be recognized by its serial number.
- The first time the instrument is paired with FlowSuite, a six-digit passkey must be created.
- Subsequently, the instrument can only be paired by entering the passkey that is stored in the instrument.

- *After pairing the instrument, Bluetooth can also be enabled or disabled by using digital communication. See parameter section Bluetooth 36 for the according parameters.*
- *Configuration using a Bluetooth wireless connection requires powering the instrument through the power connector or support interface.*

3.2.5 Adjusting zero point

Zero-stability

The zero point of a Bronkhorst® flow meter/controller (the measurement signal that indicates the absence of a flow) is factory adjusted at approximately 20 °C and atmospheric pressure (ambient conditions), with the instrument positioned upright. Under normal circumstances (i.e. at stable process conditions), the zero point will remain stable. However, over time several factors can induce a slight deviation of the measured value from the zero point, causing the instrument to detect a flow when in reality there is none. Readjusting the zero point eliminates this deviation.

- *After installation or relocation, always check the zero point.*
- *If the instrument still detects a (steady) flow while all valves are closed and the fluid system is leak tight, adjusting the zero point is recommended.*

Prerequisites

Zeroing an instrument requires that:

- the ambient conditions (temperature, pressure) match those of the operating environment of the instrument.
- the instrument is filled homogeneously and pressurized with the operational media, according to the typical process conditions.
- the instrument has been warmed up sufficiently.
- there is absolutely no flow through the instrument; preferably, this is achieved by closing a valve immediately after the outlet of the instrument (control valve, shut-off valve).

Blocking the flow through the instrument is essential; zeroing an instrument while there is still a flow will lead to measurement errors.

Procedure

FlowSuite provides a quick and easy way to adjust the zero point of an instrument; the Autozero *function automatically performs the procedure described here.*

To adjust the zero point using digital communication, set parameter values in the following sequence (see section Parameters 23 for more information about instrument parameters):

Sequence #	Parameter	Value	Action
1	Setpoint or fSetpoint	0	stop flow
2	Init Reset	64	unlock secured parameters
3	Control Mode	9	enable calibration mode
4	Calibration Mode	0	reset calibration mode
5	Calibration Mode	9	start zeroing

The status indication light[7] starts blinking blue (1 second on, 1 second off), indicating that the procedure is in progress. On completion, the indication light assumes the color of the current instrument status[8] .

If the procedure is successful, parameter *Calibration Mode* changes to 0 (idle). If the procedure fails, *Calibration Mode* changes to 255.

After zeroing, parameter *Control Mode* returns to its initial value. The output signal should be 0 % (parameter *Measure* = 0).

After performing the procedure, remember to set parameter Init Reset *to value 82 to lock secured parameters.*

3.3 Maintenance

Inexpertly servicing instruments can lead to serious personal injury and/or damage to the instrument or the system it is used in. Servicing must therefore be performed by trained and qualified personnel. Contact your Bronkhorst representative for information about cleaning and calibration. Bronkhorst has trained staff available.

The FLEXI-FLOW™ needs no regular maintenance if operated properly, with clean, non-corrosive media, compatible with the wetted materials, avoiding pressure and thermal shocks and vibrations.

- *Before disconnecting or disassembling any fluid system related parts, always make sure the fluid system is depressurized to atmospheric pressure.*
- *When depressurizing, prevent sudden pressure changes by shutting off the fluid supply gradually.*

3.3.1 Cleaning

Fluid path

- The instrument's fluid path (the wetted parts) may be purged with a clean, dry and inert gas.
- In case of severe contamination, cleaning the wetted parts may be necessary. This requires the instrument to be returned to the factory.

Exterior parts

Exterior parts can be cleaned with a soft, lint free cloth, preferably dry, or, if necessary, moistened with a mild water soluble cleaning agent.

- *Moisten the cloth only slightly, to prevent liquid penetrating the interior and causing damage to the electrical parts.*
- *Only use a water soluble cleaning agent, never an oil based liquid like paint thinner or white spirit, as these might damage parts made of synthetic materials.*

3.3.2 Calibration

The FLEXI-FLOW™ has been factory calibrated. Periodical inspection, recalibration or verification of the accuracy may be subject to individual requirements of the user. Whenever necessary, contact your Bronkhorst representative for information and/or making arrangements for recalibration.

Bronkhorst certifies that the instrument meets the rated accuracy. Calibration has been performed using measurement standards traceable to the Dutch Metrology Institute (VSL).

3.4 Troubleshooting

General problems

- *Electronic problems can be traced by restarting the equipment.*
- *If the equipment starts up normally, the measurement and control behavior can be checked by applying fluid pressure.*
- *To track down problems in the fluid system, depressurize the fluid system and disconnect the suspected unit from the process line. Dirt or clogging might be quickly detected by visual inspection of disassembled fluid connections.*

If you suspect leakage, do not disassemble the device for inspection, but contact your Bronkhorst representative for service or repairs.

3.4.1 Zooming in on NAMUR status

Errors and warnings

- *Detailed error and warning information can be found by connecting the instrument to a Windows computer running FlowSuite. FlowSuite's diagnostic function makes comprehensive diagnostic information accessible based on the NAMUR status* 14.
- *The built-in diagnostic instrument parameters* 38 *which FlowSuite uses for this purpose are also available through the digital communication interface.*

3.4.2 Default valve state

When a controlling instrument is not powered or cannot communicate with the fieldbus network (if applicable), all electrical valves operated by the instrument (whether integrated or external) automatically return to their default state. The default state is closed for 'normally closed' valves (n/c) and fully open for 'normally open' valves (n/o).

Check the serial number label or the technical specifications 9 to see which valve type is used on your instrument (if applicable).

3.4.3 Common issues

Symptom	Possible cause	Corrective action
No communication	No power supply	• Check power supply • Check cable connection • Check cable hook-up
	Invalid node address	Change node address (see Changing communication settings 15)
	Invalid baud rate	Make sure instrument baud rate matches master/application baud rate
	Other	Reset instrument and/or restart master. If problem persists, contact your Bronkhorst representative
No output signal	No power supply	• Check power supply • Check cable connection • Check cable hook-up
	Invalid control mode (instrument accepts no setpoint)	Check control mode (see Special parameters 39)
	Valve(s) in default state (normally closed)	Check if connected valves are in default state; solve cause if necessary (see Default valve state 20)
	Upstream pressure or differential pressure too low	Increase upstream pressure
	Piping, filters and/or control valve clogged or blocked	Clean fluid system (flush with clean, dry air)
	Sensor failure	Contact your Bronkhorst representative

Symptom	Possible cause	Corrective action
Control behavior unstable	Measurement disturbed by vibrations	• If possible, avoid installation in close proximity of mechanical vibration • Reduce sensitivity to vibrations by using a mass block, shock absorbers, and flexible tubing
	Upstream pressure unstable	Install pressure regulator or increase buffer volume between controlling instruments
	Upstream and/or downstream pressure too high or too low	Adjust pressure and/or set instrument pressure in accordance with actual process pressure
	Wrong process gas selected	Select correct process gas
	Wrong controller settings	Adjust settings (e.g. with FlowSuite)
	Control valve damaged	Contact your Bronkhorst representative
No flow (sending a setpoint has no effect)	No fluid supply	Check upstream components for obstruction, e.g.: • fluid lines • valves • filters
	Wrong control mode selected	• Check parameter Control mode 40 • Make sure instrument accepts setpoint from actual setpoint source (bus)
	Valve(s) in default state (normally closed)	Check if valves are in default state; solve cause if necessary (see Default valve state 20)
	Upstream pressure or differential pressure out of bounds	Set upstream pressure to a value within specifications
Flow rate never reaches setpoint	• Fluid system clogged or blocked • Sensor obstructed or contaminated	Flush fluid system with clean, dry air or non-aggressive cleaning liquid (e.g. ethanol or isopropyl alcohol)
	Upstream pressure too low	Increase upstream pressure (to a value within specifications)
	Downstream pressure too high	Decrease downstream pressure (to a value within specifications)
	Differential pressure too low	Make sure differential pressure is within specifications
	Process outlet blocked	Check process outlet and downstream piping
	Process gas condensation	Decrease upstream pressure or increase gas temperature
	Supplied fluid type does not match selected fluid type	Supply equipment with other fluid or change fluid type in instrument configuration
Pressure signal gradually decreasing without setpoint change	Process gas condensation	Decrease upstream pressure or increase gas temperature
Measured value or output signal indicates flow, while there should be none	Fluid system leakage	• Check fluid system for leakage • Follow mounting instructions when installing third party components (e.g. adapters, tubing, valves)
	Zero point adjustment performed incorrectly	Readjust zero point, following instructions in Adjusting zero point 18

Symptom	Possible cause	Corrective action
Continuous maximum measured value or output signal	Upstream pressure too high	Check upstream pressure
	Valve fully open	• Close valve • In case of normally open valve: check if valve is in default state; resolve cause if necessary (see Default valve state 20)
	Sensor failure	Contact your Bronkhorst representative
Fluid system leakage	Bad connection between parts (e.g. ferrules, nuts, tubing, piping, valves)	Follow mounting instructions issued by third party components (e.g. adapters, tubing, valves)

3.5 Returns

3.5.1 Removal and return instructions

When returning materials, always clearly describe the problem, and, if possible, the work to be done, in a covering letter.

Instrument handling:

1. Purge all fluid lines (if applicable)
2. If the instrument has been used with toxic or otherwise hazardous fluids, it must be cleaned before shipping
3. Disconnect all external cabling and tubing and remove the instrument from the process line
4. If applicable, secure movable parts with appropriate transport safety materials, to prevent damage during transportation
5. The instrument must be at ambient temperature before packaging
6. Insert the instrument into a plastic bag and seal the bag
7. Place the bag in an appropriate shipping container; if possible, use the original packaging box

Add documentation:

- Reason of return
- Failure symptoms
- Contaminated condition
- Declaration on decontamination

It is absolutely required to notify the factory if toxic or dangerous fluids have been in contact with the device!
This is to enable the factory to take sufficient precautionary measures to safeguard the staff in their repair department.

All instruments must be dispatched with a completely filled in 'Declaration on decontamination'. Instruments without this declaration will not be accepted.

*A safety information document containing a 'Declaration on decontamination' form (document no 9.17.032) can be downloaded from the **Service & Support** section of the Bronkhorst website (**www.bronkhorst.com**).*

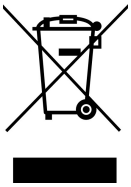
Important:
Clearly note, on top of the package, the customs clearance number of Bronkhorst High-Tech B.V.:

NL801989978B01

(only if applicable, otherwise contact your Bronkhorst representative for local arrangements.)

3.5.2 Disposal (end of lifetime)

If you are a customer within the European Union and wish to dispose of Bronkhorst® equipment bearing the symbol of a crossed out waste disposal bin, you can return it in accordance with the removal and return instructions 22 . Bronkhorst will then take care of proper dismantling, recycling and/or reuse (wherever possible). In the covering letter, mention that you are returning the product for disposal.



In countries outside the EU, disposal of electrical and electronic equipment (EEE) may be subject to local or national directives and/or legislation. If applicable, consult local or national authorities to learn how to handle EEE properly in your area.

4 Communication interface

4.1 Fieldbus communication

Not all parameters described in this document are necessarily available with all digital interface types. For information about parameter access and availability for Bronkhorst® instruments in a specific fieldbus network, consult the according fieldbus manual[9] .

The power connector is equipped with a FLOW-BUS or Modbus RTU communication interface as ordered (see hook-up diagram[9]).

FLOW-BUS

Digital Bronkhorst® instruments can be monitored and operated using the free **FlowWare** software tools for Windows. These tools provide a graphical interface to the ProPar[24] protocol (used by FLOW-BUS), for monitoring and editing parameter values.

The FlowWare toolkit provides functionality for monitoring and operating digital instruments (FlowSuite, FlowPlot) and selection of the active fluid and configuration of the fieldbus connection (if applicable). For instruments that support the definition and use of multiple fluids, FlowTune™ can be used to define and store fluids in the instrument and select the active fluid.

Digital instrument parameters are made accessible by **FlowDDE**, a Dynamic Data Exchange server (DDE) that handles communication between the instrument and (dedicated) client software in Windows (e.g. FlowPlot). FlowDDE can also be used by other client applications, such as Microsoft Office or custom made software, built with third party development software like LabVIEW or a SCADA platform.

The FlowWare tools and associated documentation can be downloaded from the product pages on the Bronkhorst website: ***www.bronkhorst.com/flexi-flow***

Modbus

In a Modbus system instruments can be monitored and operated using third party software as a master device, such as LabVIEW, ModScan, or a Modbus PLC.

4.2 Bluetooth or support interface?

A Bluetooth connection and the support interface can both be used to configure and monitor the instrument. Apart from your own preference, the choice depends on the available power supply facilities and the software to be used.

Support interface

- A regular USB connection provides sufficient power for instrument pre-configuration.
- During operation, the USB connection can be used to change the configuration or monitor the instrument, while powered through the main power connector.

Bluetooth

- A Bluetooth connection requires the instrument to be powered through the main power connector or the support interface.
- Configuration, monitoring can then be carried out without disconnecting the instrument form the main power connector or fieldbus interface.
- By default, the Bluetooth connection is turned off. To activate the Bluetooth connection, see Bluetooth[36] .

Software tools

- Configuration is best done using FlowSuite. FlowSuite works through the support interface as well as through a Bluetooth connection.
- Alternatively, use a ProPar-enabled software tool like FlowDDE. This requires a physical connection between the instrument and the Windows computer the program runs on.

4.3 Parameters

A summary of all digital parameters in this section can be found in the back of this manual.

This section describes the most commonly used parameters for digital operation of the FLEXI-FLOW™. Descriptions are grouped by category in tables as shown below:

Type	Access	Range	FlowDDE	FLOW-BUS	Modbus
[type]	RW 🔑	[x]…[y]	[DDE par]	[Pro]/[Par]	[address]/[register]

In this manual, parameter names are printed in italics (reverted to normal *where embedded in italics, like in this tip).*

Type
Unsigned char 1 byte unsigned integer (0…255)
Unsigned int 2 byte unsigned integer, MSB first (0…65535)
Unsigned long 4 byte unsigned integer, MSB first (0…4294967295)
Float 4 byte floating point, IEEE 32-bit single precision, MSB first
Unsigned char [x] x byte text string

Access
R Parameter value can be read
W Parameter value can be written
🔑 Parameter is secured and only accepts values if parameter *Init Reset* is set to 'unlocked' first

Range
Some parameters only accept values within a certain range:
[x] Minimum value
[y] Maximum value

FlowDDE
Parameter number within FlowDDE

FLOW-BUS
FLOW-BUS uses the ProPar protocol, where parameters are identified by a unique combination of a process number and a parameter number.

- *For more information about setting up a FLOW-BUS network with Bronkhorst® instruments, consult the FLOW-BUS manual (see Documentation[9]).*
- *For more information about the ProPar protocol, consult the RS-232 manual (see Documentation[9]).*

Modbus
In the Modbus protocol, parameters are accessed by specifying their unique decimal register number or corresponding PDU address (Protocol Data Unit). The PDU address is the hexadecimal translation of the register number minus 1, e.g. register number 1 corresponds to PDU address 0x0000, register number 11 corresponds to PDU address 0x000A:
[address] Hexadecimal PDU address
[register] Decimal register number

Modbus address blocks are two bytes big. Larger data types use up to 8 subsequent address blocks, resulting in a maximum variable length of 16 bytes. Values longer than the maximum length are truncated.

For more detailed information about setting up a Modbus network with Bronkhorst® instruments, consult the Modbus manual (see Documentation[9]).

4.3.1 Measurement and control

Fmeasure

Type	Access	Range	FlowDDE	FLOW-BUS	Modbus
Float	R	-3.4E+38… 3.4E+38	205	33/0	0xA100…0xA101/ 41217…41218

This parameter represents the value of parameter *Measure*, expressed in the selected *Capacity Unit*. Its value is calculated from the dimensionless value of *Measure*, using the fluid set parameters *Capacity 100%* and *Capacity Unit*.

Fsetpoint

Type	Access	Range	FlowDDE	FLOW-BUS	Modbus
Float	RW	0…3.4E+38	206	33/3	0xA118…0xA119/ 41241…41242

This parameter represents the value of parameter *Setpoint*, expressed in the selected *Capacity Unit*. Conversion between *Fsetpoint* and the dimensionless value of *Setpoint* uses fluid set parameters *Capacity 100%* and *Capacity Unit*.

Control Function

Type	Access	Range	FlowDDE	FLOW-BUS	Modbus
Unsigned char	RW	0…6	432	115/10	0x0E6A/3691

- This parameter determines whether the instrument works as a flow controller or a pressure controller.
- Use the setpoint on the associated communication channel to control the flow or pressure (see section Multi-parameter addressing 41).
- The selected function is effective immediately.
- The instrument remembers the selected value on restart (persistent setting).

Available functions:

Value	Description
0	Flow
1	Upstream pressure
2	Downstream pressure
3	Flow with upstream pressure limit
4	Flow with downstream pressure limit
5	Upstream pressure with flow limit
6	Downstream pressure with flow limit

Measure

Type	Access	Range	FlowDDE	FLOW-BUS	Modbus
Unsigned int	R	0…41942	8	1/0	0x0020/33

This parameter returns a dimensionless representation of the measured flow rate or pressure. Value 32000 corresponds to 100 %, the maximum value corresponds to 131.07 %.

Setpoint

Type	Access	Range	FlowDDE	FLOW-BUS	Modbus
Unsigned int	RW	0…32000	9	1/1	0x0021/34

The value of this parameter is a dimensionless representation of the required flow rate or pressure. Value 32000 corresponds to 100 %.

Temperature

Type	Access	Range	FlowDDE	FLOW-BUS	Modbus
Float	R	-250…500	142	33/7	0xA138…0xA139/41273…41274

This parameter returns the internal temperature in the instrument housing in °C, which is an approximation of the actual media temperature.

4.3.1.1 Advanced measurement and control

Setpoint Slope

Type	Access	Range	FlowDDE	FLOW-BUS	Modbus
Unsigned int	RW	0…30000	10	1/2	0x0022/35

The value of this parameter represents the time it would take to adjust the setpoint if it were changed from 0 to 100%. This feature can be used to smooth 'nervous' controller behavior, e.g. to reduce setpoint overshoot or undershoot.
The supported range corresponds to 0…3000 seconds. Default value = 0.

Example:
If *Setpoint Slope* = 100 it will take 10 seconds to adjust the setpoint if it is changed from 0 to 100%. A setpoint change of 20% will take (20%/100%)*10 seconds = 2 seconds.

Valve Output

Type	Access	Range	FlowDDE	FLOW-BUS	Modbus
Unsigned long	RW	0… 16777215	55	114/1	0xF208…0xF209/61961…61962

This parameter represents the controller output signal for control valve operation.

4.3.2 Alarms

Alarm settings are most easily accessible using FlowSuite, FlowPlot or FlowView or a Bronkhorst® readout and control unit.

The built-in alarm functionality can be used to handle different alarm types:
- system errors and warnings
- min/max alarms
- response alarms
- batch alarms
- master/slave alarms

The alarm type can be set with parameter *Alarm Mode*. When an alarm is activated, the type can be read out using parameter *Alarm Info*. An automatic setpoint change can be set using the parameters *Alarm Setpoint Mode* and *Alarm New Setpoint*. It is also possible to set an alarm delay, to prevent overreaction to small disturbances, using parameter *Alarm Delay Time*. The methods by which an alarm can be reset are controlled by *Reset Alarm Enable*.

Alarm Mode

Type	Access	Range	FlowDDE	FLOW-BUS	Modbus
Unsigned char	RW	0…3	118	97/3	0x0C23/3108

Available modes:

Value	Description
0	Alarm off
1	Alarm on absolute limits
2	Alarm on limits related to setpoint (response alarm)
3	Alarm at power-up(e.g. after power-down)

Alarm Info

Type	Access	Range	FlowDDE	FLOW-BUS	Modbus
Unsigned char	R	0…255	28	1/20	0x0034/53

This parameter provides information about the event type(s) that triggered an alarm situation. The value is a bitwise summation of the issued alarm types; convert the value to binary to see which types are issued. The following alarm types can be issued:

Bit	Value	Type	Description
0	1	Error	Error flag raised
1	2	Warning	Warning flag raised
2	4	Minimum alarm	*Measure < Alarm minimum limit*
3	8	Maximum alarm	*Measure > Alarm maximum limit*
4	16	Batch counter alarm	Batch counter reached its limit
5	32	• This bit only: Power-up alarm	Alarm possibly caused by a power dip
		• If combined with bit 2 or 3: Response alarm	Difference between *Measure* and *Setpoint* too big
6	64	Master/slave alarm	Setpoint out of limits (caused by *Slave factor*)
7	128	Hardware alarm	Hardware error

Alarm Delay Time

Type	Access	Range	FlowDDE	FLOW-BUS	Modbus
Unsigned char	RW	0…255	182	97/7	0x0C27/3112

This value represents the time in seconds the alarm action will be delayed when an alarm limit has been exceeded. This value also delays the alarm off action if an alarm limit is no longer exceeded.
Default value = 0.

Alarm Maximum Limit

Type	Access	Range	FlowDDE	FLOW-BUS	Modbus
Unsigned int	RW	0…32000	116	97/1	0x0C21/3106

Maximum limit for *Measure* to activate the maximum alarm situation (after *Alarm Delay Time*). Range 0…32000 represents 0… 100% signal. *Alarm Maximum Limit* must be greater than *Alarm Minimum Limit*.
Default value: 0.

Alarm Minimum Limit

Type	Access	Range	FlowDDE	FLOW-BUS	Modbus
Unsigned int	RW	0…32000	117	97/2	0x0C22/3107

Minimum limit for *Measure* to activate the minimum alarm situation (after *Alarm Delay Time*). Range 0…32000 represents 0… 100% signal. *Alarm Minimum Limit* must be smaller than *Alarm Maximum Limit*.
Default value: 0.

Alarm Setpoint Mode

Type	Access	Range	FlowDDE	FLOW-BUS	Modbus
Unsigned char	RW	0…1	120	97/5	0x0C25/3110

Specifies whether or not to change the setpoint after an alarm situation is activated.

Value	Description
0	No setpoint change (default)
1	Change setpoint to *Alarm new setpoint*

Alarm New Setpoint

Type	Access	Range	FlowDDE	FLOW-BUS	Modbus
Unsigned int	RW	0…32000	121	97/6	0x0C26/3111

New (safe) setpoint during an alarm until reset. Range 0…32000 represents 0…100% setpoint.
Default value: 0

Reset Alarm Enable

Type	Access	Range	FlowDDE	FLOW-BUS	Modbus
Unsigned char	RW	0…15	156	97/9	0x0C29/3114

Available reset methods. The value is a bitwise summation of the enabled methods; convert the value to binary to see which methods are enabled.
Default value: 15 (all bits/methods enabled)

The following methods are supported:

Bit	Value	Description
0	1	By hardware switch (if present)
1	2	Externally (obsolete)
2	4	By parameter *Reset*
3	8	Automatically (when alarm conditions no longer apply)

4.3.3 Counter

- *Counter settings are most easily accessible using FlowSuite, FlowPlot or FlowView or a Bronkhorst® readout and control unit.*
- *When the instrument is powered down, it remembers the state of the counter. If the counter is active when the instrument is powered down, it is activated when powered up and then continues to count from the value at the time of power down.*

Counter Mode

Type	Access	Range	FlowDDE	FLOW-BUS	Modbus
Unsigned char	RW	0…2	130	104/8	0x0D08/3337

Available modes:

Value	Description
0	Counter off (default)
1	Counting up continuously
2	Counting up until limit reached (set by *Counter Limit*)

Counter Unit

Type	Access	Range	FlowDDE	FLOW-BUS	Modbus
Unsigned char[4]	RW	see table below	128	104/7	0xE838…0xE839/59449…59450

This parameter contains the name of the counter readout unit.
Counter Unit supports the following values:

Mass	Normal volume (1.01325 bar(a), 0 °C)	Standard volume (1.01325 bar(a), 20 °C)	Custom volume (*Capacity Unit Pressure, Capacity Unit Type Temperature*)
ug, mg, g, kg	uln, mln, ln, mm3n, cm3n, dm3n, m3n	uls, mls, ls, mm3s, cm3s, dm3s, m3s	ul, ml, l, mm3, cm3, dm3, m3

Counter Value

Type	Access	Range	FlowDDE	FLOW-BUS	Modbus
Float	RW	0… 10000000	122	104/1	0xE808…0xE809/59401…59402

Current counter value in units selected with parameter *Counter Unit*.

Counter Limit

Type	Access	Range	FlowDDE	FLOW-BUS	Modbus
Float	RW	0…9999999	124	104/3	0xE818…0xE819/59417…59418

Counter limit/batch size in units selected with parameter *Counter Unit*.
Default value: 0.

Counter Setpoint Mode

Type	Access	Range	FlowDDE	FLOW-BUS	Modbus
Unsigned char	RW	0…1	126	104/5	0x0D05/3334

Specifies whether or not to change the setpoint after reaching the counter limit.

Value	Description
0	No setpoint change (default)
1	Change setpoint to *Counter new setpoint*

Counter New Setpoint

Type	Access	Range	FlowDDE	FLOW-BUS	Modbus
Unsigned int	RW	0…32000	127	104/6	0x0D06/3335

New (safe) setpoint when a counter limit is reached until reset. Range 0…32000 represents 0…100% setpoint.
Default value: 0

Reset Counter Enable

Type	Access	Range	FlowDDE	FLOW-BUS	Modbus
Unsigned char	RW	0…15	157	104/9	0x0D09/3338

Available reset methods. The value is a bitwise summation of the enabled reset methods; convert the value to binary to see which methods are enabled.
Default value: 7 (bits/methods 0, 1 and 2 enabled)

The following methods are supported:

Bit	Value	Description
0	1	By hardware switch (if present)
1	2	Externally (obsolete)
2	4	By parameter *Reset*
3	8	Automatically (e.g. when counter value is reset)

Totalizer Unit

Type	Access	Range	FlowDDE	FLOW-BUS	Modbus
Unsigned char[4]	RW	See parameter *Counter Unit*	394	104/18	0xE890…0xE891/59537…59538

This parameter contains the name of the totalizer readout unit.

Totalizer Value

Type	Access	Range	FlowDDE	FLOW-BUS	Modbus
Float	RW	0… 10000000	393	104/17	0xE888…0xE889/59529…59530

Current totalizer value in units as selected with parameter *Totalizer Unit*.

4.3.4 Network configuration

*Changes made to the network settings will **not** be restored by a factory reset.*

If the manual address selector[7] is set to a value other than 0, it overrides the digital address setting.

Fieldbus1 Selection

Type	Access	Range	FlowDDE	FLOW-BUS	Modbus
Unsigned char	RW	[0…2]	305	125/8	0x0FA8/4009

- Selected communication interface on the power and signal connector.
- Changing the selected communication interface is preferably done .
- Changes are effective immediately.
- Always set *Fieldbus 1 Selection* first before editing *Address*, *Baud Rate* or *Parity* parameters.
- Default value: 1

Available interfaces:

Value	Description
0	FLOW-BUS
1	Modbus RTU
2	ProPar

Fieldbus Interface Index

Type	Access	Range	FlowDDE	FLOW-BUS	Modbus
Unsigned char	RW	[0,5]	378	125/7	0x0FA7/4008

- Applicable communication interface (also see Bluetooth[36])
- Make sure the value is 0 before editing *Address*, *Baud Rate* or *Parity* parameters.
- Default value: 0

Available interfaces:

Value	Description
0	Fieldbus
5	Bluetooth

Fieldbus1 Address

Type	Access	Range	FlowDDE	FLOW-BUS	Modbus
Unsigned char	RW	0…255	199	125/10	0x0FAA/4011

Fieldbus1 Baud Rate

Type	Access	Range	FlowDDE	FLOW-BUS	Modbus
Unsigned long	RW	0…1.0E10	201	125/9	0xFD48…0xFD49/64841…64842

Fieldbus1 Parity

Type	Access	Range	FlowDDE	FLOW-BUS	Modbus
Unsigned char	RW	0…2	335	125/12	0x0FAC/4013

The following values are supported:

Value	Description
0	No parity
1	Odd parity
2	Even parity

Default settings
Network configuration is done ex factory as ordered. The table below shows the supported configurations for the available interface protocols (default settings are printed in bold):

Protocol	FLOW-BUS	Modbus RTU
Address	**3**…125	**1**…247
Baud Rate	**187500**	9600 **19200** 38400 56000 57600 115200
Parity	**0**	0, 1, **2**

Although each communication channel[17] acts as an individual instrument, all three communication channels of the FLEXI-FLOW™ are accessible on the same node address.

4.3.5 Fluid set

Fluid Set Index

Type	Access	Range	FlowDDE	FLOW-BUS	Modbus
Unsigned char	RW	0…7	24	1/16	0x0030/49

With this parameter, any of the pre-configured fluids (up to 8) can be selected. Each fluid has its specific (configurable) properties, such as *Fluid Name*, *Capacity*, etc.
Default value: 0 (fluid 1).

Note that the selected value is equal to the fluid number minus 1 (value 0 corresponds to fluid 1, value 1 to fluid 2, etc.)

Fluid Name

Type	Access	Range	FlowDDE	FLOW-BUS	Modbus
Unsigned char[10]	RW	-	25	1/17	0x8188…0x818C/33161…33165

This parameter contains the name of the selected fluid.

Capacity 100%

Type	Access	Range	FlowDDE	FLOW-BUS	Modbus
Float	RW	1E-10… 1E+10	21	1/13	0x8168…0x8169/33129…33130

- This parameter represents the 100 % readout/control value (span), expressed in the *Capacity Unit* of the selected fluid.
- *Capacity 100%* is scaled when *Inlet Pressure*, *Fluid Temperature* or *Fluid Name* is changed for the selected fluid.

Capacity Unit

Type	Access	Range	FlowDDE	FLOW-BUS	Modbus
Unsigned char[7]	RW	see below	129	1/31	0x81F8…0x81FB/33273…33276

This parameter represents the unit in which *Capacity 100%* is expressed.
Available units:

Mass flow	Normal volume flow (1.01325 bar(a), 0 °C)	Standard volume flow (1.01325 bar(a), 20 °C)	Custom volume flow (*Capacity Unit Type Pressure*, *Capacity Unit Type Temperature*)
ug/h, ug/min, ug/s, mg/h, mg/min, mg/s, g/h, g/min, g/s, kg/h, kg/min, kg/s	uln/h, uln/min, uln/s, mln/h, mln/min, mln/s, ln/h, ln/min, ln/s, ccn/h, ccn/min, ccn/s, mm3n/h, mm3n/m, mm3n/s, cm3n/h, cm3n/m, cm3n/s, m3n/h, m3n/min, m3n/s, scfh, scfm, scfs, sccm, slm	uls/h, uls/min, uls/s, mls/h, mls/min, mls/s, ls/h, ls/min, ls/s, ccs/h, ccs/min, ccs/s, mm3s/h, mm3s/m, mm3s/s, cm3s/h, cm3s/m, cm3s/s, m3s/h, m3s/min, m3s/s	ul/h, ul/min, ul/s, ml/h, ml/min, ml/s, l/h, l/min, l/s, cc/h, cc/min, cc/s, mm3/h, mm3/m, mm3/s, cm3/h, cm3/m, cm3/s, m3/h, m3/min, m3/s, cfh, cfm, cfs

Because of the maximum string length (7 characters), some unit names are abbreviated. For instance mm3n/m means mm^3n/min.

Capacity Unit Type Temperature

Type	Access	Range	FlowDDE	FLOW-BUS	Modbus
Float	RW	-273.15… 3.4E+38	245	33/10	0xA150…0xA151/41297…41298

This parameter defines a reference temperature for conversion of the measured mass flow to a volume flow. See also parameters *Capacity Unit* and *Counter Unit*.

Capacity Unit Type Pressure

Type	Access	Range	FlowDDE	FLOW-BUS	Modbus
Float	RW	0…3.4E+38	246	33/11	0xA158…0xA159/41305…41306

This parameter defines a reference pressure for conversion of the measured mass flow to a volume flow. See also parameters *Capacity Unit* and *Counter Unit*.

4.3.5.1 Advanced fluid set parameters

Note that the parameters described in this section do not contain any actual measurement values, but only fixed reference values, which can be used for capacity calculations, etc.

Inlet Pressure

Type	Access	Range	FlowDDE	FLOW-BUS	Modbus
Float	RW	0…3.4E+38	178	113/13	0xF168…0xF169/61801…61802

Upstream pressure of the selected fluid in bar(a)

Outlet Pressure

Type	Access	Range	FlowDDE	FLOW-BUS	Modbus
Float	RW	0…3.4E+38	179	113/14	0xF170…0xF171/61809…61810

Downstream pressure of the selected fluid in bar(a).

Fluid Temperature

Type	Access	Range	FlowDDE	FLOW-BUS	Modbus
Float	RW	-250…500	181	113/16	0xF180…0xF181/61825…61826

Temperature of the selected fluid in °C.

Density

Type	Access	Range	FlowDDE	FLOW-BUS	Modbus
Float	RW	0…3.4E+38	170	33/21	0xA1A8…0xA1A9/41385…41386

Density of the selected fluid in kg/m^3

Heat Capacity

Type	Access	Range	FlowDDE	FLOW-BUS	Modbus
Float	RW	0…3.4E+38	250	113/18	0xF190…0xF191/61841…61842

Heat capacity of the selected fluid in J/kg·K

Thermal Conductivity

Type	Access	Range	FlowDDE	FLOW-BUS	Modbus
Float	RW	0…3.4E+38	251	113/20	0xF1A0…0xF1A1/61857…61858

Thermal conductivity of the selected fluid in W/m·K

Viscosity

Type	Access	Range	FlowDDE	FLOW-BUS	Modbus
Float	RW	0…3.4E+38	252	113/21	0xF1A8…0xF1A9/61865…61866

Dynamic viscosity of the selected fluid in Pa·s

4.3.5.2 Fluid mixture parameters

Mix Fraction Type

Type	Access	Range	FlowDDE	FLOW-BUS	Modbus
Unsigned char	RW	0…2	346	126/4	0x0FC4/4037

Sets the fraction type of the mixture:

Value	Description
0	Volume fraction
1	Mass fraction
2	Mole fraction

Mix Volume Temperature

Type	Access	Range	FlowDDE	FLOW-BUS	Modbus
Float	RW	-250…500	347	126/5	0xFE28…0xFE29/65065…65066

Temperature of the mixture in °C. The value of this parameter is only relevant if *Mix Fraction Type* = 0.

Mix Volume Pressure

Type	Access	Range	FlowDDE	FLOW-BUS	Modbus
Float	RW	0…3.4E+38	348	126/6	0xFE30…0xFE31/65073…65074

Pressure of the mixture in bar(a). The value of this parameter is only relevant if *Mix Fraction Type* = 0.

Mix Component Index

Type	Access	Range	FlowDDE	FLOW-BUS	Modbus
Unsigned char	RW	0…4	349	126/7	0x0FC7/4040

Index of the selected component of the mixture (max. 5 components).

Mix Component Fraction

Type	Access	Range	FlowDDE	FLOW-BUS	Modbus
Float	RW	0…1	350	126/8	0xFE40…0xFE41/65089…65090

Mix fraction of the selected mix component (*Mix Component Index*). The value range corresponds to 0…100%. The sum of the all mix fractions must be equal to 1.
If the value is 0, the next component slots are ignored.

Mix Component Fluid Name

Type	Access	Range	FlowDDE	FLOW-BUS	Modbus
Unsigned char[10]	RW	-	351	126/9	0xFE48…0xFE4C/65097…65101

This parameter contains the fluid name of the selected mix component (*Mix Component Index*). This parameter may contain one of two value types:
- Gas name, e.g. 'N2', 'He', 'C3H6 #2'.
- CAS Registry Number, e.g. '7727-37-9', '7440-59-7', '115-07-1'

If the parameter contains no name, the next component slots are ignored.

4.3.6 Master/slave configuration (FLOW-BUS)

Normally, there is no communication between the instruments in a fieldbus system. The FLOW-BUS protocol, however, provides a feature to set up a master/slave relationship between two instruments. The typical behavior of a slave instrument is to automatically set its own setpoint relative to the output (measurement value) of its master.

The output value of any instrument in a FLOW-BUS network is automatically available to all other instruments without extra wiring. A slave instrument can also be a master to other instruments.

To set up a master/slave relationship between instruments, first determine which instrument should be the master and which should be the slave, then set *Control Mode* of the slave instrument to 'FLOW-BUS slave' (value 2; also see parameter *Control Mode* 40).

The slave instrument polls the output value of its master periodically and uses the slave factor to set its own setpoint relative to the master's.

To prevent damage to the instruments an/or the system(s) they are connected to, be sure to avoid circular references between devices on the same fieldbus. The FLOW-BUS system does not have a protection mechanism.

Master Node

Type	Access	Range	FlowDDE	FLOW-BUS	Modbus
Unsigned char	RW	1…128	158	33/14	n/a

Sets the master node for the instrument.
Note that this parameter is only effective in a FLOW-BUS network (RS-485).

Slave Factor

Type	Access	Range	FlowDDE	FLOW-BUS	Modbus
Float	RW	0…500	139	33/1	0xA108…0xA109/41225…41226

The controller output from the master instrument is multiplied by *Slave Factor*/100 % to get the slave instrument setpoint. In systems other than FLOW-BUS, *Slave Factor* is effective only if *Control Mode* is set to 'Analog slave', and the analog output signal of the master instrument is redirected to the input of the slave instrument.

Example:
- master output = 80 %
- *Slave Factor* = 50

⇨ slave instrument setpoint = 80 % x 50 %/100 % = 40 %

4.3.7 Digital input and output

IO Switch Status

Type	Access	Range	FlowDDE	FLOW-BUS	Modbus
Unsigned long	RW	0, 1	288	114/31	0xF2F8…0xF2F9/62201…62202

This parameter is only functional for FLEXI-FLOW™ models that are equipped with an (internal) shut-off valve.
On FLEXI-FLOW™ models that are equipped with an internal shut-off valve, *IO Switch Status* is used to actuate the valve.

Depending on the valve type, actuation leads to closing or opening the valve:

Value	Description	Normally open	Normally closed
0	Inactive	open	closed
1	Active	closed	open

- *Immediately after powering-up,* IO Switch Status *is inactive.*
- *In the event of communication faults, the shut-off valve will fall back to its* default state 20 .

4.3.8 Device identification

User Tag

Type	Access	Range	FlowDDE	FLOW-BUS	Modbus
Unsigned char[16]	RW	-	115	113/6	0xF130…0xF137/ 61745…61752

With this parameter, the instrument can be given a custom tag name, with a maximum of 16 characters.

Customer Model

Type	Access	Range	FlowDDE	FLOW-BUS	Modbus
Unsigned char[16]	RW	-	93	113/4	0xF120…0xF127/ 61729…61736

This parameter is used to add extra information to the model number information, such as a customer-specific model number.

Serial Number

Type	Access	Range	FlowDDE	FLOW-BUS	Modbus
Unsigned char[20]	R	-	92	113/3	0xF118…0xF11F/ 61721…61728

Instrument serial number for identification.

BHT Model Number

Type	Access	Range	FlowDDE	FLOW-BUS	Modbus
Unsigned char[35]	RW	-	91	113/2	0xF110…0xF117/ 61713…61720

This parameter shows the Bronkhorst® instrument model type information.

Firmware Version

Type	Access	Range	FlowDDE	FLOW-BUS	Modbus
Unsigned char[16]	R	-	105	113/5	0xF128…0xF12A/ 61737…61739

Revision number of the firmware

Identification Number

Type	Access	Range	FlowDDE	FLOW-BUS	Modbus
Unsigned char	RW	0…255	175	113/12	0x0E2C/3629

Bronkhorst® (digital) device type identification number.

Device Type

Type	Access	Range	FlowDDE	FLOW-BUS	Modbus
Unsigned char[6]	R	-	90	113/1	0xF108…0xF10A/ 61705…61707

Device type information string; this parameter contains an abbreviation referring to the identification number.

4.3.9 Bluetooth

Fieldbus Interface Index

Type	Access	Range	FlowDDE	FLOW-BUS	Modbus
Unsigned char	RW	[0,5]	378	125/7	0x0FA7/4008

- Applicable communication interface (also see Network configuration 30).
- Change the value to 5 before editing *Fieldbus Connection Mode* or *Fieldbus Passkey*.
- Default value: 0

Available interfaces:

Value	Description
0	Fieldbus
5	Bluetooth

Fieldbus Connection Mode

Type	Access	Range	FlowDDE	FLOW-BUS	Modbus
Unsigned int	RW	[0,1]	427	125/24	0x0FB8/4025

- The FLEXI-FLOW™ Compact is delivered with Bluetooth switched off.
- Value modifications become effective immediately.
- The instrument remembers the selected mode on restart (persistent setting).

Available modes:

Value	Description
0	Off
1	On

Fieldbus Passkey

Type	Access	Range	FlowDDE	FLOW-BUS	Modbus
Unsigned long	RW	0…999999	428	125/25	0x0FB9…0x0FBA/ 4026…4027

- PIN code required to make a Bluetooth connection with the instrument (pair).
- Default value: -1

4.3.10 Operational history

Single values

Name	Type	Access	Range	FlowDDE	FLOW-BUS	Modbus*
BHT1 Production Date	String	R		94	118/1	0xF608/62985 [8]
BHT2 Operation Time	Unsigned int	R		95	118/2	0x0EC2/3779 [1]
BHT3 Flow Time	Unsigned long	R		96	118/3	0xF618/63001 [2]
BHT4 Actuation Count	Unsigned int	R		97	118/4	0x0EC4/3781 [1]
BHT5 Mode Change Count	Unsigned char	R		98	118/5	0x0EC5/3782 [1]
BHT6 Watchdog Reset Count	Unsigned char	R		99	118/6	0x0EC6/3783 [1]
BHT7 Power Cycle Count	Unsigned char	R		100	118/7	0x0EC7/3784 [1]
BHT8 Normal Reset Count	Unsigned char	R		101	118/8	0x0EC8/3785 [1]
BHT9 NVRAM Error Count	Unsigned long	R		102	118/9	0xF648/63049 [2]
BHT12 NVRAM Write Count	Unsigned long	R		330	118/12	0xF660/63073 [2]

*) the numbers in square brackets indicate the number of blocks/registers occupied by a parameter.

Statistical data

- Statistical data is stored in a matrix, where each item is represented by 1 row, identified by an index.
- Setting the index to the required value populates the other parameters with the associated statistical data.

Name	Type	Access	Range	FlowDDE	FLOW-BUS	Modbus*
Operational History Parameter Index	Unsigned int	RW	see below	420	118/23	0x0ED7/3800 [1]
Operational History Parameter Name	String	R		421	118/24	0xF6C0/63169 [8]
Operational History Minimum Value	Float	R		422	118/25	0xF6C8/63177 [2]
Operational History Maximum Value	Float	R		423	118/26	0xF6D0/63185 [2]
Operational History Average	Float	R		424	118/27	0xF6D8/63193 [2]
Operational History Standard Deviation	Float	R		425	118/28	0xF6E0/63201 [2]

*) the numbers in square brackets indicate the number of blocks/registers occupied by a parameter.

The following statistical items are available:

Index	Parameter name
0	Flow (lifetime)
1	Flow (last 30 days)
2	Flow (last 24 hours)
3	Upstream pressure (lifetime)
4	Upstream pressure (last 30 days)
5	Upstream pressure (last 24 hours)
6	Downstream pressure (lifetime)
7	Downstream pressure (last 30 days)
8	Downstream pressure (last 24 hours)
9	Flow setpoint (lifetime)
10	Flow setpoint (last 30 days)
11	Flow setpoint (last 24 hours)
12	Upstream pressure setpoint (lifetime)
13	Upstream pressure setpoint (last 30 days)
14	Upstream pressure setpoint (last 24 hours)
15	Downstream pressure setpoint (lifetime)
16	Downstream pressure setpoint (last 30 days)
17	Downstream pressure setpoint (last 24 hours)
18	Actuator output (lifetime)
19	Actuator output (last 30 days)
20	Actuator output (last 24 hours)
21	Sensor bridge voltage (lifetime)
22	Sensor bridge voltage (last 30 days)
23	Sensor bridge voltage (last 24 hours)
24	Temperature (lifetime)
25	Temperature (last 30 days)
26	Temperature (last 24 hours)

4.3.11 Diagnostics

General information

Name	Type	Access	Range	FlowDDE	FLOW-BUS	Modbus*
Instrument NAMUR Status Current instrument status	Unsigned char	R	see below	418	118/0	0x0EC0/3777 [1]

Event details

- Diagnostic event data is stored in a matrix, where each row represents 1 event, identified by an index.
- The event matrix has a maximum size of 50 rows and is updated cyclically.
- Setting *Diagnostic Event Index* to the required value populates the other parameters with the associated event data.

Name	Type	Access	Range	FlowDDE	FLOW-BUS	Modbus*
Diagnostic Newest Event Index Index of the most recently added event Refers to *Diagnostic Event Index*	Unsigned int	R	0…49	411	118/14	0x0ECE/3791 [1]
Diagnostic Event Index Unique row identifier	Unsigned int	RW	0…49	412	118/15	0x0ECF/3792 [1]
Diagnostic Event Code	Unsigned int	R		413	118/16	0x0ED0/3793 [1]
Diagnostic Event Description	String	R		414	118/20	0xF6A0/63137 [8]
Diagnostic Event Active Is the event still applicable? Updated if the cause of the event has been eliminated	Unsigned char	R	see below	415	118/17	0x0ED1/3794 [1]
Diagnostic Event NAMUR Status Instrument status at the time of event occurrence	Unsigned char	R	see below	416	118/18	0x0ED2/3795 [1]
Diagnostic Event Timestamp	Unsigned long	R		417	118/21	0xF6A8/63145 [2]

*) the numbers in square brackets indicate the number of blocks/registers occupied by a parameter.

Value ranges

Parameter	Value	Description
Diagnostic Event Active	0	false
	1	true
NAMUR Status (also see section Instrument status 14)	0	Normal operation
	1	Maintenance required
	2	Out of specification
	4	Check function
	8	Failure

4.3.12 Special parameters

Init Reset

Type	Access	Range	FlowDDE	FLOW-BUS	Modbus
Unsigned char	RW	82/64	7	0/10	0x000A/11

Init Reset is used to unlock secured parameters (marked with a 🔑 symbol) for writing. It supports the following values:

Value	Description
64	unlocked, secured parameters can be read and written to
82	locked, secured parameters are read-only

At power-up, *Init Reset* is always set to 'Locked' (value 82).

Reset

Type	Access	Range	FlowDDE	FLOW-BUS	Modbus
Unsigned char	R	0…7	114	115/8	0x0E68/3689

This parameter is used to reset the program, counter or alarms (alarms are reset on all channels).

Value	Description
0	No reset
1	Reset counter
2	Reset alarm
3	Reset counter
4	Reset and disable counter
5	Reset firmware program (soft reset)
6	Reset *Alarm info* error bit
7	Reset *Alarm info* warning bit

- *Resetting alarms or the counter can be disabled by* Reset Alarm Enable *or* Reset Counter Enable *respectively.*
- Reset *value 2 resets alarms on all three communication channels, unless resetting is disabled for 1 or more channels.*

Wink

Type	Access	Range	FlowDDE	FLOW-BUS	Modbus
Unsigned char [27]	W	0…9	1	0/0	0x0000/1

Sending any decimal value between 1 and 9* to this parameter makes the status indication light flash white for that number of seconds. This can be useful in order to identify a specific device in a large fieldbus network.

*) On Modbus the required number of seconds is represented by these values:

No. of seconds	Wink value
1	12544
2	12800
3	13056
4	13312
5	13568
6	13824
7	14080
8	14336
9	14592

Control Mode

Type	Access	Range	FlowDDE	FLOW-BUS	Modbus
Unsigned char	RW	0…255	12	115/1	0x0024/37

Control Mode is used to select different control modes of the instrument and determines from which source(s) it accepts a setpoint.

The following modes are available:

Value	List option	Description	Setpoint source
0	Bus/RS232	Normal operation	Fieldbus
2	FLOW-BUS slave	Acting as slave instrument on FLOW-BUS	FLOW-BUS master
3	Valve close	Controller disabled, valve closed	
4	Controller idle	Controller disabled, valve frozen in current position	
7	Setpoint 100%	Setpoint fixed at 100 %	
8	Valve fully open	Controller disabled, valve fully open	
9	Calibration mode	Calibration mode enabled	
12	Setpoint 0%	Setpoint fixed at 0%	
18	RS232	Controlling, default/safe state[20] disabled	Fieldbus
20	Valve steering	Controller disabled, setpoint redirected to *Valve Output*	
22	Valve safe state	Instrument in default/safe state[20]	

- Default value: 0
- If *Control mode* is changed to value 9 or 18, the instrument returns to the default value at the next power-up or reset. Other values are persistent.
- *Control mode* 18 prevents the instrument from assuming its default/safe state[20] in the event of a digital communication failure.
- The column labeled *List option* shows the control modes as used in Bronkhorst® software (which explains the RS-232 references, although the FLEXI-FLOW™ has no such interface).

Calibration Mode

Type	Access	Range	FlowDDE	FLOW-BUS	Modbus
Unsigned char	RW	0, 9, 255	58	1/4	0x0E61/3682

After enabling calibration mode by means of parameter *Control Mode*, this parameter is used to start the autozero function of the flow sensor. The following modes are supported:

Value	Description
0	Idle (no action)
9	Start zeroing
255	Error (result of previous calibration mode)

4.4 Multi-parameter addressing

This section lists all parameters that are available on all 3 communication channels[17] (F, P1, P2), including their FLOW-BUS and Modbus addresses. Classification is consistent with section Parameters[23]. See the according subsections for detailed parameter descriptions.

General address derivation using offset

In a Modbus system, parameters of communication channels P1 and P2 can be accessed by applying an offset to the Modbus PDU address of the parameter on channel F:

- For address range 0x0000…0x0FFF, add 0x20 to the Modbus PDU address for channel P1, or 0x40 for channel P2.
- For address range 0x8000…0xFFFF, add 0x100 to the Modbus PDU address for channel P1, or 0x200 for channel P2.

On FLOW-BUS, parameters of communication channels P1 and P2 can be accessed by applying an offset to the process number of the parameter on channel F:

- Add 1 to the process number for channel P1
- Add 2 to the process number for channel P2

Measurement and control

Name	Channel F (flow)		Channel P1 (upstream pressure)		Channel P2 (downstream pressure)	
	FLOW-BUS	Modbus	FLOW-BUS	Modbus	FLOW-BUS	Modbus
Measure (8)	1/0	0x0020	2/0	0x0040	3/0	0x0060
Setpoint (9)	1/1	0x0021	2/1	0x0041	3/1	0x0061
Setpoint Slope (10)	1/2	0x0022	2/2	0x0042	3/2	0x0062
Temperature (142)	33/7	0xA138	34/7	0xA238	35/7	0xA338
Fmeasure (205)	33/0	0xA100	34/0	0xA200	35/0	0xA300
Fsetpoint (206)	33/3	0xA118	34/3	0xA218	35/3	0xA318

Fluid set

Communication channels P1 and P2 do not support the definition of fluid sets. The fluid set parameters on channels P1 and P2 are used only for measurement and control data conversion.

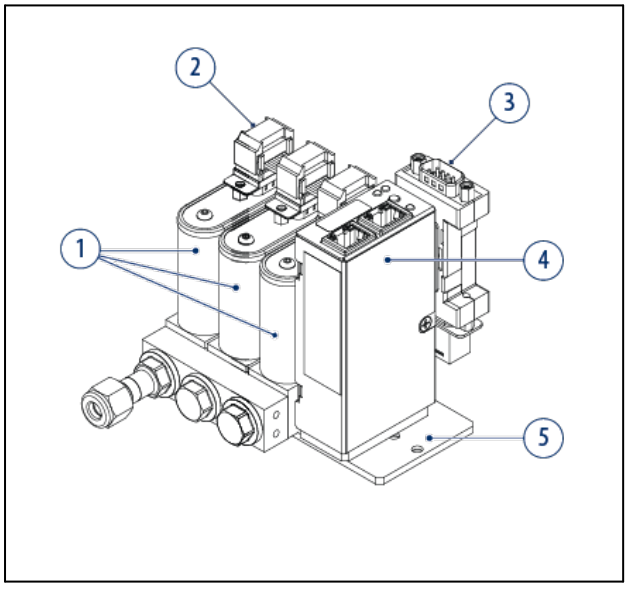
Name	Channel F (flow)		Channel P1 (upstream pressure)		Channel P2 (downstream pressure)	
	FLOW-BUS	Modbus	FLOW-BUS	Modbus	FLOW-BUS	Modbus
Capacity (21)	1/13	0x8168	2/13	0x8268	3/13	0x8368
Capacity Unit (129)	1/31	0x81F8	2/31	0x82F8	3/31	0x83F8
Capacity Unit Type Temperature (245)	33/10	0xA150	34/10	0xA250	35/10	0xA350
Capacity Unit Type Pressure (246)	33/11	0xA158	34/11	0xA258	35/11	0xA358
Density (170)	33/21	0xA1A8	34/21	0xA2A8	35/21	0xA3A8

Alarms

Name	Channel F (flow)		Channel P1 (upstream pressure)		Channel P2 (downstream pressure)	
	FLOW-BUS	Modbus	FLOW-BUS	Modbus	FLOW-BUS	Modbus
Alarm Info (28)	1/20	0x0034	2/20	0x0054	3/20	0x0074
Alarm Maximum Limit (116)	97/1	0x0C21	98/1	0x0C41	99/1	0x0C61
Alarm Minimum Limit (117)	97/2	0x0C22	98/2	0x0C42	99/2	0x0C62
Alarm Mode (118)	97/3	0x0C23	98/3	0x0C43	99/3	0x0C63
Alarm Setpoint Mode (120)	97/5	0x0C25	98/5	0x0C45	99/5	0x0C65
Alarm New Setpoint (121)	97/6	0x0C26	98/6	0x0C46	99/6	0x0C66
Alarm Delay Time (182)	97/7	0x0C27	98/7	0x0C47	99/7	0x0C67
Reset Alarm Enable (156)	97/9	0x0C29	98/9	0x0C49	99/9	0x0C69

4.5 Gateway (multi-modular systems)

The FLEXI-FLOW concept offers the option of multiple channels systems, in wihich multiple channels Mass Flow & Pressure Meters/Controllers are combined into one microfluidic system. The following functional modules can be configured into one compact sub-system: mass flow meter or controller, pressure meter or controller, shut-off valve, mixing chamber.



1. Multiple instruments
2. Flat cable
3. Power connector
4. Gateway
5. Mounting plate

On communication platforms other than FLOW-BUS or Modbus, Bronkhorst® instruments can be controlled through a gateway. 1 gateway can accommodate up to 8 Bronkhorst® instruments.

When communicating through a gateway, parameter addressing might differ from what is described in this document.

- *For information about parameter addressing when using a Bronkhorst® gateway in a PROFIBUS DP or PROFINET system, consult the according fieldbus manual[9] .*
- *For information about parameter addressing on third party gateways, consult the gateway manual.*

Parameter index

Parameters