

EtherNet/IP™

Device interface
for digital multibus instruments

EtherNet/IP™

Manual

English

IMPORTANT!

Read carefully before use.
Keep for future reference.



Bronkhorst®

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1 Safety information

1.1 General safety information

⚠ Please read this document and all other applicable documents carefully before installing and operating the product.

All instructions must be observed. Failure to comply with instructions may result in material damage and personal injury.

2 General information

2.1 Scope

This document provides a general description of the interface between the Ethernet/IP™ and Bronkhorst® products and provides an overview of all parameters available on EtherNet/IP™.

2.2 About this document

Illustrations used

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

Document validity

Documents are updated regularly. The most recent version is available online.

- ▶ Prior to work, check whether a newer version of this document is available on the Bronkhorst website.
- ▶ For download information, see the back cover of this manual.

2.3 Warranty

- ▶ For information about the warranty, the general terms of delivery, please visit the Bronkhorst website: <https://bronzhorst.com/terms-and-conditions/>

2.4 Ethernet/IP™ communication protocol

Ethernet/IP™ is an industrial network protocol that combines standard Ethernet with the Common Industrial Protocol (CIP) to enable real-time control and data exchange in automation systems. It uses TCP/IP and UDP/IP for reliable communication between devices, ensuring scalability and interoperability. For information about Ethernet/IP™:

- ▶ Visit the Ethernet/IP™ website at <https://www.odva.org/>

2.4.1 Declaration of Conformity

Bronkhorst® Mass Flow Meters/Controllers comply with the Ethernet/IP™ specifications and regulations as specified by ODVA inc.

The applicable declaration can be downloaded from the Bronkhorst website.

- ▶ For download information, see the back cover of this manual.

3 Installation

3.1 Bronkhorst® product information

All product descriptions, including LEDs and labels, are provided in the appropriate product documentation.

- ▶ See applicable product information in the online available manuals.
- ▶ For download information, see the back cover of this manual.

3.1.1 Pin-out

- ▶ Check the pin-out before connecting (» par. 8.1, page 30)

3.2 Connection cables



For a Ethernet/IP™ network a cable length of 0.15 to 100 meter is permitted.

- ▶ Use Ethernet patch or crossover FTP or SFTP cables in CAT5e, with shielded connectors.
-or-
- ▶ Use M12-D-coded cables.

3.2.1 Ethernet/IP™ connection



According to IEC 802.3 the maximum cable length for 100 MBaud Ethernet is 100m (100BaseT), e.g. between two devices.

The Bronkhorst® instruments are equipped with two RJ45 or M12-D connectors. Both connectors can be used as input or output. One of the Ethernet/IP™ connectors can be used to connect the instrument with the Ethernet/IP™ master and the other connector can be used to connect to another Ethernet/IP™ instruments.

3.2.2 Ethernet/IP™ bus termination

A bus terminator (e.g. using bus terminating resistors) is not necessary.

3.3 Routing and shielding



Only use shielded cables and connection elements that meet the requirements of Category 5, Class 2 according to IEC11801, Edition 2.0.

Correct shielding of the bus cable reduces electrical interference that can occur in industrial environments

3.4 Power supply

Bronkhorst products are power by using a power connector. The type of connector differs per product series.

- ▶ For more information, see online available hook-up diagrams.
- ▶ For download information, see the back cover of this manual.

4 Configuration

4.1 Rotary switch network configuration (waar is de info van de)

The network settings can be configured directly on the product using the rotary switches.

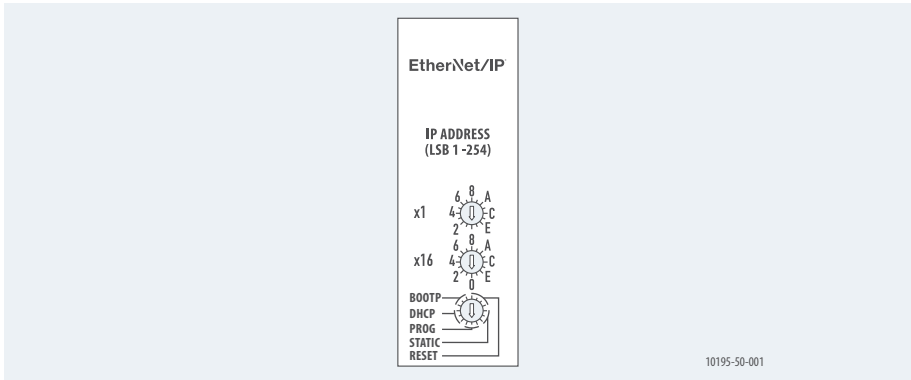


Fig. 1. Example rotary switches

4.1.1 RESET

This will restore the default network settings. This will erase all network address settings made previously, including any custom delivered static address.

- ▶ Set the “x1” rotary switch to “0”.
- ▶ Set the “x16” rotary switch to “0”.
- ▶ Set the Mode rotary switch to RESET.
- ▶ Power cycle (power OFF/ON) the product.

Addresses are reset to :

- The Fieldbus1 IP Address 0.0.0.0
- Default Fieldbus1 Subnet Mask 0.0.0.0
- Default Fieldbus1 Gateway Address 0.0.0.0

4.1.2 STATIC default

This will set the default static network settings.

- ▶ Reset to the default network settings (RESET).
- ▶ Set the Mode rotary switch to STATIC.
- ▶ Power cycle (power OFF/ON) the product.

Addresses are set to :

- The Fieldbus1 IP Address 192.168.19.100
- Default Fieldbus1 Subnet Mask 255.255.255.0
- Default Fieldbus1 Gateway Address 192.168.19.0

4.1.3 STATIC custom

This will set custom static network settings.

When set to STATIC the LSB (LeastSignificantByte) of the IP Address can be set using the IP Address rotary switches. instrument can be configured to an IP address in the range of 192.168.19.1 to 192.168.19.255

Example: Set LSB to 42 (IP Address 192.168.19.42)

- ▶ Reset to the default network settings (RESET).
- ▶ Set the Mode rotary switch to STATIC.
- ▶ Set the “x1” rotary switch to “A” which is 10 decimal.
- ▶ Set the “x16” rotary switch to “2” which is $2 \times 16 = 32$ decimal
- ▶ Power cycle (power OFF/ON) the product.

Addresses are set to :

- The Fieldbus1 IP Address 192.168.19.42
- Default Fieldbus1 Subnet Mask 255.255.255.0
- Default Fieldbus1 Gateway Address 192.168.19.0

4.1.4 PROG



If a product has not accessible rotary switches they will be default on 00 and PROG.

This will allow the network settings to be set by RS-232 or Bronkhorst FlowSuite.

- ▶ Set the “x1” rotary switch to “0”.
- ▶ Set the “x16” rotary switch to “0”.
- ▶ Set the Mode rotary switch to PROG.
- ▶ Power cycle (power OFF/ON) the product.

Bl bla bla parameter 7 en zo. Maar wat doen we met FlowSuite?(pagina 13 9.17.132 oud)

4.2 Product EDS-file

The EDS-file offers easy access to the IO connections and configuration parameters/options available for Bronkhorst products. The EDS-file can be downloaden from the Bronkhorst website.

- ▶ For download information, see the back cover of this manual.

4.2.1 EDS-file structure

The following information is included in the EDS file:

- Device identification info. This contains general information like:
 - Model name Bronkhorst Meter Controller
 - Vendor name Bronkhorst High-Tech B.V.
 - Vendor code 706
 - Product code 7
 - Product type 26 - (Mass Flow Controller)
 - Parameters
- Parameters
 - Parameters that are included in the IO data - Status, Flow, Setpoint, Override, Valve.
 - Parameters available for additional configuration.
 - Non-Profile parameters.
- Assemblies

Configuration

- Combinations of parameters used in the IO Connections.
- IO Connections
 - Basic (INT)
 - Extended (INT)
 - Basic (REAL)
 - Extended (REAL)
- Profile Classes
 - S-Device Supervisor
 - S-Analog Sensor
 - S-Analog Actuator
 - S-Single Stage
 - S-Gas Calibration

4.2.2 Loading the EDS-file

- See Youtube.

4.2.3 Add ethernet/ip device to configuration

- See Youtube.

4.3 Select IO connection

- See Youtube.

4.4 Configuration parameters

- See Youtube.

5 Objects and services

Bronkhorst® MFC's consist of several objects with attributes and services for interfacing to EtherNet/IP™.

The EtherNet/IP Mass Flow Controller will be in "Idle" state after powered on or reset. In this state, the device will not allow the Master to use the Setpoint Attribute to control gas flow. Instead, gas flow will be controlled by the value previously set in the Analog Actuator Object's Safe-State Attribute and Safe-Value Attribute.

In order to activate the controller, the Master device establish an IO Connection. This will move the device into the Executing state. Alternatively the master can send a "Start" service request to the supervisor object of the Mass Flow Controller. (kunnen we dit niet beter als 'stappen' beschrijven?)

5.1 IO connections

The IO connections predefined in the EDS file, offer cyclic connections to the assemblies, which can be used to control several parameters of the instrument. IO connections use the lower latency UDP protocol to allow for fast messaging of cyclic process data. Of the 4 predefined IO connections, only one can be active at a time. When an IO connection is established the instrument will move to Executing state, which enables the PID controller for MFCs.

The following IO connections are available in the EDS file of the device: (dit is nu dus incl FFC)

IO connection	Direction ¹	Assembly	Size (bytes)	Parameter	Data Type	Size (bytes)
Basic INT	In	7	6	Setpoint	INT	2
				Pressure Inlet Setpoint	INT	2
				Pressure Outlet Setpoint	INT	2
	Out	2	7	Status	USINT	1
				Flow	INT	2
				Pressure Inlet	INT	2
Extended INT	In	8	7	Pressure Outlet	INT	2
				Override	USINT	1
				Setpoint	INT	2
				Pressure Inlet Setpoint	INT	2
				Pressure Outlet Setpoint	INT	2
	Out	6	16	Status	USINT	1
				Flow	INT	2
				Setpoint	INT	2
				Override	USINT	1
				Valve	UINT	2
				Pressure Inlet	INT	2
				Pressure Inlet Setpoint	INT	2
				Pressure Outlet	INT	2

¹ Direction seen from product

IO connection	Direction ^{/1}	Assembly	Size (bytes)	Parameter	Data Type	Size (bytes)
Basic REAL	In	19	12	Pressure Outlet Setpoint	INT	2
				Setpoint	REAL	4
				Pressure Inlet Setpoint	REAL	4
	Out	14	13	Pressure Outlet Setpoint	REAL	4
				Status	USINT	1
				Flow	REAL	4
Extended REAL	In	20	13	Pressure Inlet	REAL	4
				Pressure Outlet	REAL	4
				Override	USINT	1
				Setpoint	REAL	4
				Pressure Inlet Setpoint	REAL	4
				Pressure Outlet Setpoint	REAL	4
	Out	18	30	Status	USINT	1
				Flow	REAL	4
				Setpoint	REAL	4
				Override	USINT	1
				Valve	REAL	4
				Pressure Inlet	REAL	4
				Pressure Inlet Setpoint	REAL	4
				Pressure Outlet	REAL	4
				Pressure Outlet Setpoint	REAL	4

Tab. 1. IO connctions and assemblies

There are two sets of connections available (Basic and Extended) in two different data types (INT and REAL). The data type only applies to the Setpoint, Flow, and Valve parameters in the assemblies in these connections. Upon establishment of the connection, the data type is set in the classes of the parameters (S-Analog Sensor, S-Analog Actuator, and the S-Single Stage Controller).

5.2 Device configuration

5.2.1 Available parameter data

Using the EDS-file in the configuration program of the master, following parameters are available in the standard EDS file for customizing the attributes in the assemblies or the profile classes.

Additional parameters can be added manually using the class, instance, and attribute id values from the tables in the previous chapters.

Attribute value	Description
Analog Sensor Gas Calibration Object Instance	Selects calibration/fluid instance.: 1...8

Attribute value	Description
Analog Sensor Data Unit	Selects data unit for analog sensor attributes (measure)
Analog Sensor Alarm Mode	Enables or disables the alarm
Analog Sensor Alarm Trip Point High	Sets the upper limit for the alarm
Analog Sensor Alarm Trip Point Low	Sets the lower limit for the alarm
Analog Actuator Data Unit	Selects data unit for analog actuator attributes (valve)
Single Stage Controller Data Unit	Selects data unit for controller attributes (setpoint)
Single Stage Controller Control Mode	Selects the control mode for the single stage controller

Tab. 2. Available parameters

5.3 Classes

The following classes are supported by the device, and can be accessed using explicit messaging (acyclic messages). The classes prefixed with 'S-' are part of the MFC device profile. The Bronkhorst classes are custom defined classes that offer access to the most used Bronkhorst parameters, without conversion to CIP or EtherNet/IP specific units and types.

The ProPar column shows how EtherNet/IP attributes are related to the internal variables of the instrument. This information can be useful for who is familiar with ProPar or for diagnostics.

5.3.1 Identity Object

This object provides identification of and general information about the device. The Identity Object is present in all CIP products.

Identity object's instance attributes (Instance = 1)						
Object	Attribute	Name	Service code	Data type	ProPar	Comment
0x01	0x01	Vendor Id	0x0E	UINT		706 (0x2C2)
0x01	0x02	Device Type	0x0E	UINT		26 (0x1A)
0x01	0x03	Product Code	0x0E	UINT	113,12	
0x01	0x04	Revision	0x0E	STRUCT		
0x01	0x05	Status	0x0E	WORD		
0x01	0x06	Serial Number	0x0E	UDINT		See Chapter 6.7 Serial number
0x01	0x07	Product Name	0x0E	SHORT-STRING		"Bronkhorst meter/controller"

Tab. 3. Identity object's instance attributes

Identity object services			
Object	Service code	Name	Service description
0x01	0x05	Reset	Reset device, parameters: 0 = reset (like power cycle), 1 = load default values + reset
0x01	0x0E	Get_Attribute_Single	Returns the contents of the specified attribute
0x01	0x10	Set_Attribute_Single	Modifies an attribute value
0x01	0x4B	Wink_LEDs	Winks the LEDs on the device for identification purposes

Tab. 4. Identity object services

5.3.2 S-Device Supervisor Object

Class Code 0x30

This object models the interface, functions and behavior associated with the management of application objects for devices within the “Hierarchy of Semiconductor Equipment Devices”

Supervisor object's instance attributes (Instance = 1)						
Object	Attribute	Name	Service code	Data type	ProPar	Comment
0x30	0x01	Number of Attributes	0x0E	USINT	20	
0x30	0x02	Attribute List	0x0E	Array of USINT		
0x30	0x03	Manufacturer's Device Type	0x0E	SHORT-STRING	113,1	“MFM” or “MFC”
0x30	0x04	SEMI Standard Revision	0x0E	SHORT-STRING		“E54-0997”
0x30	0x05	Manufacturer's Name	0x0E	SHORT-STRING		“Bronkhorst High-Tech B.V.”
0x30	0x06	Manufacturer's Model #	0x0E	SHORT-STRING	113,2	
0x30	0x07	Digital MFC Software Revision Level	0x0E	SHORT-STRING	113,5	“V1.23a”
0x30	0x08	EtherNet/IP Hardware Revision Level	0x0E	SHORT-STRING	113,7	“A”
0x30	0x09	Manufacturer's Serial Number	0x0E	SHORT-STRING	113,3	Unique serial number for Bronkhorst instruments
0x30	0x0A	Device Configuration	0x0E	SHORT STRING	113,4	Manufacturer configuration

Supervisor object's instance attributes (Instance = 1)						
Object	Attribute	Name	Service code	Data type	ProPar	Comment
0x30	0x0B	Device Status	0x0E	USINT		
0x30	0x0C	Exception Status	0x0E	BYTE		
0x30	0x0D	Exception Detail Alarm	0x0E	STRUCT		
0x30	0x0E	Exception Detail Warning	0x0E	STRUCT		
0x30	0x0F	Alarm Enable	0x0E, 0x10	BOOL		0-1
0x30	0x10	Warning Enable	0x0E, 0x10	BOOL		0-1
0x30	0x13	Last Maintenance Date	0x0E	DATE	113,11	Service date
0x30	0x17	Running Hours	0x0E	UDINT	118,2	0-65535

Tab. 5. Supervisor object's instance attributes

Device status	
Attribute value	State
0	Undefined
1	Self-testing
2	Idle
3	Self-test Exception
4	Executing
5	Abort
6	Critical fault
7-50	Reserved by CIP
51-99	Device specific
100-255	Vendor specific

Tab. 6. Device status

Exception Status		
Bit	Exception status bit map, Bit 7 set to 0 Function	State
0	Device specific definition	Alarm/device-common
1		Alarm/device-specific
2		Alarm/manufacture-specific
3		reserved – is set to 0

Exception Status		
Bit	Exception status bit map, Bit 7 set to 0 Function	State
4		Warning/device-common
5		Warning/device-specific
6		Warning/manufacturer-specific
7		1 = Expanded Method

Tab. 7. Exception status

When alarm is active bit 7 is always set. Bit 1 will be set when the Analog Sensor Status indicates a high or low flow alarm. For detail read either the Exception Detail Alarm parameter or the Analog Sensor Status attribute when bit 1 is set.

Supervisor object services			
Object	Service code	Name	Service description
0x30	0x05	Reset	Resets the device to the Self-Testing state
0x30	0x06	Start	Starts the device execution by moving the device to the Executing state
0x30	0x07	Stop	Moves the device to the Idle state
0x30	0x0E	Get_Attribute__Single	Returns the contents of the specified attribute
0x30	0x10	Set_Attribute__Single	Modifies an attribute value
0x30	0x4B	Abort	Moves the device to the Abort state
0x30	0x4C	Recover	Moves the device out of the Abort state
0x30	0x4E	Perform__Diagnostics	Causes the device to perform a set of diagnostic routines

Tab. 8. Supervisor object services

5.3.3 S-Analog Sensor Object

The S-Analog Sensor Objects models the acquisition of a reading from a physical sensor in a device.

Analog sensor object's instance attributes (Instance = 1)						
Object	Attribute	Name	Service code	Data type	ProPar	Comment
0x31	0x01	Number of Attributes	0x0E	USINT		12
0x31	0x02	Attribute List	0x0E	Array of USINT		
0x31	0x03	Data Type	0x0E, 0x10	USINT		0xC3=INT, 0xCA=REAL

Analog sensor object's instance attributes (Instance = 1)						
Object	Attribute	Name	Service code	Data type	ProPar	Comment
0x31	0x04	Data Unit	0x0E, 0x10	UINT		See Chapter 5.5
0x31	0x05	Reading Valid	0x0E	BOOL		0 = invalid, 1 = valid
0x31	0x06	Sensor Value	0x0E	INT or REAL1	1,0	see attribute 3 and 4 For data unit counts the value attribute will be in the range of 0..32767 where: 0 = no flow/pressure 32000 = max flow / pressure (100.0%) 32767 = max flow / pressure (102.4%) Note: 32767 is max. flow for data type INT. Max. flow REAL = 41943.04 (131.07%)
0x31	0x07	Status	0x0E	BYTE		1=High Alarm Exception, 2=Low Alarm Exception
0x31	0x08	Alarm Enable	0x0E, 0x10	BOOL		
0x31	0x0A	Full Scale	0x0E	INT		32000
0x31	0x11	Alarm Trip Point High	0x0E, 0x10	INT	97,1	see attribute 3 and 4
0x31	0x12	Alarm Trip Point Low	0x0E, 0x10	INT	97,2	see attribute 3 and 4
0x31	0x14	Alarm Settling Time	0x0E, 0x10	UINT	97,7	0-65000, alarm delay (msec)
0x31	0x1C	Auto zero status	0x0E	UINT		1 = busy, 0 = ready
0x31	0x23	Gas Calibration Object Instance	0x0E, 0x10	UINT		1-8 1 = fluid 1 selected

Tab. 9. Analog sensor object's instance attributes

1 Depends on the value assigned to the Data Type attribute. If the value of this attribute is 0xC3, the selected data type is Integer. If the value of this attribute is 0xCA, the selected data type will be the IEEE-754 single-precision floating-point.

Analog sensor object services			
Object	Service code	Name	Service description
0x31	0x0E	Get_Attribute_Single	Returns the contents of the specified attribute
0x31	0x10	Set_Attribute_Single	Modifies an attribute value
0x31	0x4B	Zero Adjust	Start auto zero

Tab. 10. Analog sensor object services

5.3.4 S-Analog Actuator Object

The S-Analog Actuator Object models the interface to a physical actuator in a device.

Analog actuator object's instance attributes (Instance = 1)						
Object	Attribute	Name	Service code	Data type	Propar	Comment
0x32	0x01	Number of Attributes	0x0E	USINT		7
0x32	0x02	Attribute List	0x0E	Array of USINT		
0x32	0x03	Data Type	0x0E, 0x10	USINT		0xC3=INT, 0xCA=REAL
0x32	0x04	Data Units	0x0E, 0x10	UINT		0x1001 = counts, 0x1007 = %
0x32	0x05	Override	0x0E, 0x10	USINT		
0x32	0x06	Actuator Value	0x0E, 0x10	INT or REAL1	114,1	See attribute 3 and 4 For data unit counts the value attribute will be in the range of 0..32767. Where: 0 = valve closed 32767 = valve fully open
0x32	0x07	Status	0x0E	BYTE		always 0
0x32	0x15	Safe State	0x0E, 0x10	USINT		
0x32	0x16	Safe Value	0x0E, 0x10	INT	114,6	

Tab. 11. Analog actuator object's instance attributes

1 Depends on the value assigned to the Data Type attribute. If the value of this attribute is 0xC3, the selected data type is Integer, and if the value of this attribute is 0xCA, the selected data type will be the IEEE-754 single-precision floating-point.

Analog actuator object services			
Object	Service code	Name	Description
0x32	0x0E	Get_Attribute_Single	Returns the contents of the specified attribute
0x32	0x10	Set_Attribute_Single	Modifies an attribute value

Tab. 12. Analog actuator object services

5.3.5 S-Single Stage Controller Object

The S-Single Stage Controller Object models a closed-loop control system within a device.

Controller object's instance attributes (Instance = 1)						
Object		Name	service code	Data type		
0x33	0x01	Number of Attributes	0x0E	USINT		6
0x33	0x02	Attribute List	0x0E	Array of USINT		
0x33	0x03	Data Type	0x0E, 0x10	USINT		
0x33	0x04	Data Units	0x0E, 0x10	UINT		See Chapter 5.5
0x33	0x05	Control Mode	0x0E, 0x10	USINT		
0x33	0x06	Setpoint	0x0E, 0x10	INT or REAL1	1,1	See
0x33	0x0A	Status	0x0E	BYTE		
0x33	0x13	Ramp Rate	0x0E, 0x10	UDINT	1,2	

1 Depends on the value assigned to the Data Type attribute. If the value of this attribute is 0xC3, the selected data type is Integer, and if the value of this attribute is 0xCA, the selected data type will be the IEEE-754 single-precision floating-point.

Controller object services			
Object	Service code	Name	Description
0x33	0x0E	Get_Attribute_Single	Returns the contents of the specified attribute
0x33	0x10	Set_Attribute_Single	Modifies an attribute value

Due to floating point precision and conversion between EtherNet/IP and internal instrument datatypes, the value written to the Single Stage Controller Value attribute might not exactly equal the actual value used in the instrument. The value read back on the Single Stage Controller Value attribute is the actual value used by the instrument.

5.3.6 S-Gas Calibration Object

An S-Gas Calibration Object affects the behavior of an associated S-Analog Sensor object instance.

Gas calibration object's class attributes (Instance = 0)

Object	Attribute	Name	Service code	Data type	ProPar	Comment
0x34	0x02	Max Instance1	0x0E	UINT		8

Gas calibration object's instance attributes (Instance = 1...8)

Gas calibration object	Attribute	Attribute name	Service code	Data type	ProPar	
0x34	0x01	Number of attributes	0x0E	USINT		6
0x34	0x02	Attribute List	0x0E	Array of USINT		
0x34	0x03	Gas Standard number	0x0E	UINT		see list from SEMI
0x34	0x04	Valid Sensor instance	0x0E	UINT		1
0x34	0x05	Gas Symbol	0x0E	SHORT STRING	1,17	Fluid name
0x34	0x06	Full Scale	0x0E	STRUCT		Full scale capacity (REAL), capacity unit (UINT)
0x34	0x08	Calibration Date	0x0E	DATE	113,9	

Gas calibration object services

Gas calibration object	Service code	Service name	Service description
0x34	0x0E	Get_Attribute_Single	Returns the contents of the specified attribute
0x34	0x10	Set_Attribute_Single	Modifies an attribute value

5.3.7 Bronkhorst Sensor and Control object

Note: To comply with the MFC profile, the Bronkhorst specific objects should not be used. As some parameters will influence the profile object functionality. When an IO connection is active, all write parameters in that connection that are mapped to one of these parameters internally, will be overwritten with the IO connection data.

Class - 100				Bronkhorst
Attribute	Parameter	Access	Data Type	Par ID
3	fMeasure (Actual Measure)	R	REAL	205
4	fSetpoint (Actual Setpoint)	RW	REAL	206
5	Measure (0-32000)	R	UINT	8
6	Setpoint (0-32000)	RW	UINT	9
7	Setpoint Slope	RW	USINT	10
8	Valve output (Actuator Output Value)	RW	UDINT	55
9	Control Mode	RW	USINT	12
10	Alarm info (Device Status)	R	USINT	28
11	Temperature	R	REAL	142
12	Pressure	R	REAL	143
13	Density	R	REAL	170

Tab. 13. Sensor and Control object (class 100)

5.3.8 Bronkhorst Advanced

Class - 101				Bronkhorst
Attribute	Parameter	Access	Data Type	Par ID
3	Controller Speed	RW	REAL	254
4	Dynamic Display Filter	RW	REAL	56
5	Static Display Filter	RW	REAL	57
6	IO Switch Status (shutoffs)	RW	UDINT	288
7	Analog Input	R	INT	11
8	Frequency (CORI-Flow)	R	REAL	149
9	Controller Hysteresis (P800)	RW	REAL	361
10	PID-Kp	RW	REAL	167
11	PID-Ti	RW	REAL	168
12	PID-Td	RW	REAL	169
13	Monitor mode	RW	USINT	60
14	Density Actual	R	REAL	270

Tab. 14. Bronkhorst Advanced

5.3.9 Bronkhorst Fluid Calibration

CIP	Parameter	Access	Data Type	FlowDDE	Propar	Note		
Class	Attribute					Process		
102	3	Fluid Index	RW	USINT	24	1	16	

CIP	Parameter	Access	Data Type	FlowDDE	Propar	Note		
Class	Attribute					Process		
	4	Fluid Name	R	SHORT_STRING	25	1	17	
	5	Capacity 100%	RW	REAL	21	1	13	
	6	Capacity 0%	RW	REAL	183	33	22	
	7	Capacity Unit	RW	SHORT_STRING	129	1	31	
	8	Auto Zero (calibration mode = 22)	RW	USINT	NA	NA	NA	
	9	Calibration Certificate	R	SHORT_STRING	171	113	8	
	10	Calibration Date	R	SHORT_STRING	172	113	9	

Tab. 15. Bronkhorst Fluid Calibration

5.3.10Bronkhorst Identification

CIP	Parameter	Access	Data Type	FlowDDE	Propar		
Class	Attribute						
103	3	Bronkhorst Model Number	R	SHORT_STRING	91	113	2
	4	Serial Number	R	SHORT_STRING	92	113	3
	5	Model Number	R	SHORT_STRING	208	113	4
	6	Firmware Version	R	SHORT_STRING	105	113	5
	7	User Tag	RW	SHORT_STRING	115	113	6

Tab. 16. Bronkhorst Identification

5.3.11Bronkhorst Alarm

CIP	Parameter	Access	Data Type	FlowDDE	Propar	Note		
Class	Attribute					Process		
104	3	Alarm Reset	W	USINT	NA	NA	NA	write
	4	Alarm Mode	RW	USINT	118	97	3	
	5	Alarm Delay	RW	USINT	182	97	7	
	6	Alarm Reset Enable	RW	USINT	156	97	9	

CIP	Parameter	Access	Data Type	FlowDDE	Propar	Note		
Class	Attribute					Process		
	7	Alarm Max Limit	RW	UINT	116	97	1	
	8	Alarm Min Limit	RW	UINT	117	97	2	
	9	Alarm Setpoint Mode	RW	USINT	120	97	5	
	10	Alarm New Setpoint	RW	UINT	121	97	6	

Tab. 17. Bronkhorst Alarm

5.3.12 Bronkhorst Counter

CIP		Access	Data Type	FlowDDE	Propar	Note		
Class						Process		
105	3	Counter Reset	W	USINT	NA	NA	NA	write value 1 to reset
	4	Counter Mode	RW	USINT	130	104	8	
	5	Counter Reset Enable	RW	USINT	157	104	9	
	6	Counter Value	R	REAL	122	104	1	
	7	Counter Limit	RW	REAL	124	104	3	
	8	Counter Unit	RW	SHORT_STRING	128	104	7	
	9	Counter Setpoint Mode	RW	USINT	126	104	5	
	10	Counter New Setpoint	RW	UINT	127	104	6	
	11	Counter Controller Overrun Correction	RW	REAL	274	104	10	
	12	Counter Controller Gain	RW	REAL	275	104	11	

Tab. 18. Bronkhorst Counter

For all Bronkhorst attributes: R = Service 0x0E (Get Attribute Single), W = Service 0x10 (Set Attribute Single)

5.4 Parameter data types

This section describes the data type specification syntaxes, data type value ranges and operations that can be performed on the defined data types.

Table 2-18: Subset of elementary data types

Keyword	Description	Minimum range	Maximum range
BOOL	Boolean	0	1
SINT	Short Integer	-128	127
INT	Integer	-32768	32767
USINT	Unsigned Short Integer	0	255
UINT	Unsigned Integer	0	65535
UDINT	Unsigned Double Integer	0	4294967295
REAL	Floating Point	IEEE 754 single precision floating point	
DATE	Date only	D#1972-01-01	D#2151-06-06 (65536 days)
STRING	Character string (1 byte per character)	See IEC1131-3	
SHORT_STRING	Length (1 byte) followed by STRING	See IEC1131-3	

Tab. 19. Data types

5.5 UNITS

The following units are available for Bronkhorst Meter Controllers. Note that the tables list all units that are available for all types of instruments. Not all units are available in all instruments. Therefore when selecting a unit, check if the selection is successful. When the unit can be set successfully, the unit is valid for the instrument.

5.5.1 Generic

Value	CIP Unit	Description
0x1001	Counts	See full scale of object for limit value
0x1007	Percent	0-100%

Tab. 20. Generic units

5.5.2 Temperature

Value	CIP Unit	Description
0x1200	°C	degree Celsius
0x1201	°F	degree Fahrenheit
0x1202	K	Kelvin

Tab. 21. temperature units

5.5.3 Pressure

Value	CIP Unit	Description
0x1300	psi	pound-force per square inch (psi)

Value	CIP Unit	Description
0x1301	Torr	torr
0x1303	mmHg (0°C)	millimeter of mercury (at 0°C)
0x1304	inHg (0°C)	inch of mercury (at 0°C)
0x1305	cmH2O (25°C)	centimeter of water (at 25°C)
0x1306	inH2O (25°C)	inch of water (at 25°C)
0x1307	bar	bar
0x1308	mbar	Millibar
0x1309	Pa	pascal
0x130A	kPa	kilopascal
0x130B	atm	standard atmosphere
0x130D	mmH2O (25°C)	millimeter of water (at 25°C)
0x130E	hPa	hectopascal
0x1310	mH2O (68°F)	meter of water (at 68°F)
0x1312	MPa	megapascal
0x1313	gf/cm ²	gram force per square centimeter
0x1314	kgf/cm ²	kilogram force per square centimeter

Tab. 22. Pressure units

5.5.4 Flow

The Standard and Normal units in CIP refer to the Standard set by SEMI, which defines standard conditions as 101.325 kPa absolute pressure (14.6959 psia) and a temperature of 0°C (32°F). Normal conditions are defined as 101.325 kPa absolute pressure (14.6959 psia) and a temperature of 20°C (68°F).

Units without the standard (S), or normal (N) prefix refer to Custom conditions.

Value	CIP Unit	Description
0x1400	SCCM	standard cubic centimeter per minute
0x1401	SLM	standard liter per minute
0x1402	CFM	cubic foot per minute
0x1404	kg/s	kilogram per second
0x1405	m3/s	cubic meter per second
0x1406	l/s	liter per second
0x1407	ml/s	milliliter per second
0x140E	mg/min	milligram per minute
0x140F	g/min	gram per minute
0x1410	kg/h	kilogram per hour
0x1411	ml/m	milliliter per minute
0x1412	ml/h	milliliter per hour
0x1413	l/m	liter per minute

Value	CIP Unit	Description
0x1414	l/h	liter per hour
0x142A	cm ³ /h	cubic centimeter per hour
0x142B	cm ³ /min	cubic centimeter per minute
0x142C	cm ³ /s	cubic centimeter per second
0x1432	m ³ /h	cubic meter per hour
0x1433	m ³ /min	cubic meter per minute
0x1436	g/h	gram per hour
0x1437	g/s	gram per second
0x1445	kg/min	kilogram per minute
0x1451	Nm ³ /h	normal cubic meter per hour
0x1452	Nm ³ /min	normal cubic meter per minute
0x1453	Nm ³ /s	normal cubic meter per second
0x1455	l/h	normal liter per hour
0x1456	l/min	normal liter per minute
0x1457	l/s	normal liter per second
0x145E	Sm ³ /h	standard cubic meter per hour
0x145F	Sm ³ /min	standard cubic meter per minute
0x1460	Sm ³ /s	standard cubic meter per second
0x1466	ft ³ /h	cubic foot per hour
0x1467	ft ³ /s	cubic foot per second
0x146C	SCFS	Standard cubic foot per second
0x146D	SCFM	Standard cubic foot per minute
0x146E	SCFH	Standard cubic foot per hour
0x1486	SLH	Standard liter per hour
0x1487	SLS	Standard liter per second

Tab. 23. Flow units

6 Object properties

Addressing a PROFINET IO-Device is done by using a device name and IP address.

6.1 Profile objects

All profile objects with the Data Type and Data Unit parameters, have to option to switch certain parameters to a different data type or unit. The data type and unit can be changed only when the device is not in Executing state.

The data type can be switched between INT (0xC3) and REAL (0xCA). The default type is INT. Performing a reset service will reset all data type and data units to default. Connecting to an IO connection of a certain type will set the data type of all classes to the data type of the connection.

The data unit can be changed as well. For the S-Analog Sensor and the S-Single Stage Controller classes see the unit list in Chapter 5.5 Units. For the S-Analog Actuator class only the units Counts (0x1001) and Percentage (0x1007) are available.

6.2 Supervisor object

6.2.1 Safe state

The safe state is active when the device is not in the EXECUTING state. In safe state, the valve will go the safe value configured in the analog actuator object. The device will move to executing state automatically upon establishment of an IO connection, or can be moved manually by sending the Start service to the Supervisor object.

When a network error is detected while the device is in Executing state, it is set back to the Idle or Critical Fault state. In those states the valve is set to the Safe state (see attribute Safe State in Analog Actuator object). Such errors are shown by the LED's on the instrument. See the chapter "Troubleshooting"

6.2.2 Exception Status

Exception status is a single byte which indicates the status of alarms and warnings. The expanded method of alarm messaging is used, therefore bit 7 of this parameter is always set (128, 0x80, is therefore the normal, all ok, value). Bit 1 is used to indicate that a device alarm is active. Device alarms include the Analog Sensor High/Low Trip point alarms. When the alarm is active the exception status parameter value will be 130, or 0x82. For information about which alarm is active, read the alarm status parameter of the Analog Sensor object.

Bit	Description
0	Alarm device common
1	Alarm device specific
2	Alarm manufacturer specific
3	Reserved
4	Warning device common
5	Warning device specific
6	Warning manufacturer specific

Object properties

Bit	Description
7	1 = expanded method

Tab. 24. Exception status

6.3 Single stage controller

6.3.1 Control mode

The Control Mode is implemented as follows:

Control Mode	Actuator Value
0 (Normal)	set by attribute 6 (setpoint)
1 (Close)	0
2 (Open)	max. value
3 (Hold)	last used value
4 (Safe state)	safe value, (safe state attribute)

Tab. 25. Control mode

When Override attribute of Analog actuator (object 0x32, attribute 0x05) is set to a value other than 0, this attribute will override the Control Mode attribute.

6.4 Analog sensor object

6.4.1 Alarm enable

Attribute Alarm enable of Analog Sensor object is linked to propr 97;3 (Alarmmode).

Propr	EtherNet/IP
Alarm mode	Alarm enable
proc 97; par 3	obj 0x31, attr 8
ALRM_OFF (ALRM_RESPONSE) (ALRM_POWERFAILURE)	0 (off)
ALRM_MINMAX	1 (on)

Tab. 26. Alarm enabled

When 0 is written to Alarm enable attribute, the internal alarm mode is always set to ALRM_OFF. The modes ALRM_RESPONSE and ALRM_POWERFAILURE can be set using the 'Alarm Mode' attribute of the Bronkhorst Alarm Class (see chapter 5.3.11 Bronkhorst Alarm)

More information can be found in the manual "917023 Operational instructions digital instruments" This document can be found at: http://www.bronkhorst.com/en/downloads/instruction_manuals/

6.4.2 Alarm Trip Points

The Alarm Trip Point High and Low are set in the same unit and data type as the sensor measurement value (analog sensor data unit and type).

A value outside the valid range is rounded to the nearest value within the range. Note that the Trip Point values are dependent on the selected data types/units.

6.4.3 Gas calibration object instance

Indicates which Gas Calibration object instance is active for this object. The value of this attribute is equal to (fluid index + 1). Value 0 is not supported.

6.5 Analog actuator object instance

6.5.1 Actuator value

The followings data units are supported:

0x1001 (counts): 0 = valve closed, 32767 = valve fully open

0x1007 (percent): 0 = valve closed, 100 = valve fully open

The following data types are supported: 0xC3 (int) 0xCA (real)

6.5.2 Override

The Override attribute is implemented as follows:

Override	Value to Valve
0 (Normal)	set by attribute 6 (Actuator Value)
1 (Zero)	0
2 (Maximum value)	max. value
3 (Hold)	last used value
4 (Safe state)	See section 6.5.3.

Tab. 27. Override

6.5.3 Safe state

In the following table the implemented values of the Valve output are shown:

Safe state	Value to Valve
0 (zero/off)	0
1 (full scale/on)	max. value
2 (hold last value)	last used value
3 (use safe value)	Safe value (See section 5.3.4)

Tab. 28. Safe state

6.6 Gas calibration object instance

6.6.1 Gas standard number

The retrieval of the gas standard number is implemented as follows: the first 2 characters of the fluid name are interpreted as a decimal number. This number is returned as the gas standard number.

6.6.2 Gas Symbol

The fluid name is returned as the Gas Symbol.

6.7 Serial number

The EtherNet/IP serial number (attribute 6 of Identity object) is a unique unsigned 32 bit integer value, and is generated from the Serial Number parameter of the instrument.

MY2020RNN

The M or other first character is omitted. The year number is converted modulo 43. The 2 is omitted.

The order number is added.

The NN is converted to a number where A = 1, AA = 27, and ZZ = 702.

Examples:

Product serial number	EtherNet/IP serial number
M18212645A	1812645001
M18212645Z	1812645026
M19209539AA	1909539027
M19210764ZZ	1910782702

Tab. 29. Safe state

7 **Faults and Error handling**

7.1 **Product LED indications**

- ▶ See applicable device information in the online available manuals.
- ▶ For download information, see the back cover of this manual.

7.2 **BUS diagnostics**

The Fieldbus1 Diagnostics parameter offers diagnostic information about the Ethernet/IP™ interface on the product.

Format string - sAAecBBBBleCCCCscDDDDIsEEEEpsF		
Parameter ID - 202		
Field	Name	Description
DS	Device state	NMT state
MS	Module state	Error code count
NS	Network state	Last error code
AI	Active input assembly	Status code count
AT	Active assembly type	Last status code
CC	Connection count	Port status
RS	Rotary Status	

Tab. 30. Bus diagnostics

7.3 **Factory reset**

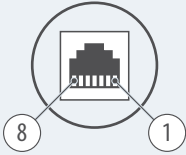
A Ethernet/IP™ factory reset of the device, sets the IP address, subnetmask, gateway and device name to their default values.

The Ethernet/IP™ factory reset does not apply to the device functions.

8 Appendix

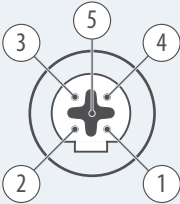
8.1 Pinout Ethernet/IP™

Pinout RJ45 connector

 10007-37-002					
Pin			Pin		
1	Transmit +		5	--	
2	Transmit -		6	Receive -	
3	Receive +		7	--	
4	--		8	--	

Tab. 31. Legend RJ45 connector

Pinout M12 D-coded male

 10007-37-002					
Pin			Pin		
1	Transmit +		4	Receive -	
2	Receive +		5	--	
3	Transmit -				

Tab. 32. Legend M12 D-coded male



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Service & Support



Contact



Downloads



Bronkhorst High-Tech B.V.
Nijverheidsstraat 1a
NL-7261 AK Ruurlo, The Netherlands

+31 573 45 88 00
info@bronkhorst.com
www.bronkhorst.com