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Instruction manual
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EtherNet/IP™ interface for Mass Flow / Pressure instruments

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ATTENTION

Please read this instruction manual carefully before installing and operating the instrument.
Not following the guidelines could result in personal injury and/or damage to the equipment.



Disclaimer

The information in this manual has been reviewed and is believed to be wholly reliable. No responsibility, however, is assumed for inaccuracies. The material in this manual is for information purposes only.

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Symbols



Important information. Discarding this information could cause injuries to people or damage to the instrument or installation.



Helpful information. This information will facilitate the use of this instrument.



Additional info available on the internet or from your local sales representative.

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 the instructions in this manual and that they are not subjected to abuse, physical damage or contamination.

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 paragraph 9 of the Conditions of sales:
http://www.bronkhorst.com/files/corporate_headquarters/sales_conditions/en_general_terms_of_sales.pdf*

The warranty includes all initial and latent defects, random failures, and undeterminable 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 party of the service is performed under warranty, unless otherwise agreed upon beforehand. However, if the product has been returned collect to our factory or service center, these costs are added to the repair invoice. Import and/or export charges, foreign shipping methods/carriers are paid for by the customer.

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1 GENERAL PRODUCT INFORMATION

1.1 INTRODUCTION

The EtherNet/IP interface offers a direct connection to EtherNet/IP Networks for Bronkhorst® digital mass-flow/pressure meters/controllers according to the Mass Flow Controller Profile specified by the ODVA.



This manual will explain how to install and operate a Bronkhorst® instrument to your EtherNet/IP system, and provides an overview of all instrument parameters available on EtherNet/IP.

1.2 REFERENCES TO OTHER APPLICABLE DOCUMENTS

Manuals and guides for digital instruments are modular. General instructions give information about the functioning and installation of instruments. Operational instructions explain the use of the digital instruments features and parameters. Field bus specific information explains the installation and use of the field bus installed on the instrument.

1.2.1 Manuals and user guides:

General instructions Instrument type based	Operational instructions	Field bus specific information
Document 9.17.022 Bronkhorst® General instructions digital Mass Flow / Pressure	Document 9.17.023 Operational instructions for digital multibus Mass Flow / Pressure instruments	Document 9.17.024 FLOW-BUS interface
Document 9.17.031 Bronkhorst® General instructions CORI-FLOW		Document 9.17.025 PROFIBUS DP interface
Document 9.17.050 Bronkhorst® General instructions mini CORI-FLOW		Document 9.17.026 DeviceNet interface
Document 9.17.044 Bronkhorst® General instructions digital LIQUI-FLOW L30		Document 9.17.035 Modbus interface
Document 9.17.104 / 9.17.105 Bronkhorst® Instruction manual MASS-STREAM D-6300		Document 9.17.027 RS232 interface with FLOW-BUS protocol
		Document 9.17.063 EtherCAT interface
		Document 9.17.095 PROFINET interface
		Document 9.17.131 CANopen
		Document 9.17.132 EtherNet/IP
		Document 9.17.142 POWERLINK interface

1.2.2 Technical Drawings:

Hook-up diagram laboratory-style EtherNet/IP	(document nr. 9.16.215)
Hook-up diagram ML-series EtherNet/IP	(document nr. 9.16.222)
Hook-up diagram ES-FLOW Ethernet interfaces	(document nr. 9.16.251)
Hook-up diagram Industrial Ethernet M12	(document nr. 9.16.253)

1.2.3 *Software tooling:*

Bronkhorst FlowWare tools can be used to configure the address and baud rate of your Modbus instrument. Please refer to the Bronkhorst website for more details.



Bronkhorst FlowWare software tools can be acquired at
<http://www.bronkhorst.com/en/downloads>

2 QUICK START

By following these steps, you will quickly get your Bronkhorst EtherNet/IP device up and running. The following steps are generalized, and not specific to a type of PLC. For more detail on the steps, see the following chapters or refer to the chapters mentioned in the steps below. These will also show some of these steps with screenshots for two different pieces of PLC software (CODESYS and RSLogix5000).

1. Configure the device with the desired address (see chapter 3.3 Address configuration). DHCP is used by default.
2. Load the Bronkhorst EtherNet/IP EDS file (Bronkhorst_Meter_Controller_EtherNetIP.eds) into the PLC software.
3. Add the Bronkhorst Meter Controller device to the EtherNet/IP Scanner in the PLC.
 - Optionally some PLCs offer a scan function to check for devices on the network. This requires a live connection to the PLC, and the instrument should be connected to the EtherNet/IP interface of the PLC.
4. Set the address of the device to the address configured in step 1.
5. Select the desired IO Connection. This is usually one of the first options presented on the device page. A Bronkhorst Meter Controller offers 4 predefined IO connections that make use of the available Assemblies:
 - Basic (INT)
 - Extended (INT)
 - Basic (REAL)
 - Extended (REAL)

These offer the parameter sets basic and extended in the data types INT and REAL. The data type only applies to the Flow, Setpoint, and Valve parameters, the Status and Override parameters are USINT.

The parameters in the basic and extended set are:

Set	Direction (seen from instrument)	Parameter
Basic	In	Setpoint
	Out	Status
		Flow
Extended	In	Override
		Setpoint
	Out	Status
		Flow
		Setpoint
		Override
Valve		

For details about the assemblies and parameters, see chapter 5.1 IO connections.

6. Set the desired configuration parameters. Most commonly used are:
 - Analog Sensor Gas Calibration Object Instance, which selects the active fluid.
 - Analog Sensor Data Unit, which sets the unit of the measure parameter. The default is counts, where 0 – 32000 is 0 – 100% full scale.
 - Single Stage Controller Data Unit, which sets the unit of the Setpoint parameter. The default is counts, where 0 – 32000 is 0 – 100% full scale.

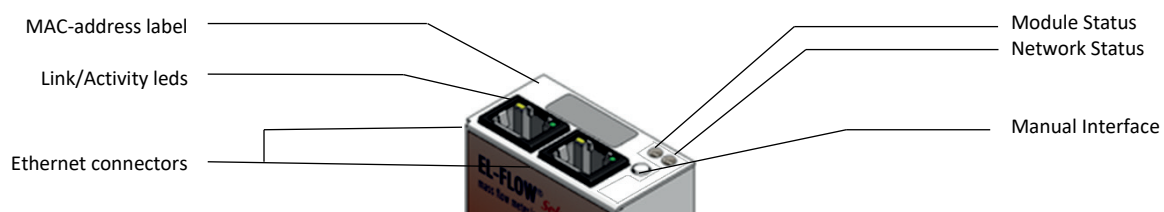
For the full options for these parameters, either use the options provided in the PLC tool (availability depends on PLC tool used) or the Data Unit options table in chapter 5.3.3 S-Analog Sensor Object. **Note: not all units are available on all instruments; availability depends on the sensor type of the instrument.**

7. With the instrument fully setup in the PLC, compile the program and load it into the PLC. Most PLCs will show the actual device parameters in the device overview in the PLC software. Here you can check that the expected values are received.


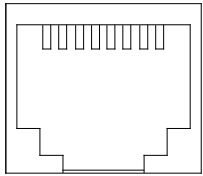
3 ETHERNET/IP INSTALLATION


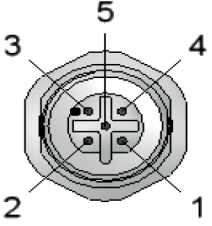
This chapter will get your instrument connected to power and to the network.

3.1 INSTRUMENT OVERVIEW



Ethernet connectors

RJ45 connector	Receptacle	Pin number	Description
		1	TX+
		2	TX-
		3	RX+
		4	Not used
		5	Not used
		6	RX-
		7	Not used
		8	Not used

M12 –D coded male Connector	Receptacle	Pin number	Description
		1	Transmit +
		2	Receive +
		3	Transmit -
		4	Receive -
		5	Not used

3.2 ETHERNET CABLING

For a robust communication in industrial environments it is advised to use high quality shielded Ethernet cable capable of Full Duplex 100Mbit communication.



More information about EtherNet/IP cabling can be found in the “Media Planning and Installation Manual” available at www.odva.org.



According to IEC 802.3 the maximum cable length for 100 Mbit Ethernet is 100 meters (100BaseT) between two nodes.

Example of POWERINK cable with M12-D-coded



3.3 ADDRESS CONFIGURATION

The address can be changed via EtherNet/IP, Propar/FlowDDE, or the rotary switches. The default address source is DHCP. Using DHCP an address can be assigned to the instrument, allowing the network configuration to be changed via EtherNet/IP (in the TCP/IP object).

When no DHCP server is available the address can be set via:

- BOOTP, by changing the mode rotary switch to BOOTP.
- STATIC, by changing the mode rotary switch to STATIC.

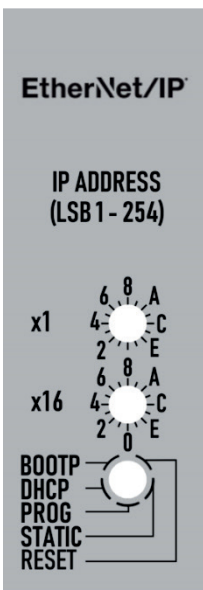
When set to STATIC the instrument will be available in the default range of 192.168.19.100. In this mode the LSB of the IP Address can be set using the IP Address rotary switches.

Alternatively, the network can be configured to a static address via software using the RS232 interface on the instrument (using FlowDDE, or another tool using the Propar protocol). With the rotary switches set to PROG, a static range can be configured by writing to the “Fieldbus1 IP Address” parameter (parameters for the Subnet Mask and Gateway Address are also available for configuration, and should also be configured properly).

Optionally the instrument can be delivered pre-set to a desired static address range, which allows the LSB of the IP Address to be set using the rotary switches.

When the address configuration is lost, and no RS232 or Ethernet connection can be made to recover the address, the RESET option of the mode rotary switch can be used. By switching to this mode, and power-cycling, the instrument will restore the default network settings (this will erase all network address settings made previously, including any custom delivered static address). After performing the reset the rotary switches must be set to the desired mode (PROG for default mode), as leaving the rotary set to RESET will keep resetting the values on each power-up.

All rotary switch address mode or IP Address LSB changes require the instrument to be power-cycled before they are applied. The LSB of the IP address can only be set by rotaries, when the network mode is set to STATIC (either set by software or by the address mode rotary switch).



3.3.1 PROPAR/FlowDDE

For the configuration of IP addresses via Propar/FlowDDE, the following parameters are available on the instrument:

Name	DDE	Process	Parameter	Type	Description
Fieldbus1 IP Address	390	125	14	string	IP address. When no address configured value is 0.0.0.0 (DHCP). When writing an IP address, addressing mode switches to static. When rotaries are not set to 0, the last byte of the IP address is set by the rotaries. <i>Writing 0.0.0.0 will enable DHCP (only when rotaries are set to 0).</i>
Fieldbus1 Subnet Mask	391	125	15	string	Subnet mask for the IP address.
Fieldbus1 Gateway Address	392	125	16	string	IP address of the gateway.

When changing the configuration via PROPAR, the new settings are **not** automatically applied. A restart is needed (power-cycle or soft-reset) for the settings to be applied.

3.3.2 EtherNet/IP

For configuration of the address via EtherNet/IP use the parameters in the “Configuration Control” and the “Interface Configuration” attributes of the TCP/IP object of the device (object 0xF5, attributes 0x03 and 0x05). These parameters can be accessed from the PLC or from a special tool for configuring EtherNet/IP devices such as the Molex EtherNet/IP Tool.

When changing the configuration via EtherNet/IP, the new settings are automatically applied when written. Therefore communication with the configuration tool may be lost.

4 INSTRUMENT CONFIGURATION

4.1 INSTRUMENT EDS-FILE

We provide an EDS file for our flow/pressure meter/controllers for EtherNet/IP, to offer easy access to the IO connections and configuration parameters/options available for Bronkhorst instruments. The generic EDS file for EtherNet/IP is called is called: **Bronkhorst_Meter_Controller_EtherNetIP.eds**. This EDS-file is a text-file which contains information about the options of EtherNet/IP interface of the instrument.

The following information is included in the EDS file:

Identification

- 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 that are included in the IO data.
 - Status
 - Flow
 - Setpoint
 - Override
 - Valve
- Parameters available for additional configuration.
- Non-Profile parameters.

Assemblies

- 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



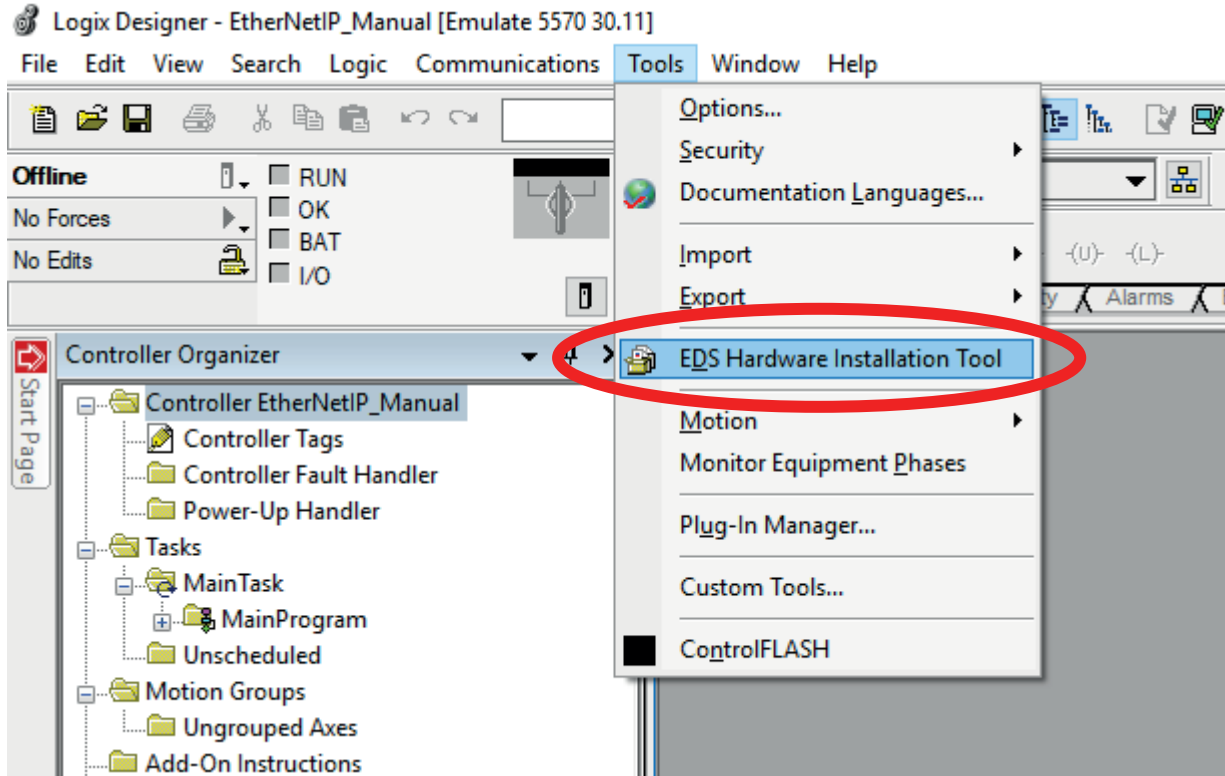
The latest version of the **Bronkhorst_Meter_Controller_EtherNetIP.eds** file can be found in the **BRONKHORST FIELDBUS FILES** section on the *Software Downloads* page of the Bronkhorst website at: <http://www.bronkhorst.com/download>

4.2 LOADING EDS FILE

The following images will show how to import the EDS file into the PLC software. For the examples we use RSLogix 5000 and CODESYS.

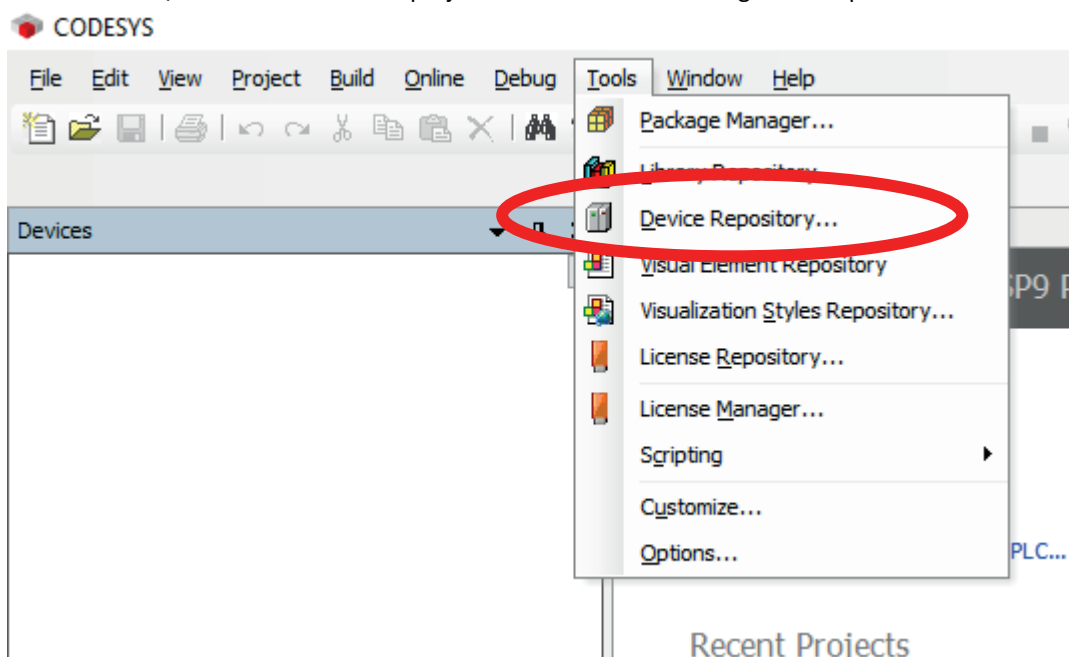
4.2.1 RSLogix 5000

Open the “EDS Hardware Installation Tool” and follow the steps in the EDS Wizard to import the Bronkhorst Meter Controller EDS file.



4.2.2 CODESYS

Open the “Device Repository” and import the EDS file into the appropriate repository. The device can now be added to an EtherNet/IP Scanner in the PLC project via the “Add Device” right-click option on the scanner.



4.3 ADD ETHERNET/IP DEVICE TO CONFIGURATION



In next paragraphs some example screens will be showed of a master configuration tool to explain how to install a Bronkhorst® meter/controller EtherNet/IP slave. Examples are given for RSLogix5000 and CODESYS.

4.3.1 RSLogix5000

Right click on the Ethernet interface and click on add module. Select the Bronkhorst Meter Controller from the selection window, and click Create to add the module to the configuration.

Select Module Type

Catalog Module Discovery Favorites

Enter Search Text for Module Type... Clear Filters Hide Filters ^

Module Type Category Filters
 Analog
 CIP Motion Converter
 Communication
 Communications Adapter
 Controller

Module Type Vendor Filters
 Allen-Bradley
 Advanced Energy Industries, Inc.
 Bronkhorst High-Tech B.V.
 Endress+Hauser
 FANUC CORPORATION

Catalog Number	Description	Vendor	Category
0005_007B_0030	SP600	Reliance Electric	DPI to EtherNet/IP
0005_007B_0038	SP600 ER 400V	Reliance Electric	DPI to EtherNet/IP
0005_007B_0039	SP600 ER 200V	Reliance Electric	DPI to EtherNet/IP
0005_007B_003A	SP600 ER 600V	Reliance Electric	DPI to EtherNet/IP
0005_007B_0060	Liquiflo 2.0	Reliance Electric	DPI to EtherNet/IP
0005_007F_0027	MD60	Reliance Electric	MDI to EtherNet/IP
0005_007F_0028	MD65	Reliance Electric	MDI to EtherNet/IP
02C2_001A_0007	Bronkhorst Meter Controller	Bronkhorst High-Tech B.V.	Mass Flow Controller
1305-ACDrive-EN1	AC Drive via 1203-EN1	Allen-Bradley	Drive
1336E-IMPACTDrive-EN1	AC Drive via 1203-EN1	Allen-Bradley	Drive
1336F-PLUSIIIDrive-EN1	AC Drive via 1203-EN1	Allen-Bradley	Drive
1336R-REGENBrake-EN1	Brake via 1203-EN1	Allen-Bradley	Drive
1336S-PLUSDriveLG-EN1	007-600 HP Code AC Drive via 1203-EN1	Allen-Bradley	Drive
1336S-PLUSDriveSM-EN1	F05-F100 HP Code AC Drive via 1203-EN1	Allen-Bradley	Drive

468 of 468 Module Types Found Add to Favorites

Close on Create

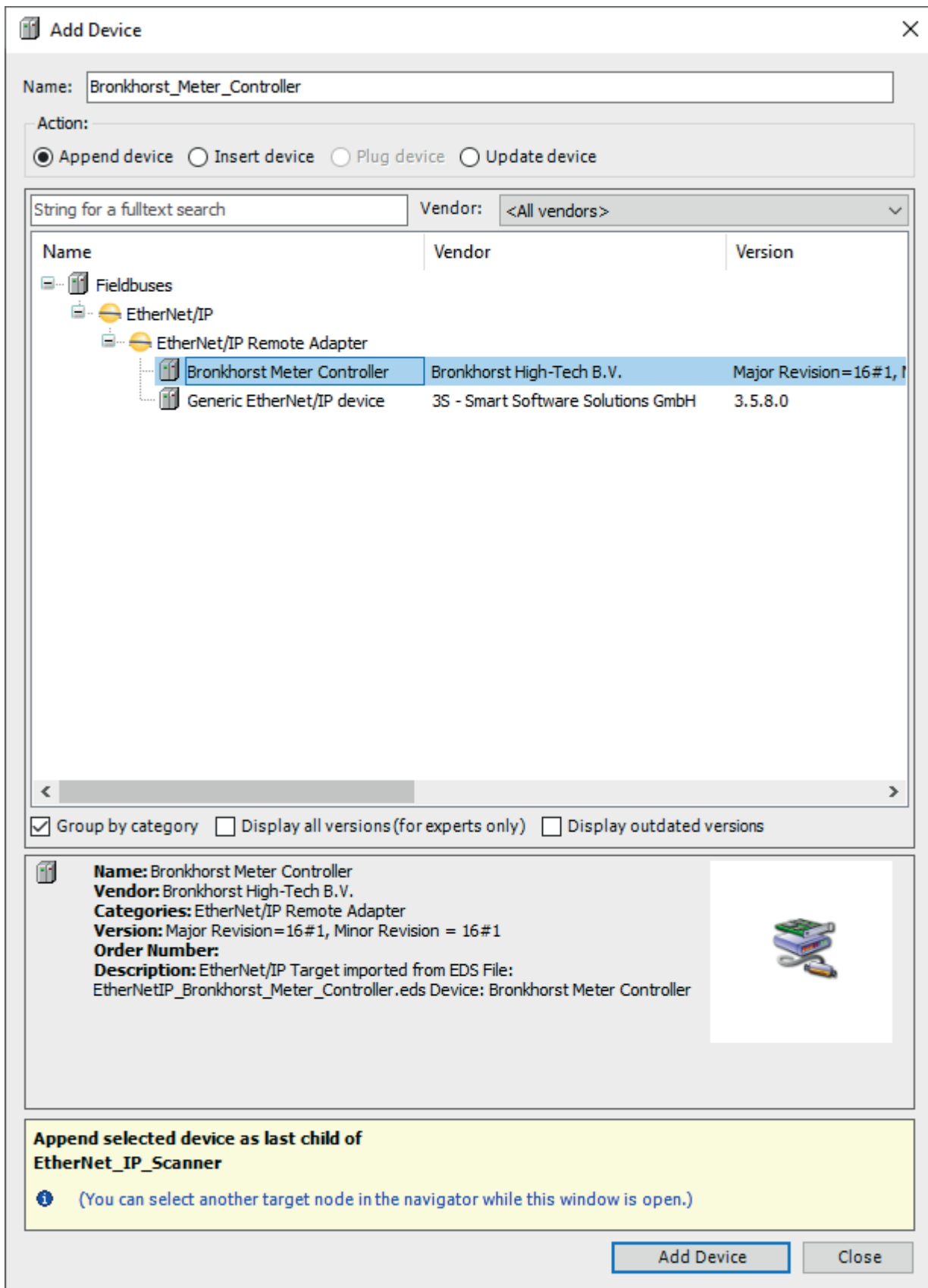
Create Close Help

On the New Module screen, configure the IP address as well as the desired IO connection for the device.

The image shows a software dialog box titled "New Module" with a close button (X) in the top right corner. The dialog has several tabs: "General", "Connection", "Module Info", "Internet Protocol", "Port Configuration", and "Network". The "Network" tab is currently selected. The "General" section contains the following information: Type: Bronkhorst Meter Controller, Vendor: Bronkhorst High-Tech B.V., Parent: ENET, Name: (empty text box), and Description: (empty text area). The "Ethemet Address" section has three radio button options: "Private Network:" (with a dropdown menu showing "192.168.1."), "IP Address:" (which is selected and circled in red), and "Host Name:" (with an empty text box). The "Module Definition" section shows: Revision: 1.001, Electronic Keying: Compatible Module, and Connections: Basic (INT). A "Change ..." button is located at the bottom of this section. At the bottom of the dialog, the status is "Status: Creating" and there are three buttons: "OK", "Cancel", and "Help".

4.3.2 CODESYS

Right click the EtherNet/IP Scanner and click on Add Device. Select the Bronkhorst Meter Controller and click on Add Device to add the module to the configuration.



On the device configuration page (shown when double clicking on the added device in the Device tree view), configure the address of the device in the General page.

The screenshot shows the configuration page for a Bronkhorst Meter Controller. The interface includes a breadcrumb trail at the top: Ethernet > EtherNet_IP_Scanner > Bronkhorst_Meter_Controller x. On the left is a navigation sidebar with the following items: General (selected), Connections, Assemblies, User-Defined Parameters, EtherNet/IP I/O Mapping, EtherNet/IP IEC Objects, Status, and Information. The main content area is titled 'Address Settings' and features the EtherNet/IP logo. The 'IP Address' field is set to '192 . 168 . 0 . 2' and is circled in red. Below this is the 'Electronic Keying' section, which includes 'Keying Options' with radio buttons for 'Compatibility Check' and 'Strict Identity Check' (selected). There are five checked checkboxes for device verification: 'Check Device Type' (value 26), 'Check Vendor Code' (value 706), 'Check Product Code' (value 7), 'Check Major Revision' (value 1), and 'Check Minor Revision' (value 1). A 'Restore default values' button is located at the bottom of the keying options.

4.4 SELECT IO CONNECTION

Select the desired IO connection for this device. Choice is between the parameters in the connection, Basic or Extended, and the data type of some of the parameters, INT or REAL. For the full contents of the IO connections and assemblies, see Chapter 5.1 IO connections.

4.4.1 RSLogix5000

The 'New Module' dialog box shows the following configuration:

- Type: Bronkhorst Meter Controller
- Vendor: Bronkhorst High-Tech B.V.
- Parent: ENET
- Name: [Empty text box]
- Description: [Empty text area]
- Ethernet Address:
 - Private Network: 192.168.1. [Spinners]
 - IP Address: [IP Address text box]
 - Host Name: [Host Name text box]
- Module Definition:
 - Revision: 1.001
 - Electronic Keying: Compatible Module
 - Connections: Basic (INT)

The 'Change ...' button is circled in red.

The 'Module Definition' dialog box shows the following configuration:

- Revision: 1 [Dropdown] 001 [Spinners]
- Electronic Keying: Compatible Module [Dropdown]
- Connections:

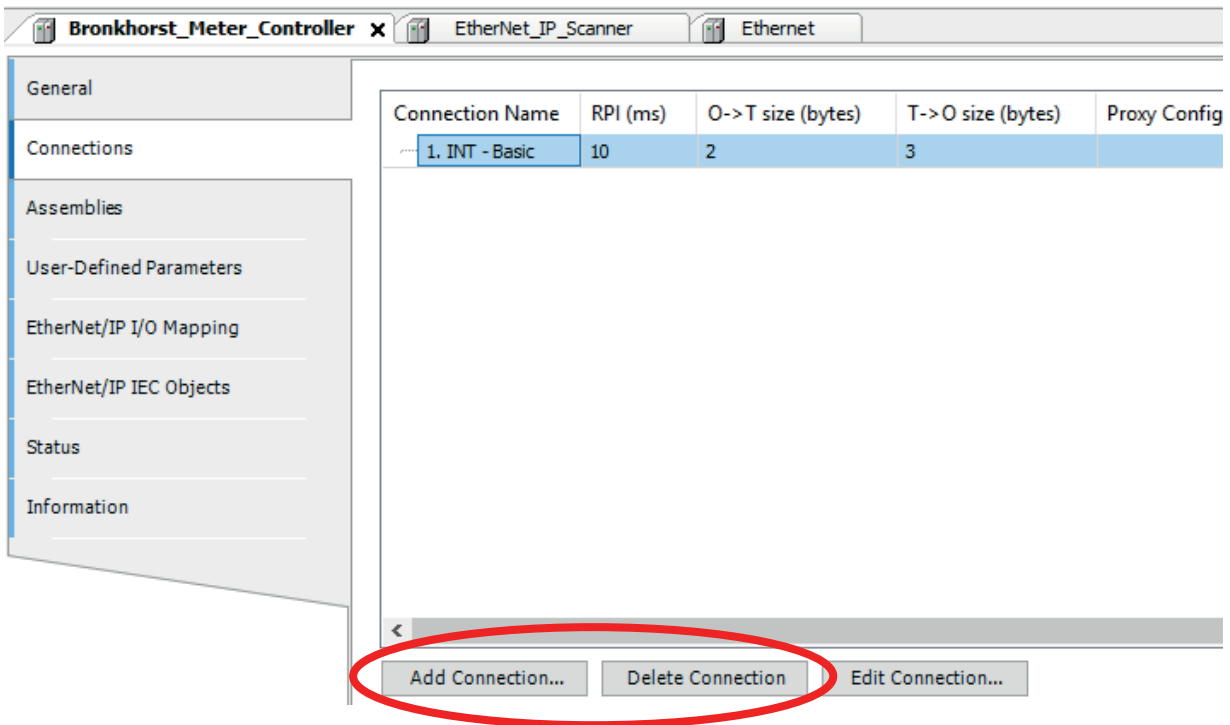
Name	Input	Size	Tag Suffix
Basic_INT	Input: 3	SINT	1 I1
	Output: 2		O1

The dropdown menu for 'Basic_INT' is open, showing the following options:

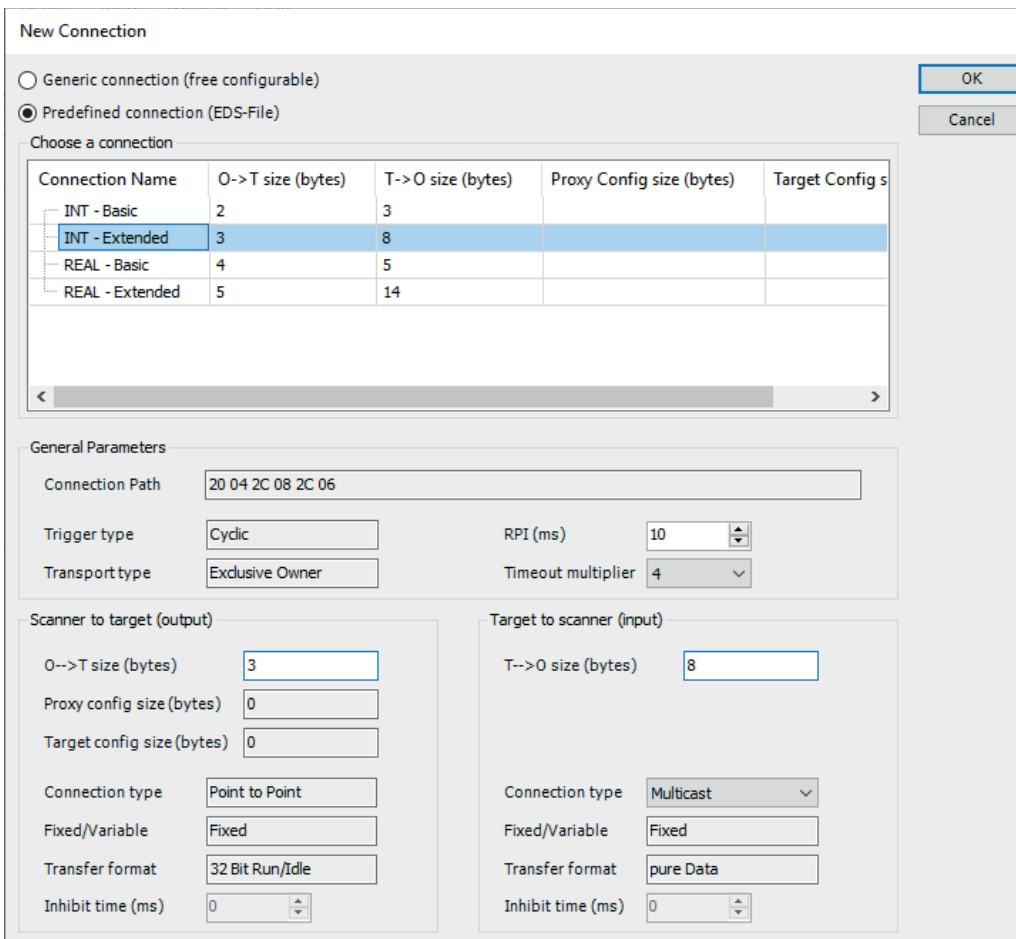
- Basic_INT
- Extended_INT
- Basic_REAL
- Extended_REAL

4.4.2 CODESYS

Navigate to the Connections page of the device page and delete the default IO Connection (Basic INT), if another connection is desired.



When the connection is deleted, click on Add Connection to select a new connection. In the New Connection window, select the desired connection and click OK to add the connection to the configuration of the device.



The Assemblies configuration page will show the contents of the selected IO connections, with the Input and Output assemblies built from the device parameters.

The screenshot shows the configuration software interface for the Bronkhorst Meter Controller. The 'Assemblies' page is active, displaying the following data:

Connections Table:

Connection Name	O->T size (bytes)	T->O size (bytes)	Proxy Config size (bytes)	Target Config size (bytes)
1. INT - Extended	3	8		

Output Assembly "I-Override/Setpoint" (O->T):

Name	Data Type	Bitlength	Help String
Override	USINT	8	
Setpoint	INT	16	

Input Assembly "O-Status/Flow/Setpoint/Override/Valve" (T->O):

Name	Data Type	Bitlength	Help String
Status	USINT	8	
Flow	INT	16	
Setpoint	INT	16	
Override	USINT	8	
Valve	UINT	16	

To connect the IO parameters to PLC variables, configure the IO Mapping in the EtherNet/IP I/O Mapping page of the device configuration.

4.5 CONFIGURATION PARAMETERS

4.5.1 RSLogix5000

RSLogix5000 does not offer the functionality to send parameters to the instrument prior to connection setup. Instead a custom program in the PLC is required. Alternatively some of the parameters (the non-volatile parameters) can be changed using a separate tool (EtherNet/IP tool).

The primary parameters are the Data Unit for the Sensor, Actuator, and Controller classes. These affect the unit of the Measure, Setpoint, and Valve values in the IO data.

By default the data unit is set to counts. If another unit is desired, set the unit for the desired class. The value will be stored and will persist. When connecting the IO, the values will use the new data unit.

4.5.2 CODESYS

The screenshot shows a software window titled "Bronkhorst_Meter_Controller". On the left is a navigation pane with the following items: General, Connections, Assemblies, User-Defined Parameters (highlighted), EtherNet/IP I/O Mapping, EtherNet/IP IEC Objects, Status, and Information. The main area displays a table of user-defined parameters.

Line	Name	Value	Unit	Bitlength	Abort if error
1	Single Stage Controller Data Unit	4097		16	<input type="checkbox"/>
2	Analog Actuator Data Unit	4097		16	<input type="checkbox"/>
3	Analog Sensor Data Unit	4097		16	<input type="checkbox"/>
4	Analog Sensor Gas Calibration Object Instance	1		16	<input type="checkbox"/>

The User-Defined Parameters are sent before establishing the IO connection. Using the Data Unit parameters of the classes in the IO data, the unit of the Measure, Setpoint, and Valve parameters can be changed. To detect errors, use the Abort if error checkbox. This will stop configuration of the device if an error occurs here.

The data unit parameters are non-volatile, if they have been changed in a previous configuration they might not be set to defaults. Change the data unit to the desired unit using this mechanism, or perform a reset with option 1 via EtherNet/IP (reset the device to out of box settings).

5 OBJECTS AND SERVICES

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

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 and 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.

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 four 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 table list the IO connections available in the EDS file of the device.

IO Connection	Direction (seen from instrument)	Assembly	Size (bytes)	Parameter	Data Type	Size (bytes)
Basic INT	In	7	2	Setpoint	INT	2
	Out	2	3	Status	USINT	1
				Flow	INT	2
Extended INT	In	8	3	Override	USINT	1
				Setpoint	INT	2
	Out	6	8	Status	USINT	1
				Flow	INT	2
				Setpoint	INT	2
				Override	USINT	1
Valve	UINT	2				
Basic REAL	In	19	4	Setpoint	REAL	4
	Out	14	5	Status	USINT	1
				Flow	REAL	4
Extended REAL	In	20	5	Override	USINT	1
				Setpoint	REAL	4
	Out	18	14	Status	USINT	1
				Flow	REAL	4
				Setpoint	REAL	4
				Override	USINT	1
Valve	REAL	4				

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:

1. Analog Sensor Gas Calibration Object Instance : selects calibration/fluid instance.: 1...8
2. Analog Sensor Data Unit : selects data unit for analog sensor attributes (measure)
3. Analog Sensor Alarm Mode : enables or disables the alarm
4. Analog Sensor Alarm Trip Point High : sets the upper limit for the alarm
5. Analog Sensor Alarm Trip Point Low : sets the lower limit for the alarm
6. Analog Actuator Data Unit : selects data unit for analog actuator attributes (valve)
7. Single Stage Controller Data Unit : selects data unit for controller attributes (setpoint)
8. Single Stage Controller Control Mode : selects the control mode for the single stage controller

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

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

Class Code: 0x01

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)						
IDENTITY OBJECT	ATTRIBUTE	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"

IDENTITY OBJECT SERVICES			
IDENTITY OBJECT	SERVICE CODE	SERVICE 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

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)						
DEVICE SUPERVISOR OBJECT	ATTRIBUTE	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
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

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

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/manufacturer-specific
3		reserved – is set to 0
4		Warning/device-common
5		Warning/device-specific
6		Warning/manufacturer-specific
7		1 = Expanded Method

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			
SUPERVISOR OBJECT	SERVICE CODE	SERVICE 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

5.3.3 S-Analog Sensor Object

Class Code 0x31

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)						
ANALOG SENSOR OBJECT	ATTRIBUTE	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
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 REAL ¹	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



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			
ANALOG SENSOR OBJECT	SERVICE CODE	SERVICE 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

5.3.4 S-Analog Actuator Object

Class Code 0x32

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

ANALOG ACTUATOR OBJECT'S INSTANCE ATTRIBUTES (Instance = 1)						
ANALOG ACTUATOR OBJECT	ATTRIBUTE	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 REAL ¹	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	



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			
ANALOG ACTUATOR OBJECT	SERVICE CODE	SERVICE NAME	SERVICE DESCRIPTION
0x32	0x0E	Get_Attribute_Single	Returns the contents of the specified attribute
0x32	0x10	Set_Attribute_Single	Modifies an attribute value

5.3.5 S-Single Stage Controller Object

Class Code 0x33

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

CONTROLLER OBJECT'S INSTANCE ATTRIBUTES (Instance = 1)						
SINGLE STAGE CONTROLLER OBJECT	ATTRIBUTE	ATTRIBUTE NAME	SERVICE CODE	DATA TYPE	PROPAR	Comment
0x33	0x01	Number of Attributes	0x0E	USINT		6
0x33	0x02	Attribute List	0x0E	Array of USINT		
0x33	0x03	Data Type	0x0E, 0x10	USINT		0xC3=INT, 0xCA=REAL
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 REAL ¹	1,1	See attribute 3 and 4. For data unit counts the setpoint attribute must be in the range of 0..32000. Where: 0 = min. setpoint (0%) 32000 = max. setpoint (100%)
0x33	0x0A	Status	0x0E	BYTE		
0x33	0x13	Ramp Rate	0x0E, 0x10	UDINT	1,2	Setpoint slope in msec (max. 255000 msec) Resolution is seconds.



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			
SINGLE STAGE CONTROLLER OBJECT	SERVICE CODE	SERVICE NAME	SERVICE 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

Class Code 0x34

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

GAS CALIBRATION OBJECT'S CLASS ATTRIBUTES (Instance = 0)						
GAS CALIBRATION OBJECT	ATTRIBUTE	ATTRIBUTE NAME	SERVICE CODE	DATA TYPE	PROPAR	Comment
0x34	0x02	Max Instance ¹	0x0E	UINT		8

GAS CALIBRATION OBJECT'S INSTANCE ATTRIBUTES (Instance = 1...8)						
GAS CALIBRATION OBJECT	ATTRIBUTE	ATTRIBUTE NAME	SERVICE CODE	DATA TYPE	PROPAR	Comment
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.

CIP		Parameter	Access	Data Type	FlowDDE	Propar	
Class	Attribute					Process	Parameter
100	3	Actual Measure (fMeasure)	R	REAL	205	33	0
	4	Actual Setpoint (fSetpoint)	RW	REAL	206	33	3
	5	Measure (0-32000)	R	UINT	8	1	0
	6	Setpoint (0-32000)	RW	UINT	9	1	1
	7	Setpoint Slope	RW	USINT	10	1	2
	8	Actuator Output Value	RW	UDINT	55	114	1
	9	Control Mode	RW	USINT	12	1	4
	10	Device Status (alarm info/status)	R	USINT	28	1	20
	11	Temperature	R	REAL	142	33	7
	12	Pressure	R	REAL	143	33	8
	13	Density	R	REAL	270	116	15

5.3.8 Bronkhorst Advanced

CIP		Parameter	Access	Data Type	FlowDDE	Propar	
Class	Attribute					Process	Parameter
101	3	Controller Speed	RW	REAL	254	114	30
	4	Dynamic Display Filter	RW	REAL	56	117	1
	5	Static Display Filter	RW	REAL	57	117	2
	6	IO Switch Status (shutoffs)	RW	UDINT	288	114	31
	7	Analog Input	R	INT	11	1	3
	8	Frequency (CORI-Flow)	R	REAL	149	33	9
	9	Controller Hysteresis (P800)	RW	REAL	361	114	15
	10	PID-Kp	RW	REAL	167	114	21
	11	PID-Ti	RW	REAL	168	114	22
	12	PID-Td	RW	REAL	169	114	23

5.3.9 Bronkhorst Fluid Calibration

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

5.3.10 Bronkhorst Identification

CIP		Parameter	Access	Data Type	FlowDDE	Propar	
Class	Attribute					Process	Parameter
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

5.3.11 Bronkhorst Alarm

CIP		Parameter	Access	Data Type	FlowDDE	Propar	
Class	Attribute					Process	Parameter
104	3	Alarm Reset	W	USINT	NA	NA	NA
	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
	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

5.3.12 Bronkhorst Counter

CIP		Parameter	Access	Data Type	FlowDDE	Propar	
Class	Attribute					Process	Parameter
105	3	Counter Reset	W	USINT	NA	NA	NA
	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

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	

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%

5.5.2 Temperature

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

5.5.3 Pressure

Value	CIP Unit	Description
0x1300	psi	pound-force per square inch (psi)
0x1301	Torr	torr
0x1303	mmHg (0°C)	millimeter of mercury (at 0°C)
0x1304	inHg (0°C)	inch of mercury (at 0°C)
0x1305	cmH ₂ O (25°C)	centimeter of water (at 25°C)
0x1306	inH ₂ O (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	mmH ₂ O (25°C)	millimeter of water (at 25°C)
0x130E	hPa	hectopascal
0x1310	mH ₂ O (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

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).

For more information please refer to the Bronkhorst website:

<https://www.bronkhorst.com/int/blog/do-you-know-why-mass-flow-reference-conditions-matter/>

Units without the standard (S), or normal (N) prefix refer to Custom conditions which by default are the actual conditions (for ordered temperature and pressure).

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	m ³ /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
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	NI/h	normal liter per hour
0x1456	NI/min	normal liter per minute
0x1457	NI/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

6 OBJECT PROPERTIES

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	Meaning
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
7	1 = expanded method

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)

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 propar 97;3 (Alarmmode).

Propar	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)

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 number + 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.

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)

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.

MYY2ORDERNN

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 = 0, AA = 26, and ZZ = 701.

Some examples:

Bronkhorst Serial Number	EtherNet/IP Serial Number
M18212645A	1812645000
M18212645Z	1812645025
M19209539AA	1909539026
M19210764ZZ	1910782701

7 TROUBLESHOOTING

7.1 LED INDICATIONS

7.1.1 Network Status (NET)

State	Led	Indication
Not powered No address	Off	Device is not online <ul style="list-style-type: none"> The device may not be powered, look at module status LED If the device is powered, there is not IP address. Configure and address, or wait for an address to be assigned by DHCP or BOOTP (when configured).
No connections	Flashing ● green 0.5 sec on 0.5 sec off	The device is online but has no established connections.
Connected	On ● green	Device is online and has an established connection.
Connection timeout	Flashing ● red 0.5 sec on 0.5 sec off	An IO connection is in the timed-out state.
Address conflict	On ● red	The device has a duplicate IP address, which has rendered it incapable of communicating on the network.
Device self-testing	Flashing ● red / ● green 0.5 sec on 0.5 sec off	The device is performing (power-up) self-test.

7.1.2 Module Status (MOD)

State	Led	Indication
No power	Off	There is no power applied to the device
Device standby	Flashing ● green 0.5 sec on 0.5 sec off	The device needs commissioning due to configuration missing, incomplete or incorrect.
Device operational	On ● green	The device is operating in normal condition.
Minor fault	Flashing ● red 0.5 sec on 0.5 sec off	The device has a minor fault, which is recoverable. An incorrect configuration is considered a minor fault.
Unrecoverable fault	On ● red	The device has an unrecoverable fault, may need replacing.
Device self-testing	Flashing ● red / ● green 0.5 sec on 0.5 sec off	The device is performing (power-up) self-test.



More information can be found in the manual "9.17.023 Operational instructions digital instruments"
This document can be found at: http://www.bronkhorst.com/en/downloads/instruction_manuals/

7.2 BUS DIAGNOSTICS

Using the Fieldbus1 Diagnostics parameter additional information about the state of the EtherNet/IP interface on the instrument can be found.

The diagnostics string has the following format: **DSnnMSnnNSnnAI nnATnnCCnnnnRSn**

Field	Name	Description
DS	Device state	State of device supervisor.
MS	Module state	State of module (also visible on LEDs).
NS	Network state	State of network (also visible on LEDs).
AI	Active input assembly	ID of the active input assembly.
AT	Active assembly type	Type of the active input assembly (0xC3/INT or 0xCA/REAL).
CC	Connection count	Number of established connections.
RS	Rotary Status	Address mode (bit 0...2) and IP LSB used (bit 3).

8 SERVICE

For current information on Bronkhorst® and service addresses please visit our website:

 <http://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, our Customer Service Department is available with help and guidance. To contact CSD by e-mail:

 aftersales@bronkhorst.com

No matter the time zone, our experts within the Support Group are available to answer your request immediately or ensure appropriate further action. Our experts can be reached at:

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