Instruction manual

POWERLINK® slave interface for digital multibus Mass Flow / Pressure instruments

Doc. no.: 9.17.142B Date: 30-11-2022

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.

Bronkhorst®

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.

Copyright

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:
www.bronkhorst.com/about/conditions-of-sales

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 centre, 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 POWERLINK interface offers a direct connection to POWERLINK networks for Bronkhorst® digital mass-flow/pressure meters/controllers by supporting the CiA® 404 device profile for measuring devices and closed-loop controllers. This manual is limited to the description of the interface between the POWERLINK Mass Flow Controller with a POWERLINK managing node.

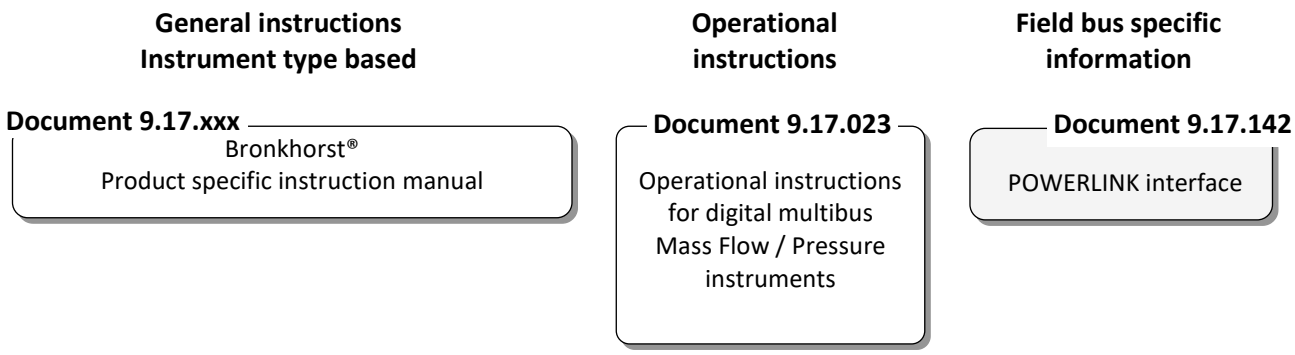
This manual will explain how to install and operate a Bronkhorst® instrument in your POWERLINK system.

Information about POWERLINK can be found on the website of the "Ethernet POWERLINK Standardization Group" organization. http://www.ethernet-powerlink.org/

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:*



All these documents can be found at:
http://www.bronkhorst.com/en/downloads

2 QUICK START

By following these steps, you will quickly get your Bronkhorst POWERLINK 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 B&R Automation Studio.

1. Configure the device to the desired Node-ID, using the rotary switches or software. (see Chapter 3.6 Node-ID).

2. Load the Bronkhorst POWERLINK XDD file (000004A5_Bronkhorst_Meter_Controller_POWERLINK.xdd) into the PLC software. Download link: http://www.bronkhorst.com/int/products/accessories-and-software/flowware/powerlink-xdd/

3. Add the Bronkhorst Meter Controller device to the POWERLINK master 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 POWERLINK interface of the PLC.

4. Set the Node-ID of the Bronkhorst Meter Controller in the PLC configuration to the Node-ID configured in step 1.

5. Configure the process data objects (PDOs) to contain the desired parameters. By default the RPDO and TPDO do not contain any configuration. There is one RPDO and one TPDO.
    - When using the profile objects, it is recommended to not use Propar objects that internally map to the same parameter (and vice versa). See Chapter 5.3 Profile Objects.

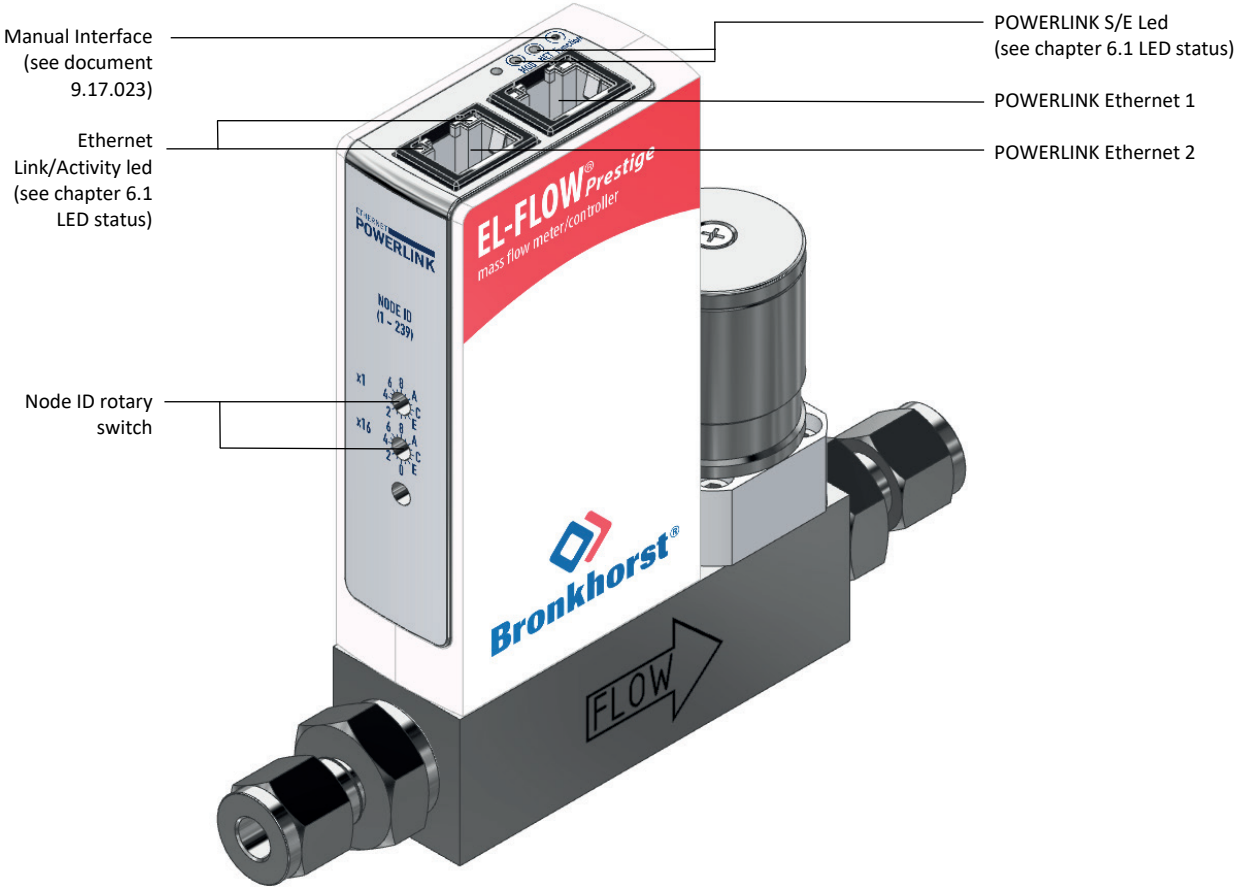
6. Next setup any parameters that should only be written on initialization. This can usually be found under SDO in your PLC Tool or Master Program. These parameters are written during the configuration of the instrument, before entering operational state. With this mechanism you could for example enable alarm functionality of the instrument, or select the desired fluid.

    It is also possible to change these values when the instrument is connected and communicating cyclically. This usually requires PLC programming, and is not within the scope of this manual.

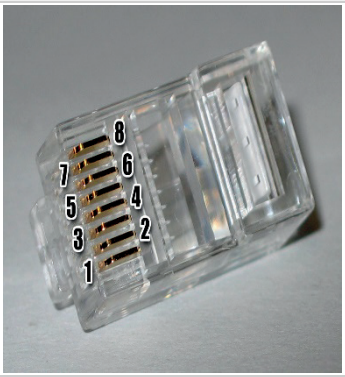
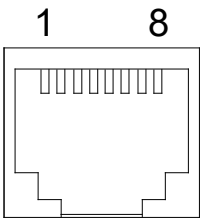
7. With the instrument fully setup in the PLC, build the program and load it into the PLC. Most PLCs will show the actual device parameters in the device overview in the PLC software, once the program is loaded and running. Here you can check that the expected values are received and test operation by forcing values.

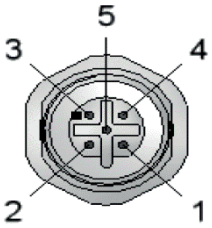
3 INSTALLATION

3.1 INSTRUMENT OVERVIEW



3.2 PIN ASSIGNMENT

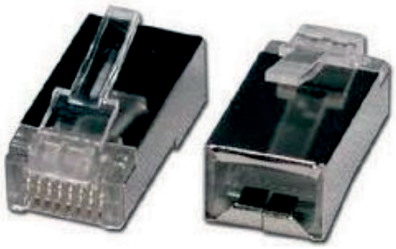
RJ45 Connector	Receptacle	Pin number	Description
		1	Transmit +
		2	Transmit -
		3	Receive +
		4	Not used
		5	Not used
		6	Receive -
		7	Not used
		8	Not used

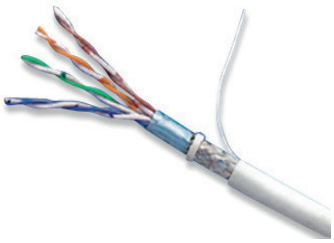
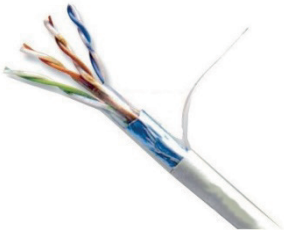
M12 –D coded male Connector	Receptacle	Pin number	Wire color	Description
		1		Transmit +
		2		Receive +
		3		Transmit -
		4		Receive -
		5		Not used

3.3 CONNECTION CABLES

Ethernet patch or crossover FTP or SFTP cables in CAT5e quality can be used as the connection cables. Lengths of 0.15 to 100 m are permitted for a POWERLINK network.

If you want to make the cables yourself, be sure to select a suitable crimp tool. Afterwards check the quality with a cable tester to avoid transmission problems.

RJ45 FTP CAT.5e cable	RJ45 shielded connectors
	

Example of POWERINK cable with M12-D-coded	SFTP cable	FTP cable
		

3.4 POWERLINK CONNECTION

The Bronkhorst® instruments are equipped with a linear bus structure with two RJ45 or M12-D connectors. The POWERLINK managing node is connected (via a series of hubs, often integrated on a controlled node) with a shielded, twisted pair, cable to one of the two POWERLINK ethernet connectors (RJ45 or M12-D). Other devices can be connected to the second ethernet port via the internal hub.

According to IEC 802.3 the maximum cable length for 100 Mbit/s Ethernet is 100m (100BaseT), e.g. between two instruments.

3.5 ROUTING AND SHIELDING THE BUS CABLE

Only use shielded cables and connection elements that also meet the requirements of category 5, class 2 according to IEC11801, edition 2.0.

Correct shielding of the bus cable attenuates electrical interference that may occur in industrial environments. The following measures ensure the best possible shielding:

- Manual tighten the mounting screws on the connectors, modules, and equipotential bonding conductors.
- Use only connectors with a metal housing or a metalized housing.
- Connect the shielding in the connector over a wide surface area.
- Apply the shielding of the bus cables on both ends.
- Route signal and bus cables in separate cable ducts. Do not route them parallel to power cables (motor leads)
- Route the signal cable and the corresponding equipotential bonding, if necessary, close to each other using the shortest possible route.
- Route the bus cable closely along existing grounding surfaces.

In case of fluctuations in the ground potential, a compensating current may flow via the bilaterally connected shield that is also connected to the protective earth (PE). Make sure you supply adequate equipotential bonding in such a case.

3.6 NODE-ID

Each device in a POWERLINK network must have a unique Node-ID between 1 and 239. This Node-ID can be set in several ways which are described in the following paragraphs.

3.6.1 Rotary switches

The device supports 2 rotary switches for setting the Node-ID. The rotary switches are base 16, and can be used to set any valid address in the range 1 to 239. The Node-ID switches are read during power up of the instrument, so to apply a new address the instrument must be power cycled. When the rotary switch is in an invalid position (default position is 0), the Node-ID is software programmable.

3.6.2 Software

By default the rotary switches for Node-ID are set to 0. In this position the Node-ID is software programmable Bronkhorst software (Fieldbus1 Address). The newly written Node-ID will become active after a power cycling the instrument.

POWERLINK parameter	Bronkhorst DDE parameter	Default value	Min Value	Max Value
Node-ID	199: Fieldbus1 address	1	1	239

4 INSTRUMENT CONFIGURATION

4.1 INSTRUMENT XDD FILE

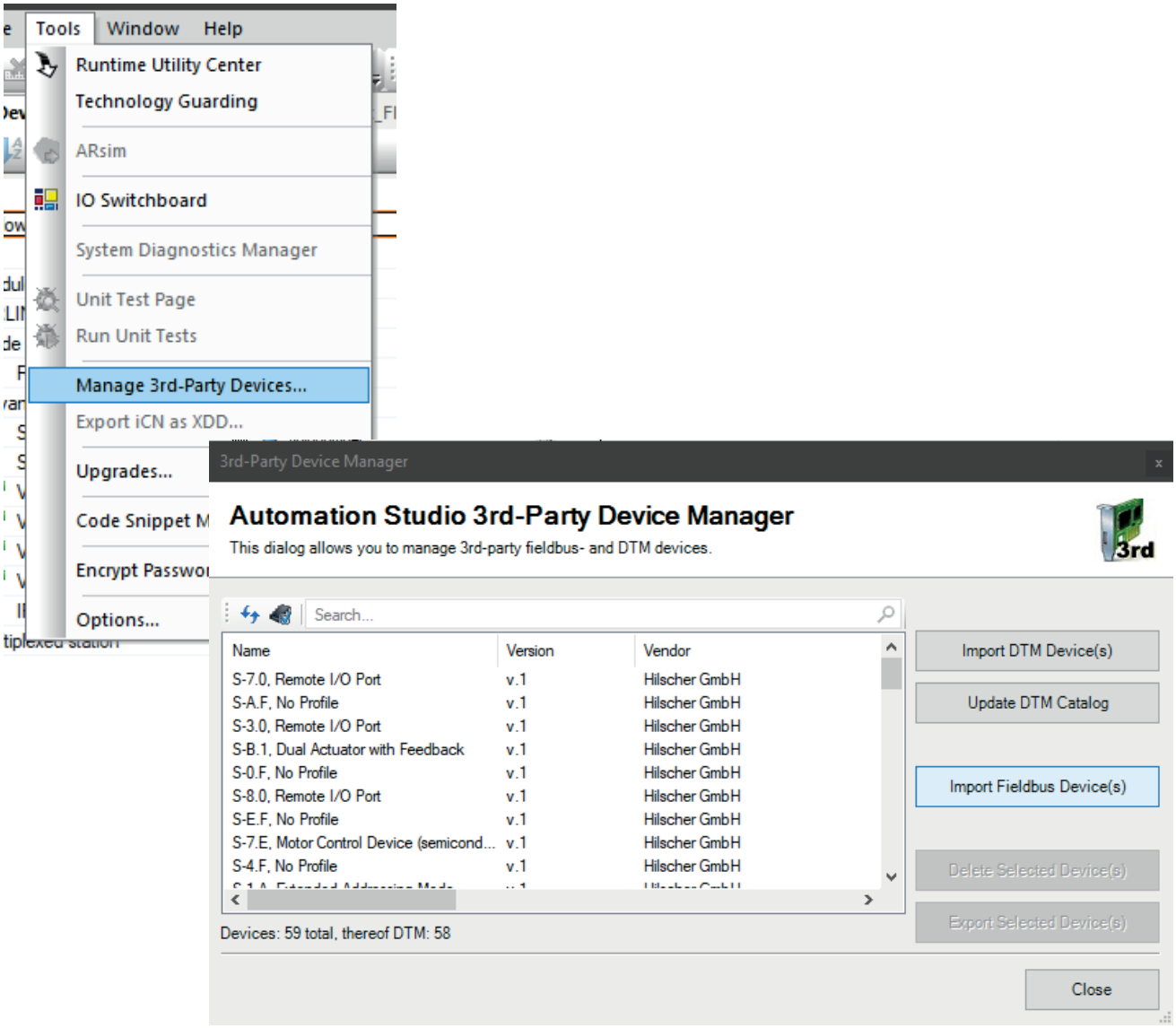
For operating Bronkhorst POWERLINK instruments, an XDD file is provided that offers easy access to all objects and configuration parameters available for Bronkhorst instruments. The generic XDD file for Bronkhorst instruments with POWERLINK, **000004A5_Bronkhorst_Meter_Controller_POWERLINK.xdd**, is an XML-file which contains information about the options and parameters of the POWERLINK interface of the instrument.

In order to make use of the XDD file, it must first be loaded into the PLC software tool. The following chapters will show how to configure a Bronkhorst Meter Controller POWERLINK instrument using B&R Automation Studio. Other PLC software programs are also supported, and largely follow the same procedures. Refer to the manual of your PLC application software for the specifics of the required steps.

The XDD file can be downloaded from the Bronkhorst web-site:
http://http://www.bronkhorst.com/int/products/accessories-and-software/flowware/powerlink-xdd/

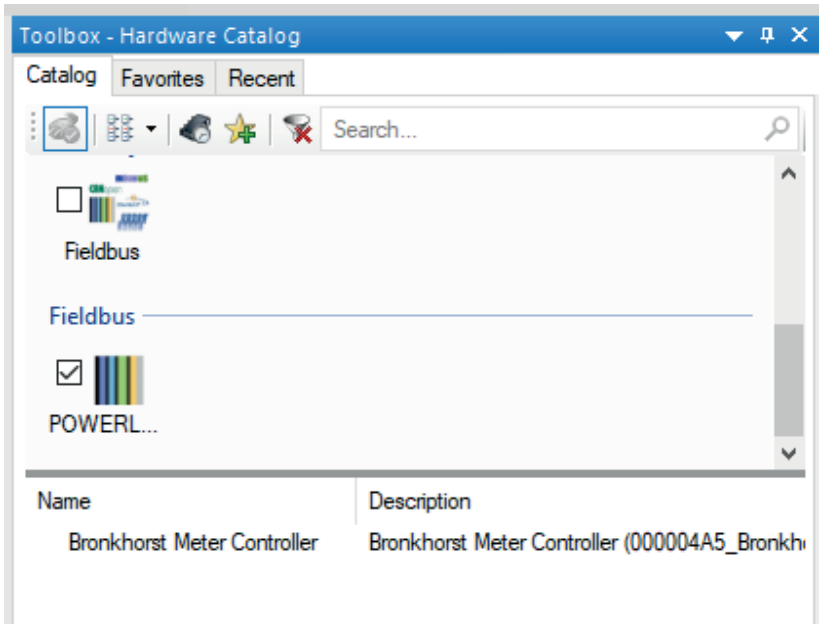
4.2 LOADING XDD FILE

Select the “Manage 3rd-Party Devices” option in the “Tools” menu. Now select the “Import Fieldbus Device(s)” option, and select the 000004A5_Bronkhorst_Meter_Controller_POWERLINK.xdd file.

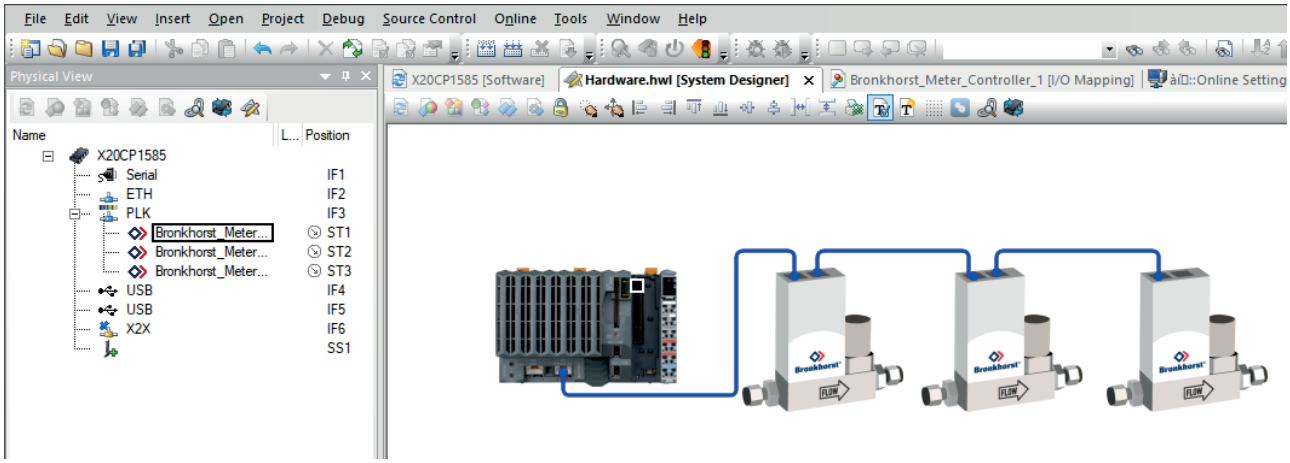


4.3 ADD THE BRONKHORST METER CONTROLLER TO A HARDWARE CONFIGURATION

In the “Toolbox – Hardware Catalog” menu on the right hand of the screen (in the hardware view), select the “POWERLINK” option under the “Fieldbus” category, and double click on the “Bronkhorst Meter Controller” to add the instrument to the PLC project hardware configuration.

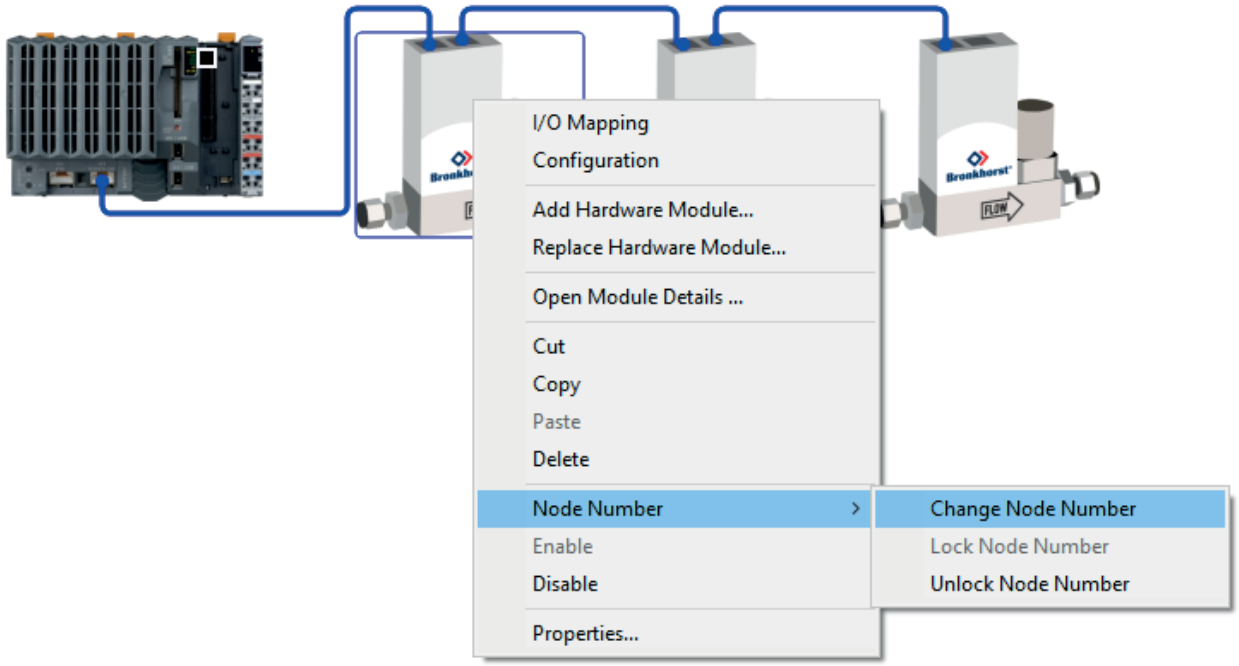


The instrument will be added to the configuration, and be visible in the “System Designer” view of the hardware layout for the PLC project.

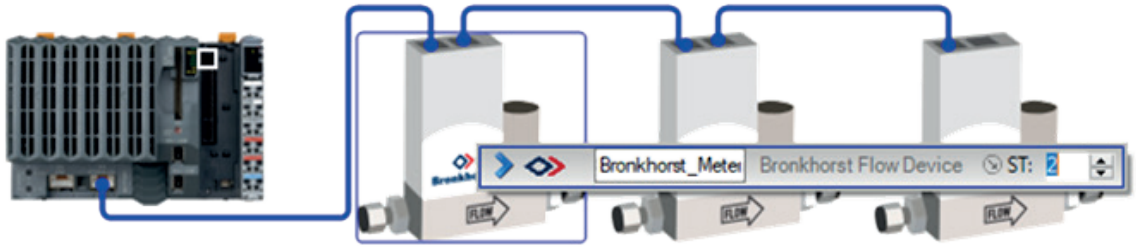


4.4 CONFIGURE NODE-ID

To configure the Node-ID, right click on the instrument, and select “Node Number” -> “Change Node Number”.

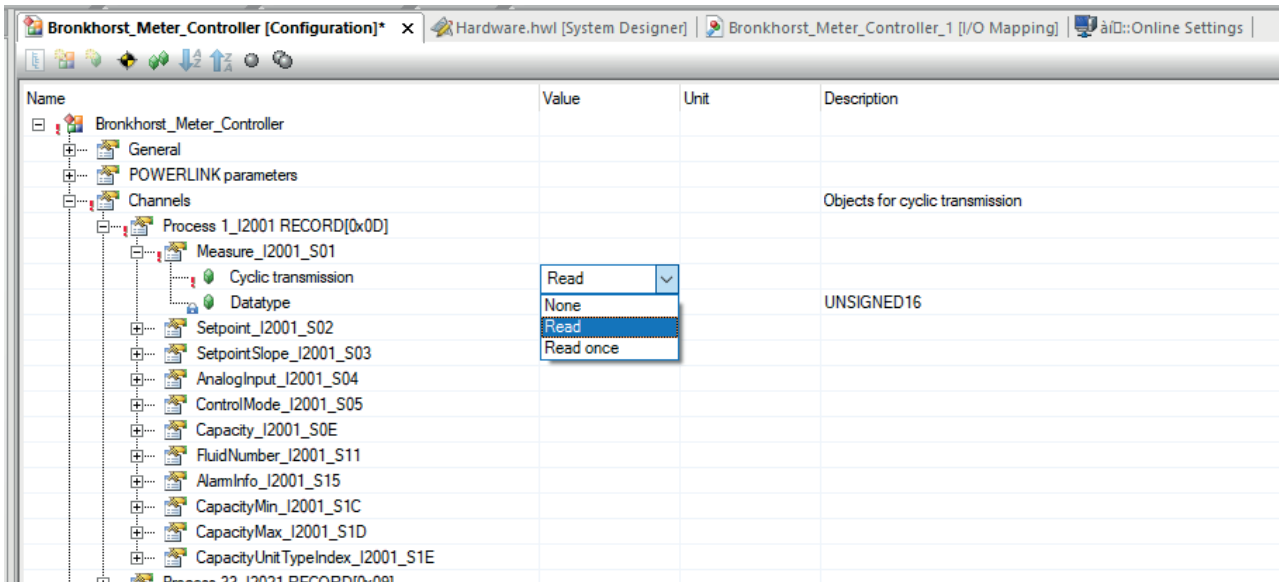


The Node-ID can now be changed in the small popup window (“ST” on the right hand side).



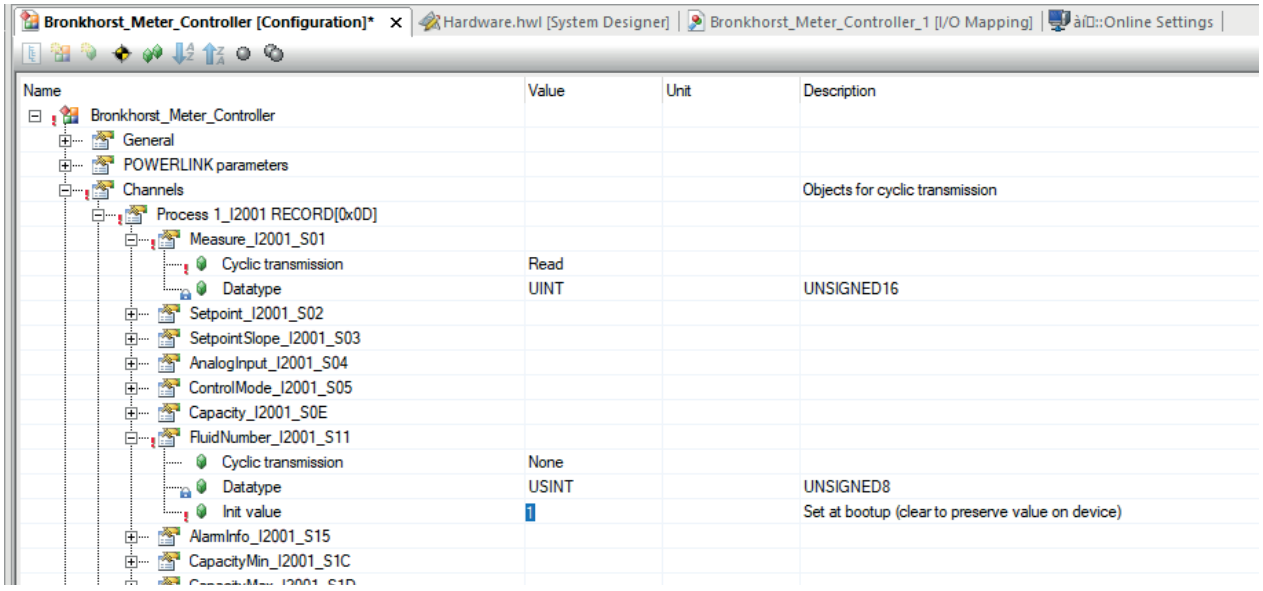
4.5 CONFIGURE CYCLIC PARAMETERS

Configure the cyclic parameters as desired, by enabling “Read”, “Write”, or “Read and Write” options for the desired parameters in the “Configuration” view.



4.6 CONFIGURATION PARAMETERS

In the same “Configuration” view it is possible to provide and initial value “Init value” for writable parameters.



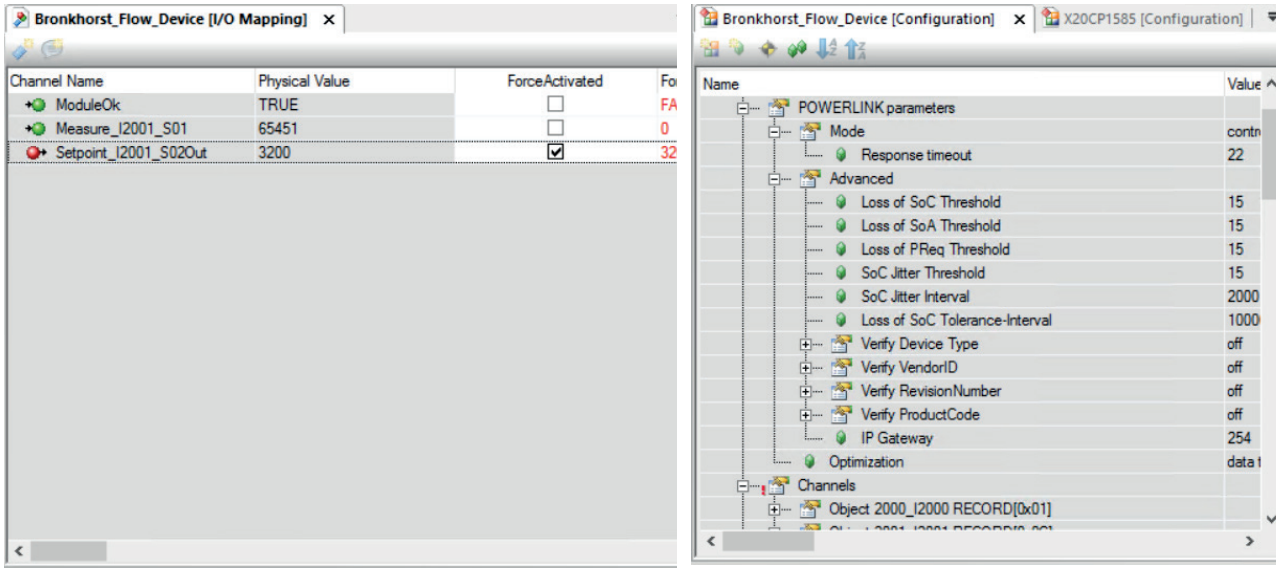
Parameters with a configured “Init value” are written when configuring the instrument (before cyclic communication starts and the instrument moves to the operational state). Here you can add parameters that only need to be written once, for example the fluid number or the alarm settings.

It is also possible to write these kind of parameters via SDO when the cyclic communication is active, but this will require programming in the PLC. This is outside the scope of this manual.

4.7 TEST COMMUNICATION

Data-exchange between the PLC and the instrument can be checked by going online. Select “Online” -> “Start debug mode”. The “Online state” will turn “green” when everything is working correctly.

The “I/O Mapping” view will now show the live values received from the instrument. Using the “Force” column, a value can be written to the instrument (overruling any PLC program value). This is very useful for testing.



5 OBJECT DESCRIPTION

The POWERLINK object dictionary can be divided into three parts:

1. Communication area (0x1000 – 0x1FFF)
2. Manufacturer area (0x2000 – 0x5FFF)
3. Profile area (0x6000 – 0x9FFF)

The communication area contains POWERLINK specific objects like the PDO mapping parameters and identity information.

The manufacturer area contains a direct mapping between POWERLINK objects (index, sub index) to instrument parameters (process, parameter). This area offers full access to the parameters available in the instrument.

The profile area contains the parameters of the CiA® 404 profile for measuring devices and closed-loop controllers, providing a standardized interface to this type of instrument.

The next chapters will go over these parts in more detail.

5.1 MANUFACTURER OBJECTS

In the manufacturer area, all parameters that are required to operate the instrument are available. They are the internal instrument parameters, connected directly to the POWERLINK Object Dictionary. Most parameters are already listed in the XDD file.

In case a parameter is not listed there, the conversion between internal parameters and POWERLINK objects (index, sub index) is:

POWERLINK	
Index	**Sub Index**
0x2000 + process nr	0x01 + parameter nr

Examples:

Setpoint
Internal parameter (Propar)
Process 1, Parameter 1
=
POWERLINK Object
Index 0x2001, Sub Index 0x02

Valve Output
Internal parameter (Propar)
Process 114, Parameter 1
=
POWERLINK Object
Index 0x2072, Sub Index 0x02

Using this conversion, advanced parameters (that might be unlisted in the XDD file) can be accessed for acyclic communication.

The parameter and process numbers of instrument parameters (referred to as Propar), can be found in:
"Operation instructions digital instruments" (document nr. 9.17.023), or the instrument specific manual. http://www.bronkhorst.com/en/downloads/instruction_manuals/

5.2 PROFILE OBJECTS

Bronkhorst instruments support the mandatory objects from the controller function block from CiA® 404 V1.2, *Measurement Devices and Closed Loop Controllers.* These objects (0x6400 – 0x7405) are also listed in Appendix A: Object Dictionary

Object 0x6406 contains a representation of the unit for current value and setpoint. This representation only contains SI units (see Appendix B: SI Unit AND Prefix Specification). Bronkhorst instruments support a lot of non-SI units, which are described in Appendix C: Non-SI Unit Specification.

The unit is represented by an unsigned32 value with the following meaning:

Prefix		Numerator		Denominator		reserved	
31	24	23	16	15	8	7	0

Examples:

kg/s is represented by

Prefix	Numerator	Denominator	reserved
0x00	0x02	0x03	0x00

with

Prefix = 0x00	means no prefix
Numerator = 0x02	means kg
Denominator = 0x03	means s

mln/min is represented by

Prefix	Numerator	Denominator	reserved
0xFD	0xC0	0x47	0x00

with

Prefix = 0xFD	means 10^{-3} = milli
Numerator = 0xC0	means ln
Denominator = 0x47	means min

Bit 0 of object 0x6425:01 "CO Control Byte" should be 1 to activate the PID controller (bit 0 = controller on/off).

The PID controller is activated by default, but if this object is included in the process data (PDO), the value 0 can be written by the master after entering the operational state.

See APPENDIX A: OBJECT DICTIONARY, description of 0x6425 "CO Control byte"

6 TROUBLESHOOTING

6.1 LED STATUS

Bronkhorst® instruments contain a POWERLINK bi color status led: green and red. The led indicates the actual POWERLINK run state (green) and the actual error state (red). On RJ45 instruments, the RJ45 ports also contain a combined link/activity indicator (green). Other LEDs on the instrument do not (directly) reflect the state of the POWERLINK interface.

The status led has several indicator states, which are applicable for both green and red. They are described in the table below.

Indicator state	Definition
on	The indicator is constantly on
off	The indicator is constantly off
blinking	The indicator is slowly blinks (2.5Hz)
single flash	The indicator flashes one time, followed by a longer off period.
double flash	The indicator flashes two times, followed by a longer off period.
triple flash	The indicator flashes three times, followed by a longer off period.
flickering	The indicator rapidly flashes (10Hz)

6.1.1 Run indicator

POWERLINK state	Indicator state (green)
Operational	on
Ready to Operate	triple flash
Pre-Operational 2	double flash
Pre-Operational 1	single flash
Basic Ethernet	flickering
Stopped	blinking
Initializing	off

6.1.2 Error indicator

Error state	Indicator state (red)
No Error	off
Error	on

6.1.3 Link/Activity indicator

Link/Activity state	Indicator state (green)
Ethernet link, no activity	on
Ethernet link, with activity (sending/receiving frames)	flickering (load dependent)
No ethernet link	off

6.2 BUS DIAGNOSTICS

The Fieldbus1 Diagnostics parameter offers diagnostic information about the POWERLINK interface on the instrument. This parameter is available in FlowDDE (parameter nr 202), or via Propar (process 125, parameter 20, parameter type String).

sAAecBBBBleCCCCscDDDDlsEEEEpsF			
Part	**Description**		
s	NMT state		
ec	Error code count		
le	Last error code		
sc	Status code count		
ls	Last status code		
ps	Port status	0	no link
		1	link on port 1
		2	link on port 2
		3	link on both ports

7 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:

support@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:

+31 859 02 18 66

APPENDIX A: OBJECT DICTIONARY

For the full object dictionary of the instrument, please refer to the instrument XDD file. What follows is additional information on the functionality of several profile area objects. For more information, refer to the CiA® 404 specification.

Object 0x6410: CO Effective controller output Y

hexadecimal value	decimal value	percent value
0xFC18	-1000	-100.0%
:::	:::	:::
0xFE0C	-500	-50.0%
:::	:::	:::
0x0000	0	0.0%
:::	:::	:::
0x1F4	500	50.0%
:::	:::	:::
0x3E8	1000	100.0%

0x6422 CO Control On/Off

control byte	Mode
TRUE	DDE parameter 12 control mode = 0 (controller active)
FALSE	DDE parameter 12 control mode = 12 (setpoint 0%)

0x6423 CO Controller mode

control byte	Mode
0x80	manufacturer specific controller type
:::	:::
0xFF	manufacturer specific controller type

Bronkhorst instruments only support range 0x80h – 0x96. It is used as follows:

0x80: DDE parameter 12 control mode = 0
0x81: DDE parameter 12 control mode = 1
0x82: DDE parameter 12 control mode = 2
Etc.

Essential control modes:

Nr.	Mode	Instrument action
0	Controlling	Control at setpoint value
3	Valve closed	No controller action, valve is closed
4	Controller Idle	No controller action, valve remains its position
8	Valve purge	No controller action, valve is fully open

More available control modes can be found in
"Operation instructions digital instruments" (document nr. 9.17.023).
http://www.bronkhorst.com/en/downloads/instruction_manuals/

0x6425 CO Control byte

MSB				LSB
Reserved	**Setpoint switch**	**Manual Mode**	**Self-optimization**	**Controller on / off**
7 … 4	3	2	1	0

Value	Meaning
0	disable function
1	enable function

Self- optimization is not supported (is always 0)

0x6427 CO Status word

MSB									LSB
reserved	**Net overload**	**Over-load**	**Data not valid**	**reserved**	**Optimization error**	**Setpoint switch**	**Manual Mode**	**Self-optimization**	**Controller on / off**
15 … 11	10	9	8	7 … 5	4	3	2	1	0

Value	Meaning
0	not valid (not occurred)
1	valid (occurred)

The following objects are mapped to the following DDE parameters:

Index	Sub Index	Description	DDE parameter
0x6400	1	CO Effective current value Xeff	fMeasure / Measure
0x6401	1	CO Effective setpoint Weff	fSetpoint / Setpoint
0x6402	1	CO Setpoint W	fSetpoint / Setpoint
0x6404	1	CO Lower setpoint limit W0	Capacity 0% (read only)
0x6405	1	CO Upper setpoint limit W100	Capacity (read only)
0x6410	1	CO Effective controller output Y	Valve output (scaled to % as described above)
0x6422	1	CO Controller on / off	- (is described above)
0x6423	1	CO Controller mode	Control mode
0x6425	1	CO Control byte	- (is described above)
0x6425	1	CO Status word	- (is described above)
0x7400	1	CO Effective current value Xeff (INT)	fMeasure / Measure [1]
0x7401	1	CO Effective setpoint Weff (INT)	fSetpoint / Setpoint [5]
0x7402	1	CO Setpoint W (INT)	fSetpoint / Setpoint [5]
0x7404	1	CO Lower setpoint limit W0 (INT)	Capacity 0% (read only) [5]
0x7405	1	CO Upper setpoint limit W100 (INT)	Capacity (read only) [5]

The value of object 0x6407:01 CO Decimal digits current value / set point is determined and optimized automatically during instrument power-up.

[5] Examples:

fMeasure = 1.15 ln/min
object 0x6407:01 CO Decimal digits current value / set point = 3
object 0x7401:01 CO Effective current value Xeff = 1.15 x (10 x 10 x 10) = 1150

object 0x6407:01 CO Decimal digits current value / set point = 4
object 0x7402:01 CO Setpoint W (INT) = 22500
fSetpoint = 22500 / (10 x 10 x 10 x 10) = 2.25 ln/min

[1] Integer16 value scaled with the value of object 0x6407:01
[5] Integer16 value scaled with the value of object 0x6407:01

APPENDIX B: SI UNIT AND PREFIX SPECIFICATION

SI Unit Specification				
Name	**Symbol**	**Notation index (hex)**	**Index**	**Description**
Kilogram	kg	0x02	0x402	Mass
Second	s	0x03	0x403	Time
Kelvin	K	0x05	0x405	Temperature
Pascal	Pa	0x22	0x422	Pressure
Degree Celsius	^{o}C	0x2D	0x42D	Temperature
Liter	l	0x44	0x444	Volume
Minute	min	0x47	0x447	Time
Hour	h	0x48	0x448	Time
Bar	bar	0x4E	0x44E	Pressure
Cubic meter	m^3	0x59	0x459	Volume

Prefix Specification			
Prefix	**Symbol**	**Factor**	**Notation Index**
reserved	-	-	*0x13 – 0x7F*
exa	E	10^{18}	0x12
		10^{17}	0x11
		10^{16}	0x10
peta	P	10^{15}	0x0F
		10^{14}	0x0E
		10^{13}	0x0D
tera	T	10^{12}	0x0C
		10^{11}	0x0B
		10^{10}	0x0A
giga	G	10^{9}	0x09
		10^{8}	0x08
		10^{7}	0x07
mega	M	10^{6}	0x06
		10^{5}	0x05
		10^{4}	0x04
kilo	k	10^{3}	0x03
hecto	h	10^{2}	0x02
deca	da	10^{1}	0x01
		10^{0}	0x00
deci	d	10^{-1}	0xFF
centi	c	10^{-2}	0xFE
milli	m	10^{-3}	0xFD
		10^{-4}	0xFC
		10^{-5}	0xFB
micro	µ	10^{-6}	0xFA
		10^{-7}	0xF9
		10^{-8}	0xF8
nano	n	10^{-9}	0xF7
		10^{-10}	0xF6
		10^{-11}	0xF5
pico	p	10^{-12}	0xF4
		10^{-13}	0xF3
		10^{-14}	0xF2
femto	f	10^{-15}	0xF1
		10^{-16}	0xF0
		10^{-17}	0xEF
atto	a	10^{-18}	0xEE
reserved	-	-	*0xED – 0x80*

APPENDIX C: NON-SI UNIT SPECIFICATION

Name	Symbol	Notation index (hex)	Index	Description
gram-force per square centimeter	gf/cm2	0xA0	0x4A0	pressure
pound-force per square inch	psi	0xA1	0x4A1	pressure
torr pressure	torr	0xA2	0x4A2	pressure
standard atmosphere pressure	atm	0xA3	0x4A3	pressure
meter of water pressure	mH2O	0xA4	0x4A4	pressure
inch of water pressure	"H2O	0xA5	0x4A5	pressure
feet of water pressure	ftH2O	0xA6	0x4A6	pressure
meter of mercury pressure	mHg	0xA7	0x4A7	pressure
inch of mercury pressure	"Hg	0xA8	0x4A8	pressure
cubic centimeter	cc	0xB0	0x4B0	volume
cubic millimeter	mm3	0xB1	0x4B1	volume
cubic centimeter	cm3	0xB2	0x4B2	volume
cubic foot per hour	cfh	0xB3	0x4B3	volume
cubic foot per minute	cfm	0xB4	0x4B4	volume
cubic foot per second	cfs	0xB5	0x4B5	volume
liter (normal)	ln	0xC0	0x4C0	volume (normal flow)
cubic centimeter (normal)	ccn	0xC1	0x4C1	volume (normal flow)
cubic millimeter (normal)	mm3n	0xC2	0x4C2	volume (normal flow)
cubic centimeter (normal)	cm3n	0xC3	0x4C3	volume (normal flow)
cubic meter (normal)	m3n	0xC4	0x4C4	volume (normal flow)
standard cubic foot per hour	scfh	0xC5	0x4C5	volume (normal flow)
standard cubic foot per minute	scfm	0xC6	0x4C6	volume (normal flow)
standard cubic foot per second	scfs	0xC7	0x4C7	volume (normal flow)
standard cubic centimeter per minute	sccm	0xC8	0x4C8	volume (normal flow)
standard liter per minute	slm	0xC9	0x4C9	volume (normal flow)
liter (standard)	ls	0xD0	0x4D0	volume (standard flow)
cubic centimeter (standard)	ccs	0xD1	0x4D1	volume (standard flow)
cubic millimeter (standard)	mm3s	0xD2	0x4D2	volume (standard flow)
cubic centimeter (standard)	cm3s	0xD3	0x4D3	volume (standard flow)
cubic meter (standard)	m3s	0xD4	0x4D4	volume (standard flow)