Instruction manual

PROFINET IO-Device interface for digital multibus Mass Flow / Pressure instruments

Doc. no.: 9.17.095B Date: 28-09-2015

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.

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Disclaimer

Even though care has been taken in the preparation and publication of the contents of this manual, we do not assume legal or other liability for any inaccuracy, mistake, mis-statement or any other error of whatsoever nature contained herein. The material in this manual is for information purposes only, and is subject to change without notice.

Bronkhorst High-Tech B.V.
September 2015

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

The products of Bronkhorst High-Tech B.V. are warranteed 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.

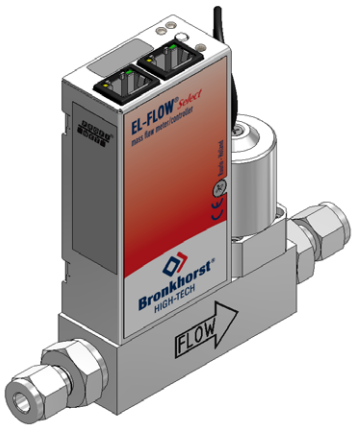
Table of contents

1 GENERAL PRODUCT INFORMATION

1.1 INTRODUCTION

This manual will explain how to install a Bronkhorst[1] instrument to your PROFINET system. It only contains information which is needed most.

More detailed information about PROFINET can be obtained on the website of the (international) PROFINET organization: www.profibus.com or on the website of the (local) PROFINET organization of your country (when available).



Example of a Bronkhorst instrument with PROFINET interface

*[1)] **Bronkhorst:** **This includes Bronkhorst High-Tech B.V. , Bronkhorst Cori-Tech B.V. and M+W Instruments GmbH.***

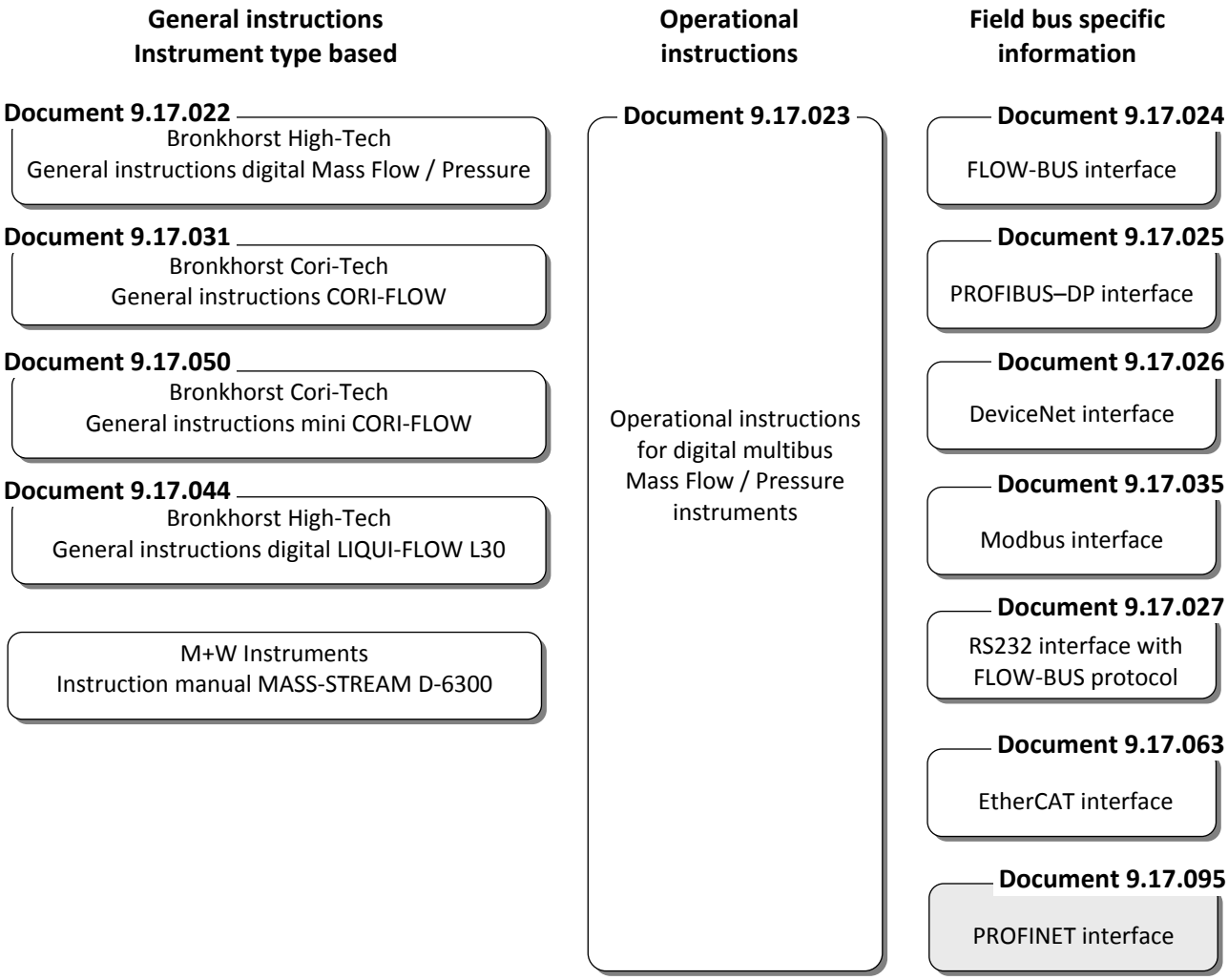
1.2 MULTIBUS TYPES

The Bronkhorst High-Tech digital instruments offers great flexibility thanks to the “multibus” concept, whereby the instruments can be equipped with an on-board interface with DeviceNet™, Profibus-DP®, PROFINET®, Modbus, EtherCAT® or FLOW-BUS protocol.

1.3 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. Fieldbus specific information explains the installation and use of the field bus installed on the instrument.

1.3.1 Manuals and user guides:



1.3.2 Technical Drawings:

Hook-up diagram MBC3 laboratory-style PROFINET (document nr. 9.16.147)

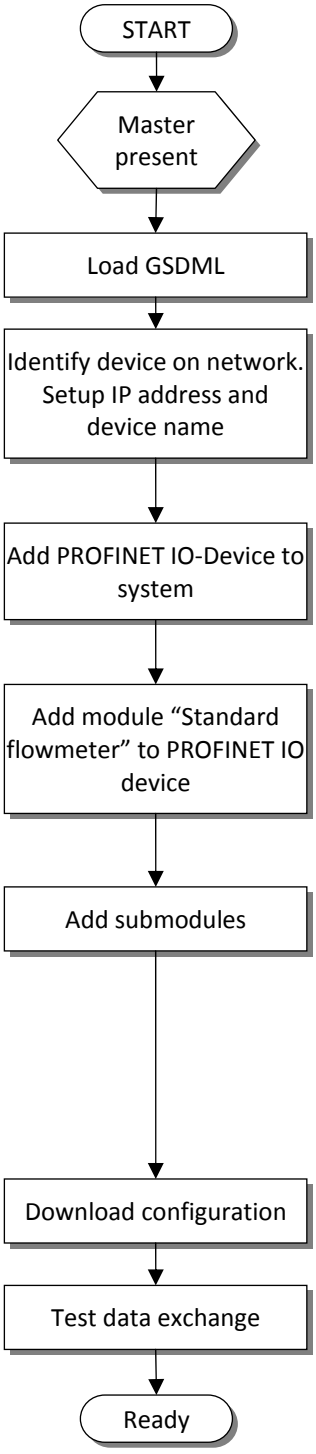
1.3.3 Software tooling:

FlowDDE
GSDML file

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

1.4 SHORT FORM START-UP

All necessary settings for this module are already performed at Bronkhorst.
To follow next steps carefully is the quickest way to get this module operational in your own PROFINET environment.



Make sure your master has been installed to the PROFINET system

Load GSDML-file into the configuration tool (software at PROFINET master).

Perform a network scan to identify the devices connected to the network. Setup the device’s IP-address and device name.

Select "Bronkhorst meter/controller" and add new instrument to the bus (with configuration tool).

Depending on the instrument type a “module” can be added to slot 1 of the PROFINET IO-Device.
NOTE: at this point, the GSDML-file only supports Standard flowmeter.

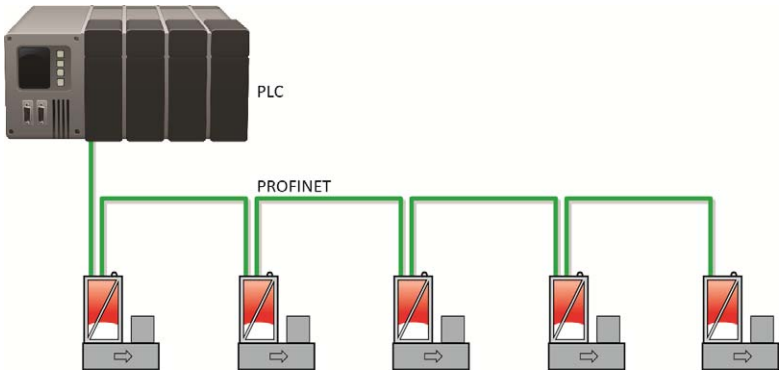
Submodules can be added to the subslots of the module. The submodules represent the parameters of the device (i.e. measure or setpoint). These modules will be read/written cyclically.

Download all configuration settings into your master.

Test data-exchange communication between your master and the instrument(s).

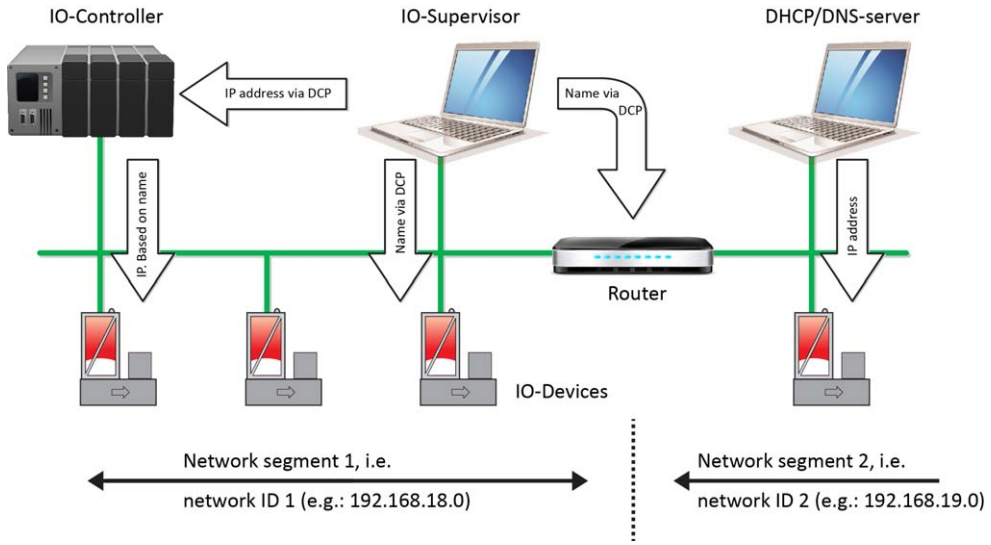
1.5 FUNDAMENTALS OF PROFINET

The PROFINET protocol is 100% Ethernet-compatible and is used for data exchange between IO-Controllers (PLC, etc.) and IO-Devices (slaves, field devices). It uses the proven communication model and application view of PROFIBUS DP and extends it by Ethernet as the communication medium.



Simple PROFINET system.

PROFINET is a master/slave bus system. Bronkhorst instruments are all slaves. There is no mutual communication between PROFINET slaves, only between a master and slave. The cycle time is 8 ms. The slaves are addressed using MAC addresses and IP addresses. The figure below shows a network that comprises two subnets. These are represented by the different
Network-IDs (subnet mask). For PROFINET IO field devices, address resolution is based on the symbolic name of the device, to which a unique MAC address is assigned. After the system is configured, the engineering tool loads all information required for data exchange to the IO-Controller, including the IP addresses of the connected IO-Devices. Based on the name (and the associated MAC address), an IO-Controller can recognize the configured field devices and assign them the specified IP addresses using the DCP protocol (Discovery and Configuration Protocol) integrated in PROFINET IO. Alternatively, addressing can be performed via a DHCP serve Following address resolution, the system powers up and parameters are transmitted to the IO-Devices. The system is then available for productive data traffic.

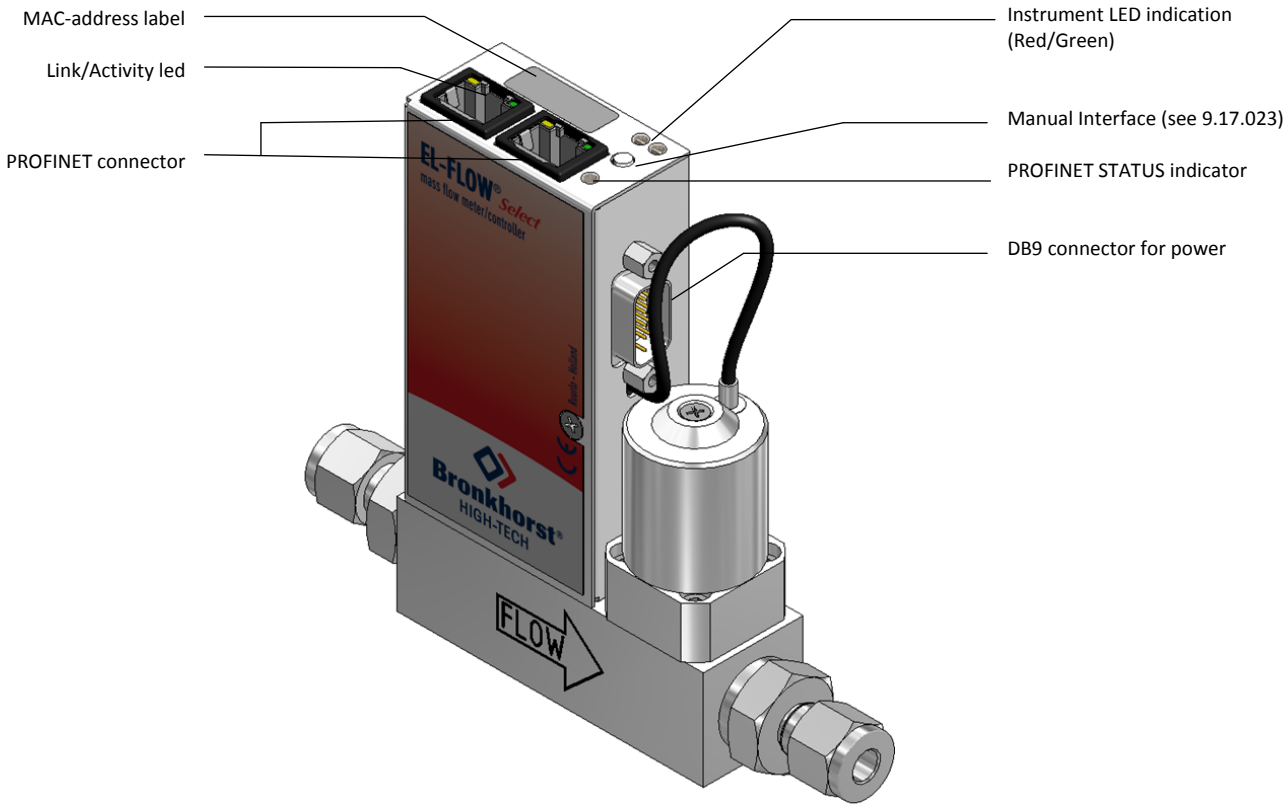


- **Master configuration software.**
  The IP-address and Device name can be configured with the Master configuration software. For example:
  - PROFINET Master Simulator from Bihl + Wiedemann (used in this manual).
  - Step 7 from Siemens for PLC type S7-300 2DP.

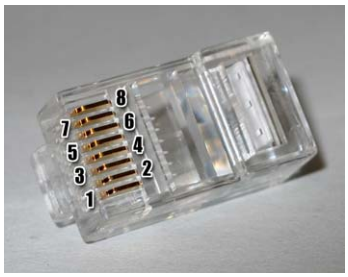
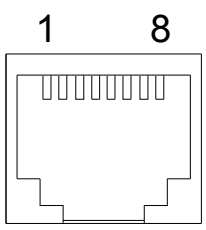
  Most master configuration software tools work in the same way, because PROFINET is a standardized fieldbus system. Only on details and program operation things could be different.
  Read user manual carefully for correct operation of other programs than Sycon and Step 7.
- **Bronkhorst tooling software: eq FlowDDE and FlowView**
  The Bronkhorst tooling software is able to communicate with the instrument via RS232 using a special cable. If you don't have such a cable ask your local sales representative.

2 PROFINET INSTALLATION

2.1 INSTRUMENT OVERVIEW



2.2 PIN ASSIGNMENT

RJ45 Connector	Receptacle	Pin number	Wire color	Description
		1	Yellow	Transmit +
		2	Orange	Transmit -
		3	White	Receive +
		4		Not used
		5		Not used
		6	Blue	Receive -
		7		Not used
		8		Not used

2.3 CONNECTION CABLES

For a robust communication it is advised to use the dedicated PROFINET cable that uses a 4-wire robust quad cable. The electrical performance is optimised for 100Base-Tx and shielded against interference.

Example of a PROFINET cable

More information about PROFINET cables can be found at:
http://www.profibus.com

2.4 PROFINET CONNECTION

The Bronkhorst instruments are equipped with two RJ45 connectors. Both connectors can be used as input or output. One of the PROINET RJ45 connectors can be used to connect the instrument with the PROFINET master and the other RJ45 connector can be used to connect to another PROFINET instruments.

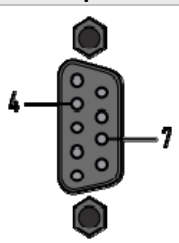
According to IEC 802.3 the maximum cable length for 100 MBaud Ethernet is 100m (100BaseT), e.g. between two instruments.

2.5 PROFINET BUS TERMINATION

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

2.6 POWER CONNECTOR

The instrument is powered through the DB9 connector.

DB9 Connector	Receptacle	Pin number	Description
		4 7	0V Power +V power

For more details of the possibilities of the DB9 connector see Hook-up diagram (document nr. 9.16.147).

3 CONFIGURATION

3.1 GSDML-FILE

Each type PROFINET instrument has its own GSDML-file with instrument specifications to tell the master configuration software which facilities/features the instruments offers to the PROFINET system. For Bronkhorst meter/controller the file is called: GSDML-Vx.y-BHT-Flowmeters-yyyymmdd.xml. This file is available on the Multibus documentation/software tool CD and describes the whole Bronkhorst product range.

The most actual version of the GSDML-file cables can be found at:
http://www.bronkhorst.com

The GSDML file is a xml file containing:

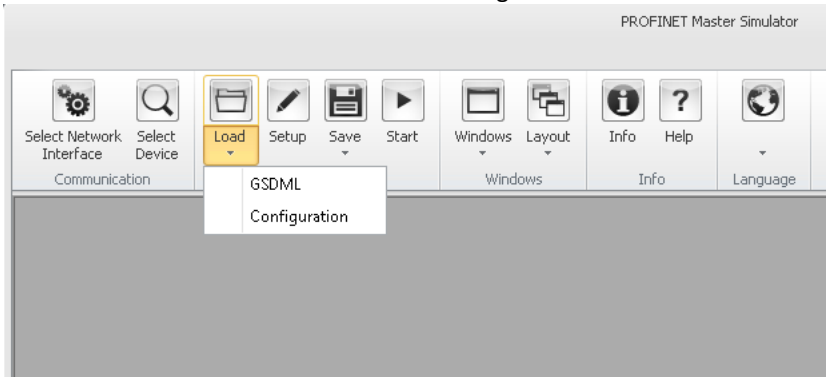
- Device identification info:
  Here you can find general information about the GSDML file like:
  - Vendor (Bronkhorst)
  - Vendor ID (0x02F3)
  - Product family.
- Device Access Point (DAP) information.
  This contains information about:
  - Used hardware
  - Ethernet related settings
  - Supported features.
- Modules
  Modules represent Bronkhorst devices (i.e. Flowmeters, pressure controllers etc.). Modules can be assigned to a slot of the PROFINET IO-Device. Depending on the hardware, 1 to 3 modules can be assigned.
- Submodules
  Submodules represent the variables of the Module. Submodules can be added to the cyclic IO by assigning them to a subslot of the corresponding slot.

3.2 CONFIGURATION SOFTWARE

In this manual we use as an example the software tool “PROFINET Master Simulator” from Bihl + Wiedemann.

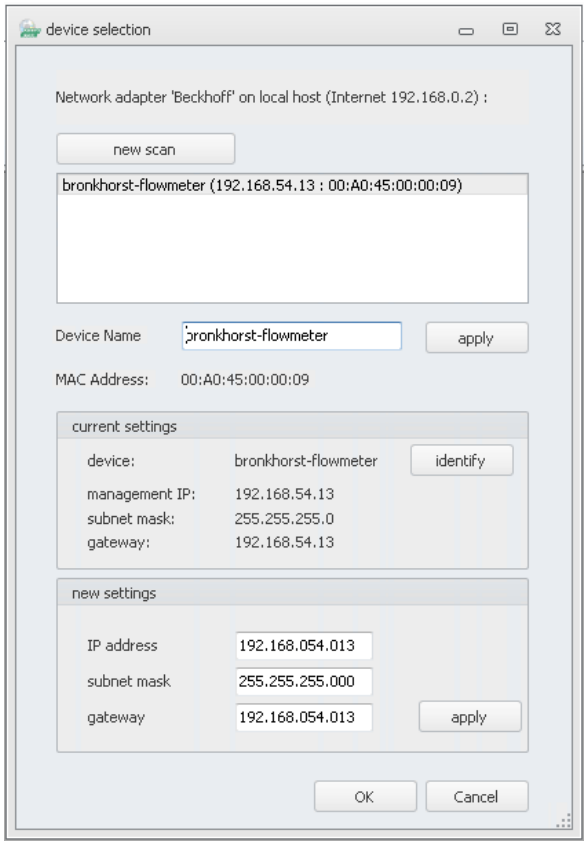
3.3 LOAD GSDML-FILE

The GSDML-file must be loaded into the configuration software.



3.4 ADD SLAVE TO PROFINET IO

The configuration software is able to scan the PROFINET for devices. After a “new scan” the Bronkhorst flowmeter will be detected. The MAC address of the device is shown. In the example below the MAC-address is 00:A0:45:00:00:09. Each instrument has its own unique MAC address.
The user can change the IP address, subnet mask and gateway settings (see screenshot below).

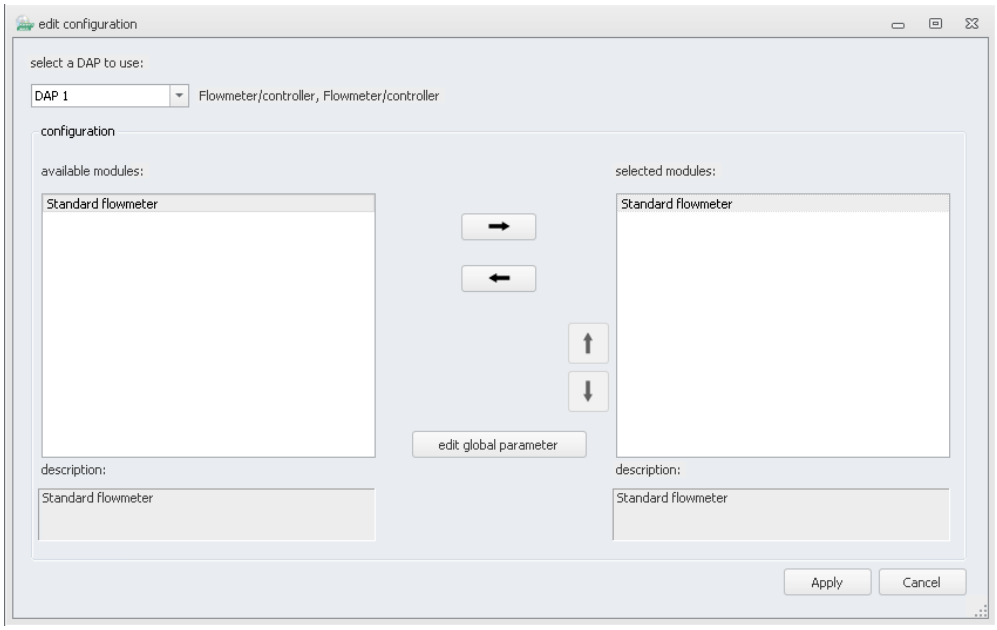


3.5 SLAVE CONFIGURATION SETTINGS

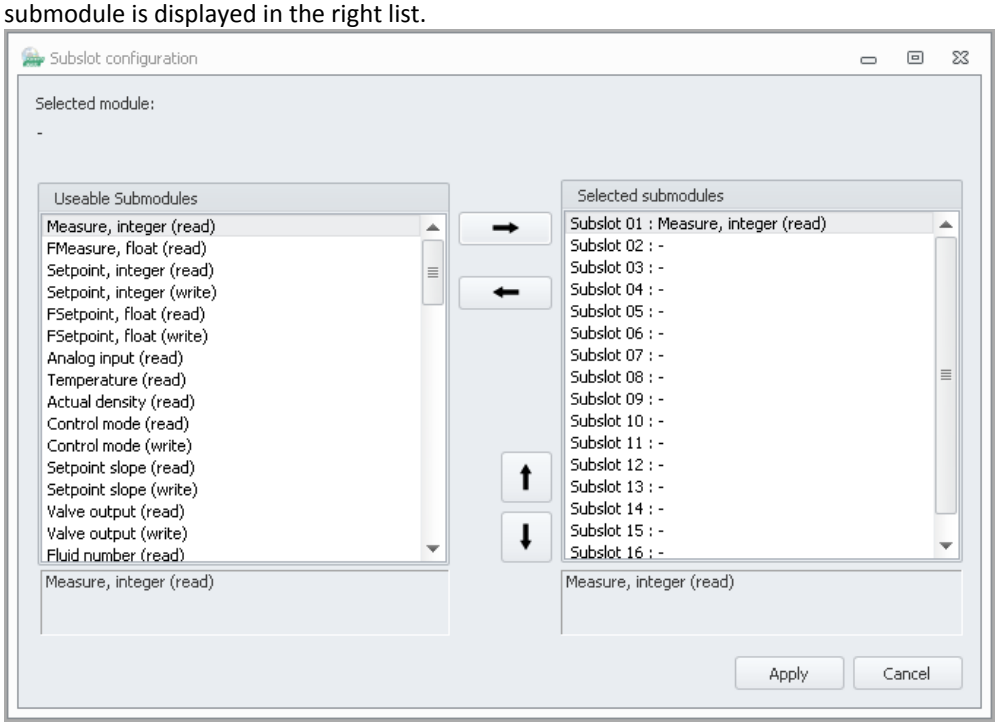
Bronkhorst PROFINET instruments offer many available modules/parameters for operation of the instruments. These modules/parameters can be selected by means of the master configuration tooling software.

After installing the slave to the PROFINET system, point to actual slave and select: [setup]. In the first table (left) the available module(s) are listed. Select the module(s) you want to use. The selected module(s) will be displayed in the second table (right).

Select the “Standard flowmeter” module from the list of available modules.



As next step the cyclic parameters you want to use in your application can be selected from the “Useable Submodules”-list. In the example below the flow measurement “Measure, integer (read)” is selected. The selected submodule is displayed in the right list.



3.6 CYCLIC PARAMETER ACCESS

The parameters of the instrument can be accessed cyclically by its name, e.g.:

- “Measure, integer (read)": to access the measurement value
- “Setpoint, integer (write)": write the setpoint to the controller

Cyclic Parameter	Proc/Param
Measure, integer (read)	1/0
Fmeasure, float (read)	33/0
Setpoint, integer (read)	1/1
Setpoint, integer (write)	1/1
Fsetpoint, float (read)	33/3
Fsetpoint, float (write)	33/3
Analog input (read)	1/3
Temperature (read)	33/7
Actual density (read)	116/15
Control mode (read)	1/4
Control mode (write)	1/4
Setpoint slope (read)	1/2
Setpoint slope (write)	1/2
Valve output (read)	114/1
Valve output (write)	114/1
Fluid number (read)	1/16
Fluid number (write)	1/16
Fluid name (read)	1/17
Capacity 100 % (read)	1/13
Capacity 0 % (read)	33/22
Capacity unit string (read)	1/31
Calibration mode (read)	115/1
Calibration mode (write)	115/1
Serial number (read)	113/3
BHT Model number (read)	113/2
Firmware version (read)	113/5
Identification number (read)	113/12
Device type (read)	113/1
Usertag (read)	113/6
Usertag (write)	113/6
Customer model number (read)	113/4
Alarm maximum limit (read)	97/1
Alarm maximum limit (write)	97/1
Alarm minimum limit (read)	97/2

Cyclic Parameter	Proc/Param
Alarm minimum limit (write)	97/2
Alarm mode (read)	97/3
Alarm mode (write)	97/3
Alarm setpoint mode (read)	97/5
Alarm setpoint mode (write)	97/5
Alarm new setpoint (read)	97/6
Alarm new setpoint (write)	97/6
Alarm delay time (read)	97/7
Alarm delay time (write)	97/7
Reset alarm enable (read)	97/9
Reset alarm enable (write)	97/9
Counter value (read)	104/1
Counter unit (read)	104/2
Counter limit (read)	104/3
Counter limit (write)	104/3
Counter setpoint mode (read)	104/5
Counter setpoint mode (write)	104/5
Counter new setpoint (read)	104/6
Counter new setpoint (write)	104/6
Counter unit string (read)	104/7
Counter mode (read)	104/8
Counter mode (write)	104/8
Reset counter enable (read)	104/9
Reset counter enable (write)	104/9
Counter controller overrun correction (read)	104/10
Counter controller overrun correction (write)	104/10
Counter controller gain (read)	104/11
Counter controller gain (write)	104/11
Alarm info (read)	1/20
Reset (write)	115/8
Initreset (write)	0/10
IO switch status (read)	114/31
IO switch status (write)	114/31

More information about modules/parameters or an example of counter and alarm usage *can be found in the manual “917023 Operational instructions digital instruments”. The description of the parameter can be found in the manual by searching for the process/parameter (Proc/Param), e.g. search for “1/0” to find the definition of “Measure, integer (read)”.*
This document can be found at:
http://www.bronkhorst.com/en/downloads/instruction_manuals/

3.7 A-CYCLIC PARAMETER ACCESS.

All parameters can be read/written using A-cyclic communication. To address these parameters, a parameter index is used. This index is built of:

1 An instance ID.
This is the flowmeter instance. In case of a single channel device the instance ID is always 0 and refers to the device on slot 1.
In case of a multichannel device
0 = MFC on slot 1.
1 = MFC on slot 2.
2 = MFC on slot 3.

2 A process number.
Process numbers are listed in the “Parameter list in FlowDDE” or the parameter table in chapter 3.6.

3 A parameter number.
Parameter numbers are listed in the “Parameter list in FlowDDE” or the parameter table in chapter 3.6.

The a-cyclic parameter index can be calculated as follows
Index = (instance * 4096) + (process * 32) + parameter

A list with frequently used parameters can be found in appendix A.

A-cyclic requests must be addressed to the hardware ID of the Profinet interface (slot 0-Head).

4 SLAVE ADDRESSING

4.1 GENERAL

Addressing a PROFINET IO-Device is done by means of a device name and IP-addresses.

4.2 MAC ADDRESS

The MAC address of the device is an unique address and is listed on the sticker on the device. The MAC address cannot be changed but can be used to identify the device on the network.

4.3 IP ADDRESS AND DEVICE NAME

When configuring the PROFINET IO network, each device is given a logical device name to identify the device. The user is free to choose the name. An IP-address is also assigned to the device. This IP address is unique within the network.

4.4 FACTORY RESET.

The PROFINET factory reset, sets the ip-address, subnetmask, gateway and device name to their default values.
The PROFINET factory reset does not apply to the device functions. For resetting the device's factory settings, please refer to the user manual 9.17.023.

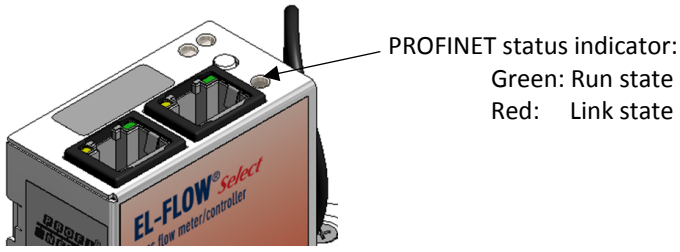
5 SAFE STATE

If PROFINET communication problems occur, so when instrument is not in data exchange mode, the instrument forces the valve (controllers only) into a safe state mode. This safe state depends on the type of valve. NC valves will be closed, NO valves will be opened fully. The green and red Led on top of the instrument indicates this mode by a short flash: 0.1 sec on, 2 sec off. As long as there is no data exchange between master and slave the instrument will stay in this mode. It will leave this mode automatically when data exchange starts. Via the RS232 communication interface it is possible to force the instrument out of the safe state by changing the control mode to a value other than 0. At for example control mode = 18 (RS232) or control mode = 1 (Analog input) the instrument will not get into safe state.

6 TROUBLESHOOTING

6.1 PROFINET STATUS INDICATOR

Bronkhorst instruments contain an PROFINET two color status led: green and red. The led indicates the actual PROFINET run state (green) and the actual link state (red).
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 repeatedly on for 200 ms and off for 200 ms
single flash	The indicator is repeatedly on for 200 ms and off for 1000 ms
double flash	The indicator shows repeatedly a sequence of two short flashes (200 ms), separated by an off phase (200 ms), followed by a long off phase (1000 ms)

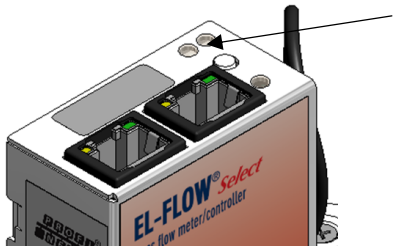
6.1.1 PROFINET run state indicator

Run state	Indicator state (green)
PROFINET interface not started (yet)	off
PROFINET interface in Init state	blinking
PROFINET interface started correctly	on

6.1.2 PROFINET link state indicator

Link status	Indicator state (red)
Application relation established with IO-controller	off
Link status OK, No Application relation with IO-controller	blinking
No link.	on

6.2 INSTRUMENT LED INDICATION



Instrument LED indication
Green and Red

Led	Time	Indication
Green		
off	Continuously	Power-off or program not running
on	Continuously	Normal running/operation mode
short flash	0.1 sec on, 2 sec off	• Initialization mode • Secured parameters can be changed • Safe state active
normal flash	0.2 sec on, 0.2 sec off	Special function mode Instrument is busy performing any special function. E.g. auto-zero or self-test
Red		
off	Continuously	No error, application relation established.
short flash	0.1 sec on, 2 sec off	No application relation established.
long flash	2 sec on, 0.1 sec off	Configuration error. For example, a requested parameter is not available.
on	Continuously	Critical error in PROFINET interface hardware
Wink Mode	**Green Red Green Red**	**turn by turn**
normal wink	0.2 sec on, 0.2 sec off	Wink mode By a command send via PROFINET the instrument can “wink” with Led’s to indicate its position in a (large) system
slow wink	1 sec on, 1 sec off	Alarm indication: minimum alarm, limit/maximum alarm; power-up alarm or limit exceeded or batch reached.
fast wink	0.1 sec on, 0.1 sec off	Switch-released, selected action started

6.3 TROUBLESHOOTING HINTS AND TIPS

PROFINET problems	
No Communication	• Check power supply and cabling. • Check all PROFINET settings at your master. Master and slave settings for use of memory modules must be the same. Select at least one module e.g. 'Measure, integer (read)' otherwise there will be no data-exchange. • Check IP address, Subnetmask and gateway settings of interface (slave) • Try to reset the instrument and/or restart your master. • Make sure all settings for your slave are downloaded to your master (otherwise it won't work). • Contact PROFINET sales representative or service department.
Flow is not reacting to setpoint commands	• In case of PROFINET communication problems instrument will put it's valve into a safe state. This will close (NC) or open the valve fully (NO). When data exchange between master and slave has been re-established, instrument will respond to setpoint again. For overruling safe state via RS232 interface, see setpoint /control modes in chapter 2.5 from doc. nr. 9.17.023, (digital instrument description).
Red Led has long flash	• Make sure the requested parameters are available in the particular Bronkhorst PROFINET-slave. • Delete the PROFINET slave configuration and add a new slave in your software, this will remove a corruption in the software configuration.

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:

+31 573 45 88 39

8 APPENDIX A: A-CYCLIC PARAMETER INDICES

					Instance: 0		Instance: 1		Instance: 2	
Parameter name:	Type:	Process	Parameter	Length:	Index (Dec):	Index (Hex):	Index (Dec):	Index (Hex):	Index (Dec):	Index (Hex):
Measure	integer	1	0	2	32	0x20	4128	0x1020	8224	0x2020
Fmeasure	float	33	0	4	1056	0x420	5152	0x1420	9248	0x2420
Setpoint	integer	1	1	2	33	0x21	4129	0x1021	8225	0x2021
Fsetpoint	float	33	3	4	1059	0x423	5155	0x1423	9251	0x2423
Analog Input	integer	1	3	2	35	0x23	4131	0x1023	8227	0x2023
Temperature	float	33	7	4	1063	0x427	5159	0x1427	9255	0x2427
Actual Density	float	116	15	4	3727	0xE8F	7823	0x1E8F	11919	0x2E8F
Control mode	integer	1	4	1	36	0x24	4132	0x1024	8228	0x2024
Setpoint slope	integer	1	2	2	34	0x22	4130	0x1022	8226	0x2022
Valve output	integer	114	1	4	3649	0xE41	7745	0x1E41	11841	0x2E41
Fluid number	integer	1	16	1	48	0x30	4144	0x1030	8240	0x2030
Fluid name	string	1	17	10	49	0x31	4145	0x1031	8241	0x2031
Capacity 100%	float	1	13	4	45	0x2D	4141	0x102D	8237	0x202D
Capacity 0%	float	33	22	4	1078	0x436	5174	0x1436	9270	0x2436
Capacity unit string	string	1	31	7	63	0x3F	4159	0x103F	8255	0x203F
Calibration mode	integer	115	1	1	3681	0xE61	7777	0x1E61	11873	0x2E61
Serial number	string	113	1	20	3617	0xE21	7713	0x1E21	11809	0x2E21
BHT model number	string	113	2	23	3618	0xE22	7714	0x1E22	11810	0x2E22
Firmware Version	string	113	5	6	3621	0xE25	7717	0x1E25	11813	0x2E25
Identification number	integer	113	12	1	3628	0xE2C	7724	0x1E2C	11820	0x2E2C
Device type	string	113	1	6	3617	0xE21	7713	0x1E21	11809	0x2E21
Usertag	string	113	6	16	3622	0xE26	7718	0x1E26	11814	0x2E26
Customer model number	string	113	4	16	3620	0xE24	7716	0x1E24	11812	0x2E24
Alarm maximum limit	integer	97	1	2	3105	0xC21	7201	0x1C21	11297	0x2C21
Alarm minimum limit	integer	97	2	2	3106	0xC22	7202	0x1C22	11298	0x2C22
Alarm mode	integer	97	3	1	3107	0xC23	7203	0x1C23	11299	0x2C23
Alarm setpoint mode	integer	97	5	1	3109	0xC25	7205	0x1C25	11301	0x2C25
Alarm new setpoint	integer	97	6	2	3110	0xC26	7206	0x1C26	11302	0x2C26
Alarm delay time	integer	97	7	1	3111	0xC27	7207	0x1C27	11303	0x2C27
Reset alarm enable	integer	97	9	1	3113	0xC29	7209	0x1C29	11305	0x2C29
Counter value	float	104	1	4	3329	0xD01	7425	0x1D01	11521	0x2D01
Counter unit	integer	104	2	1	3330	0xD02	7426	0x1D02	11522	0x2D02
Counter limit	float	104	3	4	3331	0xD03	7427	0x1D03	11523	0x2D03
Counter setpoint mode	integer	104	5	1	3333	0xD05	7429	0x1D05	11525	0x2D05
Counter new setpoint	integer	104	6	2	3334	0xD06	7430	0x1D06	11526	0x2D06
Counter unit string	string	104	7	4	3335	0xD07	7431	0x1D07	11527	0x2D07
Counter mode	integer	104	8	1	3336	0xD08	7432	0x1D08	11528	0x2D08
Reset counter enable	integer	104	9	1	3337	0xD09	7433	0x1D09	11529	0x2D09
Counter controller overrun correction	float	104	10	4	3338	0xD0A	7434	0x1D0A	11530	0x2D0A
Counter controller gain	float	104	11	4	3339	0xD0B	7435	0x1D0B	11531	0x2D0B
Alarm info	integer	1	20	1	52	0x34	4148	0x1034	8244	0x2034
Reset	integer	115	8	1	3688	0xE68	7784	0x1E68	11880	0x2E68
Initreset	integer	0	10	1	10	0xA	4106	0x100A	8202	0x200A
IO swich status	integer	114	31	4	3679	0xE5F	7775	0x1E5F	11871	0x2E5F