MFC 400 Supplementary Instructions

Signal converter for mass flowmeters

Description of PROFINET IO interface

Electronic Revision: ER 2.0.x

The documentation is only complete when used in combination with the relevant documentation for the flow sensor.

1.1 Scope of the document

These instructions are supplementary to the standard handbook of the MFC 400 with ER 2.0.x (refer to document MA MFC 400 from version R05). They provide additional information for the devices when being operated and connected to a PROFINET IO network.

To ensure safety, please read this document carefully before installation and follow the instructions herein.

1.2 Used abbreviations

AWG	American Wire Gauge
DAP	Device Access Point
DCP	Dynamic Configuration Protocol
EIA/TIA	Electronic Industries Alliance/Telecommunications Industry Association
EMC	Electromagnetic Compatibility
EMI	Electromagnetic Interference
GSD	General Station Description
GSDML	General Station Description Markup Language
ID	unique Parameter ID
I&M	Information & Maintenance
I/O	Input/Output
IEC	International Electrotechnical Commission
IEEE	Institute of Electrical and Electronics Engineers
IP	Internet Protocol
IRT	Isochronous Real-Time
LFC	Low Flow Cut-off
LLDP	Link Layer Discovery Protocol
MAC	Media Access Control
MIB	Management Information Base
NIC	Network Interface Controller
OUI	Organizationally Unique Identifier
PE	Protective Earth
PLC	Programmable Logic Controller
PN	PROFINET
PNIO	PROFINET IO
RT	Real-Time
SNMP	Simple Network Management Protocol
t63	Time until 63% of the end value is reached for a step change. For details refer to *Locking of configuration* on page 16, ID 61.

Table 1-1: Used abbreviations

1.3 Device description

The mass flowmeters are designed exclusively to directly measure mass flow rates, product density and temperature as well to indirectly measure parameters such as the total volume, concentration of dissolved substances and the volume flow rate.

Your measuring device is supplied ready for operation. The factory settings for the operating data have been made in accordance with your order specifications.

The following versions are available:

- Compact version (the signal converter is mounted directly on the flow sensor)
- Remote version (electrical connection to the flow sensor via field current and signal cable)

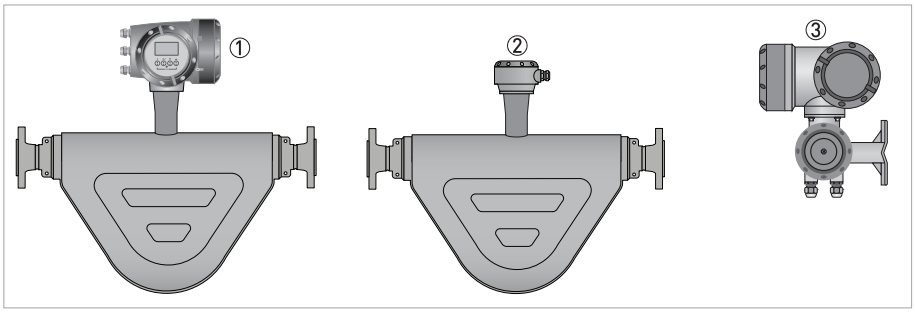


Figure 1-1: Versions with bent tube

① Compact version
② Flow sensor with connection box
③ Field housing

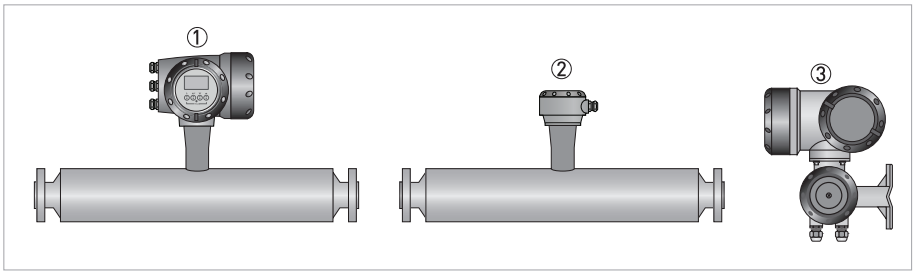


Figure 1-2: Versions with straight tube

① Compact version
② Flow sensor with connection box
③ Field housing

1.4 Special notes

INFORMATION!
This device is a Group 1, Class A device as specified within CISPR11:2009. It is intended for use in industrial environment. There may be potential difficulties in ensuring electromagnetic compatibility in other environments, due to conducted as well as radiated disturbances.

INFORMATION!
This device is a digital device used exclusively as an electronic control system utilised by a public utility or in an industrial plant.

INFORMATION!
This PROFINET IO device is certified by the PROFIBUS Nutzerorganisation e.V.

2.1 PROFINET IO general information

PROFINET IO is an Ethernet based communications protocol. The device features two Ethernet ports with an integrated industrial Ethernet switch (for details refer to *Assembly of the terminals with PROFINET IO* on page 12).

The Ethernet standard 100BASE-TX is supported. Additionally, the device supports the following features:

- Auto negotiation
- Auto crossover
- Auto polarity

The device itself supports PROFINET IO Conformance Class B (CC-B in table below).

- PROFINET IO version 2.3.3
- GSDML version 2.3.2

	Device
Conformance Class	**CC-B**
Basic function	**PROFINET IO with RT communication** - Cyclic I/O - Configuration parameters - Alarms - Network diagnostics via IP (SNMP) - Topology information (LLDP) with LLDP-MIB
Cabling	- IEC 61784-5-3 - Copper
Typical application	- Factory Automation - Process Automation

Table 2-1: Supported PROFINET IO Conformance Class

3.1 Safety instructions

DANGER!
Cables may only be connected when the power is switched off.

WARNING!
- *The device must be grounded in accordance with regulations in order to protect personnel against electric shocks.*
- *Follow the local health and safety regulations. Any work done on the electrical components of the measuring device may only be carried out by properly trained specialists.*

3.2 Shielding and grounding

- Only shielded cables with at least Category 5 must be used for PROFINET IO communication (for details refer to *PROFINET IO cable types* on page 9), otherwise EMI protection of the signal converter cannot be assured
- The cable shield must be grounded at least at one end
- If the cable shield is grounded at both ends, it shall have a connection to a common ground

INFORMATION!
- *Special grounding instructions for the various flow sensors are contained in the handbook for the signal converter.*

3.3 PROFINET IO cable types

The decision for 2 or 4 pair cabling is depending on the application.

Decision criteria can be as follows:

	2 pair cabling	4 pair cabling
Cable design	2 pair cabling shall be realised as one star-quad or as 2 twisted pair design	4 pair cabling shall be realised as two star-quad or as 4 twisted pair design
Devices in the network	PROFINET IO devices	PROFINET IO devices and also other IT devices
Max. length ①	100 m	100 m
Field of application	Specialised and optimised for defined PROFINET IO automation tasks	Universal use of a PROFINET IO network for PROFINET IO and other Ethernet applications

Table 3-1: Decision criteria for 2 or 4 pair cabling

① From connection point to connection point. E.g. Ethernet switch to device, device to device, control system to device.

INFORMATION!
If the PROFINET IO device is used with 4 pair cabling only 2 pairs are connected.

Application	Data cabling	
Mode	2 pairs	4 pairs
Type	RJ45 plug compatible or M12 D coded	RJ45 plug compatible
Mandatory number of contacts	4	8
Rated voltage	57 VDC	
Current (min.)	600 mA per contact at +70°C / +158°F	
Outer cable diameter	5.5...8.0 mm / 0.22...0.31"	5.5...9.0 mm / 0.22...0.35"
Wire cross-section	AWG 22	AWG 22...24
Wire diameter	1.4...1.6 mm / 0.055...0.0063"	1.0...1.6 mm / 0.039...0.0063"
Wire construction	Solid / Stranded	
Transmission performance	ISO/IEC 11801 Edition 2.0 Amendment 2, Class D at least Category 5	
Category (min.)	ISO/IEC 11801 Edition 2.0 Connector Category 5	
Shielding	Yes	
Cable strain relief	IEC 61984	
Mating cycles	Min. 50	

Table 3-2: Recommended cabling

3.4 Electrical connection of PROFINET IO

3.4.1 Overview of the PROFINET IO M12 connectors

The PROFINET IO device will be supplied with at least one external M12 data connector. Optional there is a second M12 data connector and a M12 power supply connector available.

- If one M12 data connector is assembled, PROFINET IO port 2 is available, only.
- If two M12 data connectors are assembled, PROFINET IO port 1 and 2 are available.

INFORMATION!
The optional M12 power supply connector is only available for the 24 VDC version.

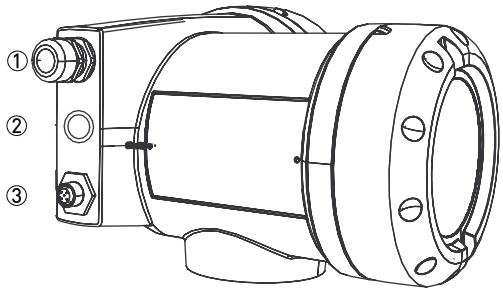
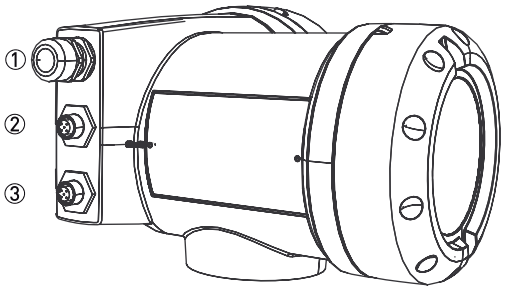
PROFINET IO with one M12 data connector	PROFINET IO with two M12 data connectors
	
① – Cable gland (optional M12 power supply connector) ② – not used ③ – PROFINET IO port 2 connector	① – Cable gland (optional M12 power supply connector) ② – PROFINET IO port 1 connector ③ – PROFINET IO port 2 connector

Table 3-3: M12 data connector overview

INFORMATION!
- *Unused M12 connectors must be covered by the provided cap to protect the connector from dust and humidity.*
- *Straight M12 connectors are recommended.*

Standardised M12 connectors (IP66/67 or higher) must be used and are described in the following standards: IEC 61076-2-101

3.4.2 Assembly of the M12 power supply connector with PROFINET IO

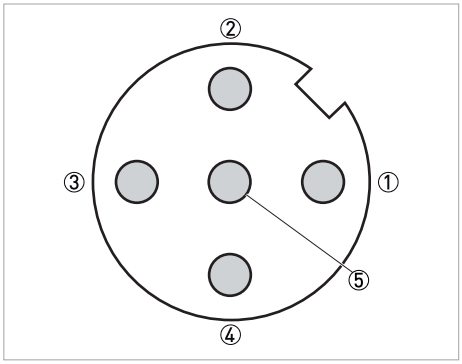


Figure 3-1: PROFINET IO M12 power supply connector (male, A coded)

Number	Description		Colour
①	L+	+24 VDC	brown
②	not connected		
③	not connected		
④	L-	GND	black
⑤	PE/shield		grey

Table 3-4: PROFINET IO M12 power supply connector pinout and colouring scheme

3.4.3 Assembly of the M12 data connector with PROFINET IO

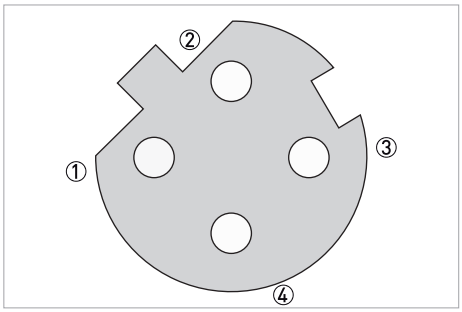


Figure 3-2: PROFINET IO M12 data connector (female, D coded)

Number	Signal	Colour
①	TX+	yellow
②	RX+	white
③	TX-	orange
④	RX-	blue

Table 3-5: PROFINET IO M12 data connector pinout and colouring scheme

3.4.4 Assembly of the terminals with PROFINET IO

The PROFINET IO device will be equipped with either one or two external M12 connectors. For details refer to *Overview of the PROFINET IO M12 connectors* on page 10.

The internal connection of the M12 connectors to the screw terminal is presented in the following table.

	Connection terminals								
	A	A-	A+	B	B-	C	C-	D	D-
PROFINET IO	Port 2					Port 1			
100BASE-TX	RX+	RX-		TX+	TX-	TX+	TX-	RX+	RX-
EIA/TIA 568A ①	white/ orange	orange		white/ green	green	white/ green	green	white/ orange	orange
EIA/TIA 568B ①	white/ green	green		white/ orange	orange	white/ orange	orange	white/ green	green
2-pair/ star-quad ②	white	blue		yellow	orange	yellow	orange	white	blue

Table 3-6: Terminal connection of PROFINET IO

① If used with 4 pair wires, leave unused pairs unconnected
② Specified in PROFIBUS Nutzerorganisation e.V., "PROFINET Cabling and Interconnection Technology - Guideline for PROFINET v3.1"

3.5 Topology of PROFINET IO networks

3.5.1 Point-to-point or star topology

Devices in this topology have only one connection to the control system (point-to-point) or to an Ethernet switch (star).

INFORMATION!
Devices in this network topology only need one Ethernet port.
Devices with two Ethernet connectors can still be used (for details refer to Overview of the PROFINET IO M12 connectors on page 10).

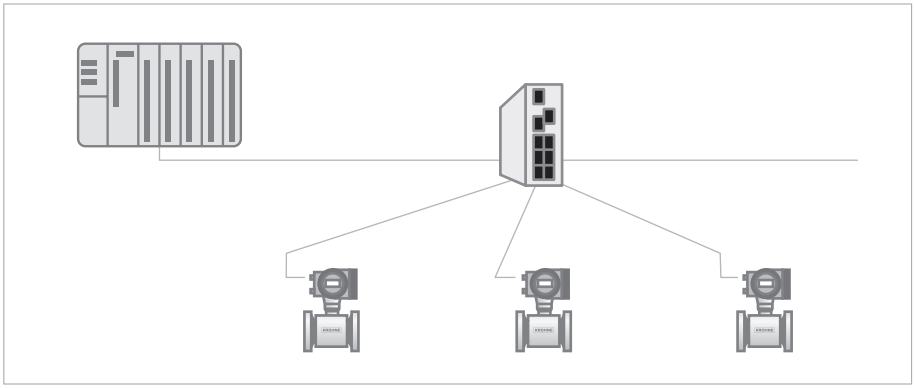


Figure 3-3: Point-to-point or star topology

3.5.2 Line topology

Devices and control systems in this topology are connected to each other in line (daisy chain). There is no need for an additional Ethernet switch to connect the devices.

INFORMATION!
Devices in this network topology need two Ethernet ports to forward the data telegrams to the next device. If the device is placed at the end of a line, then a device with only one Ethernet port is sufficient. Devices with two Ethernet ports can be used (for details refer to Overview of the PROFINET IO M12 connectors on page 10).

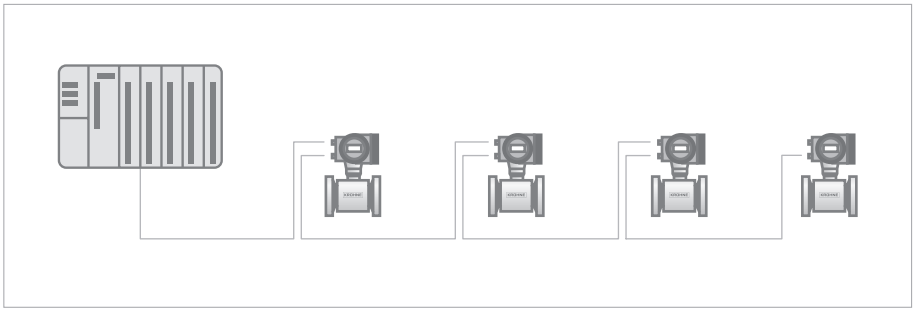


Figure 3-4: Line topology

3.5.3 Ring topology

Devices and control systems in this topology are connected to each other in line. Additionally the first and the last device are connected to the control system building a ring. The control system must support this topology. This topology is typically preferred if redundancy is required.

INFORMATION!
Devices in this network topology need two Ethernet ports.

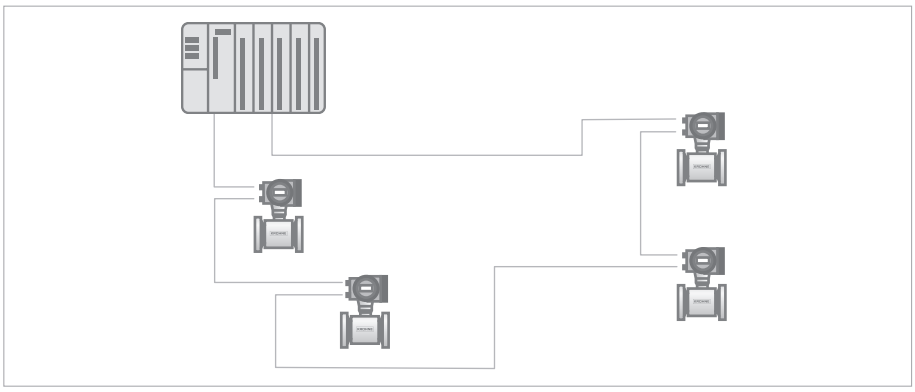


Figure 3-5: Ring topology

4.1 System integration

A PROFINET IO General Station Description (PN-GSD) file is required for system integration. The file contains a device description written in GSD Markup Language (GSDML).

The GSD file is available for download from the KROHNE website.

PROFINET IO version	2.3.3
Manufacturer ID	0x45 = 69 = KROHNE
Device ID	0x4512 = 17682 = MFC 400
GSD file	GSDML-V2.32-KROHNE-MFC400-YYYYMMDD.xml

Table 4-1: Device description

4.1.1 Default communication settings

Unless it is ordered with customised settings the device is shipped with the following default settings:

Parameter	Value	Description
Device Name (NameOfStation)		Empty / not set
IP Address	000.000.000.000	Empty / not set
Subnet Mask	000.000.000.000	Empty / not set
Default Gateway	000.000.000.000	Empty / not set

Table 4-2: Default communication settings

4.1.2 Device discovery and identification (DCP signal)

To identify the device, the DCP signal service can be used. While a DCP signal is active the Network Status LED is flashing yellow at 1 Hz (for details refer to *Network status* on page 16).

4.2 Display menu

A detailed description of the display menus and functions can be found in the standard product documentation of the signal converter. Special settings concerning the PROFINET IO features can be accessed through "Setup" (C4.x) menus.

Menu number		Parameter	Description
C4.x	.1	MAC Address Device	Shows the device MAC Address.
	.2	MAC Address Port 1	Shows the MAC Address of Port 1.
	.3	MAC Address Port 2	Shows the MAC Address of Port 2.
	.4	IP Address	Read or change IP Address.
	.5	Subnet Mask	Read or change Subnet Mask.
	.6	Default Gateway	Read or change Default Gateway.
	.7	Information	Shows the software version.

Table 4-3: Menu structure for PROFINET IO

INFORMATION!
The display shows only the permanent configuration of IP address, subnet mask and default gateway. A temporary IP configuration from a DCP server is not shown on the display.

4.3 Status LEDs on display

The local display has two status LEDs dedicated to the PROFINET IO interface.

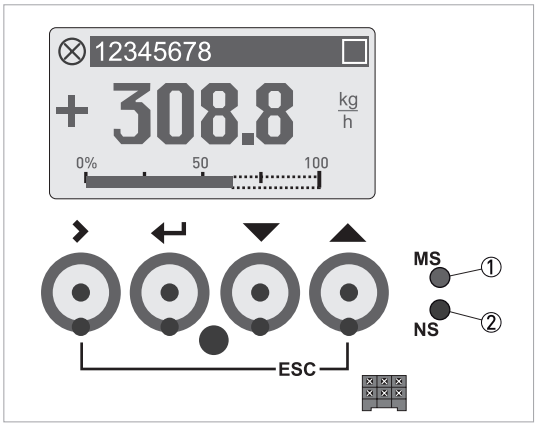


Figure 4-1: Location of the status LED indication on the display for a PROFINET IO device

① MS - Module Status LED
② NS - Network Status LED

4.3.1 Module status

The MS (Module Status) LED indicates the status of the PROFINET IO interface.

Colour / signal	Description
Red, steady on	Communication module failure.
Green, steady on	Operating correctly.

Table 4-4: MS LED

4.3.2 Network status

The NS (Network Status) LED indicates the PROFINET IO communication state.

Colour / signal	Description
Yellow, flashing	PROFINET DCP signal used for device identification.
Red, steady on	No Ethernet link.
Green, flashing	Ethernet link at least on one port but no active PROFINET IO connection.
Green, steady on	Active PROFINET IO connection.

Table 4-5: NS LED

4.4 Locking of configuration

The device provides a locking mechanism for the local display when a PROFINET IO connection is active. The lock covers all parameters within the start-up parameters as well as totalizers and sensor control (e.g. zero calibration).

To enable the lock, set "Use configuration by PN controller" and "Lock Local Display" in the start-up parameters (for details refer to *General* on page 19).

The write lock will be activated as soon as the PROFINET IO connection is established.
Once the PROFINET IO connection is released, the write lock will be deactivated.

INFORMATION!
The lock jumper must not be used with the PROFINET IO communication option. Otherwise the device signals a device failure.

4.5 Interface description

The device has a static slot/subslot configuration that is shown in the following table.

Slot	Subslot	Name	Ident No.	Description
0	Device Access Point		0x1	Standard PROFINET IO DAP with up to 2 ports.
	32768	Interface	0xa	
	32769	Port 1	0xb	
	32770	Port 2	0xc	
1	Sensors		0x2	Module representing the sensor system.
	1	Sensor Data	0x2	I/O data, start-up records

Table 4-6: Static PROFINET IO slot/subslot mapping

4.6 Data types and byte order

The data transmitted over the PROFINET IO interface is classified by several data types (according to IEC 61158-5) described in the following subsections.

4.6.1 Float32

Float32 is also known as REAL in PLC language (IEC 61131-3).

Byte order on bus	0	1	2	3
IEEE 754 bits	SEEE EEEE	EMMM MMMM	MMMM MMMM	MMMM MMMM
Example	Value = 1234.567			
	0x44	0x9A	0x52	0x25

Table 4-7: Data type Float32

S = Sign, E = Exponent, M = Mantissa

For more details refer to the standard IEEE 754 for single precision floating point format.

4.6.2 Unsigned8

Unsigned8 is also known as USINT or BYTE in PLC language (IEC 61131-3). Data of this type may to be interpreted as an unsigned integer (USINT) or bit-wise (BYTE) depending on context.

4.6.3 Unsigned16

Unsigned16 is also known as UINT or WORD in PLC language (IEC 61131-3). Data of this type may to be interpreted as an unsigned integer (UINT) or bit-wise (WORD) depending on context.

Byte order on bus	0	1
Significance	MSB	LSB
Example	Value = 1234	
	0x04	0xD2

Table 4-8: Data type Unsigned16

4.7 Information & Maintenance (I&M)

The device supports the I&M functions 0 to 4.

I&M0 provides standardised information about the device, the so-called electronic type plate.

I&M1 to I&M4 are typically used for storage of PROFINET IO engineering related information. The following subsections describe all I&M tables in detail. The length specifies the number of octets of each element.

4.7.1 I&M0 - Electronic type plate

I&M0 data is read-only.

Name	Length	Description
MANUFACTURER_ID	2	0x45 = 69 = KROHNE
ORDER_ID	20	Combination of flow sensor and signal converter IDs e.g. VN12345678CG43011N00
SERIAL_NUMBER	16	System serial number e.g. G170000001101111
HARDWARE_REVISION	2	1
SOFTWARE_REVISION	4	= Electronic revision e.g. V202 = V2.0.2
REV_COUNTER	2	Always 0
PROFILE_ID	2	0 = non-profile device
PROFILE_SPECIFIC_TYPE	2	0 = non-profile device
IM_VERSION	2	0x0101 = I&M version 1.1
IM_SUPPORTED	2	0x1E = I&M 1 to 4 supported

Table 4-9: Description of I&M0

4.7.2 I&M1 - Tags

I&M1 parameters can be changed by user.

Name	Length	Description
TAG_FUNCTION	32	Task or function of the device. This text is shown on the local display, too.
TAG_LOCATION	22	Location of the device.

Table 4-10: Description of I&M1

4.7.3 I&M2 - Installation date

I&M2 parameters can be changed by user.

Name	Length	Description
INSTALLATION_DATE	16	Date of installation or commissioning.

Table 4-11: Description of I&M2

4.7.4 I&M3 - Descriptor

I&M3 parameters can be changed by user.

Name	Length	Description
DESCRIPTOR	54	Additional information.

Table 4-12: Description of I&M3

4.7.5 I&M4 - Signature

I&M4 parameters can be changed by user.

Name	Length	Description
SIGNATURE	54	Application specific signature.

Table 4-13: Description of I&M4

4.8 Units of measurement

The PROFINET IO interface provides unit codes according to the official PROFIBUS PA Profile for Process Control Devices V3.02. The supported unit codes are listed in the GSD file.

INFORMATION!
The selection of the units of measurement on the local display and the units of measurement on PROFINET IO are independent and are not synchronized. The PROFINET IO units can be set via the start-up parameter configuration.

4.9 Start-up parameter configuration

The "Sensor Data" submodule (ident number 2; for details refer to *Interface description* on page 17) provides a set of parameters, the so-called record data or start-up records, that can be used for device parameterization during connection setup. The GSD file contains descriptions of the record data. We recommend using typical PROFINET IO engineering tools, which are able to conveniently display the complete record data as a list of parameters.

The following sections provide a list of all parameters within the record data. A unique parameter ID is introduced in order to reference each parameter explicitly.

4.9.1 General

ID	Name	Data type	Remarks
0	Use configuration by PN controller	Unsigned8	Yes - The following parameters will be applied. No - The following parameters ID 1 to ID 74 will be ignored, the device runs with previous configuration.
1	Lock Local Display	Unsigned8	Yes - The local display will be locked as long as a PROFINET IO connection is established. No - The local display is not locked. Device settings can be modified through the local display during an active PROFINET IO connection.

Table 4-14: Parameter group - General

4.9.2 Process Input - Flow

ID	Name	Data type	Remarks
2	Flow Direction	Unsigned8	Forwards (default), Backwards
3	Operation Mode	Unsigned8	Stop, Measuring (default), Standby
4	Damping [s]	Float32	Process noise damping for all flow measurements.
5	Low Flow Cut-off (LFC) [%]	Float32	Low flow cut-off threshold for all flow measurements relative to nominal mass flow rate. Zero flow will be reported if the actual flow is below this threshold.
6	Pipe Diameter [mm]	Float32	Pipe diameter for flow speed calculation.
7	Pressure Suppression LFC [%]	Float32	Pressure suppression low flow cut-off threshold relative to nominal mass flow rate.
8	Pressure Suppression Time [s]	Float32	Pressure suppression time.

Table 4-15: Parameter group - Process Input - Flow

4.9.3 Process Input - Density

ID	Name	Data type	Remarks
9	Density Mode	Unsigned8	Process (default), Fixed, Referred, Standard
10	Fixed Density	Float32	Density value for density mode "Fixed". Unit: selected by ID 53
11	Referred Density Temperature	Float32	Reference temperature for density mode "Referred". Unit: selected by ID 54
12	Referred Density Slope	Float32	Density slope for density mode "Referred".

Table 4-16: Parameter group - Process Input - Density

4.9.4 Process Input - System Control

ID	Name	Data type	Remarks
13	Function	Unsigned8	Off (default), Set Flow to 0. System control, used in order to set all flow variables to zero if variable is exceeding min. or max. density/temperature.
14	Variable	Unsigned8	Density, Temperature
15	Min. Density	Float32	Minimum density for variable "Density". Unit: selected by ID 53
16	Max. Density	Float32	Maximum density for variable "Density". Unit: selected by ID 53
17	Min. Temperature	Float32	Minimum temperature for variable "Temperature". Unit: selected by ID 54
18	Max. Temperature	Float32	Maximum temperature for variable "Temperature". Unit: selected by ID 54

Table 4-17: Parameter group - Process Input - System Control

4.9.5 Process Input - Concentration

INFORMATION!
For usage of concentration measurement, please order the "Concentration package".

ID	Name	Data type	Remarks
19	Concentration - Data Select	Unsigned8	Concentration Data 1, Concentration Data 2
20	Concentration 1 - Mode	Unsigned8	Concentration mode
21	Concentration 1 – Offset [%]	Float32	Concentration offset
22	Concentration 1 - Product	Unsigned8	Concentration product
23	Concentration 1 - Coefficient 1	Unsigned8	Concentration type: Linear, Non-Linear
24	Concentration 1 - Coefficient 2	Float32	Density of product A in g/cm³
25	Concentration 1 - Coefficient 3	Float32	Temp. coeff. for product A
26	Concentration 1 - Coefficient 4	Float32	Temp. coeff. squared for product A
27	Concentration 1 - Coefficient 5	Unsigned8	Product B type: Pure Water, Town Water, Other
28	Concentration 1 - Coefficient 6	Float32	Density of product B in g/cm³
29	Concentration 1 - Coefficient 7	Float32	Temp. coeff. for product B
30	Concentration 1 - Coefficient 8	Float32	Temp. coeff. squared for product B
31	Concentration 1 - Coefficient 9	Float32	Linear temp. corr.
32	Concentration 1 - Coefficient 10	Float32	Squared temp. corr.
33	Concentration 1 - Coefficient 11	Float32	Linear dens. corr.
34	Concentration 1 - Coefficient 12	Float32	Squared dens. corr.
35	Concentration 2 - Mode	Unsigned8	Concentration mode
36	Concentration 2 – Offset [%]	Float32	Concentration offset
37	Concentration 2 - Product	Unsigned8	Concentration product
38	Concentration 2 - Coefficient 1	Unsigned8	Concentration type: Linear, Non-Linear
39	Concentration 2 - Coefficient 2	Float32	Density of product A in g/cm³
40	Concentration 2 - Coefficient 3	Float32	Temp. coeff. for product A
41	Concentration 2 - Coefficient 4	Float32	Temp. coeff. squared for product A
42	Concentration 2 - Coefficient 5	Unsigned8	Product B type: Pure Water, Town Water, Other
43	Concentration 2 - Coefficient 6	Float32	Density of product B in g/cm³
44	Concentration 2 - Coefficient 7	Float32	Temp. coeff. for product B
45	Concentration 2 - Coefficient 8	Float32	Temp. coeff. squared for product B
46	Concentration 2 - Coefficient 9	Float32	Linear temp. corr.
47	Concentration 2 - Coefficient 10	Float32	Squared temp. corr.
48	Concentration 2 - Coefficient 11	Float32	Linear dens. corr.
49	Concentration 2 - Coefficient 12	Float32	Squared dens. corr.

Table 4-18: Parameter group - Process Input - Concentration

4.9.6 Unit

ID	Name	Data type	Remarks
50	Volume Flow	Unsigned16	Unit selector for volume flow values.
51	Mass Flow	Unsigned16	Unit selector for mass flow values.
52	Flow Speed	Unsigned16	Unit selector for flow speed values.
53	Density	Unsigned16	Unit selector for density values.
54	Temperature	Unsigned16	Unit selector for temperature values.
55	Totalizer 1 - Volume	Unsigned16	Unit selector for totalizer 1 volume values if measurement (ID 59) is set to "Volume flow".
56	Totalizer 2 - Volume	Unsigned16	Unit selector for totalizer 2 volume values if measurement (ID 66) is set to "Volume flow".
57	Totalizer 1 - Mass	Unsigned16	Unit selector for totalizer 1 mass values if measurement (ID 59) is set to "Mass flow".
58	Totalizer 2 - Mass	Unsigned16	Unit selector for totalizer 2 mass values if measurement (ID 66) is set to "Mass flow".

Table 4-19: Parameter group - Unit

4.9.7 Totalizer 1

ID	Name	Data type	Remarks
59	Measurement	Unsigned8	Select measurement connected to the totalizer: Volume Flow, Mass Flow, Concentration Mass Flow 1, Concentration Volume Flow 1, Concentration Mass Flow 2, Concentration Volume Flow 2
60	Function	Unsigned8	Off, Absolute Total, Incremental Total, Decremental Total
61	Damping [s]	Float32	Damping for measurement connected to the totalizer, based on t63.
62	LFC Volume - Threshold	Float32	Low flow cutoff threshold if measurement is set to "Volume flow". Unit: selected by ID 50
63	LFC Volume - Hysteresis	Float32	Low flow cutoff hysteresis if measurement is set to "Volume flow". Unit: selected by ID 50
64	LFC Mass - Threshold	Float32	Low flow cutoff threshold if measurement is set to "Mass flow". Unit: selected by ID 51
65	LFC Mass - Hysteresis	Float32	Low flow cutoff hysteresis if measurement is set to "Mass flow". Unit: selected by ID 51

Table 4-20: Parameter group - Totalizer 1

4.9.8 Totalizer 2

ID	Name	Data type	Remarks
66	Measurement	Unsigned8	Select measurement connected to the totalizer: Volume Flow, Mass Flow, Concentration Mass Flow 1, Concentration Volume Flow 1, Concentration Mass Flow 2, Concentration Volume Flow 2
67	Function	Unsigned8	Off, Absolute Total, Incremental Total, Decremental Total
68	Damping [s]	Float32	Damping for measurement connected to the totalizer, based on t63.
69	LFC Volume - Threshold	Float32	Low flow cutoff threshold if measurement is set to "Volume flow". Unit: selected by ID 50
70	LFC Volume - Hysteresis	Float32	Low flow cutoff hysteresis if measurement is set to "Volume flow". Unit: selected by ID 50
71	LFC Mass - Threshold	Float32	Low flow cutoff threshold if measurement is set to "Mass flow". Unit: selected by ID 51
72	LFC Mass - Hysteresis	Float32	Low flow cutoff hysteresis if measurement is set to "Mass flow". Unit: selected by ID 51

Table 4-21: Parameter group - Totalizer 2

4.9.9 Status and Diagnostics

ID	Name	Data type	Remarks
73	NE107 Proc. System Control	Unsigned8	NE107 mapping possible to: - Information - Maintenance Required - Function Check - Out Of Specification - Failure
74	NE107 Conf. Totalizer	Unsigned8	
75	NE107 Proc. Signal Low	Unsigned8	
76	NE107 Proc. Two Phase Flow	Unsigned8	
77	Two Phase Signaling Threshold	Float32	Process-dependent threshold of the 2 phase signal status message ①. 0 disables detection of 2 phase flow.

Table 4-22: Parameter group - Status and Diagnostics

① For usage of concentration measurement, please order the "Concentration package".

4.10 Cyclic data

The section describes the cyclic data that is exchanged between the PLC and the device at a certain interval when a PROFINET IO connection is established.

The entire I/O data is provided by a module/submodule combination that is located in slot 1, subslot1. The data is structured in different blocks with distinct characteristics. The following subsections explain the available blocks.

4.10.1 Measurement blocks

A measurement block provides the process value of a measurement accompanied by the current status (for details refer to *Status information* on page 27) and unit code (for details refer to *Units of measurement* on page 19).

4.10.2 Totalizer blocks

A totalizer block provides the totalized value of the process value that is selected in the settings (either volume flow, mass flow or concentration flow). The totalizer value is accompanied by the current status (for details refer to *Status information* on page 27) and unit code (for details refer to *Units of measurement* on page 19).

The totalizer can be controlled by the corresponding control octet in the output data (for details refer to *Output data* on page 26).

4.10.3 Generic blocks

The generic blocks provide device status information and internal device diagnosis.

4.10.4 Input data

No.	Block name	Block type	Element	Data type	Data size	Offset
1	Volume Flow	Measurement	Value	Float32	4	0
			Status	Unsigned16	2	4
			Unit Code	Unsigned16	2	6
2	Totalizer 1	Totalizer	Value	Float32	4	8
			Status	Unsigned16	2	12
			Unit Code	Unsigned16	2	14
3	Totalizer 2	Totalizer	Value	Float32	4	16
			Status	Unsigned16	2	20
			Unit Code	Unsigned16	2	22
4	Density	Measurement	Value	Float32	4	24
			Status	Unsigned16	2	28
			Unit Code	Unsigned16	2	30
5	Flow Speed	Measurement	Value	Float32	4	32
			Status	Unsigned16	2	36
			Unit Code	Unsigned16	2	38
6	Mass Flow	Measurement	Value	Float32	4	40
			Status	Unsigned16	2	44
			Unit Code	Unsigned16	2	46
7	Temperature	Measurement	Value	Float32	4	48
			Status	Unsigned16	2	52
			Unit Code	Unsigned16	2	54
8	Concentration 1	Measurement	Value	Float32	4	56
			Status	Unsigned16	2	60
			Unit Code	Unsigned16	2	62
9	Concentration 2	Measurement	Value	Float32	4	64
			Status	Unsigned16	2	68
			Unit Code	Unsigned16	2	70
10	Concentration 1 Flow	Measurement	Value	Float32	4	72
			Status	Unsigned16	2	76
			Unit Code	Unsigned16	2	78
11	Concentration 2 Flow	Measurement	Value	Float32	4	80
			Status	Unsigned16	2	84
			Unit Code	Unsigned16	2	86
12	Sensor	Generic	Status	Unsigned16	2	88
13	Device	Generic	Status	Unsigned16	2	90
14	Diagnosis	Generic	Diag 1	Unsigned8	1	92
			Diag 2	Unsigned8	1	93

Table 4-23: Cyclic input data

4.10.5 Output data

Block name	Block type	Element	Data type	Data size	Offset
Totalizer 1	Totalizer	Control	Unsigned8	1	0
Totalizer 2	Totalizer	Control	Unsigned8	1	1
Sensor	Generic	Control	Unsigned8	1	2

Table 4-24: Cyclic output data

4.11 Totalizer

The PROFINET IO interface provides access to two separate totalizers, which realize a time integration of the measured values. They can be configured using the start-up parameters (for details refer to *Totalizer 1* on page 22 and refer to *Totalizer 2* on page 23).

During operation, each individual totalizer can be stopped, started or reset using the dedicated control octets of the output data (for details refer to *Output data* on page 26).

The following figure shows the effect of the different control commands on the totalizer value. This example assumes a constant flow that is being totalized.

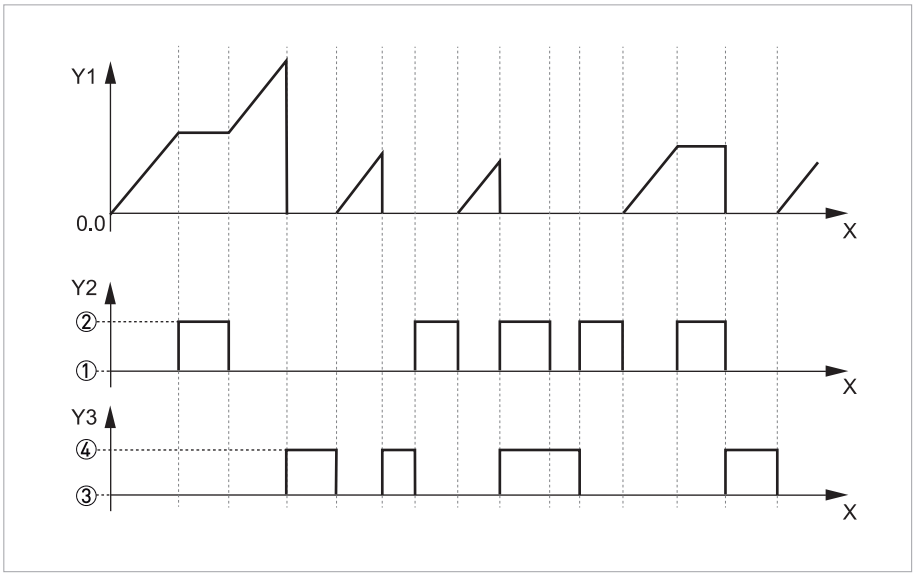


Figure 4-2: Example for totalizer control

X: time
Y1: totalizer value
Y2: totalizer run/stop
Y3: totalizer reset

	Bit	Value	Description
①	0	0	RUN
②	0	1	STOP
③	1	0	n/a
④	1	1	RESET

4.12 Zero point calibration

The zero point calibration can be started via the sensor block in the output data (for details refer to *Output data* on page 26).

The zero point calibration is edge-controlled and is started with rising edge (bit 0). It can not be retriggered until a running calibration has finished.

4.13 Status information

4.13.1 Status coding - Device

The device status (for details refer to *Input data* on page 25, No. 13) is a 2-octet status. The status gives information about the validity and applicability of the whole device.

The status coding is implemented on the basis of the NE 107 (NAMUR Recommendation 107 – Self-Monitoring and Diagnosis of Field Devices) compatible condensed status described in the official PROFIBUS PA Profile for Process Control Devices V3.02.

The first octet (octet 0) encodes according to the condensed status regardless of the simulation indicator which is moved to a separate bit in the second octet (octet 1).

The following table explains the status coding.

Status	Octet 1	Octet 0	Description	NE 107 status
BAD - Maintenance Alarm	0x00	0x24	Process value faulty because of a device failure.	Failure (0x80)
BAD - Function Check	0x01	0x3C	Status during maintenance or function checking.	Function Check (0x10)
UNCERTAIN - Process Related	0x00	0x78	Process value is potentially invalid (accuracy not guaranteed).	Out of Specification (0x20)
GOOD - Maintenance Required	0x00	0xA4	Maintenance required.	Maintenance Required (0x04)
GOOD	0x00	0x80	Valid process value.	None (0x00)

Table 4-25: Status coding - Device

4.13.2 Status coding - Values

Each measurement value or totalizer value (for details refer to *Input data* on page 25, No. 1...11) is accompanied by a 2-octet status. The status gives information about the validity and applicability of the corresponding value.

The status coding is implemented on the basis of the condensed status described in the official PROFIBUS PA Profile for Process Control Devices V3.02.

The first octet (octet 0) encodes according to the condensed status despite the simulation indicator which is moved to a separate bit in the second octet (octet 1).

The following table explains the status coding.

Status	Octet 1	Octet 0	Description	NE 107 status
BAD - Passivated	0x00	0x20	Measurement is inactive, substitute value.	None (0x00)
BAD - Function Check	0x01	0x3C	Measurement is simulated.	Function Check (0x10)
BAD - Maintenance Alarm	0x00	0x24	Process value faulty because of a device failure.	Failure (0x80)
UNCERTAIN - Initial Value	0x00	0x4F	Initial value as long as no measurement is available.	Function Check (0x10)
UNCERTAIN - Process Related	0x00	0x78	Process value is potentially invalid (accuracy not guaranteed).	Out of Specification (0x20)
GOOD - Maintenance Required	0x00	0xA4	Maintenance required.	Maintenance Required (0x04)
GOOD	0x00	0x80	Valid process value.	None (0x00)

Table 4-26: Status coding - Values

4.13.3 Status coding - Sensor

The device provides an input block which contains sensor status information (for details refer to *Input data* on page 25, No. 12) according to the following table:

Bit	Description
0	Zero Calibration Running
1	Stop Mode
2	Standby Mode
3	System Control Active
4	Sensor Simulation Active

Table 4-27: Status coding - Sensor

4.14 Diagnosis

4.14.1 Diagnosis 1

Bit	Description	Recommended action
0	Flow Out Of Range	Check process conditions.
1	Velocity Out Of Range	Check process conditions.
2	Process Temperature Out Of Range	Check process conditions.
3	Density Over Range	Check process conditions.
4	Electronics Temperature Out Of Specification	Move electronics away from process influences. Protect the electronics against direct sunlight.
5	Hardware Failure	Perform a power reset. If the status returns, contact manufacturer.
6	Memory Failure	Perform a power reset. If the status returns, contact manufacturer.
7	Sensor Error	Check cabling in case of remote device or replace sensor.

Table 4-28: Diagnosis 1

4.14.2 Diagnosis 2

Bit	Description	Recommended action
0	Temperature or strain sensor defective	Check cabling in case of remote device or replace sensor.
1	Data Error	Check process input configuration or reset to factory configuration.
2	No Sensor Signal	Check process conditions (entrained gas, viscosity). In case of remote sensor check sensor cabling. Check internal sensor connections.
3	Sensor Signal Low	Check for entrained gas or viscosity of product.
4	2 Phase Flow Over Threshold	Check process for entrained gas.
5	Density Calibration Invalid	Restart density calibration, check product and operation mode or reset to factory settings.
6	PROFINET Startup records invalid	Check start-up records. **Note: Some parameters are scaled by a configurable unit within the start-up records. Changing those units requires adjustment of the affected parameters.** E.g. if density unit (ID 53) changes, the values of parameters ID 10, ID 15 and ID 16 must be converted to the new unit manually.
7	Reserved	-

Table 4-29: Diagnosis 2

KROHNE – Process instrumentation and measurement solutions

- Flow
- Level
- Temperature
- Pressure
- Process Analysis
- Services

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