



OPTISONIC 3400 Handbook

Robust, ultrasonic flowmeter for District Heating

ER 3.1.x

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1.1 Software history

For all GDC devices, the "Electronic Revision" (ER) is consulted to document the revision status of the electronics according to NE 53. It is easy to see from the ER whether any fault repairs or major changes to the electronic equipment have taken place and what effect they have had on compatibility.

1	Downwards compatible changes and fault repair with no effect on operation (e.g. spelling mistakes on display)	
2-__	Downwards compatible hardware and/or software change of interfaces:	
	H	HART® version 7
3-__	Downwards compatible hardware and/or software change of inputs and outputs	
	I	Current output
	F, P	Frequency output, pulse output
	S	Status output
	C	Control input
	X	all inputs and outputs
4	Downwards compatible changes with new functions	
5	Incompatible changes, i.e. electronic equipment must be changed	

Table 1-1: Description of changes

Release date	Electronic revision	Changes and compatibility	Documentation
2016-01	ER 3.0.1_	-	MA OPTISONIC 3400 MI-004 R01
2017-09	ER 3.0.2_	1	-
2018-03	ER 3.0.3_	1	-
not published	ER 3.0.4_	1	-
2019-07	ER 3.0.5_	1	MA OPTISONIC 3400 MI-004 R02
2026-06	ER 3.1.0_	1	MA OPTISONIC 3400 MI-004 R03

Table 1-2: Changes and effect on compatibility

1.2 Intended use

**CAUTION!**

Responsibility for the use of the measuring devices with regard to suitability, intended use and corrosion resistance of the used materials against the measured fluid lies solely with the operator.

**INFORMATION!**

The manufacturer is not liable for any damage resulting from improper use or use for other than the intended purpose.

The **OPTISONIC 3400 MI-004** is designed exclusively for flow measurement in both unidirectional (standard operation) and bidirectional applications, on conductive and / or non-conductive fluids. Contaminations, like entrained gas, particles, 2 phase and non-homogeneous mixtures, can affect the acoustic signal and must be avoided.

The overall functionality of the **OPTISONIC 3400 MI-004** flowmeter is the continuous measurement of actual volume flow, mass flow, flow speed, the velocity of sound, gain, SNR, totalized flow mass and diagnosis values.

1.3 Certification

Product marking



Figure 1-1: Example of marking logo

The manufacturer certifies successful testing of the product by applying the conformity mark on the device.

This device fulfils the statutory requirements of the relevant directives.

For more information on the directives, standards and the approved certifications, please refer to the declaration of conformity supplied with the device or downloadable from the manufacturer's website.

Other approvals and standards

- Measuring Instruments Directive 2014/32/EU, Annex VI (MI-004).
- NAMUR NE 21/04

For more information, please refer to the dedicated documentation.

**DANGER!**

For devices used in hazardous areas, additional safety notes apply; please refer to the Ex documentation.

1.4 Safety instructions from the manufacturer

1.4.1 Copyright and data protection

The contents of this document have been created with great care. Nevertheless, we provide no guarantee that the contents are correct, complete or up-to-date.

The contents and works in this document are subject to copyright. Contributions from third parties are identified as such. Reproduction, processing, dissemination and any type of use beyond what is permitted under copyright requires written authorisation from the respective author and/or the manufacturer.

The manufacturer tries always to observe the copyrights of others, and to draw on works created in-house or works in the public domain.

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We hereby expressly prohibit the use of the contact data published as part of our duty to publish an imprint for the purpose of sending us any advertising or informational materials that we have not expressly requested.

1.4.2 Disclaimer

The manufacturer will not be liable for any damage of any kind by using its product, including, but not limited to direct, indirect or incidental and consequential damages.

This disclaimer does not apply in case the manufacturer has acted on purpose or with gross negligence. In the event any applicable law does not allow such limitations on implied warranties or the exclusion of limitation of certain damages, you may, if such law applies to you, not be subject to some or all of the above disclaimer, exclusions or limitations.

Any product purchased from the manufacturer is warranted in accordance with the relevant product documentation and our Terms and Conditions of Sale.

The manufacturer reserves the right to alter the content of its documents, including this disclaimer in any way, at any time, for any reason, without prior notification, and will not be liable in any way for possible consequences of such changes.

1.4.3 Product liability and warranty

The operator shall bear responsibility for the suitability of the device for the specific purpose. The manufacturer accepts no liability for the consequences of misuse by the operator. Improper installation or operation of the devices (systems) will cause the warranty to be void. The respective "Standard Terms and Conditions" which form the basis for the sales contract shall also apply.

1.4.4 Information concerning the documentation

To prevent any injury to the user or damage to the device it is essential that you read the information in this document and observe applicable national standards, safety requirements and accident prevention regulations.

If this document is not in your native language and if you have any problems understanding the text, we advise you to contact your local office for assistance. The manufacturer cannot accept responsibility for any damage or injury caused by misunderstanding of the information in this document.

This document is provided to help you establish operating conditions, which will permit safe and efficient use of this device. Special considerations and precautions are also described in the document, which appear in the form of icons as shown below.

1.4.5 Warnings and symbols used

Safety warnings are indicated by the following symbols.



DANGER!

This warning refers to the immediate danger when working with electricity.



DANGER!

This warning refers to the immediate danger of burns caused by heat or hot surfaces.



DANGER!

This warning refers to the immediate danger when using this device in a hazardous atmosphere.



DANGER!

These warnings must be observed without fail. Even partial disregard of this warning can lead to serious health problems and even death. There is also the risk of seriously damaging the device or parts of the operator's plant.



WARNING!

Disregarding this safety warning, even if only in part, poses the risk of serious health problems. There is also the risk of damaging the device or parts of the operator's plant.



CAUTION!

Disregarding these instructions can result in damage to the device or to parts of the operator's plant.



INFORMATION!

These instructions contain important information for the handling of the device.



LEGAL NOTICE!

This note contains information on statutory directives and standards.



• **HANDLING**

This symbol designates all instructions for actions to be carried out by the operator in the specified sequence.

➞ **RESULT**

This symbol refers to all important consequences of the previous actions.

1.5 Safety instructions for the operator



WARNING!

*In general, devices from the manufacturer may only be installed, commissioned, operated and maintained by properly trained and authorized personnel.
This document is provided to help you establish operating conditions, which will permit safe and efficient use of this device.*

2.1 Scope of delivery

**INFORMATION!**

Do a check of the packing list to make sure that you have all the elements given in the order.

**INFORMATION!**

Inspect the packaging carefully for damages or signs of rough handling. Report damage to the carrier and to the local office of the manufacturer.

**INFORMATION!**

The field device will arrive in two cartons. One carton contains the converter and one carton contains the sensor.

**INFORMATION!**

Make sure to combine the sensor and the converter correctly, so they match by the devices serial number.

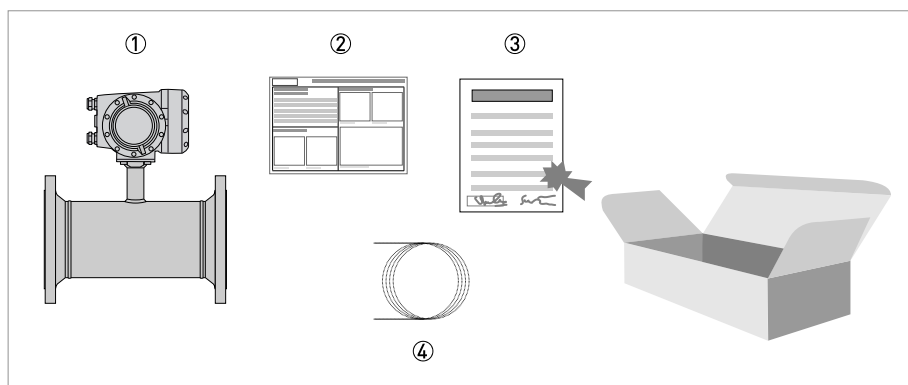


Figure 2-1: Scope of delivery - compact version

- ① Ordered flowmeter
- ② Product documentation
- ③ Factory calibration certificate
- ④ Signal cable

**INFORMATION!**

Assembly materials and tools are not part of the delivery. Use the assembly materials and tools in compliance with the applicable occupational health and safety directives.

2.2 Device description

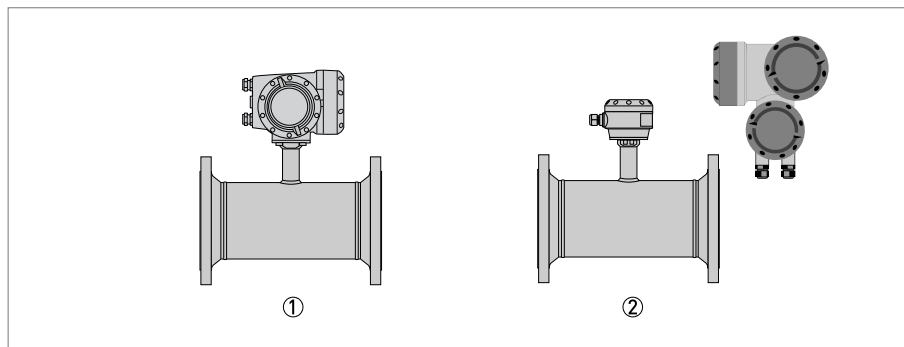
This ultrasonic flowmeter is designed for the continuous measurement of actual volume flow, mass flow, flow speed, velocity of sound, gain, SNR and diagnosis value.

Exclusively for bi-directional measuring of conductive and / or non-conductive fluids in closed, completely filled pipeline circuits.

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 measuring sensor)
- Remote version (electrical connection to the measuring sensor via signal cable)



- ① Compact version
② Remote version

2.2.1 Field housing (remote version)

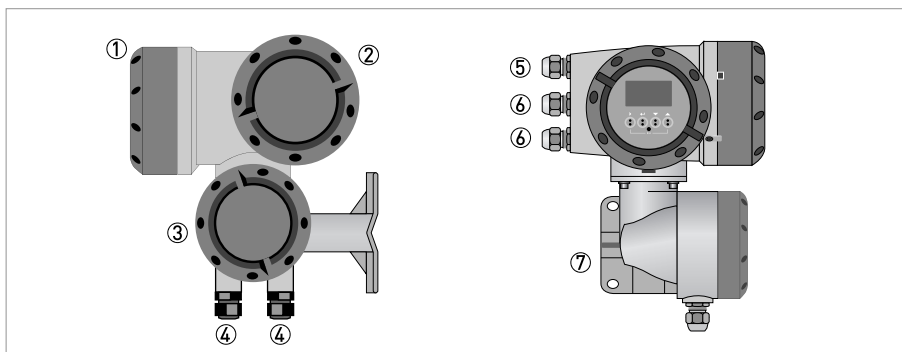


Figure 2-2: Construction of the field housing for remote versions

- ① Cover for electronics and display
- ② Cover for power supply and inputs/outputs terminal compartment
- ③ Cover for flow sensor terminal compartment
- ④ Cable entry for signal cable
- ⑤ Cable entry for power supply
- ⑥ Cable entry for inputs and outputs
- ⑦ Mounting plate for pipe and wall mounting



INFORMATION!

*Each time a housing cover is opened, the thread should be cleaned and greased.
Use only resin-free and acid-free grease.
Ensure that the housing gasket is properly fitted, clean and undamaged.*

2.3 Nameplates



INFORMATION!

Look at the device nameplate to ensure that the device is delivered according to your order.
Check for the correct supply voltage printed on the nameplate.

2.3.1 Example of nameplate for the compact version

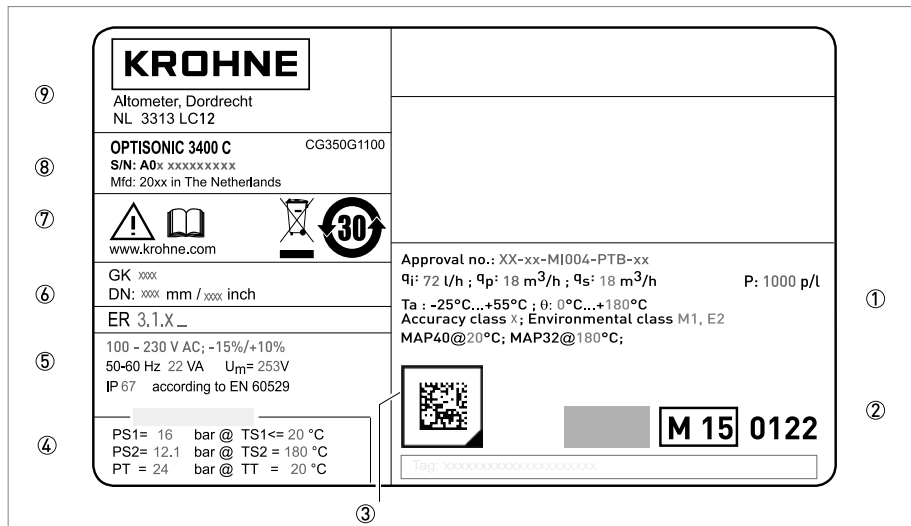


Figure 2-3: Example of nameplate for the compact version

- ① MI004 approval number and specific data
- ② Tag number and conformity mark (e.g. CE) with number(s) of notified body / bodies
- ③ Data matrix
- ④ Pressure Equipment (safety) data, Category I / II / III or SEP
- ⑤ Mains supply data and protection category
- ⑥ GK & size info and Electronic Revision number
- ⑦ Manufacturer website and disposal logo
- ⑧ Type designation of the flowmeter
- ⑨ Name and address of the manufacturer

Auto ID according to DIN specifications

The auto ID code (data matrix) guides you directly to the PICK server (Product Information Center KROHNE).

Scan the auto ID code on the device nameplate to download all product specific information.

- Handbooks, Quick Starts and Supplementary instructions
- Calibration certificates
- Factory settings as .bin file
- Parameter data sheets
- Digital nameplates

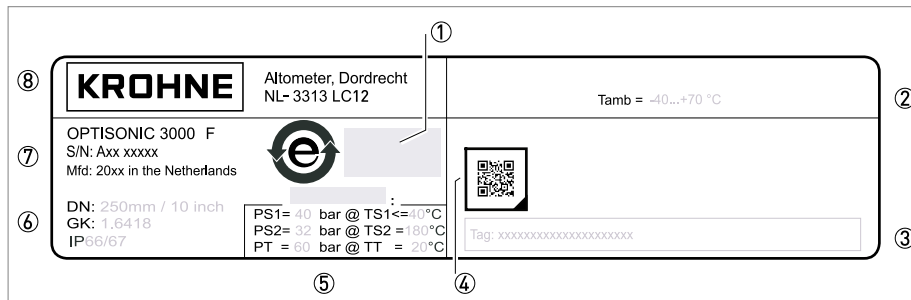
Electrical connection data of inputs/outputs (example of basic version)

①

- ① Power supply (AC: L and N, DC: L+ and L-, PE for $\geq 24V$ AC, FE for ≤ 24 VAC and DC)
 ② Connection data of connection terminal D/D-
 ③ Connection data of connection terminal C/C-
 ④ Connection data of connection terminal B/B-
 ⑤ Connection data of connection terminal A/A-, A+ only operable in basic version

- A = active mode; the signal converter supplies the power for connection of the subsequent devices
- P = passive mode; external power supply required for operation of the subsequent devices
- N/C = connection terminals not connected

2.3.2 Example of the marking labels for the measuring sensor



1. Conformity mark (e.g. CE) with number(s) of notified body/bodies and disposal logo
2. Ambient temperature
3. Tag number
4. Data matrix
5. PED data, Category I / II / III or SEP
6. Protection category, size and GK information
7. Type designation of the flowmeter and manufacturing date
8. Name and address of the manufacturer

2.3.3 Examples of nameplates on the signal converter (field version)

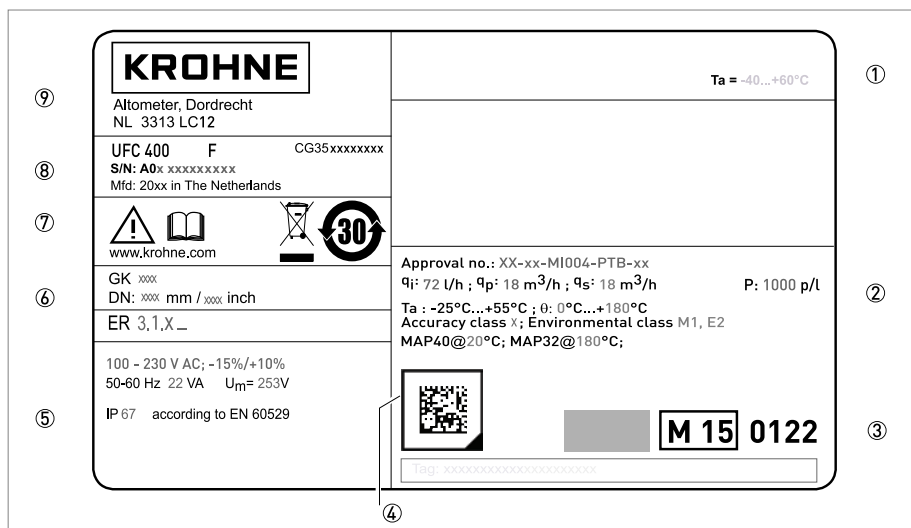


Figure 2-4: Examples of nameplates on the signal converter (field version)

- ① Ambient temperature
- ② MI004 approval number and certified data
- ③ Tag number and conformity mark (e.g. CE) with number(s) of notified body / bodies
- ④ Data matrix
- ⑤ Mains supply data and protection category
- ⑥ Calibration, size and GK data and Electronics Revision number
- ⑦ Manufacturer website and disposal logo
- ⑧ Type designation of the flowmeter
- ⑨ Name and address of the manufacturer

3.1 General notes on installation

**INFORMATION!**

Inspect the packaging carefully for damages or signs of rough handling. Report damage to the carrier and to the local office of the manufacturer.

**INFORMATION!**

Do a check of the packing list to make sure that you have all the elements given in the order.

**INFORMATION!**

Look at the device nameplate to ensure that the device is delivered according to your order. Check for the correct supply voltage printed on the nameplate.

3.2 Storage

- Store the device in a dry, dust-free location.
- Avoid continuous direct sunlight.
- Store the device in its original packaging.
- Storage temperature: -50...+70°C / -58...+158°F

3.3 Transport

Signal converter

- Do not lift the signal converter by the cable glands.

Flow sensor

- Do not lift the flow sensor by the connection box.
- Use hoisting belts only.
- To transport flange devices, use lifting straps. Wrap these around both process connections.

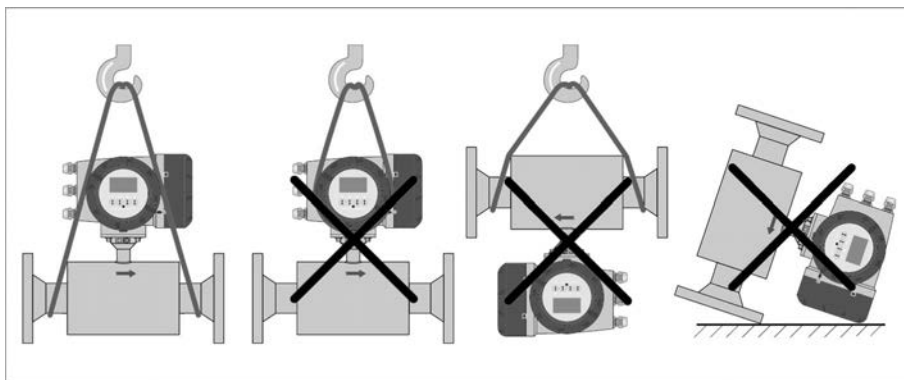


Figure 3-1: Transport

3.4 Pre-installation requirements

**INFORMATION!**

To assure a quick, safe and uncomplicated installation, we kindly request you to make provisions as stated below.

Make sure that you have all necessary tools available:

- Allen key (4 and 5 mm)
- Set of screwdrivers
- Wrench for cable glands and for pipe mounting bracket; refer to *Pipe mounting* on page 25
- Torque wrench for installing flowmeter in pipeline

3.5 General requirements

**INFORMATION!**

The following precautions must be taken to ensure a reliable installation.

- *Make sure that there is adequate space on the sides.*
- *Protect the signal converter from direct sunlight and install a sunshade if necessary.*
- *Signal converters installed in control cabinets require adequate cooling, e.g. by fan or heat exchanger.*
- *Do not expose the signal converter to intense vibrations and mechanical shocks. The measuring devices are tested for a vibration/shock level as described in the chapter "Technical data".*

3.5.1 Vibration

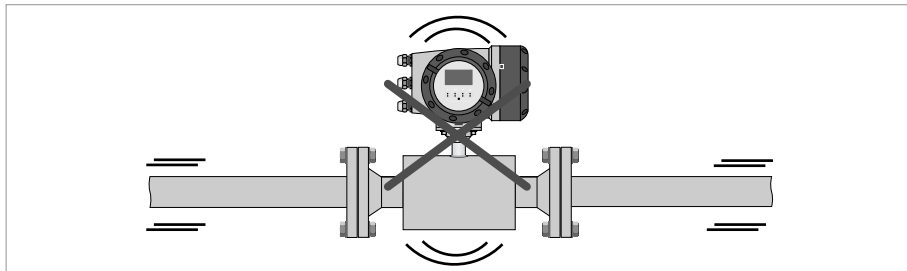


Figure 3-2: Avoid vibrations

**INFORMATION!**

In case of expected vibrations, please install a remote signal converter (field version).

3.6 Installation conditions

3.6.1 Inlet and outlet

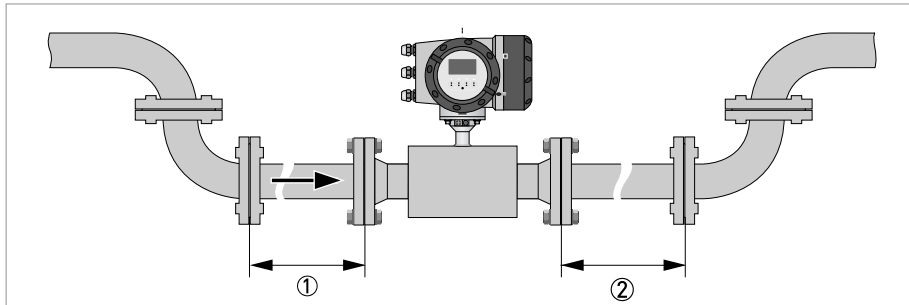


Figure 3-3: Required inlet and outlet

- ① Minimal 10 DN with a minimum of 1 meter/ 3.3 ft (straight inlet)
- ② ≥ 3 DN

3.6.2 Mounting position

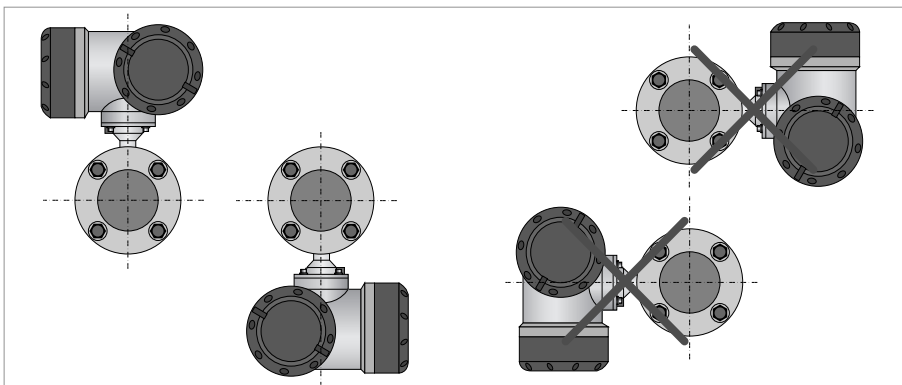


Figure 3-4: Installation position on horizontal pipe sections

3.6.3 Bends

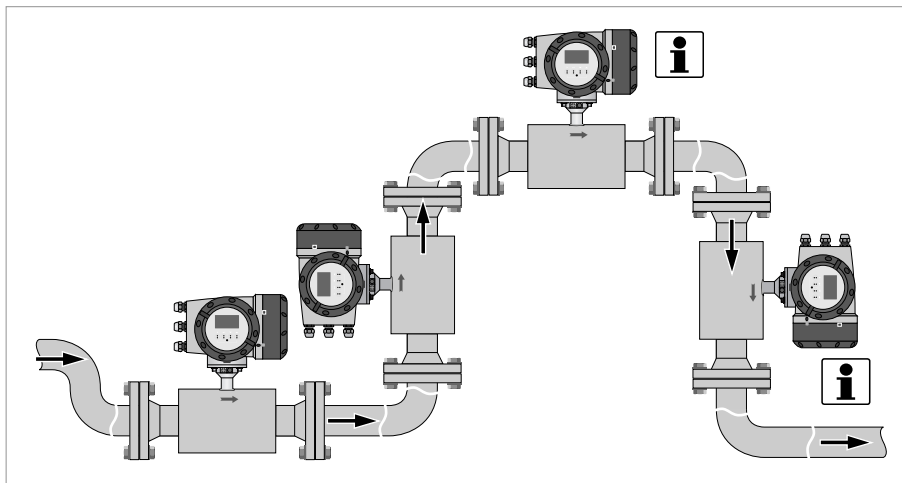


Figure 3-5: Installation in bending pipes (90°)



INFORMATION!

Recommended installation positions are at a lowered or ascending section of the pipeline installation. Installation at the highest point will enlarge the risk of flowmeter malfunction, because of air/gas bubbles.

Vertical installation in combination with an open discharge has to be avoided.

Vertical installation with a controlled back-pressure is possible.

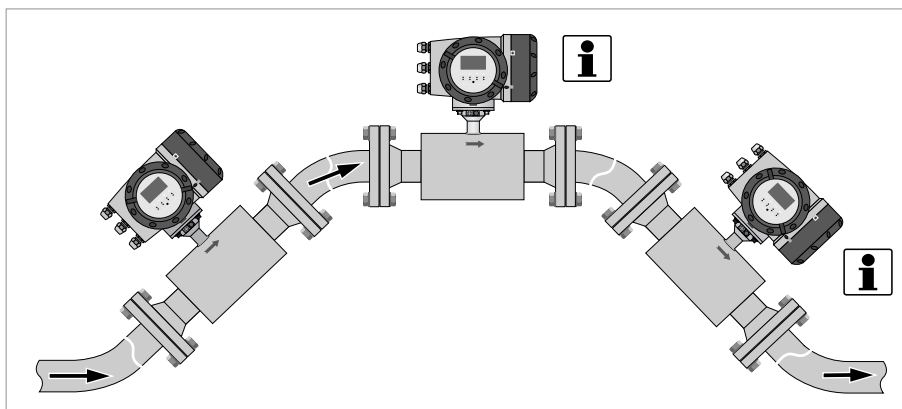


Figure 3-6: Installation in bending pipes (45°)



INFORMATION!

Vertical installation on a descending slope in the pipeline is only recommended when the back-pressure is controlled.

3.6.4 Control valve

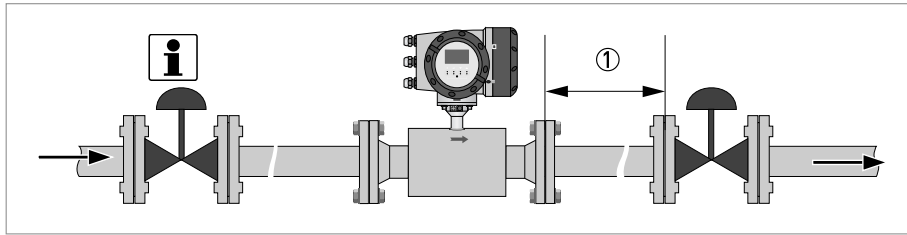


Figure 3-7: Installation in front of a control valve

① $\geq 3 \text{ DN}$ **INFORMATION!**

Recommended position to install a flowmeter is upstream a control valve.

An ultrasonic flowmeter can be installed downstream of the control valve if there is no cavitation in the pipeline system (e.g. flow profile disturbances are resolved).

3.6.5 Position of pump

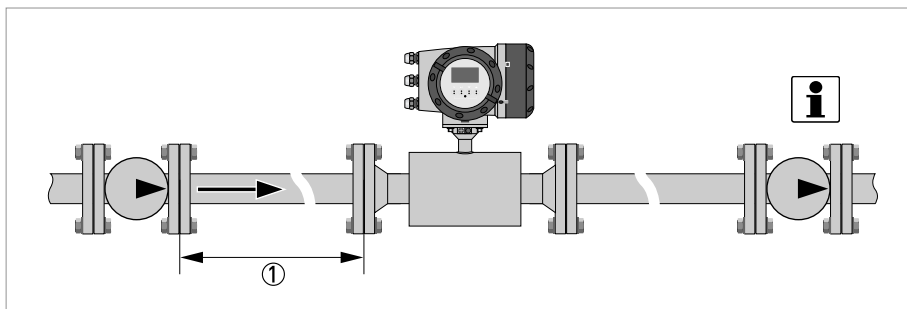


Figure 3-8: Installation behind a pump

① $\geq 15 \text{ DN}$

Provide a minimum straight upstream length $\geq 15 \text{ DN}$ to ensure resolving of flow disturbances (dependig on pump type).

**INFORMATION!**

Recommended position to install a flowmeter is downstream a pump (on a position where the flow disturbances of the pump are resolved).

An ultrasonic flowmeter can be installed in the suction line of a pump if there is no cavitation in the pipeline system.

3.6.6 Open feed or discharge

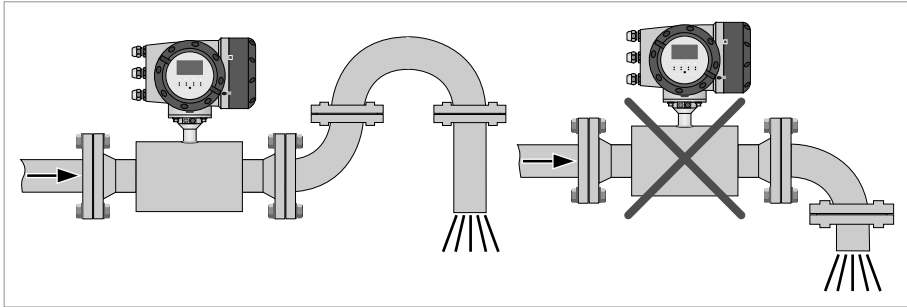


Figure 3-9: Open discharge



INFORMATION!

Install the flowmeter on a lowered section of the pipe to ensure a full pipe condition through the meter.

3.6.7 Insulation

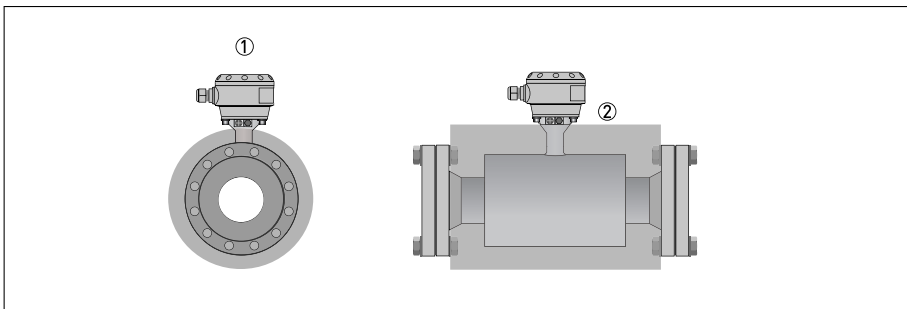


Figure 3-10: Insulation

- ① Connection box or compact converter
- ② Insulation area



WARNING!

The flow sensor can be insulated completely, except for the connection box (or the signal converter on the compact version).

For devices used in hazardous area, additional maximum temperature and insulation precautions apply. Please refer to the Ex documentation!

3.6.8 Flange deviation

**CAUTION!**

Max. permissible misalignment of pipe flange faces: M_{max} 0.5 degree,
according ASME B16.5 Individual flanges. See Appendix 12 ; Flange face alignment of the
General Piping Requirements DEP 31.38.01.11-GEN

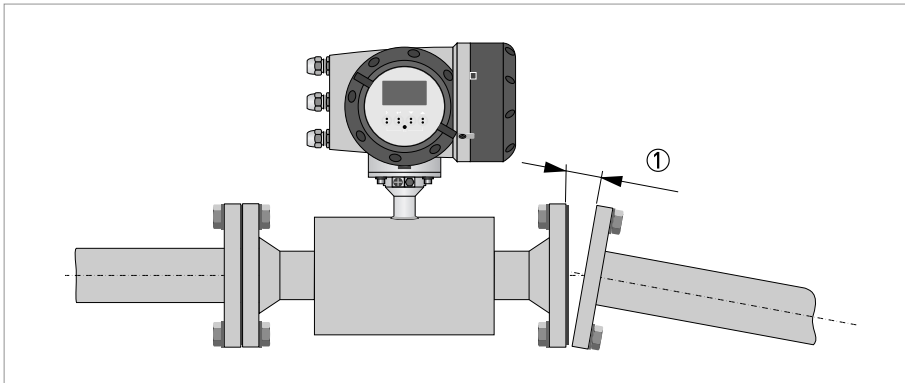


Figure 3-11: Flange deviation

① M_{max}

3.7 Mounting the field housing, remote version

**INFORMATION!**

Assembly materials and tools are not part of the delivery. Use the assembly materials and tools in compliance with the applicable occupational health and safety directives.

3.7.1 Pipe mounting

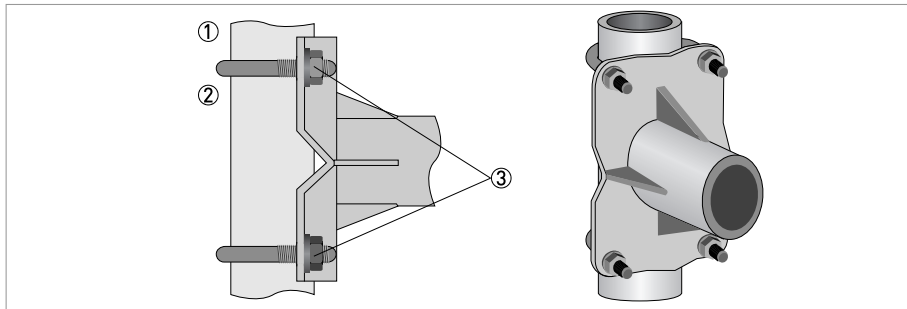


Figure 3-12: Pipe mounting of the field housing



- ① Fix the signal converter to the pipe.
- ② Fasten the signal converter using standard U-bolts and washers.
- ③ Tighten the nuts.

4.1 Safety instructions

**DANGER!**

All work on the electrical connections may only be carried out with the power disconnected.
Take note of the voltage data on the nameplate!

**DANGER!**

Observe the national regulations for electrical installations!

**DANGER!**

For devices used in hazardous areas, additional safety notes apply; please refer to the Ex documentation.

**WARNING!**

Observe without fail the local occupational health and safety regulations.
Any work done on the electrical components of the measuring device may only be carried out by properly trained specialists.

**INFORMATION!**

Look at the device nameplate to ensure that the device is delivered according to your order.
Check for the correct supply voltage printed on the nameplate.

4.2 Laying electrical cables correctly

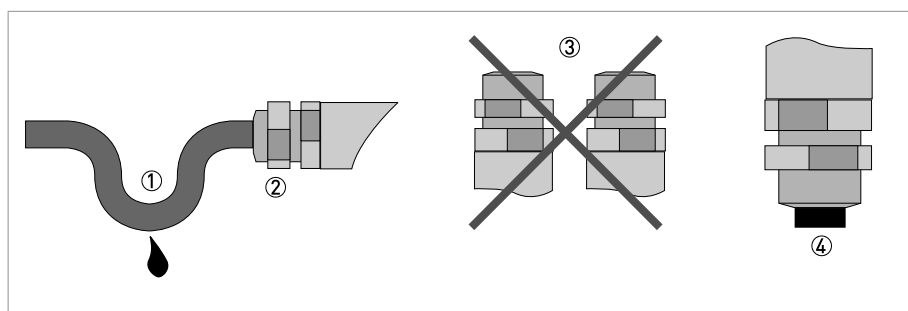


Figure 4-1: Protect housing from dust and water



- ① Lay the cable in a loop just before the housing.
- ② Tighten the screw connection of the cable entry securely.
- ③ Never mount the housing with the cable entries facing upwards.
- ④ Seal cable entries that are not needed with a plug.

4.3 Signal cable (remote versions only)

The flow sensor is connected to the signal converter via one signal cable, with 6(labeled) inner coax cables for the connection of maximal three acoustic paths.

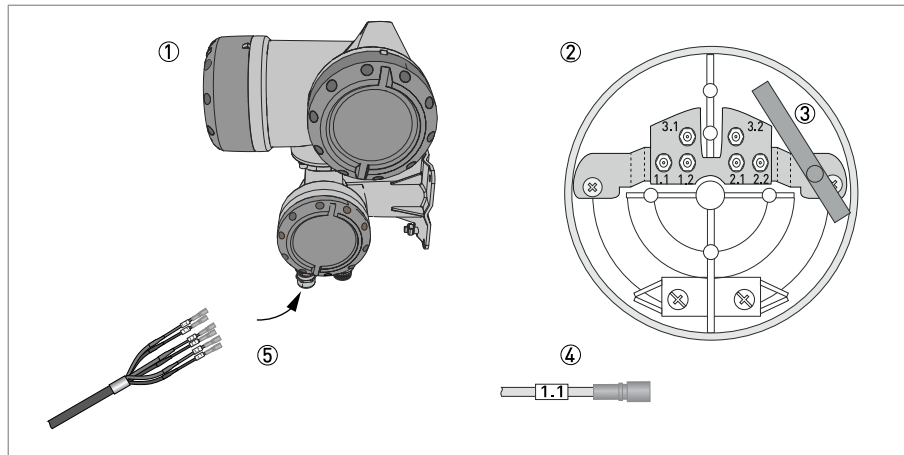


Figure 4-2: Construction of field version

- ① Signal converter
- ② Open connection box
- ③ Tool for releasing connectors
- ④ Marking on cable
- ⑤ Insert cable(s) into terminal compartment



CAUTION!

To ensure smooth functioning and safe instrument usage, always use the signal cable(s) included in the delivery.

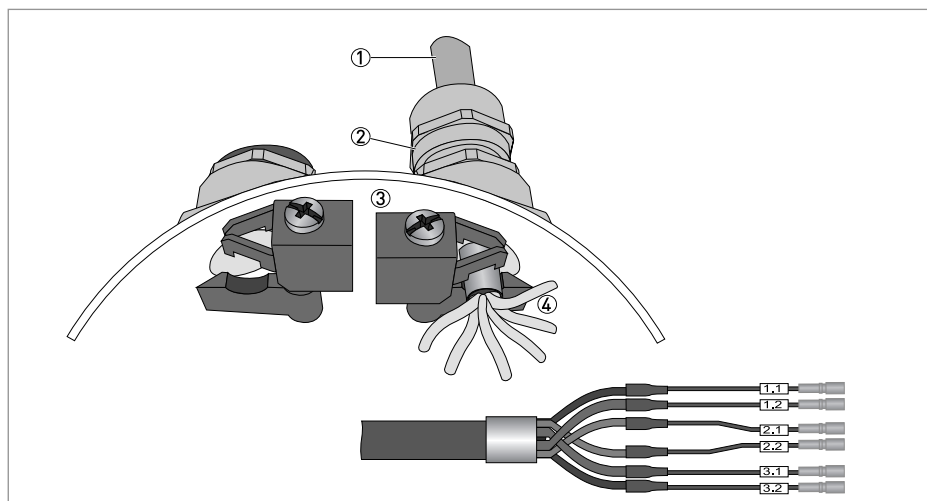


Figure 4-3: Clamp the cables on the shielding bush

- ① Cables
- ② Cable glands
- ③ Grounding clamps
- ④ Cable with metal shielding bush

Electrical connection - Standard version

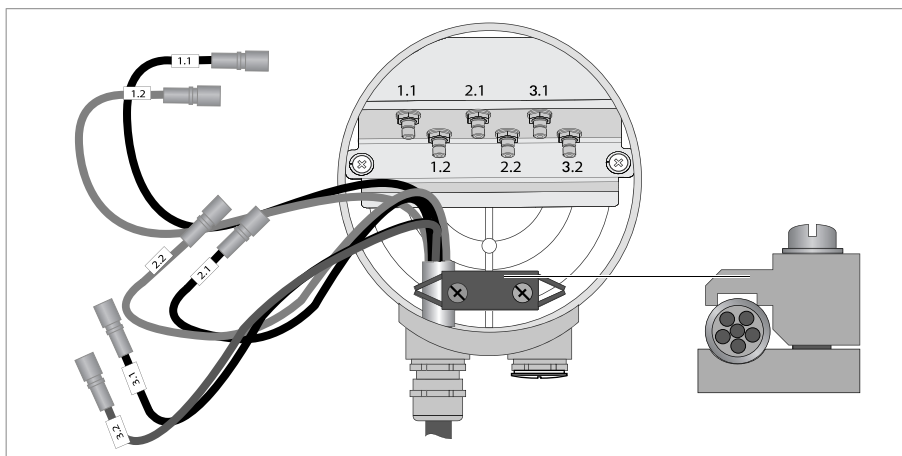


Figure 4-4: Connect the cables in the connection box of the flow sensor.

**INFORMATION!**

Connect the cable on connector with similar numeral marking.

4.4 Power supply



WARNING!

If this device is intended for permanent connection to the mains, it is required (for example for service) to mount an external switch or circuit breaker near the device for disconnection from the mains. It shall be easily reachable by the operator and marked as the disconnecting device for this equipment.

The switch or circuit breaker and wiring has to be suitable for the application and shall also be in accordance with the local (safety) requirements of the (building) installation (e.g. IEC 60947-1 / -3).



INFORMATION!

For devices used in hazardous areas, additional safety notes apply; please refer to the Ex documentation.



INFORMATION!

The power terminals in the terminal compartments are equipped with additional hinged lids to prevent accidental contact.

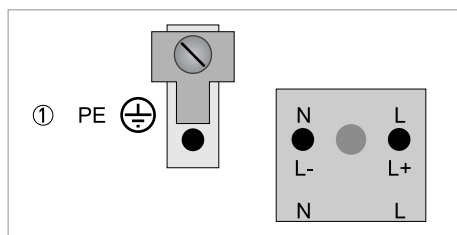


Figure 4-5: Power supply connection

① 100...230 VAC (-15% / +10%), 22 VA



DANGER!

The device must be grounded in accordance with regulations in order to protect personnel against electric shocks.

100...230 VAC (tolerance range: -15% / +10%)

- Note the power supply voltage and frequency (50...60 Hz) on the nameplate.
- The protective ground terminal **PE** of the power supply must be connected to the separate U-clamp terminal in the terminal compartment of the signal converter.



INFORMATION!

240 VAC+5% is included in the tolerance range.

4.5 Inputs and outputs, overview

4.5.1 Combinations of the inputs/outputs (I/Os)

This signal converter is available in Basic version with fixed outputs or as a Modular I/O with a flexible I/O configuration and communication within the available options.

Basic version

- Has 1 current output with HART 7, 1 pulse output and 2 status outputs / limit switches.
- The pulse output can be set as status output/limit switch and one of the status outputs as a control input.

Modular version

- Depending on the task, the device can be configured with various output modules .

Ex option

- For hazardous areas, all of the input/output variants for compact and field housings with terminal compartment in the Ex d (pressure-resistant casing) or Ex e (increased safety) versions can be delivered.
- Please refer to the separate instructions for connection and operation of the Ex-devices.

4.5.2 Description of the CG-number

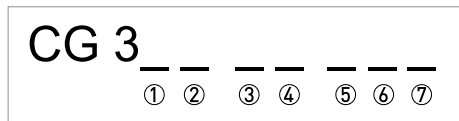


Figure 4-6: Marking (CG number) of the electronics module and input/output variants

- ① ID number: 5
- ② ID number: 0 = standard
- ③ Power supply option
- ④ Display (language versions)
- ⑤ Input/output version (I/O)
- ⑥ 1st optional module for connection terminal A
- ⑦ 2nd optional module for connection terminal B

The last 3 digits of the CG number (⑤ , ⑥ and ⑦) indicate the assignment of the terminal connections. Please refer to the following examples.

Examples for CG number-35021100

CG 350 21 100	100...230 VAC & standard display; basic I/O: I _a or I _p & S _p /C _p & S _p & P _p /S _p
---------------	--

Description of abbreviations and CG identifier for possible optional modules on terminals A and B

Abbreviation	Identifier for CG No.	Description
I _a	A	Active current output
I _p	B	Passive current output
P _a / S _a	C	Active pulse output, frequency output, status output or limit switch (changeable)
P _p / S _p	E	Passive pulse output, frequency output, status output or limit switch (changeable)
C _a	G	Active control input
C _p	K	Passive control input
-	8	No additional module installed
-	0	No further module possible

4.5.3 Fixed, non-alterable input/output versions

This signal converter is available with various input/output combinations.

- The gray boxes in the tables denote unassigned or unused connection terminals.
- In the table, only the final digits of the CG no. are depicted.
- Connection terminal A+ is only operable in the basic input/output version.

CG-No.	Connection terminals								
	A+	A	A-	B	B-	C	C-	D	D-

Basic in-/output (I/O) (Standard)

1 0 0		I _p + HART® passive ①		S _p / C _p passive ②		S _p passive		P _p / S _p passive ②	
	I _a + HART® active ①								

① Function changed by reconnecting

② Changeable

4.5.4 Alterable input/output versions

This signal converter is available with various input/output combinations.

- The grey boxes in the tables denote unassigned or unused connection terminals.
- In the table, only the final digits of the CG no. are depicted.
- Term. = (connection) terminal

CG no.	Connection terminals								
	A+	A	A-	B	B-	C	C-	D	D-

Modular IOs (option)

4 _ _		max. 2 optional modules for term. A + B				I _a + HART® active		P _a / S _a active ①	
8 _ _		max. 2 optional modules for term. A + B				I _p + HART® passive		P _a / S _a active ①	

① changeable

4.6 Description of the inputs and outputs

4.6.1 Control input

**INFORMATION!**

Depending on the version, the control inputs must be connected passively or actively or according to NAMUR EN 60947-5-6! Which I/O version and inputs/outputs are installed in your signal converter are indicated on the sticker in the cover of the terminal compartment.

- All control inputs are galvanically isolated from each other and from all other circuits.
- All operating data and functions can be adjusted.
- Passive mode: external power supply required:
 $V_{\text{ext}} \leq 32 \text{ VDC}$
- Active mode: use of the internal power supply:
 $V_{\text{nom}} = 24 \text{ VDC}$
- NAMUR mode: in accordance with EN 60947-5-6
(Active control input to EN 60947-5-6 (NAMUR): signal converter monitors cable breaks and short circuits acc. to EN 60947-5-6. Errors indicated on LC display. Error messages possible via status output).
- For information on the adjustable operating states refer to *Function tables* on page 63.

**DANGER!**

For devices used in hazardous areas, additional safety notes apply; please refer to the Ex documentation.

4.6.2 Current output

**INFORMATION!**

The current outputs must be connected depending on the version! The I/O version and inputs/outputs installed in your signal converter are indicated on the sticker in the cover of the terminal compartment.

- All outputs are electrically isolated from each other and from all other circuits.
- All operating data and functions can be adjusted.
- Passive mode:
External power $V_{\text{ext}} \leq 32 \text{ VDC}$ at $I \leq 22 \text{ mA}$
- Active mode:
Load impedance $R_L \leq 1 \text{ k}\Omega$ at $I \leq 22 \text{ mA}$;
 $R_L \leq 450 \Omega$ at $I \leq 22 \text{ mA}$ for Ex i outputs
- Self-monitoring: interruption or load impedance too high in the current output loop
- Error message possible via status output, error indication on LC display.
- Current value error detection can be adjusted.
- Automatic range conversion via threshold or control input. The setting range for the threshold is between 5 and 80% of $Q_{100\%}$, $\pm 0...5\%$ hysteresis (corresponding ratio from smaller to larger range of 1:20 to 1:1.25).
Signaling of the active range possible via a status output (adjustable).
- Forward/reverse flow measurement (F/R mode) is possible.

**INFORMATION!**

For further information refer to Connection diagrams of inputs and outputs on page 37.

**DANGER!**

For devices used in hazardous areas, additional safety notes apply; please refer to the Ex documentation.

4.6.3 Pulse output and frequency output



INFORMATION!

Depending on the version, the pulse and frequency outputs must be connected passively or actively or according to IEC 60947-5-6 (NAMUR)! The I/O version and inputs/outputs installed in your signal converter are indicated on the sticker in the cover of the terminal compartment.

- All outputs are electrically isolated from each other and from all other circuits.
- All operating data and functions can be adjusted.
- Passive mode:
External power supply required: $V_{\text{ext}} \leq 32 \text{ VDC}$
 $I \leq 20 \text{ mA}$ at $f \leq 10 \text{ kHz}$ (over range up to $f_{\text{max}} \leq 12 \text{ kHz}$)
 $I \leq 100 \text{ mA}$ at $f \leq 100 \text{ Hz}$
- Active mode:
Use of the internal power supply: $V_{\text{nom}} = 24 \text{ VDC}$
 $I \leq 20 \text{ mA}$ at $f \leq 10 \text{ kHz}$ (over range up to $f_{\text{max}} \leq 12 \text{ kHz}$)
 $I \leq 20 \text{ mA}$ at $f \leq 100 \text{ Hz}$
- NAMUR mode: passive in accordance with IEC 60947-5-6, $f \leq 10 \text{ kHz}$,
over range up to $f_{\text{max}} \leq 12 \text{ kHz}$
- Scaling:
Frequency output: in pulses per time unit (e.g. 1000 pulses/s at $Q_{100\%}$);
Pulse output: value per pulse.
- Pulse width:
symmetric (pulse duty factor 1:1, independent of output frequency)
automatic (with fixed pulse width, duty factor approx. 1:1 at $Q_{100\%}$) or
fixed (pulse width adjustable as required from 0.05 ms...2 s)
- Forward/reverse flow measurement (F/R mode) is possible.
- All pulse and frequency outputs can also be used as a status output / limit switch.



INFORMATION!

For further information refer to Connection diagrams of inputs and outputs on page 37.



DANGER!

For devices used in hazardous areas, additional safety notes apply; please refer to the Ex documentation.

4.6.4 Status output and limit switch

**INFORMATION!**

Depending on the version, the status outputs and limit switches must be connected passively or actively or according to NAMUR EN 60947-5-6! Which I/O version and inputs/outputs are installed in your signal converter are indicated on the sticker in the cover of the terminal compartment.

- The status outputs / limit switches are electrically isolated from each other and from all other circuits.
- The output stages of the status outputs/limit switches during simple active or passive operation behave like relay contacts and can be connected with any polarity.
- All operating data and functions can be adjusted.
- Passive mode:
External power supply required: $V_{\text{ext}} \leq 32 \text{ VDC}$; $I \leq 100 \text{ mA}$

**INFORMATION!**

For further information refer to Connection diagrams of inputs and outputs on page 37.

**DANGER!**

For devices used in hazardous areas, additional safety notes apply; please refer to the Ex documentation.

4.7 Connection diagrams of inputs and outputs

4.7.1 Important notes



INFORMATION!

Depending on the version, the inputs/outputs must be connected passively or actively or acc. to NAMUR EN 60947-5-6! Which I/O version and inputs/outputs are installed in your signal converter are indicated on the sticker in the cover of the terminal compartment.

- All groups are galvanically isolated from each other and from all other input and output circuits.
- Passive mode: An external power supply is necessary to operate (activation) the subsequent devices (V_{ext}).
- Active mode: The signal converter supplies the power for operation (activation) of the subsequent devices, observe max. operating data.
- Terminals that are not used should not have any conductive connection to other electrically conductive parts.



DANGER!

For devices used in hazardous areas, additional safety notes apply; please refer to the Ex documentation.

Description of the used abbreviations

I_a	I_p	Current output active or passive
P_a	P_p	Pulse/frequency output active or passive
P_N		Pulse/frequency output passive acc. to NAMUR EN 60947-5-6
S_a	S_p	Status output/limit switch active or passive
S_N		Status output/limit switch passive acc. to NAMUR EN 60947-5-6
C_a	C_p	Control input active or passive
C_N		Control input active acc. to NAMUR EN 60947-5-6: Signal converter monitors cable breaks and short circuits acc. to NAMUR EN 60947-5-6. Errors indicated on LC display. Error messages possible via status output.

4.7.2 Description of the electrical symbols

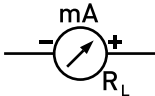
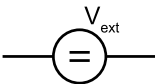
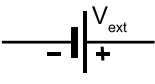
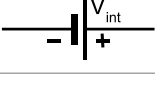
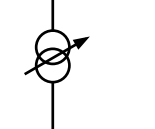
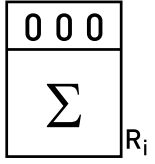
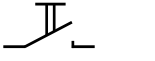
	mA meter 0...20 mA or 4...20 mA and other R_L is the internal resistance of the measuring point including the cable resistance
	DC voltage source (V_{ext}), external power supply, any connection polarity
	DC voltage source (V_{ext}), observe connection polarity according to connection diagrams
	Internal DC voltage source
	Controlled internal current source in the device
	Electronic or electromagnetic counter At frequencies above 100 Hz, shielded cables must be used to connect the counters. R_i Internal resistance of the counter
	Button, N/O contact or similar

Table 4-1: Description of the electrical symbols

4.7.3 Basic inputs/outputs


CAUTION!

Observe connection polarity.


INFORMATION!

For further information refer to *Description of the inputs and outputs on page 33* and refer to *HART® connection on page 51*.

Current output active HART®, basic I/Os

- $V_{\text{int, nom}} = 24 \text{ VDC nominal}$
- $I \leq 22 \text{ mA}$
- $R_L \leq 1 \text{ k}\Omega$

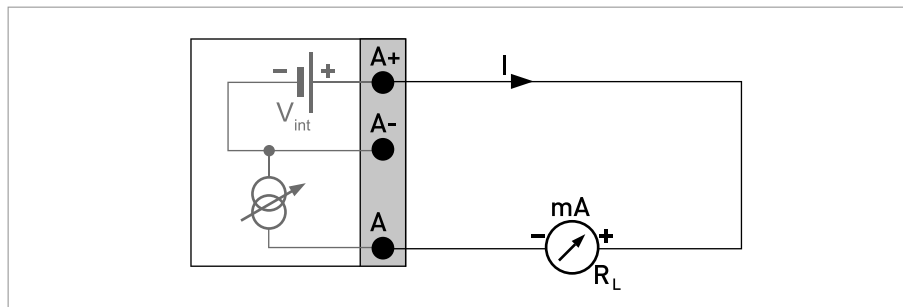


Figure 4-7: Current output active

Current output passive HART®, basic I/Os

- $V_{\text{int, nom}} = 24 \text{ VDC nominal}$
- $V_{\text{ext}} \leq 32 \text{ VDC}$
- $I \leq 22 \text{ mA}$
- $V_0 \geq 1.8 \text{ V}$
- $R_L \leq (V_{\text{ext}} - V_0) / I_{\text{max}}$

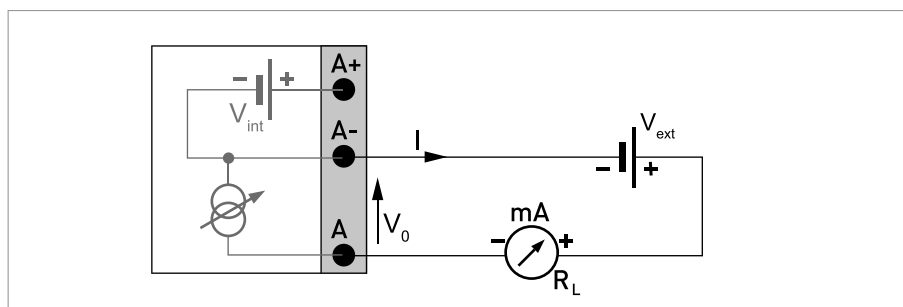


Figure 4-8: Current output passive

**INFORMATION!**

- For frequencies above 100 Hz, shielded cables are to be used in order to reduce effects from electrical interferences (EMC).
- housing versions:** Shield connected via the cable terminals in the terminal compartment.

**INFORMATION!**

Any connection polarity

Pulse/frequency output passive, basic I/Os

- $V_{\text{ext}} \leq 32 \text{ VDC}$
- f_{max} in operating menu set to $f_{\text{max}} \leq 100 \text{ Hz}$:
 $I \leq 100 \text{ mA}$
 open:
 $I \leq 0.05 \text{ mA}$ at $V_{\text{ext}} = 32 \text{ VDC}$
 closed:
 $V_{0, \text{max}} = 0.2 \text{ V}$ at $I \leq 10 \text{ mA}$
 $V_{0, \text{max}} = 2 \text{ V}$ at $I \leq 100 \text{ mA}$
- f_{max} in the operating menu set to $100 \text{ Hz} < f_{\text{max}} \leq 10 \text{ kHz}$:
 $I \leq 20 \text{ mA}$
 open:
 $I \leq 0.05 \text{ mA}$ at $V_{\text{ext}} = 32 \text{ VDC}$
 closed:
 $V_{0, \text{max}} = 1.5 \text{ V}$ at $I \leq 1 \text{ mA}$
 $V_{0, \text{max}} = 2.5 \text{ V}$ at $I \leq 10 \text{ mA}$
 $V_{0, \text{max}} = 5.0 \text{ V}$ at $I \leq 20 \text{ mA}$
- If the following maximum load resistance $R_{L, \text{max}}$ is exceeded, the load resistance R_L must be reduced accordingly by parallel connection of R :
 $f \leq 100 \text{ Hz}$: $R_{L, \text{max}} = 47 \text{ k}\Omega$
 $f \leq 1 \text{ kHz}$: $R_{L, \text{max}} = 10 \text{ k}\Omega$
 $f \leq 10 \text{ kHz}$: $R_{L, \text{max}} = 1 \text{ k}\Omega$
- The minimum load resistance $R_{L, \text{min}}$ is calculated as follows:
 $R_{L, \text{min}} = (V_{\text{ext}} - V_0) / I_{\text{max}}$
- Can also be set as status output; for the electrical connection refer to status output connection diagram.

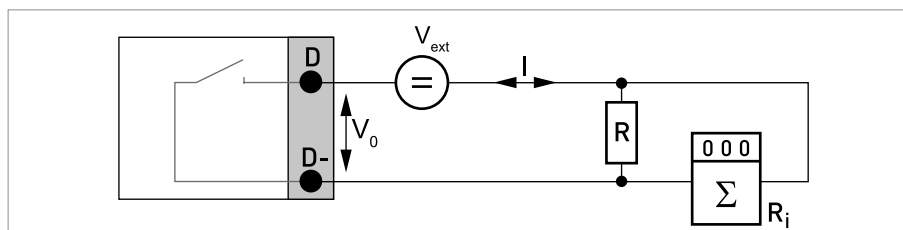


Figure 4-9: Pulse output / frequency output passive

**INFORMATION!***Any connection polarity***Status output / limit switch passive, basic I/Os**

- $V_{\text{ext}} \leq 32 \text{ VDC}$
- $I \leq 100 \text{ mA}$
- $R_{L, \text{max}} = 47 \text{ k}\Omega$
 $R_{L, \text{min}} = (V_{\text{ext}} - V_0) / I_{\text{max}}$
- open:
 $I \leq 0.05 \text{ mA}$ at $V_{\text{ext}} = 32 \text{ VDC}$
 closed:
 $V_{0, \text{max}} = 0.2 \text{ V}$ at $I \leq 10 \text{ mA}$
 $V_{0, \text{max}} = 2 \text{ V}$ at $I \leq 100 \text{ mA}$
- The output is open when the device is de-energized.
- X stands for the terminals B, C or D. The functions of the connection terminals depend on the settings.

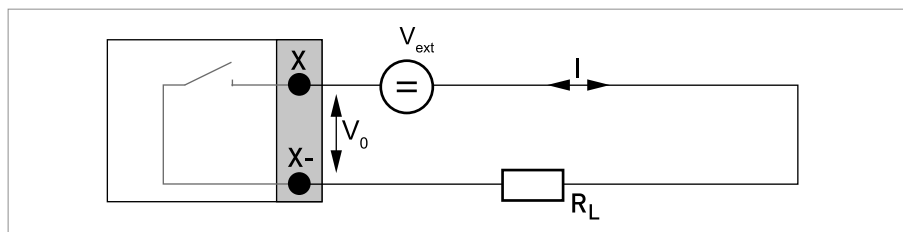


Figure 4-10: Status output / limit switch passive

Control input passive, basic I/Os

- $8 \text{ V} \leq V_{\text{ext}} \leq 32 \text{ VDC}$
- $I_{\text{max}} = 6.5 \text{ mA}$ at $V_{\text{ext}} \leq 24 \text{ VDC}$
 $I_{\text{max}} = 8.2 \text{ mA}$ at $V_{\text{ext}} \leq 32 \text{ VDC}$
- Switching point for identifying "contact open or closed":
 Contact open (off): $V_0 \leq 2.5 \text{ V}$ with $I_{\text{nom}} = 0.4 \text{ mA}$
 Contact closed (on): $V_0 \geq 8 \text{ V}$ with $I_{\text{nom}} = 2.8 \text{ mA}$
- Can also be set as a status output; for the electrical connection refer to status output connection diagram.

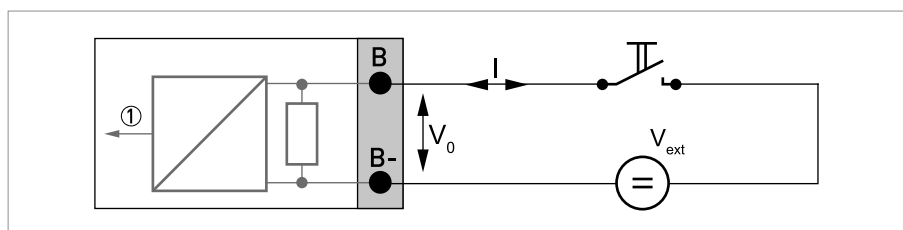


Figure 4-11: Control input passive

① Signal

4.7.4 Modular inputs/outputs and bus systems

**CAUTION!**

Observe connection polarity

**INFORMATION!**

- For further information on electrical connection refer to *Description of the inputs and outputs* on page 33.
- For the electrical connection of bus systems, please refer to the supplementary documentation for the respective bus systems.
- **housing versions:** Shield connected via the cable terminals in the terminal compartment.
- For frequencies above 100 Hz, shielded cables are to be used in order to reduce effects from electrical interferences (EMC).

Current output active (only current output terminals C/C- have HART® capability), modular I/Os

- $V_{\text{int, nom}} = 24 \text{ VDC}$
- $I \leq 22 \text{ mA}$
- $R_L \leq 1 \text{ k}\Omega$
- X designates the connection terminals A, B or C, depending on the version of the signal converter.

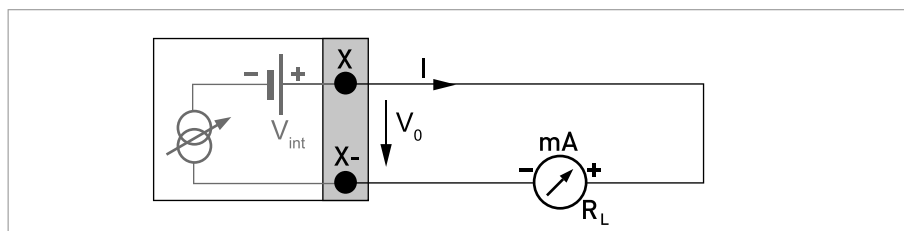


Figure 4-12: Current output active

**CAUTION!***Observe connection polarity*

Current output passive (only current output terminals C/C- have HART[®] capability), modular I/Os

- $V_{\text{ext}} \leq 32 \text{ VDC}$
- $I \leq 22 \text{ mA}$
- $V_0 \geq 1.8 \text{ V}$
- $R_L \leq (V_{\text{ext}} - V_0) / I_{\text{max}}$
- X designates the connection terminals A, B or C, depending on the version of the signal converter.

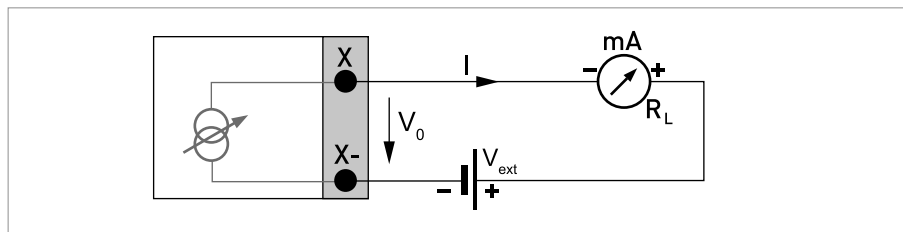


Figure 4-13: Current output passive

**CAUTION!***Observe connection polarity***Pulse/frequency output active, modular I/Os**

- $V_{nom} = 24 \text{ VDC}$
- f_{max} in the operating menu set to $f_{max} \leq 100 \text{ Hz}$:
 $I \leq 20 \text{ mA}$
 open:
 $I \leq 0.05 \text{ mA}$
 closed:
 $V_{0, nom} = 24 \text{ V}$ at $I = 20 \text{ mA}$
- f_{max} in operating menu set to $100 \text{ Hz} < f_{max} \leq 10 \text{ kHz}$:
 $I \leq 20 \text{ mA}$
 open:
 $I \leq 0.05 \text{ mA}$
 closed:
 $V_{0, nom} = 22.5 \text{ V}$ at $I = 1 \text{ mA}$
 $V_{0, nom} = 21.5 \text{ V}$ at $I = 10 \text{ mA}$
 $V_{0, nom} = 19 \text{ V}$ at $I = 20 \text{ mA}$
- If the following maximum load impedance $R_{L, max}$ is exceeded, the load impedance R_L must be reduced accordingly by parallel connection of R :
 $f \leq 100 \text{ Hz}$: $R_{L, max} = 47 \text{ k}\Omega$
 $f \leq 1 \text{ kHz}$: $R_{L, max} = 10 \text{ k}\Omega$
 $f \leq 10 \text{ kHz}$: $R_{L, max} = 1 \text{ k}\Omega$
- The minimum load impedance $R_{L, min}$ is calculated as follows:
 $R_{L, min} = (V_{ext} - V_0) / I_{max}$
- X designates the connection terminals A, B or D, depending on the version of the signal converter.

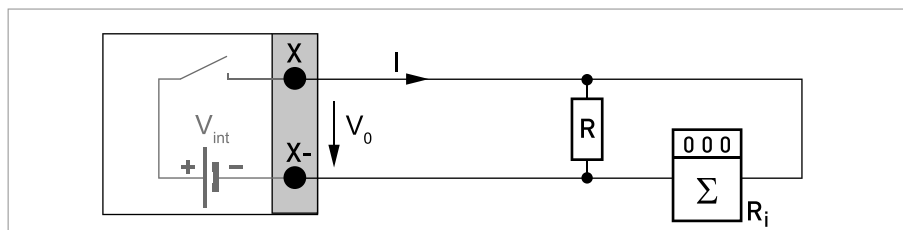


Figure 4-14: Pulse output / frequency output active

**INFORMATION!***Any connection polarity***Pulse/frequency output passive, modular I/Os**

- $V_{\text{ext}} \leq 32 \text{ VDC}$
- f_{max} in the operating menu set to $f_{\text{max}} \leq 100 \text{ Hz}$:
 $I \leq 100 \text{ mA}$
 open:
 $I \leq 0.05 \text{ mA}$ at $V_{\text{ext}} = 32 \text{ VDC}$
 closed:
 $V_{0, \text{max}} = 0.2 \text{ V}$ at $I \leq 10 \text{ mA}$
 $V_{0, \text{max}} = 2 \text{ V}$ at $I \leq 100 \text{ mA}$
- f_{max} in operating menu set to $100 \text{ Hz} < f_{\text{max}} \leq 10 \text{ kHz}$:
 open:
 $I \leq 0.05 \text{ mA}$ at $V_{\text{ext}} = 32 \text{ VDC}$
 closed:
 $V_{0, \text{max}} = 1.5 \text{ V}$ at $I \leq 1 \text{ mA}$
 $V_{0, \text{max}} = 2.5 \text{ V}$ at $I \leq 10 \text{ mA}$
 $V_{0, \text{max}} = 5 \text{ V}$ at $I \leq 20 \text{ mA}$
- If the following maximum load impedance $R_{L, \text{max}}$ is exceeded, the load impedance R_L must be reduced accordingly by parallel connection of R :
 $f \leq 100 \text{ Hz}$: $R_{L, \text{max}} = 47 \text{ k}\Omega$
 $f \leq 1 \text{ kHz}$: $R_{L, \text{max}} = 10 \text{ k}\Omega$
 $f \leq 10 \text{ kHz}$: $R_{L, \text{max}} = 1 \text{ k}\Omega$
- The minimum load impedance $R_{L, \text{min}}$ is calculated as follows:
 $R_{L, \text{min}} = (V_{\text{ext}} - V_0) / I_{\text{max}}$
- Can also be set as status output; refer to status output connection diagram.
- X designates the connection terminals A, B or D, depending on the version of the signal converter.

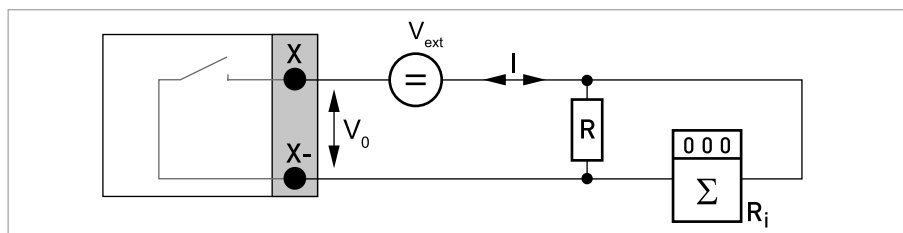


Figure 4-15: Pulse output / frequency output passive

**INFORMATION!**

- *housing versions:* Shield connected via the cable terminals in the terminal compartment.

**INFORMATION!**

Any connection polarity

Pulse and frequency output passive P_N NAMUR, modular I/O

- Connection in conformity with NAMUR EN 60947-5-6
- open:
 $I_{nom} = 0.6 \text{ mA}$
 closed:
 $I_{nom} = 3.8 \text{ mA}$
- X designates the connection terminals A, B or D, depending on the version of the signal converter.

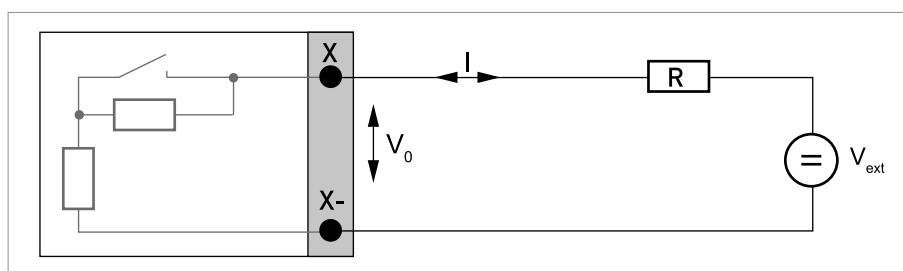


Figure 4-16: Pulse output / frequency output passive according to IEC 60947-5-6 (NAMUR)

**CAUTION!***Observe connection polarity***Status output / limit switch active, modular I/Os**

- $V_{\text{int}} = 24 \text{ VDC}$
- $I \leq 20 \text{ mA}$
- $R_L \leq 47 \text{ k}\Omega$
- open:
 $I \leq 0.05 \text{ mA}$
 closed:
 $V_{0, \text{nom}} = 24 \text{ V}$ at $I = 20 \text{ mA}$
- X designates the connection terminals A, B or D, depending on the version of the signal converter.

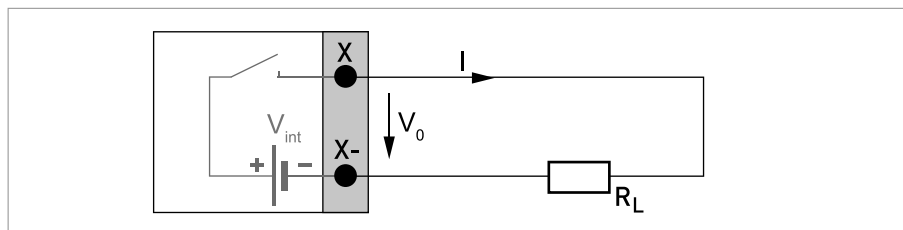


Figure 4-17: Status output / limit switch active

**INFORMATION!***Any connection polarity***Status output / limit switch passive, modular I/Os**

- $V_{\text{ext}} = 32 \text{ VDC}$
- $I \leq 100 \text{ mA}$
- $R_{L, \text{max}} = 47 \text{ k}\Omega$
 $R_{L, \text{min}} = (V_{\text{ext}} - V_0) / I_{\text{max}}$
- open:
 $I \leq 0.05 \text{ mA}$ at $V_{\text{ext}} = 32 \text{ VDC}$
 closed:
 $V_{0, \text{max}} = 0.2 \text{ V}$ at $I \leq 10 \text{ mA}$
 $V_{0, \text{max}} = 2 \text{ V}$ at $I \leq 100 \text{ mA}$
- The output is open when the device is de-energized.
- X designates the connection terminals A, B or D, depending on the version of the signal converter.

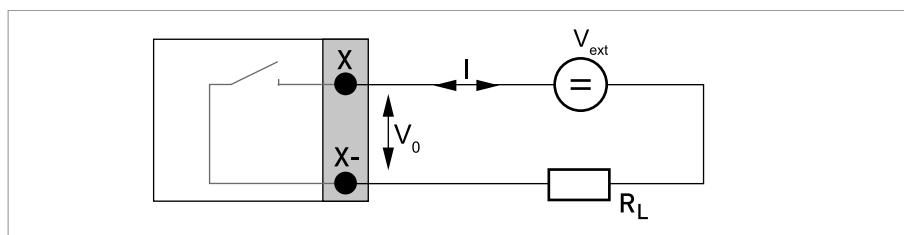


Figure 4-18: Status output / limit switch passive

Status output / limit switch S_N NAMUR, modular I/Os

- Connection in conformity with NAMUR EN 60947-5-6
- open:
 $I_{\text{nom}} = 0.6 \text{ mA}$
 closed:
 $I_{\text{nom}} = 3.8 \text{ mA}$
- The output is open when the device is de-energized.
- X designates the connection terminals A, B or D, depending on the version of the signal converter.

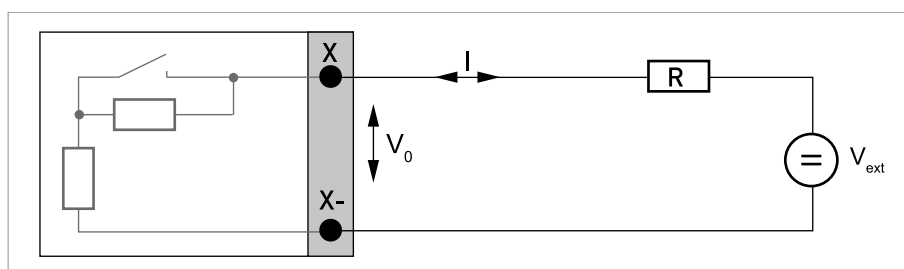
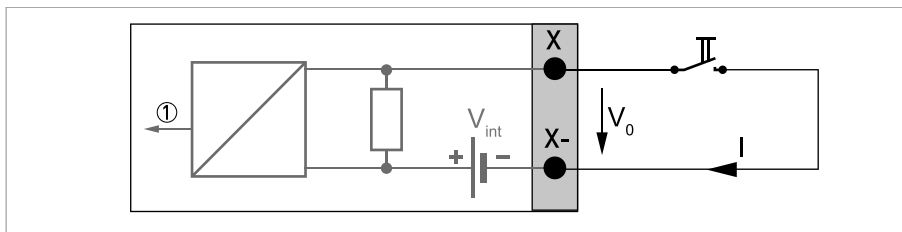


Figure 4-19: Status output / limit switch according to IEC 60947-5-6 (NAMUR)

**CAUTION!***Observe connection polarity***Control input active, modular I/Os**

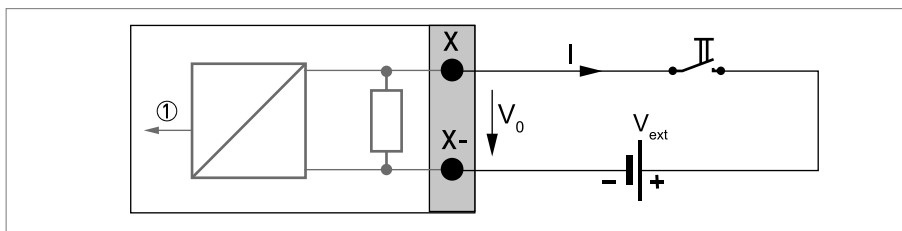
- $V_{\text{int}} = 24 \text{ VDC}$
- External contact open:
 $V_{0, \text{nom}} = 22 \text{ V}$
- External contact closed:
 $I_{\text{nom}} = 4 \text{ mA}$
- Switching point for identifying "contact open or closed":
Contact open (off): $V_0 \leq 10 \text{ V}$ with $I_{\text{nom}} = 1.9 \text{ mA}$
Contact closed (on): $V_0 \geq 12 \text{ V}$ with $I_{\text{nom}} = 1.9 \text{ mA}$
- X designates the connection terminals A or B, depending on the version of the signal converter.

**Figure 4-20: Control input active**

① Signal

Control input passive, modular I/Os

- $3 \text{ V} \leq V_{\text{ext}} \leq 32 \text{ VDC}$
- $I_{\text{max}} = 9.5 \text{ mA}$ at $V_{\text{ext}} \leq 24 \text{ V}$
 $I_{\text{max}} = 9.5 \text{ mA}$ at $V_{\text{ext}} \leq 32 \text{ V}$
- Switching point for identifying "contact open or closed":
Contact open (off): $V_0 \leq 2.5 \text{ V}$ with $I_{\text{nom}} = 1.9 \text{ mA}$
Contact closed (on): $V_0 \geq 3 \text{ V}$ with $I_{\text{nom}} = 1.9 \text{ mA}$
- X designates the connection terminals A or B, depending on the version of the signal converter.

**Figure 4-21: Control input passive**

① Signal

**CAUTION!***Observe connection polarity***Control input active C_N NAMUR, modular I/Os**

- Connection acc. to NAMUR EN 60947-5-6
- Switching point for identifying "contact open or closed":
Contact open (off): $V_{0, \text{nom}} = 6.3 \text{ V}$ with $I_{\text{nom}} < 1.9 \text{ mA}$
Contact closed (on): $V_{0, \text{nom}} = 6.3 \text{ V}$ with $I_{\text{nom}} > 1.9 \text{ mA}$
- Detection of cable break:
 $V_0 \geq 8.1 \text{ V}$ with $I \leq 0.1 \text{ mA}$
- Detection of cable short circuit:
 $V_0 \leq 1.2 \text{ V}$ with $I \geq 6.7 \text{ mA}$
- X designates the connection terminals A or B, depending on the version of the signal converter.

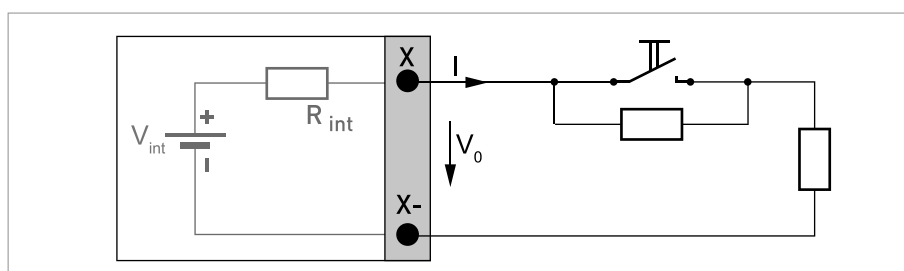


Figure 4-22: Control input active according to IEC 60947-5-6 (NAMUR)

4.7.5 HART® connection



INFORMATION!

- In the basic I/O the current output at connection terminals A+/A-/A always has generic HART® capability.
- For modular I/O and Ex i I/O, only the output module for the connection terminals C/C- has HART® capability.

HART® connection active (point-to-point)

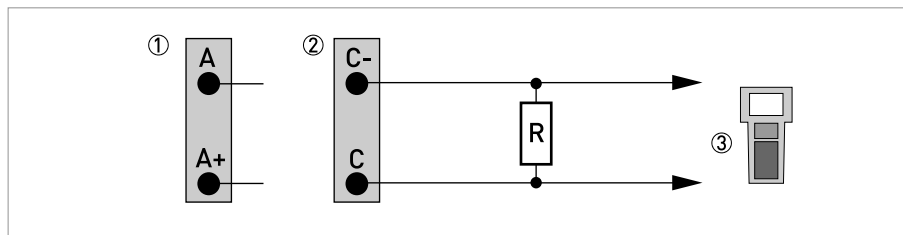


Figure 4-23: HART® connection active (I_a)

- ① Basic I/O: terminals A and A+
- ② Terminals C- and C
- ③ HART® communicator

The parallel resistance to the HART® communicator must be $R \geq 230 \Omega$.

HART® connection passive (Multi-Drop mode)

- $I: I_{0\%} \geq 4 \text{ mA}$
- Multi-Drop mode $I: I_{fix} \geq 4 \text{ mA} = I_{0\%}$
- $V_{ext} \leq 32 \text{ VDC}$
- $R \geq 230 \Omega$

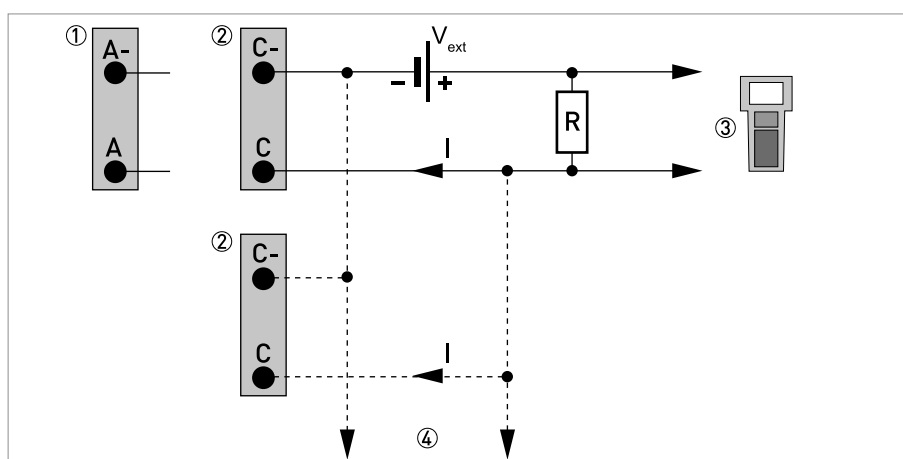


Figure 4-24: HART® connection passive (I_p)

- ① Basic I/O: terminals A- and A
- ② Terminals C- and C
- ③ HART® communicator
- ④ Other devices with HART® capability

5.1 Starting the signal converter

The measuring device, consisting of the measuring sensor and the signal converter, is supplied ready for operation. All operating data have been set at the factory in accordance with your order specifications.

When the power is switched on, a self test is carried out. After that the device immediately begins measuring, and the current values are displayed.

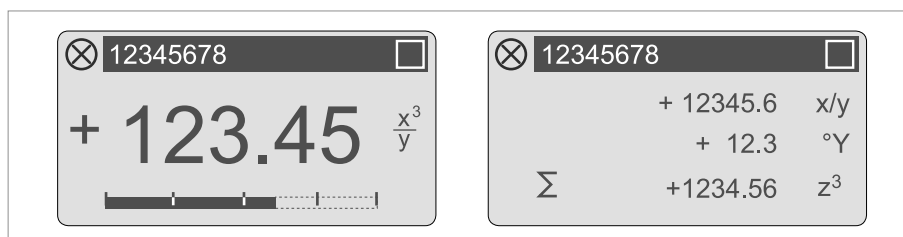


Figure 5-1: Displays in measuring mode (examples for 2 or 3 measured values)
x, y and z denote the units of the measured values displayed

It is possible to change between the two measured value windows, the trend display and the list with the status messages by pressing the keys $\uparrow$ and $\downarrow$. For possible status messages, their meaning and cause refer to *Status messages and diagnostic information* on page 84.

5.2 Switching on the power

Before connecting to power, please check that the system has been correctly installed. This includes:

- The device must be mounted in compliance with the local regulations.
- The power connections must have been made in compliance with the local regulations for measuring devices.
- The electrical terminal compartments must be tightened and the cover has been screwed on.
- Check that the electrical operating data of the power supply are correct.



- Switching on the power.

6.1 Display and operating elements

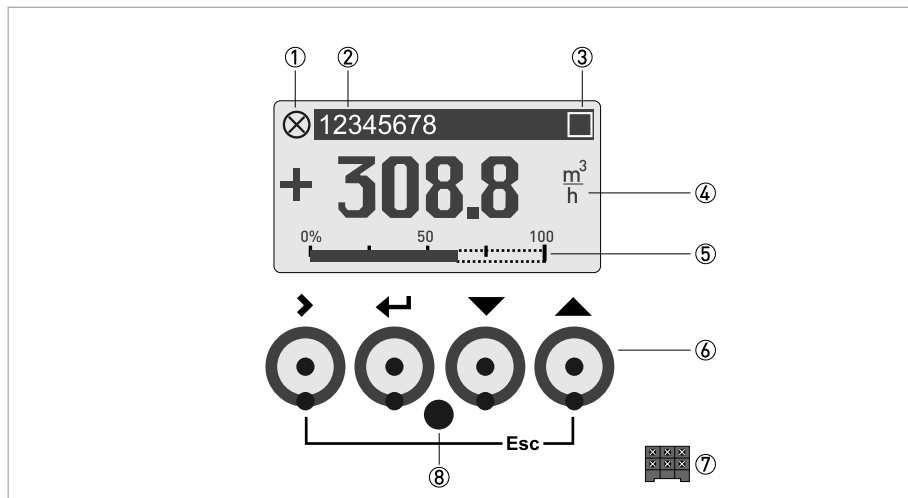


Figure 6-1: Display and operating elements (Example: flow indication with 2 measuring values)

- ① Indicates a possible status message in the status list
- ② Tag number (is only indicated if this number was entered previously by the operator)
- ③ Indicates when a key has been pressed
- ④ 1st measured variable in large representation
- ⑤ Bar graph indication
- ⑥ Operating keys, optical (see table below for function and representation in text)
- ⑦ Interface to the GDC bus (not present in all signal converter versions)
- ⑧ Infrared sensor (not present in all signal converter versions)



INFORMATION!

The OPTISONIC 3400 MI-004 is factory supplied with a jumper to lock the access to custody transfer relevant parameters.



INFORMATION!

Access to the hardware and software of relevant items are blocked, to comply to the MID MI-004 directive



INFORMATION!

- The switching point for the 4 optical keys is located directly in front of the glass. It is recommended to activate the keys at right angles to the front. Touching them from the side can cause incorrect operation.
- After 5 minutes of inactivity, there is an automatic return to measuring mode. Previously changed data is not saved.

Key	Measuring mode	Menu mode	Submenu or function mode	Parameter and data mode
>	Switch from measuring mode to menu mode; press key for 2.5 s, "Quick Start" menu is then displayed	Access to displayed menu, then 1st submenu is displayed	Access to displayed submenu or function	For numerical values, move cursor (highlighted in blue) one position to the right
↵	Reset display; "Quick Access" function	Return to measuring mode but prompt whether the data should be saved	Press 1 to 3 times, return to menu mode, data saved	Return to submenu or function, data saved
↓ or ↑	Switch between display pages: measured value 1 + 2, trend page and status page	Select menu	Select submenu or function	Use cursor highlighted in blue to change number, unit, property and to move the decimal point
Esc (> + ↑)	-	-	Return to menu mode without acceptance of data	Return to submenu or function without acceptance of data

Table 6-1: Description of functionality of operating keys

6.1.1 Meters subject to metrology

After verification to MID Annex MI-004, hardware and software components that are critical for measurement characteristics and metrologically important parameters need to be protected against intervention such as accidental or intentional corruption during operation.

If the meter has been verified to MID Annex VI (MI-004), access to the programming menu of the software containing the metrologically relevant parameters is blocked at the factory after the verification procedure:

The software version, diameter and meter constant are fiscal parameters. These values can be read on the display and checked with the values on the name plate without breaking the sealing.

6.1.2 Metrological and utility seals

After a meter is verified to MID Annex VI (MI-004), the following metrological and/or utility seals are applied on:

- The housing of the converter box and signal converter (field and compact version).
- The electronic units against removal from the outer housing of the heat meter.
- The name plate on the housing of the meter to secure the nameplate against removal.



INFORMATION!

Breaking the metrological seals could mean that the meter needs to be re-verified. For detailed information, please check your local regulations.

To prevent intervention by non-authorised persons to the hardware and software, the following measures can be taken after installation and commissioning of the heat meter in the field. For detailed information, please check your local regulations.

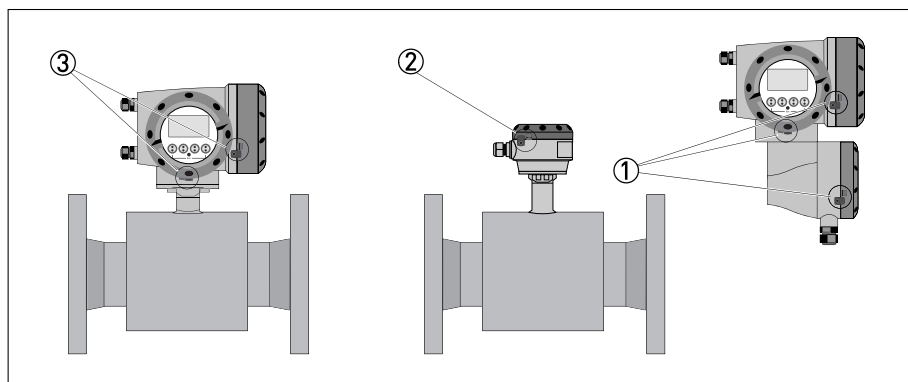


Figure 6-2: Location of metrological seals on compact and field version

- ① UFC 400 signal converter
- ② Connection box on sensor
- ③ Compact version

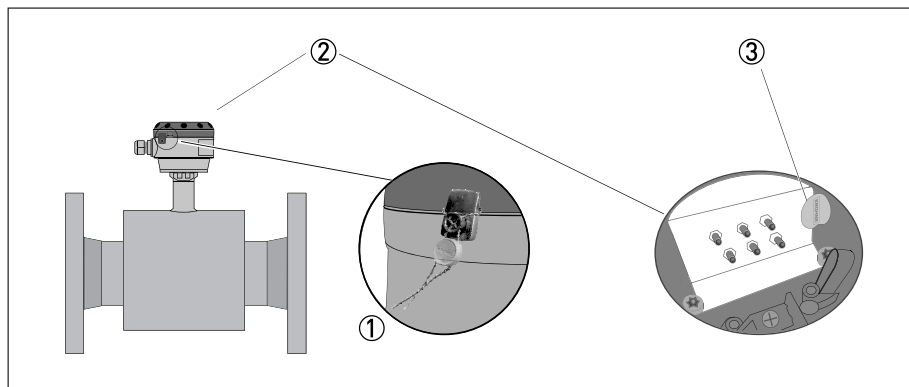


Figure 6-3: Metrological and utility seals on and inside connection box

- ① Detail of metrological seal
- ② Connection box (inside electronic terminal board)
- ③ Utility seal between inside of housing and terminal board

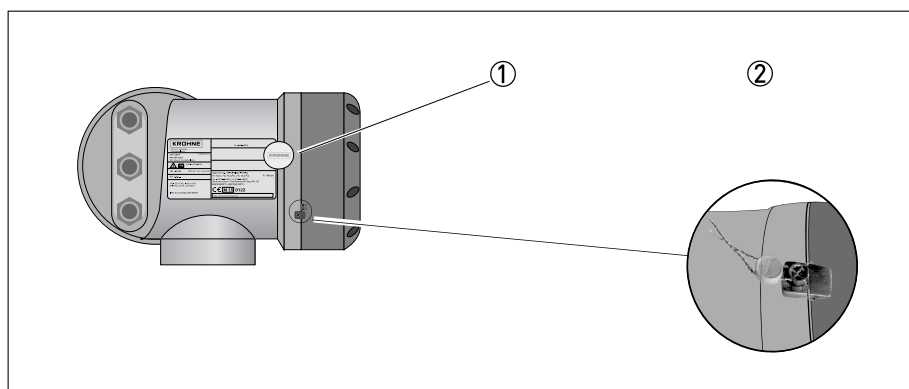


Figure 6-4: Metrological and utility seals on nameplate and housing

- ① Utility seal on nameplate
- ② Metrological seal on housing

6.1.3 Display in measuring mode with 2 or 3 measured values

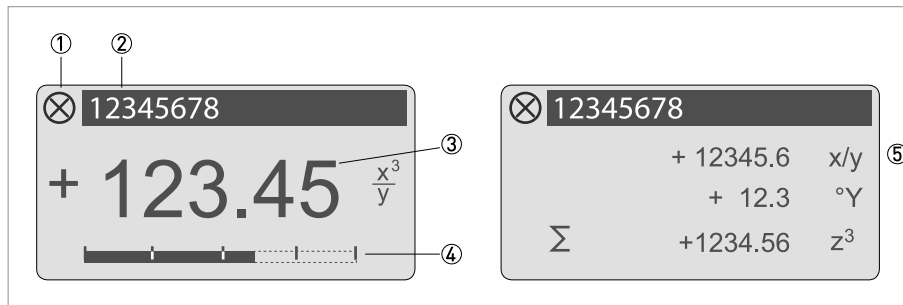


Figure 6-5: Example for display in measuring mode with 2 or 3 measured values

- ① Indicates a possible status message in the status page
- ② Tag (is only indicated if this string was entered previously by the operator)
- ③ 1st measured variable in large representation
- ④ Bargraph indication
- ⑤ Depiction with 3 measured values

6.1.4 Display for selection of submenu and functions in menu mode

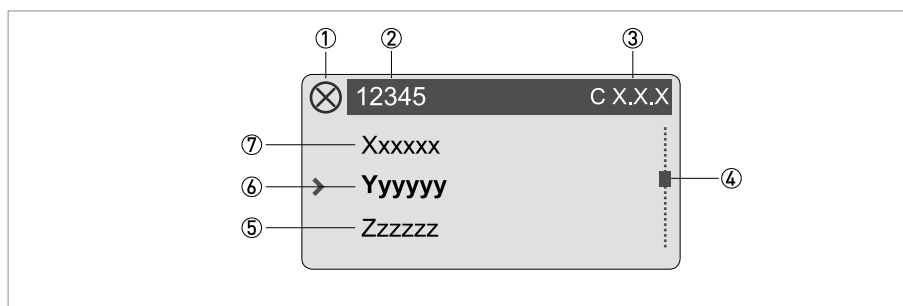


Figure 6-6: Display for selection of submenu and functions in menu mode

- ① Indicates a possible status message in the status page
- ② Menu, submenu or function name
- ③ Number relating to ⑥
- ④ Indicates position within menu, submenu or function list
- ⑤ Next menu(s), submenu or function
[___ signals in this line the end of the list]
- ⑥ Current menu(s), submenu or function
- ⑦ Previous menu(s), submenu or function
[___ signals in this line the beginning of the list]

6.1.5 Display when setting a parameter in parameter and data mode

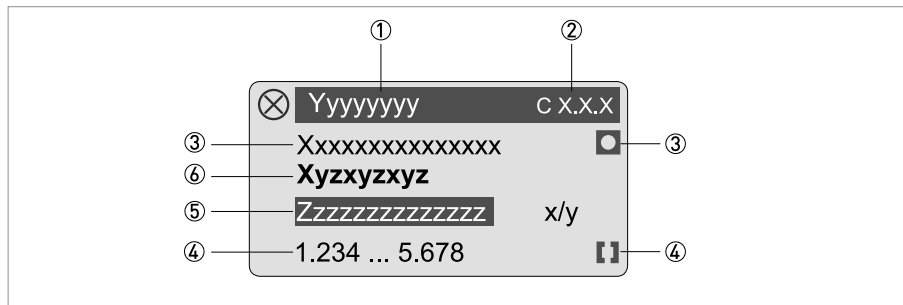


Figure 6-7: Display when setting a parameter in parameter and data mode

- ① Current menu(s), submenu or function
- ② Number related to this parameter
- ③ Factory setting of this parameter
- ④ Permissible value range for this parameter
- ⑤ Currently set value, unit or function (when selected, appears with white text, black background); this is where the parameter value is changed
- ⑥ Name of this parameter

6.1.6 Display when previewing parameters, 4 lines

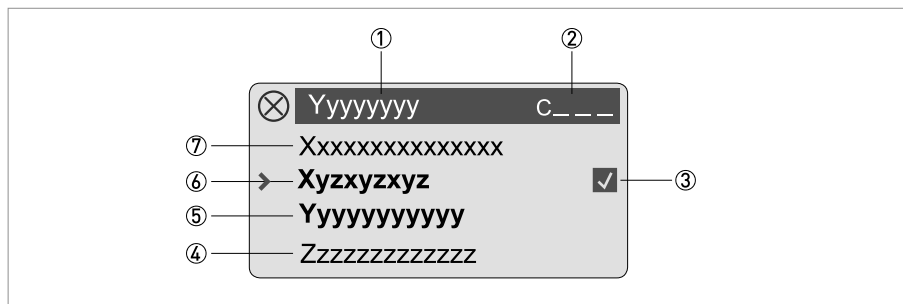


Figure 6-8: Display when previewing parameters, 4 lines

- ① Current menu(s), submenu or function
- ② Number relating to ⑥
- ③ Denotes a changed parameter (simple check of changed data when browsing through lists)
- ④ Next parameter
- ⑤ Currently set data from ⑥
- ⑥ Current parameter (for selection press key >; then see previous chapter)
- ⑦ Factory setting of parameter

6.1.7 Using an IR interface (option)

The optical IR interface serves as an adapter for PC-based communication with the signal converter without opening the housing.



INFORMATION!

- This device is not part of the scope of delivery.
- For more information about activation with the functions A6 or C6.6.7.

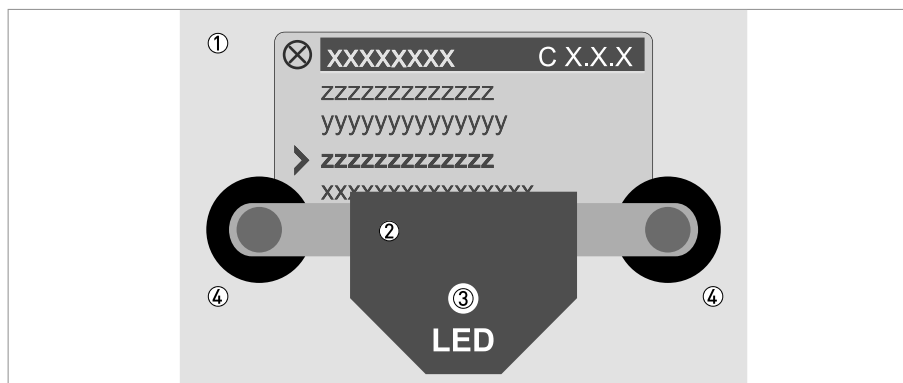


Figure 6-9: IR interface

- ① Glass panel in front of the control and display panel
- ② IR interface
- ③ LED lights up when IR interface is activated.
- ④ Suction cups

Timeout function

Following activation of the IR interface in Fct. A6 or C6.6.7 the interface must be properly positioned and attached to the housing with the suction cups within 60 seconds. If this does not happen within the specified time period, the device can be operated using the optical keys again. Upon activation, the LED ③ lights up and the optical keys no longer function.

6.2 Menu structure


INFORMATION!

Note the key function within and between the columns.

Measure mode		Select menu	Select menu and/or submenu				Select function and set data		
			↓					↓ ↑ >	
			↑						
↵	Press > 2.5 s								
	A Quick Setup	>	A1 Language	>				>	
		↵	A2 Tag					↵	
			A3 Reset	>	A3.1 Reset Errors	🔒			
				↵	A3.2 Totaliser 1	🔒			
					A3.3 Totaliser 2	🔒			
			A4 Analog Outputs		A4.1 Measurement				
					A4.2 Unit				
					A4.3 Range				
					A4.4 Low Flow Cutoff				
					A4.5 Time Constant				
			A5 Digital Outputs		A5.1 Measurement				
					A5.2 Pulse Value Unit				
					A5.3 Value p. Pulse				
					A5.4 Low Flow Cutoff				
			A6 GDC IR interface						
				↓ ↑		↓ ↑			↓ ↑ >

...: indicates "locked for MI004 variant"

Measuring mode		Select menu	↓ ↑	Select menu and/or submenu ↓ ↑	↓ ↑	Select function and set data ↓ ↑ >
↵	Press > 2.5 s					
	B Test		> ↵	B1 Simulation	> ↵	B1.1 Volume Flow  B1.2 Velocity of sound  B1._ Current Output X B1._ Status Output X B1._ Control Input X B1._ Pulse Output X 
				B2 Actual Values	> ↵	B2.1 Act. volume flow B2.2 Act. mass flow B2.3 Act. vel. of sound B2.4 Act. Flow speed B2.5 Act. gain B2.6 Act. SNR B2.7 Act. Reynolds data B2.8 Operating Hours B2.9 Date and Time
				B3 Information	> ↵	B3.1 Status Log B3.2 Status Details B3.3 C Number B3.4 Process input B3.5 SW.REV. MS B3.6 SW.REV. UIS B3.8 Electronic Revision B3.9 Change log
		↓ ↑		↓ ↑		↓ ↑ >

 ...: indicates "locked for MI004 variant"

6.3 Function tables



INFORMATION!

- The following tables describe the functions of the standard device with HART® connection.
- Depending on the device version, not all functions are available.
- Some menu entries suited for advanced users are by default hidden in the menu. They can be shown if "C6.4.5 Menu display" is set to "Advanced".

6.3.1 Menu A, Quick Setup

No.	Function	Setting / Description
-----	----------	-----------------------

A1 Language

A1	language	language selection depends on the device version.
----	----------	---

A2 Tag

A2	Tag	measuring point identifier [Tag no.] (also for HART® operation) appears in the LCD header (max. 8 digits).
----	-----	--

A3 Reset

A3	reset	
A3.1	reset errors 	reset errors? Select: no/yes
A3.2	totalizer 1 	reset totaliser? Select: No / Yes
A3.3	totalizer 2 	reset totaliser? Select: No / Yes
①		

A4 Analog outputs (only for HART®)

A4	analog outputs	applicable to all current outputs (terminals A, B and C), frequency outputs (terminals A, B and D), limit switch (terminals A, B, C, and / or D) and the 1st display page / line 1
A4.1	measurement	1) select measurement: Volume Flow / Velocity of Sound / Mass Flow / Flow Speed / Gain / SNR / diagn flow speed, diagn VoS, diagn gain, diagn SNR 2) use for all outputs? (also use this setting for Fct. A4.2...A4.5!) Setting: no (applies only to the main current output) / yes (applies to all analogue outputs)
A4.2	unit	selection of the unit from a list, depending on the measurement
A4.3	range	1) setting for main current output (range: 0...100%) setting: 0...x.xx (format and unit, depending on measurement, see A4.1 and A4.2 above) 2) Use for all outputs? Make setting, see Fct. A4.1 above!
A4.4	low flow cutoff	1) setting for main current output (sets output value to "0") setting: x.xxx ± x.xxx% (Range: 0.0...20%) (1st value = switching point / 2nd value = hysteresis), condition: 2nd value ≤ 1st value 2) Use for all outputs? Make setting, see Fct. A4.1 above!
A4.5	time constant	1) setting for main current output (applicable to all flow measurements) setting: xxx.x s (range: 000.1...100 s) 2) use for all outputs? Make setting, see Fct. A4.1 above!

No.	Function	Setting / Description
-----	----------	-----------------------

A4 Station address

A4	station address	for Profibus / FF / Modbus devices.
----	-----------------	-------------------------------------

A5 Digital Outputs

A5	digital outputs	valid for all pulse outputs (terminals A, B and/or D) and totaliser 1.
A5.1	measurement 	1) select measurement: volume flow / mass flow 2) use for all outputs? (also use this setting for Fct. A5.2...A5.4!) setting: No (only for pulse output D) / Yes (for all digital outputs)
A5.2	pulse value unit 	selection of the unit from a list, depending on the measurement.
A5.3	value p. pulse 	1) setting for pulse output D (volume or mass value per pulse) setting: xxx.xxx in l/s or kg/s 2) Use for all outputs? Make setting, see Fct. A5.1 above!
A5.4	low flow cutoff 	1) setting for pulse output D (sets output value to "0") setting: x.xxx ± x.xxx% (range: 0.0...20%) (1st value = switching point / 2nd value = hysteresis), condition: 2nd value ≤ 1st value 2) Use for all outputs? Make setting, see Fct. A5.1 above!

A6 GDC IR interface

A6	GDC IR interface	after this function has been activated an optical GDC adapter can be connected to the LC display. After 60 seconds pass without a connection being established or after the adapter is removed, the function is exited and the optical keys are active again break (exit function without connection) activate (the IR interface adapter and interrupt the optical keys) 
----	------------------	--

① Depends on IO hardware module  ...: indicates "locked for MI-004 variant"

6.3.2 Menu B; test

No.	Function	Setting / Description
-----	----------	-----------------------

B0 Test

B1	Simulation	Simulation
B1.1	Volume Flow 	Simulation of volume flow
B1.2	Velocity of Sound 	Simulation of velocity of sound
B1.3	Terminals A	Sets simulated value of output on Terminal A
B1.4	Terminals B	Sets simulated value of output on Terminal B
B1.5	Terminals C	Sets simulated value of output on Terminal C
B1.6	Terminals D 	Sets simulated value of output on Terminal D

B2 Actual Values

B2	Actual values	Display of actual values;
B2.1	Act. volume flow	Displays current unfiltered volume flow
B2.2	Act. mass flow	Displays current unfiltered mass flow
B2.3	Act. velocity of sound	Displays current unfiltered velocity of sound
	B2.3.1 path 1	Value path 1
	B2.3.2 path 2	Value path 2
	B2.3.3 path 3	Value path 3
B2.4	Act. flow speed	Displays current unfiltered flow speed
	B2.4.1 path 1	Value path 1
	B2.4.2 path 2	Value path 2
	B2.4.3 path 3	Value path 3
B2.5	Act. gain	Displays current unfiltered gain
	B2.5.1 path 1	Value path 1
	B2.5.2 path 2	Value path 2
	B2.5.3 path 3	Value path 3
B2.6	Act. SNR	Displays current unfiltered SNR
	B2.6.1 path 1	Value path 1
	B2.6.2 path 2	Value path 2
	B2.6.3 path 3	Value path 3
B2.7	Reynolds data	Displays current number & correction
B2.8	Operating hours	Displays device operating hours
B2.9	Date and Time	Displays device date & time setting yyyy-mm-dd hh:mm

B3 Information

B3	Information	
B3.1	Status Log	Log for errors and warnings
B3.2	Status Details	Present errors and warnings in NE107 groups
B3.3	C Number	Displays C number of the installed electronics
B3.4	Process input	Displays information of the sensor electronics PCB
	B3.4.1 Sensor CPU	Displays information of the sensor CPU software
	B3.4.2 Sensor DSP	Displays information of the sensor DSP software
	B3.4.3 Sensor Driver	Displays information of the sensor driver hardware
B3.5	SW. REV. MS	Displays information of Main Software
B3.6	SW. REV. UIS	Displays information of User Interface
B3.8	Electronic Revision	Displays information of the Electronics Revision
B3.9	Change Log	The last changes of parameters are listed in this menu point, together with date and time. As a reference a CRC (checksum) over all parameters is used. This reference can be used by the customer for their documentation. The preview shows the actual CRC.

🔒 ...: indicates "locked for MI004 variant"

6.3.3 Menu C; setup

No.	Function	Settings / descriptions
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C1 Setup

C1.0 Process Input

C1.1	Meter size 🔒	Sets pipe diameter
C1.2	Calibration	Zero Offset
C1.2.1	Zero calibration 🔒	Performs zero calibration
C1.2.2	GK 🔒	Set meter factor
C1.3	Filters	
C1.3.1	Limitation 🔒	Limits for the flow speed
C1.3.2	flow direction 🔒	Sets polarity of flow direction
C1.3.3	Time constant	Sets timing constant of the sensor
C1.3.4	Low flow cutoff 🔒	Sets the low flow cutoff
C1.4	Plausibility	Error filtering
C1.4.1	Error limit 🔒	Sets error limit of MV in %
C1.4.2	Counter decrease 🔒	Sets decrease of plausibility counter
C1.4.3	Counter limit 🔒	Sets limit of plausibility counter
C1.5	Simulation	Simulation
C1.5.1	Volume flow 🔒	Simulation of volume flow
C1.5.2	Velocity of sound 🔒	Simulation of velocity of sound
C1.6	Information	

No.	Function	Settings / descriptions
C1.6.1	Sensor CPU	Displays the ID of the CPU on the FrontEnd
C1.6.2	Sensor DSP	Displays the ID of the DSP on the FrontEnd
C1.6.3	Sensor driver	Displays the ID of the Sensor Driver on the FrontEnd
C1.6.4	Calibration date	Displays the date of calibration of the sensor
C1.6.5	Serial no. Sensor	Displays the serial number of the measuring sensor
C1.6.6	V no. Sensor	Displays the Order number of the measuring sensor
C1.7	Linearization	
C1.7.1	Linearization	Compensation for errors made by different Reynolds Numbers
C1.7.2	Dynamische Viscositeit	Sets dynamic viscosity value for Reynolds calculation
C1.8	Pipe temperature	Temperature compensation
C1.9	Density	Sets density of the fluid
C1.10	Diagnosis	
C1.10.1	Diagnosis 1	Sets the parameter to be assigned to cyclic value; none, flow speed [1-2-3], velocity of sound [1-2-3]
C1.10.2	Diagnosis 2	Sets the parameter to be assigned to cyclic value ; none, gain [1-2-3], SNR [1-2-3]
C1.10.3	Proc: Empty pipe	Change NE107 status signal for status group "Proc: Empty pipe"
C1.10.4	Proc: Signal Lost	Change NE107 status signal for status group "Proc: Signal Lost"
C1.10.5	Proc: Signal Unreliable	Change NE107 status signal for status group "Proc: Signal Unreliable"
C1.10.6	Config: Totaliser	Change NE107 status signal for status group "Config: Totaliser"
C1.10.7	Electr: IO Connection	Change NE107 status signal for status group "Electr: IO Connection"
C1.10.8	Electr: Power Failure	Change NE107 status signal for status group "Electr: Power Failure"

...: indicates "locked for MI004 variant"

No.	Function	Settings / descriptions
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C2.0_I/O

C2.1	Hardware	Configuration of connection terminals. Selection depends on signal converter version.
C2.1.1	Terminal A	Sets the output associated with terminal A Select: Off (switched off) / current output / frequency output / pulse output / status output / limit switch / control input
C2.1.2	Terminal B	Sets the output associated with terminal B Select: Off (switched off) / current output / frequency output / pulse output / status output / limit switch / control input
C2.1.3	Terminal C	Sets the output associated with terminal C Select: Off (switched off) / current output / status output / limit switch
C2.1.4	Terminal D	Sets the output associated with terminal D Select: Off (switched off) / frequency output / pulse output / status output / limit switch

C2.2_ Current Output A

C2.2.1	Range 0%...100%	Range setting for current output A
C2.2.2	Extended Range	Min. and max. settings for current output A
C2.2.3	Error Current	Error current setting for error current output A
C2.2.4	Error Condition	Sets condition for error current output A
C2.2.5	Measurement	Measurement value for current output A; volume flow, velocity of sound, mass flow, flow speed, gain, SNR, diagn flow speed, diagn VoS, diagn gain, diagn SNR.
C2.2	Range	Measurement value range for current output A
C2.2.7	Polarity	Set response of current output A to measurement polarity
C2.2.8	Limitation	Limitation before applying the time constant.
C2.2.9	Low Flow Cutoff	Low flow cutoff for current output A
C2.2.10	Time Constant	Time constant for current output A
C2.2.11	Special Function	Range change setting for current output A
C2.2.12	Threshold	Threshold value for range change setting for current output A
C2.2.13	Information	Displays information of current output I/O board
C2.2.14	Simulation	Sets simulated output of current output A
C2.2.15	4mA Trimming	Trimming of current output A at 4 mA
C2.2.16	20mA Trimming	Trimming of current output A at 20 mA

C2._ Limit Switch

C2._0	Limit Switch X	X stands for one of the connection terminals A, B, C or D
C2._1	Measurement 	Select: Volume Flow / Mass Flow / Flow Speed / Velocity of Sound / Gain / SNR / diagn flow speed, diagn VoS, diagn gain, diagn SNR
		Locked for terminal D
C2._2	Threshold	Switching level, set threshold with hysteresis
		xxx.x ± x.xxx (format and unit depend on the measurement, see above)
		(1st value = threshold / 2nd value = hysteresis), condition: 2nd value ≤ 1st value
C2._3	Polarity 	Set polarity, please note Flow Direction
		Select: Both Polarities (plus and minus values are displayed) / Positive Polarity (display for negative values = 0) / Negative Polarity (display for positive values = 0) / Absolute Value (always displays positive, with both negative and positive values)
		Locked for terminal C & D
C2._4	Time Constant 	Range: 000.1...100 s
		Locked for terminal D
C2._5	Invert Signal	Select: Off (activated output: switch closed) / On (activated output: switch open)
C2._6	Information	Serial no. of the I/O board, software version no. and production date of the circuit board (read only)
C2._7	Simulation	Sequence see B1._ Limit Switch X

C2_ Frequency Output X

C2._1	Pulse Shape	Pulse shape of frequency X
C2._2	Pulse Width	Pulse width of frequency X
C2._3	100% Pulse Rate	Pulse rate for 100% of the measuring range for frequency output X;
		Range: 1...10000 Hz
		Limitation 100% Pulse Rate $\leq 100/s$: $I_{max} \leq 100 \text{ mA}$ Limitation 100% Pulse Rate $> 100/s$: $I_{max} \leq 20 \text{ mA}$
C2._4	Measurement	Measurements for activating the output.
		Select measurement:
C2._5	Range	0...100% of the measurement set in Fct. C2._4
		x.xx...xx.xx _ _ _ (format and unit depend on the measurement, see above)
C2._6	Polarity	Set measured value polarity, please note flow direction in C1.3.2!
		Select:
C2._7		Limitation before applying the time constant.
		$\pm xxx \dots \pm xxx\%$; range: -150...+150%
C2._8	Low Flow Cutoff	Sets the measurement to "0" for low values
		$x.xxx \pm x.xxx\%$; range: 0.0...20%
		(1st value = switching point / 2nd value = hysteresis), condition: 2nd value $\leq$ 1st value
C2._9	Time Constant	Range: 000.1...100 s
C2._10	Invert Signal	Select:
C2._12	Information	Serial no. of the I/O board, software version no. and production date of the circuit board
C2._13	Simulation	Sequence see B1._ Frequency Output X

C2._ Pulse Output

C2._	Pulse Output X	X stands for one of the connection terminals
C2._.1	Pulse Shape	Specify the pulse shape Select: Symmetric (about 50% on and 50% off) / Automatic (constant pulse with about 50% on and 50% off at 100% pulse rate) / Fixed (fixed pulse rate, setting see below Fct. C2._.3 100% pulse rate)
C2._.2	Pulse Width	Only available if set to "Fixed" in Fct. C2._.1. Range: 0.05...2000 ms Note: max. setting value T_p [ms] $\leq$ 500 / max. pulse rate [1/s], gives the pulse width = time where the output is activated
C2._.3	Max. Pulse Rate	Pulse rate for 100% of the measuring range Range: 0.0...10000 1/s Limitation 100% pulse rate $\leq$ 100/s: $I_{\max} \leq$ 100 mA Limitation 100% pulse rate $>$ 100/s: $I_{\max} \leq$ 20 mA
C2._.4	Measurement	Measurements for activating the output Select: Volume Flow / Mass Flow
C2._.5	Pulse Value Unit	Selection of the unit from a list, depending on the measurement
C2._.6	Value p. Pulse	Set value for volume or mass per pulse. xxx.xxx, measured value in [l] or [kg] depending on setting in C3._.6 At max. pulse rate see above 2._.3 Pulse Output
C2._.7	Polarity	Set polarity, please note Flow Direction Select: Both Polarities (plus and minus values are displayed) / Positive Polarity (display for negative values = 0) / Negative Polarity (display for positive values = 0) / Absolute Value (always displays positive, with both negative and positive values)
C2._.8	Low Flow Cutoff	Sets the measurement to "0" for low values x.xxx $\pm$ x.xxx%; range: 0.0...20% (1st value = switching point / 2nd value = hysteresis), condition: 2nd value $\leq$ 1st value
C2._.9	Time Constant	Range: 000.1...100 s
C2._.10	Invert Signal	Select: Off (activated output: switch closed) / On (activated output: switch open)
C2._.12	Information	Serial no. of the I/O board, software version no. and production date of the circuit board
C2._.13	Simulation	Sequence see B1._ Pulse Output X

C2._ Status Output

C2._0	Status Output X	X (Y) stands for one of the connection terminals A, B, C or D
C2._1	Mode	The output shows the following measuring conditions:
		Out Of Specification (output set, signals status of category "Error in Device" or "Application Failure" or "Out Of refer to <i>Status messages and diagnostic information</i> on page 84)/ Application Failure (output set, signals status of category "Error in Device" or "Application Failure" refer to <i>Status messages and diagnostic information</i> on page 84) / Flow Polarity (polarity of the current flow) Flow Over Range (over range of the flow) Totaliser 1 Preset (activates when totaliser X preset value is reached) / Totaliser 2 Preset (activates when totaliser X preset value is reached) / Totaliser 3 Preset (activates when totaliser X preset value is reached) / Output A (activated by the status of output Y, additional output data see below) / Output B (activated by the status of output Y, additional output data see below) / Output C (activated by the status of output Y, additional output data see below) / Output D (activated by the status of output Y, additional output data see below) / Off (switched off) / Empty Pipe (when pipe empty, output activated) / Error in Device (output set, signals status of category "Error in Device" refer to <i>Status messages and diagnostic information</i> on page 84)
C2._2	Current Output Y	Only appears if output A...C is set under "Mode" (see above), and this output is a "Current Output". Polarity (is signalled) Over Range (is signalled) Automatic Range signals lower range
C2._2	Frequency Output Y and Pulse Output Y	Only appears if output A, B or D is set under "Mode" (see above), and this output is a "Frequency/Pulse Output". Polarity (is signalled) Over Range (is signalled)
C2._2	Status Output Y	Only appears if output A...D is set under "Mode" (see above), and this output is a "Status Output". Same Signal (like other connected status output, signal can be inverted, see below)
C2._2	Limit Switch Y and Control Input Y	Only appears if output A...D / input A or B is set under "Mode" (see above), and this output / input is a "Limit Switch / Control Input". Status Off (is always selected here if Status Output X is connected with a Limit Switch / Control Input Y).
C2._2	Output Y	Only appears if output A...D is set under "Mode" (see above) and this output is switched off.
C2._3	Invert Signal 	Select: Off (activated output: switch closed) / On (activated output: switch open)
C2._4	Information	Serial no. of the I/O board, software version no. and production date of the circuit board
C2._5	Simulation	Sequence see B1._ Status Output X

C2._ Control Input X

C2._	Mode	X stands for one of the connection terminals A, B, C or D
	Off (control input switched off) / Hold All Outputs (hold current values, not display and totalisers) / Output Y (hold current values) / All Outputs To Zero (current values = 0%, not display and totalisers) / Output Y To Zero (current value = 0%) / All Totalisers (reset all totalisers to "0") / Totaliser "Z" Reset (set totaliser 1, [2 or 3] to "0") / Stop All Totalisers / Stop Totaliser "Z" (stops totaliser 1, [2 or 3] / Zero Outp.+Stop Tot. (all outputs 0%, stop all totalisers, not the display) / External Range Y (control input for external range of current output Y) - also make this setting on current output Y (no check if current output Y is available) / Error Reset (all resettable errors are deleted) Zero Calibration	
C2._2	Invert Signal	Select:
		Off (activated output: switch closed) /
		On (activated output: switch open)
C2._3	Information	Set polarity, please note Flow Direction
		Serial no. of the I/O board, software version no. and production date of the circuit board
C2._4	Simulation	Sequence see B1._ Control Input X

 .: indicates "locked for MI004 variant"

No.	Function	Settings / descriptions
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C3 I/O Totalisers

C3.1	Totaliser 1	Set function of totaliser. _ stands for 1, 2, 3 (= Totaliser 1, 2, 3) The basic version (standard) has only 2 totaliser!
C3.2	Totaliser 2	
C3.3	Totaliser 3 	
	C3._.1 Totaliser Function 	Select: Absolute Total (counts positive + negative values) / +Totaliser (counts only the positive values) / -Totaliser (counts only the negative values) / Off (Totaliser is switched off)
	C3._.2 Measurement 	Selection of the measurement for Totaliser _ Select: Volume Flow / Mass Flow
	C3._.3 Low Flow Cutoff 	Sets the measurement to "0" for low values
		Range: 0.0...20% (1st value = switching point / 2nd value = hysteresis), condition: 2nd value ≤ 1st value
	C3._.4 Time Constant 	Range: 000.1...100 s
	C3._.5 Preset Value 	If this value is reached, positive or negative, a signal is generated that can be used for a status output at which "Preset Totaliser X" has to be set.
		Preset value (max. 8 digits) x.xxxxx in selected unit, see C5.7.10 + 13
	C3._.6 Reset Totaliser 	Sequence see Fct. A3.2, A3.3 and A3.4
	C3._.7 Set Totaliser 	Set Totaliser _ to the desired value
		Select: Break (exit function) / Set Value (opens the editor to make the entry)
		Query: Set Totaliser?
	C3._.8 Stop Totaliser 	Select: Select: No (exit function without setting the value) / Yes (sets the totaliser and exits the function)
Totaliser _ stops and holds the current value.		
C3._.9 Start Totaliser 	Select: No (exits the function without stopping the totaliser) / Yes (stops the totaliser and exits the function)	
	Start Totaliser _ after that totaliser is stopped	
C3._.10 Information 	Select: No (exits the function without starting the totaliser) / Yes (starts the totaliser and exits the function)	
	Serial no. of the I/O board, software version no. and production date of the circuit board	

 ...: indicates "locked for MI004 variant"

No.	Function	Settings / descriptions
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C4 I/O HART

C4	I/O HART	Selection or display of the 4 dynamic variables (DV) for HART®
		The HART® current output (terminal A basic I/Os) always has a fixed link to the primary variables (PV). Fixed links of the other DVs (1-3) are only possible if additional analogue outputs (current and frequency output) are available; if not, the measurement can be freely selected from the following list: in Fct. A4.1 "Measurement"
		_ stands for 1, 2, 3 or 4 X stands for connection terminals A...D
C4.1	PV is	Current output (primary variable)
C4.2	SV is	(secondary variable)
C4.3	TV is	(tertiary variable)
C4.4	4V is	(4th variable)
C4.5	HART Units	Changes units of DVs (dynamic variables) in the display
		Break: return with ↵ key
		HART® display: copies the settings for the display units to the settings for DVs
		Standard: factory settings for DVs
C4._.1	Current Output X	Shows the current analog measured value of the linked current output. The measurement cannot be changed!
C4._.1	Frequency Output X	Shows the current analog measured value of the linked frequency output, if present. The measurement cannot be changed!
C4._.1	HART Dynamic Var.	Measurements of the dynamic variables for HART®.
		Select: Volume Flow / Mass Flow / Diagnosis / Velocity / Totaliser 1 / Totaliser 2 / Totaliser 3 / Operating Hours

No.	Function	Settings / descriptions
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C5.0 Device

C5.1	Device Info	-
	C5.1.1 Tag	Settable characters (max. 8 digits): A...Z; a...z; 0...9; / - , .
	C5.1.2 C Number	Displays the CG number of the installed electronics
	C5.1.3 Device Serial No.	Serial no. of the measuring sensor, cannot be changed
	C5.1.4 Electronics Serial No.	Displays the serial number of the electronics
	C5.1.5 Information	Empty
	C5.1.6 Electronic Revision ER	Displays the electronic revision of the electronics

C5.2 Display

C5.2	Display	-
	C5.2.1 Language	Language selection depends on the device version.
	C5.2.2 Contrast	Adjust display contrast for extreme temperatures. Setting: -9...0...+9 This change takes place immediately, not just when setting mode is exited!
	C5.2.3 Default Display	Specification of the default display page that is returned to after a short delay period. Select: None (the current page is always active) / 1st Meas. Page (show this page) / 2nd Meas. Page (show this page) / Status Page (show only status messages) / Graphic Page (trend display of the 1st measurement)
	C5.2.4 Optical Keys	Activate or deactivate the optical keys 

C5.3 and C5.4 1st Meas. Page and 2nd Meas. Page

C5.3	1st Meas. Page	_ stands for 3 = 1st Meas. Page and 4 = 2nd Meas. Page
C5.4	2nd Meas. Page	
	C5._.1 Function	Specify number of measured value lines (font size) Select: One Line / Two Lines / Three Lines
	C5._.2 1st Line Variable	Specify 1st Line Variable Select measurement: Volume Flow / Mass Flow / Flow Speed / Velocity of Sound / Gain / SNR / diagn flow speed, diagn VoS, diagn gain, diagn SNR.
	C5._.3 Range	0...100% of the measurement set in Fct. C5._.2 x.xx...xx.xx _ _ _ (format and unit depend on the measurement)
	C5._.4 Limitation	Limitation before applying the time constant $\pm$ xxx ... $\pm$ xxx%; range: -150...+150%
	C5._.5 Low Flow Cutoff	Sets low flow values to "0" x.xxx $\pm$ x.xxx %; Range: 0.0...20 % (1st value = switching point / 2nd value = hysteresis), condition: 2nd value $\leq$ 1st value
	C5._.6 Time Constant	Range: 000.1...100 s
	C5._.7 1st Line Format	Specify decimal places. Select: Automatic (adaptation is automatic) / X (= none) ...X.XXXXXXXXXX (max. 8 digits) depends on size of font
	C5._.8 2nd Line Variable	Specify 2nd Line Variable (only available if this 2nd line is activated) Select: Bar Graph (for measurement selected in the 1st line) Volume Flow / Mass Flow / Flow Speed / Velocity of Sound / Gain / SNR / diagn flow speed, diagn VoS, diagn gain, diagn SNR. Totalisers / Operating hours
	C5._.9 2nd Line Format	Specify decimal places Select: Automatic (adaptation is automatic) / X (= none) ...X.XXXXXXXXXX (max. 8 digits) depends on size of font
	C5._.10 3rd Line Variable	Specify 3rd Line Variable (only available if this 3rd line is activated) Select: Volume Flow / Mass Flow / Flow Speed / Velocity of Sound / Gain / SNR / diagn flow speed, diagn VoS, diagn gain, diagn SNR / Totalisers / Operating hours
	C5._.11 3rd Line Format	Select: Automatic (adaptation is automatic) / X (= none) ...X.XXXXXXXXXX (max. 8 digits) depends on size of font

C5.5 Graphic Page

C5.5	Graphic Page	-
	C5.5.1 Select Range	Graphic page always shows trend curve of the measurement of the 1st page / 1st line, see Fct. C6.3.2 Select: Manual (set range in Fct. C5.5.2) ; Automatic (automatic depiction based on the measured values) Reset only after parameter change or after switching off and on.
	C5.5.2 Range	Set the scaling for the Y axis. Only available if "Manual" is set in C5.5.1. $\pm xxx \pm xxx\%$; range: -100...+100% (1st value = lower limit / 2nd value = upper limit), condition: 1st value $\leq$ 2nd value
	C5.5.3 Time Scale	Set the time scaling for the X axis, trend curve xxx min; range: 0...100 min

C5.6 Special Functions

C5.6	Special Functions	-
	C5.6.1 Reset Errors 	Reset Errors? Select: No / Yes
	C5.6.2 Save Settings 	Save current settings. Select: Break (exit function without saving) / Backup 1 (save in storage location 1) / Backup 2 (save in storage location 2) Query: Continue To Copy? (cannot be undone afterwards) Select: No (exit function without saving) / Yes (copy current settings to storage backup 1 or backup 2)
	C5.6.4 Password Quick Set	Password required to change data in the quick setup menu. 0000 (= to quick setup menu without password) xxxx (password required); range 4 digits: 0001...9999
	C5.6.5 Password Setup	Password required to change data in the setup menu 0000 (= to quick setup menu without password) xxxx (password required); range 4 digits: 0001...9999
	C5.6.6 Date and Time	Set real time
	C5.6.7 Quick access	Configure quick access functions
	C5.6.8 GDC IR Interface 	After this function has been activated an optical GDC adapter can be connected to the LC display. If approximately 60 seconds pass without a connection being established or after the adapter is removed, then the function is exited and the optical keys are active once again. Break (exit function without connection) Activate (the IR interface adapter and interrupt the optical keys) If approximately 60 seconds pass without a connection being established, then the function is exited and the optical keys are active once again.

C5.7 Units

C5.7	Units	
	C5.7.1 Size	Sets displayed units for the pipe diameter
	C5.7.2 Volume Flow	m ³ /h; m ³ /min; m ³ /s; L/h; L/min; L/s (L = litres); IG/s; IG/min; IG/h cf/h; cf/min; cf/s; gal/h; gal/min; gal/s; barrel/h; barrel/day Free Unit (set factor and text in the next two functions, sequence see below)
	C5.7.3 Text Free Unit	For text to be specified refer to <i>Set free units</i> on page 79:
	C5.7.4 [m ³ /s]*Factor	Specification of the conversion factor, based on m ³ /s: xxx.xxx refer to <i>Set free units</i> on page 79
	C5.7.5 Mass Flow	kg/s; kg/min; kg/h; t/min; t/h; g/s; g/min; g/h; lb/s; lb/min; lb/h; ST/min; ST/h (ST = Short Ton); LT/h (LT = Long Ton); Free Unit (set factor and text in the next two functions, sequence see below)
	C5.7.6 Text Free Unit	For text to be specified refer to <i>Set free units</i> on page 79:
	C5.7.7 [kg/s]*Factor	Specification of the conversion factor, based on kg/s: xxx.xxx refer to <i>Set free units</i> on page 79
	C5.7.8 Velocity	m/s; ft/s
	C5.7.9 Volume 	m ³ ; L; hL; mL; gal; IG; in ³ ; cf; yd ³ ; barrel Free Unit (set factor and text in the next two functions, sequence see below)
	C5.7.10 Text Free Unit 	For text to be specified refer to <i>Set free units</i> on page 79:
	C5.7.11 [m ³]*Factor 	Specification of the conversion factor, based on m ³ : xxx.xxx refer to <i>Set free units</i> on page 79
	C5.7.12 Mass	kg; t; mg; g; lb; ST; LT; oz; Free Unit (set factor and text in the next two functions, sequence see below)
	C5.7.13 Text Free Unit	For text to be specified refer to <i>Set free units</i> on page 79:
	C5.7.14 [kg]*Factor	Specification of the conversion factor, based on kg: xxx.xxx refer to <i>Set free units</i> on page 79
	C5.7.15 Density	kg/L; kg/m ³ ; lb/cf; lb/gal; SG Free Unit (set factor and text in the next two functions, sequence see below)
	C5.7.16 Text Free Unit	For text to be specified refer to <i>Set free units</i> on page 79:
	C5.7.17 [kg/m ³]*Factor	Specification of the conversion factor, based on kg/m ³ : xxx.xxx refer to <i>Set free units</i> on page 79
	C5.7.18 Temperature	Sets displayed units for temperature [°C - °F - K]

C5.8 HART

C5.8	HART	
	C5.8.1 HART	Switch HART® communication on/off: Select: On (HART® activated) possible current range for current output 4...20 mA / Off (HART® not activated) possible current range for current output 0...20 mA
	C5.8.2 Address	Set address for HART® operation: Select: 00 (Point-to-Point operation, current output has normal function, current = 4...20 mA) / 01...15 (Multi-Drop operation, current output has a constant setting of 4 mA)
	C5.8.3 Loop current mode	Configure loop current mode: - disable multidrop mode - enable current signal mode
	C5.8.4 Message	Set required text: A...Z ; a...z ; 0...9 ; / - + , . *
	C5.8.5 Description	Set required text: A...Z ; a...z ; 0...9 ; / - + , . *
	C5.8.6 HART long Tag	Up to 32 digits (on display max. 8 digits)

C5.9 Quick Setup

C5.9	Quick Setup	Activate quick access in Quick Setup menu: Select: Yes (switched on) / No (switched off)
	C5.9.1 Reset Totaliser 1	Reset Totaliser 1 in Quick Setup menu? Select: Yes (activated) / No (switched off)
	C5.9.2 Reset Totaliser 2	Reset Totaliser 2 in Quick Setup menu? Select: Yes (activated) / No (switched off)
	C5.10 OPTICHECK verific.	Activation of OPTICHECK verification feature. For OPTICHECK verification activation code, contact supplier.

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6.3.4 Set free units

Free units	Sequences to set texts and factors
Texts	
Volume flow, mass flow, mass, volume, density and pressure	3 digits before and after the slash xxx/xxx (max. 6 characters plus a "/")
Permissible characters	A...Z; a...z; 0...9; / - + , . *; @ \$ % ~ () [] _
Conversion factors	
Desired unit	= base unit * conversion factor
Conversion factor	Max. 9 digits
Shift decimal point	↑ to the left and ↓ to the right

Table 6-2: Sequences to set texts and factors

6.4 Description of functions

6.4.1 Reset totaliser in the menu "Quick Setup"



INFORMATION!

It may be necessary to activate resetting of the totaliser in the menu "Quick Setup".

Key	Display	Description and setting
>	Quick Setup	Press and hold for 2.5 s, then release the key.
>	Language	-
2 x ↓	Reset	-
>	Reset Errors	-
↓	All Totaliser	Select desired totaliser.
↓	Totaliser 1	
↓	Totaliser 2	
↓	Totaliser 3	
>	Reset Totaliser No	-
↓ or ↑	Reset Totaliser Yes	-
↵	Totaliser 1,2	Totaliser has been reset.
3 x ↵	Measuring mode	-

6.4.2 Deleting error messages in the menu "Quick Setup"



INFORMATION!

The detailed list of the possible error messages.

Key	Display	Description and setting
>	Quick Setup	Press and hold for 2.5 s, then release the key.
>	Language	-
2 x ↓	Reset	-
>	Reset Errors	-
>	Reset? No	-
↓ or ↑	Reset? Yes	-
↵	Reset Errors	Error has been reset.
3 x ↵	Measuring mode	-

6.4.3 Diagnosis messages

These settings make it possible to change the status signal of the respective diagnosis message (status group).

6.4.4 Graphic page

With this converter, the trend of the main measurement can be graphically displayed. The first measurement on display page 1 is always defined as the main measurement.

- Menu C.5.1 defines the range for the trend indicator (manual or automatic).
- Menu C.5.2 defines the range for manual setting.
- Menu C.5.3 defines the time span for the trend indicator.

6.4.5 Save settings

This function allows all settings to be stored in a memory.

- Backup 1: Saves settings in backup memory area 1
- Backup 2: Saves settings in backup memory area 2

6.4.6 Load settings

This function allows the complete stored settings to be loaded again.

- Backup 1: Loading from backup - memory 1
- Backup 2: Loading from backup - memory 2
- Factory: Uploading the original factory settings

6.4.7 Passwords

To create a password for the Quick Set menu or Setup menu, you must enter a 4-digit code into the menu. You are then prompted for this password every time changes are to be made to the corresponding menus. There is a hierarchy. The Setup password can also be used to perform changes in the Quick Setup menu. Enter 0000 in each menu to disable the password.

6.4.8 Date and time

The signal converter has a real time clock which is used for all of the log functions in the device. This function C.6.6 can be used to set the date and time of the real time clock.

6.4.9 Low flow cutoff

The low flow cutoff can be individually set for each output and each display line. If the low flow cutoff has been activated, the respective output or display is set to zero when the flow is below the low flow cutoff value entered.

The value can either be entered as a percentage of the nominal flow of the sensor or, in the case of a pulse output, as a discrete flow value.

Two values must be entered. The first is for the operating point of the sensor and the second is for hysteresis. Condition: 1st value > 2nd value

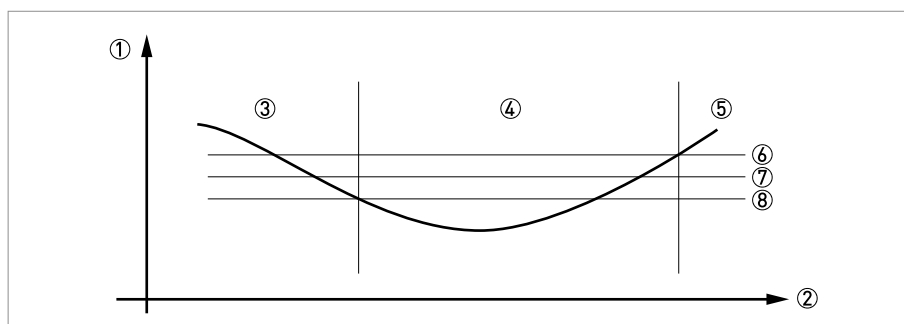


Figure 6-10: Indication of low flow cutoff

- ① Flow speed
- ② Time
- ③ Currently indicated flow speed
- ④ Display set to zero
- ⑤ Currently indicated flow
- ⑥ Positive hysteresis
- ⑦ Threshold
- ⑧ Negative hysteresis

6.4.10 Time constant

To better process widely fluctuating measured values in the device, the measured values are digitally filtered to stabilise the output. The time constant can be individually set for each output, the first line of the display and the density measurement. However, keep in mind that the degree of filtration affects the response time of the device in the event of rapid changes.

Short time constant	Fast response times
	Fluctuating reading
Long time constant	Slow response time
	Stable reading

The time constant corresponds to the elapsed time until 67% of the end value has been reached according to a step function.

6.4.11 Timeouts in programming mode

Normal menu function: If no key has been pressed for 5 minutes in a normal menu function, the display automatically switches to measuring mode. All changes are lost.

Test function: In test mode, the test function is finished after 60 minutes.

6.4.12 Output hardware

Depending on the hardware modules used (see CG number), it may be possible to change the output options on terminals A, B, C or D in the menus C1.x. For example, a pulse output to a frequency output or a status output to a control input.

The available options are determined by the hardware module used. It is not possible to change the type of output, e.g. from active to passive or to NAMUR.

6.5 Status messages and diagnostic information

The diagnostic messages are displayed in accordance with NAMUR standard NE 107. NE 107 states that there are up to 32 status groups which can have different status signals. NE 107 was implemented with 16 status groups with fixed status signals and 8 groups with variable status signals. To facilitate identification of the problem source, the status groups are then divided into the groups: Sensor, Electronics, Configuration and Process.

The variable status signal can be changed in menu **Mapping; C1.10.3 ...C1.10.8**. Changing the status signal to "Information", switches off the message.



INFORMATION!

As status message always the name of the relevant status group and the status signal (F/S/M/C) is displayed.

Each status message (= status signal) has a specific symbol, determined by NAMUR, which is displayed with the message. The length of each message is limited to one line.

All status messages are saved in the status log (menu B3.1). Use the ↑ and ↓ keys to navigate through this list. Use the ↵ key to exit the list.

The status screen shows the status groups of all errors that have occurred since the last time the status screen was opened. All errors that are not current disappear after 2 seconds. They are shown in the list in brackets.

Symbol	Letter	Status signal	Description and consequence
	F	Failure	No measurement possible.
	S	Out of specification	Measurements are available but are no longer sufficiently accurate and should be checked
	M	Maintenance required	Measurements are still accurate but this could soon change
	C	Function check	A test function is active; The displayed or transferred measured value does not correspond to the actual measured value.
	I	Information	No direct influence on the measurements

All status messages are saved in the status log (menu B3.1). Use the ↑ and ↓ keys to navigate through this list. Use the ↵ key to exit the list.

The status screen shows the status groups of all errors that have occurred since the last time the status screen was opened. All errors that are not current disappear after 2 seconds. They are shown in the list in brackets.

Legend

	Fixed status signal
	Variable status signal

Error type	Event group	Single event	Description	Actions to eliminate the event
F	F Electronics	System Error	Electronics error in internal bus communication or due to a hardware error	Perform cold start. If message reappears, contact manufacturer.
		System Error A		
		System Error C		
		HW Combination Error		
		BM Failure		
		DM Failure		
		Frontend Failure		
		Mproc Failure		
		DSP Failure		
		Sensor driver Failure		
		Fieldbus Failure		
		PROFIBUS Failure		
		Modbus Failure		
		IO 1 Failure		
		IO 2 Failure		
		Tot 1 Failure		
		Tot 2 Failure		
		Tot 3 Failure		
		IO A Failure		
		IO B Failure		
		IO C Failure		
F	F Configuration	BM Configuration	Error detected when starting device. Possible causes: inadmissible parameter settings or fault with electronics component.	Check settings of appropriate function or load factory settings. If the error persists, contact manufacturer.
		DM Configuration		
		Process Input Config. ①	Settings for process input invalid	Check settings for process input or load factory settings

Error type	Event group	Single event	Description	Actions to eliminate the event
		Fieldbus Config.		Check Fieldbus configuration or load factory settings
		PROFIBUS Config.		Check PROFIBUS settings or load factory settings
		Tot 1 FB2 Unit Error	Totaliser is out of operation due to inadmissible unit	Check unit in totaliser 1 FB2 or load factory settings
		Tot 2 FB3 Unit Error		Check unit in totaliser 2 FB3 or load factory settings
		Tot 3 FB4 Unit Error		Check unit in totaliser 3 FB4 or load factory settings.
		Modbus Config.		Check Modbus configuration or load factory settings
		Display Config.	Inadmissible settings for the display	Check display settings or load factory settings
		IO1 Configuration	Inadmissible settings for IO1	Check settings for IO1 or load factory settings
		IO2 Configuration	Inadmissible settings for IO2	Check settings for IO2 or load factory settings
		Tot 1 Configuration	Inadmissible settings for totaliser 1	Check settings for totaliser 1 or load factory settings
		Tot 2 Configuration	Inadmissible settings for totaliser 2	Check settings for totaliser 2 or load factory settings
		Tot 3 Configuration	Inadmissible settings for totaliser 3	Check settings for totaliser 3 or load factory settings
		IO A Configuration	Inadmissible settings for IO A	Check settings for IO A or load factory settings
		IO B Configuration	Inadmissible settings for IO B	Check settings for IO B or load factory settings
		IO C Configuration	Inadmissible settings for IO C	Check settings for IO C or load factory settings
		IO D Configuration	Inadmissible settings for IO D	Check settings for IO D or load factory settings
F	F Process			
C	C Sensor			
C	C Electronics			

C	C Configuration			
		Flow Simulation Active ①	Simulation of volume flow, mass flow.	Switch off measured value simulation
		VoS Simulation Active ①	Simulation of a certain velocity of sound (VoS)	Switch off measured value simulation
		Fieldbus Sim. Active	The simulation function in the Foundation Fieldbus module is active and being used	Check Fieldbus settings
		PROFIBUS Sim. Active	The simulation function in the PROFIBUS module is active and being used	Check PROFIBUS settings
		IO A Simulation Active	IO A simulation is active.	Switch off simulation.
		IO B Simulation Active	IO B simulation is active.	
		IO C Simulation Active	IO C simulation is active.	
		IO D Simulation Active	IO D simulation is active.	
C	C Process			
S	S Sensor			
		Delay Test Error	Invalid on-line measurement of the transducer delay	Adjust the trigger level of the delay time measurement, or use a fixed delay time
S	S Electronics			
		Electr.Temp.A Out of Spec	Temperature of the signal converter electronics is out of range	Protect signal converter from process effects and sunlight
		Electr.Temp.C Out of Spec		
		Converter zero too large	Converter zero too large	Recalibrate the converter or contact manufacturer

S	S Configuration			
		PROFIBUS Uncertain	The output value is limited by a filter	Check the range setting of the output
		IO A Overage		
		IO B Overage		
		IO C Overage		
		IO D Overage		
S	S Process			
		Mass Flow Out of Range	The flow is out of range. The actual flow is higher than the displayed value.	Check process conditions
		Vol. Flow Out of Range		
		Velocity Out of Range ①		
M	M Installation required	Installation is needed	Use installation menu to install the converter and "end installation" with "yes"	
M	M Sensor			
		Crossed cabling	The measuring sensor signals are out of range. Flow measurements are not possible.	Check connection between measuring sensor and signal converter (remote version)
M	M Electronics			
		Backplane Data Faulty	The backplane data record is faulty	Check the correct installation of the signal converter electronics. After changing one parameter, the message should disappear within one minute. If not, contact the manufacturer.
		Factory Data Faulty	Factory settings are invalid	Contact manufacturer
		Backplane Difference	The data on the backplane differ from the data in the device	After changing one parameter, the message should disappear within one minute. If not, contact the manufacturer.
		PROFIBUS Baudrate	The PROFIBUS searches for the current Baudrate.	
M	M Configuration			
		Backup 1 Data Faulty	Error when checking the data record for Backup 1	Use C7.6.2 "Setup > Device > Special Functions > Save Settings" to save the data record. If the message continues to appear, contact the manufacturer.
		Backup 2 Data Faulty	Error when checking the data record for Backup 2	
M	M Process			
F	F Proc: Current Input			
S	S Electr: IO Connection			

S	S Electr: IO Connection			
		IO A Connection	Current output A cannot provide the necessary current. The current provided is too low. The current at Input A is below 0.5 mA or above 23 mA.	Check connection at A. Measure resistance of current loop at A. Check current at A.
		IO A Connection	Open circuit or short circuit at IO A	
		IO B Connection	Current output B cannot provide the necessary current. The current provided is too low. The current at Input B is below 0.5 mA or above 23 mA.	Check connection at B. Measure resistance of current loop at B. Check current at B.
		IO B Connection	Open circuit or short circuit at IO B	
		IO C Connection	Current output C cannot provide the necessary current. The current provided is too low.	Check connection at C. Measure resistance of current loop at C.
S	S Proc: Empty pipe			
		Empty pipe ①	All relevant paths have lost their signal. The most obvious reason is the absence of liquid in the sensor.	Fill the sensor with liquid to return to normal operation.
S	S Proc: Signal lost			
		Signal lost path 1 ①	No signal present in path 1 of the sensor	Remove the dampening or blockage in path 1 in the sensor
		Signal lost path 2 ①		
S	S Proc: Signal unreliable			
		Path 1 unreliable ①	The sensor signals do not reach the expected amplitude. This can influence the measuring accuracy.	Check the acoustic properties of the medium. Particles, air bubbles or inhomogeneity, may cause an instable signal. Check gain and SNR in this path.
		Path 2 unreliable ①		
		Time of flight unreliable		
S	S Config: Totaliser			
		Tot 1 FB2 Overflow	Totaliser has overflowed and started again at zero	Check totaliser format
		Tot 2 FB3 Overflow		
		Tot 3 FB4 Overflow		
		Tot 1 Overflow		
		Tot 2 Overflow		
		Tot 3 Overflow		
I	S Proc: System Control			

I	S Electr: Power Failure			
		Tot 1 Power Failure	Power failure has occurred. The totaliser state may be invalid.	Check the value of the totaliser.
		Tot 2 Power Failure		
		Tot 3 Power Failure		
		Power Failure Detected		
I	I Electr. Operation Info			
		Zero Calibr. Running ①	A zero calibration in progress	Wait until finished
		Sensor Starting up	Sensor starts up. This is normal operation at the beginning of measuring mode. Other error messages are suppressed.	After some moments, the converter will act and respond with the converter status.
		PROFIBUS: no data	No data exchange via PROFIBUS	
		Tot 1 Stopped	Totaliser 1 was stopped.	If totaliser is to continue counting, select "Yes" in Fct. C5.y.9 (Start Totaliser). for y = 1; 2; 3: 1 = totaliser 1; 2 = totaliser 2; 3 = totaliser 3
		Tot 2 Stopped	Totaliser 2 was stopped	
		Tot 3 Stopped	Totaliser 3 was stopped	
		Control In A Active		
		Control In B Active		
		Status Out A Active		
		Status Out B Active		
		Status Out C Active		
		Status Out D Active		
		Disp. 1 Overrange	The value in the 1st measurement line of the display page is limited	Check setting for 1st measurement line
		Disp. 2 Overrange	The value in the 2nd measurement line of the display page is limited	Check setting for 2nd measurement line
		Optical Interf. Active	The optical interface is being used. The optical keys are deactivated.	The keys are ready for operation again approximately 60 seconds after the end of the data transfer/removal of the optical interface

7.1 Spare parts availability

The manufacturer adheres to the basic principle that functionally adequate spare parts for each device or each important accessory part will be kept available for a period of 3 years after delivery of the last production run for the device.

This regulation only applies to spare parts which are subject to wear and tear under normal operating conditions.

7.2 Availability of services

The manufacturer offers a range of services to support the customer after expiration of the warranty. These include repair, maintenance, technical support and training.



INFORMATION!

For more precise information, please contact your local sales office.

7.3 Returning the device to the manufacturer

7.3.1 General information

This device has been carefully manufactured and tested. If installed and operated in accordance with these operating instructions, it will rarely present any problems.



WARNING!

Should you nevertheless need to return a device for inspection or repair, please pay strict attention to the following points:

- *Due to statutory regulations on environmental protection and safeguarding the health and safety of the personnel, the manufacturer may only handle, test and repair returned devices that have been in contact with products without risk to personnel and environment.*
- *This means that the manufacturer can only service this device if it is accompanied by the following certificate (see next section) confirming that the device is safe to handle.*



WARNING!

If the device has been operated with toxic, caustic, radioactive, flammable or water-endangering products, you are kindly requested:

- *to check and ensure, if necessary by rinsing or neutralising, that all cavities are free from such dangerous substances,*
- *to enclose a certificate with the device confirming that it is safe to handle and stating the product used.*

7.3.2 Form (for copying) to accompany a returned device



CAUTION!

To avoid any risk for our service personnel, this form has to be accessible from outside of the packaging with the returned device.

Company:		Address:	
Department:		Name:	
Telephone number:		Email address:	
Fax number:			
Manufacturer order number or serial number:			
The device has been operated with the following medium:			
This medium is:		radioactive	
		water-hazardous	
		toxic	
		caustic	
		flammable	
		We checked that all cavities in the device are free from such substances.	
		We have flushed out and neutralized all cavities in the device.	
We hereby confirm that there is no risk to persons or the environment caused by any residual media contained in this device when it is returned.			
Date:		Signature:	
Stamp:			

7.4 Disposal



LEGAL NOTICE!

Disposal must be carried out in accordance with legislation applicable in your country.

Separate collection of WEEE (Waste Electrical and Electronic Equipment):



According to the directive 2012/19/EU or UK Regulation 2013 No. 3113, the monitoring and control instruments marked with the WEEE symbol and reaching their end-of-life **must not be disposed of with other waste.**

The user must dispose of the WEEE to a designated collection point for the recycling of WEEE or send them back to our local organisation or authorised representative.

8.1 Measuring principle

- Like canoes crossing a river, acoustic signals are transmitted and received along a diagonal measuring path.
- A sound wave going downstream with the flow travels faster than a sound wave going upstream against the flow.
- The difference in transit time is directly proportional to the average flow velocity of the medium.

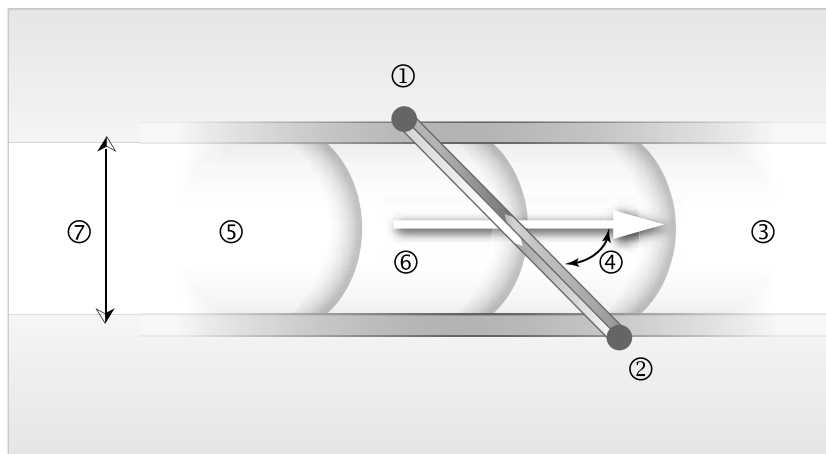


Figure 8-1: Measuring principle

- ① Transducer A
- ② Transducer B
- ③ Flow velocity
- ④ Angle of incidence
- ⑤ Velocity of sound of liquid
- ⑥ Path length
- ⑦ Inner diameter

8.2 Technical data



INFORMATION!

- The following data is provided for general applications. If you require data that is more relevant to your specific application, please contact us or your local sales office.
- Additional information (certificates, special tools, software,...) and complete product documentation can be downloaded free of charge from the website (Download Center).

Measuring system

Measuring principle	Ultrasonic transit time
Application range	Flow measurement of heated water
Measured value	
Primary measured value	Transit time
Secondary measured values	Volume flow, mass flow, flow speed, flow direction, velocity of sound, gain, signal to noise ratio, reliability of flow measurement, totalised volume or mass

Design

Features	3 parallel acoustic paths fully welded.
Modular construction	The measurement system consists of a measuring sensor and a signal converter.
Compact version	OPTISONIC 3400
Remote version	OPTISONIC 3000 F with UFC 400 signal converter
Nominal diameter	DN25...2000 / 1...80"
Measurement range	0.1...10 m/s / 0.33...33 fts For more details refer to <i>MID Annex MI-004</i> on page 104
Signal converter	
Inputs / outputs	Current (incl. HART®), pulse, frequency and/or status output, limit switch and/or control input (depending on the I/O version)
Totaliser	Optional 2 internal totalisers with a max. of 8 digits (e.g. for totalising volume and/or mass units)
Verification and self-diagnostics	Integrated verification, diagnostic functions: measuring device, process, measured values, device configuration, etc.
Display and user interface	
Graphic display	LC display, backlit white
	Size: 128 x 64 pixels Corresponds to 59 x 31 mm = 2.32" x 1.22"
	Display turnable in 90° steps.
Operating elements	4 push buttons for operator control of the signal converter without opening the housing.
Remote operation	PACTware™, including Device Type Manager (DTM)
	HART® handheld communicator (Emerson), AMS (Emerson), PDM (Siemens)

Display functions	
Operating menu	Programming of parameters at 2 measured value pages, 1 status page, 1 graphic page (measured values and descriptions adjustable as required)
Language of display texts (as language package)	Standard: English, French, German, Dutch
	Russia: English, German, Russian
Measurement functions	Units: Metric, British and US units selectable as desired from lists for volume/mass flow and counting, velocity, temperature
	Measured values: volume flow, mass flow, flow speed, velocity of sound, gain, signal to noise ratio, flow direction, diagnostics
Diagnostic functions	Standards: VDI/NAMUR NE 107
	Status messages: output of status messages via display, current and/or status output
	Sensor diagnostics: per acoustic path velocity of sound, flow speed, gain, signal to noise ratio
	Process diagnostics: empty pipe, signal integrity, cabling, flow conditions
	Signal converter diagnostics: data bus monitoring, I/O connections, electronics temperature, parameter and data integrity

Measuring accuracy

Reference conditions	
Medium	Water
Temperature	+20°C / +68°F
Pressure	1 bar / 14.5 psi
Inlet section	Minimal 10 DN with a minimum of 1 meter/ 3.3 ft (straight inlet)
Maximum measuring error	
Class 1	Temporarily not available
Class 2	$\pm 2\% (2 + 0.02 q_p / q) =$ with limit of 5%
Class 3	$\pm 3\% (3 + 0.03 q_p / q) =$ with limit of 5%
Calibration / Verification	Standard
	3 Point calibration by a direct volume comparison
	Optional
MID MI-004 (Directive 2014/32/EU)	Verification to Measurement Instrument Directive (MID), Annex VI (MI-004)
	EC-Type examination certificate to MID Annex VI (MI-004)
	Diameter: DN25....2000
	Minimal straight inlet flow: 10 DN with a minimum of 1 m/ 3.3 ft
	Minimal straight outlet flow: 3 DN
	Forward and reverse (bi-directional) flow
	Orientation: horizontal, vertical
	Ratio: up to 100
	Maximum operating pressure: 40 bar- 580 psi at 20°C - 68°F / 32 bar - 460psi at 180°C - 356°F
	For more details refer to <i>MID Annex MI-004</i> on page 104
Environmental class	Electromagnetic: E2
	Mechanical: M1

Operating conditions

Temperature	
Process temperature	Compact version: -0...+90°C / 32...+194°F
	Remote version: 0...+180°C / +32...+356°F
	Carbon steel flanges; minimal process temperatures acc. to EN1092: -10°C / +14°F; ASME: -29°C / -20°F
Ambient temperature	-25...+55°C / -13...+131°F
	Ambient temperatures below -25°C / -13°F may affect the readability of the display.
Protect inside electronics against self-heating. Protect the signal converter from external heat sources such as direct sunlight, as higher temperatures reduce the life cycle of all electronic components.	
Storage temperature	-50...+70°C / -58...+158°F
Pressure	
Atmospheric	
EN 1092-1	DN25...80: PN 40
	DN100...150: PN 16, PN 25, PN 40
	DN200...2000: PN 10, PN 16, PN 25, PN 40
ASME B16.5	1...80": 150 lb RF
	1...80": 300 lb RF
Properties of medium	
Physical condition	Liquid, single phase, water (clean), heated or chilled

Installation conditions

Installation	For detailed information refer to <i>Installation</i> on page 18.
Inlet run	Minimal 10 DN (straight inlet with a minimum of 1 m/ 3.3 ft)
Outlet run	Minimal 3 DN (straight outlet)
Dimensions and weights	For detailed information refer to <i>Dimensions and weights</i> on page 106.

Materials

Measuring sensor	
Flanges (wetted)	DN25...65 / 1...2½": stainless steel 1.4401 / 1.4404 - AISI 316/316L
	DN80...2000 / 3...80": carbon steel A105N
	Option: stainless steel 1.4401 / 1.4404 - AISI 316/316L
	Other materials on request.
Measuring tube (wetted)	DN25...65 / 1...2½": stainless steel 1.4401 / 1.4404 - AISI 316/316L
	DN80...2000 / 3...80": carbon steel A106 gr B or equivalent
	Option: stainless steel 1.4404 / AISI 316L
Measuring sensor housing	DN25...300 / 1"...12": carbon steel
	Option: stainless steel 1.4404 / AISI 316L
Transducer	
Transducers (wetted)	Stainless steel 1.4404 / AISI 316L
Transducer holders incl. caps	DN350...2000 / 14"...80"; stainless steel 1.4404 / AISI 316L
Tube transducer cabling	Stainless steel 1.4404 / AISI 316L
Connection box and connection box support (remote version only)	Standard: die-cast aluminium; standard coated
	Option: stainless steel 316 / 1.4408
Coating (flow sensor)	Standard coating
Signal converter	
Housing	Versions C and F: die-cast aluminium
	Option: stainless steel 316 / 1.4408
Coating	Standard coating

Electrical connections

Description of used abbreviations; Q = xxx; $I_{\max}$ = maximum current; V_{in} = xxx; V_{int} = internal voltage; V_{ext} = external voltage; $V_{\text{int, max}}$ = maximal internal voltage	
General	Electrical connection is carried out in conformity with the VDE 0100 directive "Regulations for electrical power installations with line voltages up to 1000 V" or equivalent national specifications.
Power supply	Standard: 100...230 VAC (-15% / +10%), 50/60 Hz
Power consumption	AC: 22 VA
Signal cable (remote version only)	MR06 (shielded cable with 6 coax cores): Ø 10.6 mm / 0.4"
	5 m / 16 ft
	Option: 10...30 m / 33...98 ft
Cable entries	Standard: M20 x 1.5 (8...12 mm)
	Option: ½" NPT, PF ½

Inputs and outputs

General	All outputs are electrically isolated from each other and from all other circuits.		
	All operating data and output values can be adjusted.		
Description of used abbreviations	V _{ext} = external voltage; R _L = load + resistance; V ₀ = terminal voltage; I _{nom} = nominal current Safety limit values (Ex i): V _i = max. input voltage; I _i = max. input current; P _i = max. input power rating; C _i = max. input capacity; L _i = max. input inductivity		
Current output			
Output data	Measurement of volume flow, mass flow, flow speed, velocity of sound, gain, SNR, diagnostics (flow speed, VoS, SNR, gain), NAMUR NE107, HART® communication.		
Temperature coefficient	Typically ± 30 ppm/K		
Settings	Without HART®		
	Q = 0%: 0...20 mA; Q = 100%: 10...20 mA		
	Error identification: 3...22 mA		
	With HART®		
	Q = 0%: 4...20 mA; Q = 100%: 10...20 mA		
	Error identification: 3...22 mA		
	Q = 100%: 10...20 mA		
	Error identification: 3...22 mA		
Operating data	Basic I/Os	Modular I/Os	
Active	V _{int, nom} = 24 VDC I ≤ 22 mA R _L ≤ 1 kΩ		
Passive	V _{ext} ≤ 32 VDC I ≤ 22 mA V ₀ ≥ 1.8 V R _{L, max} = (V _{ext} - V ₀ / I _{max}		

HART®			
Description	HART® protocol via active and passive current output		
	HART® version: V7		
	Universal HART® parameter: completely integrated		
Load	≥ 250 Ω at HART® test point: Note maximum load for current output!		
Multidrop	Yes, current output = 10% e.g. 4 mA		
	Multidrop addresses adjustable in operation menu 0...63		
Device drivers	DD for FC 375/475, AMS, PDM, DTM for FDT		
Pulse or frequency output			
Output data	Volume flow, mass flow		
Function	Pulse / frequency output is fixed and set in factory according order.		
Pulse rate/frequency	0.01...10000 pulses/s or Hz		
Settings	For Q = 100%: 0.01...10000 pulses per second or pulses per unit volume		
	Pulse width: adjustable as automatic, symmetric or fixed (0.05...2000 ms)		
Operating data	Basic I/Os	Modular I/Os	
Active	-	V _{nom} = 24 VDC	
		f _{max} in operating menu set to: f _{max} ≤ 100 Hz: I ≤ 20 mA R _{L, max} = 47 kΩ open: I ≤ 0.05 mA closed: V _{0, nom} = 24 V at I = 20 mA	
		f _{max} in operating menu set to: 100 Hz < f _{max} ≤ 10 kHz: I ≤ 20 mA R _L ≤ 10 kΩ for f ≤ 1 kHz R _L ≤ 1 kΩ for f ≤ 10 kHz open: I ≤ 0.05 mA closed: V _{0, nom} = 22.5 V at I = 1 mA V _{0, nom} = 21.5 V at I = 10 mA V _{0, nom} = 19 V at I = 20 mA	

Passive	$V_{\text{ext}} \leq 32 \text{ VDC}$		-
	f_{max} in operating menu set to: $f_{\text{max}} \leq 100 \text{ Hz}$: $I \leq 100 \text{ mA}$ $R_{L, \text{max}} = 47 \text{ k}\Omega$ $R_{L, \text{max}} = (V_{\text{ext}} - V_0) / I_{\text{max}}$ open: $I \leq 0.05 \text{ mA}$ at $V_{\text{ext}} = 32 \text{ VDC}$ closed: $V_{0, \text{max}} = 0.2 \text{ V}$ at $I \leq 10 \text{ mA}$ $V_{0, \text{max}} = 2 \text{ V}$ at $I \leq 100 \text{ mA}$		
	f_{max} in operating menu set to: $100 \text{ Hz} < f_{\text{max}} \leq 10 \text{ kHz}$: $I \leq 20 \text{ mA}$ $R_L \leq 10 \text{ k}\Omega$ for $f \leq 1 \text{ kHz}$ $R_L \leq 1 \text{ k}\Omega$ for $f \leq 10 \text{ kHz}$ $R_{L, \text{max}} = (V_{\text{ext}} - V_0) / I_{\text{max}}$ open: $I \leq 0.05 \text{ mA}$ at $V_{\text{ext}} = 32 \text{ VDC}$ closed: $V_{0, \text{max}} = 1.5 \text{ V}$ at $I \leq 1 \text{ mA}$ $V_{0, \text{max}} = 2.5 \text{ V}$ at $I \leq 10 \text{ mA}$ $V_{0, \text{max}} = 5.0 \text{ V}$ at $I \leq 20 \text{ mA}$		
	NAMUR	-	

Status output / limit switch			
Function and settings	Adjustable as automatic measuring range conversion, display of flow direction, overflow, error, switching point		
	Valve control with activated dosing function		
Operating data	Basic I/Os	Modular I/Os	
Active	-	$V_{\text{int}} = 24 \text{ VDC}$ $I \leq 20 \text{ mA}$ $R_{\text{L, max}} = 47 \text{ k}\Omega$ open: $I \leq 0.05 \text{ mA}$ closed: $V_{0, \text{nom}} = 24 \text{ V at } I = 20 \text{ mA}$	
Passive	$V_{\text{ext}} \leq 32 \text{ VDC}$ $I \leq 100 \text{ mA}$ $R_{\text{L, max}} = 47 \text{ k}\Omega$ $R_{\text{L, max}} = (V_{\text{ext}} - V_0) / I_{\text{max}}$ open: $I \leq 0.05 \text{ mA at } V_{\text{ext}} = 32 \text{ VDC}$ closed: $V_{0, \text{max}} = 0.2 \text{ V at } I \leq 10 \text{ mA}$ $V_{0, \text{max}} = 2 \text{ V at } I \leq 100 \text{ mA}$	$V_{\text{ext}} = 32 \text{ VDC}$ $I \leq 100 \text{ mA}$ $R_{\text{L, max}} = 47 \text{ k}\Omega$ $R_{\text{L, max}} = (V_{\text{ext}} - V_0) / I_{\text{max}}$ open: $I \leq 0.05 \text{ mA at } V_{\text{ext}} = 32 \text{ VDC}$ closed: $V_{0, \text{max}} = 0.2 \text{ V at } I \leq 10 \text{ mA}$ $V_{0, \text{max}} = 2 \text{ V at } I \leq 100 \text{ mA}$	
NAMUR	-	Passive to EN 60947-5-6 open: $I_{\text{nom}} = 0.6 \text{ mA}$ closed: $I_{\text{nom}} = 3.8 \text{ mA}$	

Control input			
Function	Hold value of the outputs (e.g. for cleaning work), set value of the outputs to "zero", counter and error reset, stop counter, range conversion, zero calibration		
	Start of dosing when dosing function is activated.		
Operating data	Basic I/Os	Modular I/Os	
Active	-	$V_{int} = 24 \text{ VDC}$ Terminals open: $V_{0, nom} = 22 \text{ V}$ Terminals bridged: $I_{nom} = 4 \text{ mA}$ On: $V_0 \geq 12 \text{ V}$ with $I_{nom} = 1.9 \text{ mA}$ Off: $V_0 \leq 10 \text{ V}$ with $I_{nom} = 1.9 \text{ mA}$	
Passive	$V_{ext} \leq 32 \text{ VDC}$ $I_{max} = 6.5 \text{ mA}$ at $V_{ext} \leq 24 \text{ VDC}$ $I_{max} = 8.2 \text{ mA}$ at $V_{ext} \leq 32 \text{ VDC}$ Contact closed (On): $V_0 \geq 8 \text{ V}$ with $I_{nom} = 2.8 \text{ mA}$ Contact open (Off): $V_0 \leq 2.5 \text{ V}$ with $I_{nom} = 0.4 \text{ mA}$	$V_{ext} \leq 32 \text{ VDC}$ $I_{max} = 9.5 \text{ mA}$ at $V_{ext} \leq 24 \text{ V}$ $I_{max} = 9.5 \text{ mA}$ at $V_{ext} \leq 32 \text{ V}$ Contact closed (On): $V_0 \geq 3 \text{ V}$ with $I_{nom} = 1.9 \text{ mA}$ Contact open (Off): $V_0 \leq 2.5 \text{ V}$ with $I_{nom} = 1.9 \text{ mA}$	
NAMUR	-	Active to EN 60947-5-6 Contact open: $V_{0, nom} = 8.7 \text{ V}$ Contact closed (On): $I_{nom} = 7.8 \text{ mA}$ Contact open (off): $V_{0, nom} = 6.3 \text{ V}$ with $I_{nom} = 1.9 \text{ mA}$ Identification for open terminals: $V_0 \geq 8.1 \text{ V}$ with $I \leq 0.1 \text{ mA}$ Identification for short circuited terminals: $V_0 \leq 1.2 \text{ V}$ with $I \geq 6.7 \text{ mA}$	

Approvals and certificates

CE	
This device fulfils the statutory requirements of the relevant directives. The manufacturer certifies successful testing of the product by applying the conformity mark on the device.	
	For more information on the directives, standards and the approved certifications, please refer to the declaration of conformity supplied with the device or downloadable from the manufacturer's website.
NAMUR	NE 21, 43, 53, 80, 107
MID directive	Directive 2014/32/EU, Annex VI (MI-004) For more information, please refer to the dedicated documentation.
Other approvals and standards	
Non-Ex	Standard
Hazardous areas	
Ex zone 1 - 2	For detailed information, please refer to the relevant Ex documentation.
	According to European directive 2014/34/EU (ATEX 114)
IECEx	Approval number: IECEx KIWA15.0033 X
ATEX	Approval number: KIWA 15ATEX0007 X
Protection category acc. to IEC 60529	Signal converter
	Compact (C): IP66/67, NEMA 4X/6
	Field (F): IP66/67, NEMA 4X/6
	Flow sensors
	IP66/67, NEMA 4X/6
Shock resistance	IEC 60068-2-27
	30 g for 18 ms
Vibration resistance	IEC 60068-2-6; 1 g up to 2000 Hz
	IEC 60721; 10 g

8.3 MID Annex MI-004

All liquid flow meters for heated water e.g. thermal energy measurement, that are to be used for legal purposes in Europe, require certification under the Measurement Instrument Directive (MID) 2014/32/EU.

Annex VI (MI-004) of the MID applies to these liquid flow meters intended for the measurement of volume of heated water in residential, commercial, and industrial use. An EC-type examination certificate is valid in all countries of the European Union.

The OPTISONIC 3400 has an EC type examination certificate and can be verified to the MID Annex VI (MI-004) for liquid flow meters for class 2 and 3 with diameter DN25...DN2000 / 1" ...80". The conformity assessment procedure followed for OPTISONIC 3400 is Module B (Type Examination) and Module D (Quality Assurance of the Production Process).

In general for accuracy class 1, 2 and 3:

The flow range, Q_p and Q_i must be defined as follows;

Ratio of $Q_p / Q_i \geq 10$

Minimum flow rate: $Q_p \geq 0.1 \times Q_p (\text{max})$

Q_s = flow range

Q_p = maximum flow

Q_i = minimum flow

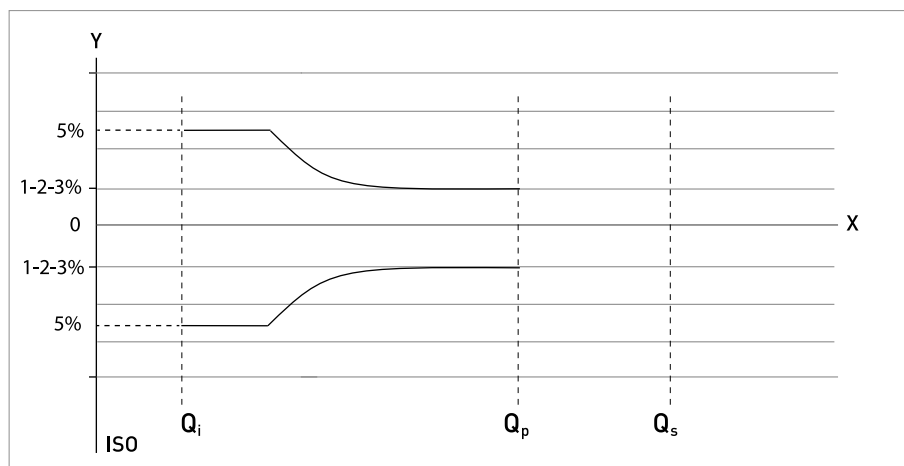


Figure 8-2: ISO flow rates added to figure as comparison towards MID

X: Flow rate

Y [%]: Maximum measuring error

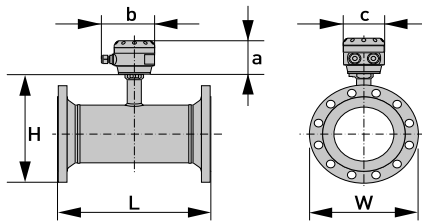
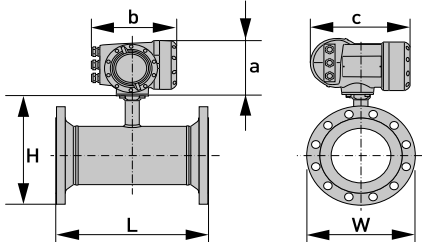
MI-004 certified flow characteristics; valid for accuracy classes 2 and 3

DN Size	Maximum pressure rating	Overall length [mm]		Flow rate [m ³ /h]		
		Min.	Max.	Q _s	Q _p	Q _i
25	PN 40	250	400	18 [27]	18	0.18
32	PN 40	260	400	29 [44]	29	0.29
40	PN 40	270	400	45 [68]	45	0.45
50	PN 40	300	475	71 [106]	71	0.71
65	PN 40	300	475	180	120	1.2
80	PN 40	300	400	180 [270]	180	1.8
100	PN 40 *	350	400	280 [430]	280	2.8
125	PN 40 *	350	400	500	440	4.4
150	PN 40 *	350	400	630	630	6.3
200	PN 40 *	400	500	1130	1130	11.3
250	PN 40 *	400	600	1750	1750	17.5
300	PN 40 *	500	600	2500	2500	25.0
350	PN 40 *	500	880	3400	3400	34.0
400	PN 40 *	600	975	4500	4500	45.0
450	PN 40 *	600	1000	5750	5750	57.5
500	PN 40 *	600	1080	7000	7000	70.0
600	PN 40 *	600	1165	10000	10000	100
700	PN 40 *	800	1240	14000	14000	140
800	PN 40 *	800	1240	18000	18000	180
900	PN 40 *	900	1370	23000	23000	230
1000	PN 40 *	1000	1370	28000	28000	280
1200	PN 40 *	1200	1600	40000	40000	400
1400	PN 40 *	1400	1800	55000	55000	550
1600	PN 40 *	1600	2000	70000	70000	700
1800	PN 40 *	1600	2100	90000	90000	900
2000	PN 40 *	1800	2100	113000	113000	1130

* maximum pressure 40 bar- 580 psi at 20°C - 68°F / 32 bar - 460 psi at 180°C - 356°F

Between brackets () ; Q_s value only valid for accuracy classes 2 & 3 (class 1 is not available).

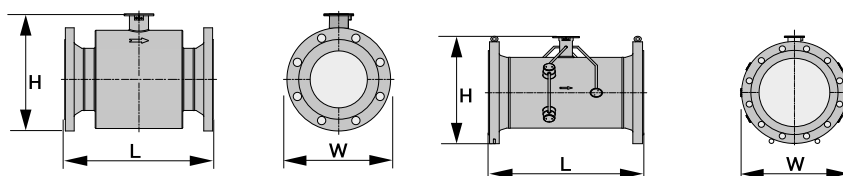
8.4 Dimensions and weights

Remote version		$a = 88 \text{ mm} / 3.5''$ $b = 139 \text{ mm} / 5.5''$ ① $c = 106 \text{ mm} / 4.2''$ Total height = $H + a$ ②
Compact version		$a = 155 \text{ mm} / 6.1''$ $b = 230 \text{ mm} / 9.1''$ ① $c = 260 \text{ mm} / 10.2''$ Total height = $H + a$ ②

① The value may vary depending on the used cable glands.

② The value depends on version

8.4.1 Standard flow sensor



The following dimensions are applicable for the OPTISONIC 3400 in compact and remote versions.

EN1092-1; Standard variant - PN 40

Nominal size	Dimensions [mm], CS = carbon steel / SS = stainless steel / Di = inner diameter					Approx. weight [kg]	
DN	L	H	W	Di CS	Di SS	CS	SS
25	250	155	115	27	27	8	8
32	260	156	140	35	35	9	10
40	270	173	150	39	41	11	14
50	300	193	165	53	53	14	17
65	300	203	185	63	63	18	19
80	300	238	200	78	81	17	18
100	350	268	235	102	104	24	24
125	350	297	270	127	130	30	29
150	400	326	300	154	158	37	37
200	400	427	375	207	207	63	63
250	500	492	450	260	260	100	100
300	500	547	515	308	308	140	140



INFORMATION!

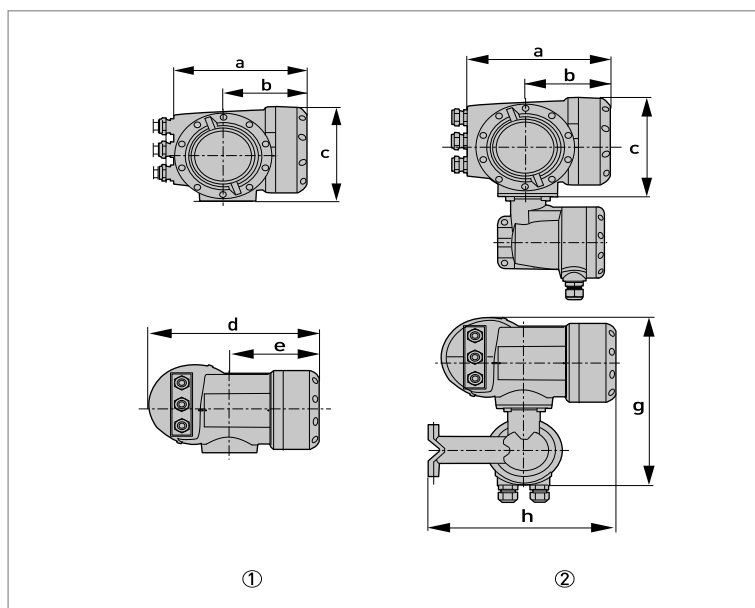
Other pressure classes like PN 25, PN 16, PN 10 or ASME 150, 300 lb are also MI-004 certified. Dimensions and weights are available on request.



INFORMATION!

Mounting length of larger diameters; on request.

8.4.2 Signal converter housing



- ① Compact housing (C)
 ② Field housing (F)

Dimensions and weights in mm and kg

Version	Dimensions [mm]							Weight [kg]
	a	b	c	d	e	g	h	
C	202	120	155	260	137	-	-	4.2
F	202	120	155	-	-	295.8	277	5.7

Dimensions and weights in inch and lb

Version	Dimensions [inch]							Weight [lb]
	a	b	c	d	e	g	h	
C	7.75	4.75	6.10	10.20	5.40	-	-	9.30
F	7.75	4.75	6.10	-	-	11.60	10.90	12.60

8.5 Pressure derating

EN 1092-1

A = Carbon steel C22.8 / B = Stainless steel 1.4404

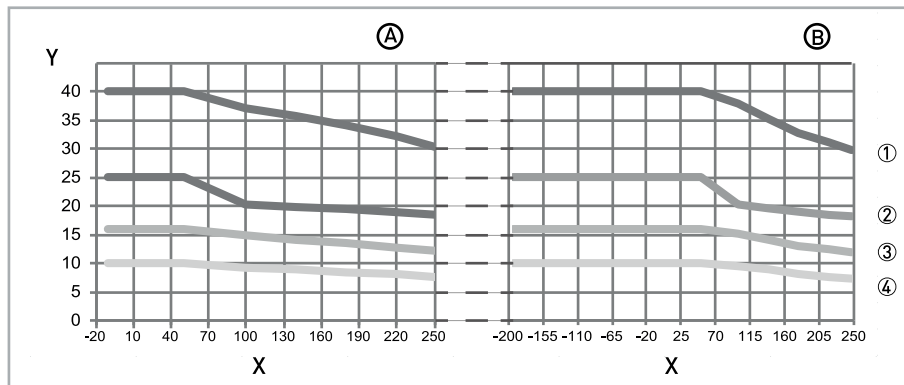


Figure 8-3: X = Temperature [°C] / Y = Pressure [bar]

- ① PN 40
- ② PN 25
- ③ PN 16
- ④ PN 10

For temperatures down to -25°C, other materials are available on request.

9.1 General description

The open HART® protocol, which can be used freely, is integrated into the signal converter for communication.

Devices which support the HART® protocol are classified as either operating devices or field devices. When it comes to operating devices (Master), both manual control units (Secondary Master) and PC-supported workstations (Primary Master) are used in, for example, a control centre.

HART® field devices include flow sensors, signal converters and actuators. The field devices range from 2-wire to 4-wire to intrinsically safe versions for use in hazardous areas.

The HART® data are superimposed over the analogue 4...20 mA signal via FSK modem. This way, all of the connected devices can communicate digitally with one another via the HART® protocol while simultaneously transmitting the analogue signals.

When it comes to the field devices and secondary masters, the FSK or HART® modem is integrated, whereas with a PC communication takes place via an external modem which must be connected to the serial interface. There are, however, other connection variants which can be seen in the following connection diagrams.

9.2 Software history



INFORMATION!

In the table below, "x" is a placeholder for possible multi-digit alphanumeric combinations, depending on the available version.

Release date	Electronic Revision	HART®	
		Device Revision	DD Revision
2013-04-29	2.2.0	1	1

HART® identification codes and revision numbers

Manufacturer ID:	69 [0x45]
Expanded Device Type:	0x45d2
Device Revision:	1
DD Revision:	1
DD version NAMUR:	01.11
HART® Universal Revision:	7
FC 375/475 system SW.Rev.:	≥ 3.7
AMS version:	≥ 11.1
PDM version:	≥ 6.0
FDM version:	≥ 4.10

9.3 Connection variants

The signal converter is a 4-wire device which is available in a variant with 4...20 mA current output and HART® interface.

Depending on the version, the settings and the wiring, the current output can operate as passive or active output.

- **Multi-drop mode is supported**

In a multi-drop communication system, more than 2 devices are connected to a common transmission cable.

- **Burst mode is not supported**

In the Burst mode a slave device transfers cyclic pre-defined response telegrams, to get a higher rate of data transfer.



INFORMATION!

For detailed information about the electrical connection of the signal converter for HART®, refer to the section "Electrical connection".

There are two ways of using the HART® communication:

- as Point-to-Point connection and
- as multi-drop connection, with 2-wire connection or as multi-drop connection, with 3-wire connection.

9.3.1 Point-to-Point connection - analogue / digital mode

Point-to-Point connection between the signal converter and the HART® Master.

The current output of the device may be active or passive.

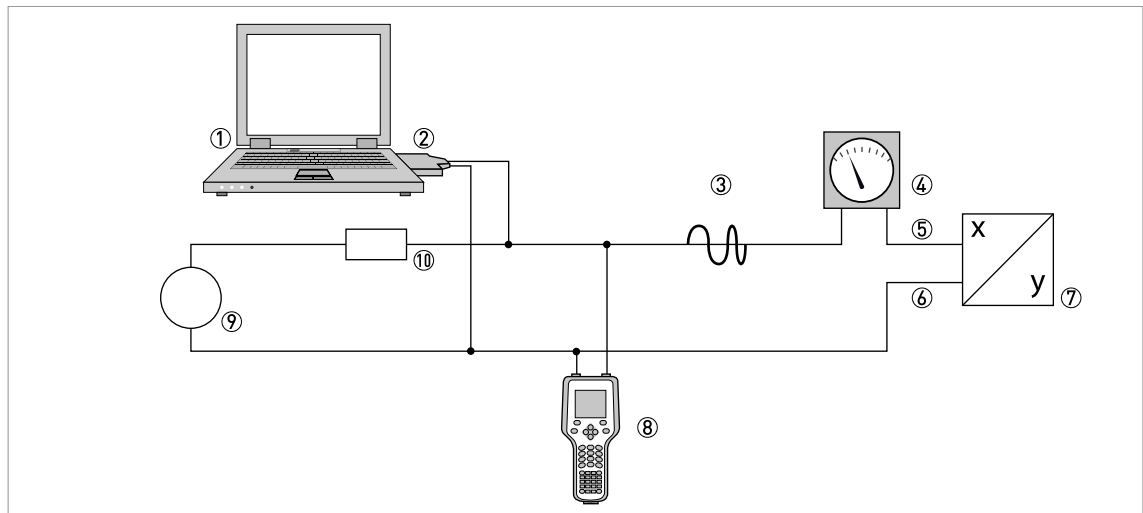


Figure 9-1: Point-to-Point connection

- ① Primary master
- ② FSK modem or HART® modem
- ③ HART® signal
- ④ Analog indication
- ⑤ Signal converter terminals A (C)
- ⑥ Signal converter terminals A- (C-)
- ⑦ Signal converter with address = 0 and passive or active current output
- ⑧ Secondary Master
- ⑨ Power supply for devices (slaves) with passive current output
- ⑩ Load $\geq 230 \Omega$

9.3.2 Multi-drop connection (2-wire connection)

In the case of a multi-drop connection, up to 15 devices may be installed in parallel (this signal converter and other HART® devices).

The current outputs of the devices must be passive!

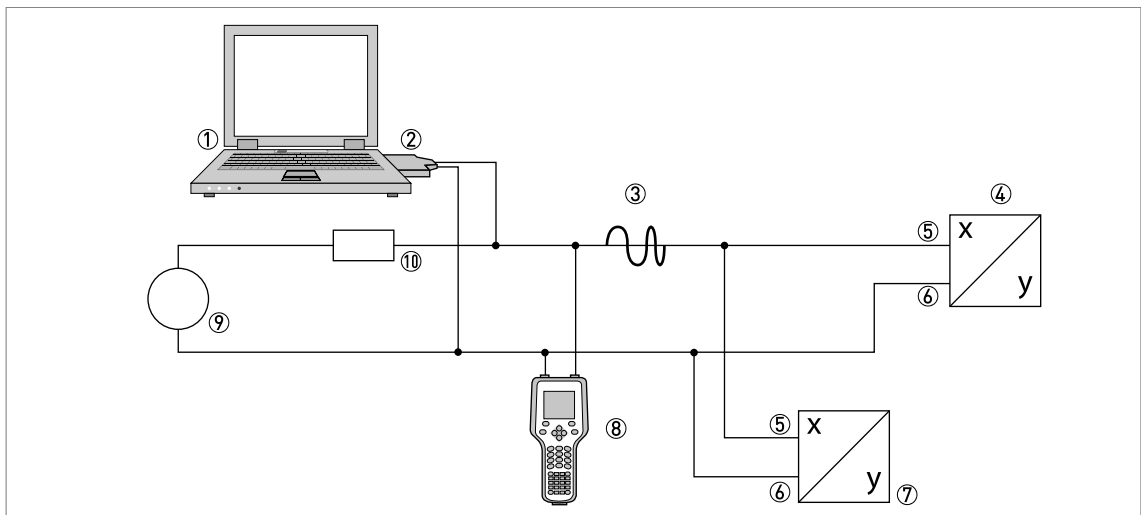


Figure 9-2: Multi-Drop connection (2-wire connection)

- ① Primary Master
- ② HART® modem
- ③ HART® signal
- ④ Other HART® devices or this signal converter (refer also to ⑦)
- ⑤ Signal converter terminals A (C)
- ⑥ Signal converter terminals A- (C-)
- ⑦ Signal converter with address ≥ 0 and passive current output, connection of max. 15 devices (slaves) with 4...20 mA
- ⑧ Secondary Master
- ⑨ Power supply
- ⑩ Load $\geq 230 \Omega$

9.3.3 Multi-drop connection (3-wire connection)

Connection of 2-wire and 4-wire devices in the same network. In order that the current output of the signal converter is working continuously active, an additional third wire must be connected to the devices in the same network. These devices must be powered via a 2-wire loop.

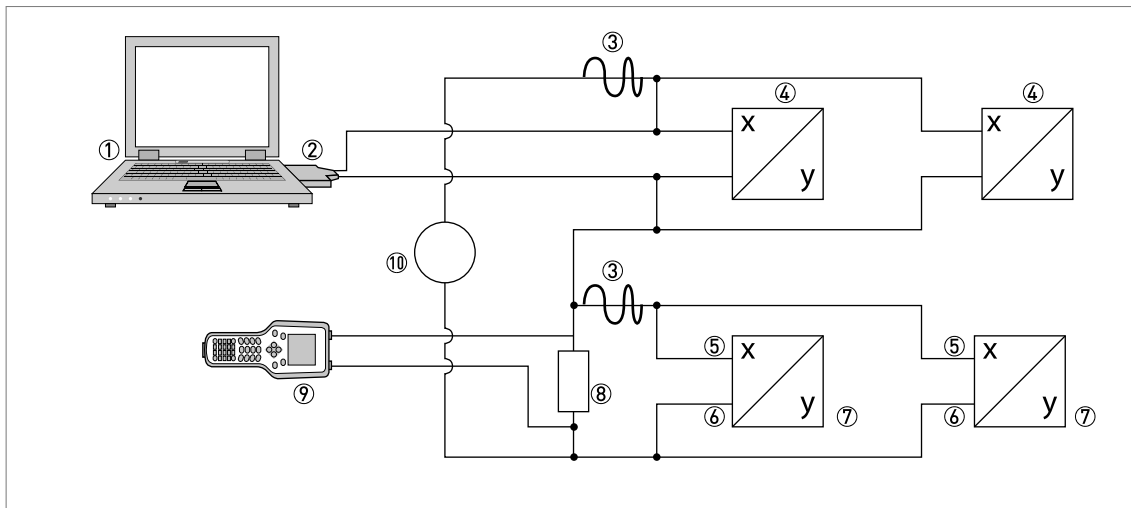


Figure 9-3: Multi-Drop connection (3-wire connection)

- ① Primary Master
- ② HART® modem
- ③ HART® signal
- ④ 2-wire external devices (slaves) with 4...20 mA, addresses > 0, powered by current loop
- ⑤ Signal converter terminals A (C)
- ⑥ Signal converter terminals A- (C-)
- ⑦ Connection of active or passive 4-wire devices (slaves) with 4...20 mA, addresses ≥ 0
- ⑧ Load ≥ 230 Ω
- ⑨ Secondary Master
- ⑩ Power supply

9.4 Inputs/outputs and HART[®] dynamic variables and device variables

The signal converter is available with various in-/output combinations.

The connection of the terminals A...D to the HART[®] dynamic variables PV, SV, TV and QV depends on the device version.

PV = Primary Variable; SV = Secondary Variable; TV = Third Variable; QV = Quarternary Variable

Signal converter version	HART [®] dynamic variable			
	PV	SV	TV	QV
Basic I/O, connection terminals	A	D	-	-
Modular I/O connection terminals	C	D	A	B

The signal converter can provide up to 14 measurement-related values. These values are accessible as so-called HART[®] device variables and can be connected to the HART[®] dynamic variables. The availability of these variables depends on the device versions and the settings. Code = device variable code

Device variables

HART [®] device variable	Code	Type	Explanations
volume flow	0	linear	
velocity of sound	1	linear	
mass flow	2	linear	
flow speed	3	linear	
signal gain	4	linear	
SNR	5	linear	
diagnostics velocity of sound	6	linear	*
diagnostics flow speed	7	linear	*
diagnostics gain	8	linear	*
diagnostics SNR	9	linear	*
operating hours	10	linear	
volume totaliser 1	11	linear	*
mass totaliser 1	12	linear	**
volume totaliser 2	13	linear	**
mass totaliser 2	14	linear	**
volume totaliser 3	15	linear	**
mass totaliser 3	16	linear	**

* Availability depends on diagnosis value setting.

** Availability depends on concentration measurement settings.

For the dynamic variables connected to the linear analogue outputs (for current and/or frequency) the device variables are assigned by selecting the measurement for the related outputs. Only linear device variables can be assigned in this case.

For dynamic variables not connected to linear analogue outputs both linear and totaliser device variables can be assigned.

9.5 Remote operation

In addition to the local user interface panel the device may be operated remotely via the communication interface. There are different operating tools including small handhelds and large integrated maintenance systems. For adaptation to different devices two main technologies are used: The Device Description (DD) and the Field Device Tool Device Type Manager (FDT DTM). Both a DD and a DTM contain the description of a device's user interface, parameter database and communication interface. After being installed in an operating tool they allow access to device specific data. In the DD environment an operating tool is usually referred to as "host"; in the FDT DTM environment it is called "frame application" or "FDT container".

A DD is sometimes also referred to as EDD for Enhanced Device Description. This emphasizes some enhancements in specification like e.g. GUI support but doesn't imply a new technology.

For improving interoperability between DD hosts standard menu entry points have been specified:

- Root Menu
Default top level menu for DD host applications with limited display space (e.g. handhelds).
- Process Variables Root Menu
Provides process measurements and set points. For GUI based DD host applications.
- Diagnostic Root Menu
Shows device state and diagnostic information. For GUI based DD host applications.
- Device Root Menu
Provides access to all field device capabilities. For GUI based DD host applications.
- Offline Root Menu
Provides access to all field device capabilities that can be manipulated while the host application is not connected to the field device.

For detailed information about the standard menus refer to *HART Menu Tree; UFC400* on page 122.

The support of the standard menu entry points by the different DD hosts is described next.

9.5.1 Online/offline operation

DD hosts have different characteristics and support different operating modes for configuring devices, online and offline mode.

In online mode the host application can currently communicate with the device. The device can immediately check and perform configuration changes and update dependent parameters in case.

In offline mode the host application works only with a copy of the device's configuration data set and the DD needs to imitate the device's checks and updates.

Unfortunately the DD isn't informed by the host whether it is running in online or offline mode. In order to avoid interference between update functionality of the DD and the device there is a local parameter "Online Mode?" in the "Detailed Setup / HART" menu which can be set accordingly by the user.

9.5.2 Parameters for the basic configuration

There are parameters, such as measurement of counters, selection of diagnosis values and setting of concentration function, which require a warm start of the device following data changes before other parameters may be written. Depending on the operating mode of the host system (online/offline mode) these parameters need to be treated differently.

In online mode the settings should be changed with the corresponding online methods only, in order to perform the warm start immediately and update dependent parameters automatically afterwards.

In the menu tree these methods are located below the related parameters (e.g. in a counter menu the method "Select Measurement" below the parameter "Measurement").

In offline mode the parameter "Online Mode?" in the "Detailed Setup / HART" menu should be set to "no" before the configuration settings are changed as desired. Before writing the entire offline configuration data set to the device the method "Prepare Parameter Download" in the "Detailed Setup / HART" menu should be executed. This method writes the parameters for basic configuration to the device and performs a warm start afterwards.



INFORMATION!

The Emerson Field Communicator and Simatic PDM execute this method automatically before sending a configuration or performing a "Download to Device" respectively.

9.5.3 Units

There are separate physical units settings for configuration parameters and HART[®] dynamic/device variables. The units settings for configuration parameters are the same as on the device's local display. They are available in the menu "Detailed Setup / Device / Units". For each HART[®] dynamic/device variable the physical unit can be set individually. They are available in the menu "Detailed Setup / Process Input / HART". The different units settings can be aligned with the method "Align HART Units" in the menu "Detailed Setup / Process Input / HART".

9.6 Field Communicator 375/475 (FC 375/475)

The Field Communicator is a hand terminal from Emerson Process Management that is designed to configure HART® and Foundation Fieldbus devices. Device Descriptions (DDs) are used to integrate different devices into the Field Communicator.

9.6.1 Installation

The HART® Device Description for the signal converter must be installed on the Field Communicator. Otherwise only the functions of a generic DD are available to the user and the entire device control is not possible. A "Field Communicator Easy Upgrade Programming Utility" is required to install the DDs on the Field Communicator.

The Field Communicator must be equipped with a system card with "Easy Upgrade Option". For details consult the Field Communicator User's Manual.

9.6.2 Operation

The Field Communicator supports the DD Root Menu for online access to the device. The Root Menu is implemented as a combination of the other standard menus Process Variables Root Menu, Diagnostic Root Menu and Device Root Menu.



INFORMATION!

For more detailed information see, HART Menu Tree Field Communicator HART Application on page; refer to Process Variables Root Menu on page 126

Operating the signal converter via the Field Communicator is very similar to manual device control using the keyboard. The help attribute of each parameter contains its function number as a reference to the local device display and the handbook.

Parameter protection for custody transfer is the same as on the device's local display. Other specific protective functions such as the passwords for the quick setup menu and the setup menu are not supported with HART®.

The Field Communicator always saves a complete configuration for the exchange with AMS. However, in the offline configuration and when sending to the device, the Field Communicator only takes into account a partial parameter set (like the standard configuration of the old HART® Communicator 275).

9.7 Asset Management Solutions (AMS®)

The Asset Management Solutions Device Manager (AMS®) is a PC program from Emerson Process Management which is designed to configure and manage HART®, PROFIBUS and Foundation Fieldbus devices. Device Descriptions (DDs) are used to integrate different devices into the AMS®.

9.7.1 Installation

If the signal converter Device Description has not yet been installed on the AMS® system, a so-called Installation Kit HART® AMS® is required. It is available for download from the website.

For installation with the Installation Kit refer to the "AMS Intelligent Device Manager Books Online" section "Basic Functionality / Device Information / Installing Device Types".



INFORMATION!

Please read the "readme.txt", which is also contained in the Installation Kit.

9.7.2 Operation

AMS supports the Process Variables Root Menu, Diagnostic Root Menu and Device Root Menu for online access to the device.



INFORMATION!

For more detailed information see, on page refer to HART Menu Tree AMS - Device's context menu on page 123.

Operating the signal converter via the AMS Device Manager is similar to manual device control using the keyboard. The help attribute of each parameter contains its function number as a reference to the local device display and the handbook.

Parameter protection for custody transfer and service is the same as on the device's local display. Other specific protective functions such as the passwords for the quick setup menu and the setup menu are not supported with HART®.

When copying configurations in AMS, unit parameters need to be transferred first. Otherwise related parameters may be not transferred correctly. When the compare view has been opened during a copy process, go at first to the units section of the device menu ("Detailed Setup / Device / Units") and transfer all unit parameters. Note that read-only parameters need to be transferred individually!

9.8 Process Device Manager (PDM)

The Process Device Manager (PDM) is a Siemens PC program designed to configure HART® devices. Device Descriptions (DDs) are used to integrate different devices into the PDM.

9.8.1 Installation

If the signal converter Device Description has not yet been installed on the PDM system, a so-called Device Install HART® PDM is required for the signal converter. This is available for download from the website.

For installation with the Device Install, see the PDM manual, Section 13 - Integrating devices.



INFORMATION!

Please read the "readme.txt", which is also contained in the Installation Kit.

9.8.2 Operation

PDM supports the Process Variables Root Menu, Diagnostic Root Menu and Device Root Menu for online access to the device and the Offline Root Menu for offline configuration.



INFORMATION!

For more detailed information see on page 124.

The classic approach for PDM is the offline operation with the PDM parameter table and the transfer of entire configuration data sets with the "Download to Device" and "Upload to PG/PC" functions. The parameter "Online Mode?" in the "Detailed Setup / HART" table section of the parameter table should be set to "no". However PDM also supports online operation from the "Device" and the "View" sections of the menu bar which is more similar to manual device control using the keyboard. Usually offline and online configuration data sets are separated in PDM. Still there is some interdependency e.g. regarding evaluation of parameter and menu conditionals: If e.g. the "Access Level" is changed in an online menu the offline configuration data set needs to be updated with "Upload to PG/PC" before the related online menus actually become accessible.

The help attribute of each parameter contains its function number as a reference to the local device display and the handbook.

Parameter protection for custody transfer and service is the same as on the device's local display. Other specific protective functions such as the passwords for the quick setup menu and the setup menu are not supported with HART®.

9.9 Field Device Manager (FDM)

A Field Device Manager (FDM) is basically a PC program from Honeywell used to configure HART®, PROFIBUS and Foundation Fieldbus devices. Device Descriptions (DDs) and Device Type Managers (DTMs) are used to integrate different devices into the FDM.

9.9.1 Installation

If the signal converter Device Description has not yet been installed on the FDM system, the Device Description is required in binary format and is available for download from the website.

For information on installing the Device Description, refer to the FDM User Guide - section 4.8 Managing DDs.

9.9.2 Operation

FDM supports the Process Variables Root Menu, the Diagnostic Root Menu and the Device Root Menu for online access to the device and the Offline Root Menu for offline configuration.



INFORMATION!

For more detailed information see; on page 125.

The help attribute of each parameter contains its function number as a reference to the local device display and the handbook.

Parameter protection for custody transfer is the same as on the device's local display. Other specific protective functions such as the passwords for the quick setup menu and the setup menu are not supported with HART®.

9.10 Field Device Tool Device Type Manager (FDT DTM)

A Field Device Tool Container or Frame Application is basically a PC program used to configure HART® devices. Device Type Managers (DTMs) are used to integrate different devices into a FDT container.

9.10.1 Installation

If the Device Type Manager for the signal converter has not yet been installed on the FDT Container, a setup is required which is available for download from the website.

See the supplied documentation for information on how to install and set up the DTM.

9.10.2 Operation

Operating the signal converter via DTM is very similar to manual device control using the keyboard. See also the local device display and the handbook.

9.11 HART Menu Tree; UFC400

9.11.1 HART Menu Tree - Field Communicator HART Application

The Field Communicator supports the standard EDDL Root Menu.

In the signal converter HART DD it is implemented as a combination of other standard EDDL menus:

- Process Variables Root Menu (details on page 126)
- Diagnostic Root Menu (details on page 129)
- Device Root Menu (details on page 131)

The menus are located in the Field Communicator user interface as follows:

Field Communicator HART Application

1 Offline	
2 Online	1 Process Variables (Process Variables Root Menu)
	2 Diag/Service (Diagnostic Root Menu)
	3 Quick Setup (Device Root Menu)
	4 Detailed Setup (Device Root Menu)
	5 Service (Device Root Menu)
3 Utility	
4 HART Diagnostics	

9.11.2 HART Menu Tree AMS - Device's context menu

AMS supports the following standard EDDL menus:

- Process Variables Root Menu (details on page 126)
- Diagnostic Root Menu (details on page 129)
- Device Root Menu (details on page 131)

The menus are located in the AMS user interface as follows:

Device's context menu

Configure/Setup	Configure/Setup (Device Root Menu)
Compare	
Clear Offline	
Device Diagnostics	Device Diagnostics (Diagnostic Root Menu)
Process Variables	Process Variables (Process Variables Root Menu)
Scan Device	
Calibration Management	
Rename	
Unassign	
Assign / Replace	
Audit Trail	
Record Manual Event	
Drawings / Notes...	
Help...	

9.11.3 HART Menu Tree PDM - Menu Bar and Working Window

PDM supports the following standard EDDL menus:

- Process Variables Root Menu (details on page 126)
- Diagnostic Root Menu (details on page 129)
- Device Root Menu (details on page 131)
- Offline Root Menu (details on page 133)

The menus are located in the PDM user interface as follows:

Menu Bar

File	
Device	Communication path
	Download to Device...
	Upload to PG/PC...
	Update Diagnostic Status
	Quick Setup (Device Root Menu)
	Detailed Setup (Device Root Menu)
	Service (Device Root Menu)
View	Process Variables (Process Variables Root Menu)
	Diag/Service (Diagnostic Root Menu)
	Toolbar
	Status Bar
	Update
Options	
Help	

Working Window

Parameter Group Overview	[Offline Root Menu]
Parameter Table	

9.11.4 HART Menu Tree FDM - Device Configuration

FDM supports the following standard EDDL menus:

- Root Menu
- Process Variables Root Menu (details on page 126)
- Diagnostic Root Menu (details on page 129)
- Device Root Menu (details on page 131)

In the signal converter HART DD the Root Menu it is implemented as a combination of the other standard EDDL menus.

The menus are located in the FDM user interface as follows:

Device Configuration Window

Entry Points
Device Functions
Online (Root Menu)
Device (Device Root Menu)
Process Variables (Process Variables Root Menu)
Diagnostic (Diagnostic Root Menu)
Method List
FDM Status
FDM Device Properties
FDM Tasks
...

9.11.5 Description of used abbreviations

- ^{Opt} Optional, depending on device implementation/configuration
- Rd Read only
- ^{Loc} Local DD, affects only DD views
- ^{Cust} Custody lock protection

9.11.6 Process Variables Root Menu

Measured Values Overview

• Volume FlowRd • Volume Flow Data QualityRd • Volume Flow Limit StatusRd • Velocity of SoundRd • Velocity of Sound Data QualityRd • Velocity of Sound Limit StatusRd • Mass FlowRd • Mass Flow Data QualityRd • Mass Flow Limit StatusRd • Flow VelocityRd • Flow Velocity Data QualityRd • Flow Velocity Limit StatusRd	• GainRd • Gain Data QualityRd • Gain Limit StatusRd • SNRRd • SNR Data QualityRd • SNR Limit StatusRd • Time StampRd • Ext. Field Device Status (0x08)Rd • Ext. Field Device Status (0x20)Rd • Ext. Field Device Status (0x10)Rd • Ext. Field Device Status (0x01)Rd
--	--

Output, HART Dynamic Variables

Primary • Measured ValueRd • Percent RangeRd • Loop CurrentRd	Secondary • Measured ValueRd • Percent Range^{Rd, Opt} • Output Value^{Rd, Opt}
Tertiary • Measured ValueRd • Percent Range^{Rd, Opt} • Output Value^{Rd, Opt}	Quaternary • Measured ValueRd • Percent Range^{Rd, Opt} • Output Value^{Rd, Opt}

Totaliser Overview

• Mass Totaliser 1^{Rd, Opt} • Mass Totaliser 1 Data Quality^{Rd, Opt} • Mass Totaliser 1 Limit Status^{Rd, Opt} • Volume Totaliser 1^{Rd, Opt} • Volume Totaliser 1 Data Quality^{Rd, Opt} • Volume Totaliser 1 Limit Status^{Rd, Opt} • Mass Totaliser 2^{Rd, Opt} • Mass Totaliser 2 Data Quality^{Rd, Opt} • Mass Totaliser 2 Limit Status^{Rd, Opt} • Volume Totaliser 2^{Rd, Opt}	• Volume Totaliser 2 Data Quality^{Rd, Opt} • Volume Totaliser 2 Limit Status^{Rd, Opt} • Mass Totaliser 3^{Rd, Opt} • Mass Totaliser 3 Data Quality^{Rd, Opt} • Mass Totaliser 3 Limit Status^{Rd, Opt} • Volume Totaliser 3^{Rd, Opt} • Volume Totaliser 3 Data Quality^{Rd, Opt} • Volume Totaliser 3 Limit Status^{Rd, Opt} • Time StampRd
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Diagnosis Overview

• Diagnosis Flow Velocity^{Rd, Opt} • Diagnosis Flow Velocity Data Quality^{Rd, Opt} • Diagnosis Flow Velocity Limit Status^{Rd, Opt} • Diagnosis Velocity of Sound^{Rd, Opt} • Diagnosis Velocity of Sound Data Quality^{Rd, Opt} • Diagnosis Velocity of Sound Limit Status^{Rd, Opt} • Diagnosis Gain^{Rd, Opt} • Diagnosis Gain Data Quality^{Rd, Opt}	• Diagnosis Gain Limit Status^{Rd, Opt} • Diagnosis SNR^{Rd, Opt} • Diagnosis SNR Data Quality^{Rd, Opt} • Diagnosis SNR Limit Status^{Rd, Opt} • Operating HoursRd • Operating Hours Data QualityRd • Operating Hours Limit StatusRd • Time StampRd
---	---

Table 9-1: Designations;

Opt; Optional, depend on device implementation / configuration

Rd; Read-only

9.11.7 Process Variables Root Menu Charts

Mesured Values (Charts)

Mesured Values (Bar)	Volume Flow Rd
	Velocity of Sound Rd
	Mass Flow Rd
	Flow Velocity Rd
	Gain Rd
	SNR Rd
Mesured Values (Scope)	Volume Flow Rd
	Velocity of Sound Rd
	Mass Flow Rd
	Flow Velocity Rd
	Gain Rd
	SNR Rd

Diagnostic Values (Charts)

Diagnostic Values (Bar)	Diagnosis Flow Velocity Rd
	Diagnosis Velocity of Sound Rd
	Diagnosis Gain Rd
	Diagnosis SNR Rd
Diagnostic Values (Scope)	Diagnosis Flow Velocity Rd
	Diagnosis Velocity of Sound Rd
	Diagnosis Gain Rd
	Diagnosis SNR Rd

Output (Chart)

Output (Bar)	PV Measured Value Rd
	PV Loop Current Rd
	TV Measured Value ^{Rd, Opt}
	TV Output Value ^{Rd, Opt}
	SV Measured Value ^{Rd, Opt}
	SV Output Value ^{Rd, Opt}
	QV Measured Value ^{Rd, Opt}
	QV Output Value ^{Rd, Opt}
Output (Scope)	PV Measured Value Rd
	PV Loop Current Rd
	TV Measured Value ^{Rd, Opt}
	TV Output Value ^{Rd, Opt}
	SV Measured Value ^{Rd, Opt}
	SV Output Value ^{Rd, Opt}
	QV Measured Value ^{Rd, Opt}
	QV Output Value ^{Rd, Opt}

Table 9-2: **Designations;**^{Opt}; Optional, depend on device implementation / configurationRd; Read-only

9.11.8 Diagnostic Root Menu

Status

Condensed Status NE 107	Failure Rd / Function check Rd / Out of specification Rd / Maintenance required Rd	
Standard	Device status Rd	Primary variable outside the operation limits
		Non-primary variable outside the operation limits
		Analog output outside the operating range limits
		Analog output in fixed mode
		More status available
		Cold start occurred
		Configuration changed
		Field device malfunctioned
	Extended device status Rd	Maintenance required
		Device variable alert
		Critical Power Failure
		Failure
		Out of specification
		Function check
Write Protect Rd		
	Device Diagnostic Status 0 Rd	Simulation active
		Non-Volatile memory failure
		Volatile memory error
		Watchdog reset executed
		Voltage conditions out of range
		Environmental conditions out of range
		Electronic failure
	Device Diagnostic Status 1	Status Simulation Active
		Discrete Variable Simulation Active
		Event Notification Overflow
	AO saturated Rd	Secondary Analog Channel Saturated
		Tertiary Analog Channel Saturated
		Quarternary Analog Channel Saturated
	AO fixed Rd	Secondary Analog Channel Fixed
		Tertiary Analog Channel Fixed
		Quarternary Analog Channel Fixed
Additional		
Process Rd	Mapping	<Details>
Configuration Rd	Mapping	<Details>
Electronics Rd	Mapping	<Details>
Sensor Rd	Mapping	<Details>

Status Display

Status Simulation	<Enable/disable status simulation>	Simulation values ^{Opt}
	Status Simulation Active Rd	
	<Simulation Values> ^{Opt}	
	Process Rd	Mapping Rd
	Configuration Rd	Mapping Rd
	Electronics Rd	Mapping Rd
	Sensor Rd	Mapping Rd
Status Mapping	Process	
	Configuration	
	Electronics	
	Sensor	
	...	
	<Reset to default>	
Simulation		
Process Input	<Simulation Volume Flow> / <Simulation Velocity of Sound>	
Input/Output	<Simulation A> / <Simulation B> / <Simulation C> / <Simulation D>	
Actual Values		
Flow	Volume Flow Rd / Mass Flow Rd / Flow speed Path 1 Rd / Flow speed Path 2 ^{Rd, Opt} / Flow speed Path 3 ^{Rd, Opt}	
Velocity of Sound	VoS Path 1 Rd / VoS Path 2 ^{Rd, Opt} / VoS Path 3 ^{Rd, Opt}	
Gain	Gain Path 1 Rd / Gain Path 2 ^{Rd, Opt} / Gain Path 3 ^{Rd, Opt}	
Signal to Noise Ratio	SNR Path 1 Rd / SNR Path 2 ^{Rd, Opt} / SNR Path 3 ^{Rd, Opt}	
Other	Operating hours Rd / Date Rd / Time Rd	
Information		
Information	C number Rd /	
	<Sensor Electronics>	
	<Electronic Revision>	
	Sensor Revision Rd	
Test/Reset		
Test/Reset	<Reset Errors>	
	<Warmstart>	
	<Device reset>	
	<Reset Configuration Changed Flag>	
	<Read GDC Object> ^{Opt}	
	<Write GDC Object> ^{Opt}	

Table 9-3: Designations;

^{Opt}; Optional, depend on device implementation / configurationRd; Read-only

9.11.9 Device Root Menu

Quick Setup

General	Language	<Reset Totaliser 3> ^{Opt} , Cust
	Tag	
	Polling Address	

Detailed Setup

Process Input		
Meter size	Meter Size	
Density	Density	
Calibration	<Zero Calibration> / GK	
Filter	Threshold Low Flow Cutoff / Hysteresis Low Flow Cutoff	
Plausibility	Error Limit / Counter Decrease / Counter Limit	
Simulation	<Simulation Volume Flow> / <Simulation Velocity of Sound>	
Information	<Sensor CPU> / <Sensor DSP> / <Sensor Driver> Serial Number Sensor Rd / V Number Sensor Rd / V Number Converter Rd	
Linearization	Linearization	
Pipe Temperature	Pipe Temperature	
Diagnosis Value	<Select Diagnosis 1> / Diagnostics 1 <Select Diagnosis 2> / Diagnostics 2	Status Mapping: Electronics; IO connection - Power failure / Process; empty pipe - Signal lost - Signal unreliable / Configuration; totaliser <Reset to default>
HART	Sensor s/n / <Align HART Units> Volume flow, Velocity of Sound, Mass Flow, Flow Speed, Gain, SNR, Diagnosis VoS & SNR, Operating hours, Totaliser Unit / Format / Upper Sensor Limit Rd / Lower Sensor Limit Rd / Minimum Span Rd / Family Rd , Class Rd , Update Time Rd	

I/O

Hardware	Terminals A / Terminals B / Terminals C
Current Output A/B/C ^{Opt}	Range 0% / Range 100% / Extended Range Min / Extended Range Max / Error Current / Error Condition / Measurement / Range Min / Range Max / Polarity / Limitation Min / Limitation Max / LFC Threshold / LFC Hysteresis / Time Constant / Invert Signal / Special Function ^{Opt} / Phase Shift ^{Opt} / <Information> / <Simulation>
Frequency Output A/B/D ^{Opt}	Pulse Shape ^{Opt} / Pulse Width ^{Opt} / 100% Pulse Rate ^{Opt} / Measurement / Range Min / Range Max / Polarity / Limitation Min / Limitation Max / LFC Threshold / LFC Hysteresis / Time Constant / Invert Signal / Special Function ^{Opt} / Phase Shift ^{Opt} / <Information> / <Simulation>
Pulse Output A/B/D ^{Opt}	<Information>
Status Output A/B/C/D ^{Opt}	Mode / Output A ^{Opt} / Output B ^{Opt} / Output C ^{Opt} / Output D ^{Opt} / Invert Signal / <Information> / <Simulation>
Limit Switch A/B/C/D ^{Opt}	Measurement / Threshold / Hysteresis / Polarity / Time Constant / Invert Signal / <Information> / <Simulation>
Control Input A/B ^{Opt}	Mode / Invert Signal / <Information> / <Simulation>
I/O Totaliser	
Totaliser1/2/3 ^{Opt}	Totaliser Function

I/O HART

I/O HART	PV is Rd / SV is / TV is / QV is / D/A Trim / Apply Values
----------	---

Device

Device Info	Tag / C Number Rd / Device Serial No. Rd / Electronic Serial No. Rd / <Electronic Revision ER>
Display	Language / Default Display
1./2. Meas. Page	
1./2. Meas. Page	Function / Measurement 1.line / Range Min / Range Max / Limitation Min / Limitation Max / LFC Threshold / LFC Hysteresis / Time Constant / Format 1st Line / Measurement 2nd Line ^{Opt} / Format 2nd Line ^{Opt} / Measurement 3rd Line ^{Opt} / Format 3rd Line ^{Opt, Cust}
Graphic Page	Select Range / Range Centre / Range +/- / Time Scale
Special Functions	<Warmstart> / Set Date and Time / <Read GDC Object> ^{Opt} / <Write GDC Object> ^{Opt}
Units	Meter Size Unit / Volume Flow Unit / Text Free Unit ^{Opt} / [m ³ /s]*Factor ^{Opt} / Mass Flow Unit / Text Free Unit ^{Opt} / [kg/s]*Factor ^{Opt} / Flow Velocity Unit / Temperature Unit / Mass Unit / Text Free Unit ^{Opt} / [kg]*Factor ^{Opt} / Density Unit / Text Free Unit ^{Opt} / [kg/s]*Factor ^{Opt} / Temperature Unit / Pulse Value Unit (Mass) / Pulse Value Unit (Volume)

HART

HART	HARTRd / Loop current mode / Online Mode? ^{Loc} / <Prepare Parameter Download>
	Identification Polling address / Tag / Manufacturer Rd / Model Rd / Device ID Rd
	HART Revisions Universal revision Rd / Field device revision Rd / DD version Rd
	Device Info Descriptor / Message / Date / Final assembly number / Config. Change Count Rd Software revision Rd / Hardware revision Rd / Write Protect Rd / Custody Lock Rd
	Preambles Number of request preambles Rd / Number of response preambles

Table 9-4: Designations;^{Opt}; Optional, depend on device implementation / configurationRd; Read-only

9.11.10 Offline Root Menu

Identification

Identification	Tag / Long Tag / Descriptor / Message / Date
Device	Manufacturer Rd / Device Type Rd / HART Device ID Rd / Final Assembly Number / Device Serial No. Rd / C number Rd / Rd / Electronic Serial No. Rd
Detailed Setup	
Mapping of Variables	PV is / SV is / TV is / QV is

Process Input

Meter Size	Meter Size
Calibration	<Zero Calibration> / GK
Filter	Minimum Limit / Maximum Limit / Flow Direction / Threshold Low Flow Cutoff / Hysteresis Low Flow Cutoff
Plausibility	Error Limit / Counter Decrease / Counter Limit
Information	<Sensor CPU> / <Sensor DSP> / <Sensor Driver> / V No. Sensor Rd / Serial Number Sensor Rd / V no. Converter Rd
Linearization	Linearization / Dynamic Viscosity ^{Opt}
Pipe Temperature	Pipe Temperature
Density	Density
Diagnosis	<Select Diagnosis> 1/ diagn flow speed, diagn VoS, diagn gain, diagn SNR.
	<Select Diagnosis> 2 / diagn flow speed, diagn VoS, diagn gain, diagn SNR.
Status Mapping	Electronics: IO Connection / Power Failure
	Process: Empty Pipe / Signal Lost / Signal Unreliable
	Configuration: Totaliser
	<Reset to default>
HART	Sensor s/n / <Align HART Units> Volume Flow / Velocity of Sound / Mass Flow / Flow Speed / Gain / SNR / Diagnosis VoS / Diagnosis SNR / Operating Hours / Totaliser, Unit / Format / Upper Sensor Limit Rd / Lower Sensor Limit Rd / Minimum Span Rd / Family Rd / Class Rd / Update Time Rd

I/O

Hardware	Terminals A / Terminals B / Terminals C
Current Output A/B/C ^{Opt}	Range 0% / Range 100% / Extended Range Min / Extended Range Max / Error Current / Error Condition / Measurement / Range Min / Range Max / Polarity ^{Cust} / Limitation Min / Limitation Max / LFC Threshold / LFC Hysteresis / Time Constant / Special Function / Threshold Range Change ^{Opt} / Hysteresis Range Change ^{Opt}
Frequency Output A/B/D ^{Opt}	Pulse Shape ^{Opt} / Pulse Width ^{Opt} / 100% Pulse Rate ^{Opt} / Measurement / Range Min / Range Max / Polarity / Limitation Min / Limitation Max / LFC Threshold / LFC Hysteresis / Time Constant / Invert Signal / Special Function ^{Opt} / Phase Shift ^{Opt}
Pulse Output A/B/D ^{Opt}	Pulse Shape ^{Opt} / Pulse Width ^{Opt} / Max. Pulse Rate ^{Opt} / Measurement / Pulse Value Unit Rd / Value Per Pulse / Pulse value Unit / Polarity / LFC Threshold / LFC Hysteresis / Time Constant / Invert Signal / Special Function ^{Opt} / Phase Shift ^{Opt}
Status Output A/B/C/D ^{Opt}	Mode / Output A ^{Opt} / Output B ^{Opt} / Output C ^{Opt} / Output D ^{Opt} / Invert Signal
Limit Switch A/B/C/D ^{Opt}	Measurement / Threshold / Hysteresis / Polarity / Time Constant / Invert Signal

Control Input A/B ^{Opt}	Mode / Invert Signal
Current Input A/B ^{Opt}	Range 0% Rd / Range 100% Rd / Extended Range Min / Extended Range Max / Measurement / Range Min / Range Max / Time Constant
Totaliser 1/2/3 ^{Opt}	Totaliser Function / Measurement ^{Opt} / LFC Threshold ^{Opt} / LFC Hysteresis ^{Opt} / Time Constant ^{Opt} / Preset Value ^{Opt}

I/O HART

I/O HART	PV is Rd / SV is / TV is / QV is
----------	---

Device

Device Info	Tag / C Number Rd / Electronic Serial No. Rd
Display	Language / Default Display
1./2. Meas. Page	Function / Measurement 1.line / Range Min / Range Max / Limitation Min / Limitation Max / LFC Threshold / LFC Hysteresis / Time Constant / Format 1st Line / Measurement 2nd Line ^{Opt} / Format 2nd Line ^{Opt} / Measurement 3rd Line ^{Opt} / Format 3rd Line ^{Opt}
Graphic Page	Select Range / Range Centre / Range +/- / Time Scale
Units	Meter Size Unit / Volume Flow Unit / Text Free Unit ^{Opt} / [m ³ /s]*Factor / Mass Flow Unit / Text Free Unit ^{Opt} / [kg/s]*Factor ^{Opt} / Flow Velocity Unit / Temperature Unit / Mass Unit / Text Free Unit ^{Opt} / [kg]*Factor ^{Opt} / Density Unit / Pulse Value Unit (Mass) / Pulse Value Unit (Volume)

HART

HART	HART Rd / Loop current mode / Online Mode? ^{Loc}
	Identification Polling address / Tag / Long Tag / Manufacturer Rd / Model Rd / HART Device ID Rd
	HART Revisions Universal revision Rd / Field device revision Rd / DD-Version Rd
	Device Info Distributor Rd / Device Profile Rd / Descriptor / Message / Date / Final assembly number / Config. change count Rd / Software revision Rd / Hardware revision Rd / Write Protect Rd / Custody Lock Rd
	Preambles Number of request preambles Rd / Number of response preambles

Table 9-5: **Designations;**

^{Opt}; Optional, depend on device implementation / configuration

Rd ; Read-only



KROHNE – Products, Solutions and Services

- Process instrumentation for flow, level, temperature, pressure measurement and process analytics
- Flow metering, monitoring, wireless and remote metering solutions
- Engineering, commissioning, calibration, maintenance and training services

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