OPTISONIC 4400 Handbook

Ultrasonic liquid flowmeter for high temperature and high pressure

ER 3.0.1_

KROHNE

IMPRINT

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.

Changes and effect 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
	P	PROFIBUS
	F	Foundation Fieldbus
	M	Modbus
	X	all interfaces
3-_	Downwards compatible hardware and/or software change of inputs and outputs:	
	I	Current output
	F, P	Frequency / 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.	

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

Release date	Electronic Revision	Changes and compatibility	Documentation
2016-01	ER 3.0.1_	1	MA OPTISONIC 4400 R01

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 4400** is designed exclusively for bi-directional measurements on conductive and / or non-conductive fluids, in closed completely filled pipeline circuits. Excess of contaminations (gas, particles, 2 phases) disturb the acoustic signal and thus must be avoided.

The overall functionality of the **OPTISONIC 4400** flowmeter, is the continuous measurement of actual volume flow, mass flow, flow speed, velocity of sound, gain, SNR, totalized flow mass and diagnosis values.

1.3 Certification

CE marking

The manufacturer certifies successful testing of the product by applying the CE marking.

This device fulfils the statutory requirements of the relevant EU directives.

For full information of the EU directives and standards and the approved certifications, please refer to the CE declaration or the website of the manufacturer.

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

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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 can not 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.
Make sure to combine the correct devices together by comparing the serial numbers

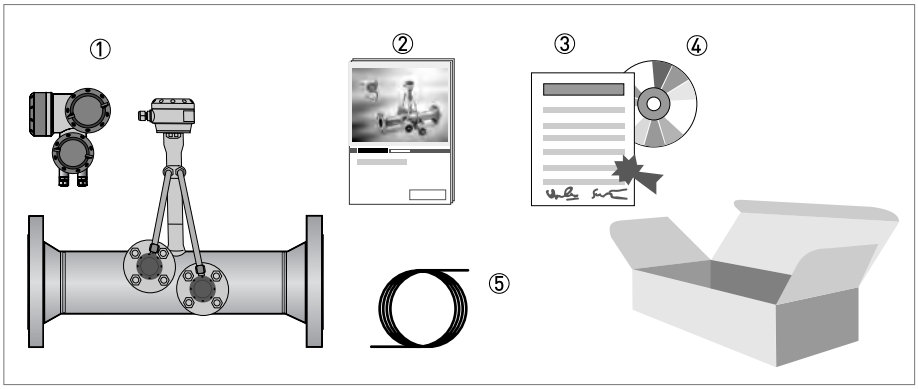


Figure 2-1: Scope of delivery (example of high temperature version)

① Remote signal converter
② Product documentation
③ Factory calibration certificate
④ CD-ROM with product documentation in available languages
⑤ Signal cable (remote versions only)

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.

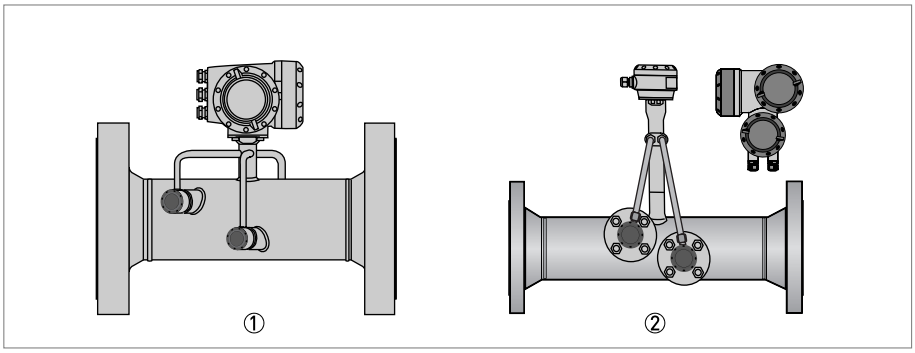
INFORMATION!
Product specific information and extensive product specification is available using PICK, the Product Information Center KROHNE web-tool.
PICK can be found via the service menu button on the KROHNE.com website.

PICK up your information

The following versions are available:

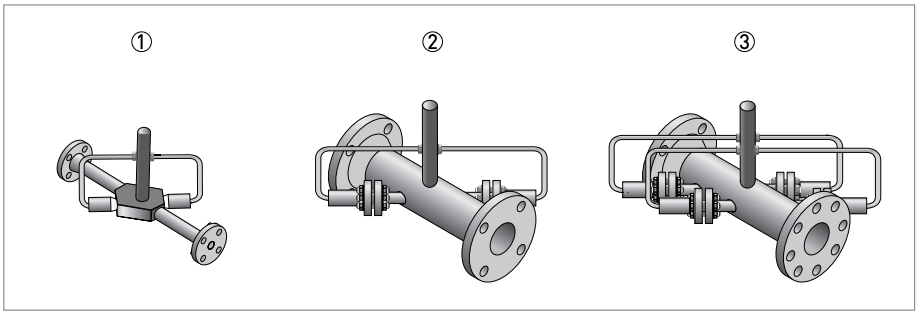
- Compact version (the signal converter is mounted directly on the measuring sensor)
- Remote version (electrical connection to the measuring sensor via signal cable)

The version shown in most of the illustrations is a High Temperature (remote only) version.
The High pressure version is available in compact and remote version



① HP Compact version
② HT Remote version

Device versions



① Single beam version HP compact version (DN25...40)
② Single beam version (DN50...80)
③ Double beam version ([≥DN100])

2.2.1 Field housing

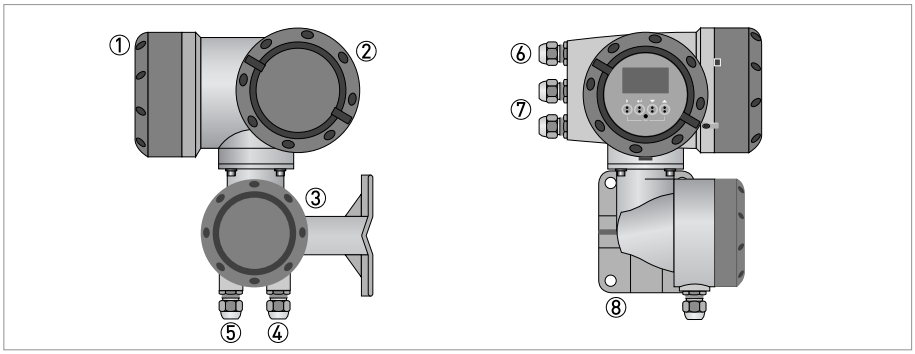


Figure 2-2: Construction of the field housing

① Cover for electronics and display
② Cover for power supply and inputs/outputs terminal compartment
③ Cover for measuring sensor terminal compartment
④ Use cable entry 4 or 5 for measuring sensor signal cable
⑤ (see ④)
⑥ Cable entry for power supply
⑦ Cable entry for inputs and outputs
⑧ 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

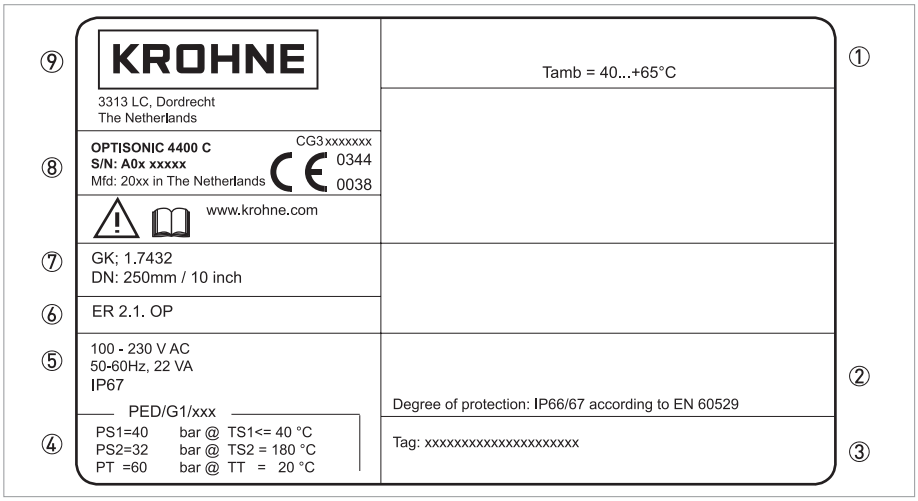
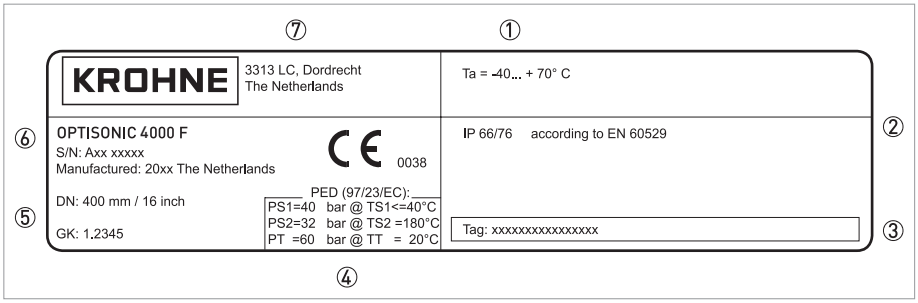


Figure 2-3: Example of nameplate for the compact version

① Ambient temperature
② Protection class
③ Tag number
④ PED data, type I / II / II or SEP
⑤ Mains supply data
⑥ Electronic revision number
⑦ Calibration data
⑧ Type designation of the flowmeter and CE sign with number(s) of notified body / bodies
⑨ Name and address of the manufacturer

2.3.2 Nameplate for the measuring sensor (field version)

Examples for measuring sensor versions StandardHP and HTversion.



1. Ambient temperature
2. Protection class
3. Tag number
4. PED data, Category I / II / III or SEP
5. Calibration data
6. Type designation of the flowmeter and CE sign with number(s) of notified body / bodies
7. Name and address of the manufacturer

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

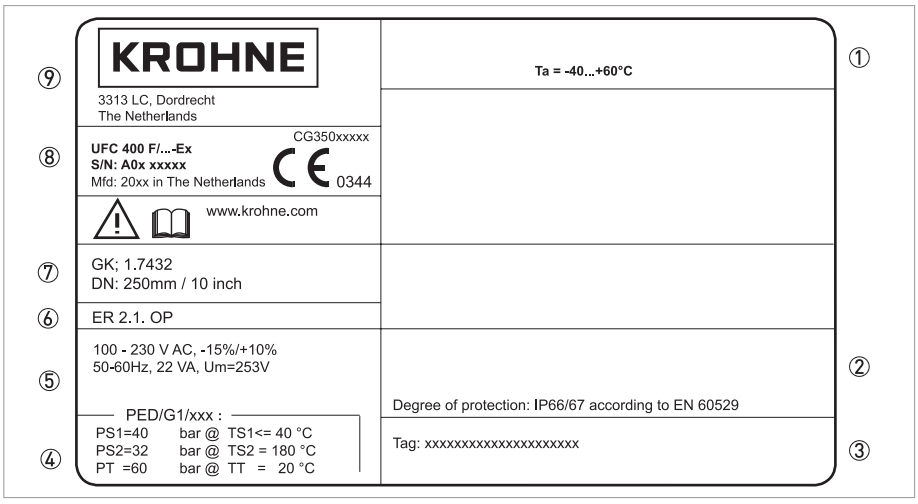
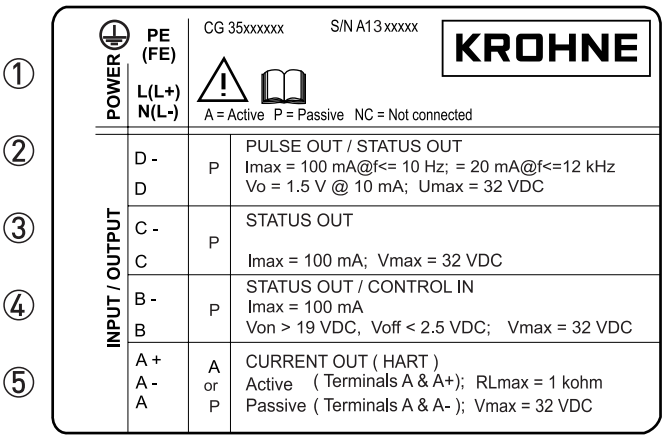


Figure 2-4: Examples of nameplates on the signal converter (field version)

① Ambient temperature
② Protection class
③ Tag number
④ PED data, category I / II / II or SEP
⑤ Mains supply data
⑥ Electronics revision number
⑦ Calibration, size and GK data
⑧ Type designation of the flowmeter and CE sign with number(s) of notified body / bodies
⑨ Name and address of the manufacturer

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



① Power supply (AC: L and N, DC: L+ and L-, PE for ≥ 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

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
- The carbon steel OPTISONIC 4000 HT flow sensor is treated with corrosion preservative on the inside and the outside. It has a limited working of maximum 3 months after manufacturing.

3.3 Transport

Signal converter

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

Measuring sensor

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

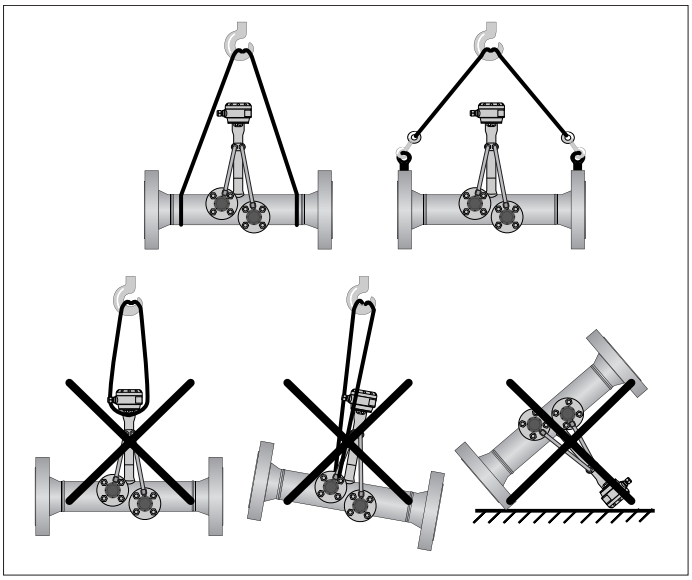


Figure 3-1: Transport

INFORMATION!
In the illustration above, use the eyebolts mounted on flanges. For versions without flanges, special eyelets are welded on the tube

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 mm)
- Small screwdriver
- Wrench for cable glands
- Wrench for pipe mounting bracket (remote version only) see; on page 28
- Torque wrench for installing flowmeter in pipeline

3.5 General requirements

INFORMATION!
The following precautions must be taken to ensure reliable installation.

- *Make sure that there is adequate space to the sides.*
- *Protect the signal converter from direct sunlight and install a sun shade 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 vibration. The flowmeters are tested for a vibration level in accordance with IEC 68-2-6.*

3.5.1 Vibration

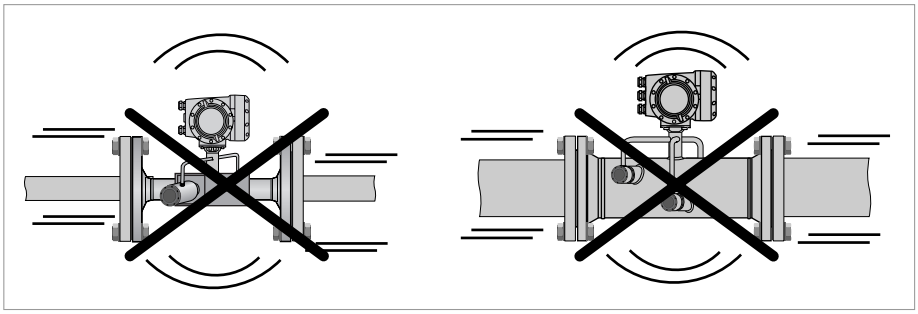


Figure 3-2: Avoid vibrations

INFORMATION!
In case of expected vibrations, please install a field version.

3.5.2 Corrosion preservation

INFORMATION!
The corrosion preservation applied is valid for three months after the manufacturing date.
*To prevent corrosion of the carbon steel flow sensor **after** installation in the pipe, corrosion prevention has to be applied.*

3.6 Installation conditions

3.6.1 Inlet and outlet

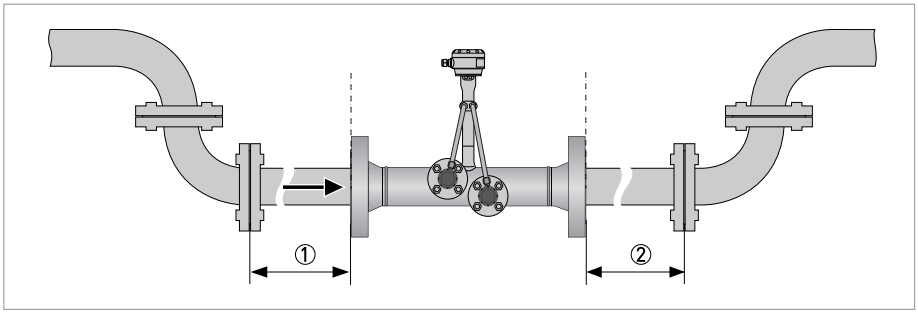


Figure 3-3: Recommended inlet and outlet

① Refer to chapter "Bends in 2 or 3 dimensions"
② ≥ 3 DN

3.6.2 Bends in 2 or 3 dimensions

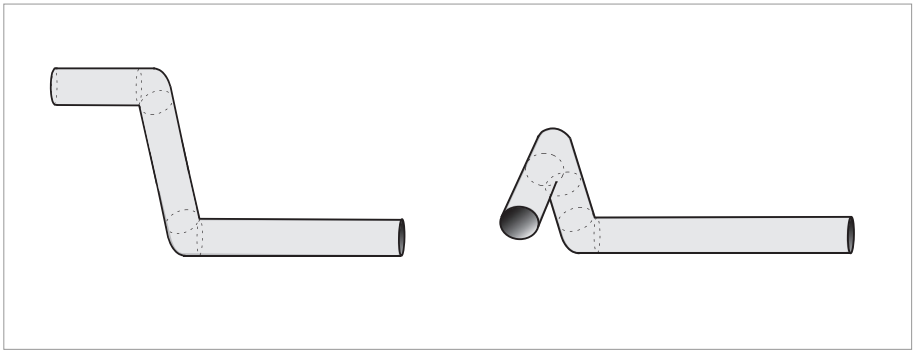


Figure 3-4: Inlet when using 2 and/or 3 dimensional bends in front of the flowmeter

Inlet length:
for 2 path using bends in 2 dimensions: ≥ 10 DN; when having bends in 3 dimensions: ≥ 15 DN
for 1 path using bends in 2 dimensions: ≥ 20 DN; when having bends in 3 dimensions: ≥ 25 DN

3.6.3 T-section

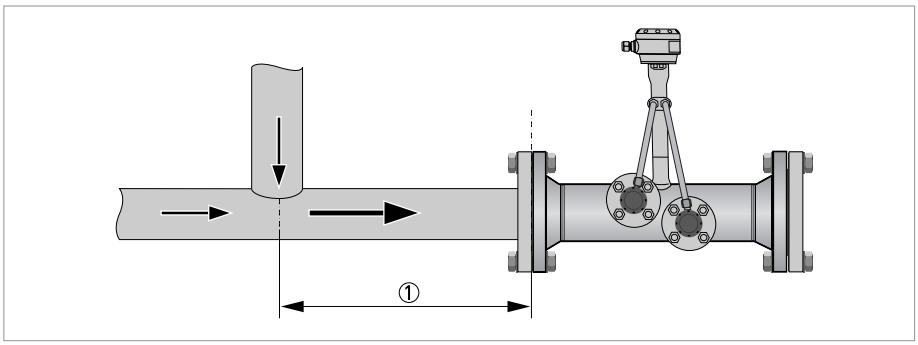


Figure 3-5: Distance behind a T-section

① 2 path ≥ 10DN, 1 path ≥ 20 DN

3.7 Pipework reducers

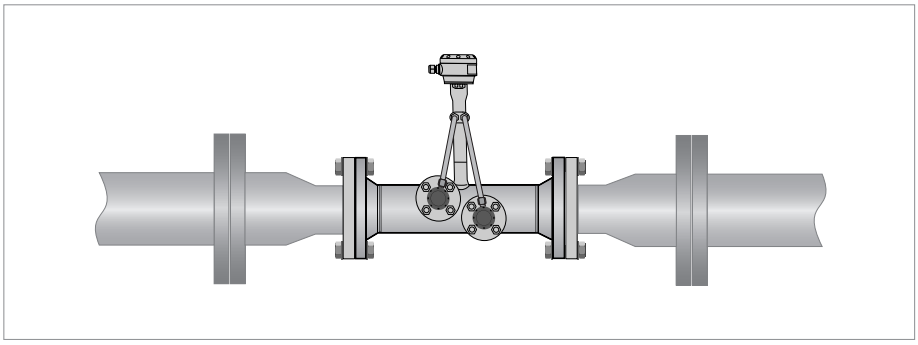


Figure 3-6: Pipework reducers

Always avoid extreme steps in pipe size. Use pipework reducers, where there is a large difference between pipework size and meter flanges.

3.8 Bends

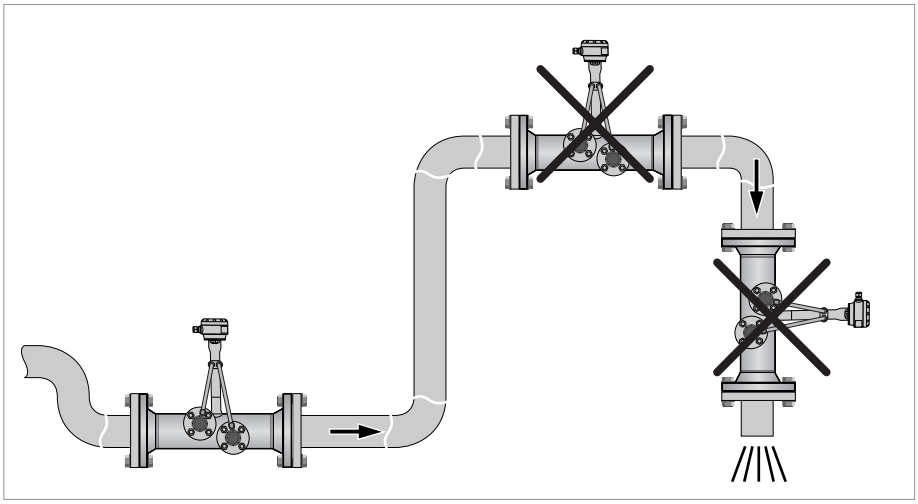


Figure 3-7: Installation in bending pipes

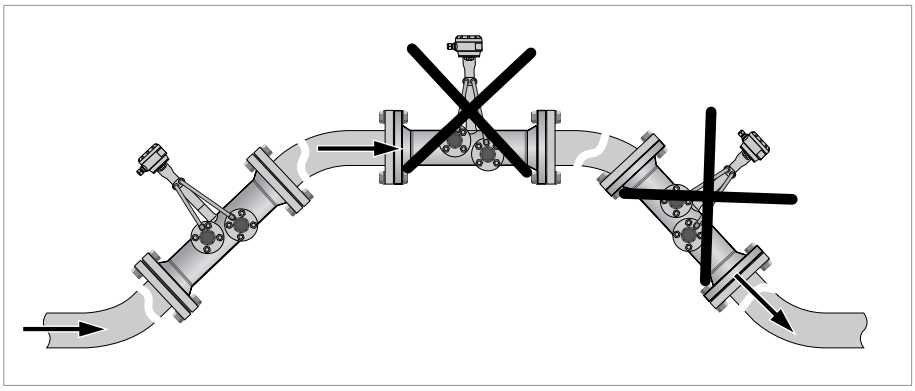


Figure 3-8: Installation in bending pipes

3.9 Open feed or discharge

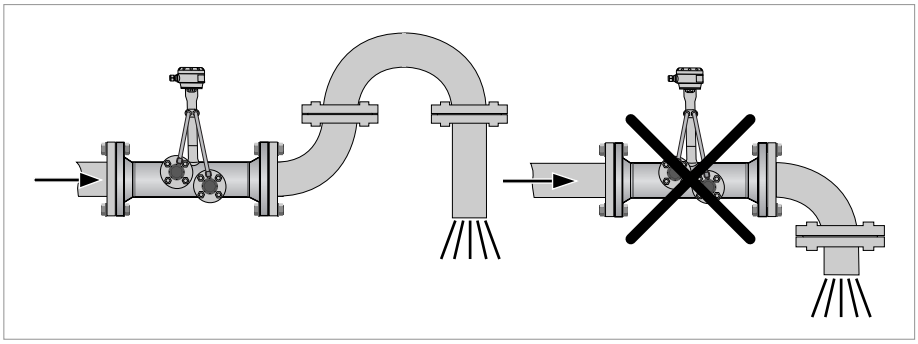


Figure 3-9: Open discharge

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

3.10 Position of pump

CAUTION!
Never install flowmeter at a pump suction side in order to avoid cavitation or flashing in the flowmeter.

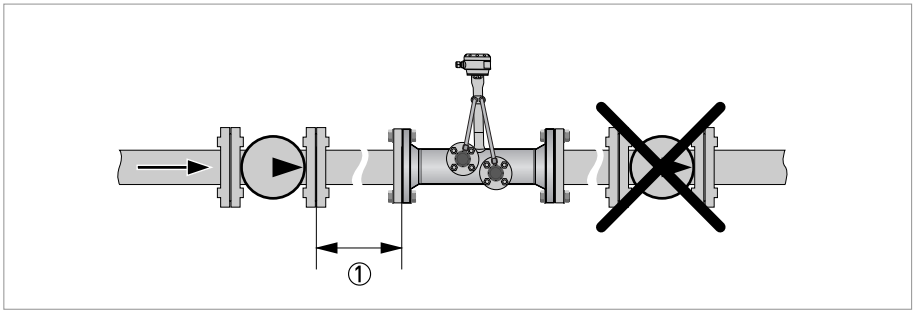


Figure 3-10: Installation behind a pump

① ≥ 30 DN

3.11 Control valve

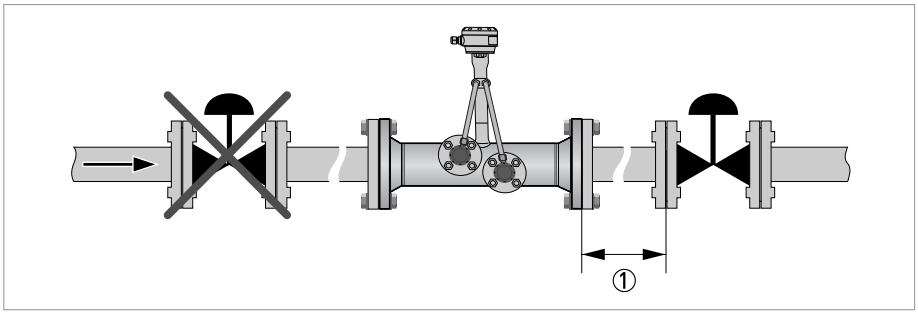


Figure 3-11: Installation in front of a control valve

① ≥ 40 DN

3.12 Down going pipeline over 5 m /16 ft length

Install air vent downstream of the flowmeter to prevent vacuum. Although this will not harm the meter, it may cause gases to come out of solution (cavitate) and interfere with proper measurements.

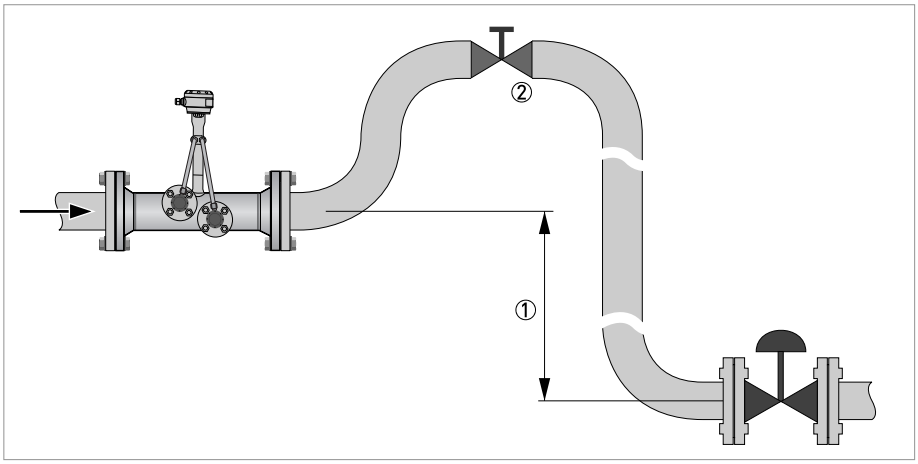


Figure 3-12: Down going pipeline over 5 m / 16 ft length

① ≥ 5 m / 16 ft
② Install air vent

3.13 Thermal insulation

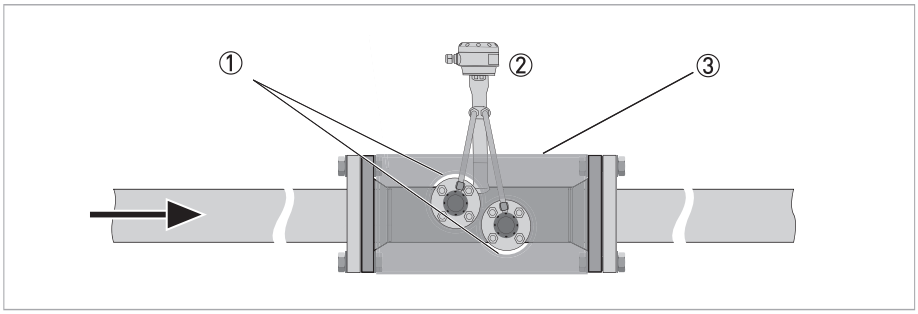


Figure 3-13: Insulation

① See the detailed transducer area on next page
② Connection box
③ Insulation area

WARNING!
The flow sensor can be insulated completely, except for the transducer piezo module(s) ① and the connection box ② to allow cooling by free air convection. The transducers can reach a temperature of up to 200 °C./ 392 °F.

See the detailed area ③ in the following illustration

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

Detailed area for insulation

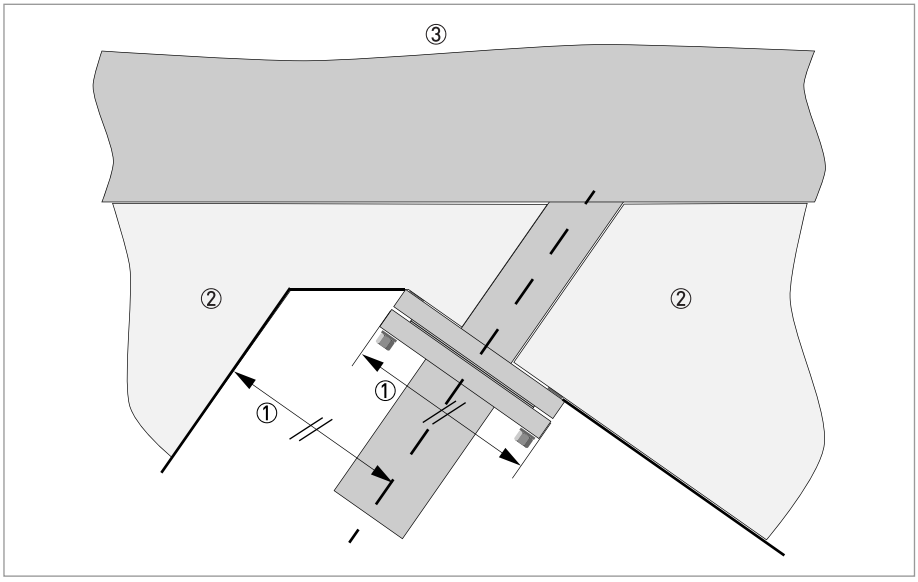


Figure 3-14: Thermal insulation

① Width of flange = free distance
② Insulation
③ Sensor tube

INFORMATION!
The free space (approximately 0.15 m/ 6") around the transducer housing is needed to remove the cover of the piezo module and/or remove the gaskets.

INFORMATION!
Do not turn the blue caps at the end of the transducer housing. These design caps have a click-connection

INFORMATION!
Please do not tighten (or loosen) the bolts on the flanges of the transducer. These bolts are pre set (according specifications) in the factory. See detailed information on the nameplate of the flow sensor.

3.14 Mounting

3.14.1 Flange deviation

CAUTION!
Max. permissible deviation of pipe flange faces:
$L_{max} - L_{min} \leq 0.5$ *mm / 0.02"*

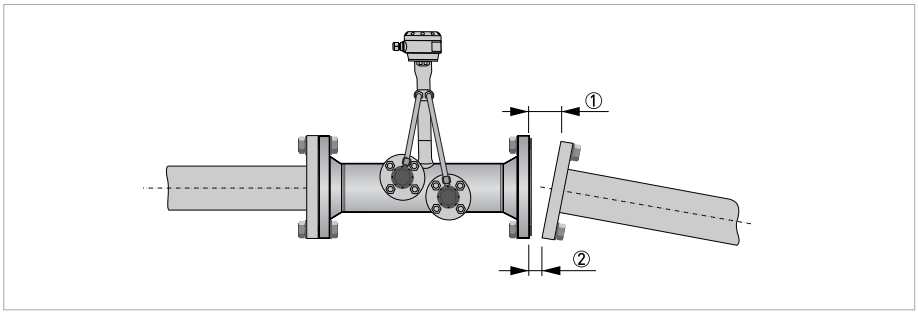


Figure 3-15: Flange deviation

① L_{max}
② L_{min}

3.14.2 Mounting position

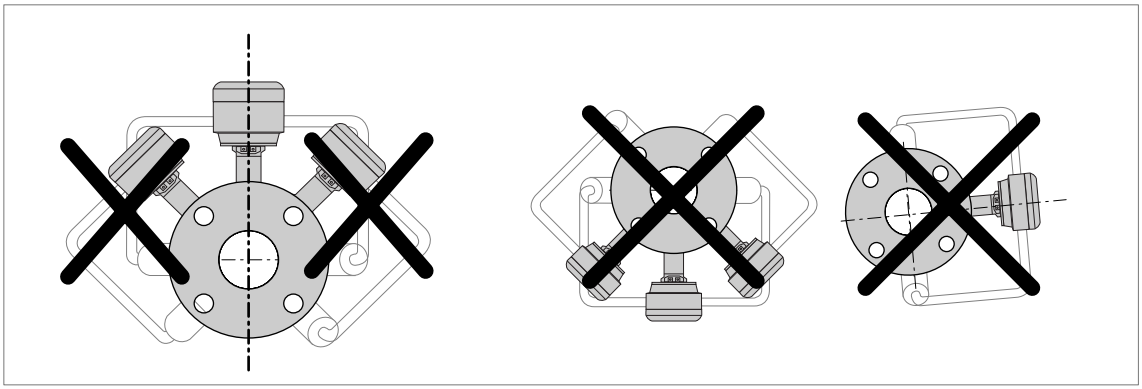


Figure 3-16: Allowed mounting position

3.15 Rotation of the compact converter housing

CAUTION!

Installing devices for hazardous areas

- DO NOT change the position of the converter housing of compact versions
- When not following this warning, there is a very high risk of damaging the internal cables of the device.

Installing devices for non-hazardous areas

Rotating the converter more than 90° relative to the sensor, is not recommended by the manufacturer.

3.16 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.

3.16.1 Pipe mounting

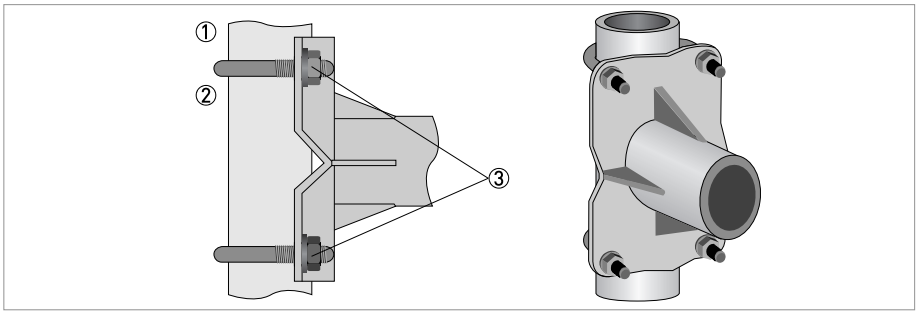


Figure 3-17: Pipe mounting of the field housing

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

3.16.2 Wall mounting

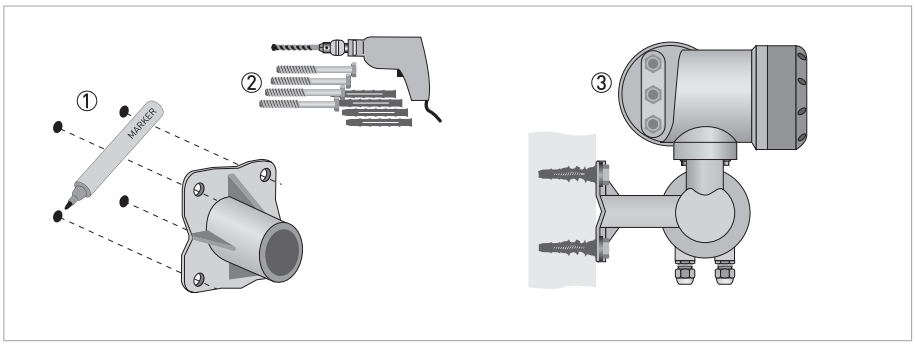


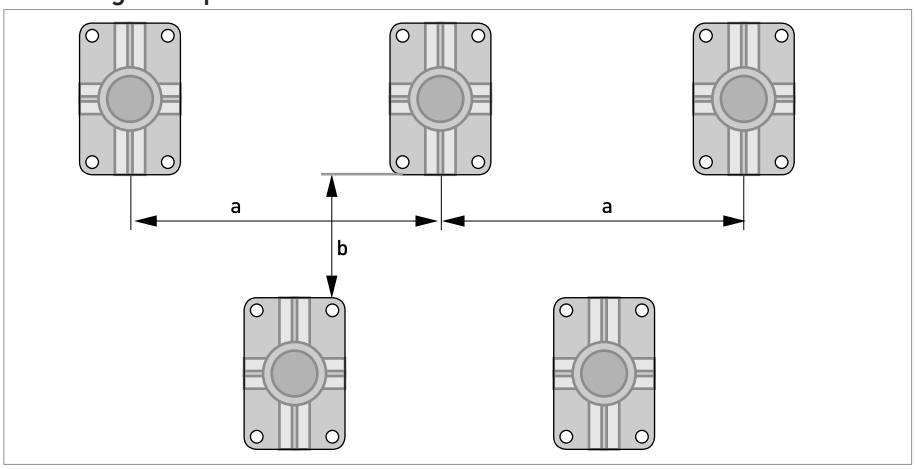
Figure 3-18: Wall mounting of the field housing

① Prepare the holes with the aid of the mounting plate.

② Use the mounting material and tools in compliance with the applicable occupational health and safety directives.

③ Fasten the housing securely to the wall.

Mounting multiple devices next to each other



a ≥ 600 mm / 23.6"
b ≥ 250 mm / 9.8"

3.16.3 Turning the display of the field housing version

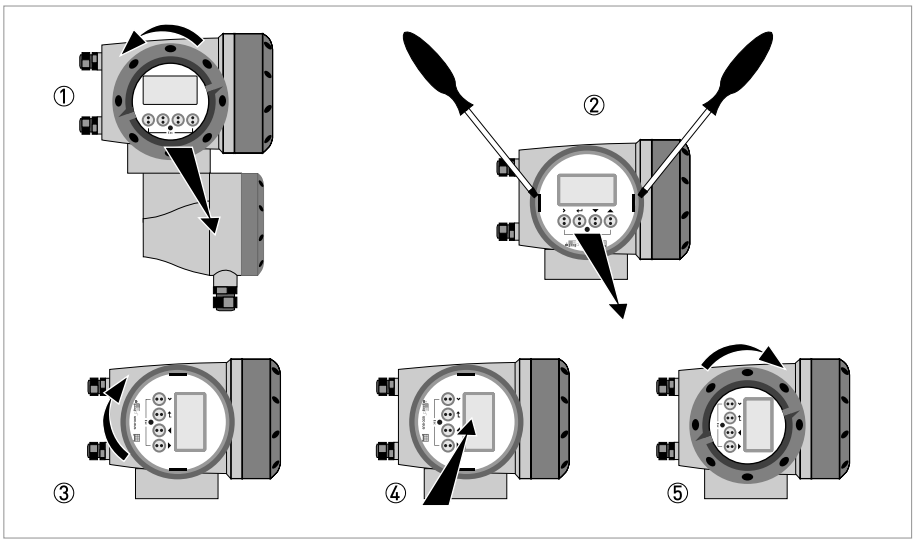


Figure 3-19: Turning the display of the field housing version

The display of the field housing version can be turned in 90° increments

① Unscrew the cover from the display and operation control unit.
② Using a suitable tool, pull out the two metal puller devices to the left and right of the display.
③ Pull out the display between the two metal puller devices and rotate it to the required position.
④ Slide the display and then the metal puller devices back into the housing.
⑤ Re-fit the cover and tighten it by hand.

CAUTION!
The ribbon cable of the display must not be folded or twisted repeatedly.

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.

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 Signal cable (remote versions only)

The flow sensor is connected to the signal converter via one signal cable, with 2 or 4 (labeled) inner coax cables for the connection of one or two acoustic paths.

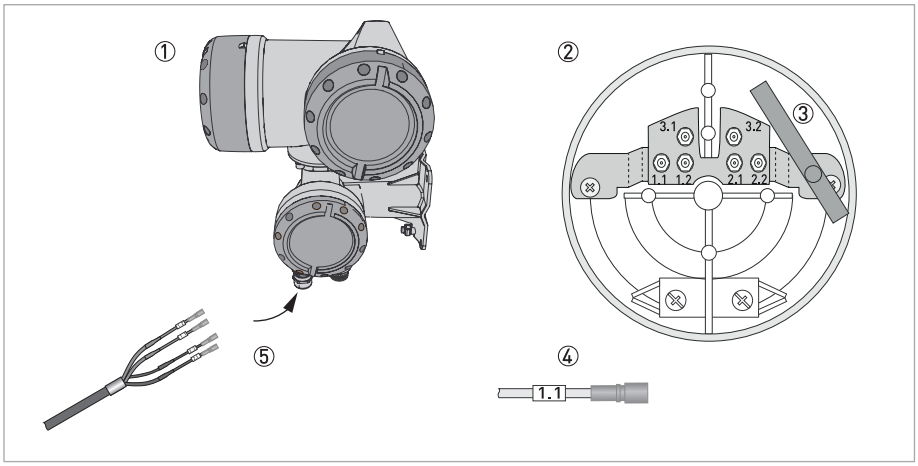


Figure 4-1: Construction of field version

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, always use the signal cable(s) included in the delivery.

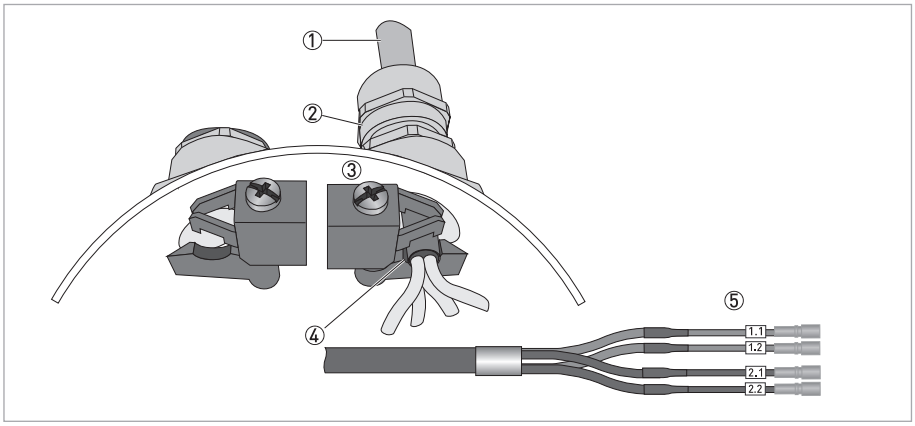


Figure 4-2: Clamp the cables on the shielding bush

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

Electrical connection - Remote

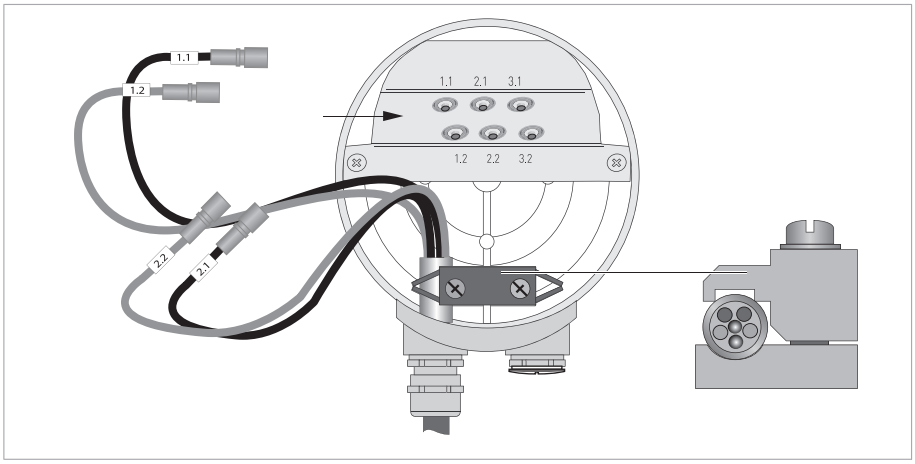


Figure 4-3: Connect the cables in the connection box

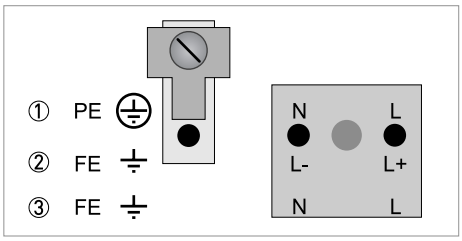
INFORMATION!
Connect the cable on connector with similar numeral marking

4.3 Power supply

WARNING!
When 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 the 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.



① 100...230 VAC (-15% / +10%), 22 VA
② 24 VDC (-55% / +30%) 12 W
③ 24 VAC/DC (AC: -15% / +10%; DC: -25% / +30%), 22 VA or 12 W

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.

24 VDC (tolerance range: -55% / +30%)
24 VAC/DC (tolerance ranges: AC: -15% / +10%; DC: -25% / +30%)

- Note the data on the nameplate!
- For measurement process reasons, a functional ground **FE** must be connected to the separate U-clamp terminal in the terminal compartment of the signal converter.
- When connecting to functional extra-low voltages, provide a facility for protective separation (PELV) (acc. to VDE 0100 / VDE 0106 and/or IEC 364 / IEC 536 or relevant national regulations).

4.4 Laying electrical cables correctly

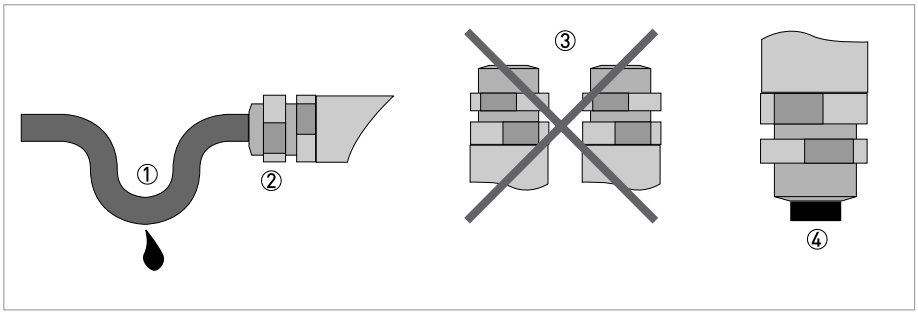


Figure 4-4: Protect housing from dust and water

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.

4.5 Inputs and outputs, overview

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

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

Basic version

- Has 1 current output, 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.

Ex i version

- Depending on the task, the device can be configured with various output modules.
- Current outputs can be active or passive.

Modular version

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

Bus systems

- The device allows intrinsically safe and non intrinsically safe bus interfaces in combination with additional modules.
- For connection and operation of bus systems, please note the separate documentation.

Ex option

- For hazardous areas, all of the input/output variants for the housing designs C and F 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

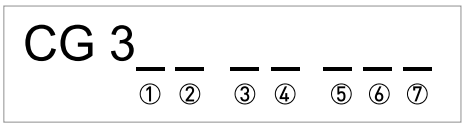


Figure 4-5: Marking (CG number) of the electronics module and input/output variants

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.

CG 350 xx 100	100...230 VAC & standard display; basic I/O: I_a or I_p & S_p/C_p & S_p & P_p/S_p
CG 350 xx 7FK	100...230 VAC & standard display; modular I/O: I_a & P_N/S_N and optional module P_N/S_N & C_N

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)
P_N / S_N	F	Passive pulse output, frequency output, status output or limit switch acc. to NAMUR (changeable)
C_a	G	Active control input
C_p	K	Passive control input
C_N	H	Active control input to 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.
-	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 grey 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								
Ex-i in-/outputs (Option)									
2 0 0						I_a + HART® active		P_N / S_N NAMUR ②	
3 0 0						I_p + HART® passive		P_N / S_N NAMUR ②	
2 1 0		I_a active		P_N / S_N NAMUR C_p passive ②		I_a + HART® active		P_N / S_N NAMUR ②	
3 1 0		I_a active		P_N / S_N NAMUR C_p passive ②		I_p + HART® passive		P_N / S_N NAMUR ②	
2 2 0		I_p passive		P_N / S_N NAMUR C_p passive ②		I_a + HART® active		P_N / S_N NAMUR ②	
3 2 0		I_p passive		P_N / S_N NAMUR C_p passive ②		I_p + HART® passive		P_N / S_N NAMUR ②	

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	
6 _ _		max. 2 optional modules for term. A + B				I_a + HART® active		P_p / S_p passive ①	
B _ _		max. 2 optional modules for term. A + B				I_p + HART® passive		P_p / S_p passive ①	
7 _ _		max. 2 optional modules for term. A + B				I_a + HART® active		P_N / S_N NAMUR ①	
C _ _		max. 2 optional modules for term. A + B				I_p + HART® passive		P_N / S_N NAMUR ①	
PROFIBUS PA/DP									
D _ _		max. 2 optional modules for term. A + B				PA+ (2)	PA- (2)	PA+ (1)	PA- (1)
F _ _		max. 2 optional modules for term. A + B				PA+ (2)	PA- (2)	PA+ (1)	PA- (1)
FOUNDATION Fieldbus (option)									
E _ _		max. 2 optional modules for term. A + B				V/D+ (2)	V/D- (2)	V/D+ (1)	V/D- (1)
Modbus (option)									
G _ _ ②		max. 2 optional modules for term. A + B					Common	Sign. B (D1)	Sign. A (D0)

① changeable

② not activated bus terminator

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 electrically isolated from each other and from all other circuits.
- All operating data and functions can be adjusted.
- Passive mode: external power supply required:
  $U_{ext} \leq 32$ VDC
- Active mode: use of the internal power supply:
  $U_{nom} = 24$ VDC
- NAMUR mode: in accordance with EN 60947-5-6
  (Active control input to NAMUR EN 60947-5-6: 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 68

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! 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 outputs are electrically isolated from each other and from all other circuits.
- All operating data and functions can be adjusted.
- Passive mode:
  External power $U_{ext} \leq 32$ VDC at $I \leq 22$ mA
- Active mode:
  Load impedance $R_L \leq 1$ kΩ at $I \leq 22$ mA;
  $R_L \leq 450$ Ω at $I \leq 22$ 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 $Q_{100\%}$, ± 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 43.

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 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 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: $U_{ext} \leq 32$ VDC
  $I \leq 20$ mA at $f \leq 10$ kHz (over range up to $f_{max} \leq 12$ kHz)
  $I \leq 100$ mA at $f \leq 100$ Hz
- Active mode:
  Use of the internal power supply: $U_{nom} = 24$ VDC
  $I \leq 20$ mA at $f \leq 10$ kHz (over range up to $f_{max} \leq 12$ kHz)
  $I \leq 20$ mA at $f \leq 100$ Hz
- NAMUR mode: passive in accordance with EN 60947-5-6, $f \leq 10$ kHz, over range up to $f_{max} \leq 12$ kHz
- Scaling:
  Frequency output: in pulses per time unit (e.g. 1000 pulses/s at $Q_{100\%}$);
  Pulse output: quantity 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 43.

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: $U_{ext} \leq 32$ VDC; $I \leq 100$ mA

  For the Ex i I/O signal converter:
  NAMUR characteristic: 4.7 mA / 0.77 mA
- Active mode:
  Use of the internal power supply: $U_{nom} = 24$ VDC; $I \leq 20$ mA
- NAMUR mode:
  Passive in accordance with EN 60947-5-6
- For information on the adjustable operating states refer to *Function tables* on page 68.

INFORMATION!
For further information refer to Connection diagrams of inputs and outputs on page 43.

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 electrically 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 (U_{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 EN 60947-5-6. Errors indicated on LC display. Error messages possible via status output.

4.7.2 Description of the electrical symbols

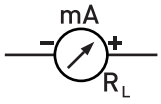
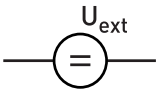
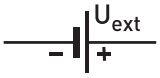
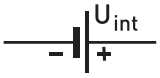
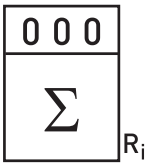
	mA meter 0...20 mA or 4...20 mA and other R_L is the internal resistance of the measuring point including the cable resistance
	DC voltage source (U_{ext}), external power supply, any connection polarity
	DC voltage source (U_{ext}), observe connection polarity according to connection diagrams
	Internal DC voltage source
	Controlled internal power 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, NO contact or similar

Table 4-1: Description of 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 39*and refer to *HART® connection on page 58*.

Current output active , basic I/Os

- $U_{int, nom}$ = 24 VDC nominal
- I ≤ 22 mA
- R_L ≤ 1 kΩ

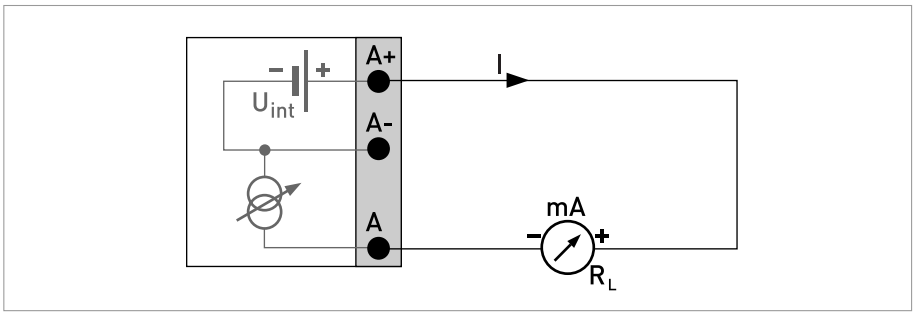


Figure 4-6: Current output active I_a

Current output passive , basic I/Os

- $U_{int, nom}$ = 24 VDC nominal
- U_{ext} ≤ 32 VDC
- I ≤ 22 mA
- U_0 ≥ 1.8 V
- R_L ≤ (U_{ext} - U_0) / I_{max}

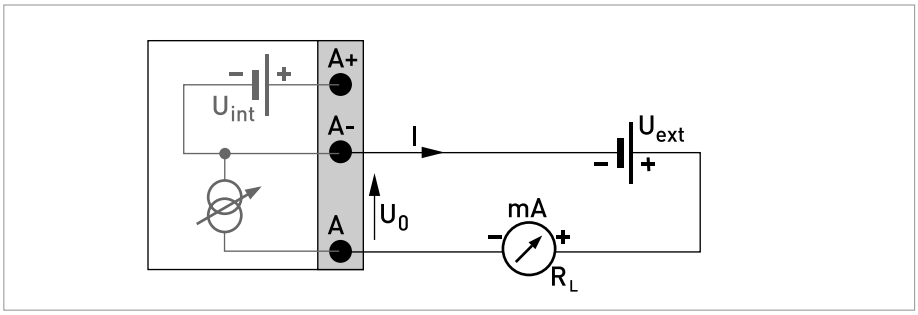


Figure 4-7: Current output passive I_p

INFORMATION!

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

Pulse/frequency output passive, basic I/Os

- $U_{ext} \leq 32$ VDC
- f_{max} in operating menu set to $f_{max} \leq 100$ Hz:
  I ≤ 100 mA
  open:
  I ≤ 0.05 mA at U_{ext} = 32 VDC
  closed:
  $U_{0, max}$ = 0.2 V at I ≤ 10 mA
  $U_{0, max}$ = 2 V at I ≤ 100 mA
- f_{max} in the operating menu set to 100 Hz < $f_{max} \leq 10$ kHz:
  I ≤ 20 mA
  open:
  I ≤ 0.05 mA at U_{ext} = 32 VDC
  closed:
  $U_{0, max}$ = 1.5 V at I ≤ 1 mA
  $U_{0, max}$ = 2.5 V at I ≤ 10 mA
  $U_{0, max}$ = 5.0 V at I ≤ 20 mA
- If the following maximum load resistance $R_{L, max}$ is exceeded, the load resistance R_L must be reduced accordingly by parallel connection of R:
  f ≤ 100 Hz: $R_{L, max}$ = 47 kΩ
  f ≤ 1 kHz: $R_{L, max}$ = 10 kΩ
  f ≤ 10 kHz: $R_{L, max}$ = 1 kΩ
- The minimum load resistance $R_{L, min}$ is calculated as follows:
  $R_{L, min} = (U_{ext} - U_0) / I_{max}$
- Can also be set as status output; for the electrical connection refer to status output connection diagram.

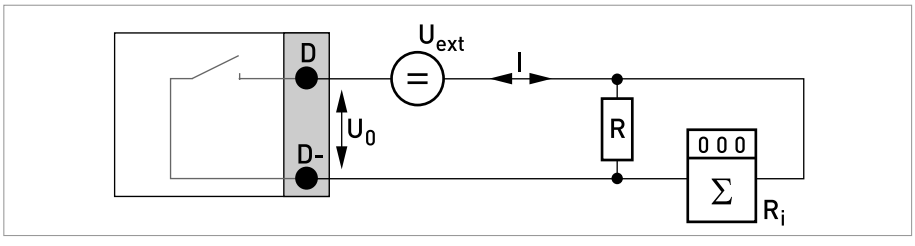


Figure 4-8: Pulse/frequency output passive P_p

INFORMATION!
- *Any connection polarity.*

Status output / limit switch passive, basic I/Os

- $U_{ext} \leq 32$ VDC
- $I \leq 100$ mA
- $R_{L, max} = 47\ k\Omega$
  $R_{L, min} = (U_{ext} - U_0) / I_{max}$
- open:
  $I \leq 0.05$ mA at $U_{ext} = 32$ VDC
  closed:
  $U_{0, max} = 0.2$ V at $I \leq 10$ mA
  $U_{0, max} = 2$ V at $I \leq 100$ 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.

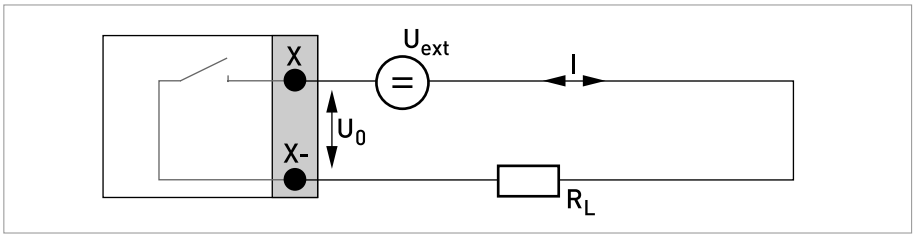


Figure 4-9: Status output / limit switch passive S_p

Control input passive, basic I/Os

- $8\ V \leq U_{ext} \leq 32$ VDC
- $I_{max} = 6.5$ mA at $U_{ext} \leq 24$ VDC
  $I_{max} = 8.2$ mA at $U_{ext} \leq 32$ VDC
- Switching point for identifying "contact open or closed":
  Contact open (off): $U_0 \leq 2.5$ V with $I_{nom} = 0.4$ mA
  Contact closed (on): $U_0 \geq 8$ V with $I_{nom} = 2.8$ mA
- Can also be set as a status output; for the electrical connection refer to status output connection diagram.

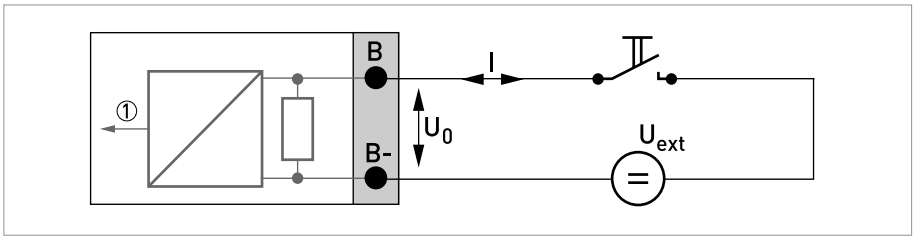


Figure 4-10: Control input passive C_p

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 39.*
- *For the electrical connection of bus systems, please refer to the separate documentation for the respective bus systems.*

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

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

- $U_{int, nom}$ = 24 VDC
- I ≤ 22 mA
- R_L ≤ 1 kΩ
- X designates the connection terminals A, B or C, depending on the version of the signal converter.

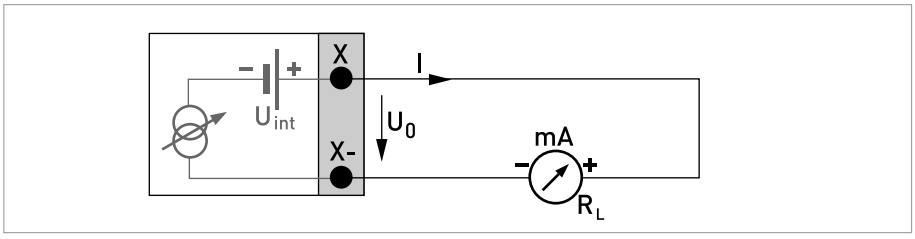


Figure 4-11: Current output active I_a

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

- $U_{ext} \leq 32$ VDC
- $I \leq 22$ mA
- $U_0 \geq 1.8$ V
- $R_{L, max} = (U_{ext} - U_0) / I_{max}$
- X designates the connection terminals A, B or C, depending on the version of the signal converter.

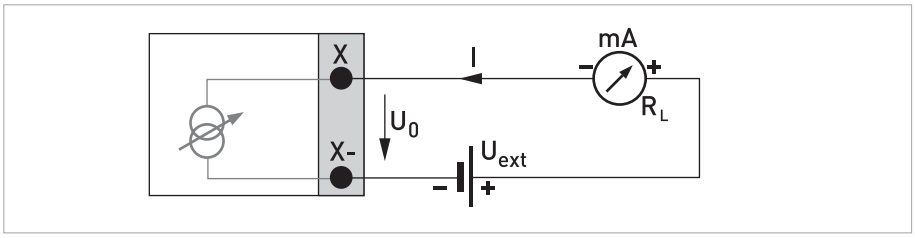


Figure 4-12: Current output passive I_p

Pulse/frequency output active, modular I/Os

- $U_{nom} = 24$ VDC
- f_{max} in the operating menu set to $f_{max} \leq 100$ Hz:
  $I \leq 20$ mA
  open:
  $I \leq 0.05$ mA
  closed:
  $U_{0, nom} = 24$ V at I = 20 mA
- f_{max} in operating menu set to 100 Hz < $f_{max} \leq 10$ kHz:
  $I \leq 20$ mA
  open:
  $I \leq 0.05$ mA
  closed:
  $U_{0, nom} = 22.5$ V at I = 1 mA
  $U_{0, nom} = 21.5$ V at I = 10 mA
  $U_{0, nom} = 19$ V at I = 20 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:
  $f \leq 100$ Hz: $R_{L, max} = 47$ kΩ
  $f \leq 1$ kHz: $R_{L, max} = 10$ kΩ
  $f \leq 10$ kHz: $R_{L, max} = 1$ kΩ
- The minimum load impedance $R_{L, min}$ is calculated as follows:
  $R_{L, min} = (U_{ext} - U_0) / I_{max}$
- X designates the connection terminals A, B or D, depending on the version of the signal converter.

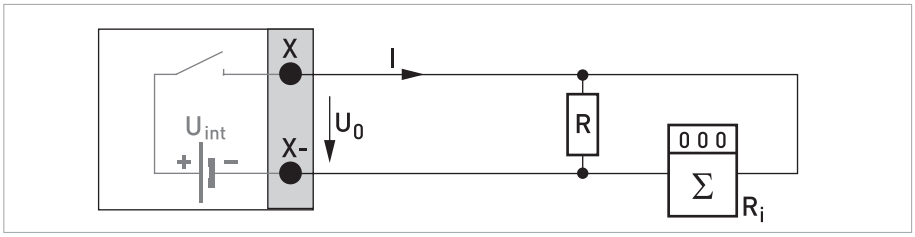


Figure 4-13: Pulse/frequency output active P_a

Pulse/frequency output passive, modular I/Os

- $U_{ext} \leq 32$ VDC
- f_{max} in the operating menu set to $f_{max} \leq 100$ Hz:
  $I \leq 100$ mA
  open:
  $I \leq 0.05$ mA at $U_{ext} = 32$ VDC
  closed:
  $U_{0, max} = 0.2$ V at $I \leq 10$ mA
  $U_{0, max} = 2$ V at $I \leq 100$ mA
- f_{max} in operating menu set to 100 Hz < $f_{max} \leq 10$ kHz:
  open:
  $I \leq 0.05$ mA at $U_{ext} = 32$ VDC
  closed:
  $U_{0, max} = 1.5$ V at $I \leq 1$ mA
  $U_{0, max} = 2.5$ V at $I \leq 10$ mA
  $U_{0, max} = 5$ V at $I \leq 20$ 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:
  $f \leq 100$ Hz: $R_{L, max} = 47$ kΩ
  $f \leq 1$ kHz: $R_{L, max} = 10$ kΩ
  $f \leq 10$ kHz: $R_{L, max} = 1$ kΩ
- The minimum load impedance $R_{L, min}$ is calculated as follows:
  $R_{L, min} = (U_{ext} - U_0) / I_{max}$
- 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.

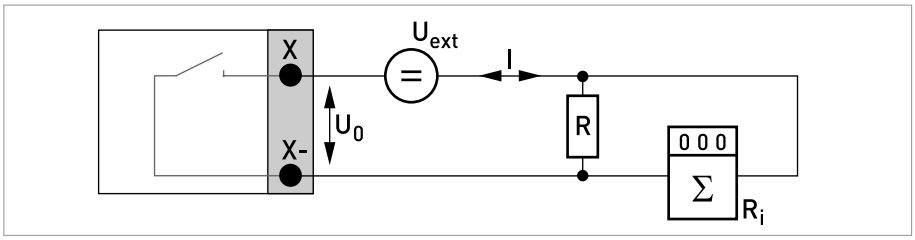


Figure 4-14: Pulse/frequency output passive P_p

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

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

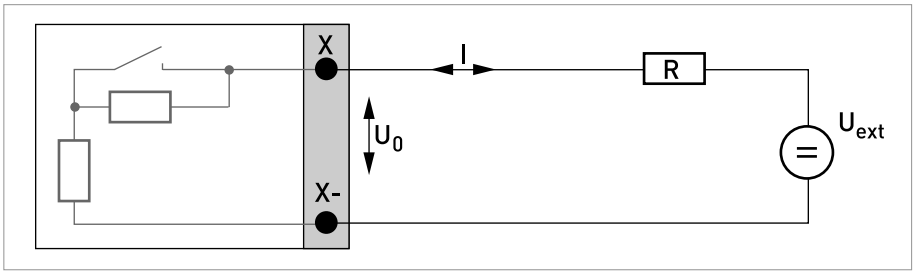


Figure 4-15: Pulse/frequency output passive P_N acc. to NAMUR EN 60947-5-6

Status output / limit switch active, modular I/Os

- Observe connection polarity.
- U_{int} = 24 VDC
- I ≤ 20 mA
- R_L ≤ 47 kΩ
- open:
  I ≤ 0.05 mA
  closed:
  $U_{0, nom}$ = 24 V at I = 20 mA
- X designates the connection terminals A, B or D, depending on the version of the signal converter.

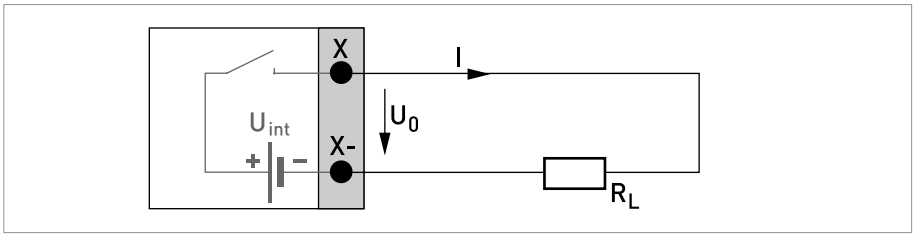


Figure 4-16: Status output / limit switch active S_a

Status output / limit switch passive, modular I/Os

- Any connection polarity.
- U_{ext} = 32 VDC
- I ≤ 100 mA
- $R_{L, max}$ = 47 kΩ
  $R_{L, min} = (U_{ext} - U_0) / I_{max}$
- open:
  I ≤ 0.05 mA at U_{ext} = 32 VDC
  closed:
  $U_{0, max}$ = 0.2 V at I ≤ 10 mA
  $U_{0, max}$ = 2 V at I ≤ 100 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.

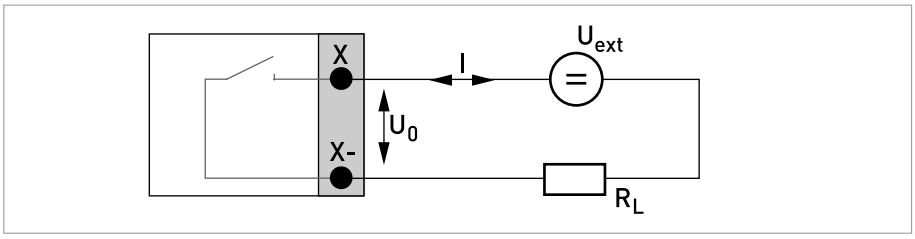


Figure 4-17: Status output / limit switch passive S_p

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

- Any connection polarity.
- Connection in conformity with EN 60947-5-6
- open:
  I_{nom} = 0.6 mA
  closed:
  I_{nom} = 3.8 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.

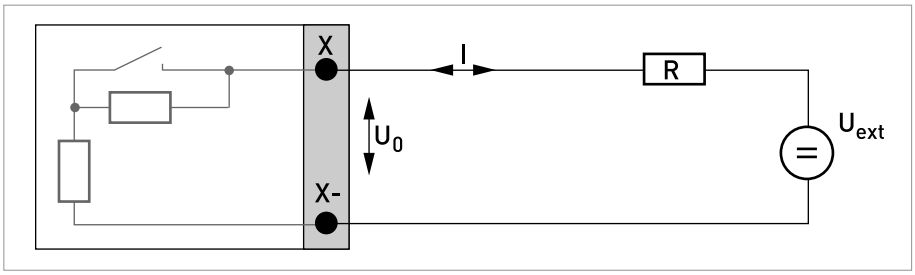


Figure 4-18: Status output / limit switch S_N acc. to NAMUR EN 60947-5-6

CAUTION!
Observe connection polarity.

Control input active, modular I/Os

- U_{int} = 24 VDC
- External contact open:
  $U_{0, nom}$ = 22 V
  External contact closed:
  I_{nom} = 4 mA
- Switching point for identifying "contact open or closed":
  Contact open (off): $U_0 \leq 10$ V with I_{nom} = 1.9 mA
  Contact closed (on): $U_0 \geq 12$ V with I_{nom} = 1.9 mA
- X designates the connection terminals A or B, depending on the version of the signal converter.

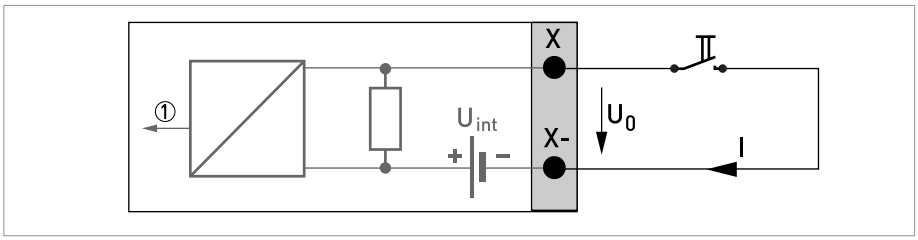


Figure 4-19: Control input active C_a

① Signal

Control input passive, modular I/Os

- 3 V ≤ U_{ext} ≤ 32 VDC
- I_{max} = 9.5 mA at $U_{ext} \leq 24$ V
  I_{max} = 9.5 mA at $U_{ext} \leq 32$ V
- Switching point for identifying "contact open or closed":
  Contact open (off): $U_0 \leq 2.5$ V with I_{nom} = 1.9 mA
  Contact closed (on): $U_0 \geq 3$ V with I_{nom} = 1.9 mA
- X designates the connection terminals A or B, depending on the version of the signal converter.

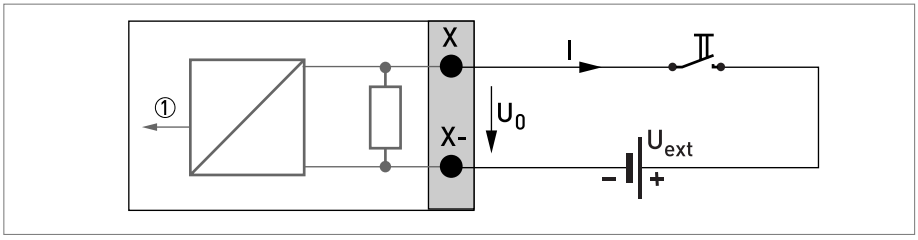


Figure 4-20: Control input passive C_p

① Signal

CAUTION!
Observe connection polarity.

Control input active C_N NAMUR, modular I/Os

- Connection acc. to EN 60947-5-6
- Switching point for identifying "contact open or closed":
  Contact open (off): $U_{0,\ nom}$ = 6.3 V with I_{nom} < 1.9 mA
  Contact closed (on): $U_{0,\ nom}$ = 6.3 V with I_{nom} > 1.9 mA
- Detection of cable break:
  $U_0 \geq 8.1$ V with $I \leq 0.1$ mA
- Detection of cable short circuit:
  $U_0 \leq 1.2$ V with $I \geq 6.7$ mA
- X designates the connection terminals A or B, depending on the version of the signal converter.

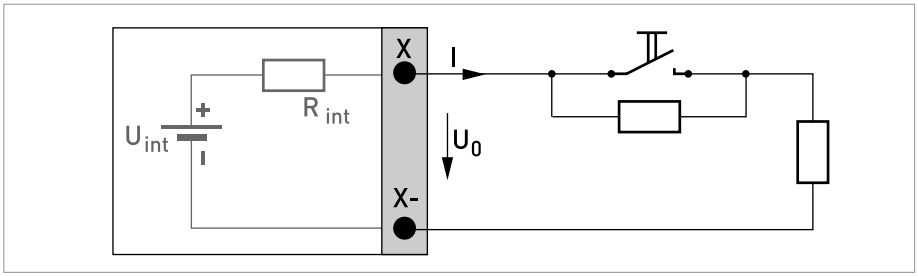


Figure 4-21: Control input active C_N acc. to NAMUR EN 60947-5-6

4.7.5 Ex i inputs/outputs

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

INFORMATION!
For further information on electrical connection refer to Description of the inputs and outputs on page 39.

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

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

- Observe connection polarity.
- $U_{int, nom}$ = 20 VDC
- I ≤ 22 mA
- R_L ≤ 450 Ω
- X designates the connection terminals A or C, depending on the version of the signal converter.

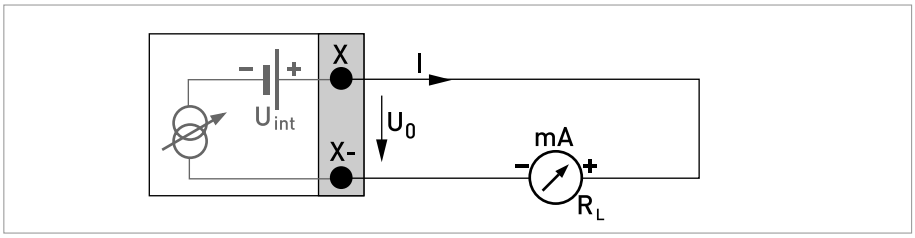


Figure 4-22: Current output active I_a Ex i

Current output passive (only current output terminals C/C- have generic HART® capability), Ex i I/Os

- Any connection polarity.
- $U_{ext} \leq 32$ VDC
- $I \leq 22$ mA
- $U_0 \geq 4$ V
- $R_{L, max} = (U_{ext} - U_0 / I_{max}$
- X designates the connection terminals A or C, depending on the version of the signal converter.

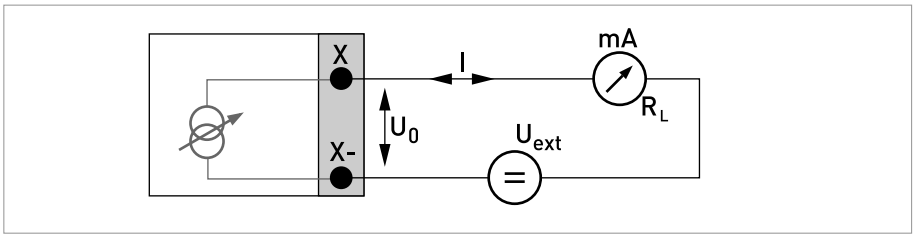


Figure 4-23: Current output passive I_p Ex i

Pulse and frequency output passive P_N NAMUR, Ex i I/Os

- Connection acc. to EN 60947-5-6
- open:
  I_{nom} = 0.43 mA
  closed:
  I_{nom} = 4.5 mA
- X designates the connection terminals B or D, depending on the version of the signal converter.

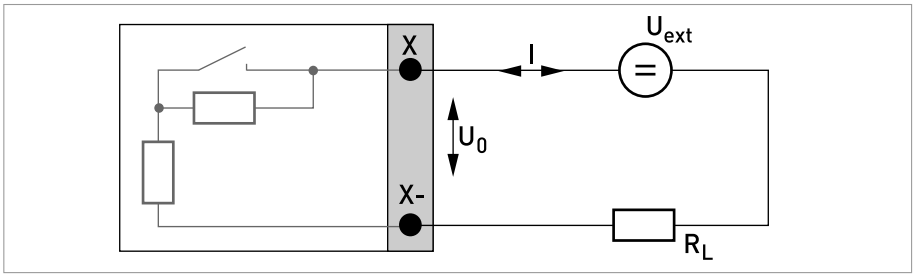


Figure 4-24: Pulse/frequency output passive P_N acc. to NAMUR EN 60947-5-6 Ex i

INFORMATION!

- *Any connection polarity.*

Control input passive, Ex i I/Os

- 5.5 V ≤ U_{ext} ≤ 32 VDC
- I_{max} = 6 mA at U_{ext} ≤ 24 V
  I_{max} = 6.5 mA at U_{ext} ≤ 32 V
- Switching point for identifying "contact open or closed":
  Contact open (off): U_0 ≤ 3.5 V with I ≤ 0.5 mA
  Contact closed (on): U_0 ≥ 5.5 V with I ≥ 4 mA
- X designates the connection terminals B, if available.

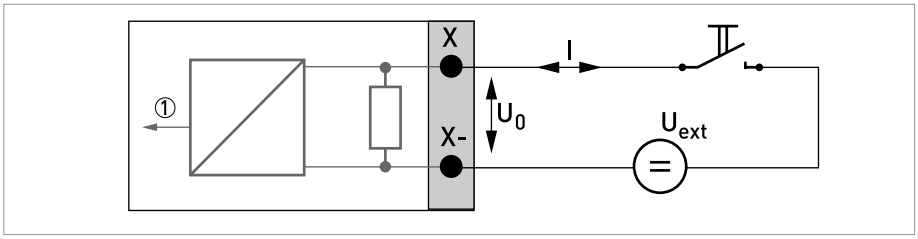


Figure 4-25: Control input passive C_p Ex i

① Signal

INFORMATION!

- *Any connection polarity.*

Status output/limit switch S_N NAMUR, Ex i I/Os

- Connection acc. to EN 60947-5-6
- open:
  I_{nom} = 0.43 mA
  closed:
  I_{nom} = 4.5 mA
- The output is closed when the device is de-energized.
- X designates the connection terminals B or D, depending on the version of the signal converter.

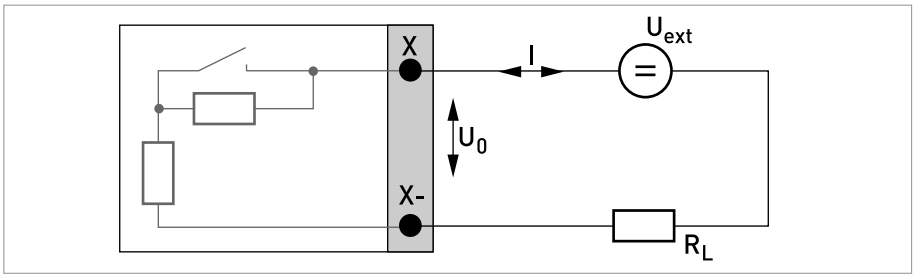


Figure 4-26: Status output / limit switch S_N acc. to NAMUR EN 60947-5-6 Ex i

4.7.6 HART® connection

INFORMATION!

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

HART® connection active (point-to-point)

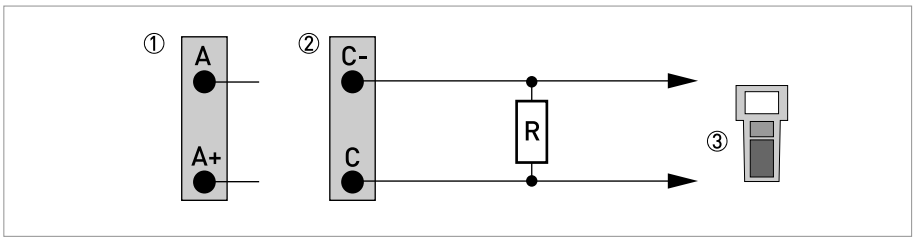


Figure 4-27: HART® connection active (I_a)

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

The parallel resistance to the HART® communicator must be R ≥ 230 Ω.

HART® connection passive (Multi-Drop mode)

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

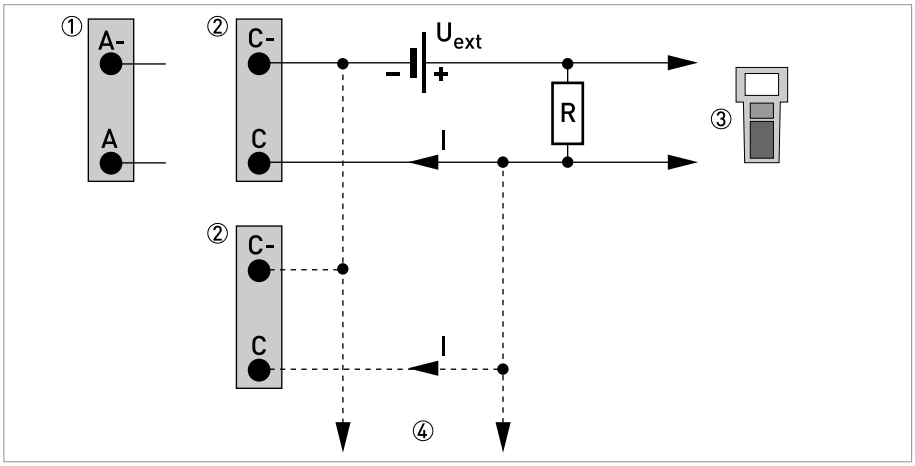


Figure 4-28: HART® connection passive (I_p)

① Basic I/O: terminals A- and A
② Modular I/O: 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.

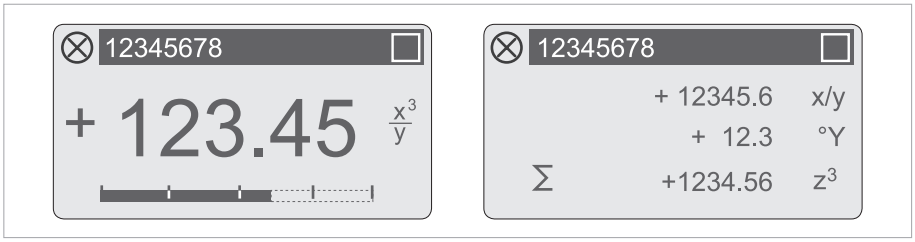


Figure 5-1: Displays in measuring mode (examples for 2 or 3 measured values)
x, y and z denote the units of the measured values displayed

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 ↑ and ↓. For possible status messages, their meaning and cause refer to *Status messages and diagnostic information* on page 89 .

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 mechanically safe and mounted in compliance with the regulations.
- The power connections must have been made in compliance with the regulations.
- The electrical terminal compartments must be secured and the covers have 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

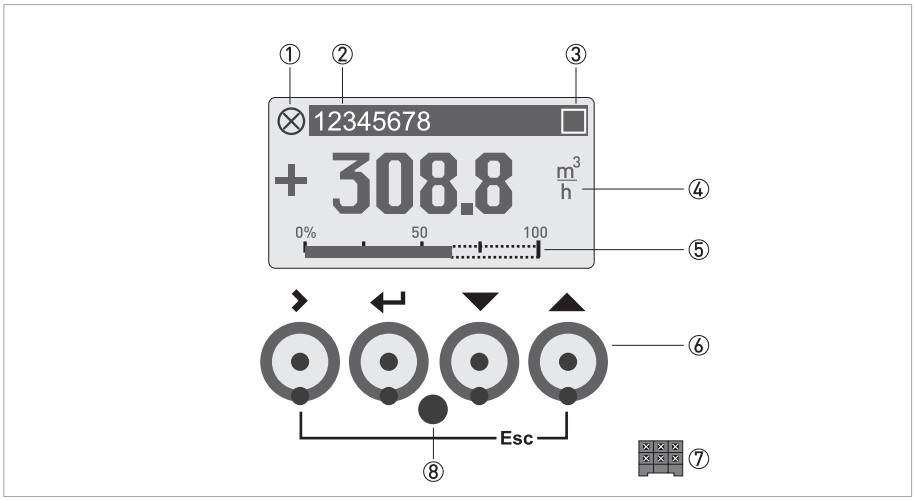


Figure 6-1: Display and operating elements (Example: flow indication with 2 measuring values)

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 Bargraph 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 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.*
- *Step over from optical- to push buttons is directly possible. After using push buttons, wait several minutes before the optical buttons become active again.*

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

6.1.1 Display in measuring mode with 2 or 3 measured values

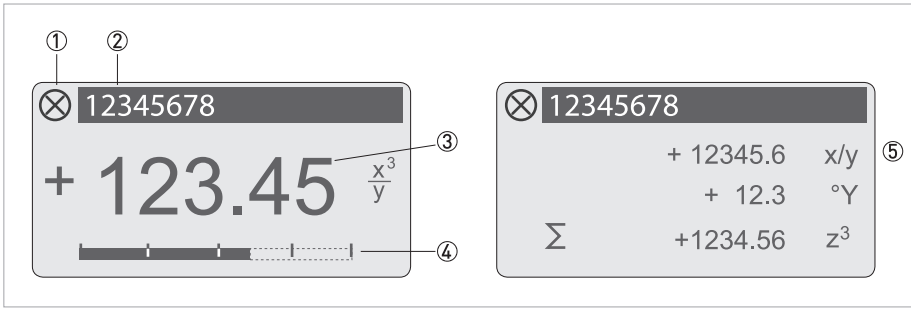


Figure 6-2: Example for display in measuring mode with 2 or 3 measured values

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 1st measured variable in large representation
④ Bargraph indication
⑤ Depiction with 3 measured values

6.1.2 Display for selection of submenu and functions, 3 lines

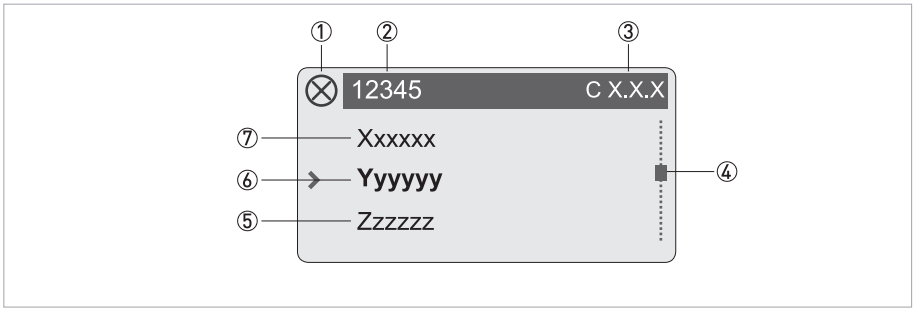


Figure 6-3: Display for selection of submenu and functions, 3 lines

① Indicates a possible status message in the status list
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)

6.1.3 Display when setting parameters, 4 lines

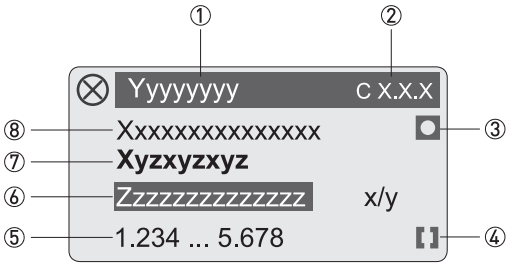


Figure 6-4: Display when setting parameters, 4 lines

① Current menu(s), submenu or function
② Number relating to ⑦
③ Denotes factory setting
④ Denotes permissible value range
⑤ Permissible value range for numeric values
⑥ Currently set value, unit or function (when selected, appears with white text, blue background) This is where the data is changed.
⑦ Current parameter
⑧ Factory setting of parameter

6.1.4 Display when previewing parameters, 4 lines

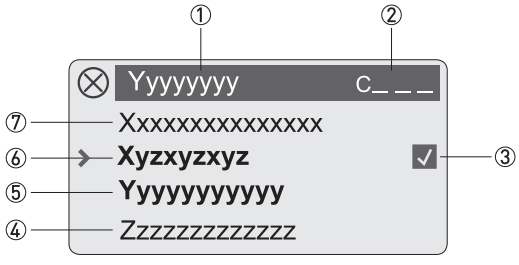


Figure 6-5: Display when previewing parameters, 4 lines

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

6.1.5 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.*

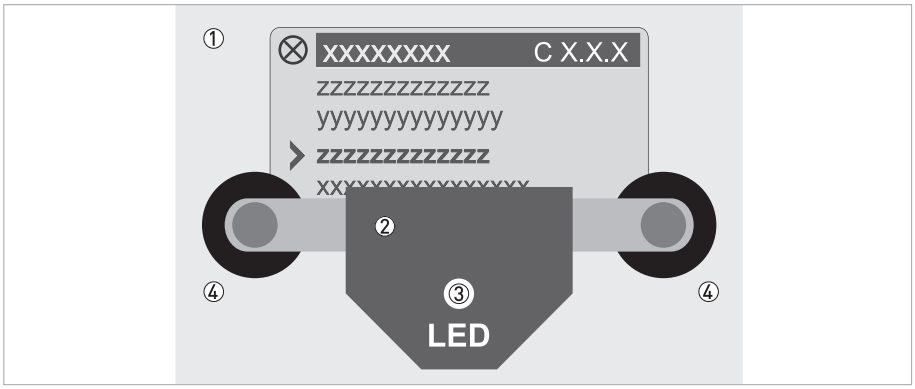


Figure 6-6: IR interface

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		
						A3.4 Totaliser 3		
				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				
		↓ ↑		↓ ↑		↓ ↑		↓ ↑ >

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 Proces input		
						B3.5 SW.REV. MS		
						B3.6 SW.REV. UIS		
						B3.8 Electronic Revision		
						B3.9 Change log		
		↓ ↑		↓ ↑		↓ ↑		↓ ↑ >

Measuring mode	Select menu		Select menu and/or sub-menu				Select function and set data
↵	Press > 2.5 s						
	C setup	> ↵	C1 process input	> ↵	C1.1 meter size	> ↵	
					C1.2 calibration		
					C1.3 filter		
					C1.4 plausibility		
					C1.5 simulation		
					C1.6 information		
					C1.7 linearization		
					C1.8 pipe temperature		
					C1.9 density		
					C1.10 diagnosis		
			C2 I/O (input/output)	> ↵	C2.1 hardware		
					current output X		
					control input X		
					C2._ status output X		
					C2._ limit switch X		
					frequency output X		
					pulse output X		
			C3 I/O totalizers	> ↵	C3.1 totalizer 1		
					C3.2 totalizer 2		
					C3.3 totalizer 3		
			C4 I/O HART	> ↵	C4.1 PV is		
					C4.2 SV is		
					C4.3 TV is		
					C4.4 QV is		
					C4.5 HART units		
			C5 device	> ↵	C5.1 device info		
					C5.2 display		
					C5.3.1. meas. page		
					C5.4.2. meas. page		
					C5.5 graphic page		
					C5.6 special functions		
					C5.7 units		
					C5.8 HART		
					C5.9 quick setup		
	↓↑		↓↑		↓↑		↓↑ >

6.3 Function tables

INFORMATION!

- *The following tables describe the functions of the standard device with HART® connection. The functions for Modbus, Foundation Fieldbus and Profibus are described in detail in the corresponding supplementary instructions.*
- *Depending on the device version, not all functions are available.*

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	
A3.1	Reset Errors	Reset Errors? Select: no/yes
A3.2	Totaliser 1	Reset Totaliser? Select: No / Yes
A3.3	Totaliser 2	Reset Totaliser? Select: No / Yes
A3.4	Totaliser 3	Reset Totaliser? Select: No / Yes
A4 Analogue Outputs (only for HART®)		
A4	Analogue 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!
A4 Station Address		
A4	Station Address	For Profibus / FF / Modbus devices.

No.	Function	Setting / Description

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...A5.5!) 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

A6.0	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)

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
B2.4	Act. flow speed	Displays current unfiltered flow speed
	B2.4.1 path 1	Value path 1
	B2.4.2 path 2	Value path 2
B2.5	Act. gain	Displays current unfiltered gain
	B2.5.1 path 1	Value path 1
	B2.5.2 path 2	Value path 2
B2.6	Act. SNR	Displays current unfiltered SNR
	B2.6.1 path 1	Value path 1
	B2.6.2 path 2	Value path 2
B2.7	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
B3.7	"Bus interface"	Only appears with Profibus, Modbus and FF
	B3.7.0 Profibus	Displays information of the Profibus interface
	B3.7.0 Foundation Field Bus	Displays information of the Foundation Fieldbus interface
	B3.7.0 Modbus	Displays information of the Modbus 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.

6.3.3 Menu C; setup

	Function	Settings / descriptions

C1 Setup

C1.0 Process Input

C1.1	Meter size	Sets the pipe diameter
C1.2	Calibration	Zero Offset
C1.2.1	Zero Calibration	Direct setting of zero offset
C1.2.2	GK	Sets the meter factor
C1.3	Filters	
C1.3.1	Limitation	Limits for the flow speed
C1.3.2	Flow Direction	Set 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 the error limit in percentage of the measured value: exceeding values will be discarded and plausibility counter increased
C1.4.2	Counter decrease	Sets the decrease of the plausibility counter when the measurement is within limits
C1.4.3	Counter limit	Sets the limit for the plausibility counter for which measurements will not be disccarded

	Function	Settings / descriptions
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	
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 at different Reynolds numbers
C1.7.2	Dynamic viscosity	Sets the value of the dynamic viscosity for Reynolds calculation
C1.8	Pipe temperature	Temperature compensation
C1.9	Density	Sets the 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), velocity of sound (1-2)
C1.10.2	Diagnosis 2	Sets the parameter to be assigned to cyclic value ; none, gain (1-2), SNR (1-2)
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"

No.	Function	Settings / descriptions

C2.0.0 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.
C2.2.6	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._ Frequency Output A

C2._.1	Pulse Shape	Pulse shape of frequency A
C2._.2	Pulse Width	Pulse width of frequency A
C2._.3	100% Pulse Rate	Pulse rate for 100% of the measuring range for frequency output A;
		Range: 1...10000 Hz
		Limitation 100% Pulse Rate ≤ 100/s: Imax ≤ 100 mA Limitation 100% Pulse Rate > 100/s: Imax ≤ 20 mA
C2._.4	Measurement	Measurements for activating the output.
		Select measurement: Volume Flow / Mass Flow / Velocity of sound / flow speed / Gain / SNR / diagn flow speed, diagn VoS, diagn gain, diagn SNR.
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: 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._.7	Limitation	Limitation before applying the time constant.
		±xxx ... ±xxx%; range: -150...+150%
C2._.8	Low Flow Cutoff	Sets the measurement to "0" for low values
		x.xxx ± x.xxx%; range: 0.0...20%
		(1st value = switching point / 2nd value = hysteresis), condition: 2nd value ≤ 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._.11	Special Functions	This function is only available at the terminal B frequency output. At the same time, 2 frequency outputs must be available: 1st output at terminal A or D / 2nd output at terminal B
		The B output is operated as a slave output, controlled and set using master output A or D
		Select: Off (no phase shift) / Phase Shift w.r.t. D or A (slave output is B and master output is D or A)
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 Tp [ms] ≤ 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 ≤ 100/s: I_{max} ≤ 100 mA Limitation 100% pulse rate > 100/s: I_{max} ≤ 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 ± x.xxx%; range: 0.0…20%
		(1st value = switching point / 2nd value = hysteresis), condition: 2nd value ≤ 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._.11	Phase Shift w.r.t. B	Only available when configuring the A or D terminal and only if output B is a pulse or frequency output. If setting in Fct. C2.2.7 is "Both Polarities", the phase shift is prefixed by a symbol, e.g. -90° and +90°
		Select: Off (no phase shift) / 0° Phase Shift (between outputs A or D and B, inversion possible) / 90° Phase Shift (between outputs A or D and B, inversion possible) / 180° Phase Shift (between outputs A or D and B, inversion possible)
C2.x.x	Special Functions	This function is only available at the pulse output of terminal B. At the same time, 2 pulse outputs must be available: 1st output at terminal A or D / 2nd output at terminal B
		The B output is operated as a slave output, controlled and set using master output A or D
		Select: Off (no phase shift) / Phase Shift w.r.t. D or A (slave output is B and master output is D or A)
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._	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 *Status messages and diagnostic information* on page 89)/ Application Failure (output set, signals status of category "Error in Device" or "Application Failure" refer to *Status messages and diagnostic information* on page 89) / 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 *Status messages and diagnostic information* on page 89)	
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._ Limit Switch

C2._	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
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)
C2._.4	Time Constant	Range: 000.1…100 s
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
C2._.7	Simulation	Sequence see B1._ Limit Switch X

C2._ Control Input

C2._	Control Input X	
C2._.1	Mode	X stands for connection terminal A or B
	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	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

No.	Function	Settings / descriptions

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?
		Select: Select: No (exit function without setting the value) / Yes (sets the totaliser and exits the function)
	C3._.8 Stop Totaliser	Totaliser _ stops and holds the current value.
		Select: No (exits the function without stopping the totaliser) / Yes (stops the totaliser and exits the function)
	C3._.9 Start Totaliser	Start Totaliser _ after that totaliser is stopped
		Select: No (exits the function without starting the totaliser) / Yes (starts the totaliser and exits the function)
	C3._.10 Information	Serial no. of the I/O board, software version no. and production date of the circuit board

No.	Function	Settings / descriptions

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

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
		Select: On / Off

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
		±xxx ... ±xxx%; range: -150…+150%
	C5._.5 Low Flow Cutoff	Sets low flow values to "0"
		x.xxx ± x.xxx %; Range: 0.0…20 %
		(1st value = switching point / 2nd value = hysteresis), condition: 2nd value ≤ 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.XXXXXXXX (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.XXXXXXXX (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	Specify decimal places.
		Select: Automatic (adaptation is automatic) / X (= none) …X.XXXXXXXX (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.
		±xxx ±xxx%; range: -100…+100%
		(1st value = lower limit / 2nd value = upper limit), condition: 1st value ≤ 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 done afterwards) Select: No (exit function without saving) / Yes (copy current settings to storage backup 1 or backup 2)
	C5.6.3 Load Settings	Load saved settings Select: Break (exit function without loading) / factory settings (restore factory settings) / backup 1 (load data from storage location 1) / backup 2 (load data from storage location 2)
		Query: Continue To Copy? (cannot be done afterwards) Select: No (exit the function without saving) / Yes (load data from the selected storage location)
	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 *Set free units* on page 84:
	C5.7.4 [m^3/s]*Factor	Specification of the conversion factor, based on m^3/s:
		xxx.xxx refer to *Set free units* on page 84
	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 *Set free units* on page 84:
	C5.7.7 [kg/s]*Factor	Specification of the conversion factor, based on kg/s:
		xxx.xxx refer to *Set free units* on page 84
	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 *Set free units* on page 84:
	C5.7.11 [m^3]*Factor	Specification of the conversion factor, based on m^3:
		xxx.xxx refer to *Set free units* on page 84
	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 *Set free units* on page 84:
	C5.7.14 [kg]*Factor	Specification of the conversion factor, based on kg:
		xxx.xxx refer to *Set free units* on page 84
	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 *Set free units* on page 84:
	C5.7.17 [kg/m^3]*Factor	Specification of the conversion factor, based on kg/m^3:
		xxx.xxx refer to *Set free units* on page 84
	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
	C5.8.2Address	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)
	C5.9.3 Reset Totaliser 3	Reset Totaliser 3 in Quick Setup menu?
		Select: Yes (activated) / No (switched off)

6.3.4 Set free units

Free units	Sequences to set texts and factors
Texts	
Volume flow, mass flow and density	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	= [unit see above] * conversion factor
Conversion factor	Max. 9 digits
Shift decimal point	↑ to the left and ↓ to the right

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.

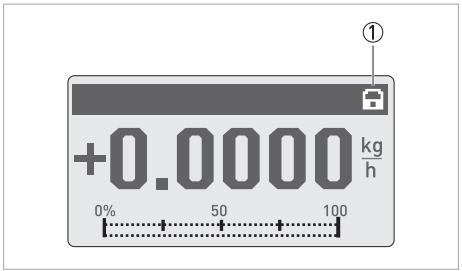
Key	Display	Description and setting
>	Quick Setup	Press and hold for 2.5 s, then release the key.
>	Language	-
2 x ↓	Reset	-
>	Reset Errors	-
>	Reset? No	-
↓ or ↑	Reset? Yes	-
↵	Reset Errors	Error has been reset.
3 x ↵	Measuring mode	-

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 Optical keys

This function can deactivate the optical keys. In the display, the switched off state of the optical keys is represented by a lock ①.



.

6.4.5 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 C5.5.1 defines the range for the trend indicator (manual or automatic).
- Menu C5.5.2 defines the range for manual setting.
- Menu C5.5.3 defines the time span for the trend indicator.

6.4.6 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

6.4.7 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

6.4.8 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.

6.4.9 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 C5.6.6 can be used to set the date and time of the real time clock.

6.4.10 Quick Access

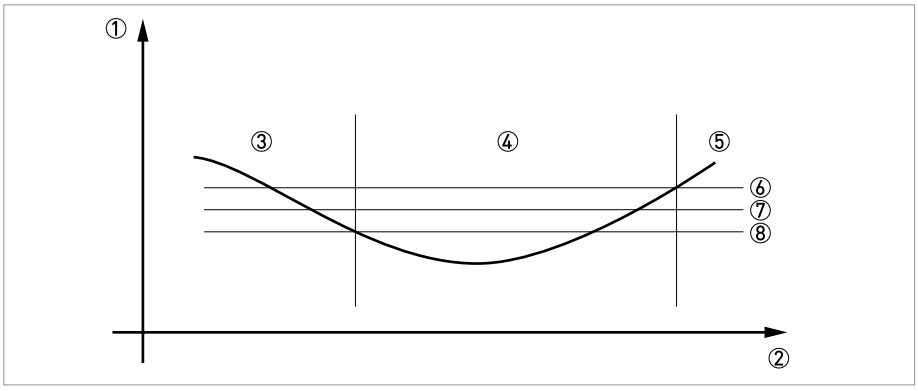
In measuring mode, pressing the ↵ key for 2.5 seconds carries out the "Quick Access" function. Totalisers 1, 2, 3 and All Totalisers can be reset.

6.4.11 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 hysterisis. Condition: 1st value > 2nd value



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

6.4.12 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.

6.4.13 Dual phase pulse output

A dual phase pulse or frequency output is possible. This operating mode requires 2 terminal pairs. Terminal pairs A and B or D and B can be used.

In this case, perform the following settings:

- C2.3.11: Phase shift to D or shift to A
- All functions for output B are set using output D or output A.
- C2.5.11: Setting phase shift from output B relative to D, if terminal pair D was selected in C2.3.11. 0°, 90° or 180° are offered as options.

6.4.14 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.

GDC IR Interface: If the GDC-IR connection is activated, it is cancelled after 60 seconds if no connection is established. If the connection is interrupted, the display can be operated again after 60 seconds using the optical keys.

6.4.15 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 C2.1.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 ...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.

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.	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	Simulation of volume flow, mass flow.	Switch off measured value simulation.
		VoS Simulation Active	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			
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		
		IO A Overrange	The output value is limited by a filter.	Check the range setting of the output.
		IO B Overrange		
		IO C Overrange		
		IO D Overrange		
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		
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 "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			
		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	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	No signal present in path 1 (2,3) of the sensor.	Remove the dampening or blockage in path 1 (2,3) in the sensor
		Signal lost path 2		
S	S Proc: Signal unreliable			
		Path 1 unreliable	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		
		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	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. C.y.9 (Start Totaliser).
		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 approx. 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.

7.2.1 Repairs

Repairs may be carried out exclusively by the manufacturer or the manufacturer authorised specialist companies.

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.

CAUTION!
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.*

CAUTION!
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 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:
Tel. no.:		Fax no. and/or Email address:
Manufacturer's order no. or serial no.:		
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 through any residual media contained in the device when it is returned.		
Date:		Signature:
Stamp:		

7.4 Disposal

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

Separate collection of WEEE (Waste Electrical and Electronic Equipment) in the European Union:

According to the directive 2012/19/EU, 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 mean flow velocity of the medium.

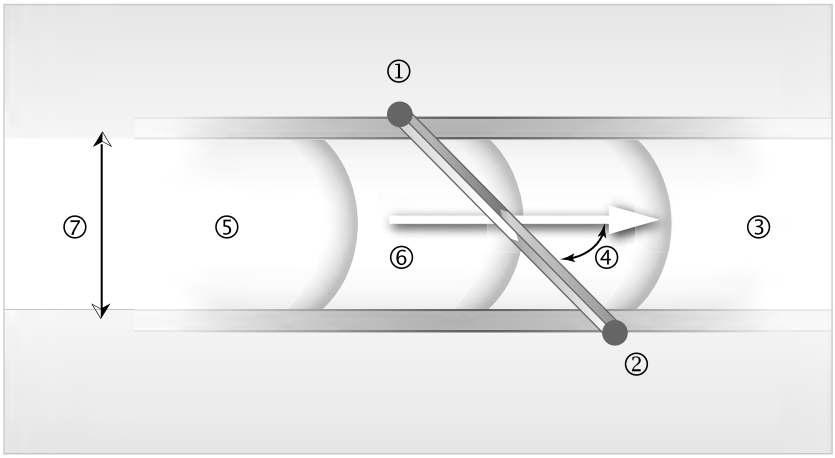


Figure 8-1: Measuring principle

① Transducer (wave guide) A
② Transducer (wave guide) 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 (Downloadcenter).*

Measuring system

Measuring principle	Ultrasonic transit time
Application range	Flow measurement of (non) conductive fluids
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	High Pressure : 1 or 2 parallel acoustic path(s), fully welded
	High Temperature : 1 or 2 parallel acoustic path(s)
Modular construction	The measurement system consists of a measuring sensor and a signal converter.
Compact version	OPTISONIC 4400 High Pressure
Remote version	OPTISONIC 4000 F High Pressure with UFC 400 signal converter
	OPTISONIC 4000 F High Temperature with UFC 400 signal converter
Nominal diameter	1 path: DN25...65 / 1...2,5"
	2 paths: DN80...1000 / 3...40" - (DN80 / 3"; 150, 300 lb)
Measurement range	0.5...20 m/s / 1.65...66 ft/s, bi-directional
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)
Counters	2 (optional 3) internal counters with a max. of 8 digits (e.g. for counting volume and/or mass units)
Self-diagnostics	Integrated verification, diagnostic functions: flowmeter, process, measured values, bargraph, device configuration, etc.
Communication interfaces	HART® 7, Foundation Fieldbus ITK6, Profibus PA /DP, Profile 3.02, Modbus RS485

Display and user interface	
Graphic display	LC display, backlit white
	Size: 128x64 pixels, corresponds to 59x31 mm = 2.32"x1.22"
	Display turnable in 90° steps.
Operating elements	4 optical and push buttons for operator control of the signal converter without opening the housing.
	Option: Infrared interface (GDC)
Remote operation	PACTware™ including Device Type Manager (DTM)
	HART® handheld communicator (Emerson), AMS (Emerson), PDM (Siemens)
	All DTM's and drivers will be available at the internet homepage of the manufacturer.
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	English, French, German, Dutch, 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, HART® or via other bus interface
	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	10 DN
Maximum measuring error	
HT version	1 path: ±1% of actual measured value ±10 mm/s
	2 paths: ±0.5% of actual measured value ±5 mm/s
	DN25 HT: ±2.5% of actual measured value ±25 mm/s
HP version	±1% of actual measured value ±10 mm/s
Repeatability	1 path: ±0.6%
	2 paths: ±0.3%

Operating conditions

Temperature	
Process temperature	
High pressure version	**Compact version:** -45...+140°C / -49...+284°F
	Remote version: -45...+180°C / -49...+356°F
High temperature version	**Remote version in general area:** -45...+600°C / -49...+1112°F **Remote version in hazardous area:** -45...+440°C / -49...+824°F
For carbon steel flanges min. process temperature acc. to ASME: -29 °C / -20 °F	
Ambient temperature	Sensor; -40…+70°C / -40…+158°F
	Signal converter; -40…+65°C / -40…+149°F
	Option (stainless steel converter housing): -40...+60°C / -40...+140°F
	Ambient temperatures below -25°C / -13°F may affect the readability of the display.
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	
ASME B16.5	
High temperature version:	DN25...300 / 1…12": 150...600 lb RF, 600 RTJ, 900 lb RTJ
	DN350...600 / 14…24": 150...600 lb RF, 600 lb RTJ
	Larger diameters and higher pressure ratings on request
High pressure version:	DN25...50 / 1…2": 1500 lb RTJ
	DN80, 200 / 3... 8": 2500 lb RTJ
	Larger diameters and higher pressure ratings on request.
EN 1092-1	On request
Design specification for pressure and temperature according to ASME	
OPTISONIC 4000 (F) :	HT at a temperature of : 250°C max 190 bar / 540°C max 160 bar / 600°C max 60 bar 482°F max 2756 psi / 1004°F max 2321 psi / 1112°F max 870 psi
OPTISONIC 4000 (C/F)	HP at a temperature of : 20°C max 490 bar / 140°C max 440 bar / 180°C max 420 bar 68°F max 7107 psi / 284°F max 6382 psi / 356°F max 6092 psi
DIN	On request
Properties of medium	
Physical condition	Liquid, single phase (well mixed, rather clean)
Permissible gas content	≤ 2% (volume)
Permissible solid content	≤ 5% (volume)
Viscosity	Maximum viscosity : on request

Installation conditions

Installation	For detailed information refer to *Installation* on page 18.
Inlet run	2 paths: 10 DN (straight inlet)
	1 path: 20 DN (straight inlet)
	If no details are known, minimal 20 DN recommended
Outlet run	Minimal 3 DN (straight outlet)
	If no details are known, minimal 5 DN recommended
Dimensions and weights	For detailed information refer to *Dimensions and weights* on page 111.

Materials

Measuring sensor	
Flanges (wetted)	HT version: DN25...1000 / 1"...40", Standard: Carbon steel ASTM A105N Option: Stainless steel AISI 316(L)
	HP version: DN25...200 / 1"...8", Stainless steel AISI 316 (L)
	Other materials on request.
Measuring Tube (wetted)	HT version: DN25...1000 / 1"...40", Standard: Carbon steel ASTM A106 gr B Option: Stainless steel AISI 316(L)
	HP version: DN25...200 / 1"...8": Stainless steel AISI 316 (L)
	Other materials on request.
Sensor conduits	Stainless steel 1.4404 (AISI 316L)
Sensor neck	Stainless steel AISI 316 (1.4408)
Transducers (wetted) HT version:	Stainless steel (321(H))
	Other materials on request.
HP version:	Stainless steel 1.4404 (AISI 316L)
Transducer holders	HP only: stainless steel 1.4404 (AISI 316L) (same material as flanges)
Transducer nozzles	Stainless steel (AISI 316L)
Transducer counter flanges	HT only: Stainless steel 1.4404 (AISI 316L)
Transducer gaskets,	HT only: Spiral wound graphite / SS for hydrocarbons up to 450°C.
	For higher temperatures: depending on application, consult Krohne.
Connection box (remote version only)	Standard: Die-cast aluminium; coated
	Option: Stainless steel 316 (1.4408)
Coating (measuring sensor)	HT version; blasted; corrosion preservative
	Option: coating on request
	HP version: coated
	Option: Offshore coating
NACE conformity	Wetted transducers conform NACE MR 175/103 and ISO 15156
	Option: measuring tube and flanges on request
Signal converter	
Housing	Versions C and F: Die-cast aluminum
	Option: Stainless steel 316 (1.4408)
Coating	Standard
	Option: Offshore coating

Electrical connections

Description of used abbreviations; Q=xxx; I_{max} = maximum current; Ui_n = xxx; U_{int} = internal voltage; U_{ext} = external voltage; $U_{int, max}$ = 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
	Option: 24 VAC/DC (AC: -15% / +10%; DC: -25% / +30%)
Power consumption	AC: 22 VA
	DC: 12 W
Signal cable (remote version only)	Shielded cable with 4 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	U_{ext} = external voltage; R_L = load + resistance; U_0 = terminal voltage; I_{nom} = nominal current Safety limit values (Ex i): U_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 1, 2, 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**	**Ex i**
Active	$U_{int, nom}$ = 24 VDC I ≤ 22 mA R_L ≤ 1 kΩ		$U_{int, nom}$ = 20 VDC I ≤ 22 mA R_L ≤ 450 Ω
			U_0 = 21 V I_0 = 90 mA P_0 = 0.5 W C_0 = 90 nF / L_0 = 2 mH C_0 = 110 nF / L_0 = 0.5 mH
Passive	U_{ext} ≤ 32 VDC I ≤ 22 mA U_0 ≥ 1.8 V $R_{L, max}$ = (U_{ext} - U_0 / I_{max}		U_{ext} ≤ 32 VDC I ≤ 22 mA U_0 ≥ 4 V $R_{L, max}$ = (U_{ext} - U_0 / I_{max}
			U_i = 30 V I_i = 100 mA P_i = 1 W C_i = 10 nF L_i ~ 0 mH

HART®			
Description	HART® protocol via active and passive current output		
	HART® version: V7		
	Universal HART® parameter: completely integrated		
Load	≥ 250 Ω t HART® test point: Note maximum load for current output!		
Multidrop	Yes, current output = 4 mA		
	Multidrop addresses adjustable in operation menu 1...15		
Device drivers	DD for FC 375/475, AMS, PDM, DTM for FDT		
Pulse or frequency output			
Output data	Volume flow, mass flow		
Function	Adjustable as pulse of frequency output		
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	Ex i
Active	-	U_{nom} = 24 VDC	-
		f_{max} in operating menu set to: **$f_{max} \leq$ 100 Hz:** I ≤ 20 mA $R_{L, max}$ = 47 kΩ open: I ≤ 0.05 mA closed: $U_{0,nom}$ = 24 V at I = 20 mA	
		F_{max} in operating menu set to: **100 Hz < $f_{max} \leq$ 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: $U_{0,nom}$ = 22.5 V at I = 1 mA $U_{0,nom}$ = 21.5 V at I = 10 mA $U_{0,nom}$ = 19 V at I = 20 mA	

<table>
<tr><td rowspan="2">Passive</td><td colspan="2">$U_{ext} \leq 32$ VDC</td><td rowspan="2">-</td></tr>
<tr><td colspan="2">f_{max} in operating menu set to:
$f_{max} \leq$ 100 Hz:

$I \leq 100$ mA

$R_{L, max} = 47$ kΩ
$R_{L, max} = (U_{ext} - U_0) / I_{max}$

open:
$I \leq 0.05$ mA at $U_{ext} = 32$ VDC
closed:
$U_{0, max} = 0.2$ V at $I \leq 10$ mA
$U_{0, max} = 2$ V at $I \leq 100$ mA</td></tr>
<tr><td></td><td colspan="2">f_{max} in operating menu set to:
100 Hz < $f_{max} \leq$ 10 kHz:

$I \leq 20$ mA

$R_L \leq 10$ kΩ for $f \leq 1$ kHz
$R_L \leq 1$ kΩ for $f \leq 10$ kHz
$R_{L, max} = (U_{ext} - U_0) / I_{max}$

open:
$I \leq 0.05$ mA at $U_{ext} = 32$ VDC
closed:
$U_{0, max} = 1.5$ V at $I \leq 1$mA
$U_{0, max} = 2.5$ V at $I \leq 10$ mA
$U_{0, max} = 5.0$ V at $I \leq 20$ mA</td></tr>
<tr><td rowspan="2">NAMUR</td><td rowspan="2">-</td><td rowspan="2">Passive to
EN 60947-5-6

open:
$I_{nom} = 0.6$ mA
closed:
$I_{nom} = 3.8$ mA</td><td>Passive to
EN 60947-5-6

open:
$I_{nom} = 0.43$ mA
closed:
$I_{nom} = 4.5$ mA</td></tr>
<tr><td>$U_i = 30$ V
$I_i = 100$ mA
$P_i = 1$ W
$C_i = 10$ nF
$L_i = 0$ mH</td></tr>
</table>

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	Ex i
Active	-	U_{int} = 24 VDC I ≤ 20 mA $R_{L, max}$ = 47 kΩ open: I ≤ 0.05 mA closed: $U_{0, nom}$ = 24 V at I = 20 mA	-
Passive	U_{ext} ≤ 32 VDC I ≤ 100 mA $R_{L, max}$ = 47 kΩ $R_{L, max}$ = (U_{ext} - U_0) / I_{max} open: I ≤ 0.05 mA at U_{ext} = 32 VDC closed: $U_{0, max}$ = 0.2 V at I ≤ 10 mA $U_{0, max}$ = 2 V at I ≤ 100 mA	U_{ext} = 32 VDC I ≤ 100 mA $R_{L, max}$ = 47 kΩ $R_{L, max}$ = (U_{ext} - U_0) / I_{max} open: I ≤ 0.05 mA at U_{ext} = 32 VDC closed: $U_{0, max}$ = 0.2 V at I ≤ 10 mA $U_{0, max}$ = 2 V at I ≤ 100 mA	-
NAMUR	-	Passive to EN 60947-5-6 open: I_{nom} = 0.6 mA closed: I_{nom} = 3.8 mA	Passive to EN 60947-5-6 open: I_{nom} = 0.43 mA closed: I_{nom} = 4.5 mA U_i = 30 V I_i = 100 mA P_i = 1 W C_i = 10 nF L_i = 0 mH

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	Ex i
Active	-	U_{int} = 24 VDC Terminals open: $U_{0, nom}$ = 22 V Terminals bridged: I_{nom} = 4 mA On: $U_0 \geq$ 12 V with I_{nom} = 1.9 mA Off: $U_0 \leq$ 10 V with I_{nom} = 1.9 mA	-
Passive	$U_{ext} \leq$ 32 VDC I_{max} = 6.5 mA at $U_{ext} \leq$ 24 VDC I_{max} = 8.2 mA at $U_{ext} \leq$ 32 VDC Contact closed (On): $U_0 \geq$ 8 V with I_{nom} = 2.8 mA Contact open (Off): $U_0 \leq$ 2.5 V with I_{nom} = 0.4 mA	$U_{ext} \leq$ 32 VDC I_{max} = 9.5 mA at $U_{ext} \leq$ 24 V I_{max} = 9.5 mA at $U_{ext} \leq$ 32 V Contact closed (On): $U_0 \geq$ 3 V with I_{nom} = 1.9 mA Contact open (Off): $U_0 \leq$ 2.5 V with I_{nom} = 1.9 mA	$U_{ext} \leq$ 32 VDC I ≤ 6 mA at U_{ext} = 24 V I ≤ 6.6 mA at U_{ext} = 32 V On: $U_0 \geq$ 5.5 V or I ≥ 4mA Off: $U_0 \leq$ 3.5 V or I ≤ 0.5 mA U_i = 30 V I_i = 100 mA P_i = 1 W C_i = 10 nF L_i = 0 mH
NAMUR	-	Active to EN 60947-5-6 Contact open: $U_{0, nom}$ = 8.7 V Contact closed (On): I_{nom} = 7.8 mA Contact open (off): $U_{0, nom}$ = 6.3 V with I_{nom} = 1.9 mA Identification for open terminals: $U_0 \geq$ 8.1 V with I ≤ 0.1 mA Identification for short circuited terminals: $U_0 \leq$ 1.2 V with I ≥ 6.7 mA	-

PROFIBUS PA / DP	
Description	Galvanically isolated acc. to IEC 61158
	Profile version: 3.02
	Current consumption: 10.5 mA
	Permissible bus voltage: 9...32 V; in Ex application 9...24 V
	Bus interface with integrated reverse polarity protection
	Typical error current FDE (Fault Disconnection Electronic): 4.3 mA
	Bus address adjustable via local display on the measuring device
Function blocks	6 x analogue input, 3 x totaliser
Output data	Volume flow, mass flow, velocity of sound, flow speed, gain, SNR, electronic temperature, power supply (Further meas. values and diagnostic data is available via acyclic access)
FOUNDATION Fieldbus	
Description	Galvanically isolated acc. to IEC 61158
	Current consumption: 10.5 mA
	Permissible bus voltage: 9...32 V; in Ex application 9...24 V
	Bus interface with integrated reverse polarity protection
	Link Master function (LM) supported
	Tested with Interoperable Test Kit (ITK) version 6.0
Function blocks	4 x analogue input, 2 x integrator, 1 x PID
Output data	Volume flow, mass flow, flow speed, electronic temperature, velocity of sound, gain, SNR Diagnostic data
MODBUS	
Description	Modbus RTU, Master / Slave, RS485
Address range	1...247
Supported function codes	01, 02, 03, 04, 05, 08, 16, 43
Supported Baudrate	1200, 2400, 4800, 9600, 19200, 38400, 57600, 115200 Baud

Approvals and certificates

CE	
This device fulfills the statutory requirements of the EU directives. The manufacturer certifies successful testing of the product by applying the CE mark.	
	For full information of the EU directive & standards and the approved certifications;please refer to the CE declaration or the website of the manufacturer.
NAMUR	NE 21,43,53,80,95,107
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
IECEx	IECEX KIWA 15.0032X
ATEX	KIWA 15ATEX0054 X
c**QPS**us ; class 1 Div. 1 and 2	Approval number; LR1338
NEPSI	Approval number; pending
DNV	Approval number; pending
EAC	Approval number; pending
Protection category acc. to IEC 529 / EN 60529	**Signal converter**
	Compact (C): IP66/67 (NEMA 4X/6)
	Field (F): IP66/67 (NEMA 4X/6)
	All flow sensors
	IP67 (NEMA 6)
Shock resistance	IEC 68-2-27
	30 g for 18 ms
Vibration resistance	IEC 68-2-64
	f= 20 - 2000 Hz, rms=4,5g, t=30 min.

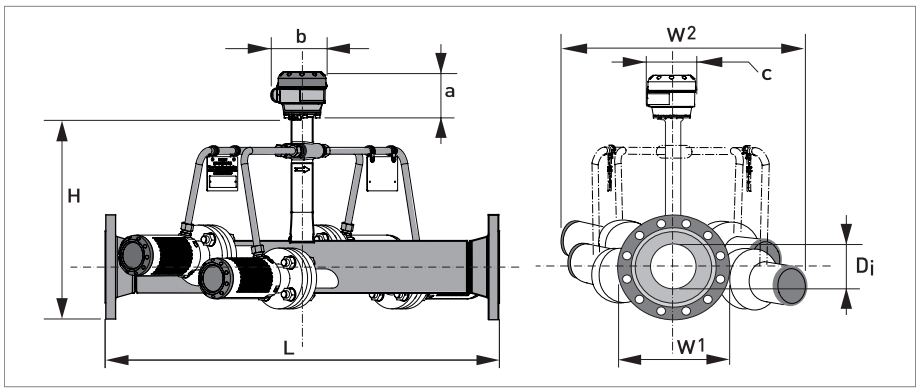
8.3 Dimensions and weights

The dimensions and weights of the different available versions are described on the following pages.

Description of the abbreviations:

- L = total length of the flowmeter
- H = height of the flowmeter (without mounted converter / connection box)
- W (W1) = width of the flanges
- W2 = total width of the flow sensor including transducers
- Di = internal width of flow sensor

Remote version High Temperature

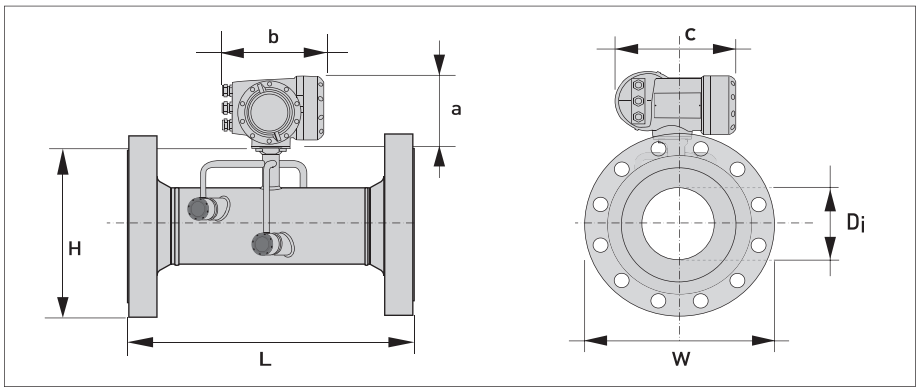


a	88 mm / 3.5"
b	139 mm / 5.5" ①
c	106 mm / 4.2"

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

Note; the dimension W2 varies, depending on the construction and diameter. The average dimension is approximately 820 mm / 31.7" (± 30mm / 1.2")

Compact version High Pressure



a	155 mm / 6.1"
b	230 mm / 9.1" ①
c	260 mm / 10.2"
Total height = H + a #The value depends on version	

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

8.4 ASME B16.5; dimensions and weights

For additional values and dimensions (e.g. not mentioned in tables); consult KROHNE.

ASME 150 lb; High temperature variant - RF flange

Nom. size	Dimensions									
	L		H		W - W1		Inner diameter [Di]		Weight	
	[inch]	[mm]	[inch]	[mm]	[inch]	[mm]	[inch]	[mm]	[lb]	[kg]
1”										
2”	27.6	700	15.4	392	6.0	152	2.1	52.5	50	23
3”										
4”	35.4	900	18.0	457	9.0	229	4.0	102	125	57
6”	35.4	900	20.1	510	11.0	279	6.1	151	161	73
8”										
10”	39.4	1000	24.6	626	16.0	406	10.0	254	287	130
12”	39.4	1000	27.1	689	19.0	483	12.0	305	364	165
14”										
16”	39.4	1000	31.0	788	23.5	597	15.0	381	569	258
18”										
20”	39.4	1000	35.0	889	27.5	699	19.0	483	672	305
24”	39.4	1000	39.3	997	32.0	813	23.0	585	886	402

ASME 300 lb; High temperature variant - RF flange

Nom. size	Dimensions									
	L		H		W - W1		Inner diameter [Di]		Weight	
	[inch]	[mm]	[inch]	[mm]	[inch]	[mm]	[inch]	[mm]	[lb]	[kg]
1”										
2”	27.6	700	15.4	392	6.0	152	2.1	52.5	50	23
3”	35.4	900	18.0	457	9.0	229	3.1	4.0	102	51
4”	35.4	900	18.5	470	10.0	254	3.8	97.1	181	82
6”	35.4	900	20.8	529	12.5	318	5.8	146	229	104
8”	39.4	1000	23.1	586	15.0	381	7.6	194	373	169
10”	39.4	1000	25.4	645	17.5	445	9.7	248	414	188
12”	39.4	1000	27.9	708	20.5	521	11.4	289	606	275
14”	39.4	1000	29.8	756	23.0	584	12.5	317	767	348
16”	39.4	1000	33.3	845	28.0	711	14.3	364	955	433
18”										
20”	39.4	1000	36.5	927	30.5	775	18.4	467	1497	679
24”										

ASME 600 lb; High temperature variant, RF & RTJ flanges

Nom. size	Dimensions									
	L		H		W - W1		Inner diameter [Di]		Weight	
	[inch]	[mm]	[inch]	[mm]	[inch]	[mm]	[inch]	[mm]	[lb]	[kg]
1”										
2”	27.6	700	15.7	399	6.5	165	1.7	42.9	66	30
3”										
4”	35.4	900	18.9	480	10.8	273	3.6	92	194	88
6”	35.4	900	21.6	548	14.0	356	5.5	140	317	144
8”										
10”	43.3	1100	26.6	677	20.0	508	9.3	236	679	308
12”	39.4	1000	28.6	727	22.0	559	10.8	273	884	401

ASME 1500 lb; High pressure variant - RTJ flange

Nom. size	Dimensions									
	L		H		W - W1		Inner diameter [Di]		Weight	
	[inch]	[mm]	[inch]	[mm]	[inch]	[mm]	[inch]	[mm]	[lb]	[kg]
1”	13.8	350	7.1	181	5.9	149	0.8	21	32	14
2”	23.6	600	9.0	228	8.5	216	1.7	43	74	34
3”	27.6	700	10.5	268	10.5	267	2.6	67	130	59
4”	39.4	1000	11.9	303	12.3	311	3.4	87	214	97
6”										
8”	39.4	1000	13.8	351	19.0	483	6.8	173	745	338

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 figures.

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 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".

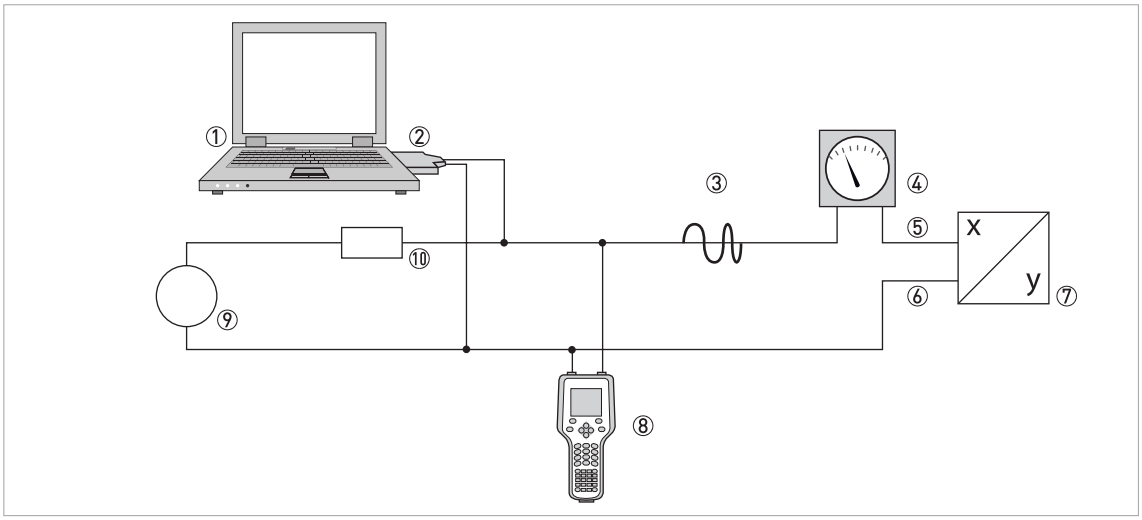
There are two ways of using the HART® communication:

- 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.

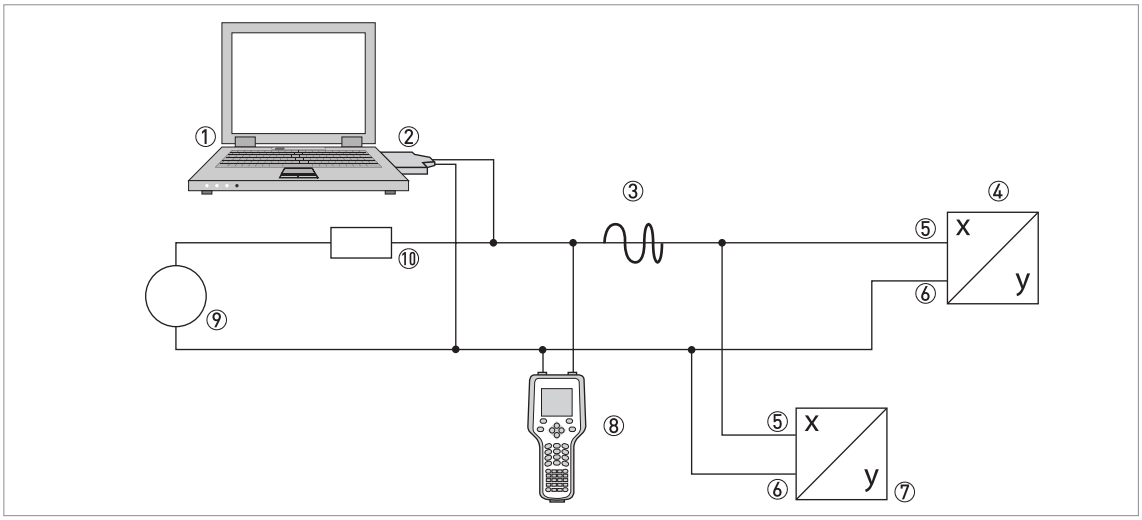


① Primary master
② FSK modem or HART® modem
③ HART® signal
④ Analog indication
⑤ Signal converter terminals A (C)
⑥ Signal converter terminals A- (C-)
⑦ Signal converter with address = 0 and passive or active current output
⑧ Secondary Master
⑨ Power supply for devices (slaves) with passive current output
①⓪ Load ≥ 250 Ω (Ohm)

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).

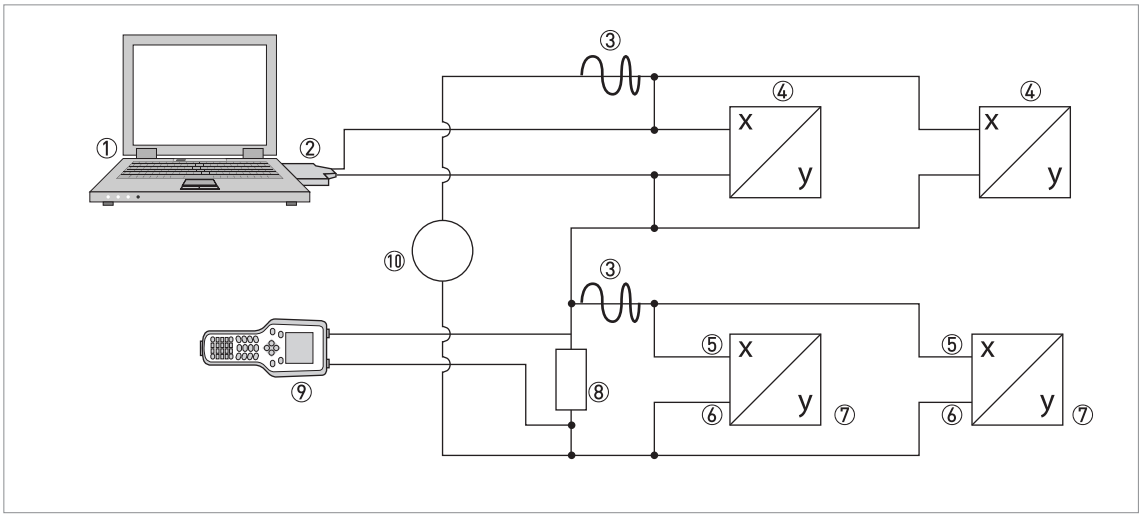
The current outputs of the devices must be passive!



① Primary Master
② HART® modem
③ HART® signal
④ Other HART® devices or this signal converter (see also 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 ≥ 250 Ω (Ohm)

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.



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 ≥ 250 Ω (Ohm)
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 refer to *HART Menu Tree; UFC400* on page 127.

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 131

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 or on CD ROM.

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 128.

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® and PROFIBUS 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 or on CD-ROM.

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 129.

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 or on CD ROM.

For information on installing the Device Description, refere 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 130.

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 or on CD-ROM.

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 131)
- Diagnostic Root Menu (details on page 134)
- Device Root Menu (details on page 136)

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 131)
- Diagnostic Root Menu (details on page 134)
- Device Root Menu (details on page 136)

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 131)
- Diagnostic Root Menu (details on page 134)
- Device Root Menu (details on page 136)
- Offline Root Menu (details on page 138)

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 131)
- Diagnostic Root Menu (details on page 134)
- Device Root Menu (details on page 136)

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 Flow Rd • Volume Flow Data Quality Rd • Volume Flow Limit Status Rd • Velocity of Sound Rd • Velocity of Sound Data Quality Rd • Velocity of Sound Limit Status Rd • Mass Flow Rd • Mass Flow Data Quality Rd • Mass Flow Limit Status Rd • Flow Velocity Rd • Flow Velocity Data Quality Rd • Flow Velocity Limit Status Rd	• Gain Rd • Gain Data Quality Rd • Gain Limit Status Rd • SNR Rd • SNR Data Quality Rd • SNR Limit Status Rd • Time Stamp Rd • 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 Value Rd • Percent Range Rd • Loop Current Rd	Secondary • Measured Value Rd • Percent Range Rd, Opt • Output Value Rd, Opt
Tertiary • Measured Value Rd • Percent Range Rd, Opt • Output Value Rd, Opt	Quaternary • Measured Value Rd • 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 Stamp Rd

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 Hours Rd • Operating Hours Data Quality Rd • Operating Hours Limit Status Rd • Time Stamp Rd

Table 9-1: **Designations;**

Opt; Optional, depent 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, depent on device implementation / configuration
[Rd] ; 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 occured
		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-Voliatile memory failure
		Voliatile 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, depent on device implementation / configuration

Rd ; 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 unriliable / 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 LockRd
	Preambles Number of request preambles Rd / Number of response preambles

Table 9-4: **Designations;**

Opt; Optional, depent on device implementation / configuration

Rd ; 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, depent on device implementation / configuration

Rd ; Read-only

KROHNE – Process instrumentation and measurement solutions

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

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