IFC 300 Handbook

Signal converter for electromagnetic flowmeters

ER 3.2.xx
(SW.REV. 3.2.xx)

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

KROHNE

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1.1 Software history

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

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®
	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
	CI	Current 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
2006-12-12	ER 3.1.0x (SW.REV.3.10 (2.21))		
2007-02-07	ER 3.1.1x (SW.REV.3.10 (2.21))	1; 2	MA IFC 300 R02
2007-03-12	ER 3.1.2x (SW.REV.3.10 (2.21))	1; 2-H; 3-I	MA IFC 300 R02
2007-05-25	ER 3.1.3x (SW.REV.3.10 (2.21))	1; 3-I	MA IFC 300 R02
2008-05-13	ER 3.2.0x (SW.REV.3.20 (3.00))	1; 2-X; 3-X; 4	MA IFC 300 R03

1.2 Intended use

The electromagnetic flowmeters are designed exclusively to measure the flow and conductivity of electrically conductive, liquid media.

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

1.3 Certifications

CE marking

$\mathsf{C}\,\mathsf{E}$

The device fulfils the statutory requirements of the following EC directives:

• Pressure Equipment Directive 97/23/EC
• Low Voltage Directive 73/23/EEC
• EMC Directive 89/336/EC

as well as

• EN 61010
• EMC specification acc. to EN 61326/A1
• NAMUR recommendations NE 21 and NE 43

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

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

1.4.2 Disclaimer

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

1.4.5 Warnings and symbols used

Safety warnings are indicated by the following symbols.

DANGER!
This information 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!
Inspect the cartons carefully for damage or signs of rough handling. Report damage to the carrier and to the local office of the manufacturer.

INFORMATION!
Check the packing list to check if you received completely all that you ordered.

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.
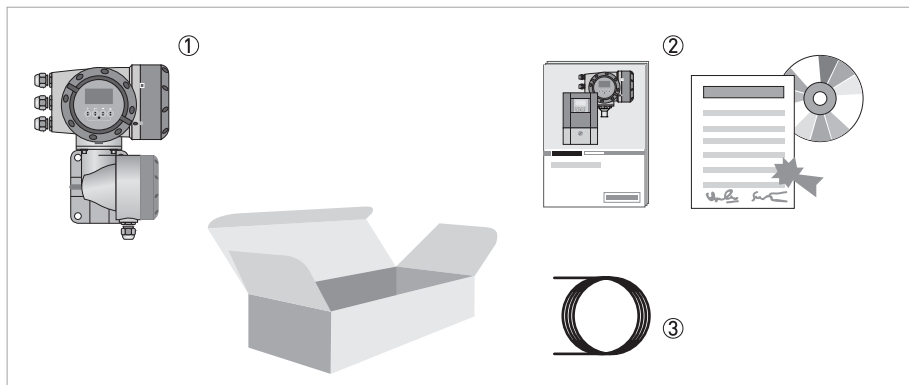
Figure 2-1: Scope of delivery

① Device in the version as ordered
② Documentation (calibration report, Quick Start, CD-Rom with product documentation for measuring sensor and signal converter)
③ Signal cable (only for remote version)

2.2 Device description

Electromagnetic flowmeters are designed exclusively to measure the flow and conductivity of electrically conductive, liquid media.

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

The following versions are available:

- Compact version (the signal converter is mounted directly on the measuring sensor)
- Remote version (electrical connection to the measuring sensor via field current and signal cable)
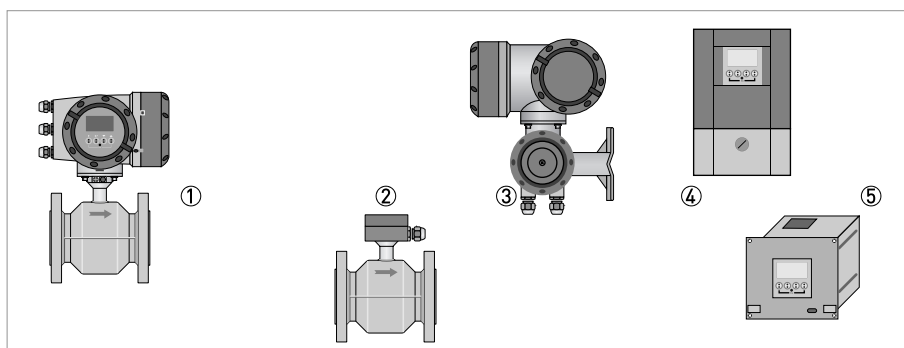
Figure 2-2: Device versions

① Compact version
② Measuring sensor with connection box
③ Field housing
④ Wall-mounted housing
⑤ 19" rack-mounted housing

2.2.1 Field housing
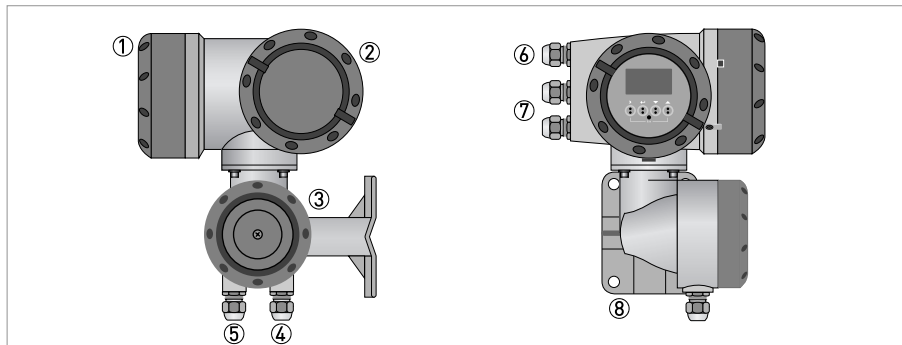
Figure 2-3: Construction of the field housing

① Cover for electronics and display
② Cover for power supply and inputs/outputs terminal compartment
③ Cover for for measuring sensor terminal compartment with locking screw
④ Cable entry for measuring sensor signal cable
⑤ Cable entry for measuring sensor field current cable
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.

2.2.2 Wall-mounted housing
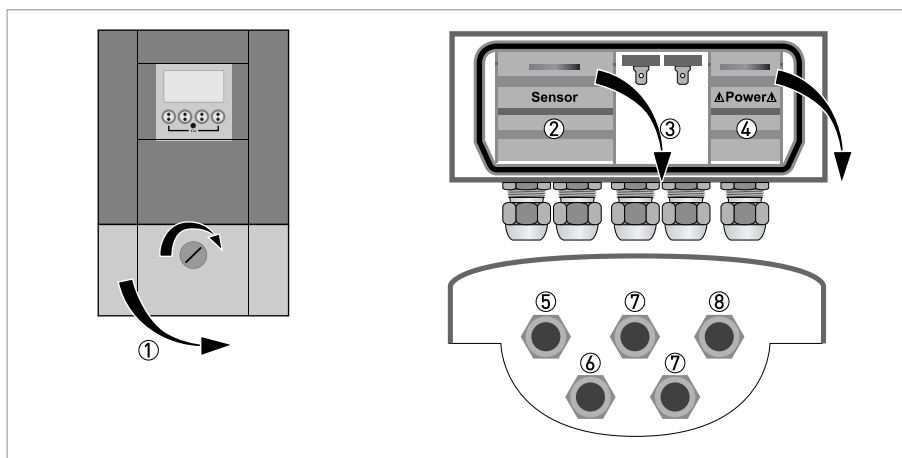
Figure 2-4: Construction of wall-mounted housing

① Cover for terminal compartments
② Terminal compartment for measuring sensor
③ Terminal compartment for inputs and outputs
④ Terminal compartment for power supply with safety cover (shock-hazard protection)
⑤ Cable entry for signal cable
⑥ Cable entry for field current cable
⑦ Cable entry for inputs and outputs
⑧ Cable entry for power supply

① Turn lock to the right and open the cover.

2.3 Nameplates

ℹ️ *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 Compact version (example)
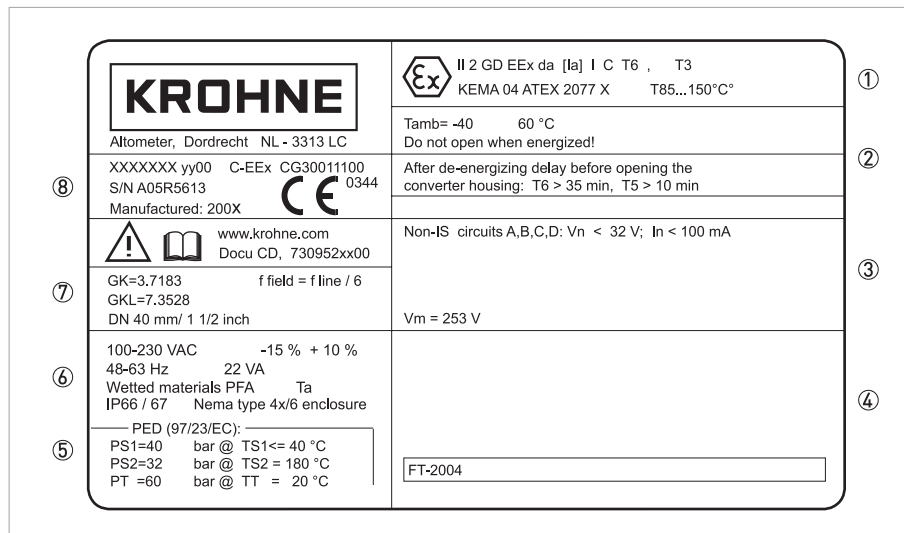
Figure 2-5: Example of a nameplate for compact version

① Approvals-related information: Ex approval, EC type test certificate, hygienic approvals, etc.
② Approvals-related thresholds
③ Approvals-related connection data of the inputs/outputs; V_m = max. power supply
④ Approvals-related data (e.g. accuracy class, measuring range, temperature thresholds, pressure thresholds and viscosity thresholds)
⑤ Approvals-related pressure and temperature thresholds
⑥ Power supply; protection category; materials of wetted parts
⑦ GK/GKL values (measuring sensor constants); size (mm /inches); field frequency
⑧ Product designation, serial number and manufacturing date

2.3.2 Remote version (example)
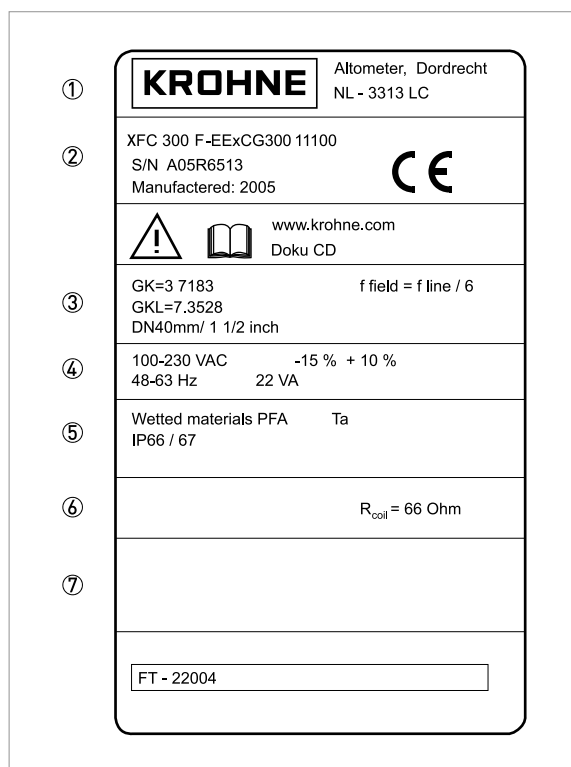
Figure 2-6: Example of a nameplate for remote version

① Manufacturer
② Product designation, serial number and manufacturing date
③ GK/GKL values (measuring sensor constants); size (mm /inches); field frequency
④ Power supply
⑤ Materials of wetted parts
⑥ Field coil resistance
⑦ Approvals-related data (e.g. accuracy class, measuring range, temperature thresholds, pressure thresholds and viscosity thresholds)

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

POWER	PE (FE)	CG 3x xxxxxx S/N: A06 xxxxx	KROHNE
	L(L+) N(L-)	⚠ 📖 A = Active P = Passive NC = Not connected	
INPUT / OUTPUT	D - D	P	PULSE OUT / STATUS OUT Imax = 100 mA@f<= 10 Hz; = 20 mA@f<=12 kHz Vo = 1.5 V @ 10 mA; Umax = 32 VDC
	C - C	P	STATUS OUT Imax = 100 mA; Vmax = 32 VDC
	B - B	P	STATUS OUT / CONTROL IN Imax = 100 mA Von > 19 VDC, Voff < 2.5 VDC; Vmax = 32 VDC
	A + A - A	A P	CURRENT OUT (HART) Active (Terminals A & A+); RLmax = 1 kohm Passive (Terminals A & A-); Vmax = 32 VDC

Figure 2-7: Example of a nameplate for electrical connection data of inputs and outputs
① Power supply (AC: L and N; DC: L+ and L–; PE for ≥ 24 VAC; 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 the 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 Notes on installation

INFORMATION!
Inspect the cartons carefully for damage or signs of rough handling. Report damage to the carrier and to the local office of the manufacturer.

INFORMATION!
Check the packing list to check if you received completely all that you ordered.

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 packing.
- Storage temperature: -50...+70°C / -58...+158°F

3.3 Transport

Signal converter
- No special requirements.

Compact version
- Do not lift the device by the signal converter housing.
- Do not use lifting chains.
- To transport flange devices, use lifting straps. Wrap these around both process connections.

3.4 Installation specifications

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 68-2-3.*

3.5 Mounting of the compact version

INFORMATION!
The signal converter is mounted directly on the measuring sensor. For installation of the flowmeter, please observe the instructions in the supplied product documentation for the measuring sensor.

3.6 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.

3.6.1 Pipe mounting
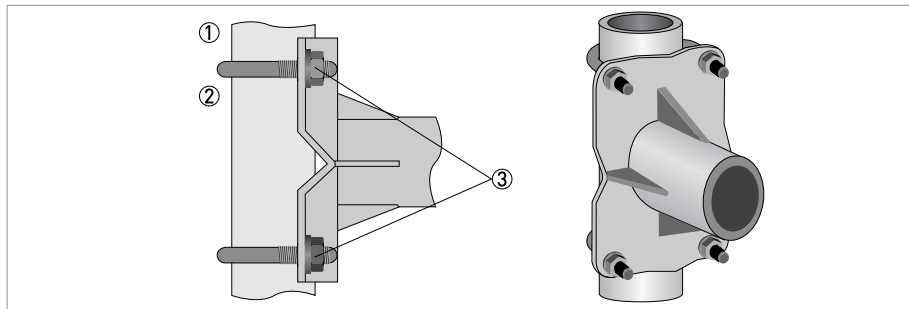
Figure 3-1: Pipe mounting of the field housing

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

3.6.2 Wall mounting
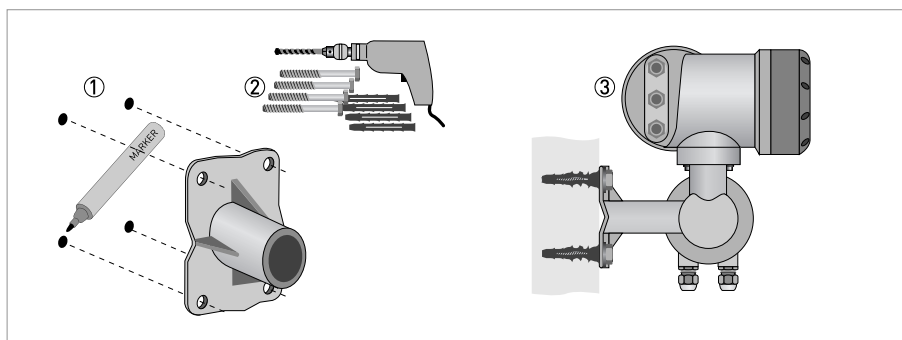
Figure 3-2: Wall mounting of the field housing

① Prepare the holes with the aid of the mounting plate. For further information refer to *Mounting plate, field housing* on page 134.
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
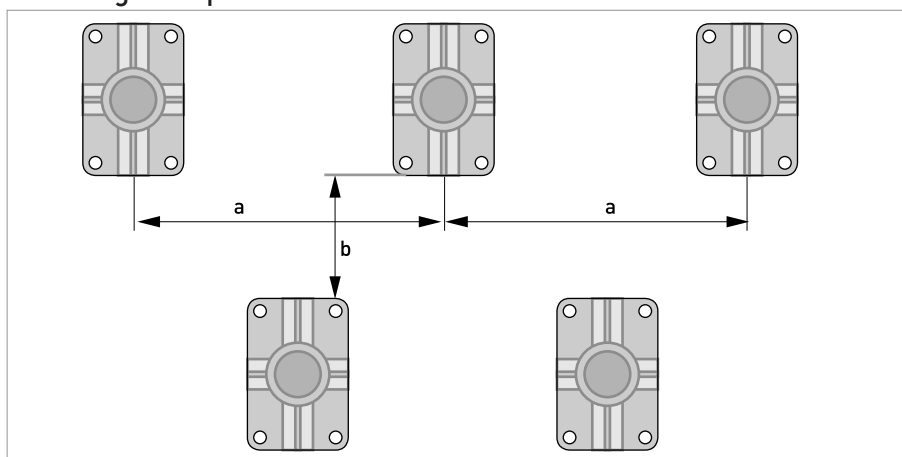
a ≥ 600 mm / 23.6"
b ≥ 250 mm / 9.8"

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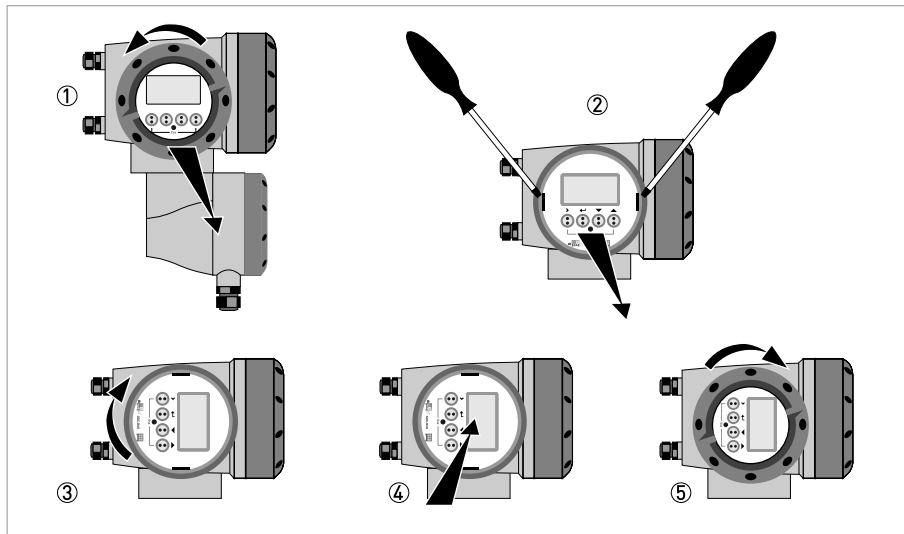
Figure 3-3: Turning the display of the field housing version

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.

3.7 Mounting the wall-mounted housing, remote version

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

3.7.1 Pipe mounting
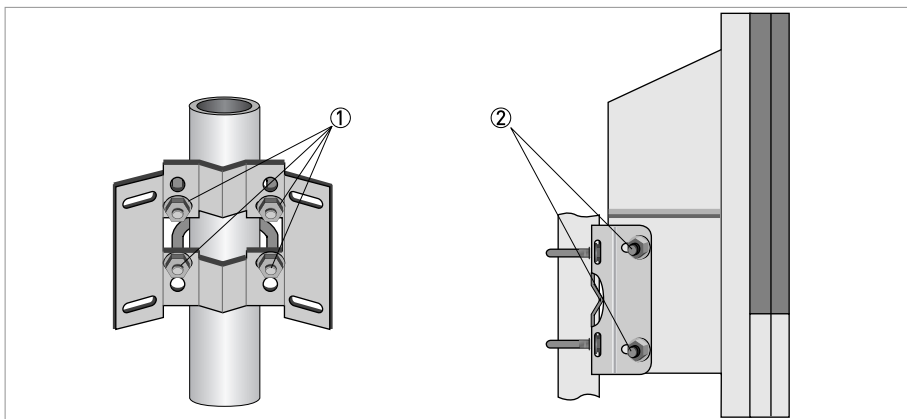
Figure 3-4: Pipe mounting of the wall-mounted housing

① Fasten the mounting plate to the pipe with standard U-bolts, washers and fastening nuts.
② Screw the signal converter to the mounting plate with the nuts and washers.

3.7.2 Wall mounting
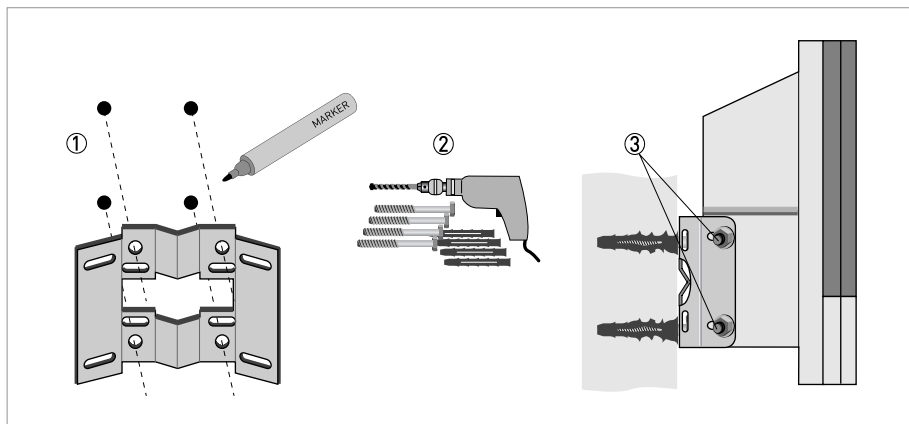
Figure 3-5: Wall mounting of the wall-mounted housing

① Prepare the holes with the aid of the mounting plate. For further information refer to *Mounting plate, wall-mounted housing* on page 134.
② Fasten the mounting plate securely to the wall.
③ Screw the signal converter to the mounting plate with the nuts and washers.

Mounting multiple devices next to each other
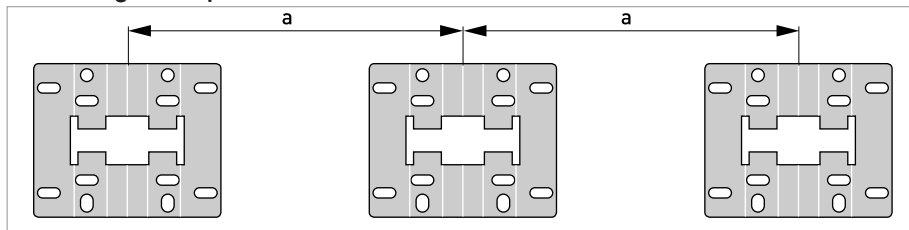
a ≥ 240 mm / 9.4"

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 Important notes on electrical connection

DANGER!
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 regulations.

CAUTION!
- *Use suitable cable entries for the various electrical cables.*
- *The measuring sensor and signal converter have been configured together at the factory. The devices should therefore be installed in pairs. Make sure that the measuring sensor constants GK/GKL have identical settings (see nameplates).*
- *In the event of separate delivery or the installation of devices that have not been configured together, the signal converter must be set to the DN size and GK/GKL of the measuring sensor, refer to Function tables on page 91.*

4.3 Electrical cables for remote device versions, notes

4.3.1 Notes on signal cables A and B

INFORMATION!
The signal cables A (type DS 300) with double shield and B (type BTS 300) with triple shield ensure proper transmission of measured values.

Observe the following notes:

- Lay the signal cable with fastening elements.
- It is permissible to lay the signal cable in water or in the ground.
- The insulating material is flame-retardant to EN 50625-2-1, IEC 60322-1.
- The signal cable does not contain any halogens and is unplasticized, and remains flexible at low temperatures.
- The connection of the inner shield is carried out via the stranded drain wire (1).
- The connection of the outer shield is carried out via the shield (60) or the stranded drain wire (6), depending on the housing version. Observe the following notes.

4.3.2 Notes on field current cable C

DANGER!
A non-shielded three-wire copper cable is sufficient for the field current cable. If you nevertheless use shielded cables, the shield must NOT be connected in the housing of the signal converter.

INFORMATION!
The field current cable is not part of the scope of supply.

4.3.3 Requirements for signal cables provided by the customer

INFORMATION!
If the signal cable was not ordered, it is to be provided by the customer. The following requirements regarding the electrical values of the signal cable must be observed:

Electrical safety

- To EN 60811 (Low Voltage Directive) or equivalent national regulations.

Capacitance of the insulated conductors

- Insulated conductor / insulated conductor < 50 pF/m
- Insulated conductor / shield < 150 pF/m

Insulation resistance

- R_{iso} > 100 GΩ x km
- U_{max} < 24 V
- I_{max} < 100 mA

Test voltages

- Insulated conductor / inner shield 500 V
- Insulated conductor / insulated conductor 1000 V
- Insulated conductor / outer shield 1000 V

Twisting of the insulated conductors

- At least 10 twists per meter, important for screening magnetic fields.

4.4 Preparing the signal and field current cables

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.

The electrical connection of the outer shield is different for the various housing variants. Please observe the corresponding instructions.

4.4.1 Signal cable A (type DS 300), construction

- Signal cable A is a double-shielded cable for signal transmission between the measuring sensor and signal converter.
- Bending radius: ≥ 50 mm / 2"
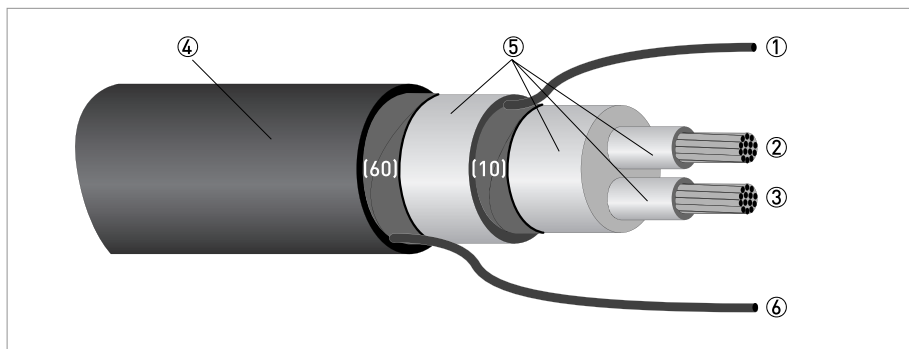
Figure 4-1: Construction of signal cable A

① Stranded drain wire (1) for the inner shield (10), 1.0 mm^2 Cu / AWG 17 (not insulated, bare)
② Insulated wire (2), 0.5 mm^2 Cu / AWG 20
③ Insulated wire (3), 0.5 mm^2 Cu / AWG 20
④ Outer sheath
⑤ Insulation layers
⑥ Stranded drain wire (6) for the outer shield (60)

4.4.2 Preparing signal cable A, connection to signal converter

Field housing

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.

- The outside shield (60) is connected in the field housing directly via the shield and a clip.
- Bending radius: ≥ 50 mm / 2"

Required materials:

- PVC insulation tubing, Ø2.5 mm / 0.1"
- Heat-shrinkable tubing
- Wire end ferrule to DIN 46 228: E 1.5-8 for the stranded drain wire (1)
- 2x wire end ferrules to DIN 46 228: E 0.5-8 for the insulated conductors (2, 3)
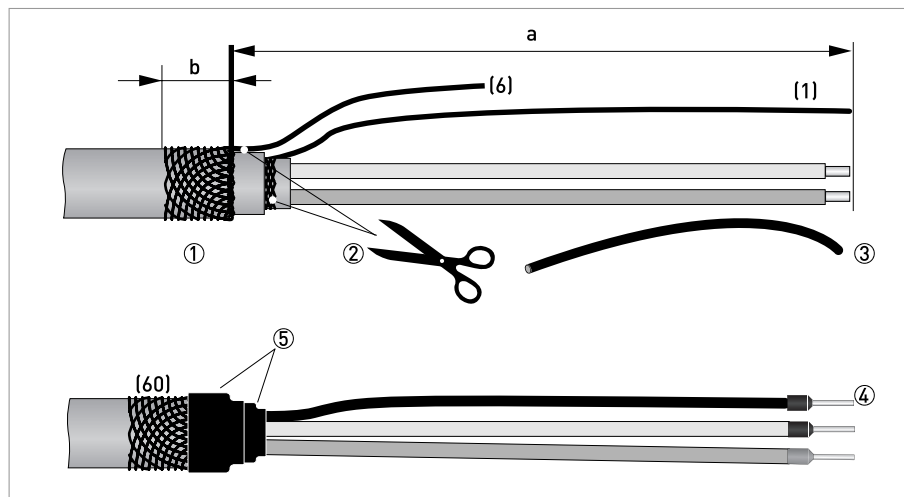
Figure 4-2: Signal cable A, preparation for field housing

a = 80 mm / 3.15"
b = 10 mm / 0.39"

① Strip the conductor to dimension a.
  Trim the outer shield to dimension b and pull it over the outer sheath.
② Cut off the inner shield (10) and the stranded drain wire (6). Make sure not to damage the stranded drain wire (1).
③ Slide an insulating tube over the stranded drain wire (1).
④ Crimp the wire end ferrules onto the conductors (2, 3) and stranded drain wire.
⑤ Pull the heat-shrinkable tubing over the prepared signal cable.

Wall mounted housing

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.

- The connection of the outer shield (60) is carried out in the wall-mounted housing via the stranded drain wire (6).
- Bending radius: ≥ 50 mm / 2"

Required materials

- Push-on connector 6.3 mm / 0.25", insulation to DIN 46245 for conductor Ø = 0.5...1 mm^2 / AWG 20...17
- PVC insulation tubing, Ø2.5 mm / 0.1"
- Heat-shrinkable tubing
- Wire end ferrule to DIN 46 228: E 1.5-8 for the stranded drain wire (1)
- 2x wire end ferrules to DIN 46 228: E 0.5-8 for the insulated conductors (2, 3)

Figure 4-3: Signal cable A, preparation for wall-mounted housing

a = 80 mm / 3.15"

① Strip the conductor to dimension a.
② Cut off the inner shield (10) and the outer shield (60). Make sure not to damage the stranded drain wires (1) and (6).
③ Slide the insulation tubing over the stranded drain wires.
④ Crimp the push-on connector onto the stranded drain wire (6).
⑤ Crimp the wire end ferrules onto the conductors (2, 3) and stranded drain wire (1).
⑥ Pull the heat-shrinkable tubing over the prepared signal cable.

4.4.3 Length of signal cable A

INFORMATION!
For temperatures of the medium above 150°C / 300°F, a special signal cable and a ZD intermediate socket are necessary. These are available including the changed electrical connection diagrams.

Measuring sensor	Nominal size		Min. electrical conductivity [µS/cm]	Curve for signal cable A
	DN [mm]	[inches]		
OPTIFLUX 1000 F	10...150	3/8...6	5	A1
OPTIFLUX 2000 F	25...150	1...6	20	A1
	200...2000	8...80	20	A2
OPTIFLUX 4000 F	2.5...150	1/10...6	1	A1
	200...2000	8...80	1	A2
OPTIFLUX 5000 F	2.5...100	1/10...4	1	A1
	150...250	6...10	1	A2
OPTIFLUX 6000 F	2.5...150	1/10...6	1	A1
WATERFLUX 3000 F	50...600	2...24	20	A1
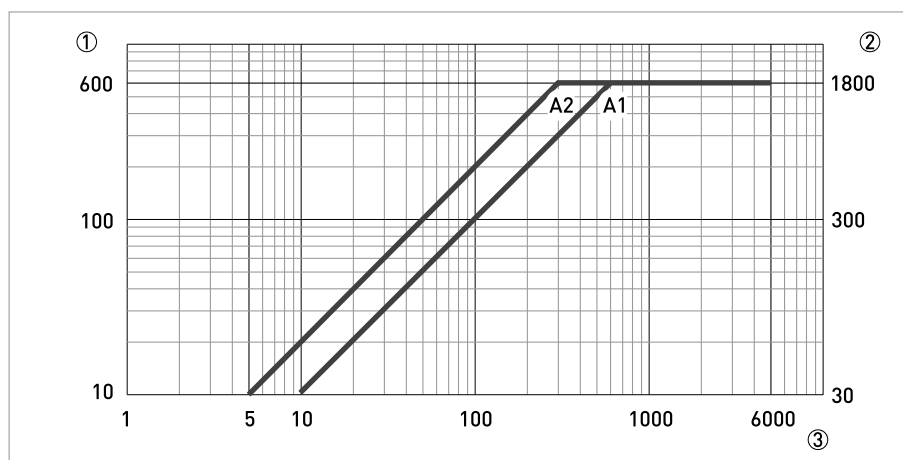
Figure 4-4: Maximum length of signal cable A

① Maximum length of signal cable A between the measuring sensor and signal converter [m]
② Maximum length of signal cable A between the measuring sensor and signal converter [ft]
③ Electrical conductivity of the medium being measured [µS/cm]

4.4.4 Signal cable B (type BTS 300), construction

- Signal cable B is a triple-shielded cable for signal transmission between the measuring sensor and signal converter.
- Bending radius: ≥ 50 mm / 2"
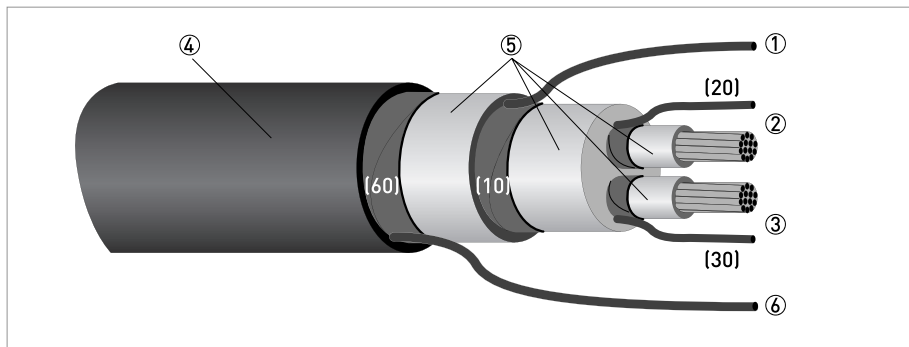
Figure 4-5: Construction of signal cable B

① Stranded drain wire for the inner shield (10), 1.0 mm^2 Cu / AWG 17 (not insulated, bare)
② Insulated wire (2), 0.5 mm^2 Cu / AWG 20 with stranded drain wire (20) of shield
③ Insulated wire (3), 0.5 mm^2 Cu / AWG 20 with stranded drain wire (30) of shield
④ Outer sheath
⑤ Insulation layers
⑥ Stranded drain wire (6) for the outer shield (60), 0.5 mm^2 Cu / AWG 20 (not insulated, bare)

4.4.5 Preparing signal cable B, connection to signal converter

Field housing

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.

- The outside shield (60) is connected in the field housing directly via the shield and a clip.
- Bending radius: ≥ 50 mm / 2"

Required materials

- PVC insulation tubing, Ø2.0…2.5 mm / 0.08…0.1"
- Heat-shrinkable tubing
- Wire end ferrule to DIN 46 228: E 1.5-8 for the stranded drain wire (1)
- 4 wire end ferrules to DIN 46 228: E 0.5-8 for the insulated conductors 2 and 3 and the stranded drain wires (20, 30)

Figure 4-6: Signal cable B, preparation for field housing

a = 80 mm / 3.15"
b = 10 mm / 0.39"

① Strip the conductor to dimension a.
② Trim the outer shield to dimension b and pull it over the outer sheath.
③ Cut off the inner shield (10), the stranded drain wire (6) and the shields of the insulated con-
   ductors. Make sure not to damage the stranded drain wires (1, 20, 30).
④ Slide the insulation tubing over the stranded drain wires (1, 20, 30).
⑤ Crimp the wire end ferrules onto the conductors and stranded drain wires.
⑥ Pull the heat-shrinkable tubing over the prepared signal cable.

Wall-mounted housing

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.

• The connection of the outer shield (60) is carried out in the wall-mounted housing via the stranded drain wire (6).
• Bending radius: ≥ 50 mm / 2"

Required materials:

• Push-on connector 6.3 mm / 0.25", insulation to DIN 46245 for conductor Ø = 0.5...1 mm^2 / AWG 20...17
• PVC insulation tubing, Ø2.5 mm / 0.1"
• Heat-shrinkable tubing
• Wire end ferrule to DIN 46 228: E 1.5-8 for the stranded drain wire (1)
• 4 wire end ferrules to DIN 46 228: E 0.5-8 for insulated conductors 2 and 3 and the stranded drain wires (20, 30)
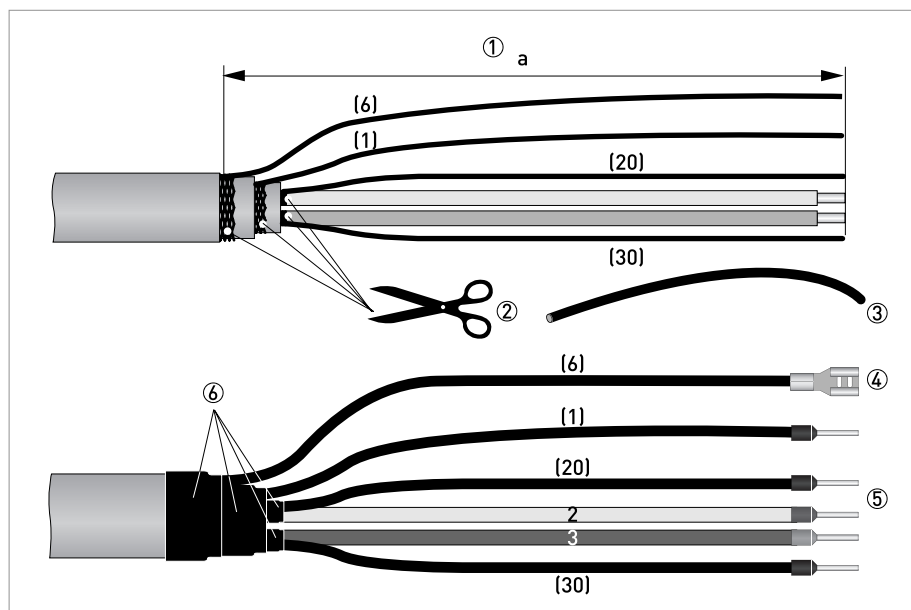
Figure 4-7: Signal cable B, preparation for wall-mounted housing

a = 80 mm / 3.15"

① Strip the conductor to dimension a.
② Cut off the inner shield (10), the outer shield (60) and the shields for the conductor (2, 3). Make sure not to damage the stranded drain wires (1, 6, 20, 30).
③ Slide the insulation tubing over the stranded drain wires.
④ Crimp the push-on connector onto the stranded drain wire (6).
⑤ Crimp the wire end ferrules onto the conductors and stranded drain wires (1, 20, 30).
⑥ Pull the heat-shrinkable tubing over the prepared signal cable.

4.4.6 Length of signal cable B

INFORMATION!
For temperatures of the medium above 150°C / 300°F, a special signal cable and a ZD intermediate socket are necessary. These are available including the changed electrical connection diagrams.

Measuring sensor	Nominal size		Min. electrical conductivity [µS/cm]	Curve for signal cable B
	DN [mm]	[inches]		
OPTIFLUX 1000 F	10...150	3/8...6	5	B2
OPTIFLUX 2000 F	25...150	1...6	20	B3
	200...2000	8...80	20	B4
OPTIFLUX 4000 F	2.5...6	1/10...1/6	10	B1
	10...150	3/8...6	1	B3
	200...2000	8...80	1	B4
OPTIFLUX 5000 F	2.5	1/10	10	B1
	4...15	1/6...1/2	5	B2
	25...100	1...4	1	B3
	150...250	6...10	1	B4
OPTIFLUX 6000 F	2.5...15	1/10...1/2	10	B1
	25...150	1...6	1	B3
WATERFLUX 3000 F	50...600	2...24	20	B1
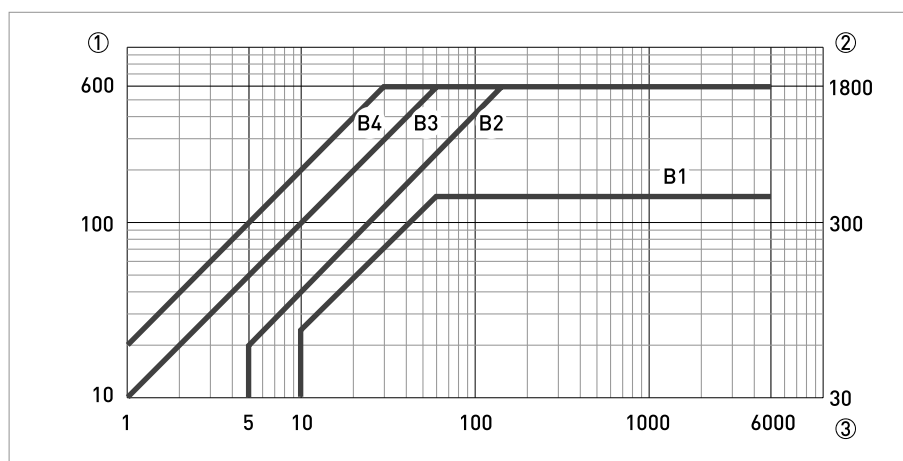
Figure 4-8: Maximum length of signal cable B

① Maximum length of signal cable B between the measuring sensor and signal converter [m]
② Maximum length of signal cable B between the measuring sensor and signal converter [ft]
③ Electrical conductivity of the medium being measured [µS/cm]

4.4.7 Preparing field current cable C, connection to signal converter

DANGER!
*A non-shielded three-wire copper cable is sufficient for the field current cable. If you nevertheless use shielded cables, the shield must **NOT** be connected in the housing of the signal converter.*

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.

- Field current cable C is not part of the scope of supply.
- Bending radius: ≥ 50 mm / 2"

Required materials:
- Shielded 3-wire copper cable with suitable heat-shrinkable tubing
- DIN 46 228 wire end ferrules: size according to the cable being used

Length and cross-section of field current cable C

Length		Cross-section A_F (Cu)	
[m]	[ft]	[mm^2]	[AWG]
0...150	0...500	3 x 0.75 Cu ①	3 x 18
150...300	500...1000	3 x 1.50 Cu ①	3 x 14
300...600	1000...2000	3 x 2.50 Cu ①	3 x 12

① Cu = copper cross-section

In the wall-mounted housing version the connection terminals are designed for the following cable cross-sections:

- Flexible cable $\leq$ 1.5 mm^2 / AWG 14

- Solid cable $\leq$ 2.5 mm^2 / AWG 12
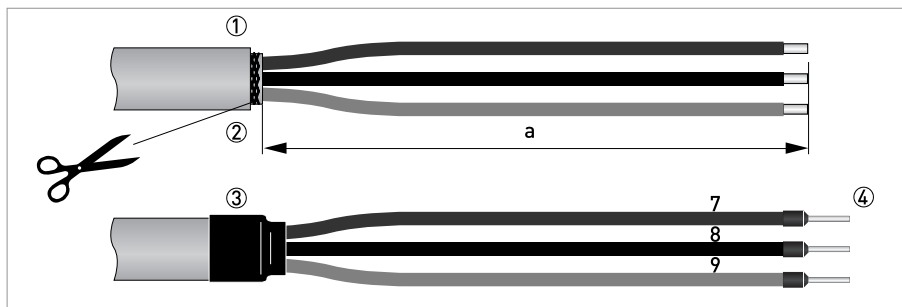
Figure 4-9: Field current cable C, preparation for the signal converter

a = 80 mm / 3.15"

① Strip the conductor to dimension a.
② Remove any shield that is present.
③ Pull a shrinkable tube over the prepared cable.
④ Crimp the wire end ferrules onto the conductors 7, 8 and 9.

4.4.8 Prepare signal cable A, connect to measuring sensor

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.

- The outer shield (60) is connected in the terminal compartment of the measuring sensor directly via the shield and a clip.
- Bending radius: ≥ 50 mm / 2"

Required materials

- PVC insulation tubing, Ø2.0...2.5 mm / 0.08...0.1"
- Heat-shrinkable tubing
- Wire end ferrule to DIN 46 228: E 1.5-8 for the stranded drain wire (1)
- 2x wire end ferrules to DIN 46 228: E 0.5-8 for the insulated conductors (2, 3)

Figure 4-10: Prepare signal cable A, connect to measuring sensor
a = 50 mm / 2"
b = 10 mm / 0.39"

① Strip the conductor to dimension a.
② Trim the outer shield (60) to dimension b and pull it over the outer sheath.
③ Remove the stranded drain wire (6) of the outer shield and the inner shield (10). Make sure not to damage the stranded drain wire (1) of the inner shield.
④ Slide an insulating tube over the stranded drain wire (1).
⑤ Crimp the wire end ferrules onto conductors 2 and 3 and the stranded drain wire (1).
⑥ Pull the heat-shrinkable tubing over the prepared signal cable.

4.4.9 Preparing signal cable B, connection to measuring sensor

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.

- The outer shield (60) is connected in the terminal compartment of the measuring sensor directly via the shield and a clip.
- Bending radius: ≥ 50 mm / 2"

Required materials

- PVC insulation tubing, Ø2.0...2.5 mm / 0.08...0.1"
- Heat-shrinkable tubing
- Wire end ferrule to DIN 46 228: E 1.5-8 for the stranded drain wire (1)
- 2x wire end ferrules to DIN 46 228: E 0.5-8 for the insulated conductors (2, 3)

Figure 4-11: Preparing signal cable B, connection to measuring sensor

a = 50 mm / 2"
b = 10 mm / 0.39"

① Strip the conductor to dimension a.
② Trim the outer shield (60) to dimension b and pull it over the outer sheath.
③ Remove the stranded drain wire (6) of the outer shield and the shields and stranded drain wires of the insulated conductors (2, 3). Remove the inner shield (10). Be sure not to damage the stranded drain wire (1).
④ Slide an insulating tube over the stranded drain wire (1).
⑤ Crimp the wire end ferrules onto conductors 2 and 3 and the stranded drain wire (1).
⑥ Pull the heat-shrinkable tubing over the prepared signal cable.

4.4.10 Preparing field current cable C, connection to measuring sensor

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.

- The field current cable is not part of the scope of supply.
- Any shield that is present must **NOT** be connected to the measuring sensor.
- Bending radius: ≥ 50 mm / 2"

Required materials

- Heat-shrinkable tubing
- 3 wire end ferrules to DIN 46 228: size according to the cable being used
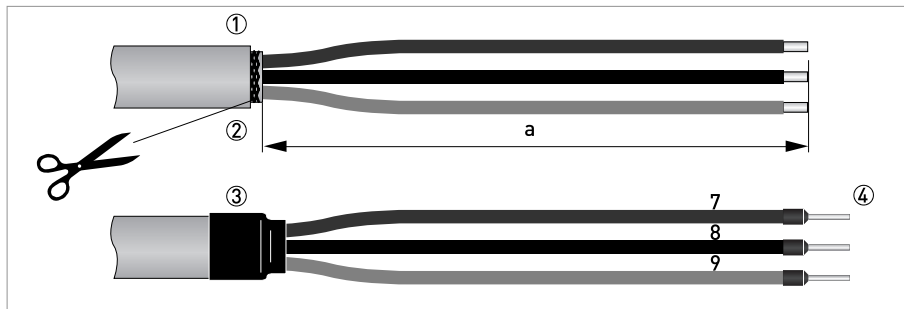
Figure 4-12: Field current cable C, preparation for the measuring sensor

a = 50 mm / 2"

① Strip the conductor to dimension a.
② Remove any shield that is present.
③ Pull a shrinkable tube over the prepared cable.
④ Crimp the wire end ferrules onto the conductors 7, 8 and 9.

4.5 Connecting the signal and field current cables

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

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

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.

4.5.1 Connecting the signal and field current cables, field housing

- The outer shield of signal cable A and/or B is connected electrically with the housing via the clip of the strain relief.
- If a shielded field current cable is used, the shield must **NOT** be connected to the device.
- Bending radius: ≥ 50 mm / 2"
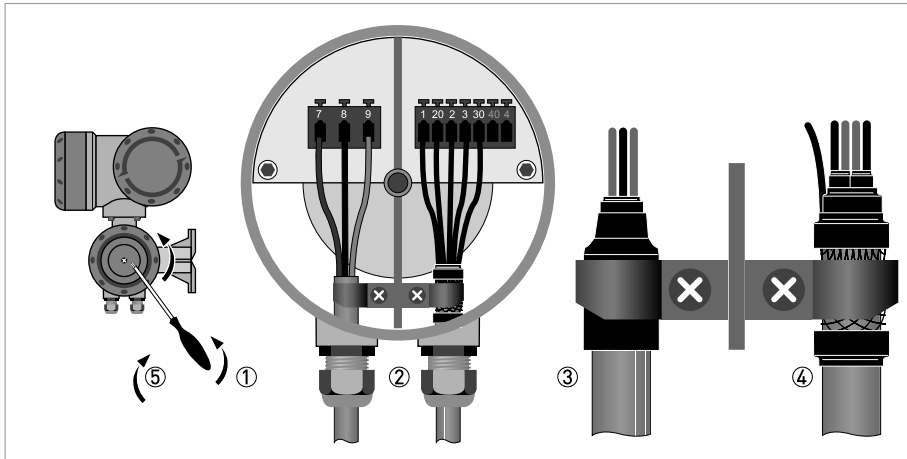
Figure 4-13: Electrical connection of the signal and field current cables, field housing

① Remove the locking screw and open the housing cover.
② Pass the prepared signal and field current cables through the cable entries and connect the corresponding stranded drain wires and conductors.
③ Secure the field current cable using the clip. Any shield that is present must **NOT** be connected.
④ Secure the signal cable using the clip. This also connects the outer shield to the housing.
⑤ Close the housing cover and secure it with the locking screw.

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.

4.5.2 Connecting the signal and field current cables, wall-mounted housing

- The outer shield of signal cable A and/or B is connected via the stranded drain wire.
- If a shielded field current cable is used, the shield must **NOT** be connected to the device.
- Bending radius: ≥ 50 mm / 2"
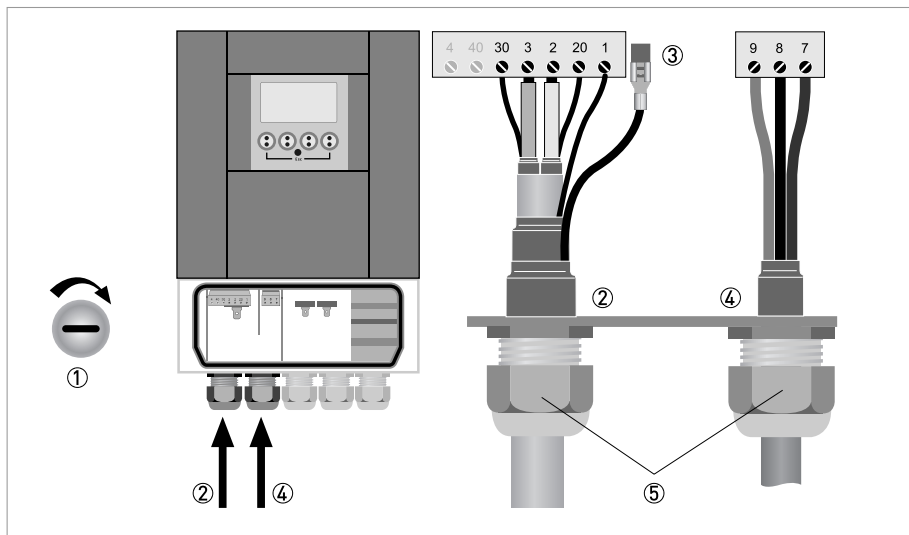
Figure 4-14: Electrical connection of the signal and field current cables, wall-mounted housing

① Open the housing cover.
② Pass the prepared signal cable through the cable entry and connect the corresponding stranded drain wires and conductors.
③ Connect the stranded drain wire of the outer shield.
④ Pass the prepared field current cable through the cable entry and connect the corresponding conductor.
   Any shield that is present must **NOT** be connected.
⑤ Tighten the screw connections of the cable entry and close the housing cover.

INFORMATION!
Ensure that the housing gasket is properly fitted, clean and undamaged.

4.5.3 Connecting the signal and field current cables, 19" rack-mounted housing
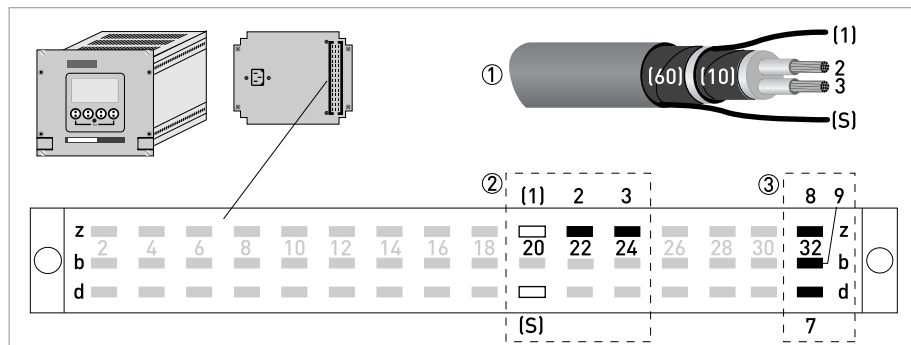
Figure 4-15: Connection signal cable A and field current cable

① Signal cable A
② Shield and insulated wires 2 and 3
③ Field current cable
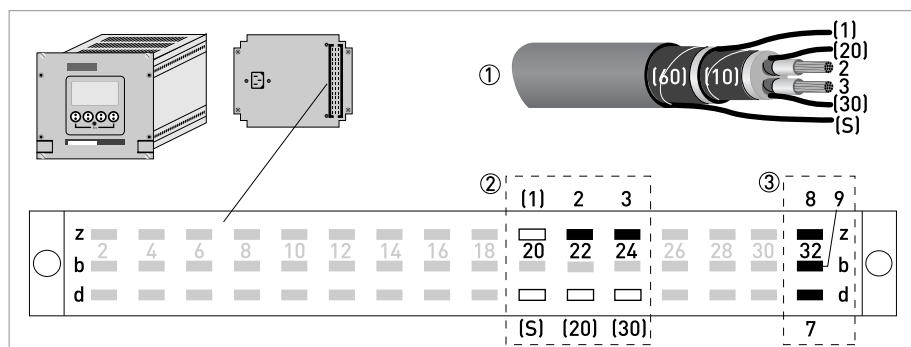
Figure 4-16: Connection signal cable B and field current cable

① Signal cable B
② Shield and insulated wires 2 and 3
③ Field current cable

4.5.4 Connection diagram for measuring sensor, field housing

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

- If a shielded field current cable is used, the shield must **NOT** be connected.
- The outer shield of signal cable A or B in the signal converter housing is connected via the strain relief terminal.
- Bending radius of signal and field current cable: ≥ 50 mm / 2"
- The following illustration is schematic. The positions of the electrical connection terminals may vary depending on the housing version.
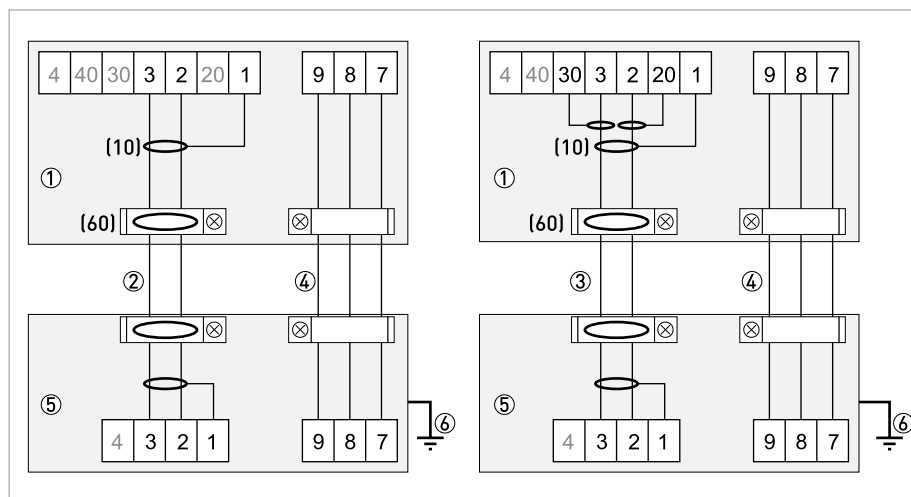
Figure 4-17: Connection diagram for measuring sensor, field housing

① Electrical terminal compartment in housing of the signal converter for signal and field current cable.
② Signal cable A
③ Signal cable B
④ Field current cable C
⑤ Connection box of measuring sensor
⑥ Functional ground FE

4.5.5 Connection diagram for measuring sensor, wall-mounted housing

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

- If a shielded field current cable is used, the shield must **NOT** be connected.
- The outer shield of the signal cable is connected in the signal converter housing via the stranded drain wire.
- Bending radius of signal and field current cable: ≥ 50 mm / 2"
- The following illustration is schematic. The positions of the electrical connection terminals may vary depending on the housing version.
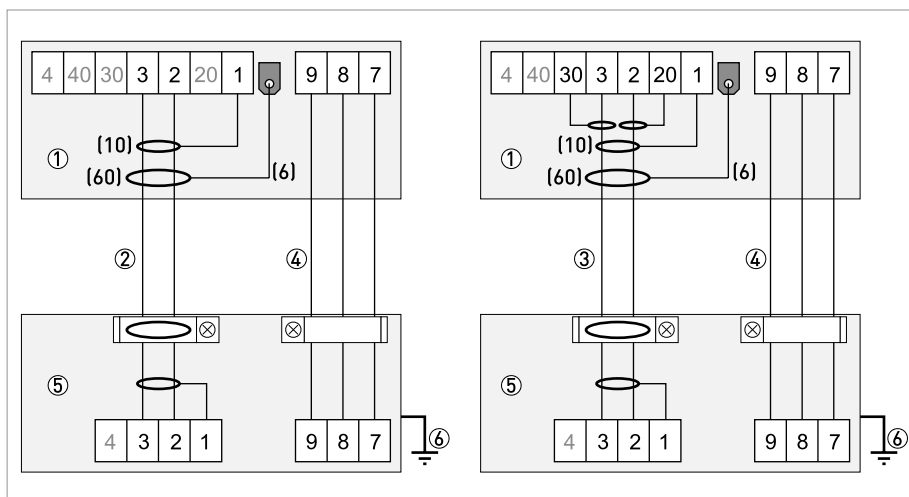
Figure 4-18: Connection diagram for measuring sensor, wall-mounted housing

① Electrical terminal compartment in housing of the signal converter for signal and field current cable.
② Signal cable A
③ Signal cable B
④ Field current cable C
⑤ Connection box of measuring sensor
⑥ Functional ground FE

4.5.6 Connection diagram for measuring sensor, 19" rack-mounted housing

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

- If a shielded field current cable is used, the shield must **NOT** be connected.
- The outer shield of the signal cable is connected in the signal converter housing via the stranded drain wire.
- Bending radius of signal and field current cable: ≥ 50 mm / 2"
- The following illustration is schematic. The positions of the electrical connection terminals may vary depending on the housing version.
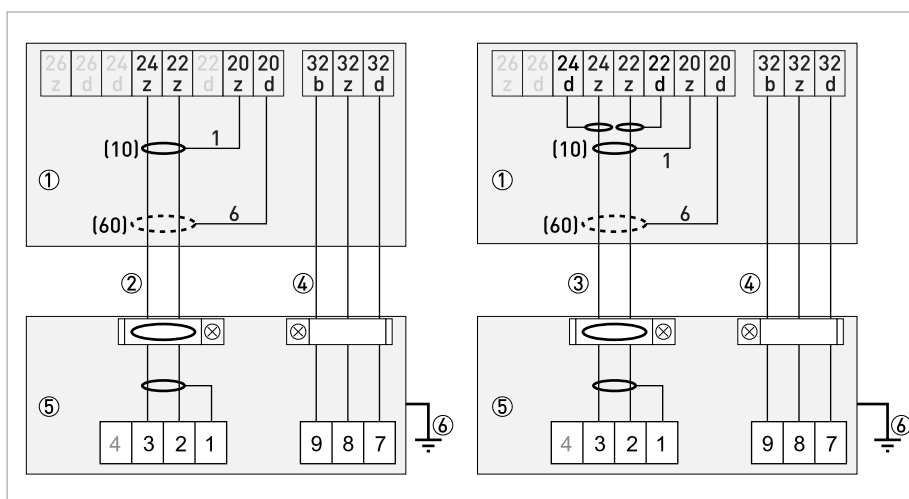
Figure 4-19: Connection diagram for measuring sensor, 19" rack-mounted housing

① Electrical terminal compartment in housing of the signal converter for signal and field current cable.
② Signal cable A
③ Signal cable B
④ Field current cable C
⑤ Connection box of measuring sensor
⑥ Functional ground FE

4.6 Grounding the measuring sensor

4.6.1 Classical method

DANGER!
There should be no difference in potential between the measuring sensor and the housing or protective earth of the signal converter!

- The measuring sensor must be properly grounded.
- The grounding cable should not transmit any interference voltages.
- Do not use the grounding cable to connect more than one device to ground at the same time.
- In hazardous areas, grounding is used at the same time for equipotential bonding. Additional grounding instructions are provided in the separate Ex documentation, which are only supplied together with hazardous-duty equipment.
- The measuring sensors are connected to ground by means of a functional grounding conductor FE.
- Special grounding instructions for the various measuring sensors are provided in the separate documentation for the measuring sensors.
- The documentation for the measuring sensors also contain descriptions on how to use grounding rings and how to install the measuring sensors in metal or plastic pipes or in pipes which are coated on the inside.

4.6.2 Virtual reference

For pipelines which are electrically insulated on the inside (e.g. have an inner liner or are made completely out of plastic), it is also possible to measure without additional grounding rings or electrodes.
The signal converter's input amplifier records the potentials of both measuring electrodes and a patented method is used to create a voltage which corresponds to the potential of the ungrounded medium. This voltage is then the reference potential for signal processing. That means there are no interfering potential differences between the reference potential and the measuring electrodes during signal processing.
 Ungrounded use is also possible for systems with voltages and currents in the pipelines, e. g. electrolysis and galvanic systems.

Thresholds for measuring operation with the virtual reference

Size	≥ DN10 / ≥ 3/8"
Electrical conductivity	≥ 200 µS/cm
Signal cable	use only A (type DS 300)
Signal cable length	≤ 50 m / ≤ 150 ft
Ex operation	is possible, consult with us first

4.7 Connecting power, all housing variants

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

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

- The protection category depends on the housing versions (IP65...67 to IEC 529 / EN 60529 or NEMA4/4X/6).
- The housings of the devices, which are designed to protect the electronic equipment from dust and moisture, should be kept well closed at all times.. Creepage distances and clearances are dimensioned to VDE 0110 and IEC 664 for pollution severity 2. Supply circuits are designed for overvoltage category III and the output circuits for overvoltage category II.
- Fuse protection ($I_N \le 16$ A) for the infeed power circuit, and also a disconnecting device (switch, circuit breaker) to isolate the signal converter must be provided.

Power supply connection (excluding 19" rack-mounted housing)
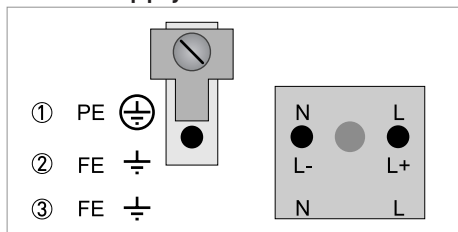
① 100...230 VAC (-15% / +10%)
② 24 VDC (-55% / +30%)
③ 24 VAC/DC (AC: -15% / +10%; DC: -25% / +30%)

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) (as per VDE 0100 / VDE 0106 and IEC 364 / IEC 536 or relevant national regulations).

INFORMATION!
For 24 VDC, 12 VDC-10% is included in the tolerance range.

Power supply connection for 19" rack-mounted housing
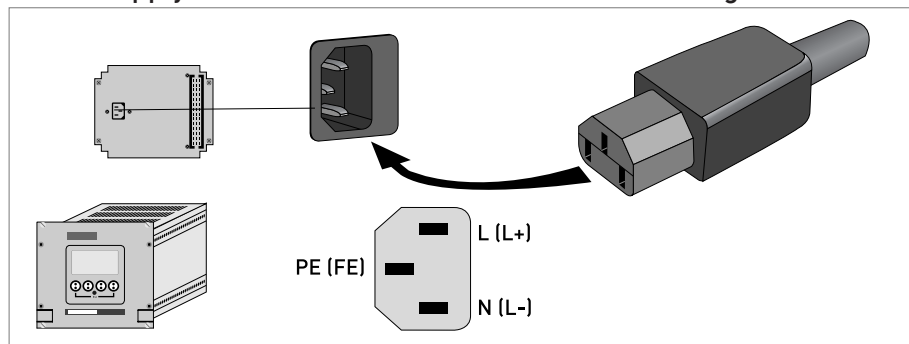
4.8 Inputs and outputs, overview

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

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

Basic version

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

Exi version

- Depending on the task, the device can be configured with various output modules.
- Current outputs can be active or passive.
- Optionally available also with Foundation Fieldbus and Profibus PA

Modular version

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

Bus system

- The device allows intrinsically safe and non intrinsically safe bus interfaces in combination with additional modules.
- For connection and operation of the 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.

4.8.2 Description of the CG number
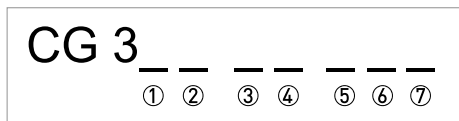
Figure 4-20: Marking (CG number) of the electronics module and input/output variants

① ID number: 0
② ID number: 0 = standard; 9 = special
③ Power supply
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 und ⑦) indicate the assignment of the terminal connections. Please see the following examples.

Examples for CG number

CG 300 11 100	100...230 VAC & standard display; basic I/O: I_a or I_p & S_p/C_p & S_p & P_p/S_p
CG 300 11 7FK	100...230 VAC & standard display; modular I/O: I_a & P_N/S_N and optional module P_N/S_N & C_N
CG 300 81 4EB	24 VDC & standard display; modular I/O: I_a & P_a/S_a and optional module P_p/S_p & I_p

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

Abbreviation	Identifier for CG No.	Description
I_a	A	Active current output (including HART = HART® capability)
I_p	B	Passive current output (including HART = HART® capability)
P_a / S_a	C	Active pulse, frequency, status output or limit switch (changeable)
P_p / S_p	E	Passive pulse, frequency, status output or limit switch (changeable)
P_N / S_N	F	Passive pulse, frequency, status output or limit switch according 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 as per EN 60947-5-6. Errors indicated on LCD display. Error messages possible via status output.
IIn_a	P	Active current input
IIn_p	R	Passive current input
-	8	No additional module installed
-	0	No further module possible

4.8.3 Fixed, non-alterable input/output versions

This signal converter is available with various in-/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)

100		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 inputs/outputs (optional)

200						I_a + HART® active		P_N / S_N NAMUR ②	
300						I_p + HART® passive		P_N / S_N NAMUR ②	
210		I_a active		P_N / S_N NAMUR C_p passive ②		I_a + HART® active		P_N / S_N NAMUR ②	
310		I_a active		P_N / S_N NAMUR C_p passive ②		I_p + HART® passive		P_N / S_N NAMUR ②	
220		I_p passive		P_N / S_N NAMUR C_p passive ②		I_a + HART® active		P_N / S_N NAMUR ②	
320		I_p passive		P_N / S_N NAMUR C_p passive ②		I_p + HART® passive		P_N / S_N NAMUR ②	

PROFIBUS PA (Ex-i) (Option)

D00						PA+	PA-	PA+	PA-
						FISCO Device		FISCO Device	
D10		I_a active		P_N / S_N NAMUR C_p passive ②		PA+	PA-	PA+	PA-
						FISCO Device		FISCO Device	
D20		I_p passive		P_N / S_N NAMUR C_p passive ②		PA+	PA-	PA+	PA-
						FISCO Device		FISCO Device	

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

FOUNDATION Fieldbus (Ex-i) (Option)

E 0 0						V/D+	V/D-	V/D+	V/D-
						FISCO Device		FISCO Device	
E 1 0		I_a active		P_N / S_N NAMUR C_p passive ②		V/D+	V/D-	V/D+	V/D-
						FISCO Device		FISCO Device	
E 2 0		I_p passive		P_N / S_N NAMUR C_p passive ②		V/D+	V/D-	V/D+	V/D-
						FISCO Device		FISCO Device	

① function changed by reconnecting
② changeable

4.8.4 Alterable input/output versions

This signal converter is available with various in-/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 inputs/outputs (Option)

CG-No.		A / A- / B		B-		C	C-	D	D-
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 (Option)

D _ _		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)

PROFIBUS DP (Option)

F _ 0		1 optional module for term. A	Termi-nation P	RxD/TxD-P(2)	RxD/TxD-N(2)	Termi-nation N	RxD/TxD-P(1)	RxD/TxD-N(1)

Modbus (Option)

G _ _ ②		max. 2 optional modules for term. A + B					Common	Sign. B (D1)	Sign. A (D0)
H _ _ ③		max. 2 optional modules for term. A + B					Common	Sign. B (D1)	Sign. A (D0)

① changeable
② not active bus terminator
③ active bus terminator

4.9 Description of the inputs and outputs

4.9.1 Current output

INFORMATION!
The current outputs must be connected depending on the version! Which I/O versions 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 LCD display.
- Current value error detection can be adjusted.
- Automatic range conversion via threshold or control input. The setting range for the threshold is between 5 and 80% of $Q_{100\%}$, $\pm$ 0...5% hysteresis (corresponding ratio from smaller to larger range of 1:20 to 1:1.25)..
  Signaling of the active range possible via a status output (adjustable).
- Forward / reverse flow measurement (F/R mode) is possible.

INFORMATION!
For further information refer to Connection diagrams of inputs and outputs on page 63 and refer to Technical data on page 121.

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

4.9.2 Pulse 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 (override 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 (override 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, override 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: in pulses per volume unit (e.g. 100 pulses/m^3).
- Pulse width:
  Symmetrical (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.

CAUTION!
At frequencies above 100 Hz, shielded cables must be used to prevent radio interference.

INFORMATION!
For further information refer to Connection diagrams of inputs and outputs on page 63 and refer to Technical data on page 121.

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

4.9.3 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.
- In simple active or passive mode, the output stages of the status outputs / limit switches behave like relay contacts, and could be connected with whatever polarity is required.
- All operating data and functions can be adjusted.
- Passive mode: external power supply required:
  $U_{ext} \leq 32$ VDC; $I \leq 100$ mA
- Active mode: use of the internal power:
  U_{nom} 24 VDC; $I \leq 200$ mA
- NAMUR mode: passive in accordance with EN 60947-5-6
- For information on the adjustable operating states refer to *Function tables* on page 91.

INFORMATION!
For further information refer to Connection diagrams of inputs and outputs on page 63 and refer to Technical data on page 121.

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

4.9.4 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 LCD display. Error messages possible via status output.)
- For information on the adjustable operating states refer to *Function tables* on page 91.

INFORMATION!
For further information refer to Connection diagrams of inputs and outputs on page 63 and refer to Technical data on page 121.

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

4.9.5 Current input

INFORMATION!
Depending on the version, the current inputs must be connected passively or actively! 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 current 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:
  $U_{int,nom}$ 24 VDC
- For information on the adjustable operating states refer to *Function tables* on page 91.

INFORMATION!
For further information refer to Connection diagrams of inputs and outputs on page 63 and refer to Technical data on page 121.

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

4.10 Electrical connection of the inputs and outputs

> **ℹ️** *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.*

4.10.1 Field housing, electrical connection of the inputs and outputs

> **⚡** *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!*

- For frequencies above 100 Hz, shielded cables are to be used in order to reduce radiation from electrical interferences (EMC).
- Terminal A+ is only operable in the basic version.
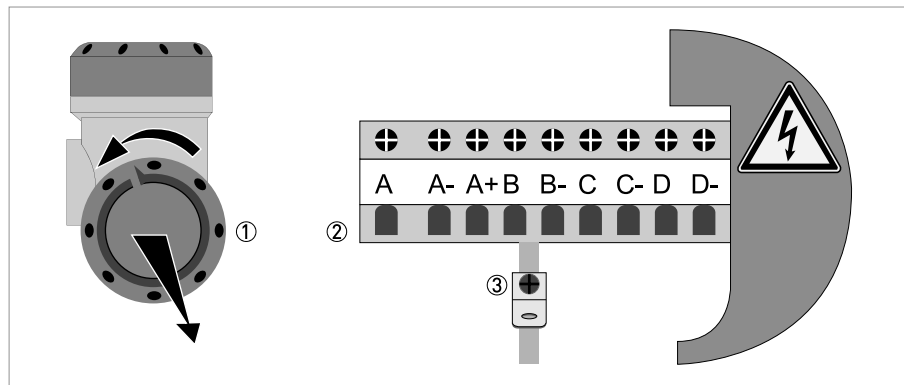
Figure 4-21: Terminal compartment for inputs and outputs in field housing

① Open the housing cover
② Push the prepared cable through the cable entry and connect the necessary conductors.
③ Connect the shield if necessary.

- Close the cover of the terminal compartment.
- Close the housing cover.

> **ℹ️** *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.*

4.10.2 Wall-mounted housing, electrical connection of the inputs and outputs

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!

- For frequencies above 100 Hz, shielded cables are to be used in order to reduce radiation from electrical interferences (EMC). The shield must be electrically connected using 6.3 mm / 0.25" push-on connectors (insulation to DIN 46245) in the I/O terminal compartment.
- Terminal A+ is only operable in the basic version.
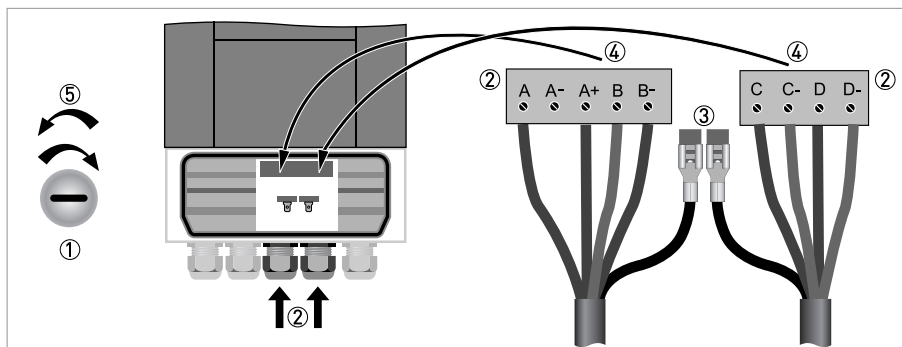
Figure 4-22: Connection of inputs and outputs in wall-mounted housing

① Open the housing cover
② Push the prepared cables through the cable entry and connect them to the supplied connector plugs ④.
③ Connect the shield if necessary.
④ Route the connector plugs with the clamped conductors into the sockets provided for that purpose.
⑤ Close the housing cover.

INFORMATION!
Ensure that the housing gasket is properly fitted, clean and undamaged.

4.10.3 19" rack-mounted housing, electrical connection of the inputs and outputs

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!

- For frequencies above 100 Hz, shielded cables are to be used in order to reduce radiation from electrical interferences (EMC).
- Terminal A+ is only operable in the basic version.
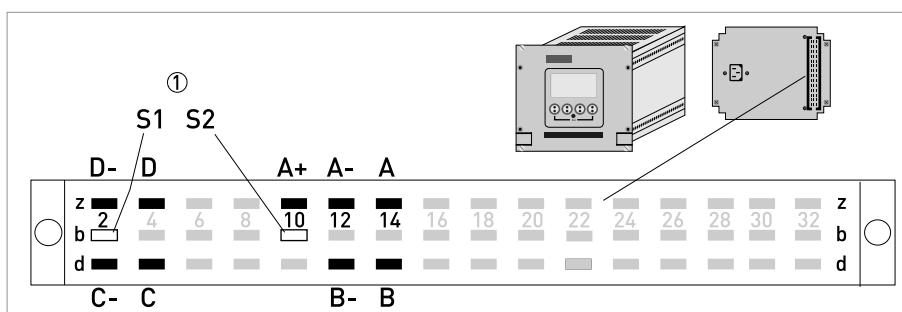
Figure 4-23: Terminal compartment for inputs and outputs in rack-mounted housing
① Shielding

- Connect the conductor to the multipolar plug according to the illustration.
- The signal cable shield is connected to the Pin S.
- Press the plug into the connector.

4.10.4 Laying electrical cables correctly
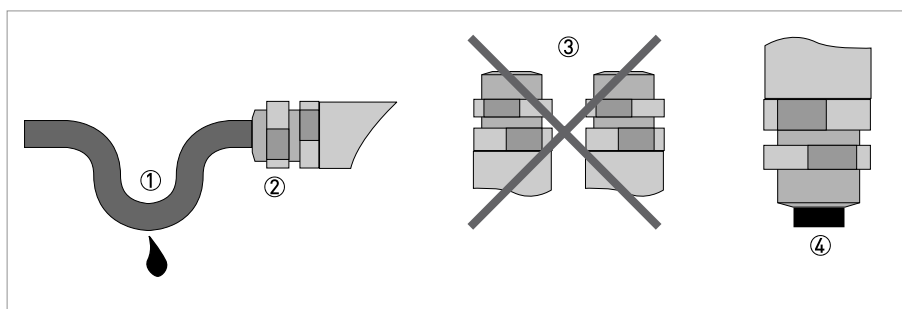
Figure 4-24: Protect housing from dust and water

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.

4.11 Connection diagrams of inputs and outputs

4.11.1 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 operating mode: An external power supply is necessary to operate (activation) the subsequent devices (U_{ext}).
- Active operating 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 LCD display. Error messages possible via status output.
IIn_a	IIn_p	Current input active or passive

4.11.2 Description of the electrical symbols
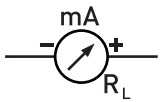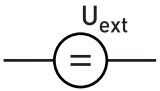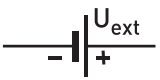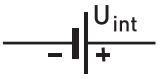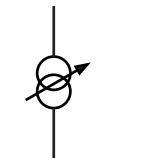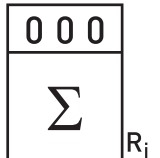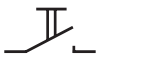
mA meter	mA meter 0...20 mA or 4...20 mA and other R_L is the internal resistance of the measuring point including the cable resistance
U_{ext}	DC voltage source (U_{ext}), external power supply, any connection polarity
U_{ext}	DC voltage source (U_{ext}), observe connection polarity according to connection diagrams
U_{int}	Internal DC voltage source
	Controlled internal power source in the device
0 0 0 Σ R_i	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

4.11.3 Basic inputs/outputs

CAUTION!
Observe connection polarity.

Current output active (HART®), basic I/Os

- $U_{int,nom}$ = 24 VDC nominal

- $I \leq 22$ mA

- $R_L \leq 1$ kΩ
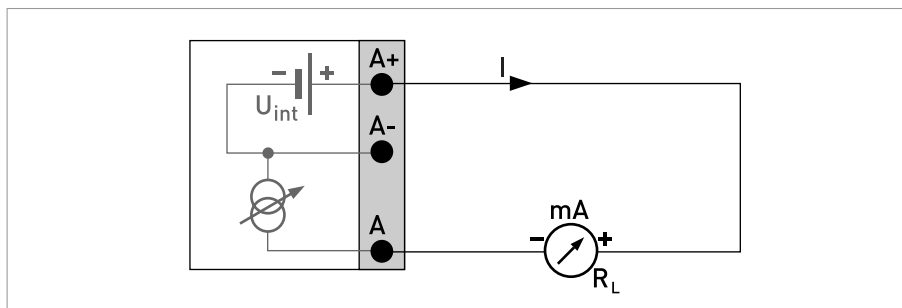
Figure 4-25: Current output active I_a

Current output passive (HART®), basic I/Os

- $U_{int,nom}$ = 24 VDC nominal

- $U_{ext} \leq 32$ VDC

- $I \leq 22$ mA

- $U_0 \geq 1.8$

- $R_L \leq (U_{ext} - U_0) / I_{max}$
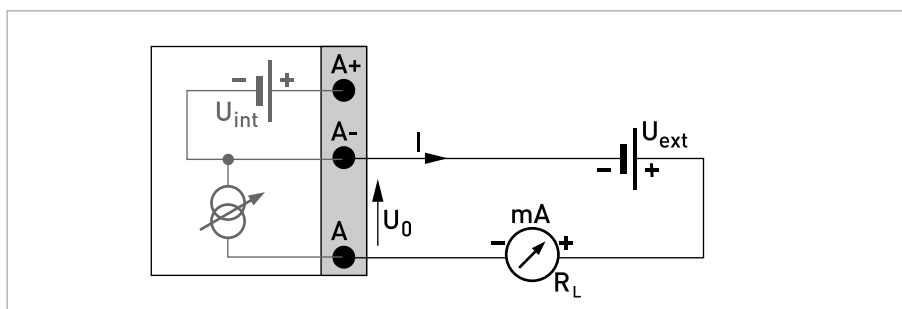
Figure 4-26: Current output passive I_p

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

  Wall-mounted version: *Shield connected using 6.3 mm / 0.25" push-on connectors (insulation to DIN 46245) 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:
  $I \leq 100$ 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 the operating menu set to 100 Hz $< f_{max} \leq 10$ kHz:
  $I \leq 20$ mA
  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
- 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:
  $f \leq 100$ 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 resistance $R_{L,\,min}$ is calculated as follows:
  $R_{L,\,min} = (U_{ext} - U_0) / I_{max}$
- Can also be set as a status output; for the electrical connection, see status output connection diagram.
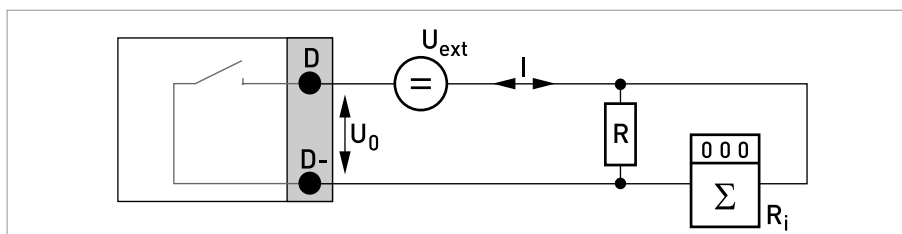
Figure 4-27: Pulse frequency output passive P_p

INFORMATION!
- *Any connection polarity.*

Status output / limit switch passive, basic I/Os

- $U_{ext} \leq 32$ VDC
- $I \leq 100$ mA
- $R_{L, max} = 47$ kΩ
  $R_{L, min} = (U_{ext} - U_0) / I_{max}$
- 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 refer to *Function tables* on page 91.
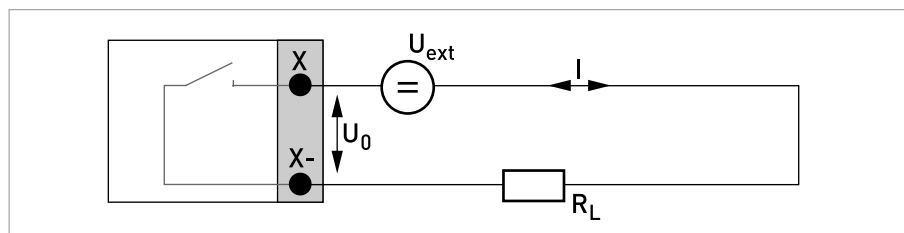
Figure 4-28: Status output / limit switch passive S_p

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
- Set switching point for detection "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, see status output connection diagram.
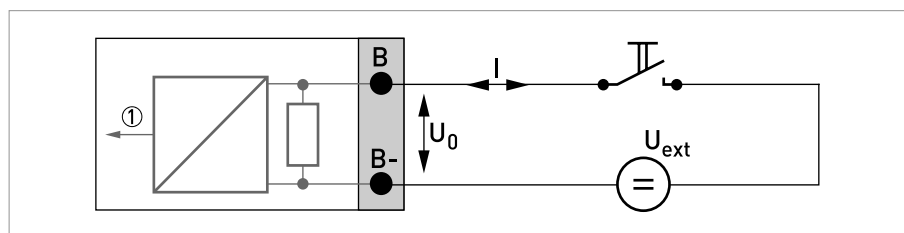
Figure 4-29: Control input passive C_p

① Signal

4.11.4 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 55.*
- *For the electrical connection of the bus systems, please refer to the separate documentation for the respective bus systems.*

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

- $U_{int, nom}$ = 24 VDC
- $I \leq 22$ mA
- $R_L \leq 1$ kΩ
- X designates the connection terminals A, B or C, depending on the version of the signal converter.
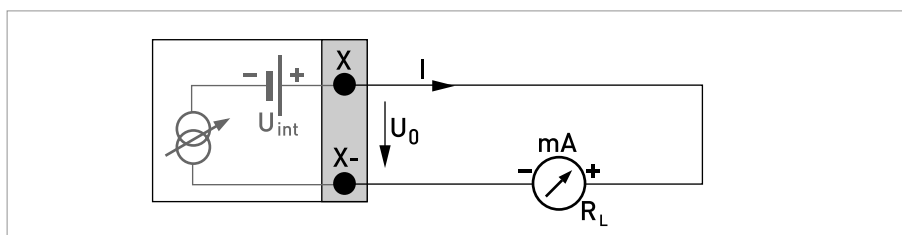
Figure 4-30: Current output active I_a

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

- $U_{ext} \leq 32$ VDC
- $I \leq 22$ mA
- $U_0 \geq 1.8$ V
- $R_L \leq (U_{ext} - U_0) / I_{max}$
- X designates the connection terminals A, B or C, depending on the version of the signal converter.
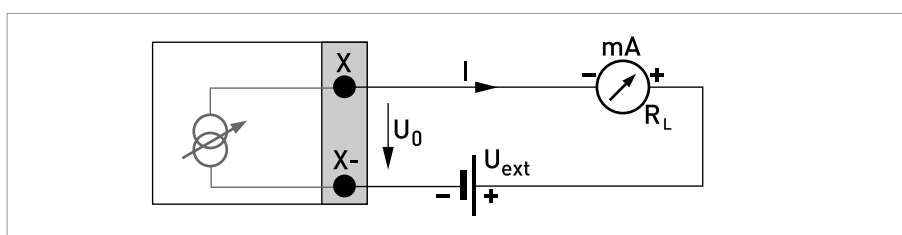
Figure 4-31: Current output passive I_p

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

  Wall-mounted version: *Shield connected using 6.3 mm / 0.25" push-on connectors (insulation to DIN 46245) in the terminal compartment.*
- *Any connection polarity.*

Pulse/frequency output active, modular I/Os

- U_{nom} = 24 VDC
- f_{max} in 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 the 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 resistance $R_{L, max}$ is exceeded, the load resistance 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 resistance $R_{L, min}$ 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.
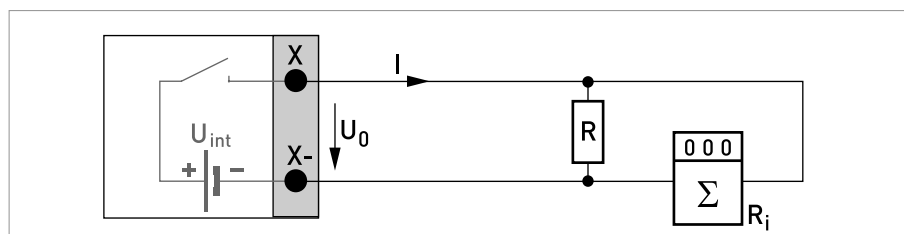
Figure 4-32: Pulse / frequency output active P_a

INFORMATION!
For frequencies above 100 Hz, shielded cables are to be used in order to reduce radiation from electrical interferences (EMC).

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 the 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 resistance $R_{L, max}$ is exceeded, the load resistance 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 resistance $R_{L, min}$ is calculated as follows:
  $R_{L, min} = (U_{ext} - U_0) / I_{max}$

- Can also be set as a status output; see status output connection diagram.

- X designates the connection terminals A, B or D, depending on the version of the signal converter.
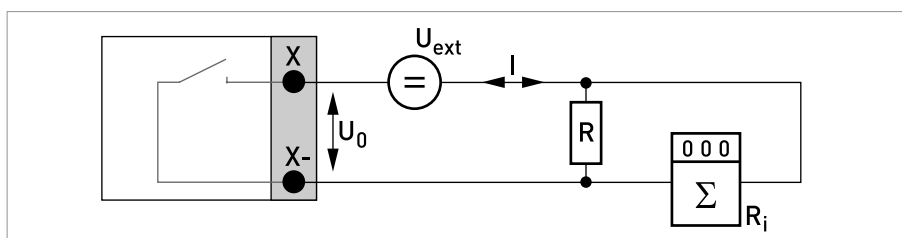
Figure 4-33: Pulse frequency output passive P_p

> **INFORMATION!**
> - *For frequencies above 100 Hz, shielded cables are to be used in order to reduce radiation from electrical interferences (EMC).*
> - **Compact and field housing versions:** *Shield connected via the cable terminals in the terminal compartment.*
>   **Wall-mounted version:** *Shield connected using 6.3 mm / 0.25" push-on connectors (insulation to DIN 46245) in the terminal compartment.*
> - *Any connection polarity.*

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.
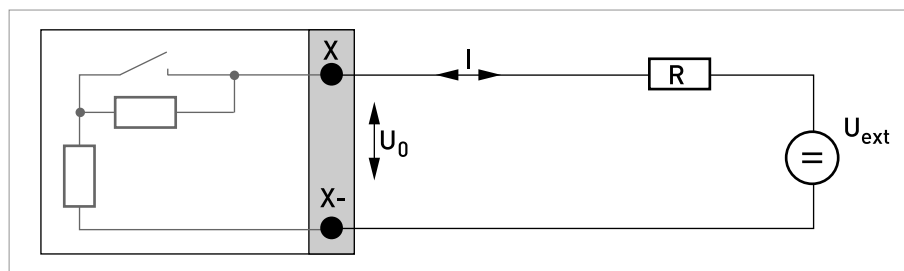
Figure 4-34: Pulse and frequency output passive P_N to NAMUR EN 60947-5-6

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.
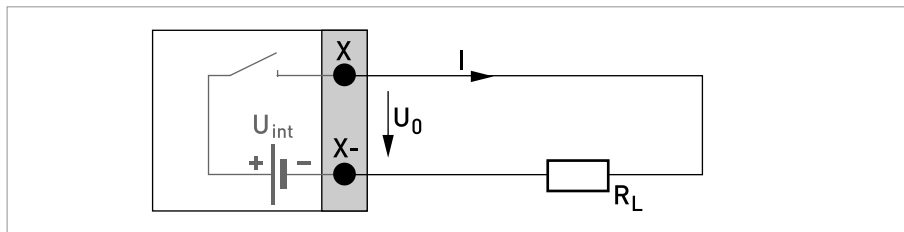
Figure 4-35: Status output / limit switch active S_a

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.
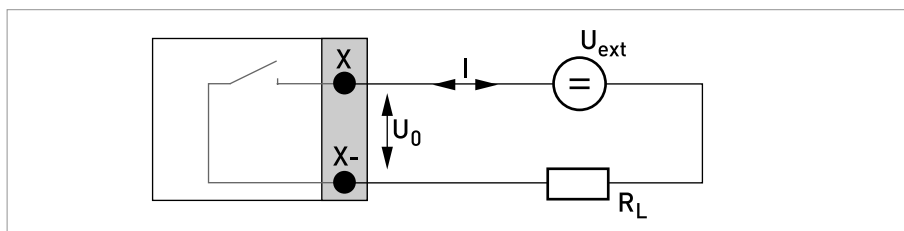
Figure 4-36: Status output / limit switch passive S_p

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.
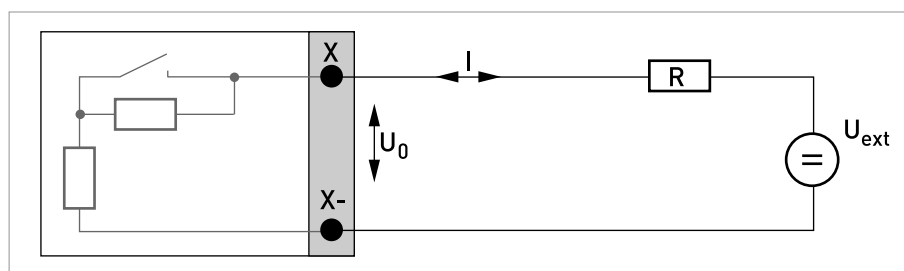
Figure 4-37: Status output / limit switch S_N to NAMUR EN 60947-5-6

⚠️ **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

- Set switching point for detection "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.
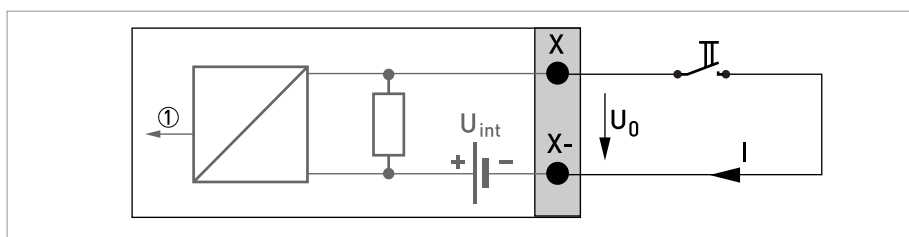
Figure 4-38: Control input active C_a

① Signal

Control input passive, modular I/Os

- 3 V $\leq U_{ext} \leq 32$ VDC

- I_{max} = 9.5 mA at $U_{ext} \leq 24$ V
  I_{max} = 9.5 mA at $U_{ext} \leq 32$ V

- Set switching point for detection "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.
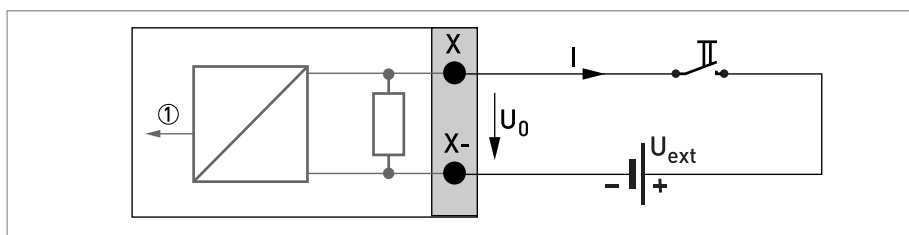
Figure 4-39: Control input passive C_p

① Signal

⚠️ CAUTION!
Observe connection polarity.

Control input active C_N NAMUR, modular I/Os

- Connection in conformity with EN 60947-5-6
- Set switching point for detection "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.
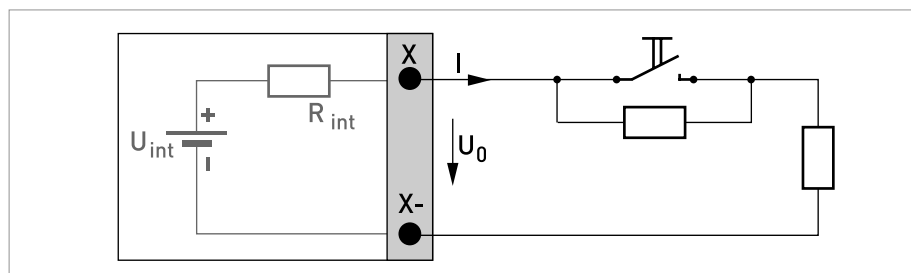
Figure 4-40: Control input active C_N to NAMUR EN 60947-5-6

Current input active, modular I/Os

- $U_{int, nom}$ = 24 VDC
- $I \leq 22$ mA
- $I_{max} \leq 26$ mA (electronically limited)
- $U_{0, min}$ = 19 V at $I \leq 22$ mA
- **no** HART
- X designates the connection terminals A or B, depending on the version of the signal converter.
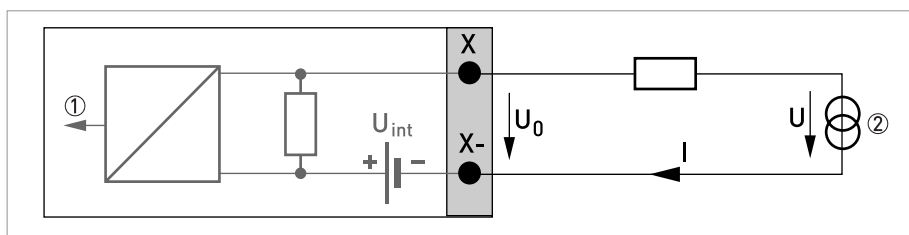
Figure 4-41: Current input active IIn$_a$

① Signal
② 2-wire transmitter (e.g. temperature)

Current input passive, modular I/Os

- $U_{ext} \leq 32$ VDC
- $I \leq 22$ mA
- $I_{max} \leq 26$ mA
- $U_{0, max}$ = 5 V at $I \leq 22$ mA
- X designates the connection terminals A or B, depending on the version of the signal converter.
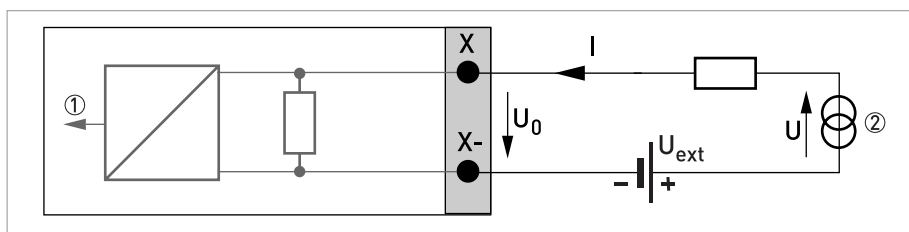
Figure 4-42: Current input passive IIn$_p$

① Signal
② 2-wire transmitter (e.g. temperature)

4.11.5 Exi 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 55.

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

- Observe connection polarity.
- Uint,nom = 20 VDC
- $I \leq 22$ mA
- $R_L \leq 450 \ \Omega$
- X designates the connection terminals A or C, depending on the version of the signal converter.
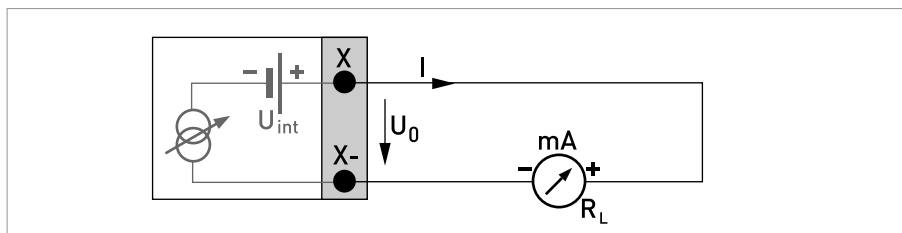
Figure 4-43: Current output active I_a Exi

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

- Any connection polarity.
- $U_{ext} \leq 32$ VDC
- $I \leq 22$ mA
- $U_0 \geq 4$ V
- $R_{L, min} = (U_{ext} - U_0) / I_{max}$
- X designates the connection terminals A or C, depending on the version of the signal converter.
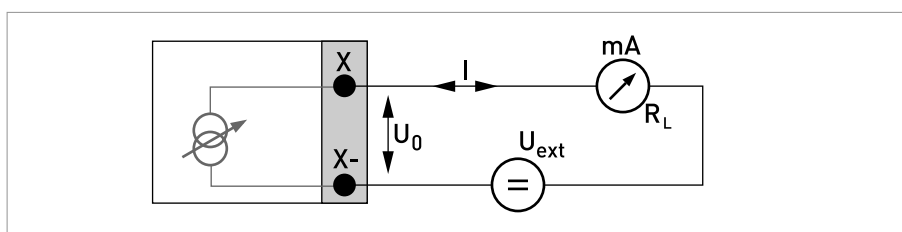
Figure 4-44: Current output passive I_p Exi

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

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

  Wall-mounted version: *Shield connected using 6.3 mm / 0.25" push-on connectors (insulation to DIN 46245) in the terminal compartment.*
- *Any connection polarity.*

Pulse and frequency output passive P_N NAMUR, Exi I/Os

- Connection in conformity with 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.
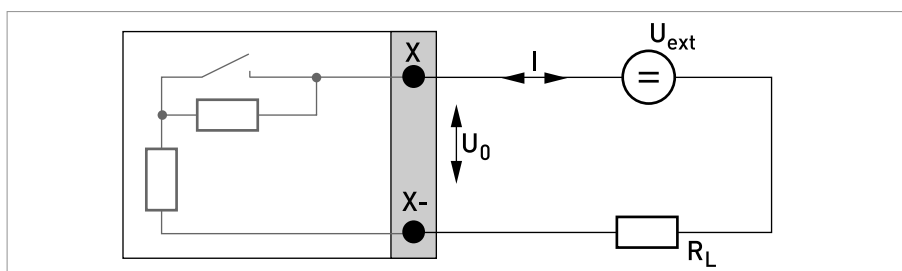
Figure 4-45: Pulse and frequency output passive P_N as per NAMUR EN 60947-5-6 Exi

INFORMATION!
• *Any connection polarity.*

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

• Connection in conformity with 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.
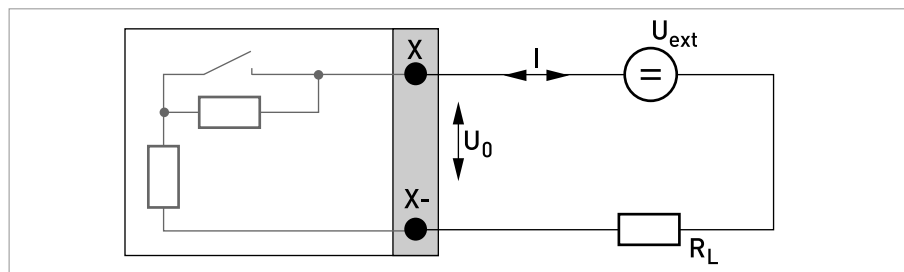
Figure 4-46: Status output/limit switch S_N to NAMUR EN 60947-5-6 Exi

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

INFORMATION!
- *Any connection polarity.*

Control input passive, Exi I/Os

- $5.5\,V \leq U_{ext} \leq 32\,VDC$

- $I_{max} = 6\,mA$ at $U_{ext} \leq 24\,V$
  $I_{max} = 6.5\,mA$ at $U_{ext} \leq 32\,V$

- Set switching point for detection "Contact open or closed:
  Contact open (off): $U_0 \leq 3.5\,V$ with $I \leq 0.5\,mA$
  Contact closed (on): $U_0 \geq 5.5\,V$ with $I \geq 4\,mA$

- X designates the connection terminals B, if available.
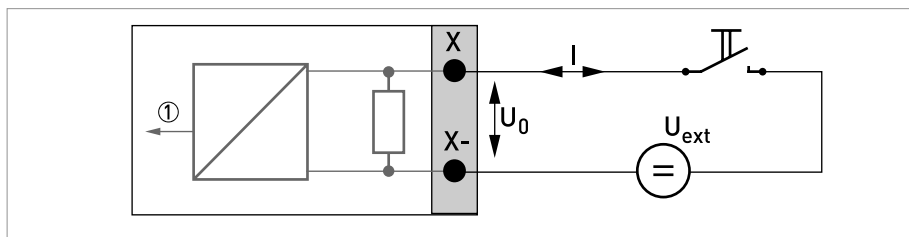
Figure 4-47: Control input passive C_p Exi

① Signal

Current input active, Exi I/Os

* $U_{int, nom}$ = 20 VDC

* $I \leq 22$ mA

* $U_{0, min}$ = 14 V at $I \leq 22$ mA

*   In the event of a short circuit, the voltage is cut off.

*   X designates the connection terminals A or B, depending on the version of the signal converter.
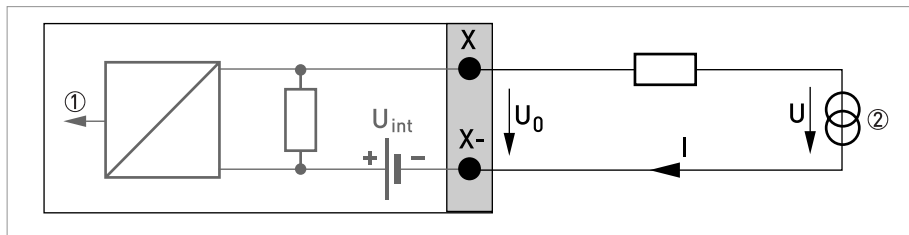
Figure 4-48: Current input active IIn_a

① Signal
② 2-wire transmitter (e.g. temperature)

Current input passive, Exi I/Os

* $U_{ext} \leq 32$ VDC

* $I \leq 22$ mA

* $U_{0, max}$ = 4 V at $I \leq 22$ mA

*   X designates the connection terminals A or B, depending on the version of the signal converter.
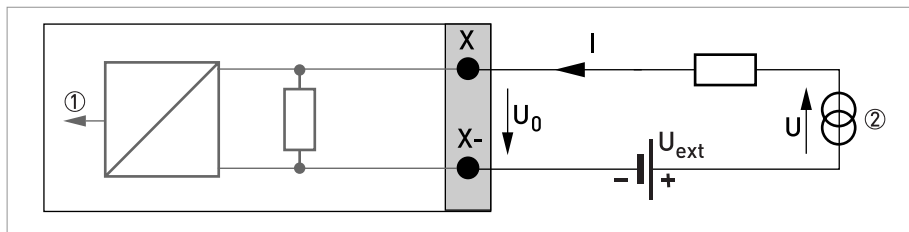
Figure 4-49: Current input passive IIn_p

① Signal
② 2-wire transmitter (e.g. temperature)

4.11.6 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, only the current output module for the connection terminals has C/C-HART® capability.*

HART® connection active (point-to-point)
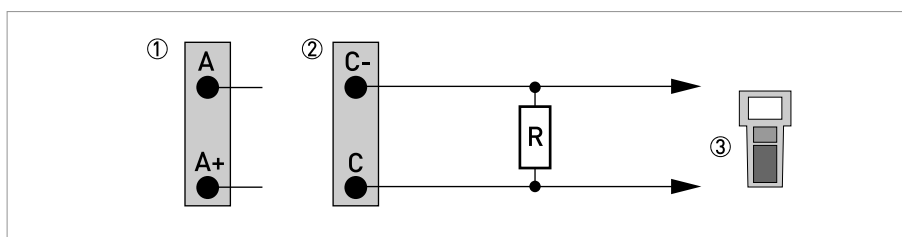
Figure 4-50: HART® connection active (I_a)

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 (multidrop mode)

- I: $I_{0\%} \geq 4$ mA

- Multidrop mode I: $I_{fix} \geq 4$ mA = $I_{0\%}$

- $U_{ext} \leq 32$ VDC

- $R \geq 230\ \Omega$
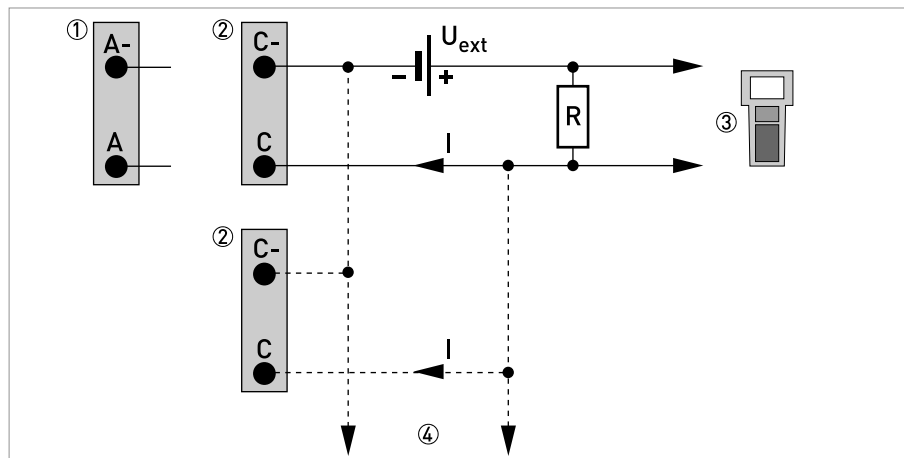
Figure 4-51: HART® connection passive (I_p)

① Basic I/O: terminals A- and A
② Modular I/O: terminals C- and C
③ HART® communicator
④ Other HART®- capable devices

5.1 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.

5.2 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.
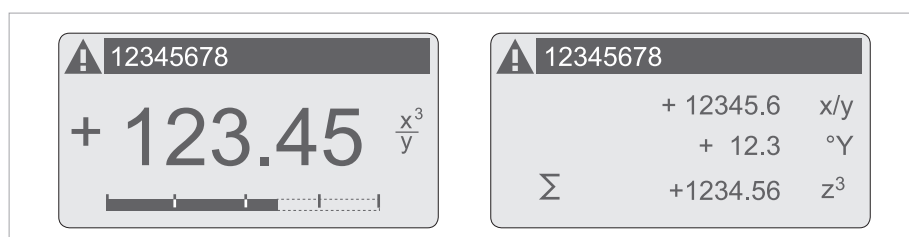
Figure 5-1: Displays in measuring mode (examples for 2 or 3 measured values)
x, y and z denote the units of the measured values displayed

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 ↓. Possible status messages, their meaning and cause refer to *Status messages and diagnostic information* on page 113.

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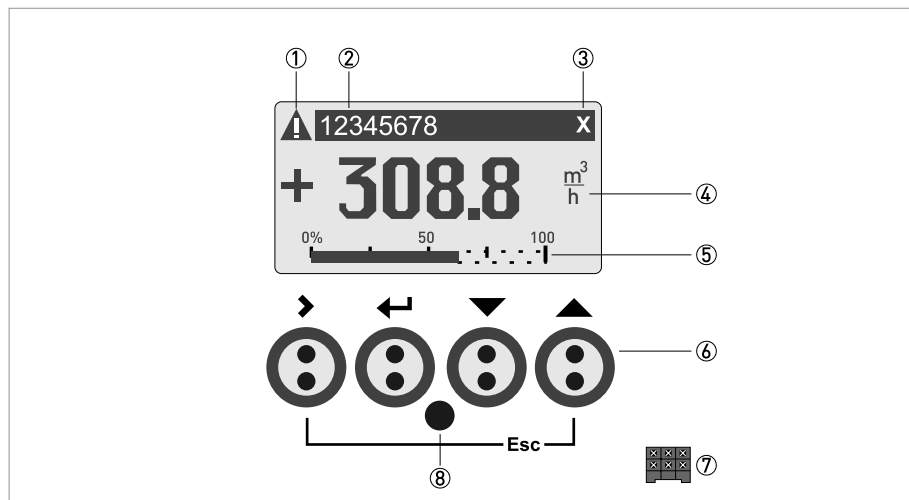
Figure 6-1: Display and operating elements (Example: flow indication with 2 measuring values)

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 depiction
⑤ Bargraph indication
⑥ Keys (see table below for function and depiction 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 best to activate the keys at right angles from the front. Touching them from the side can cause incorrect operation.*
- *After 5 minutes of inactivity, there is an automatic return to measuring mode. Previously changed data is not saved.*

Key	Measuring mode	Menu mode	Sub-menu 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 sub-menu or function	For numerical values, move cursor (highlighted in blue) one position to the right
↵	-	Return to measuring mode but first ask whether the data should be saved	Press 1 to 3 times, return to menu mode, data saved	Return to sub-menu or function, data saved
↓ or ↑	Switch between display pages: measured value 1 + 2, trend page and status page(s)	Select menu	Select sub-menu or function	Use cursor highlighted in blue to change number, unit, setting and to move the decimal point
Esc (> + ↑)	-	-	Return to menu mode without acceptance of data	Return to sub-menu or function without acceptance of data

Table 6-1: Description of key functionality

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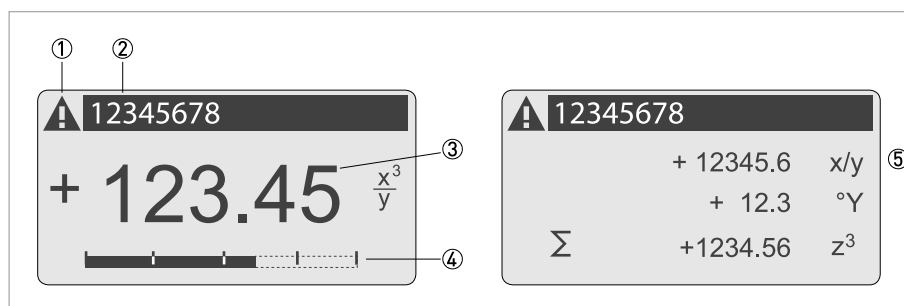
Figure 6-2: Example for display in measuring mode with 2 or 3 measured values

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 depiction
④ Bargraph indication
⑤ Depiction with 3 measured values

6.1.2 Display for selection of sub-menu and functions, 3 lines
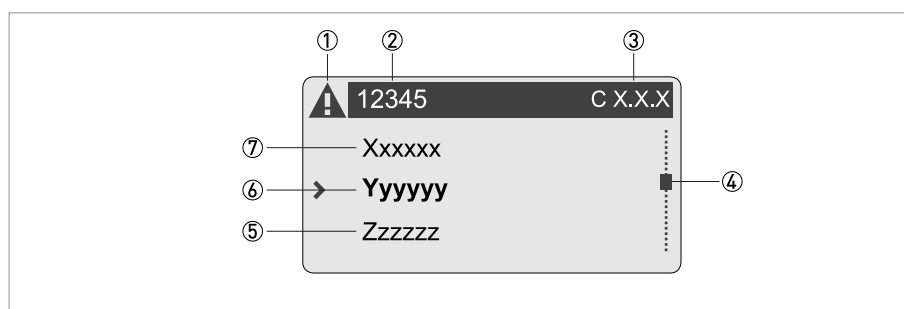
Figure 6-3: Display for selection of sub-menu and functions, 3 lines

① Indicates a possible status message in the status list
② Menu, sub-menu or function name
③ Number relating to ②
④ Indicates position within menu, sub-menu or function list
⑤ Next menu, sub-menu or function
   (_ _ _ signalise in this line the end of the list)
⑥ Current menu, sub-menu or function
⑦ Previous menu, sub-menu or function
   (_ _ _ signalise in this line the beginning of the list)

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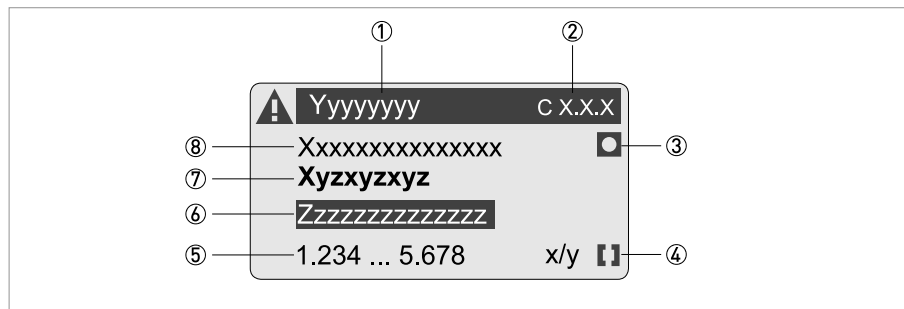
Figure 6-4: Display when setting parameters, 4 lines

① Current menu, sub-menu or function
② Number relating to ①
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 (open with >)
⑧ Factory setting of parameter (non-alterable)

6.1.4 Display when changing parameters, 4 lines
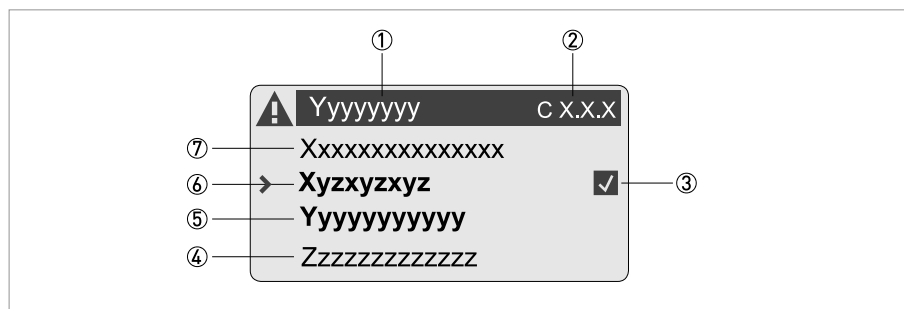
Figure 6-5: Display when changing parameters, 4 lines

① Current menu, sub-menu or function
② Number relating to ①
③ Denotes the change of a parameter (simple to check 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 (non-alterable)

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 C5.6.6 functions refer to Function tables on page 91.*
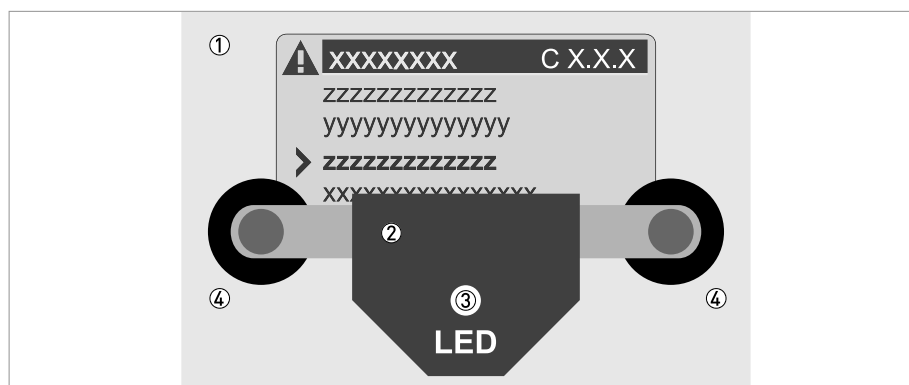
Figure 6-6: IR interface
① Glass panel in front of the control and display panel
② IR interface
③ LED lights up when IR interface is activated.
④ Suction cups

Time-out function

Following activation of the IR interface in Fct. A6 or C5.6.6, 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.

Measuring mode	Select menu	↓ ↑	Select menu and/or sub-menu ↓ ↑			Select function and set data ↓ ↑ >
↵	Press > 2.5 s					
	A quick setup	> ↵	A1 language		> ↵	
			A2 Tag			
			A3 reset?			
			A3.1 reset errors			
			A3.2...3.4 counter 1, 2 or 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			
			A7 process input			
↵	B test	> ↵	B1 simulation		> ↵	
			B2 actual values			
			B3 information			
		↓ ↑	↓ ↑	↓ ↑		↓ ↑ >

Measuring mode	Select menu	↓ ↑	Select menu and/or sub-menu ↓ ↑			Select function and set data ↓ ↑ >
↵	Press > 2.5 s					
	C setup	> ↵	C1 process input	> ↵	1.1 calibration	> ↵
					1.2 filter	
					1.3 self test	
					1.4 information	
					1.5 simulation	
↵		> ↵	C2 I/O (Input/Output)	> ↵	2.1 hardware	> ↵
					2.☐ current output X	
					2.☐ frequency output X	
					2.☐ pulse output X	
					2.☐ status output X	
					2.☐ limit switch X	
					2.☐ control input X	
					2.☐ current input X	
↵		> ↵	C3 I/O counter	> ↵	3.1 counter 1	> ↵
					3.2 counter 2	
					3.3 counter 3	
↵		> ↵	C4 I/O HART	> ↵	4.1 PV is	> ↵
					4.2 SV is	
					4.3 TV is	
					4.4 4V is	
					4.5 HART units	
↵		> ↵	C5 device	> ↵	5.1 device info	> ↵
					5.2 display	
					5.3 1. meas. page	
					5.4 2. meas. page	
					5.5 graphic page	
					5.6 special functions	
					5.7 units	
					5.8 HART	
					5.9 quick setup	
		↓ ↑		↓ ↑	↓ ↑	↓ ↑ >

6.3 Function tables

INFORMATION!
Depending on the device version, not all functions are available.

6.3.1 Menu A, quick setup

No.	Function	Settings / descriptions

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 display header (up to 8 digits).

A3 reset?

A3	reset?	
A3.1	reset errors	reset errors? Select: no/yes
A3.2	reset counter 1	reset counter? Select: no / yes (available if activated in C5.9.1)
A3.3	reset counter 2	reset counter? Select: no / yes (available if activated in C5.9.2)
A3.4	reset counter 3	reset counter? Select: no / yes (available if activated in C5.9.3)

A4 analog outputs (only for HART®)

A4	analog outputs	Applicable to all current outputs (terminals A, B and C), frequency outputs (terminals A, B and D), limit switch (terminals A, B, C, and / or D) and the 1st display page / line 1.
A4.1	measurement	1) Measurement selection: volume flow / mass flow / diagnosis value / flow speed / coil temperature / conductivity
		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 analog 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	Appropriate interface for Profibus / FF / Modbus devices.

A5 digital outputs

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

A6 GDC IR interface

A6	GDC IR interface	After this function has been called up an optical GDC adapter can be connected to the LCD display. If about 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)

A7 process input

A7.1	device serial no.	Serial no. of the system.
A7.2	zero calibration	Display of current zero calibration value.
		Query: calibrate zero?
		Setting: break (return with ↵) / standard (factory setting) / manual (display last value, set new value, range: -1.00...+1 m/s) / automatic (shows the current value as the new zero calibration value)
A7.3	size	Select from size table; range: DN2.5...3000 mm / 1/10...120"
A7.4	GK	Depending on the selection in Fct. A7.4 / A7.5, the Fct. C1.1.0, 5 or 6 appears. Set value acc. to nameplate; range: 0.5...12 (20)
A7.5	GKL	
A7.6	coil resistance Rsp	Field coil resistance at 20°C; range: 10.00...220 Ω
A7.7	calib. coil temp.	The coil temperature is derived from the coil resistance at the reference temperature.
		Set coil temperature: break (return with ↵ key) Standard (= 20°C) automatic (set current temperature); range: -40.0...+200°C
		Set coil resistance: break (return with ↵ key) Standard (= setting of Fct. C1.1.7) automatic (= calibration with the current resistance)
A7.8	target conduct.	Reference value for on-site calibration; range: 1.000...9999 µS/cm

A7.9	EF electr. factor	For calculation of the conductivity based on the electrode impedance.
		Query: calibrate EF? break (return with ↵ key)
		Set value in the following: standard (with factory setting) / manual (set desired value) / automatic (determines EF according to the setting in Fct. C1.1.10)
A7.10	field frequency	Setting as on measuring sensor nameplate = line frequency x value (from the following list):
		2; 4/3; 2/3; 1/2; 1/4; 1/6; 1/8; 1/12; 1/18; 1/36; 1/50
A7.11	flow direction	Define polarity of flow direction.
		forwards (according to the arrow on the measuring sensor) or backwards (in the opposite direction to the arrow)

6.3.2 Menu B, test

No.	Function	Settings / descriptions

B1 simulation

No.	Function	Settings / descriptions
B1	simulation	Displayed values are simulated.
B1.1	flow speed	Flow speed simulation.
		break (exit function without simulation)
		Set value (range: -12…+12 m/s; unit selection in Fct. C5.7.7)
		Query: start simulation?
		Settings: no (exit function without simulation) / yes (start simulation)
B1.2	volume flow	Volume flow simulation, sequence and settings similar to B1.1, see above!
		X stands for one of the connection terminals A, B, C or D ☐ stands for Fct. no. B1.3…1.6
B1.☐	current output X	simulation X X stands for one of the connection terminals A, B, C or D Sequence and settings similar to B1.1, see above! For pulse output a set number of pulses is output once in 1 s!
B1.☐	pulse output X	
B1.☐	frequency output X	
B1.☐	control input X	
B1.☐	limit switch X	
B1.☐	status output X	
B1.☐	current input X	

B2 actual values

No.	Function	Settings / descriptions
B2	actual values	Display the current values; exit the displayed function with key ↵.
B2.1	operating hours	
B2.2	act. flow speed	
B2.3	act. coil temp.	See also Fct. C1.1.7…C1.1.8
B2.4	electr. temperature	
B2.5	act. conductivity	See also Fct. C1.3.1…C1.3.2
B2.6	act. electr. noise	See also Fct. C1.3.13…C1.3.15
B2.7	act. flow profile	See also Fct. C1.1.10…C1.1.12
B2.8	act. coil resistance	Current resistance of the field coils according to the current coil temperature.
B2.9	current input A	Displays the active current value.
B2.10	current input B	

No.	Function	Settings / descriptions

B3 information

B3	information	LCD display
		1st line: ID No. of the circuit board
		2nd line: software version
		3rd line: production date
B3.1	C number	CG number, non-alterable (input/output version)
B3.2	process input	Process input section
B3.3	SW.REV.MS	Electronics and HART® software.
B3.4	SW.REV.UIS	User interface
B3.5	"bus interface"	Only appears with Profibus, Modbus and FF.
B3.6	Electronic Revision ER	Shows ID no., electronic revision no. and production date; Contains all hardware and software changes.

6.3.3 Menu C, setup

No.	Function	Settings / descriptions

C1 process input

C1.1 calibration

C1.1	calibration	
C1.1.1	zero calibration	Display of current zero calibration value.
		Query: calibrate zero?
		Setting: break (return with ↵) / standard (factory setting) / manual (display last value, set new value, range: -1.00…+1 m/s) / automatic (shows the current value as the new zero calibration value)
C1.1.2	size	Select from size table; range: DN2.5…3000 mm / 1/10…120"
C1.1.3	GK selection	Select the field current and the active GKx values; select GK value (see nameplate of the measuring sensor).
		Select: GK & GKL (both values possible / linearity test) / GK (250 mApp) (only GK values possible) / GKL (125 mApp) (only GKL values possible) / GKH (250 mApp) (only GKH values possible)
C1.1.4	GK	Depending on the selection in Fct. C1.1.3, Fct. C1.1.4, 5 or 6 appears. Set value acc. to nameplate; range: 0.5…12 (20)
C1.1.5	GKL	
C1.1.6	GKH	
C1.1.7	coil resistance Rsp	Field coil resistance at 20°C; range: 10.00…220 Ω
C1.1.8	calib. coil temp.	The coil temperature is derived from the coil resistance at the reference temperature.
		Set coil temperature: break (return with ↵ key) Standard (= 20°C) automatic (set current temperature); range: -40.0…+200°C
		Set coil resistance: break (return with ↵ key) Standard (= setting of Fct. C1.1.7) automatic (= calibration with the current resistance)

No.	Function	Settings / descriptions
C1.1.9	density	Calculation of mass flow with constant density of product; range: 0.1…5 kg/l
C1.1.10	target conduct.	Reference value for on-site calibration; range: 1.000…50000 µS/cm
C1.1.11	EF electr. factor	For calculation of the conductivity based on the electrode impedance.
		Query: calibrate EF? break (return with ↵ key)
		Set value in the following: standard (with factory setting) / manual (set desired value) / automatic (determines EF according to the setting in Fct. C1.1.10)
C1.1.12	num. of electrodes	Selection see measuring sensor nameplate: 2 electrodes (standard) / 3 electrodes (with full pipe electrode) / 4 electrodes (full pipe and grounding electrode)
C1.1.13	field frequency	Setting as on measuring sensor nameplate = line frequency x value (from the following list):
		2; 4/3; 2/3; 1/2; 1/4; 1/6; 1/8; 1/12; 1/18; 1/36; 1/50
C1.1.14	select settling	Select settling (special function)
		Select: standard (fixed allocation) / manual (manual time setting for the settling time for the field current)
C1.1.15	settling time	Only when "manual" selected in Fct. C1.1.14; range: 1.0…250 ms
C1.1.16	line frequency	Set line frequency.
		automatic (measuring & setting; for DC systems fixed setting 50 Hz)
		Select: 50 Hz or 60 Hz (fixed setting)
C1.1.17	act. coil resistance	Display of the current value for calculation of the temperature.

No.	Function	Settings / descriptions

C1.2 filter

No.	Function	Settings / descriptions
C1.2	filter	
C1.2.1	limitation	Limitation of all flow values, before smoothing by time constant, affects all outputs.
		Settings: -xxx.x / +xxx.x m/s; condition: 1st value < 2nd value
		Range 1st value: -100.0 m/s ≤ value ≤ -0.001 m/s
		Range 2nd value: +0.001 m/s ≤ value ≤ +100 m/s
C1.2.2	flow direction	Define polarity of flow direction.
		forwards (according to the arrow on the measuring sensor) or backwards (in the opposite direction to the arrow)
C1.2.3	time constant	For all flow measurements and outputs.
		xxx.x s; range: 0.0…100 s
C1.2.4	pulse filter	Suppresses noise due to solids, air/gas bubbles and sudden changes in pH.
		Select: off (without pulse filter) / on (with pulse filter)
C1.2.5	pulse width	Only when pulse filter switched on, Fct. C1.2.4
		Length of interference and delays to be suppressed on sudden changes in flow.
		xx.x s; range: 0.01…10 s
C1.2.6	pulse limitation	Dynamic limitation from one measured value to the next, only when pulse filter switched on, Fct. C1.2.4 effective.
		xx.x s; range: 0.01…100 m/s
C1.2.7	noise filter	Suppresses noise at low conductivity, high solids content, air and gas bubbles, and chemically inhomogeneous media.
		Select: off (without noise filter) / on (with noise filter)
C1.2.8	noise level	Range within which changes are evaluated as noise, and outside of which changes are evaluated as flow (only with noise filter switched on, Fct. C1.2.7).
		xx.xx m/s; range: 0.01…10 m/s
C1.2.9	noise suppression	Set noise suppression (only when noise filter switched on, Fct. C1.2.7).
		Range: 1…10, noise suppression factor [min = 1...max = 10]
C1.2.10	low flow cutoff	Sets output value of all outputs to "0":
		x.xxx ± x.xxx m/s (ft/s); range: 0.0…20 m/s (0.0…32.8 ft/s)
		(1st value = switching point / 2nd value = hysteresis), condition: 2nd value ≤ 1st value

No.	Function	Settings / descriptions

C1.3 self test

No.	Function	Settings / descriptions
C1.3	self test	
C1.3.1	empty pipe detect	Switch conductivity measurement off and on (measurement of the electrode resistance).
		Select: off
		conductivity (only conductivity measurement)
		cond. + empty pipe [F] (conductivity measurement and empty pipe indication, error category [F] application); Flow indication "= 0" when pipe empty
		cond. + empty pipe [S] (conductivity measurement and empty pipe indication, error category [S] measurement outside of specification); Flow indication "≠ 0" when pipe empty
C1.3.2	limit empty pipe	Only available when empty pipe activated [..] in Fct. C1.3.1
		Range: 0.0…9999 µS (set max 50% of the lowest occurring conductivity in operation. Conductivity below this value = signal as empty pipe)
C1.3.3	act. conductivity	Only available when empty pipe activated [..] in Fct. C1.3.1
		Current conductivity is indicated. Activation takes place only after setting mode is exited!
C1.3.4	full pipe detect	Only for measuring sensors with 3 (4) electrodes.
		Select: off (no full pipe measurement) / on (full pipe measurement by 3rd electrode)
C1.3.5	limit full pipe	Only when full pipe detection activated, see Fct. C1.3.4.
		Range: 0.0…9999 µS (conductivity over this value = signal as full pipe)
C1.3.6	linearity	Only if GK values "GK+GKL" are activated with Fct. C1.1.3 (check carried out with 2 field currents).
		Select: off (no linearity check) / on (linearity check activated)
C1.3.7	act linearity	Only available when linearity test "on" activated in Fct. C1.3.6. The conductivity measurement must also be activated, see Fct. C1.3.1.
		Activation takes place only after setting mode is exited!
C1.3.8	gain	Automatic test switched off / on, select: off / on
C1.3.9	coil current	Automatic test switched off / on, select: off / on
C1.3.10	flow profile	Automatic test switched off / on, select: off / on
C1.3.11	limit flow profile	Only with flow profile switched on, see Fct. C1.3.10.
		Range: 0.000…10 (absolute values above this threshold generate an error of category [S])
C1.3.12	act. flow profile	Only available when flow profile "on" activated in Fct. C1.3.10. Activation takes place only after setting mode is exited!
C1.3.13	electrode noise	Automatic test switched off / on, select: off / on
C1.3.14	limit electr. noise	Only with electrode noise activated, see Fct. C1.3.13.
		Range: 0.000…12 m/s (noise above this threshold generates an error of category [S])
C1.3.15	act. electr. noise	Only available when electrode noise "on" activated in Fct. C1.3.13. Activation takes place only after setting mode is exited!
C1.3.16	settling of field	Automatic test switched off / on, select: off / on

No.	Function	Settings / descriptions
C1.3.17	diagnosis value	Select diagnosis value for testing the various analogue outputs.
		Select: off (no diagnosis) / electrode noise (activate Fct. C1.3.13)
		flow profile (activate Fct. C1.3.10) / linearity (activate Fct. C1.3.6)
		terminal 2 DC (electrode DC voltage) / terminal 3 DC (electrode DC voltage)

C1.4 information

C1.4	information	
C1.4.1	liner	Shows material of the liner.
C1.4.2	electr. material	Shows material of the electrodes.
C1.4.3	calibration date	Not available at this time.
C1.4.4	serial no. sensor	Shows serial no. of the measuring sensor.
C1.4.5	V no. sensor	Shows the order number of the measuring sensor.
C1.4.6	sensor electr. info	Shows the production and calibration date of the electronics and the software version.

C1.5 simulation

C1.5	simulation	
C1.5.1	flow speed	Sequence see Fct. B1.1
C1.5.2	volume flow	Sequence see Fct. B1.2

No.	Function	Settings / descriptions

C2 inputs/outputs (I/Os)

C2.1 hardware

C2.1	hardware	Assignment of connection terminals dependent on signal converter version: active / passive / NAMUR
C2.1.1	terminal A	Select: off (switched off) / current output / frequency output / pulse output / status output / limit switch / control input / current input
C2.1.2	terminal B	Select: off (switched off) / current output / frequency output / pulse output / status output / limit switch / control input / current input
C2.1.3	terminal C	Select: off (switched off) / current output / status output / limit switch
C2.1.4	terminal D	Select: off (switched off) / frequency output / pulse output / status output / limit switch

C2.□ current output X

C2.□	current output X	X stands for one of the connection terminals A, B or C □ stands for Fct. no. C2.2 (A) / C2.3 (B) / C2.4 (C)
C2.□.1	range 0%…100%	Current range for the selected measured variable, e.g. 4…20 mA, corresponds to 0…100%
		xx.x … xx.x mA; range: 0.00…20 mA (condition: 0 mA ≤ 1st value ≤ 2nd value ≤ 20 mA)
C2.□.2	extended range	Exceeding the min. and max. limits.
		xx.x … xx.x mA; range: 03.5…21.5 mA (condition: 0 mA ≤ 1st value ≤ 2nd value ≤ 21.5 mA)
C2.□.3	error current	Specify error current
		xx.x mA; range: 3…22 mA (condition: outside of extended range)
C2.□.4	error condition	The following error conditions can be selected.
		Select: error in device (error category [F]) / application error (error category [F]) / out of specification (error category [S])
C2.□.5	measurement	Measurements for activating the output.
		Select: volume flow / mass flow / diagnosis value / flow speed / coil temperature / conductivity
C2.□.6	range	0…100% of the measurement set in Fct. C2□.5
		0…xx.xx _ _ _ (format and unit depend on the measured variable, see above)
C2.□.7	polarity	Set measured value polarity, please note flow direction in C1.2.2!
		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 (use for the output)
C2.□.8	limitation	Limitation before applying the time constant.
		±xxx … ±xxx%; range: -150…+150%
C2.□.9	low flow cutoff	Sets output value to "0"
		x.xxx ± x.xxx%; range: 0.0…20%
		(1st value = switching point / 2nd value = hysteresis), condition: 2nd value ≤ 1st value
C2.□.10	time constant	Range: 000.1…100 s
C2.□.11	special function	Automatic range; select:
		off (switched off)
		automatic range (range is changed automatically, extended lower range, only makes sense together with a status output)
		external range (change by control input, extended lower range, control input must also be activated)
C2.□.12	threshold	Appears only when Fct. C2.□.11 threshold is activated between extended and normal range. The automatic range function always changes from the extended to the normal range when the 100% current is reached.
		The upper 100% value of the hysteresis is then = 0. The threshold is then the hysteresis value, instead of "threshold ± hysteresis" as shown in the display.
		Range: 5.0…80%
		(1st value = switching point / 2nd value = hysteresis), condition: 2nd value ≤ 1st value
C2.□.13	information	Serial number of the I/O circuit board, software version number and production date of the circuit board
C2.□.14	simulation	Sequence see B1.□ current output X

C2.□.15	4mA trimming	Trimming of the current at 4 mA
		Reset to 4 mA restores the factory calibration.
		Used for HART® setting.
C2.□.16	20mA trimming	Trimming of the current at 20 mA
		Reset to 20 mA restores the factory calibration.
		Used for HART® setting.

C2.□ frequency output X

C2.□	frequency output X	X stands for one of the connection terminals A, B or D □ stands for Fct. no. C2.2 (A) / C2.3 (B) / C2.5 (D)
C2.□.1	pulse shape	Specify the pulse shape.
		Select: symmetric (about 50% on and 50% off) / automatic (constant pulse with about 50% on and 50% off at 100% pulse rate) / fixed (fixed pulse rate, setting see below Fct. C2.□.3 100% pulse rate)
C2.□.2	pulse width	Only available if set to "fixed" in Fct. C2.□.1.
		Range: 0.05…2000 ms
		Note: max. setting value T_p [ms] ≤ 500 / max. pulse rate [1/s], gives the pulse width = time where the output is activated
C2.□.3	100 % 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 / diagnosis value / flow speed / coil temperature / conductivity
C2.□.5	range	0…100% of the measurement set in Fct. C2.□.4
		0…xx.xx _ _ _ (format and unit depend on the measurement, see above)
C2.□.6	polarity	Set measured value polarity, please note flow direction in C1.2.2!
		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 (use for the output)
C2.□.7	limitation	Limitation before applying the time constant.
		±xxx … ±xxx%; range: -150…+150%
C2.□.8	low flow cutoff	Sets output value to "0":
		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 generates a high current at the output, switch closed)
		on (activated output generates a low current at the 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. 2.5.6 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)

C2.3.11	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
		Selection: 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 number of the I/O circuit board, software version number and production date of the circuit board
C2.☐.13	simulation	Sequence see B1.☐ frequency output X

C2.☐ pulse output X

C2.☐	pulse output X	X stands for one of the connection terminals A, B or D ☐ stands for Fct. no. C2.2 (A) / C2.3 (B) / C2.5 (D)
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, range in [l] or [kg] (volume or mass for current output C2.☐.6)
		At max. pulse rate see above 2.☐.3 pulse output.
C2.☐.7	polarity	Set polarity, please note flow direction in C1.2.2!
		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 (use for the output)
C2.☐.8	low flow cutoff	Sets output value to "0"
		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 generates a high current at the output, switch closed)
		on (activated output generates a low current at the 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. 2.5.6 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)

C2.3.11	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
		Selection: 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 number of the I/O circuit board, software version number and production date of the circuit board
C2.□.13	simulation	Sequence see B1.□ pulse output X

C2.□ status output X

C2.□	status output X	X (Y) stands for one of the connection terminals A, B, C or D □ stands for Fct. no. C2.2 (A) / C2.3 (B) / C2.4 (C) / C2.5 (D)
C2.□.1	mode	The output shows the following measuring conditions:
		out of specification (output activated, signals application error or error in device refer to *Status messages and diagnostic information* on page 113 / application error (output activated, signals application error or error in device refer to *Status messages and diagnostic information* on page 113 / polarity flow (polarity of the current flow) / over range flow (over range of the flow) / counter 1 preset (activates counter X when preset value is reached) / counter 2 preset (activates counter X when preset value is reached) / counter 3 preset (activates counter X when 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 (when error, output activated)
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 signaled)
		over range (is signaled)
		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 signaled)
		over range (is signaled)
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	off	Only appears if output A...D is set under "mode (see above)" and this output is switched off.
C2.□.3	invert signal	off (activated output supplies a high current, switch closed)
		on (activated output supplies a low current, switch open)

C2.□.4	information	Serial number of the I/O circuit board, software version number and production date of the circuit board
C2.□.5	simulation	Sequence see B1.□ status output X

C2.□ limit switch X

C2.□	limit switch X	X stands for one of the connection terminals A, B, C or D □ stands for Fct. no. C2.2 (A) / C2.3 (B) / C2.4 (C) / C2.5 (D)
C2.□.1	measurement	Select: volume flow / mass flow / diagnosis value / flow speed / coil temperature / conductivity
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 measured value polarity, please note flow direction in C1.2.2!
		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 (use for the output)
C2.□.4	time constant	Range: 000.1…100 s
C2.□.5	invert signal	Select: off (activated output generates a high current, switch closed)
		on (activated output generates a low current, switch open)
C2.□.6	information	Serial number of the I/O circuit board, software version number and production date of the circuit board
C2.□.7	simulation	Sequence see B1.□ limit switch X

C2.□ control input X

C2.□	control input X	X stands for connection terminal A or B □ stands for Fct. no. C2.2 (A) / C2.3 (B)
C2.□.1	mode	off (control input switched off) / hold all outputs (hold current values, not display and counters) / output Y (hold current values) / all outputs to zero (current values = 0%, not display and counters) / output Y to zero (current value = 0%) / all counters (reset all counters to "0") / counter "Z" reset (set counter 1, (2 or 3) to "0") / stop all counters / stop counter "Z" (stops counter 1, (2 or 3) / zero outp.+stop Cnt. (all outputs 0%, stop all counters, 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)
C2.□.2	invert signal	off (control input is activated when a current is applied at the input by voltage to passive inputs or a low-value resistor to active inputs)
		on (control input is activated when no current is applied at the input, low voltage to passive inputs or a high-value resistor to active inputs)
C2.□.3	information	Serial number of the I/O circuit board, software version number and production date of the circuit board
C2.□.4	simulation	Sequence see B 1.□ control input X

C2.□ current input X

C2.□	Current input X	X stands for connection terminal A or B □ stands for Fct. no. C2.2 (A) / C2.3 (B)
C2.□.1	range 0%…100%	Fixed current range (4…20 mA) for the assigned value range; The range indicated cannot be changed
C2.□.2	extended range	Adjustable, extended, linear range is 3.6…21.0 mA; Error ranges: 0.5…<3.6 mA / >21.0…23.0 mA / <0.5 mA open circuit / >23.0 closed circuit
C2.□.3	measurement	The connected sensor delivers the values to the current input; possible values: temperature, pressure or current
C2.□.4	range	Measuring range from 0…100% in the corresponding unit.
C2.□.5	time constant	
C2.□.6	information	Serial number of the I/O circuit board, software version number and production date of the circuit board
C2.□.7	simulation	Sequence see B 1.□ current input X
C2.□.8	4mA trimming	Trimming of the current at 4 mA
		Reset to 4 mA restores the factory calibration.
C2.□.9	20mA trimming	Trimming of the current at 20 mA
		Reset to 20 mA restores the factory calibration.

No.	Function	Settings / descriptions

C3 I/O counter

No.	Function	Settings / descriptions
C3.1	counter 1	Set function of counter □
C3.2	counter 2	□ stands for 1, 2, 3 (= counter 1, 2, 3) The basic version (standard) has only 2 counters!
C3.3	counter 3	
C3.□.1	funct. of counter	Select: sum counter (counts positive and negative values) / +counter (counts only the positive values) / -counter (counts only the negative values) / off (counter is switched off)
C3.□.2	measurement	Selection of the measurement for counter □
		Select: volume flow / mass flow
C3.□.3	low flow cutoff	Sets output value to "0"
		Range: 0.0…20%
		(1st value = switching point / 2nd value = hysteresis), condition: 2nd value ≤ 1st value
C3.□.4	time constant	Range: 0.1…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 counter X" has to be set.
		Preset value (max. 8 digits) x.xxxxx in selected unit, see C5.7.10 + 13
C3.□.6	reset counter	Sequence see Fct. A3.2, A3.3 und A3.4
C3.□.7	set counter	Set counter □ to the desired value.
		Select: break (exit function) / set value (opens the editor to make the entry)
		Query: set counter?
		Select: no (exit function without setting the value) / yes (sets the counter and exits the function)
C3.□.8	stop counter	Counter □ stops and holds the current value.
		Select: no (exits the function without stopping the counter) / yes (stops the counter and exits the function)
C3.□.9	start counter	Start counter □ after that counter is stopped.
		Select: no (exits the function without starting the counter) / yes (starts the counter and exits the function)
C3.□.10	information	Serial number of the I/O circuit board, software version number and production date of the circuit board

No.	Function	Settings / descriptions

C4 I/O HART

No.	Function	Settings / descriptions
C4	I/O HART	Selection / display of the 4 dynamic variables (DV) for HART®.
		The HART® current output (terminal A basic I/Os or terminal 0160C modular 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 analog outputs (current and frequency) 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	Unit change of DVs (dynamic variables) in the display; usually varied
		break: return with ↵ key
		HART display®: copies the settings for the 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®.
		Linear measurements: volume flow / mass flow / diagnosis value / flow speed / coil temperature / conductivity
		Digital measurements: counter 1 / counter 2 / counter 3 / operating hours

No.	Function	Settings / descriptions

C5 device

C5.1 device info

No.	Function	Settings / descriptions
C5.1	device info	
C5.1.1	Tag	Settable characters (max. 8 digits): A...Z; a...z; 0...9; / - , .
C5.1.2	C number	CG number, non-alterable (input/output versions)
C5.1.3	device serial no.	Serial no. of the system.
C5.1.4	electronic serial no.	Serial no. of the electronic assembly, cannot be changed.
C5.1.5	SW.REV.MS	Serial no. of the circuit board, version no. of the main software, production date of the circuit board
C5.1.6	Electronic Revision ER	Shows ID no., electronic revision no. and production date; Contains all hardware and software changes.

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) / 1. meas. page (show this page) / 2. meas. page (show this page) / status page (show only status messages) / graphic page (trend display of the 1st measurement)
C5.2.4	self test	Not available at this time.
C5.2.5	SW.REV.MS	Serial no. of the circuit board, version no. of user software, production date of the circuit board

C5.3 and C5.4 1. meas. page and 2. meas. page

C5.3	1. meas. page	□ stands for 3 = meas. page 1 and 4 = meas. page 2
C5.4	2. meas. page	
C5.□.1	function	Specify number of measured value lines (font size)
		Select: one line / two lines / three lines
C5.□.2	measurement 1.line	Specify measurement for 1st line.
		Select: volume flow / mass flow / diagnosis value / flow speed / coil temperature / conductivity
C5.□.3	range	0…100% of the measurement set in Fct. C5.□.2
		0…xx.xx _ _ _ (format and unit depend on the measurement)
C5.□.4	limitation	Limitation before applying the time constant.
		xxx%; range: -120…+120%
C5.□.5	low flow cutoff	Sets output 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: 0.1…100 s
C5.□.7	format 1.line	Specify decimal places.
		Select: automatic (adaptation carried out automatically) / X (= none) …X.XXXXXXXX (max. 8 digits)
C5.□.8	measurement 2.line	Specify measurement 2.line (only available if this 2.line is activated)
		Select: bar graph (for the measurement selected in 1.line) / volume flow / mass flow / diagnosis value / flow speed / counter 1 / counter 2 / counter 3 / conductivity / coil temperature
C5.□.9	format 2.line	Specify decimal places.
		Select: automatic (adaptation carried out automatically) / X (= none) …X.XXXXXXXX (max. 8 digits)
C5.□.10	measurement 3.line	Specify measurement 3.line (only available if this 3.line is activated)
		Select: volume flow / mass flow / diagnosis value / flow speed / coil temperature / conductivity / counter 1 / counter 2 / counter 3 / current input A / current input B
C5.□.11	format 3.line	Specify decimal places.
		Select: automatic (adaptation carried out automatically) / X (= none) …X.XXXXXXXX (max. 8 digits)

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. C5.3.2
		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?
		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: go on with copy? (cannot be undone) 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 (load in state as delivered) / backup 1 (load data from storage location 1) / backup 2 (load data from storage location 2) / load sensor data (factory settings of calibration data)
		Query: go on with copy? (cannot be undone) 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 4digit: 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 4digit: 0001…9999
C5.6.6	GDC IR interface	After this function has been called up an optical GDC adapter can be connected to the LCD display. If about 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 about 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	volume flow	m³/h; m³/min; m³/s; l/h; l/min; l/s (l = litres); ft³/h; ft³/min; ft³/s; gal/h; gal/min; gal/s; free unit (set factor and text in the next two functions, sequence see below)
C5.7.2	Text free unit	For text to be specified refer to *Set free units* on page 111:
C5.7.3	[m³/s]*factor	Specification of the conversion factor, based on m³/s:
		xxx.xxx refer to *Set free units* on page 111
C5.7.4	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)
C5.7.5	Text free unit	For text to be specified refer to *Set free units* on page 111:
C5.7.6	[kg/s]*factor	Specification of the conversion factor, based on kg/s:
		xxx.xxx refer to *Set free units* on page 111
C5.7.7	flow speed	m/s; ft/s
C5.7.8	conductivity	µS/cm; S/cm
C5.7.9	temperature	°C; °F; K
C5.7.10	volume	m³; l (litre); hl; ml; gal; IG; in³; ft³; yd³; free unit (set factor and text in the next two functions, sequence see below)
C5.7.11	Text free unit	For text to be specified refer to *Set free units* on page 111:
C5.7.12	[m³]*factor	Specification of the conversion factor, based on m³:
		xxx.xxx refer to *Set free units* on page 111
C5.7.13	mass	kg; t; mg; g; lb; ST; LT; oz; free unit (set factor and text in the next two functions, sequence see below)
C5.7.14	Text free unit	For text to be specified refer to *Set free units* on page 111:
C5.7.15	[kg]*factor	Specification of the conversion factor, based on kg:
		xxx.xxx refer to *Set free units* on page 111
C5.7.16	density	kg/cm³; kg/l; kg/m³; lb/ft³; lb/gal; free unit (set factor and text in the next two functions, sequence see below)
C5.7.17	Text free unit	For text to be specified refer to *Set free units* on page 111:
C5.7.18	[kg/m³]*factor	Specification of the conversion factor, based on kg/m³:
		xxx.xxx refer to *Set free units* on page 111
C5.7.19	pressure	Pa; kPa; bar; mbar; psi (no free units possible); only if current input available.

C5.8 HART

C5.8	HART	
C5.8.1	HART	Switch HART® communication on/off::
		Select: HART on (HART® activated) current = 4…20 mA / HART off (HART® not activated) current = 0…20 mA
C5.8.2	address	Set address for HART® operation:
		Select: 00 (point-to-point operation, current output has normal function, current = 4…20 mA) / 01…15 (multidrop operation, current output has a constant setting of 4 mA)
C5.8.3	message	Set required text:
		A…Z ; a…z ; 0…9 ; / - + , .*
C5.8.4	description	Set required text:
		A…Z ; a…z ; 0…9 ; / - + , .*

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 counter 1	Reset counter 1 in quick setup menu?
		Select: yes (activated) / no (switched off)
C5.9.2	reset counter 2	Reset counter 2 in quick setup menu?
		Select: yes (activated) / no (switched off)
C5.9.3	reset counter 3	Reset counter 3 in quick setup menu?
		Select: yes (activated) / no (switched off)
C5.9.4	process input	Select: yes (activated) / no (switched off); only if current input available.

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. 3 digits before / after the slash)
Volume, mass	xxx (max. 3 digits)
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 counter in quick setup menu

INFORMATION!
It may be necessary to activate resetting of the counter in the quick setup menu.

Key	Display	Description and setting
>	quick setup	Time counts backwards from 2.5...0.0 s, after that release the key.
>	language	
2 x ↓	reset	
>	reset errors	
↓	counter 1	Select desired counter. (counter 3 is optional)
↓	counter 2	
↓	counter 3	
>	reset counter no	
↓ or ↑	reset counter yes	
↵	counter 1,2 (or 3)	Counter has been reset.
3 x ↵	Measuring operation	

6.4.2 Deleting error messages in the quick setup menu

INFORMATION!
For the detailed list of the possible error messages refer to Status messages and diagnostic information on page 113.

Key	Display	Description and setting
>	quick setup	Time counts backwards from 2.5...0.0 s, after that release the key.
>	language	
2 x ↓	reset	
>	reset errors	
>	reset? no	
↓ or ↑	reset? yes	
↵	reset errors	Error has been reset.
3 x ↵	Measuring operation	

6.5 Status messages and diagnostic information

Operational faults in device

Messages on the display	Description	Actions
Status: F _ _ _ _ _	Operational fault in device, mA output ≤ 3.6 mA or set fault current (depending on the seriousness of the fault), status output open, pulse / frequency output: no pulses	Repair necessary.
F error in device	Fault or failure of device. Parameter or hardware error. No measurement possible.	Group message, when one of the following or some other severe error occurs.
F IO 1	Error, operational fault in IO 1. Parameter or hardware error. No measurement possible.	Load settings (Fct. C4.6.3) (backup 1, backup 2 or factory settings). If status message still does not disappear, replace electronic unit.
F parameter	Error, operational fault of data manager, electronic unit, parameter or hardware error. Parameters no longer usable.	
F IO 2	Error, operational fault in IO 2. Parameter or hardware error. No measurement possible.	
F configuration (also when changing modules)	Invalid configuration: display software, bus parameter or main software do not match existing configuration. This error also occurs when a module has been added or removed without confirming the configuration change.	After module change, confirm query for changed configuration. If device configuration unchanged: defective, replace electronic unit.
F display	Error, operational fault in display. Parameter or hardware error. No measurement possible.	Defective, replace electronic unit.
F sensor electronic	Error, operational fault in measuring sensor electronics. Parameter or hardware error. No measurement possible.	Defective, replace electronic unit.
F sensor global	Data error in the global data of the measuring sensor electronic equipment.	Load settings (Fct. C5.6.3) (backup 1, backup 2 or factory settings). If status message still does not disappear, replace electronic unit.
F sensor local	Data error in the local data of the measuring sensor electronic equipment.	Defective, replace electronic unit.
F field current local	Data error in the local data of the field current supply	Defective, replace electronic unit.
F current in-/output A	Error, operational fault in current output or output for terminals A/B. Parameter or hardware error. No measurement possible.	Defect, replace electronic unit or input/output module (I/O module).
F current in-/output B		
F current output C	Error, operational fault in current output for terminal C. Parameter or hardware error. No measurement possible.	Defect, replace electronic unit or output module (I/O module).
F software user interface	Fault revealed by CRC check of operation software.	Replace electronic unit.
F hardware settings (also when changing modules)	The set hardware parameters do not match the identified hardware. A dialogue appears in the display.	Answer queries in dialogue mode, follow directions. After module change, confirm query for changed configuration. If device configuration unchanged: defective, replace electronic unit.
F hardware detection	Existing hardware cannot be identified. Defective or unknown modules.	Replace electronic unit.

Messages on the display	Description	Actions
Status: F _ _ _ _ _	Operational fault in device, mA output ≤ 3.6 mA or set fault current (depending on the seriousness of the fault), status output open, pulse / frequency output: no pulses	Repair necessary.
F RAM/ROM error IO1 F RAM/ROM error IO2	A RAM or ROM error is detected during the CRC check.	Defect, replace electronic unit or input/output module (I/O module).
F Fieldbus	Malfunction of the Fieldbus, Profibus or FF interface.	
	Modbus or Ethernet interface malfunction (can also appear with some Profibus or FF errors).	

Application error

Messages on the display	Description	Actions
Status: F _ _ _ _ _	Application fault, device OK, but measured values affected.	Application test or operator action necessary.
F application error	Application-dependent fault, but device is OK.	Group message, when errors as described below or other application errors occur.
F empty pipe	1 or 2 measuring electrodes are not in contact with the medium: measured value is set to zero. No measurement possible.	Measuring pipe not filled, function dependent on Fct. C1.3.2. Check installation. Or electrodes completely insulated e.g. by oil film. Clean!
	The two empty pipe messages cannot appear at the same time. The difference lies in whether the measured value is also set to zero upon the detection of an empty pipe. The sensor electronics will use one or the other function (setting to zero or further measurement) depending on a selection made by the user.	
F flow exceeding limit	Measuring range exceeded, filter setting limits measured values. No message if empty pipe.	Limitation Fct. C1.2.1, increase values.
	If this limit occurs sporadically in processes with air pockets, solid contents or low conductivity, then either the limit has to be increased or a pulse filter used so as to quell the error messages and also reduce the measurement errors.	
F field frequency too high	Field frequency is not reaching steady state, a measured flow value is still being supplied but may have errors. Measured values are still supplied, but they are always too low. No message if coil broken or bridged.	If Fct. C1.1.14 settling time is set to "manual", increase value in Fct. C1.1.15. If "standard" is set, set field frequency in Fct. C1.1.13 acc. to signal converter nameplate.
F DC offset	ADC over-ranged by DC offsets. No measurement can be performed, the flow is set to zero. No message if empty pipe.	For remote signal converters, check the connection of the signal cable.
F open circuit A F open circuit B F open circuit C	Load on current output A/B/C too high, effective current too low.	Current not correct, mA output cable has open circuit or load too high. Check cable, reduce load (set < 1000 ohm).
F over range A F over range B F over range C	The current or the corresponding measured value is limited by a filter setting.	Check with Fct. C2.1 hardware or sticker in terminal compartment, which output is connected to the terminal. If current output: extend Fct. C2.x.6 range and Fct. C2.x.8 limitation. If frequency output: extend values in Fct. C2.x.5 and Fct. C2.x.7.
F over range A F over range B F over range C	The pulse rate or the corresponding measured value is limited by a filter setting. Or the demanded pulse rate is too high.	

Messages on the display	Description	Actions
Status: F _ _ _ _ _	Application fault, device OK, but measured values affected.	Application test or operator action necessary.
F active settings	Error during the CRC check of the active settings.	Upload backup 1 or backup 2 settings, check and adjust if necessary.
F factory settings	Error during the CRC check of the factory settings.	
F backup 1 settings	Error during the CRC check of the backup 1 or 2 settings.	Save active settings in backup 1 or 2.
F backup 2 settings		
F wiring A	Open or short circuit of control input A/B. Only available if used as an active NAMUR input.	
F wiring B		
F wiring A	The current at the current input is less than 0.5 mA or greater than the limit switch of 23 mA.	
F wiring B		

Measurements out of specification

Messages on the display	Description	Actions
Status: S _ _ _ _ _	Out of specification, measurement continues, accuracy possibly less.	Maintenance required.
S uncertain measurement	Device maintenance necessary; measured values only conditionally usable.	Group message, when errors as described below or other influences occur.
S pipe not full	Only for measuring sensors with 3 or 4 electrodes. Full pipe electrode has no contact with medium. Measured values are still supplied, but they are too high.	Measuring pipe not filled, function dependent on Fct. C1.3.5. Check installation. Or electrodes completely insulated e.g. by oil film. Clean!
S empty pipe	1 or 2 measuring electrodes are not in contact with the medium, measured value is not set to zero. Measurement continues.	Filling level of EMF less than 50% or electrodes completely insulated. If "0" to be indicated when pipe is empty, activate in Fct. C1.3.1 "cond.+empty pipe [F]".
	The two empty pipe messages cannot appear at the same time. The difference lies in whether the measured value is also set to zero upon the detection of an empty pipe. The sensor electronics will use one or the other function (setting to zero or further measurement) depending on a selection made by the user.	
S linearity	Measured values at both field current levels are not equal. Measured values are still supplied.	Very strong external magnetic fields, or defect in sensor's magnetic circuit or in signal processing.
S flow profile	Measured value is not zero in the case of a non-homogenous magnetic field. Measured values are still supplied.	Unimpeded inlet and outlet runs of the measuring sensor are too short, pipe not full, measuring tube liner damaged.
S electrode noise	Noise on the electrodes too high. Measured values are still supplied. No message if empty pipe.	a) Electrodes extremely soiled; b) Conductivity too low: activate noise or pulse filter Fct. C1.2.4, C1.2.7; c) Gas bubbles, solids or chem. reactions in medium: activate noise or pulse filter Fct. C1.2.4, C1.2.7; d) Electrode corrosion (if message also appears when flow is zero): use sensor with suitable electrode material.
S gain error	Preamplifier not equal to the calibrated value; check calibration. Measured values are still supplied.	Defective, replace electronic unit.
S electrode symmetry	Impedance of the two measuring electrodes not equal. Measured values are still supplied.	Deposits in measuring tube or electrode short-circuit to ground. Clean and check measuring tube!

Messages on the display	Description	Actions
Status: S _ _ _ _ _	Out of specification, measurement continues, accuracy possibly less.	Maintenance required.
S field coil broken	Field coil resistance too high.	Check field coil connections to the electronic module (for remote versions: field current cable) for open circuit / short circuit
S field coil bridged	Field coil resistance too low.	
S field current deviation	Measured field current not equal to the calibrated value. Check calibration. Measured values are still supplied. No message if coil broken or bridged.	Check field current connections. If OK: defective, replace electronic unit.
S field frequency too high	The ratio of the two measuring windows is not equal to 1, the magnetic field is not properly in steady state. Measured values are still supplied.	If Fct. C1.1.14 settling time is set to "manual", increase value in Fct. C1.1.15. If "standard" is set, set field frequency in Fct. C1.1.13 acc. to measuring sensor nameplate.
S electronic temperature	Upper limit for the permissible electronic temperature has been exceeded.	Ambient temperature too high, direct solar radiation or, for C version, process temperature too high.
S coil temperature	Upper limit for the permissible coil temperature has been exceeded. No message if coil broken/bridged.	Process and ambient temperature too high.
S overflow counter 1	This is counter 1 or FB2 (with Profibus). Counter has overrun and started again at zero.	
S overflow counter 2	This is counter 2 or FB3 (with Profibus). Counter has overrun and started again at zero.	
S overflow counter 3	This is counter 3 or FB4 (with Profibus). Not available without IO2. Counter has overrun and started again at zero.	
S backplane invalid	The data record on the backplane is invalid. The CRC check has revealed a fault.	No data can be loaded from the backplane when the electronics are replaced. Replace housing.
S error current A	Error current at current input	
S error current B		

Simulation of the measured values

Messages on the display	Description	Actions
Status: C _ _ _ _ _	Output values partially simulated or fixed	Maintenance required.
C checks in progress	Test mode of the device. Measured values are possibly simulated values or values with fixed settings.	Message depending on the situation via HART® or FDT. Depiction via display if outputs are held by control input or set to zero.
C test sensor	Test function of the measuring sensor electronics is active.	
C simulation fieldbus	Values on the Foundation Fieldbus interface are simulated.	

Information

Messages on the display	Description	Actions
Status: I _ _ _ _ _	Information (current measurement OK)	
I counter 1 stopped	This is counter 1 or FB2 (with Profibus). The counter has stopped.	If counter to continue counting, activate "yes" in Fct. C2.y.9 (start counter).
I counter 2 stopped	This is counter 2 or FB3 (with Profibus). The counter has stopped.	
I counter 3 stopped	This is counter 3 or FB4 (with Profibus). The counter has stopped.	
I power fail	The device was not in operation for an unknown period of time, because the emergency current was switched off. This message is for information only.	Temporary power failure. Counters did not run during it.
I control input A active	This message appears when the control input is active. This message is for information only.	
I control input B active		
I over range display 1	1st line on page 1 (2) of display limited by filter setting.	Menu display Fct. C4.3 and/or C4.4, select meas. page 1 or 2 and increase values in functions C4.z.3 meas. range and/or C4.z.4 limitation.
I backplane sensor	The data on the backplane are not usable because they have been generated with an incompatible version.	
I backplane settings	The global settings on the backplane are not usable because they have been generate with an incompatible version.	
I backplane difference	The data on the backplane differ from the data in the display. If the data are usable, a dialogue is indicated in the display.	
I optical interface	The optical interface is being used. The keys on the local display are not in operation.	The keys are ready for operation again approx. 60 sec. after the end of the data transfer/removal of the optocoupler.
I write cycles overfl.	The maximum number of write cycles of the EEPROM or FRAMS on the Profibus DP PCB has been exceeded.	
I baudrate search	The baudrate of the Profibus DP interface is searched for.	
I no data exchange	There is no data exchange between the signal converter and the Profibus.	
I conductivity off	Conductivity measurement switched off.	Changing of settings in Fct. C1.3.1.
I diagnosis channel off	Diagnosis value switched off.	Changing of settings in Fct. C1.3.17.

7.1 Spare parts availability

The manufacturer adheres to the basic principle that operational spare parts for each device or each important accessory part will be kept available for a period of 10 (ten) years after delivery of the last production run for that device.

Operational spare parts are defined as parts that are subject to faults in normal operation.

7.2 Availability of services

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

INFORMATION!
For more precise information, please contact your local representative.

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 our personnel, 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, flammable or water-endangering products, you are kindly requested:
- *to check and ensure, if necessary by rinsing or neutralizing, 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

Company:	Address:
Department:	Name:
Tel. no.:	Fax no.:
Manufacturer's order no. or serial no.:	
The device has been operated with the following medium:	

This medium is:	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.

8.1 Measuring principle

An electrically conductive fluid flows inside an electrically insulating pipe through a magnetic field. This magnetic field is generated by a current, flowing through a pair of field coils. Inside of the fluid, a voltage U is generated:

U = v * k * B * D

in which:
v = mean flow velocity
k = factor correcting for geometry
B = magnetic field strength
D = inner diameter of flow meter

The signal voltage U is picked off by electrodes and is proportional to the mean flow velocity v and thus the flow rate q. The signal voltage is quite small (typically 1 mV at v = 3 m/s / 10 ft/s and field coil power of 1 W). Finally, a signal converter is used to amplify the signal voltage, filter it (separate from noise) and convert it into signals for totalising, recording and output processing.
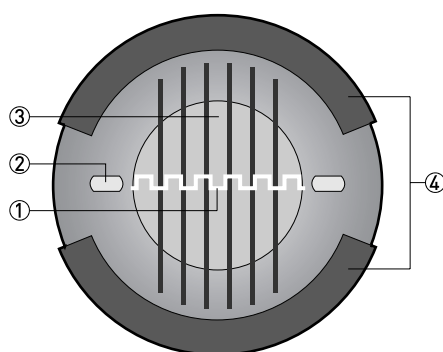
① Voltage (induced voltage proportional to flow velocity)
② Electrodes
③ Magnetic field
④ Field coils

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 representative.*
- *Additional information (certificates, special tools, software,...) and complete product documentation can be downloaded free of charge from the website (Downloadcenter).*

Measuring system

Measuring principle	Faraday's law of induction
Application range	Continuous measurement of current volume flow, flow velocity, conductivity, mass flow (at constant density), coil temperature of the measuring sensor

Design

Modular design	The measuring system consists of a measuring sensor and a signal converter.
Measuring sensor	
OPTIFLUX 1000	DN10...150 / 3/8…6"
OPTIFLUX 2000	DN25...3000 / 1…120"
OPTIFLUX 4000	DN2.5...3000 / 1/10…120"
OPTIFLUX 5000	Flange: DN15...300 / ½…12" Sandwich: DN2.5...100 / 1/10…4"
OPTIFLUX 6000	DN2.5...150 / 1/10…6"
WATERFLUX 3000	DN50...600 / 2...24"
	With the exception of the OPTIFLUX 1000 and WATERFLUX 3000 all measuring sensors are also available in an Ex-version.
Signal converter	
Compact version (C)	IFC 300 C
Field housing (F) - remote version	IFC 300 F
Wall-mounted housing (W) - remote version	IFC 300 W
19" rack-mounted housing (R) - remote version	IFC 300 R
	Compact and field housing versions are also available in Ex versions.
Options	
Outputs / inputs	Current- (incl. HART®), pulse, frequency and/or status output, limit switch and/or control input, current input (depends on the I/O version)
Counters	2 (optional 3) internal counters with a max. of 8 counter places (e.g. for counting volume and/or mass units)
Verification	Integrated verification, diagnostic functions: measuring device, process, measured value, empty pipe detection, stabilization
Communication interfaces	Foundation Fieldbus, Profibus PA and DP, Modbus, HART®

Display and user interface	
Graphic display	LC display, backlit white.
	Size: 128 x 64 Pixel, corresponds to 59 x 31 mm = 2.32" x 1.22"
	Display can be turned in steps of 90°.
	Ambient temperatures below -25°C / -13°F, may affect the readability of the display.
Operating elements	4 optical keys for operator control of the signal converter without opening the housing.
	Infrared interface for reading and writing all parameters with IR interface (option) without opening the housing.
Remote control	PACTware® (incl. Device Type Manager (DTM))
	HART® Hand Held Communicator from Emerson Process
	AMS® from Emerson Process
	PDM® from Siemens
	All DTMs and drivers are available free of charge from the manufacturer's website.
Display functions	
Operating menu	Setting the parameters using 2 measured value pages, 1 status page, 1 graphics page (measured values and graphics are freely adjustable)
Language display texts (as language package)	Standard: English, French, German, Dutch, Portuguese, Swedish, Spanish, Italian
	Eastern Europe: English, Slovenian, Czech, Hungarian
	Northern Europe: English, Danish, Polish
	China: English, Chinese
	Russia: English, Russian
Units	Metric, British and US units selectable as required from lists for volume / mass flow and counting, flow velocity, electrical conductivity, temperature, pressure

Measuring accuracy

Reference conditions	Medium: water
	Temperature: 20°C / 68°F
	Pressure: 1 bar / 14.5 psi
	Inlet run: ≥ 5 DN
Maximum measuring error	±0.15% of the measured value ±1 mm/s, depending on the measuring sensor
	For detailed information and accuracy curves, see chapter "Accuracy".
Repeatability	±0.06% to OIML R117; not valid for WATERFLUX 3000

Operating conditions

Temperature	
Process temperature	Refer to technical data for the measuring sensor.
Ambient temperature	Depends on the version and combination of outputs.
	–40…+65°C / -40…+149°F (ambient temperature 55°C / 131°F and higher: protect electronics against self-heating, because an increase in the electronics temperature in 10°C / 50°F steps leads to a corresponding reduction of the electronics' service life by a factor of two.)
	Stainless Steel housing: -40…+60°C / -40…+140°F
	Ambient temperatures below -25°C / -13°F, may affect the readability of the display.
Storage temperature	-50…+70°C / -58…+158°F
Pressure	
Medium	Refer to technical data for the measuring sensor.
Ambient pressure	Atmosphere.
Chemical properties	
Electrical conductivity	All media except for water: $\geq$ 1 µS/cm (also refer to the technical data for the measuring sensor)
	Water: $\geq$ 20 µS/cm
Physical condition	Conductive, liquid media
Solids content (volume)	$\leq$ 70% for OPTIFLUX measuring sensors
Gas content (volume)	$\leq$ 5% for OPTIFLUX measuring sensors
Flow rate	For detailed information, see chapter "Flow tables".
Other conditions	
Protection category to IEC 529 / EN 60529	C (compact version) & F (field housing): IP 67 / 68 (eq. to NEMA 4X/6)
	W (wall-mounted housing): IP65 (eq. to NEMA 4/4X)
	R (19" rack-mounted housing): IP 20 (eq. to NEMA 1)

Installation conditions

Installation	For detailed information, refer to chapter "Installation conditions".
Inlet/outlet runs	Refer to technical data for the measuring sensor.
Dimensions and weights	For detailed information refer to chapter "Dimensions and weights".

Materials

Signal converter housing	**Standard**
	Version C and F: die-cast Aluminium (polyurethane-coated)
	Version W: polyamide - polycarbonate
	Version R: Aluminium, Stainless Steel and Aluminium sheet, partially polyester-coated
	Option
	Versions C and F: Stainless Steel 316 L (1.4408)
Measuring sensor	For materials for housing, process connections, liners, grounding electrodes and gaskets, see the technical data for the measuring sensor.

Electrical connection

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 regulations.
Voltage	Standard: 100…230 VAC (-15% / +10%), 50/60 Hz
	Option 1: 24 VDC (-55% / +30%)
	Option 2: 24 VAC/DC (AC: -15% / +10%, 50/60 Hz; DC: -25% / +30%)
Power consumption	AC: 22 VA
	DC: 12 W
Signal cable	Only for remote versions.
	DS 300 (type A) Max. length: 600 m / 1950 ft (depending on electrical conductivity and measuring sensor version)
	BTS 300 (type B) Max. length: 600 m / 1950 ft (depending on electrical conductivity and measuring sensor version)
	Type LIYCY (only FM, Class 1 Div. 2) Max. length: 100 m / 330 ft (depending on electrical conductivity and measuring sensor version)
	WSC (only for WATERFLUX 3000) Max. length: 25 m / 82 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 the used abbreviations	U_{ext} = external voltage; R_L = load + resistance; U_o = 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	Volume flow, mass flow, diagnostics value, flow velocity, coil temperature, conductivity

Settings	**Without HART®**		
	Q = 0%: 0…20 mA; Q = 100%: 10…21.5 mA		
	Error identification: 0…22 mA		
	With HART®		
	Q = 0%: 4…20 mA; Q = 100%: 10…21.5 mA		
	Error identification: 3.5…22 mA		
Operating data	**Basic I/Os**	**Modular I/Os**	**Ex i**
Active	$U_{int, nom}$ = 24 VDC $I \leq 22$ mA $R_L \leq 1$ kΩ		$U_{int, nom}$ = 20 VDC $I \leq 22$ mA $R_L \leq 450$ 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	$U_{ext} \leq 32$ VDC $I \leq 22$ mA $U_0 \geq 1.8$ V $R_L \leq (U_{ext} - U_0) / I_{max}$		$U_{ext} \leq 32$ VDC $I \leq 22$ mA $U_0 \geq 4$ V $R_L \leq (U_{ext} - U_0) / I_{max}$
			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: V5
	Universal HART® parameter: completely integrated
Load	$\geq$ 250 Ω at HART® test point; Note maximum load for current output!
Multidrop operation	Yes, current output = 4 mA
	Multidrop address adjustable in operation menu 1…15
Device driver	Available for FC 375, AMS, PDM, FDT/DTM
Registration (HART Communication Foundation)	Yes

Pulse or frequency output			
Output data	Pulse output: volume flow, mass flow		
	Frequency output: volume flow, mass flow, diagnostic value, flow velocity, coil temperature, conductivity		
Function	Adjustable as pulse or frequency output		
Pulse rate/frequency	0.01…10000 pulses/s or Hz		
Settings	Pulses per volume or mass unit or max. frequency for 100% flow		
	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: $I \leq$ 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	

Passive	$U_{ext} \leq 32$ VDC		-
	f_{max} in 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: $I \leq 20$ mA 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		
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 $L_I \sim 0$ mH

Low flow cut-off

Function	Switching point and hysteresis separately adjustable for each output, counter and the display
Switching point	Set in increments of 0.1.
	0…20% (current output, frequency output) or 0…±9.999 m/s (pulse output)
Hysteresis	Set in increments of 0.1.
	0…5% (current output, frequency output) or 0…5 m/s (pulse output)

Time constant

Function	The time constant corresponds to the elapsed time until 67% of the end value has been reached according to a step function.
Settings	Set in increments of 0.1.
	0…100 s

Status output / limit switch			
Functions and settings	Adjustable as automatic measuring range conversion, display of flow direction, counter overflow, error, switching point or empty pipe detection		
	Valve control with activated dosing function		
	Status and/or control: ON or OFF		
Operating data	**Basic I/Os**	**Modular I/Os**	**Ex i**
Active	–	U_{int} = 24 VDC $I \leq 20$ mA open: $I \leq 0.05$ mA closed: $U_{0, nom}$ = 24 V at I = 20 mA	–
Passive	$U_{ext} \leq 32$ VDC $I \leq 100$ 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	U_{ext} = 32 VDC $I \leq 100$ mA $R_{L, max}$ = 47 kΩ $R_{L, min}$ = $(U_{ext} - U_0)$ / 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	–
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 output values (e.g. when cleaning), set value of outputs to "zero", counter and error reset, range conversion.		
	Start of dosing when dosing function is activated.		
Operating data	**Basic I/Os**	**Modular I/Os**	**Ex i**
Active	–	U_{int} = 24 VDC Ext. contact open: $U_{0, nom}$ = 22 V Ext. contact closed: I_{nom} = 4 mA Contact closed (on): $U_0 \geq 12$ V with I_{nom} = 1.9 mA Contact open (off): $U_0 \leq 10$ V with I_{nom} = 1.9 mA	–
Passive	$8\ V \leq U_{ext} \leq 32$ VDC I_{max} = 6.5 mA at $U_{ext} \leq 24$ VDC I_{max} = 8.2 mA at $U_{ext} \leq 32$ VDC 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	$3\ V \leq U_{ext} \leq 32$ 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 $I \leq 6$ mA at U_{ext} = 24 V $I \leq 6.6$ mA at U_{ext} = 32 V On: $U_0 \geq 5.5$ V or $I \geq 4$ mA Off: $U_0 \leq 3.5$ V or $I \leq 0.5$ 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 Terminals open: $U_{0, nom}$ = 8.7 V Contact closed (on): $U_{0, nom}$ = 6.3 V with $I_{nom} > 1.9$ mA Contact open (off): $U_{0, nom}$ = 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	–

| Current input			
Function	The following values can be delivered from the measuring sensor to the current input: temperature, pressure and current		
Operating data	**Basic I/Os**	**Modular I/Os**	**Ex i**
Active	–	$U_{int, nom}$ = 24 VDC $I \leq 22$ mA $I_{max} \leq 26$ mA (electronically limited) $U_{0, min}$ = 19 V at $I \leq 22$ mA No HART®	$U_{int, nom}$ = 20 VDC $I \leq 22$ mA $U_{0, min}$ = 14 V at $I \leq 22$ mA No HART® --- U_0 = 24.5 V I_0 = 99 mA P_0 = 0.6 W C_0 = 75 nF / L_0 = 0.5 mH No HART®
Passive	–	$U_{ext} \leq 32$ VDC $I \leq 22$ mA $I_{max} \leq 26$ mA (electronically limited) $U_{0, max}$ = 5 V at $I \leq 22$ mA No HART®	$U_{ext} \leq 32$ VDC $I \leq 22$ mA $U_{0, max}$ = 4 V at $I \leq 22$ mA No HART® --- U_I = 30 V I_I = 100 mA P_I = 1 W C_I = 10 nF L_I = 0 mH No HART®

PROFIBUS DP	
Description	Galvanically isolated acc. to IEC 61158
	Profile version: 3.01
	Automatic data transmission rate recognition (max. 12 MBaud)
	Bus address adjustable via local display at the measuring device
Function blocks	5 x analogue input, 3 x totalizer
Output data	Volume flow, mass flow, volume counter 1 + 2, mass counter, velocity, coil temperature, conductivity

PROFIBUS PA	
Description	Galvanically isolated acc. to IEC 61158
	Profile version: 3.01
	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 at the measuring device
Function blocks	5 x analogue input, 3 x totalizer
Output data	Volume flow, mass flow, volume counter 1 + 2, mass counter, velocity, coil temperature, conductivity

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 5.1
Function blocks	3 x analogue input, 2 x integrator
Output data	Volume flow, mass flow, velocity, coil temperature, conductivity, electronics temperature

Modbus	
Description	Modbus RTU, Master / Slave, RS485
Address range	1…247
Supported function codes	03, 04, 16
Broadcast	Supported with function code 16
Supported Baudrate	1200, 2400, 4800, 9600, 19200, 38400, 57600, 115200 Baud

Approvals and certifications

CE	The device fulfils the statutory requirements of the EC directives. The manufacturer certifies that these requirements have been met by applying the CE marking.
Non-Ex	Standard
Hazardous areas	
Option (only version C)	
ATEX	II 2 GD Ex d [ia] IIC T6...T3
	II 2 GD Ex de [ia] IIC T6...T3
	II 2 GD Ex e [ia] IIC T6...T3
	II 3 G Ex nA [nL] IIC T4...T3
Option (only version F)	
ATEX	II 2 GD Ex de [ia] IIC T6
	II 2(1) GD Ex de [ia] IIC T6
Nepsi	Ex de [ia] IIC T6
Optional (only versions C and F)	
FM / CSA	Class I, Div. 2, Group A, B, C and D
	Class II, Div. 2, Group F and G
SAA (in preparation)	Aus Ex zone 1/2
TIIS (in preparation)	Zone 1/2
Custody transfer	
Without	Standard
Option	Cold drinking water (OIML R 49, KIWA K618); liquids other than water 2004/22/EC (MID) acc. to OIML R 117-1; MI-001 and MI-005
Other standards and approvals	
Shock and vibration resistance	IEC 68-2-3
Electromagnetic compatibility (EMC)	89/336/EEC and 93/68/EEC in conjunction with EN 61326-1 (A1, A2)
European Pressure Equipment Directive	PED 97/23 (only for compact versions)
NAMUR	NE 21, NE 43, NE 53

8.3 Dimensions and weights

8.3.1 Housing
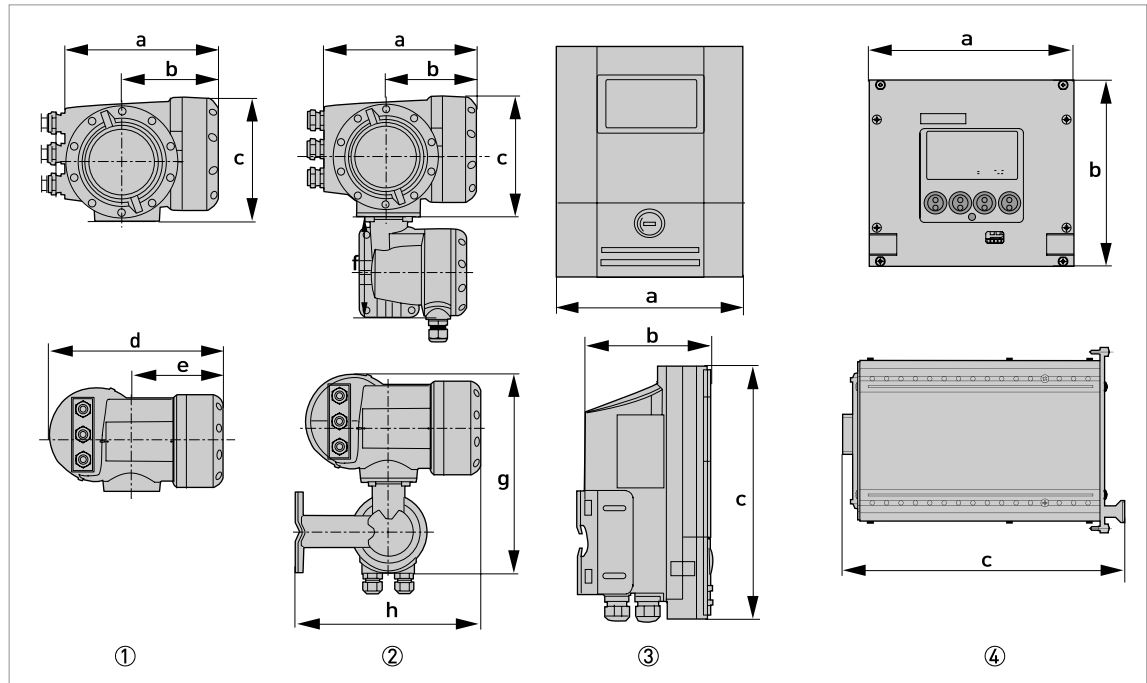
① Compact version (C)
② Field housing (F) - remote version
③ Wall-mounted housing (W) - remote version
④ 19" rack-mounted housing (R) - remote version

Dimensions and weights in mm and kg

Version	Dimensions [mm]							Weight [kg]
	a	b	c	d	e	g	h	
C	202	120	155	260	137	-	-	4.2
F	202	120	155	-	-	295.8	277	5.7
W	198	138	299	-	-	-	-	2.4
R	142 (28 TE)	129 (3 HE)	195	-	-	-	-	1.2

Dimensions and weights in inches and lbs

Version	Dimensions [inches]							Weight [lbs]
	a	b	c	d	e	g	h	
C	7.75	4.75	6.10	10.20	5.40	-	-	9.30
F	7.75	4.75	6.10	-	-	11.60	10.90	12.60
W	7.80	5.40	11.80	-	-	-	-	5.30
R	5.59 (28 TE)	5.08 (3 HE)	7.68	-	-	-	-	2.65

8.3.2 Mounting plate, field housing
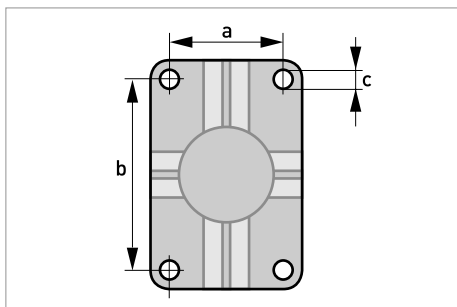
Dimensions in mm and inches

	[mm]	[inches]
a	60	2.4
b	100	3.9
c	Ø9	Ø0.4

8.3.3 Mounting plate, wall-mounted housing
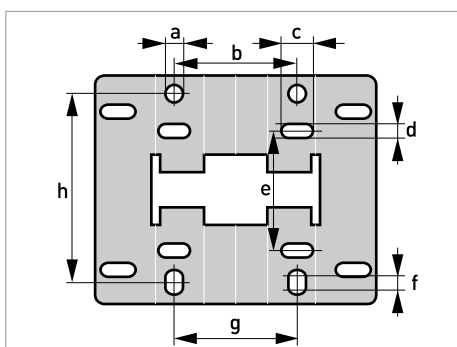
Dimensions in mm and inches

	[mm]	[inches]
a	Ø9	Ø0.4
b	64	2.5
c	16	0.6
d	6	0.2
e	63	2.5
f	4	0.2
g	64	2.5
h	98	3.85

8.4 Flow tables

Flow rate in m/s and m^3/h

v [m/s]	Q$_{100 \%}$ in m^3/h			
	0.3	1	3	12
DN [mm]	Min. flow	Nominal flow		Max. flow
2.5	0.005	0.02	0.05	0.21
4	0.01	0.05	0.14	0.54
6	0.03	0.10	0.31	1.22
10	0.08	0.28	0.85	3.39
15	0.19	0.64	1.91	7.63
20	0.34	1.13	3.39	13.57
25	0.53	1.77	5.30	21.21
32	0.87	2.90	8.69	34.74
40	1.36	4.52	13.57	54.29
50	2.12	7.07	21.21	84.82
65	3.58	11.95	35.84	143.35
80	5.43	18.10	54.29	217.15
100	8.48	28.27	84.82	339.29
125	13.25	44.18	132.54	530.15
150	19.09	63.62	190.85	763.40
200	33.93	113.10	339.30	1357.20
250	53.01	176.71	530.13	2120.52
300	76.34	254.47	763.41	3053.64
350	103.91	346.36	1039.08	4156.32
400	135.72	452.39	1357.17	5428.68
450	171.77	572.51	1717.65	6870.60
500	212.06	706.86	2120.58	8482.32
600	305.37	1017.90	3053.70	12214.80
700	415.62	1385.40	4156.20	16624.80
800	542.88	1809.60	5428.80	21715.20
900	687.06	2290.20	6870.60	27482.40
1000	848.22	2827.40	8482.20	33928.80
1200	1221.45	3421.20	12214.50	48858.00
1400	1433.52	4778.40	14335.20	57340.80
1600	2171.46	7238.20	21714.60	86858.40
1800	2748.27	9160.9	27482.70	109930.80
2000	3393.00	11310.00	33930.00	135720.00
2200	4105.50	13685.00	41055.00	164220.00
2400	4885.80	16286.00	48858.00	195432.00
2600	5733.90	19113.00	57339.00	229356.00
2800	6650.10	22167.00	66501.00	266004.00
3000	7634.10	25447.00	76341.00	305364.00

Flow rate in ft/s and gallons/min

v [ft/s]	$Q_{100\%}$ in US gallons/min			
	1	3.3	10	40
DN [inches]	Min. flow	Nominal flow		Max. flow
1/10	0.02	0.09	0.23	0.93
1/8	0.06	0.22	0.60	2.39
1/4	0.13	0.44	1.34	5.38
3/8	0.37	1.23	3.73	14.94
1/2	0.84	2.82	8.40	33.61
3/4	1.49	4.98	14.94	59.76
1	2.33	7.79	23.34	93.36
1.25	3.82	12.77	38.24	152.97
1.5	5.98	19.90	59.75	239.02
2	9.34	31.13	93.37	373.47
2.5	15.78	52.61	159.79	631.16
3	23.90	79.69	239.02	956.09
4	37.35	124.47	373.46	1493.84
5	58.35	194.48	583.24	2334.17
6	84.03	279.97	840.29	3361.17
8	149.39	497.92	1493.29	5975.57
10	233.41	777.96	2334.09	9336.37
12	336.12	1120.29	3361.19	13444.77
14	457.59	1525.15	4574.93	18299.73
16	597.54	1991.60	5975.44	23901.76
18	756.26	2520.61	7562.58	30250.34
20	933.86	3112.56	9336.63	37346.53
24	1344.50	4481.22	13445.04	53780.15
28	1829.92	6099.12	18299.20	73196.79
32	2390.23	7966.64	23902.29	95609.15
36	3025.03	10082.42	30250.34	121001.37
40	3734.50	12447.09	37346.00	149384.01
48	5377.88	17924.47	53778.83	215115.30
56	6311.60	21038.46	63115.99	252463.94
64	9560.65	31868.51	95606.51	382426.03
72	12100.27	40333.83	121002.69	484010.75
80	14938.92	49795.90	149389.29	597557.18
88	18075.97	60252.63	180759.73	723038.90
96	21511.53	71704.38	215115.30	860461.20
104	25245.60	84151.16	252456.02	1009824.08
112	29279.51	97597.39	292795.09	1171180.37
120	33611.93	112038.64	336119.31	1344477.23

8.5 Accuracy

Reference conditions

- Medium: water
- Temperature: 20°C / 68°F
- Pressure: 1 bar / 14.5 psi
- Inlet run: ≥ 5 DN
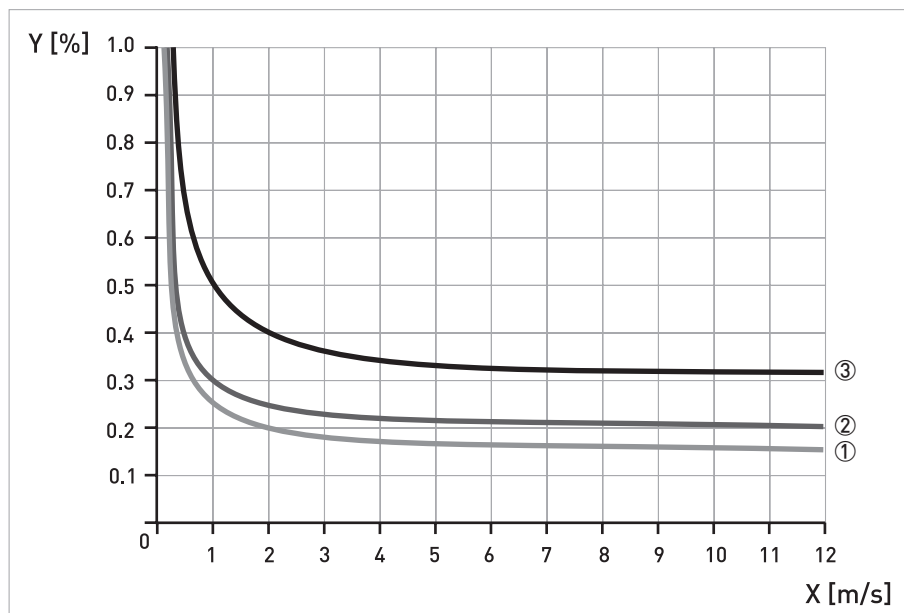
X [m/s]: flow velocity
Y [%]: deviation from the actual measured value (mv)

	DN [mm]	DN [inches]	Accuracy	Curve
OPTIFLUX 5300	10….100	3/8…4	0.15% of mv + 1 mm/s	①
	150...300	6...12	0.2% of mv + 1 mm/s	②
OPTIFLUX 2300 / 4300 / 6300	10….1600	3/8…80	0.2% of mv + 1 mm/s	②
OPTIFLUX 1300	10…150	3/8…6	0.3% of mv + 2 mm/s	③
OPTIFLUX 2300 / 4300	>1600	>64	0.3% of mv + 2 mm/s	③
OPTIFLUX 4300 / 5300 / 6300	<10	<3/8	0.3% of mv + 2 mm/s	③
WATERFLUX 3300	50...600	2...24	0.2% of mv + 1 mm/s	②

KROHNE product overview

- Electromagnetic flowmeters
- Variable area flowmeters
- Ultrasonic flowmeters
- Mass flowmeters
- Vortex flowmeters
- Flow controllers
- Level meters
- Temperature meters
- Pressure meters
- Analysis products
- Measuring systems for the oil and gas industry
- Measuring systems for sea-going tankers

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