


# IFC 050 Handbook

Signal converter for electromagnetic flowmeters

Electronic revision:
ER 3.1.x

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

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# IMPRINT

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1 Safety instructions 6

1.1 Software history ... 6
1.2 Intended use ... 7
1.3 Certification ... 7
1.4 Safety instructions from the manufacturer ... 8
1.4.1 Copyright and data protection ... 8
1.4.2 Disclaimer ... 8
1.4.3 Product liability and warranty ... 9
1.4.4 Information concerning the documentation ... 9
1.4.5 Warnings and symbols used ... 10
1.5 Safety instructions for the operator ... 10

2 Device description 11

2.1 Scope of delivery ... 11
2.2 Device description ... 12
2.3 Signal converter/flow sensor combination possibilities ... 12
2.4 Nameplates ... 13

3 Installation 14

3.1 General notes on installation ... 14
3.2 Storage ... 14
3.3 Transport ... 14
3.4 Installation specifications ... 14
3.5 Mounting of the compact version ... 15
3.6 Mounting of the wall housing, remote version ... 15

4 Electrical connections 17

4.1 Safety instructions ... 17
4.2 Important notes on electrical connection ... 17
4.3 Electrical cables for remote device versions, notes ... 18
4.3.1 Notes on signal cable A ... 18
4.3.2 Notes on field current cable C ... 18
4.3.3 Requirements for signal cables provided by the customer ... 19
4.4 Preparing the signal and field current cables ... 20
4.4.1 Signal cable A (type DS 300), construction ... 20
4.4.2 Preparing signal cable A, connection to signal converter ... 22
4.4.3 Length of signal cable A ... 24
4.4.4 Preparing field current cable C, connection to signal converter ... 25
4.4.5 Preparing signal cable A, connection to flow sensor ... 27
4.4.6 Preparing field current cable C, connection to flow sensor ... 28
4.5 Connecting the signal and field current cables ... 29
4.5.1 Connecting the signal and field current cables to the signal converter, remote version ... 29
4.5.2 Connection diagram for signal and field current cable ... 30
4.6 Grounding the flow sensor ... 31
4.7 Connecting the power supply ... 31

4.8 Inputs and outputs, overview ..... 33
4.8.1 Description of the CG number ..... 33
4.8.2 Fixed, non-alterable output versions ..... 33
4.9 Description of the inputs and outputs ..... 34
4.9.1 Current output ..... 34
4.9.2 Pulse output and frequency output ..... 35
4.9.3 Status output and limit switch ..... 36
4.10 Electrical connection of the outputs ..... 37
4.10.1 Electrical connection of the outputs ..... 37
4.10.2 Laying electrical cables correctly ..... 38
4.11 Connection diagrams of outputs ..... 38
4.11.1 Important notes ..... 38
4.11.2 Description of the electrical symbols ..... 39
4.11.3 Basic and Modbus outputs ..... 40
4.11.4 HART connection ..... 44

5 Start-up 45

5.1 Switching on the power ..... 45
5.2 Starting the signal converter ..... 45

6 Operation 46

6.1 Safety instructions for the use of the magnet pencil ..... 46
6.2 Display and operating elements ..... 46
6.2.1 Display in measuring mode with 2 or 3 measured values ..... 49
6.2.2 Display for selection of submenu and functions in menu mode ..... 49
6.2.3 Display when setting a parameter in parameter and data mode ..... 50
6.2.4 Display for selection of submenu and functions with preview ..... 50
6.3 Menu structure ..... 51
6.4 Function tables ..... 53
6.4.1 Menu "A quick setup" ..... 53
6.4.2 Menu "B test" ..... 55
6.4.3 Menu "C setup" ..... 56
6.4.4 Set free units ..... 65
6.5 Description of functions ..... 66
6.5.1 Reset counter in the menu "quick setup" ..... 66
6.5.2 Deleting error messages in the menu "quick setup" ..... 66
6.5.3 Conductivity measurement ..... 67
6.6 Status messages and diagnostic information ..... 67

7 Service 72

7.1 Spare parts availability ..... 72
7.2 Availability of services ..... 72
7.3 Returning the device to the manufacturer ..... 72
7.3.1 General information ..... 72
7.3.2 Form (for copying) to accompany a returned device ..... 73
7.4 Disposal ..... 73

8 Technical data 74

8.1 Measuring principle ... 74
8.2 Technical data ... 75
8.3 Dimensions and weight ... 82
8.3.1 Housing ... 82
8.3.2 Mounting plate, wall version ... 84
8.4 Flow tables ... 85

9 Description of HART interface 87

9.1 General description ... 87
9.2 Software history ... 87
9.3 Connection variants ... 88
9.3.1 Point-to-Point connection - analogue / digital mode ... 89
9.3.2 Multi-drop connection (2-wire connection) ... 90
9.3.3 Multi-drop connection (3-wire connection) ... 91
9.4 Inputs/outputs and HART dynamic variables and device variables ... 92

10 Notes 94

## 1.1 Software history

The "Electronic Revision" (ER) is consulted to document the revision status of electronic equipment according to NE 53 for all devices. It is easy to see from the ER whether troubleshooting or larger changes in the electronic equipment have taken place and how that has affected the 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® |
| | 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 |
| | L | Limit switch |
| | X | all inputs and outputs |
| 4 | Downwards compatible changes with new functions | |
| 5 | Incompatible changes, i.e. electronic equipment must be changed | |

Table 1-1: Description of changes

| Release date (ER) | Electronic revision (ER) | Changes and compatibility | Documentation |
|---|---|---|---|
| 2012 | ER 3.0.0 | - | MA IFC 050 R01 |
| 2012 | ER 3.0.1 | 1 | MA IFC 050 R01 |
| 2013 | ER 3.0.2 | 1; 4 | MA IFC 050 R03 |
| 2014 | ER 3.0.3 | 1; 3-F; 3-P; 4 | MA IFC 050 R03 |
| 2020 | ER 3.1.0 | 1; 2-M; 4 | MA IFC 050 R04 |
| 2021 | ER 3.1.1 | 2-X; 4 | |
| 2023 | ER 3.1.2 | - | MA IFC 050 R05 |
| | ER 3.1.3 | 1; 4 | |

Table 1-2: Changes and effect on compatibility

## 1.2 Intended use

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

*WARNING!*
*If the device is not used according to the operating conditions (refer to chapter "Technical data"), the intended protection could be affected.*

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

## 1.3 Certification

### Product marking

Figure 1-1: Examples of marking logo

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

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

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

## 1.4 Safety instructions from the manufacturer

### 1.4.1 Copyright and data protection

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

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

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

The collection of personal data (such as names, street addresses or e-mail addresses) in the manufacturer's documents is always on a voluntary basis whenever possible. Whenever feasible, it is always possible to make use of the offerings and services without providing any personal data.

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

### 1.4.2 Disclaimer

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

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

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

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

### 1.4.3 Product liability and warranty

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

### 1.4.4 Information concerning the documentation

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

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

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

### 1.4.5 Warnings and symbols used

Safety warnings are indicated by the following symbols.



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



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




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



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



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



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



*INFORMATION!*
*These instructions contain important information for the handling of the device.*




*LEGAL NOTICE!*
*This note contains information on statutory directives and standards.*



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

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

## 1.5 Safety instructions for the operator



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

## 2.1 Scope of delivery

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

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

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

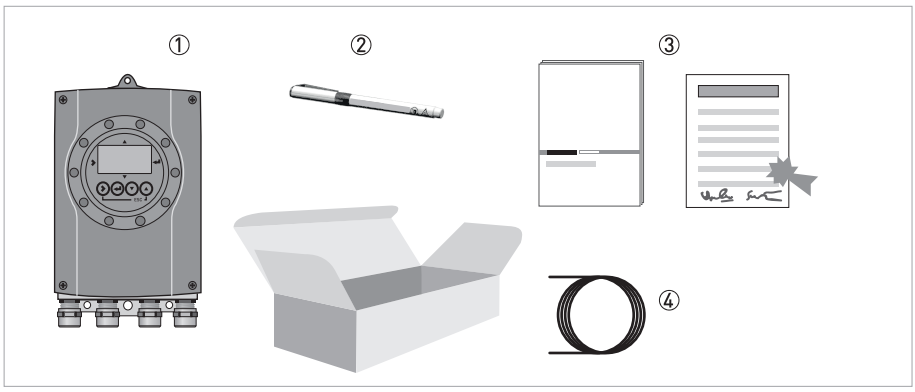



Figure 2-1: Scope of delivery

① Device in the version as ordered
② Magnet pencil (to operate the signal converter when the housing is closed)
③ Documentation (calibration report, product documentation for flow sensor and signal converter)
④ 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 flow sensor)
- Remote version (electrical connection to the flow sensor via field current and signal cable)

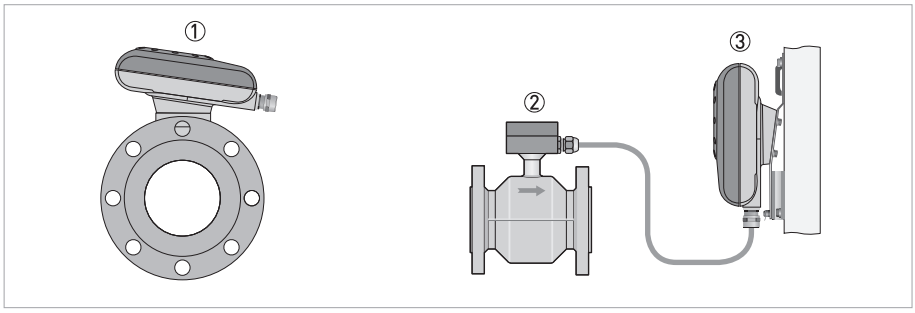



Figure 2-2: Device versions

① Compact version
② Flow sensor with connection box
③ Wall version

## 2.3 Signal converter/flow sensor combination possibilities

| Flow sensor | Flow sensor + signal converter IFC 050 | |
|---|---|---|
| | Compact | Remote wall-mounted housing |
| OPTIFLUX 1000 | OPTIFLUX 1050 C | OPTIFLUX 1050 W |
| OPTIFLUX 2000 | OPTIFLUX 2050 C | OPTIFLUX 2050 W |
| OPTIFLUX 4000 | OPTIFLUX 4050 C | OPTIFLUX 4050 W |
| OPTIFLUX 5000 | OPTIFLUX 5050 C | OPTIFLUX 5050 W |
| OPTIFLUX 6000 | OPTIFLUX 6050 C | OPTIFLUX 6050 W |
| WATERFLUX 3000 | WATERFLUX 3050 C | WATERFLUX 3050 W |

Table 2-1: Signal converter/flow sensor combination possibilities

## 2.4 Nameplates

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

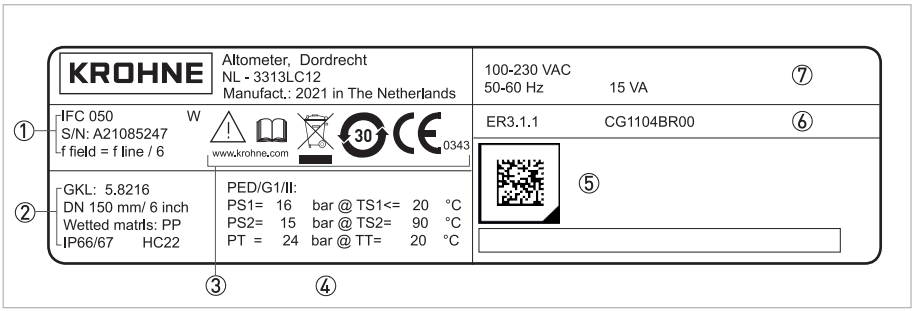



Figure 2-3: Example of a nameplate

① Type designation, serial number, field frequency values
② GKL value (flow sensor constant), size (mm/inch), materials of wetted parts, ingress protection
③ Safety instructions, disposal, China RoHS marking and conformity mark
④ Approvals-related data (e.g. temperature thresholds and pressure thresholds)
⑤ Data Matrix code
⑥ Electronic revision (ER) and CG number
⑦ Data for power supply

### Auto ID according to DIN specifications

The auto ID code (data matrix) guides you directly to the PICK server (Product Information Center KROHNE).
Scan the auto ID code on the device nameplate to download all product specific information.

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

## 3.1 General notes on installation



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



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



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

## 3.2 Storage

- Store the device in a dry, dust-free location.
- Avoid continuous direct sunlight.
- Store the device in its original packing.
- Storage temperature: -40...+70°C / -40...+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.*
- *The device must not be heated by radiated heat to an electronics housing surface temperature above the maximum permissible ambient temperature.*
  *If it is necessary to prevent damage from heat sources, a heat protection (e.g. sun shade) has to be installed.*
- *Signal converters installed in control cabinets require adequate cooling, e.g. by fan or heat exchanger.*
- *Do not expose the signal converter to intense vibrations. The measuring devices are tested for a vibration level as described in the chapter "Technical data".*
- *Protect the device from excessive solar heat or UV light. Install an adequat protection (e.g. sun shade) to prevent damage to the housing and electronics.*
- *Avoid using high pressure jets close to the device. The measuring devices are tested for an ingress protection level as described in the chapter "Technical data".*

## 3.5 Mounting of the compact version

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

## 3.6 Mounting of the wall 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.*

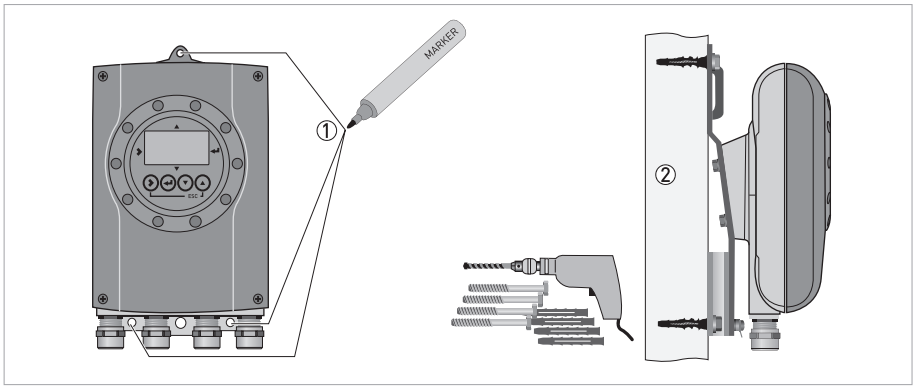



Figure 3-1: Mounting of the wall housing

① Prepare the holes with the aid of the mounting plate. For further information refer to *Mounting plate, wall version* on page 84.
② Fasten the device securely to the wall with the mounting plate.

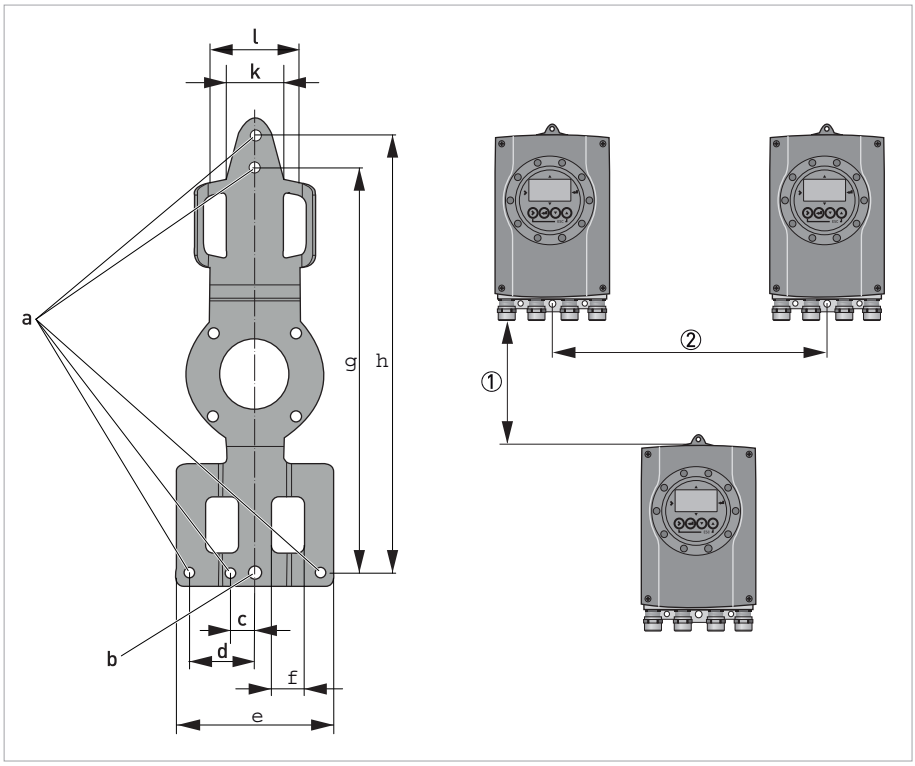



Figure 3-2: Dimensions of mounting plate and distances when mounting multiple devices next to each other

① 277 mm / 10.89"
② 310 mm / 12.2"

| | [mm] | [inch] |
|---|---|---|
| a | Ø6.5 | Ø0.26 |
| b | Ø8.1 | Ø0.3 |
| c | 15 | 0.6 |
| d | 40 | 1.6 |
| e | 96 | 3.8 |
| f | 20 | 0.8 |
| g | 248 | 9.8 |
| h | 268 | 10.5 |
| k | 35 | 1.4 |
| l | 55 | 2.2 |

Table 3-1: Dimensions in mm and inch

## 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!*



***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.*



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



***CAUTION!***
- *Use suitable cable entries for the various electrical cables.*
- *The flow sensor and signal converter have been configured together at the factory. For this reason, please connect the devices in pairs. Ensure that the flow sensor constant GKL (refer to information on the nameplates) are identically set.*
- *If delivered separately or when installing devices that were not configured together, set the signal converter to the DN size and GKL of the flow sensor, refer to Function tables on page 53.*

## 4.3 Electrical cables for remote device versions, notes

### 4.3.1 Notes on signal cable A



*INFORMATION!*
*Signal cable A (type DS 300) with double shield ensures 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.
- The signal cable does not contain any halogens and is unplasticized, and remains flexible at low temperatures.
- The connection of the inner shield (10) is carried out via the stranded drain wire (1).
- The connection of the outer shield (60) is carried out via the stranded drain wire (6).

### 4.3.2 Notes on field current cable C



*DANGER!*
*A shielded 2-wire copper cable is used for the field current cable. The shielding **MUST** be connected in the housing of the flow sensor and signal converter.*



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

### 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

- According to 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
- $V_{max}$ < 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.*

### 4.4.1 Signal cable A (type DS 300), construction

- Signal cable A is a double-shielded cable for signal transmission between the flow sensor and signal converter.
- Bending radius: ≥ 50 mm / 2"

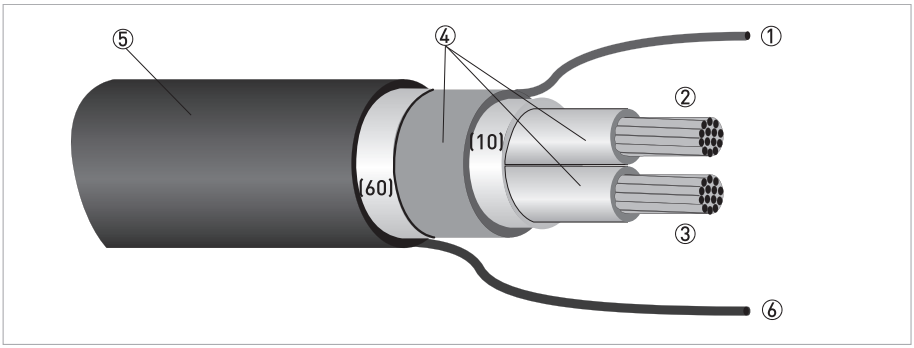



**Figure 4-1: Construction of signal cable A (standard version)**

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 Insulation layers
⑤ Outer sheath
⑥ Stranded drain wire (6) for the outer shield (60)

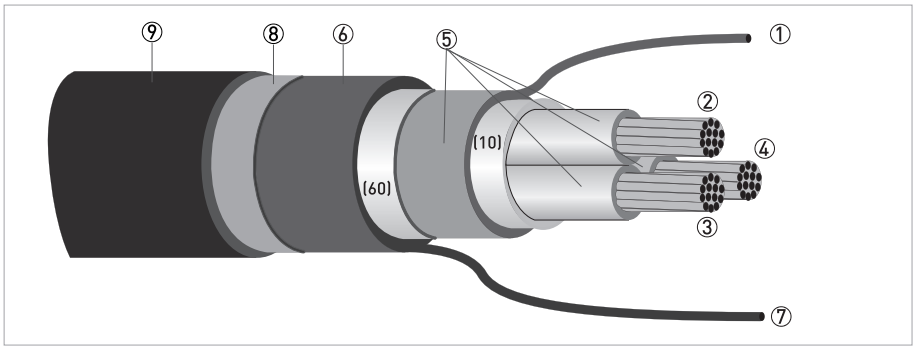



**Figure 4-2: Construction of signal cable A (armoured version)**

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 Insulated wire (4), 0.5 $mm^2$ Cu / AWG 20
⑤ Insulation layers
⑥ Outer sheath
⑦ Stranded drain wire (6) for the outer shield (60)
⑧ Armoured braiding layer
⑨ Outer jacket

## 4.4.2 Preparing signal cable A, connection to 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.*

- Connection of the two shields in the signal converter is carried out via the stranded drain wires.
- Bending radius: ≥ 50 mm / 2"

### Required materials

- PVC insulating tube, Ø2.5 mm / 0.1"
- Heat-shrinkable tubing
- 2 wire end ferrules to DIN 46228: E 1.5-8 for the stranded drain wires (1), (6)
- 2 wire end ferrules to DIN 46228: E 0.5-8 for the insulated conductors 2, 3

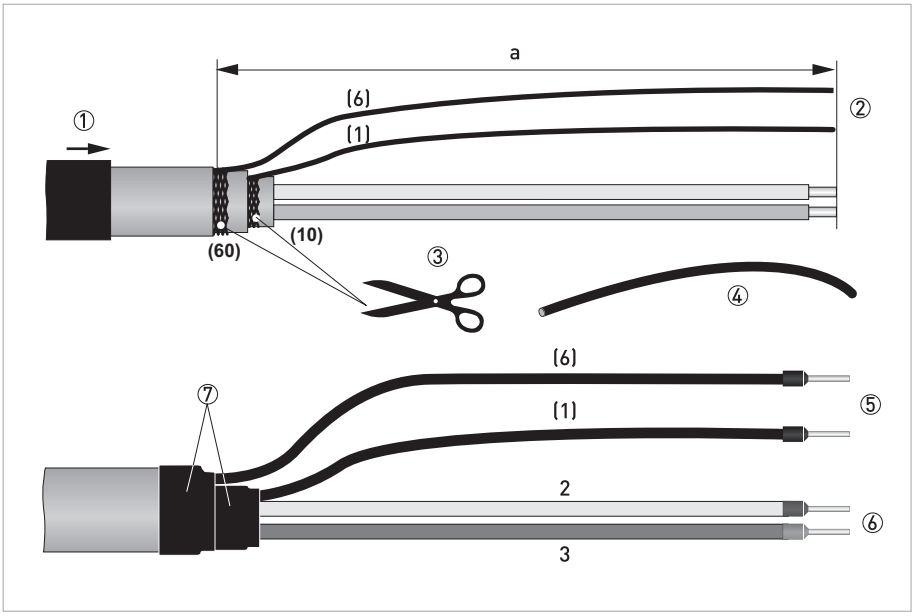



**Figure 4-3: Preparation of signal cable A (standard version)**
a = 80 mm / 3.15"

① Pull the heat-shrinkable tubing over the signal cable.
② Strip the conductor to dimension a.
③ Cut off the inner shield (10) and the outer shield (60). Make sure not to damage the stranded drain wires (1), (6).
④ Slide the insulating tubes over the stranded drain wires (1), (6).
⑤ Crimp the wire end ferrules onto the stranded drain wire.
⑥ Crimp the wire end ferrules onto the conductors 2, 3.
⑦ Shrink the heat-shrinkable tubing.

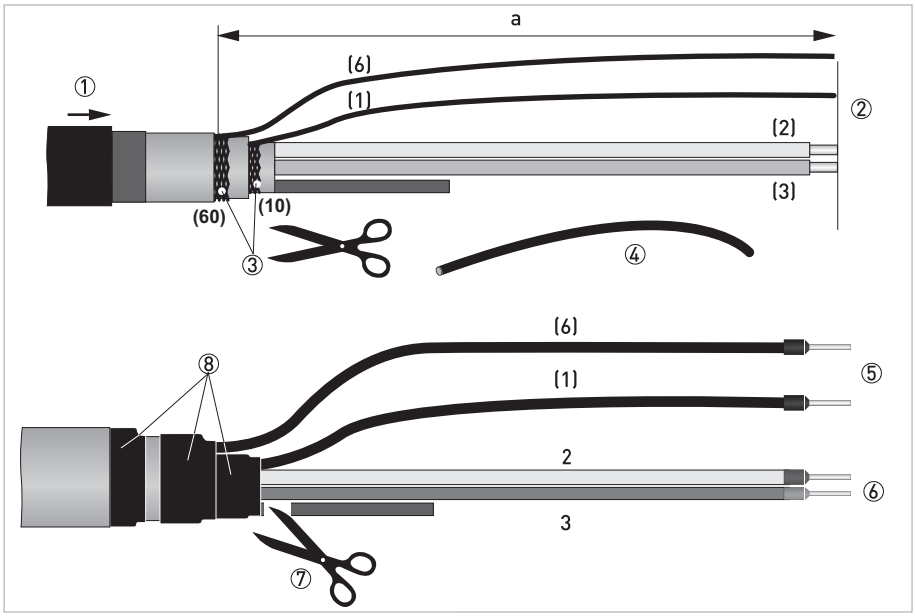



**Figure 4-4: Preparation of signal cable A (armoured version)**

a = 80 mm / 3.15"

① Pull the heat-shrinkable tubing over the signal cable.
② Strip the conductor to dimension a.
③ Cut off the inner shield (10) and the outer shield (60). Make sure not to damage the stranded drain wires (1), (6).
④ Slide the insulating tubes over the stranded drain wires (1), (6).
⑤ Crimp the wire end ferrules onto the stranded drain wire.
⑥ Crimp the wire end ferrules onto the conductors 2, 3.
⑦ Cut the outer sheath and armoured layer and isolate with heat-shrinkable tubing.
⑧ Shrink the heat-shrinkable tubing.

## 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.*

| Flow sensor | Nominal size | | Min. electrical conductivity [µS/cm] | Curve for signal cable A |
|---|---|---|---|---|
| | DN [mm] | [inch] | | |
| OPTIFLUX 1000 F | 10...150 | 3/8...6 | 20 | A1 |
| OPTIFLUX 2000 F | 25...150 | 1...6 | 20 | A1 |
| | 200...1200 | 8...48 | 20 | A2 |
| OPTIFLUX 4000 F | 10...150 | 3/8...6 | 20 | A1 |
| | 200...1200 | 8...48 | 20 | A2 |
| OPTIFLUX 5000 F | 2.5...100 | 1/10...4 | 20 | A1 |
| | 150...250 | 6...10 | 20 | A2 |
| OPTIFLUX 6000 F | 10...150 | 3/8...6 | 20 | A1 |
| WATERFLUX 3000 F | 25...600 | 1...24 | 20 | A1 |

Table 4-1: Length of signal cable A

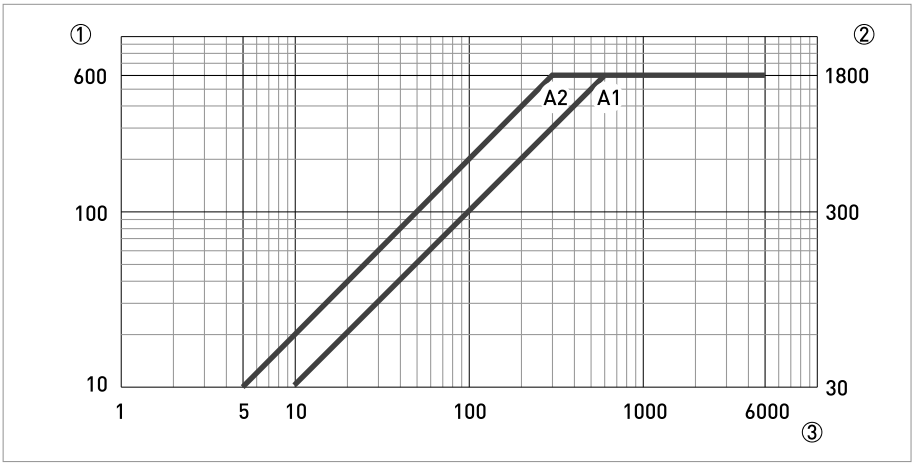



Figure 4-5: Maximum length of signal cable A

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

### 4.4.4 Preparing field current cable C, connection to signal converter



*DANGER!*
*A shielded 2-wire copper cable is used as the field current cable. The shielding **MUST** be connected in the housing of the flow sensor and 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 delivery.
- Bending radius: ≥ 50 mm / 2"

#### Required materials:

- Shielded, at least 2-wire copper cable with suitable heat-shrinkable tubing
- Insulating tube, size according to the cable being used
- Wire end ferrules to DIN 46228: size according to the cable being used

| Length | | Cross-section $A_F$ (Cu) | |
|---|---|---|---|
| [m] | [ft] | [$mm^2$] | [AWG] |
| 0...150 | 0...492 | 2 x 0.75 Cu ① | 2 x 18 |
| 150...300 | 492...984 | 2 x 1.5 Cu ① | 2 x 14 |
| 300...600 | 984...1968 | 2 x 2.5 Cu ① | 2 x 12 |

**Table 4-2: Length and cross-section of field current cable C**

① Cu = copper cross-section

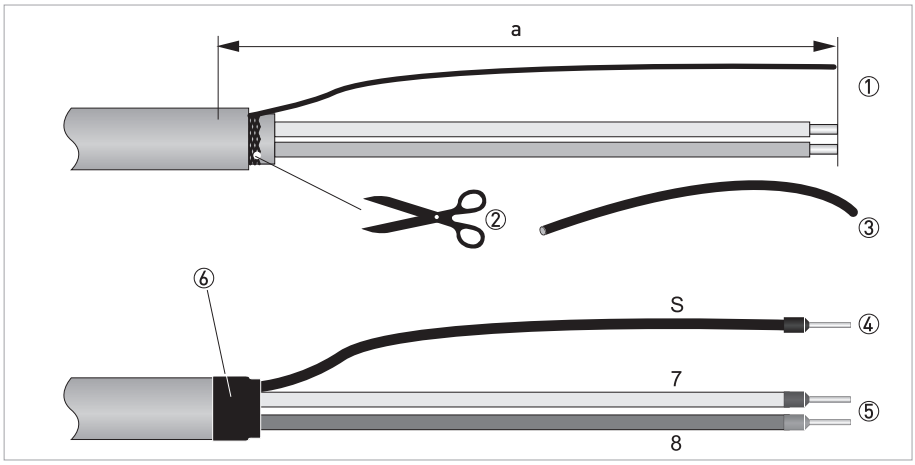



**Figure 4-6: Field current cable C, preparation for the signal converter**

a = 80 mm / 3.15"

① Strip the conductor to dimension a.
② If a stranded drain wire is present, remove the shield that is present. Make sure not to damage the stranded drain wire.
③ Slide an insulating tube over the stranded drain wire.
④ Crimp a wire end ferrule onto the stranded drain wire.
⑤ Crimp the wire end ferrules on the conductors.
⑥ Pull a shrinkable tube over the prepared cable.

## 4.4.5 Preparing signal cable A, connection to flow 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 flow sensor directly via the shield and a clip.
- Bending radius: ≥ 50 mm / 2"

### Required materials

- PVC insulating tube, Ø2.0...2.5 mm / 0.08...0.1"
- Heat-shrinkable tubing
- Wire end ferrule to DIN 46228: E 1.5-8 for the stranded drain wire (1)
- 2 wire end ferrules to DIN 46228: E 0.5-8 for the insulated conductors 2, 3

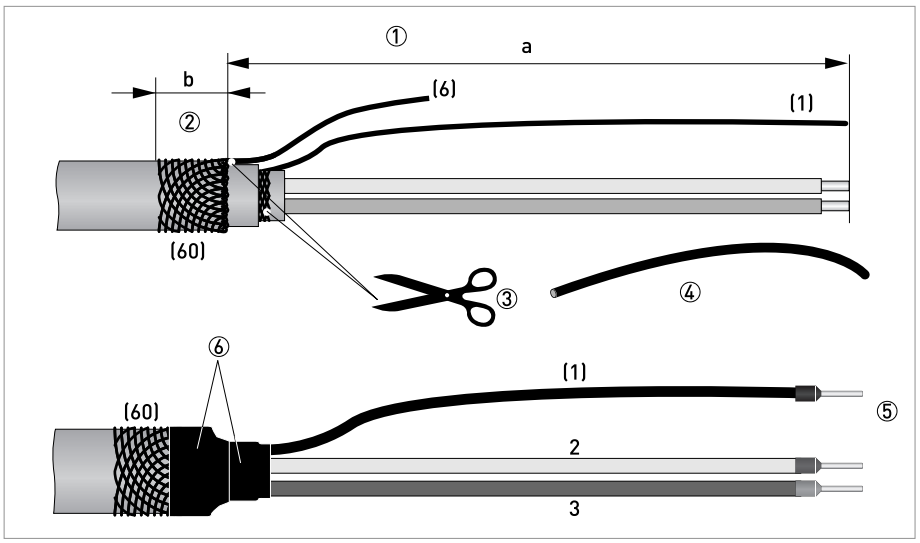



Figure 4-7: Preparing signal cable A, connection to flow sensor

a = 50 mm / 2"
b = 10 mm / 0.4"

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. 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.

## 4.4.6 Preparing field current cable C, connection to flow 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 delivery.
- The shield is connected in the terminal compartment of the flow sensor directly via the shield and a clip.
- Bending radius: ≥ 50 mm / 2"

### Required materials

- Shielded 2-wire insulated copper cable
- Insulating tube, size according to the cable being used
- Heat-shrinkable tubing
- 2 wire end ferrules to DIN 46228: size according to the cable being used

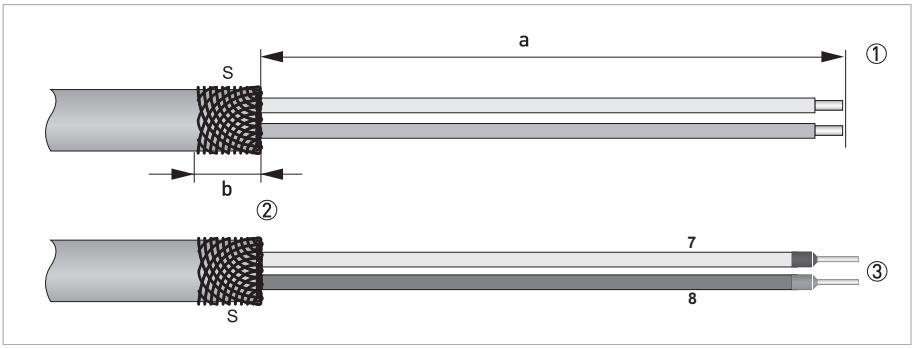



Figure 4-8: Preparation of field current cable C

a = 50 mm / 2"
b = 10 mm / 0.4"

① Strip the conductor to dimension a.
② Trim the outer shield to dimension b and pull it over the outer sheath.
③ Crimp the wire end ferrules onto both conductors 7, 8.

## 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.*

*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 to the signal converter, remote version

*INFORMATION!*
*The compact version is supplied pre-assembled from the factory.*

**Connect the electrical conductors as follows:**

① Press with a screwdriver in the slot on the spring terminal.
② Insert the electrical conductor into the plug.
③ The conductor will be clamped as soon as the screwdriver is pulled out of the slot.

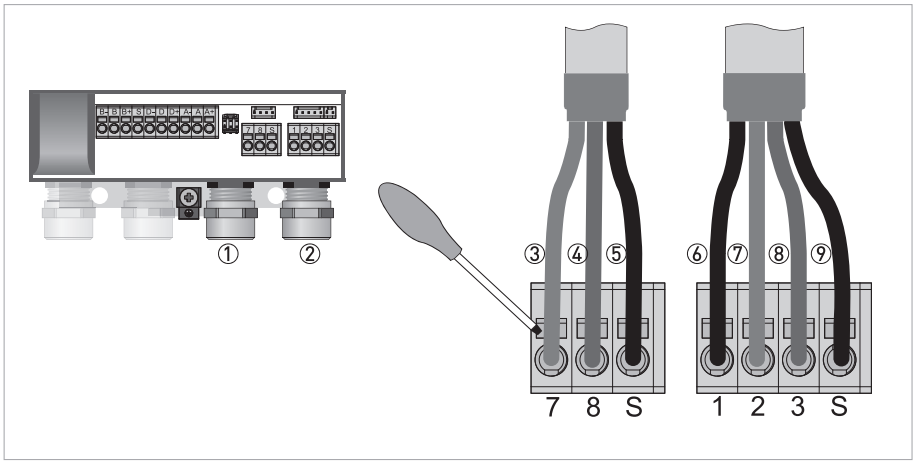



Figure 4-9: Connecting the signal and field current cables

① Cable entry for field current cable
② Cable entry for signal cable
③ Electrical conductor (7)
④ Electrical conductor (8)
⑤ Connecting the field current cable shield
⑥ Stranded drain wire (1) of the inner shield (10) of the signal cable
⑦ Electrical conductor (2)
⑧ Electrical conductor (3)
⑨ Stranded drain wire (S) of the outer shield (60)

## 4.5.2 Connection diagram for signal and field current cable

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

- A shielded 2-wire copper cable is used as the field current cable. The shielding **MUST** be connected in the housing of the flow sensor and signal converter.
- The outer shield (60) is connected in the terminal compartment of the flow sensor directly via the shield and a clip.
- 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.

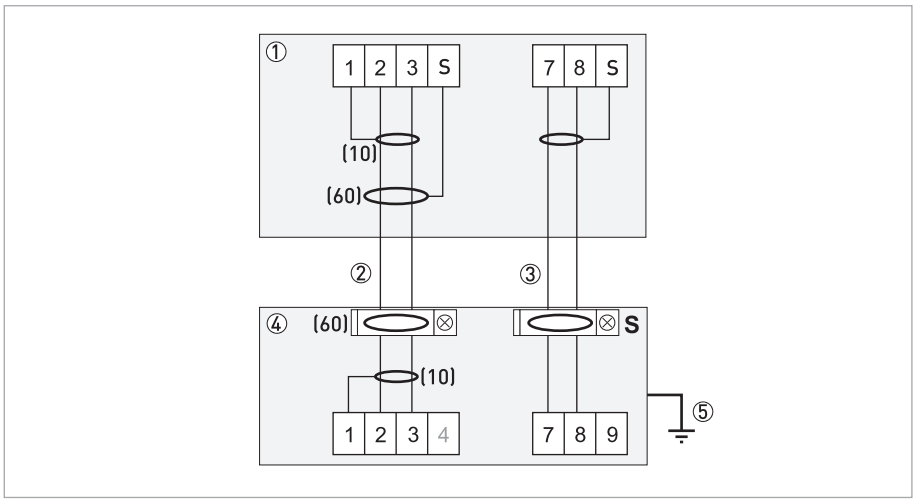



**Figure 4-10: Connection diagram for signal and field current cable**

① Electrical terminal compartment in the signal converter
② Signal cable A (type DS 300)
③ Field current cable C (type LiYCY)
④ Electrical terminal compartment in the flow sensor
⑤ Functional ground FE
(10) inner cable shield
(60) outer cable shield

## 4.6 Grounding the flow sensor



*CAUTION!*
*There should be no difference in potential between the flow sensor and the housing or protective earth of the signal converter!*

- The flow sensor must be properly grounded.
- The grounding cable should not transmit any interference voltages.
- Do not use the grounding cable to connect any other electrical devices to ground at the same time.
- The flow sensors are connected to ground by means of a functional grounding conductor FE.
- Special grounding instructions for the various flow sensors are provided in the separate documentation for the flow sensor.
- The documentation for the flow sensor also contain descriptions on how to use grounding rings and how to install the flow sensor in metal or plastic pipes or in pipes which are coated on the inside.

## 4.7 Connecting the power supply



*DANGER!*
- *To protect operators from electrical shock, during installation the cable for the power supply* ***must*** *be run with sheathing insulation up to the mains cover. The insulated individual wires have to be only below the mains cover!*
- *If there is no mains cover or if it has been lost, the 100...230 VAC device may only be operated from the outside (with a magnet pencil) while closed!*

- 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 60664 for pollution severity 2.
  Supply circuits are designed for overvoltage category III and the output circuits for overvoltage category II.
- Fuse protection ($I_N \leq$ 16 A) for the infeed power circuit, and also a separator (switch, circuit breaker) to isolate the signal converter should be provided for the device in accordance with applicable regulations.

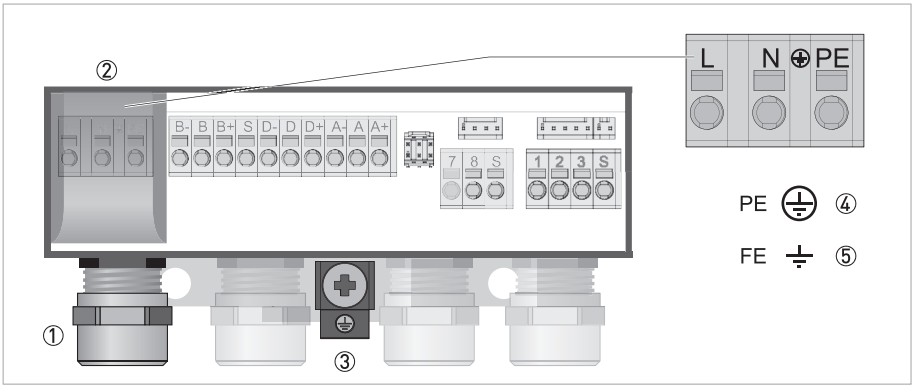



Figure 4-11: Terminal compartment for power

① Cable entry for power supply
② Mains cover
③ Ground terminal
④ 100...230 VAC (-15% / +10%)
⑤ 24 VDC (-30% /+30%)

- To open the cover of the electrical terminal compartment, lightly press in the side walls of the mains cover ② .
- Flip the mains cover up.
- Connect the power supply.
- Close the mains cover again by flipping it down.

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

- Note the power supply voltage and frequency (50...60 Hz) on the nameplate.

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

### 24 VDC (tolerance range: -30% / +30%)

- Note the data on the nameplate!

# 4.8 Inputs and outputs, overview

## 4.8.1 Description of the CG number

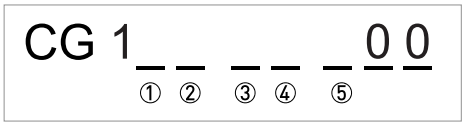



**Figure 4-12: Marking (CG number) of the electronics module and output variants**

① ID number: 0
② ID number: 0 = standard; 9 = special
③ Power supply
④ Display (language versions)
⑤ Output version

## 4.8.2 Fixed, non-alterable output versions

This signal converter is available with various 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.
- Terminals D- and A- are connected for active pulse/frequency output (no galvanic isolation anymore).
- Available are an active or passive pulse/frequency output, or the active or passive status/limit output. It's not possible to use both at the same time!

<table>
<tr><th rowspan="2">CG no.</th><th colspan="7">Connection terminals</th></tr>
<tr><th>S</th><th>D-</th><th>D</th><th>D+</th><th>A-</th><th>A</th><th>A+</th></tr>
<tr><td rowspan="3">1 0 0<br>R 0 0</td><td rowspan="3">①</td><td colspan="3">$P_p$ / $S_p$ passive</td><td colspan="2">$I_p$ + HART® passive ②</td><td></td></tr>
<tr><td>connected to A-</td><td colspan="2">$P_a$ active</td><td>connected to D-</td><td colspan="2">$I_a$ + HART® active ②</td></tr>
<tr><td colspan="3">$P_p$ / $S_p$ passive</td><td colspan="2"></td><td colspan="2">$I_a$ + HART® active ②</td></tr>
</table>

**Table 4-3: Basic outputs (I/Os)**

**① Shielding**
**② Function changed by reconnecting**

| CG no. | Connection terminals | | | |
|---|---|---|---|---|
| | B- | B | B+ | S |
| R 0 0 | Sign. A (D0-) | Common | Sign. B (D1+) | Shielding |

**Table 4-4: Modbus (I/O) (option)**

| | | |
|---|---|---|
| $I_a$ | $I_p$ | Current output active or passive |
| $P_a$ | $P_p$ | Pulse/frequency output active or passive |
| $S_a$ | $S_p$ | Status output/limit switch active or passive |

**Table 4-5: Description of used abbreviations**

## 4.9 Description of the inputs and outputs

### 4.9.1 Current output

*INFORMATION!*
*Depending on the version, the outputs must be connected passively or actively!*

- All outputs are electrically isolated from each other and from all other circuits.
- All operating data and functions can be adjusted.
- Passive mode: external power $V_{ext} \leq 32$ VDC at $I \leq 22$ mA
- Active mode: load impedance $R_L \leq 750\ \Omega$ at $I \leq 22$ mA
- Self-monitoring: interruption or load impedance too high in the current output loop
- Error message possible via status output, error indication on LC display.
- Current value error detection can be adjusted.
- Automatic range conversion via threshold. The setting range for the threshold is between 5 and 80% of $Q_{100\%}$, ± 0...5% hysteresis (corresponding ratio from smaller to larger range of 1:20 to 1:1.25).
  Signaling of the active range possible via a status output (adjustable).
- Forward / reverse flow measurement (F/R mode) is possible.

*INFORMATION!*
*For further information refer to Connection diagrams of outputs on page 38* and refer to *Technical data on page 75*.

### 4.9.2 Pulse output and frequency output

*INFORMATION!*
*Depending on the version, the outputs must be connected passively or actively!*

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

*INFORMATION!*
*For further information refer to Connection diagrams of outputs on page 38* and refer to *Technical data on page 75*.

### 4.9.3 Status output and limit switch

***INFORMATION!***
*Depending on the version, the outputs must be connected passively or actively!*

- The status outputs / limit switches are electrically isolated from each other and from all other circuits.
- The output stages of the status outputs/limit switches during simple active or passive operation behave like relay contacts and can be connected with any polarity.
- All operating data and functions can be adjusted.
- Passive mode:
  External power supply required: $V_{ext} \leq 32$ VDC; $I \leq 100$ mA
- Active mode:
  Use of the internal power supply: $V_{nom} = 20$ VDC; $I \leq 20$ mA
- For information on the adjustable operating states refer to *Function tables* on page 53.

***INFORMATION!***
*For further information refer to Connection diagrams of outputs on page 38* and refer to *Technical data on page 75*.

## 4.10 Electrical connection of the outputs

*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 Electrical connection of the 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!*

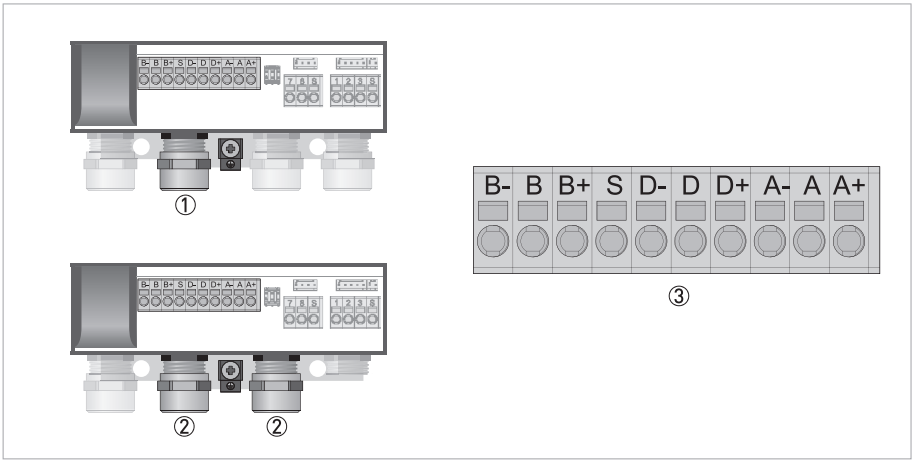



Figure 4-13: Electrical connection of the outputs

① Cable entry, remote version
② Cable entry, compact version (right cable entry is optional)
③ Terminal block for the connection of outputs

- Open the housing cover
- Push the prepared cables through the cable entries and connect the necessary conductors.
- Connect the shield.
- Close the housing cover.

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

### 4.10.2 Laying electrical cables correctly

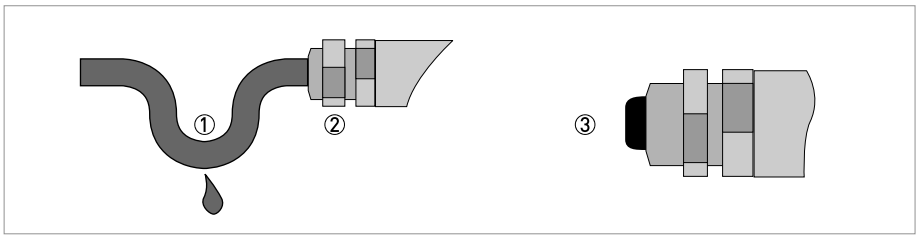



Figure 4-14: Protect housing from dust and water

① For compact versions with nearly horizontally-oriented cable entries, lay the necessary electric cables with a drip loop as shown in the illustration.
② Tighten the screw connection of the cable entry securely.
③ Seal cable entries that are not needed with a plug.

## 4.11 Connection diagrams of outputs

### 4.11.1 Important notes

***INFORMATION!***
*Depending on the version, the outputs must be connected passively or actively!*

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

| | | |
|---|---|---|
| $I_a$ | $I_p$ | Current output active or passive |
| $P_a$ | $P_p$ | Pulse/frequency output active or passive |
| $S_a$ | $S_p$ | Status output/limit switch active or passive |

Table 4-6: Description of used abbreviations

## 4.11.2 Description of the electrical symbols

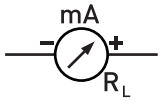
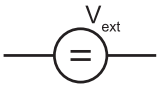
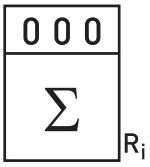
| | |
|---|---|
|  | mA meter<br>0...20 mA or 4...20 mA and other<br>$R_L$ is the internal resistance of the measuring point including the cable resistance |
|  | DC voltage source ($V_{ext}$), external power supply, any connection polarity |
|  | DC voltage source ($V_{ext}$), observe connection polarity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

Table 4-7: Description of the electrical symbols

### 4.11.3 Basic and Modbus outputs

*CAUTION!*
*Observe connection polarity.*

*INFORMATION!*
*For further information refer to Description of the inputs and outputs on page 34* and refer to *HART connection on page 44*.

#### Current output active (HART®)

- $V_{int, nom}$ = 20 VDC
- I ≤ 22 mA
- $R_L$ ≤ 750 Ω
- HART® at connection terminals A

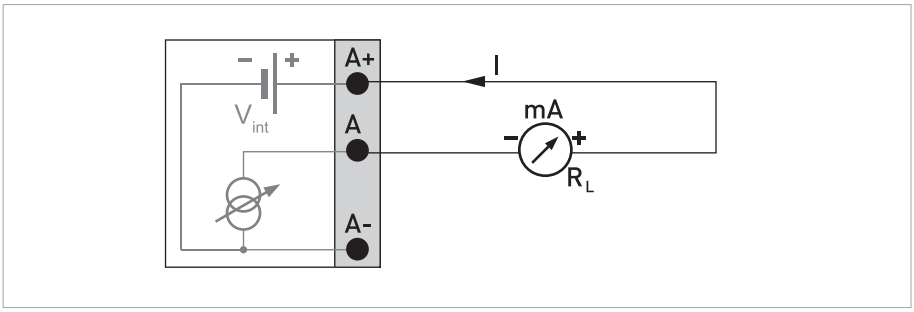



Figure 4-15: Current output active $I_a$

#### Current output passive (HART®)

- $V_{ext}$ ≤ 32 VDC
- I ≤ 22 mA
- $V_0$ ≤ 2 V at I = 22 mA
- $R_{L, max} = (V_{ext} - V_0) / I_{max}$
- HART® at connection terminals A

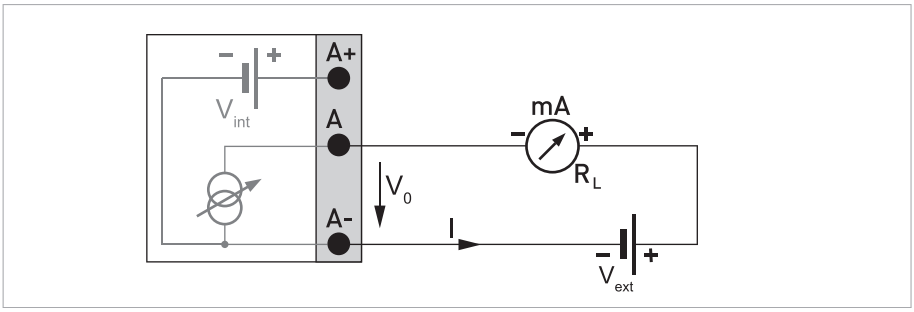



Figure 4-16: Current output passive $I_p$

*INFORMATION!*

- *For frequencies above 100 Hz, shielded cables are to be used in order to reduce effects from electrical interferences (EMC).*
- *Shielding takes place at the electrical connection (S) of the output terminal block.*

*INFORMATION!*

- *Independent of connection polarity.*
- *The output is open if the signal converter is not powered.*

### Pulse output / frequency output passive

- $V_{ext} \leq 32$ VDC
- $f_{max}$ in operating menu set to $f_{max} \leq 100$ Hz:
  $I \leq 100$ mA
  $R_L \leq 47$ kΩ
  closed:
  $V_0 \leq 0.2$ V at I = 10 mA
  $V_0 \leq 2$ V at I = 100 mA
  open:
  $I \leq 0.05$ mA at $V_{ext} = 32$ V
- $f_{max}$ in operating menu set to 100 Hz < $f_{max} \leq 10$ kHz:
  (over range up to $f_{max} \leq 12$ kHz)
  $I \leq 20$ mA
  $R_L \leq 10$ kΩ for $f \leq 1$ kHz
  $R_L \leq 1$ kΩ for $f \leq 10$ kHz
  closed:
  $V_0 \leq 1.5$ V at I = 1 mA
  $V_0 \leq 2.5$ V at I = 10 mA
  $V_0 \leq 5$ V at I = 20 mA
  open:
  $I \leq 0.05$ mA at $V_{ext} = 32$ V
  Use shielded cables!
- The minimum load impedance $R_{L, min}$ is calculated as follows:
  $R_{L, min} = (V_{ext} - V_0) / I_{max}$
- Can also be set as status output; for the electrical connection refer to status output connection diagram.

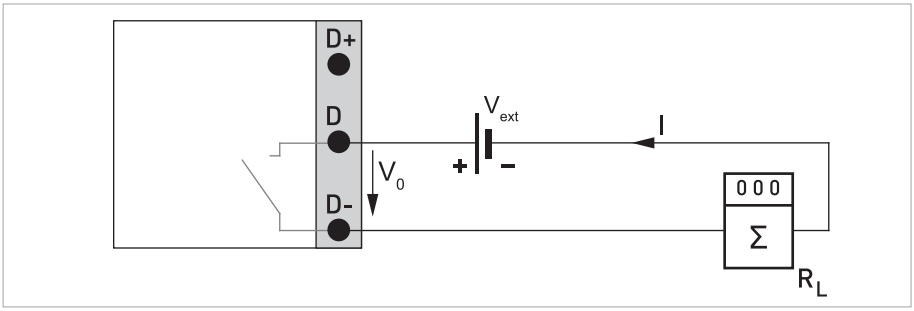



Figure 4-17: Pulse output / frequency output passive $P_p$

*INFORMATION!*

- *The active output is galvanically coupled with the current output.*
- *This output is intended to drive mechanical or electronic counters directly.*

### Pulse output / frequency output active

- $V_{int, nom} \leq 20$ V
- $R_V = 1$ kΩ
- C = 1000 µF
- **High current mechanical counter**
  $f_{max} \leq 1$ Hz
- **Low current mechanical counter**
  I ≤ 20 mA
  $R_L \leq 10$ kΩ for f ≤ 1 kHz
  $R_L \leq 1$ kΩ for f ≤ 10 kHz
  closed:
  $V_0 \geq 12.5$ V at I = 10 mA
  open:
  I ≤ 0.05 mA at $V_{nom} = 20$ V

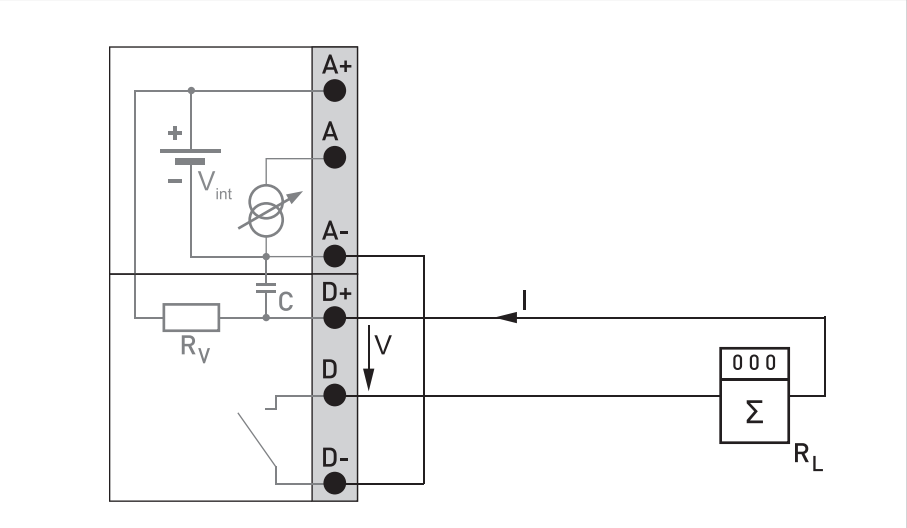



Figure 4-18: Pulse output / frequency output active $P_a$

*INFORMATION!*

- *Independent of connection polarity.*
- *The output is open if the signal converter is not powered.*

### Status output / limit switch passive

- $V_{ext}$ ≤ 32 VDC
- I ≤ 100 mA
- $R_L$ = 47 kΩ
- closed:
  $V_0$ ≤ 0.2 V at I = 10 mA
  $V_0$ ≤ 2 V at I = 100 mA
  open:
  I ≤ 0.05 mA at $V_{ext}$ = 32 V

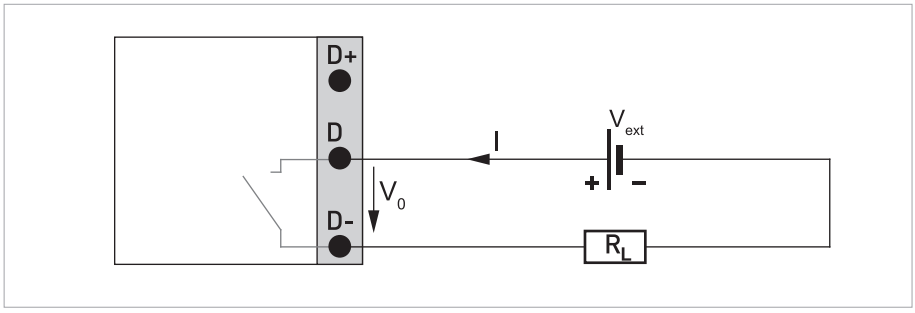



Figure 4-19: Status output / limit switch passive $S_p$

## 4.11.4 HART connection

*INFORMATION!*

*The current output always has HART® capability and is connected at connection terminals A+ / A- / A.*

*All HART® connections (point-to-point and multi-drop operation) both work actively and passively.*

### Example for active HART® connection (point-to-point)

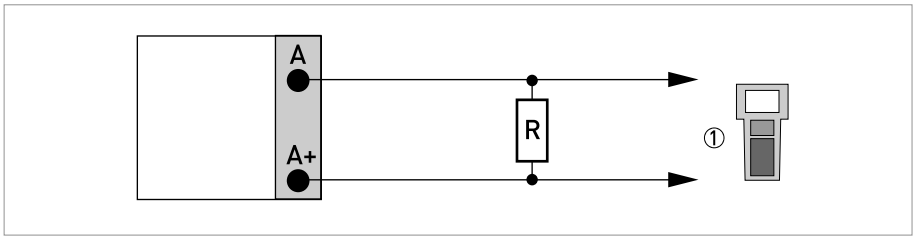



**Figure 4-20: HART® connection active ($I_a$)**

① HART® communicator

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

### Example for passive HART® connection (multi-drop mode)

- I: $I_{0\%}$ ≥ 4 mA
- Multi-drop mode I: $I_{fix}$ ≥ 4 mA = $I_{0\%}$
- $V_{ext}$ ≤ 32 VDC
- R ≥ 230 Ω

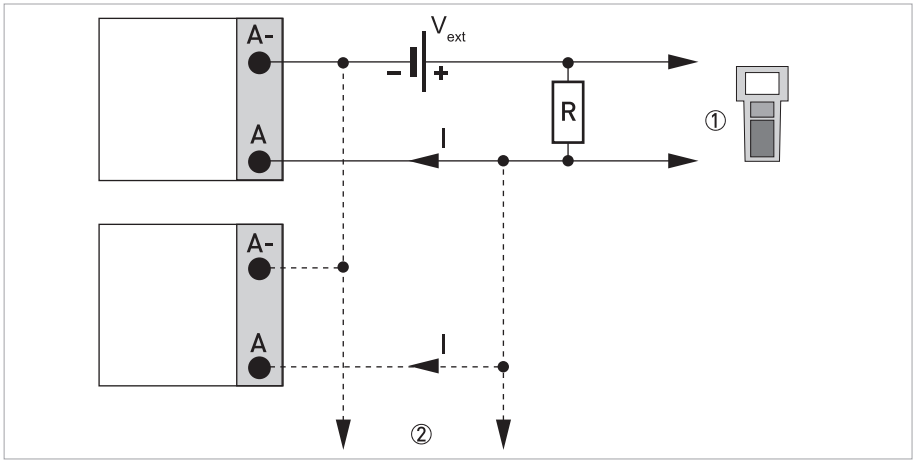



**Figure 4-21: HART® connection passive ($I_p$)**

① HART® communicator
② Other devices with HART® capability

## 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 mounted in compliance with the regulations.
- Remove the magnet pencil and keep it on a save place (is only valid for the display version).
- 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 flow sensor and the signal converter, is supplied ready for operation. All operating data have been set at the factory in accordance with your order specifications.

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

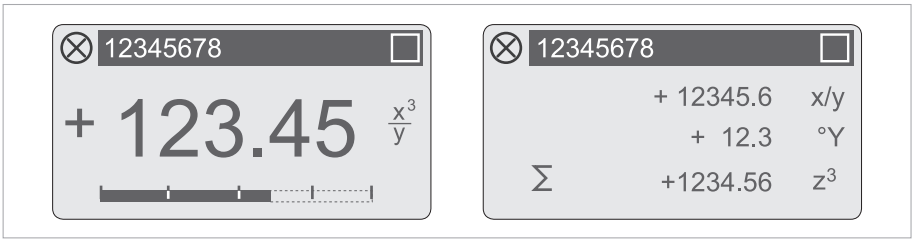



**Figure 5-1: Displays in measuring mode (examples for 2 or 3 measured values)**
**x, y and z denote the units of the measured values displayed**

It is possible to change between the two measured value windows, the trend display and the list with the status messages by pressing the keys ↑ and ↓ . For information about possible status messages, their meaning and cause refer to *Status messages and diagnostic information* on page 67.

## 6.1 Safety instructions for the use of the magnet pencil

To operate the signal converter when the housing is closed, 4 magnetic keys are available. They are activated by a magnet pencil.

***WARNING!***
*The magnet pencils can be dangerous for people with cardiac pacemakers or other metal implants. Make sure that these people do not use the magnet pencil or meet minimum clearances! Observe the relevant national and local regulations and requirements!*

## 6.2 Display and operating elements

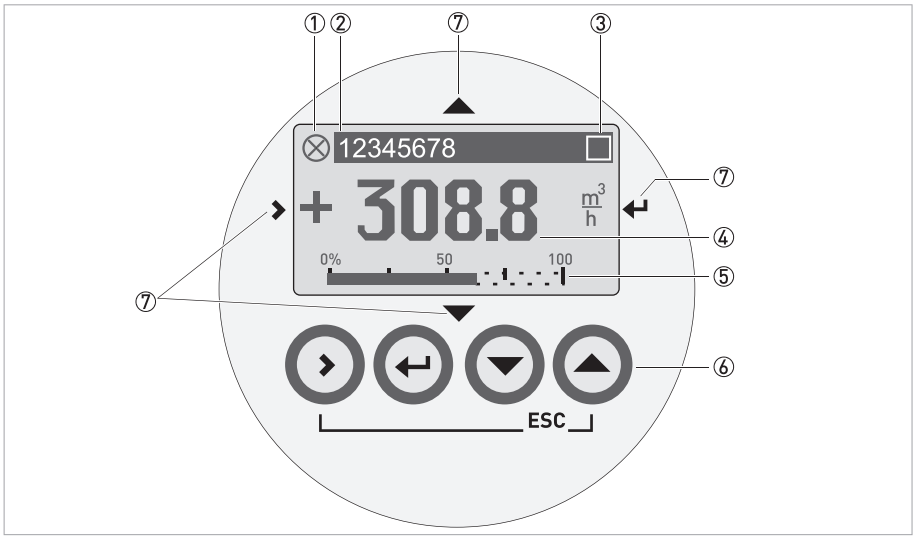



**Figure 6-1: Display and operating elements (Example: flow indication with 2 measuring values)**

① Indicates a possible status message in the status list (see table below for status icons)
② Tag number (is only indicated if this number was entered previously by the operator)
③ Indicates when a key has been pressed
④ 1st measured variable in large representation
⑤ Bargraph indication
⑥ Push buttons for operation with open housing (see table below for function and representation in text)
⑦ Magnet keys for operation with closed housing (see table below for function and representation in text)

***INFORMATION!***
- *After 5 minutes of inactivity, there is an automatic return to measuring mode. Previously changed data is not saved.*

The device user interface provides several display modes. In measuring mode the following display pages are available:

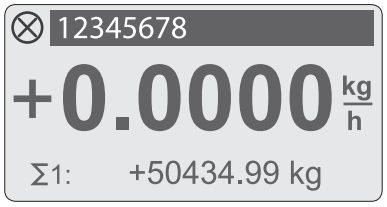
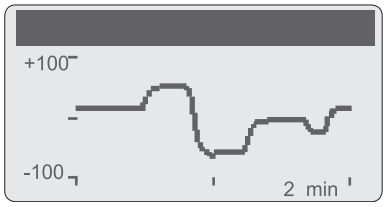
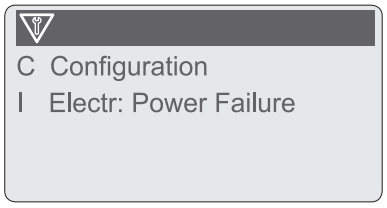
| Display page in measuring mode | Screen |
|---|---|
| 1st measuring page |  |
| 2nd measuring page |  |
| Graphic page |  |
| Status page |  |

**Table 6-1: Indication of display pages**

The following display modes are available:

| Display modes and functionality | > key | ↵ key | ↓ or ↑ key | Esc (> + ↑ ) key |
|---|---|---|---|---|
| **Measuring mode**<br>Display of measurement values | Press key for 2.5 s<br><br>At measuring pages or graphic page enters device menu for configuration.<br><br>At status page enters menu for status messages and details | Reset display | Switch between display pages: 1st and 2nd measuring page, graphic page and status page | - |
| **Menu mode**<br>Navigation through device menu or active status messages | Access to displayed menu, then 1st submenu is displayed | Either return to menu level above or to measuring mode but prompt whether the data should be saved | Select menu item | - |
| **Parameter and data mode**<br>Changing parameter values or starting function | For numerical values, move cursor (highlighted in **black**) one position to the right | Return to menu mode | Use cursor (highlighted in **black**) to change number, unit, property and to move the decimal point | Return to menu mode without acceptance of data |

Table 6-2: Description of display modes and operating keys

The following status levels with the related symbols are available:

| Symbol | Symbol background colour | Letter | Status signal | Description and consequence |
|---|---|---|---|---|
|  | white | **F**<br>(bold) | Error in device | No measurement possible. |
| | blue | F | Application error | No measurement possible due to process/application conditions.<br>The device is still OK. |
|  | blue | S | Out of specification | Measurements are available but are no longer sufficiently accurate and should be checked. |
|  | blue | M | Maintenance required | Measurements are still accurate but this could soon change |
|  | blue | C | Checks in progress | A test function is active. The displayed or transferred measured value does not correspond to the actual measured value. |
| - | - | I | Information | No direct influence on the measurements. |
| - | - | - | No message | - |

Table 6-3: Description of the icons for the status level

For further information refer to *Status messages and diagnostic information* on page 67.

## 6.2.1 Display in measuring mode with 2 or 3 measured values

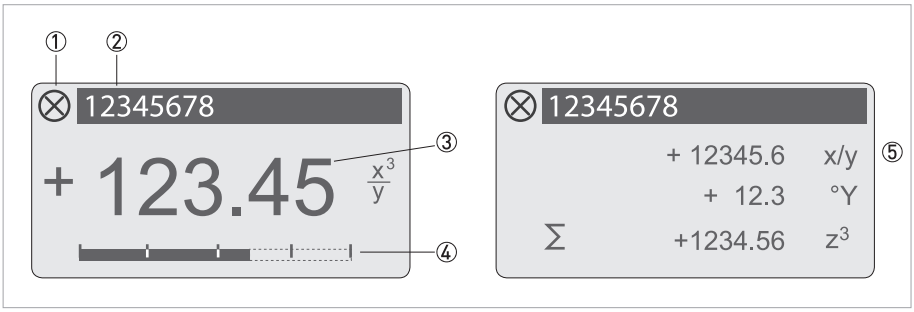



Figure 6-2: Example for display in measuring mode with 2 or 3 measured values

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

## 6.2.2 Display for selection of submenu and functions in menu mode

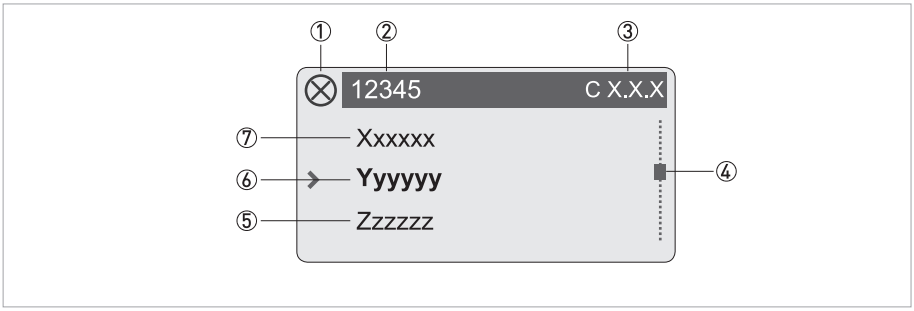



Figure 6-3: Display for selection of submenu and functions in menu mode

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

### 6.2.3 Display when setting a parameter in parameter and data mode

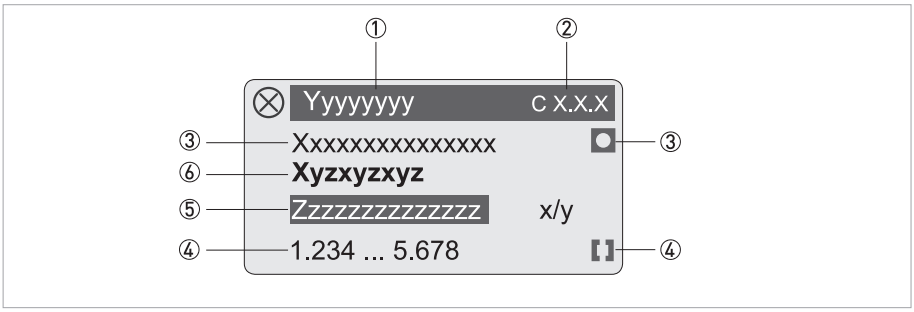



Figure 6-4: Display when setting a parameter in parameter and data mode

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

### 6.2.4 Display for selection of submenu and functions with preview

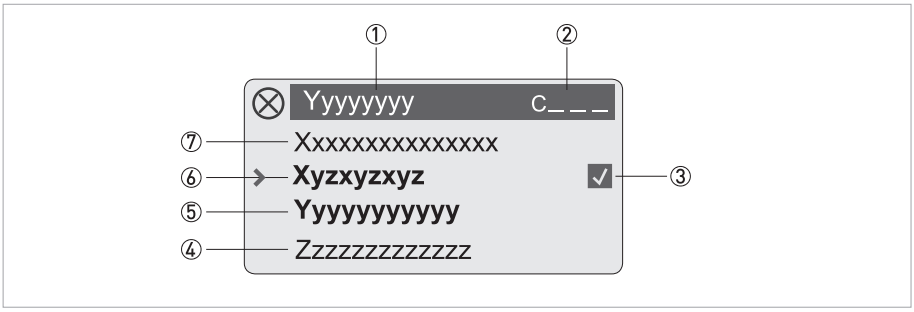



Figure 6-5: Display for selection of submenu and functions with preview

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

## 6.3 Menu structure

*INFORMATION!*

- *The menu structure for the standard device is described.*
- *Special functions for Modbus are described in detail in the corresponding supplementary instructions.*
- *Note the key function within and between the columns.*

| Measuring mode | | Select menu | ↓ ↑ | Select menu and/or submenu ↓ ↑ | | | | Select function and set data ↓ ↑ > |
|---|---|---|---|---|---|---|---|---|
| ↵ | Press > 2.5 s | | | | | | | |
| | A quick setup | | > ↵ | A1 language | > ↵ | - | > ↵ | |
| | | | | A2 HART | > ↵ | A2.1 Tag | | |
| | | | | A3 RS 485 / Modbus | > ↵ | A3.1 Tag | | |
| | | | | | | A3.2 slave address | | |
| | | | | A4 reset? | > ↵ | A4.1 reset errors | | |
| | | | | | | A4.2 counter 1 ① | | |
| | | | | | | A4.3 counter 2 ① | | |
| | | | | A5 analogue outputs | > ↵ | A5.1 range | | |
| | | | | | | A5.2 time constant | | |
| | | | | | | A5.3 low flow cutoff | | |
| | | | | A6 digital outputs | > ↵ | A6.1 max. pulse rate | | |
| | | | | | | A6.2 pulse value unit | | |
| | | | | | | A6.3 value p. pulse | | |
| | | | | A7 process input | > ↵ | A7.1 device serial no. | | |
| | | | | | | A7.2 zero calibration ① | | |
| | | | | | | A7.3 size ① | | |
| | | | | | | A7.4 GKL ① | | |
| | | | | | | A7.5 field frequency ① | | |
| | | | | | | A7.6 flow direction ① | | |
| ↵ | B test | | > ↵ | B1 simulation | > ↵ | For details about the submenus refer to *Menu "B test"* on page 55. | > ↵ | |
| | | | | B2 actual values | | | | |
| | | | | B3 information | | | | |
| | | ↓ ↑ | | ↓ ↑ | | ↓ ↑ | | ↓ ↑ > |

**Table 6-4: Menu structure "A quick setup" and "B test"**

**① Available if "quick setup" activated**

| Measuring mode | | Select menu | ↓ ↑ | Select menu and/or submenu ↓ ↑ | | | | Select function and set data ↓ ↑ > |
|---|---|---|---|---|---|---|---|---|
| ↵ | | Press > 2.5 s | | | | | | |
| | | C setup | > ↵ | C1 process input | > ↵ | C1.1 calibration | > ↵ | |
| | | | | | | C1.2 filter | | |
| | | | | | | C1.3 self test | | |
| | | | | | | C1.4 information | | |
| | | | | | | C1.5 simulation | | |
| ↵ | | | > ↵ | C2 I/O (input/output) | > ↵ | C2.1 hardware | > ↵ | |
| | | | | | | C2.1 - ① | | |
| | | | | | | C2.1 current output A ① | | |
| | | | | | | C2.5 - ① | | |
| | | | | | | C2.5 frequency out D ① | | |
| | | | | | | C2.5 pulse output D ① | | |
| | | | | | | C2.5 status output D ① | | |
| | | | | | | C2.5 limit switch D ① | | |
| ↵ | | | > ↵ | C3 I/O counter | > ↵ | C3.1 counter 1 | > ↵ | |
| | | | | | | C3.2 counter 2 | | |
| ↵ | | | > ↵ | C4 HART | > ↵ | C4.1 HART (on/off) | > ↵ | |
| | | | | | | C4.2 address | | |
| | | | | | | C4.3 message | | |
| | | | | | | C4.4 description | | |
| | | | | | | C4.5 HART units | | |
| ↵ | | | > ↵ | C6 device | > ↵ | C6.1 device info | > ↵ | |
| | | | | | | C6.2 display | | |
| | | | | | | C6.3 1. meas. page | | |
| | | | | | | C6.4 2. meas. page | | |
| | | | | | | C6.5 graphic page | | |
| | | | | | | C6.6 special functions | | |
| | | | | | | C6.7 units | | |
| | | | | | | C6.8 quick setup | | |
| | | ↓ ↑ | | ↓ ↑ | | ↓ ↑ | | ↓ ↑ > |

**Table 6-5: Menu structure "C setup"**

**① Depending on settings in "C2.2 hardware"**

## 6.4 Function tables

*INFORMATION!*

- *The functions for the standard device are described in the following tables.*
- *Special functions for Modbus are described in detail in the corresponding supplementary instructions.*
- *Depending on the device version, not all functions are available.*

### 6.4.1 Menu "A quick setup"

| Function | Setting / Description |
|---|---|
| A quick setup | |

#### A1 language

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

#### A2 HART

| | |
|---|---|
| A2.1 Tag | Measuring point identifier (Tag no.) appears in the LC display header (up to 8 digits). |

#### A3 RS485/Modbus

| | |
|---|---|
| A3.1 Tag | Measuring point identifier (Tag no.) appears in the LC display header (up to 16 digits). The first 8 digits are identical to the HART® measuring point (see above). |
| A3.2 slave address | Setting the device address at the Modbus interface. |

#### A4 reset

| | |
|---|---|
| A4.1 reset errors | Query: reset?<br>Select: no / yes |
| A4.2 counter 1 | Query: reset counter?<br>Select: no / yes (available if activated in C6.8.1) |
| A4.3 counter 2 | Query: reset counter?<br>Select: no / yes (available if activated in C6.8.2) |

#### A5 analogue outputs

| | |
|---|---|
| A5.1 range | Measuring range for the analogue outputs (current output, frequency output and display). |
| A5.2 time constant | Time constant for the analogue outputs (current output, frequency output and display). |
| A5.3 low flow cutoff | Low flow cutoff for the analogue outputs (current output and frequency output). |

#### A6 digital outputs

| | |
|---|---|
| A6.1 max. pulse rate | Setting the maximum pulse rate. |
| | Limit is 120% of this pulse rate or (refer to pulse width) by pulse width when the off time is 50% of the on time. |
| A6.2 pulse value unit | Selection of the unit from a list, depending on the "measurement". |
| A6.3 value p. pulse | Setting for pulse output D (volume or mass value per pulse). |
| | Setting: xxx.xxx in L or kg or in the unit selected in A6.2 |

| Function | Setting / Description |
|---|---|
| A quick setup | |

## A7 process input

| | |
|---|---|
| A7.1 device serial no. | Shows the serial number of the system (C5.1.3). |
| The following process input parameters are only available, if the quick access has been activated in the menu "setup / device / quick setup" (C6.8.3). | |
| A7.2 zero calibration | Display of actual zero calibration value. |
| | Query: calibrate zero?<br>Select: break / manual / default / automatic |
| | For settings refer to C1.1.1. |
| A7.3 size | Select from size table. For details refer to C1.1.2. |
| A7.4 GKL | Set value according to information on nameplate; range: 0.5...20<br>For details refer to C1.1.3. |
| A7.5 field frequency | Setting as on flow sensor nameplate = line frequency x value (from the following list): 1/2; 1/4; 1/6; 1/8; 1/12; 1/18; 1/36; 1/50<br>For details refer to C1.1.9. |
| A7.6 flow direction | Define the polarity of the flow direction. |
| | Select: normal direction (according to the arrow on the flow sensor) / reverse direction (in the opposite direction to the arrow)<br>For details refer to C1.2.2. |

Table 6-6: Description of menu "A quick setup"

## 6.4.2 Menu "B test"

| Function | Setting / Description |
|---|---|
| B test | |

### B1 simulation

| | |
|---|---|
| B1.1 volume flow<br>B1.1 mass flow | Depending on the selection, simulation of the volume or mass flow according to the following sequence:<br>Select: set value / break (exit function without simulation) |
| | Query: start simulation?<br>Select: no (exit function without simulation) / yes (start simulation) |
| B1.2 current output A | Simulation X<br><br>[X stands for one of the connection terminals A or D]<br>Sequence and settings similar to B1.2, see above!<br><br>For the pulse output the set number of pulses are displayed once in a second! |
| B1.3 pulse output D | |
| B1.3 frequency out X | |
| B1.3 limit switch D | |
| B1.3 status output D | |

### B2 actual values

| | |
|---|---|
| B2.1 operating hours | Display the actual operating hours.<br>Exit the displayed function with the ↵ key. |
| B2.2 act. flow speed | Display the actual flow speed.<br>Exit the displayed function with the ↵ key. |
| B2.3 electr. temperature | Display the actual electronics temperature.<br>Exit the displayed function with the ↵ key. |
| B2.4 act. coil resistance | Display the actual resistance of the field coils. |

### B3 information

| | |
|---|---|
| B3.1 C number | This number identifies the type of electronics; It can be found on the signal converter assembly sticker as well. |
| B3.2 Electronic Revision ER | Reference identification number, electronic revision and production date of the device; includes all hardware and software changes. |
| B3.3 device serial no. | Serial number of the system. |
| B3.4 electronic serial no. | Serial number of the electronics assembly. |

Table 6-7: Description of menu "B test"

### 6.4.3 Menu "C setup"

| Function | Setting / Description |
|---|---|
| **C setup - C1 process input** | |

#### C1.1 calibration

| | |
|---|---|
| C1.1.1 zero calibration | Display of actual zero calibration value. |
| | Query: calibrate zero?<br>Select: break (return with ↵ key) / default (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. |
| C1.1.3 GKL | Set value acc. to the information on the nameplate.<br>Range: 0.5...20 |
| C1.1.4 measurement | Select: volume flow (default setting) / mass flow (using the fixed density, the volume flow is converted into mass flow) |
| C1.1.5 range | Measuring range for the analogue outputs (only used for current output, frequency output and display).<br>Range: 0...100% |
| C1.1.6 density | For calculating the mass flow from the volume flow.<br>Range: 0.1...5 kg/L |
| C1.1.7 target conduct. | Reference value for on-site calibration.<br>Range: 1.000...50000 µS/cm |
| C1.1.8 EF electr. factor | For calculation of the conductivity based on the electrode impedance. |
| | Query: calibrate EF?<br>Select: break (return with ↵ key) / default (with factory setting) / manual (set desired value) / automatic (determines EF according to the setting in C1.1.10) |
| C1.1.9 field frequency | Setting as on flow sensor nameplate = line frequency x value (from the following list): 1/2; 1/4; 1/6; 1/8; 1/12; 1/18; 1/36; 1/50 |
| C1.1.10 select settling | Select settling (special function). |
| | Select: standard (fixed allocation) / manual (manual time setting for the settling time for the field current) |
| C1.1.11 settling time | Only available if "manual" is selected in C1.1.10.<br>Range: 1.0...250 ms |
| C1.1.12 line frequency | Setting the line frequency. |
| | Select: 50 Hz or 60 Hz |
| C1.1.13 act. coil resistance | Display of the actual resistance of the field coil. |

#### 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 the polarity of the flow direction. |
| | Select: normal direction (according to the arrow on the flow sensor) / reverse direction (in the opposite direction to the arrow) |
| C1.2.3 time constant | Time constant of all flow measurements. |
| | xxx.x s; range: 0.0...100 s |

| Function | Setting / Description |
|---|---|
| **C setup - C1 process input** | |
| 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) / automatic (with new pulse filter) |
| | **Pulse filter "on":** The change from one measurement value to the next one is limited to the value "pulse limitation" for the total time "pulse width".<br>This filter allows a faster signal tracking for slowly changing flow values. |
| | **Pulse filter "automatic":** The raw flow values are collected into a buffer, covering two times the "pulse width" values. This filter is called "median" filter.<br>This filter allows a better suppression of pulse shaped disturbances (particles or air bubbles in very noisy environment). |
| C1.2.5 pulse width | Length of interference and delays to be suppressed on sudden changes in flow. |
| | Only available, if pulse filter (C1.2.4) is "on" or "automatic". |
| | xx.x s; range for "on": 0.01...10 s or for "automatic": 0.1...20 s |
| C1.2.6 pulse limitation | Dynamic limitation from one measured value to the next; only if pulse filter (C1.2.4) is "on". |
| | xx.x s; range: 0.01...100 m/s |
| C1.2.7 low flow cutoff | Sets low flow values to "0"; affects all outputs |
| | x.xxx ± x.xxx L/h; range: 0.0...10 L/h |
| | (1st value = switching point / 2nd value = hysteresis),<br>condition: 2nd value ≤ 1st value |

## C1.3 self test

| | |
|---|---|
| C1.3.1 empty pipe detect. | Select: off / conductivity / cond.+empty pipe (F) (conductivity measurement S/m and empty pipe indication, error category [F] application) /<br>cond.+empty pipe (S) (conductivity measurement S/m and empty pipe indication, error category [S] measurement out of specification) /<br>cond. + empty pipe (I) (conductivity measurement S/m and empty pipe indication, error category [I] information) |
| | Flow indication "= 0" when "empty pipe" |
| | Activation takes place only after restart of the device (accepting the changes by leaving the menu). |
| C1.3.2 limit empty pipe | Only available if "empty pipe [..]" is activated in C1.3.1. |
| | Range: 0.0...9999 µS (set about 50% of the lowest occurring conductivity in operation.<br>Conductivity below this value means a signal as "empty pipe". |
| C1.3.3 act. conductivity | Only available if "empty pipe [..]" is activated in C1.3.1. |
| | Actual conductivity is indicated. Activation takes place only after setting mode is exited! |
| C1.3.4 time constant | Only available if "empty pipe [..]" is activated in C1.3.1. |
| | Range: xxx.x s; 0.1...100 s |
| | A damping is set for "empty pipe detect.". |

| Function | Setting / Description |
|---|---|
| C setup - C1 process input | |

### C1.4 information

| | |
|---|---|
| C1.4.1 liner | Shows the material of the liner. |
| C1.4.2 electr. material | Shows the material of the electrodes. |
| C1.4.3 calibration date | Shows the date on which the flow sensor was calibrated. |
| C1.4.4 serial no. sensor | Shows the serial number of the flow sensor. |
| C1.4.5 V no. sensor | Shows the order number of the flow sensor. |
| C1.4.6 sensor electr. info | Shows the serial number of the circuit board, the software version number and the calibration date of the circuit board. |

### C1.5 simulation

| | |
|---|---|
| C1.5.2 volume flow<br>C1.5.2 mass flow | For sequence refer to B1.1. |

Table 6-8: Description of menu "C setup - C1 process input"

| Function | Setting / Description |
|---|---|
| C setup - C2 I/O (Inputs/Outputs) | |

### C2.1 hardware

| | |
|---|---|
| C2.1.1 terminals A | Select: off (switched off) / current output |
| C2.1.2 terminals D | Select: off (switched off) / frequency output / pulse output / status output / limit switch |

### C2.2 current output A

| | |
|---|---|
| C2.2.1 range 0%...100% | Current range for the selected "measurement", e.g. 4...20 mA, corresponds to 0...100% |
| | xx.x...xx.x mA; range: 0.00...20 mA<br>Condition: 0 mA ≤ 1st value ≤ 2nd value ≤ 20 mA |
| C2.2.2 extended range | Min. and max. limits of current values. If the current range is exceeded, the current is set to these limits. |
| | xx.x ... xx.x mA; range: 03.5...21.5 mA<br>Condition: 0 mA ≤ 1st value ≤ 2nd value ≤ 21.5 mA and out of current range |
| C2.2.3 error current | Specify error current. |
| | xx.x mA; range: 3...22 mA<br>Condition: outside of extended range |
| C2.2.4 error condition | Set the error conditions. |
| | Select: error in device (error category [F]) / application error (error category [F]) / out of specification (error category [F] & [S]) |
| C2.2.5 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 (always displays positive, with both negative and positive values) |
| C2.2.6 low flow cutoff | Sets the measurement to "0" for low values. |
| | x.xxx...x.xxx%; range: 0.0...20% |
| | (1st value = switching point / 2nd value = hysteresis);<br>condition: 2nd value ≤ 1st value |

| Function | Setting / Description |
|---|---|
| **C setup - C2 I/O (Inputs/Outputs)** | |
| C2.2.7 time constant | Range: 000.1...100 s |
| C2.2.8 information | Serial number of the I/O board, software version number and production date of the circuit board. |
| C2.2.9 simulation | For sequence refer to "B1.2 current output A". |
| C2.2.10 4mA trimming | Trimming of the current at 4 mA. |
| | Reset to 4 mA restores the factory calibration. |
| | Used for HART® setting. |
| C2.2.11 20mA trimming | Trimming of the current at 20 mA. |
| | Reset to 20 mA restores the factory calibration. |
| | Used for HART® setting. |

## C2.3 frequency out X

| | |
|---|---|
| C2.3.1 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; for setting refer to "C2.3.3 100% pulse rate") |
| C2.3.2 pulse width | Only available if set to "fixed" in C2.3.1. |
| | 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 |
| C2.3.3 100% pulse rate | Pulse rate for 100% of the measuring range. |
| | Range: 1...10000 Hz |
| | Limitation 100% pulse rate ≤ 100/s: $I_{max}$ ≤ 100 mA<br>Limitation 100% pulse rate > 100/s: $I_{max}$ ≤ 20 mA |
| C2.3.4 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 (always displays positive, with both negative and positive values) |
| C2.3.5 low flow cutoff | Sets the measurement to "0" for low values. |
| | x.xxx ± x.xxx L/h; range: 0.0...20 L/h |
| | (1st value = switching point / 2nd value = hysteresis),<br>condition: 2nd value ≤ 1st value |
| C2.3.6 time constant | Range: 000.1...100 s |
| C2.3.7 invert signal | Select: off (activated output: switch closed) / on (activated output: switch open) |
| C2.3.8 information | Serial number of the I/O board, software version number and production date of the circuit board. |
| C2.3.9 simulation | For sequence refer to "B1.3 frequency out D". |

| Function | Setting / Description |
|---|---|
| C setup - C2 I/O (Inputs/Outputs) | |

## C2.3 pulse output D

| | |
|---|---|
| C2.3.1 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 max. pulse rate) / fixed (fixed pulse rate, for setting refer to "C2.3.3 max. pulse rate") |
| C2.3.2 pulse width | Only available if set to "fixed" in C2.3.1. |
| | 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 |
| C2.3.3 max. pulse rate | Setting the maximum pulse rate. |
| | Limit is 120% of this pulse rate. |
| C2.3.4 pulse value unit | Selection of the unit from a list, depending on the "measurement". |
| C2.3.5 value p. pulse | Set value for volume or mass per pulse. |
| | xxx.xxx, measured value |
| C2.3.6 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 (always displays positive, with both negative and positive values) |
| C2.3.7 invert signal | Select: off (activated output: switch closed) / on (activated output: switch open) |
| C2.3.8 information | Serial number of the I/O board, software version number and production date of the circuit board. |
| C2.3.9 simulation | For sequence refer to "B1.3 pulse output D". |

## C2.3 status output D

| | |
|---|---|
| C2.3.1 mode | Measuring conditions of the output. |
| | Select: out of specification (output set, signals status of category "error in device" or "application error" or "out of specification" refer to *Status messages and diagnostic information* on page 67) /<br>application error (output set, signals status of the category "error in device" or "application error" refer to *Status messages and diagnostic information* on page 67) /<br>polarity flow (polarity of the current flow) /<br>over range flow (over range of the flow) /<br>counter 1 preset (activates counter 1 when preset value is reached) /<br>counter 2 preset (activates counter 2 when preset value is reached) /<br>output A (displays the polarity at output A) /<br>off (switched off) /<br>empty pipe (when pipe empty, output activated) /<br>error in device (output set, signals status of the category "error in device" refer to *Status messages and diagnostic information* on page 67) |
| C2.3.2 invert signal | Select: off (activated output: switch closed) / on (activated output: switch open) |
| C2.3.3 information | Serial number of the I/O board, software version number and production date of the circuit board. |
| C2.3.4 simulation | For sequence refer to "B1.3 status output D". |

| Function | Setting / Description |
|---|---|
| **C setup - C2 I/O (Inputs/Outputs)** | |

## C2.3 limit switch D

| | |
|---|---|
| C2.3.1 threshold | Switching level, set threshold with hysteresis |
| C2.3.2 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 (always displays positive, with both negative and positive values) |
| C2.3.3 time constant | Range: 000.1...100 s |
| C2.3.4 invert signal | Select: off (activated output: switch closed) / on (activated output: switch open) |
| C2.3.5 information | Serial number of the I/O board, software version number and production date of the circuit board. |
| C2.3.6 simulation | For sequence refer to "B1.3 limit switch D". |

Table 6-9: Description of menu "C setup - C2 I/O (Inputs/Outputs)"

| Function | Setting / Description |
|---|---|
| **C setup - C3 I/O counter** | |
| C3.1 counter 1 | Set function of counter.<br>_ stands for 1, 2 (= counter 1, 2) |
| C3.2 counter 2 | |
| C3._.1 funct. of counter | Select: sum counter (counts positive + negative values) / + counter (counts only the positive values) / - counter (counts only the negative values) / off (counter is switched off) |
| C3._.2 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; refer to C5.7.10 and C5.7.13 |
| C3._.3 reset counter | Query: reset counter?<br>Select: no / yes (available if activated in C6.8.1) |
| C3._.4 set counter | Set counter _ to the desired value. |
| | Select: break (exit function) / set value (opens the editor to make the entry) |
| | Query: set counter?<br>Select: no (exit function without setting the value) / yes (sets the counter and exits the function) |
| C3._.5 stop counter | Counter _ stops and holds the current value. |
| | Select: no (exits the function without stopping the counter) / yes (stop the counter and exits the function) |
| C3._.5 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._.7 information | Serial number of the I/O board, software version number and production date of the circuit board. |

Table 6-10: Description of menu "C setup - C3 I/O counter"

| Function | Setting / Description |
|---|---|
| **C setup - C4 HART** | |
| The dynamic variables are fixed to the following values:<br>PV: flow (volume flow or mass flow, depending on the selection of "measurement" in C1.1.4)<br>SV: counter 1<br>TV: counter 2<br>4V: conductivity (default) or operating time | |
| C4.1 HART | HART® communication is activated or deactivated. |
| | Select: on (HART® is activated; default setting) / off (HART® is disabled) |
| C4.2 address | Setting the address for multi-drop operation. |
| | If "address 0" is selected, the current output is in normal operation. For all other addresses, the current at the output is set to the 0% value. |
| C4.3 message | Entry of individual text. |
| C4.4 description | Entry of individual text. |
| C4.5 HART units | Unit change of dynamic variables in the display. |
| | Select: break (return with ↵ key) / HART® display (copies the settings for the display units to the settings for the DVs) / load defaults (resets the DVs to the factory defaults) |
| C4.6 Set 4V (or QV) | Unit is HART® dynamic variable. |
| | Select: conductivity / coil temperature / mass flow / volume flow / flow speed / operating hours / counter 2 / counter 1 / diagnosis value |

Table 6-11: Description of menu "C setup - C4 HART"

| Function | Setting / Description |
|---|---|
| **C setup - C6 device** | |

## C6.1 device info

| | |
|---|---|
| C6.1.1 Tag | Settable characters (max. 8 digits):<br>A...Z; a...z; 0...9; / - , . |
| C6.1.2 C number | CG number, cannot be changed; describes the signal converter version. |
| C6.1.3 device serial no. | Serial number of the system; cannot be changed. |
| C6.1.4 electronic serial no. | Serial number of the electronic assembly; cannot be changed. |
| C6.1.5 SW.REV.MS | Serial number of the circuit board, version number of the main software, production date of the circuit board. |
| C6.1.6 Electronic Revision ER | Reference identification number, electronic revision and production date of the device; includes all hardware and software changes. |

## C6.2 display

| | |
|---|---|
| C6.2.1 language | Language selection depends on the device version. |
| C6.2.2 contrast | Adjust display contrast for extreme temperatures.<br>Setting: -9...0...+9 |
| | This change takes place immediately, not just when setting mode is exited! |
| C6.2.3 default display | Specification of the default display page that is returned to after a short delay period. |
| | Select: none (current page is always active) / 1. meas. page (shows this page) / 2. meas. page (shows this page) / status page (shows only status messages) / graphic page (trend of the 1st measurement) |

| Function | Setting / Description |
|---|---|
| **C setup - C6 device** | |
| C6.2.4 magnet keys | For activating or deactivating the magnet keys. |
| | Select: on (magnet keys are enabled) / off (magnet keys are disabled) |
| C6.2.5 status indication LED | This function is only available for device versions without display. |
| | Status display via a green or red LED (in case of device error, application error or out of specification). |
| C6.2.6 SW.REV.UIS | Serial number of the circuit board, version number of user interface software, production date of the circuit board. |

## C6.3 1. meas. page

| | |
|---|---|
| C6.3.1 format 1.line | Number of decimal places specified (depending on available space) for "1.line" of "1. meas. page". |
| C6.3.2 measurement 2.line | Selects the value to be shown on the second line of the first measurement screen. |
| | Select: conductivity / bargraph (default) |

## C6.4 2. meas. page

| | |
|---|---|
| C6.4.1 format 1.line | Number of decimal places specified (depending on available space) for "1.line" of "2. meas. page". |
| C6.4.2 format 2.line | Number of decimal places specified (depending on available space) for "2.line" of "2. meas. page". |
| C6.4.3 format 3.line | Number of decimal places specified (depending on available space) for "3.line of "2. meas. page". |

## C6.5 graphic page

| | |
|---|---|
| C6.5.1 select range | Select: manual (set range in C6.5.2) / automatic (automatic depiction based on the measured values)<br><br>Reset only after parameter change or after switching off and on. |
| C6.5.2 range | Set the scaling for the Y axis. Only available if "manual" is set in C6.5.1. |
| | ±xxx...±xxx%; range: -100...+100% |
| | (1st value = lower limit / 2nd value = upper limit), condition: 1st value ≤ 2nd value |
| C6.5.3 time scale | Set the time scaling for the X axis, trend curve |
| | xxx min; range: 0...100 min |

## C6.6 special function

| | |
|---|---|
| C6.6.1 reset errors | Query: reset? |
| | Select: no / yes |
| C6.6.2 save settings | Save current settings.<br><br>Select: break (exit function without saving) / backup 1 (saves the settings in the backup 1 storage place) / backup 2 (saves the settings in the backup 2 storage place) |
| | Query: go on with copy? (cannot be undone)<br><br>Select: no (exit function without saving) / yes (copy current settings to storage backup 1 or backup 2) |

| Function | Setting / Description |
|---|---|
| **C setup - C6 device** | |
| C6.6.3 load settings | Load saved settings.<br><br>Select: break (exit function without loading) / factory settings (reload factory settings) / backup 1 (loads the settings from the backup 1 storage place) / backup 2 (loads the settings from the backup 2 storage place) / load sensor data (restore factory setting of the values for the flow sensor. Display and I/O settings are retained!) |
| | Query: go on with copy? (cannot be undone)<br><br>Select: no (exit function without saving) / yes (load data from the selected storage place) |
| C6.6.4 password quick set | Password required to change data in the menu "quick setup". |
| | 0000 (= to this menu without password) |
| | xxxx (password required); range 4 digits: 0001...9999 |
| C6.6.5 password setup | Password required to change data in the menu "setup". |
| | 0000 (= to this menu without password) |
| | xxxx (password required); range 4 digits: 0001...9999 |

## C6.7 units

| | |
|---|---|
| C6.7.1 volume flow | $m^3/h$; $m^3/min$; $m^3/s$; L/h; L/min; L/s (L = litres);<br>cf/h; cf/min; cf/s; gal/h; gal/min; gal/s;<br>IG/h; IG/min; IG/s;<br>free unit (set factor and text in the next two functions, sequence see below) |
| C6.7.2 Text free unit | For text to be specified refer to *Set free units* on page 65: |
| C6.7.3 [$m^3/s$]*factor | Specification of the conversion factor, based on $m^3/s$: |
| | xxx.xxx refer to *Set free units* on page 65 |
| C6.7.4 mass flow | kg/s; kg/min; kg/h; t/min; t/h; g/s; g/min; g/h;<br>lb/s; lb/min; lb/h; ST/min; ST/h (ST = Short Ton); LT/h (LT = Long Ton);<br>free unit (set factor and text in the next two functions, sequence see below) |
| C6.7.5 Text free unit | For text to be specified refer to *Set free units* on page 65: |
| C6.7.6 [kg/s]*factor | Specification of the conversion factor, based on kg/s: |
| | xxx.xxx refer to *Set free units* on page 65 |
| C6.7.7 volume | $m^3$; L; hL; mL; gal; IG; $in^3$; cf; $yd^3$;<br>free unit (set factor and text in the next two functions, sequence see below) |
| C6.7.8 Text free unit | For text to be specified refer to *Set free units* on page 65: |
| C6.7.9 [$m^3$]*factor | Specification of the conversion factor, based on $m^3$: |
| | xxx.xxx refer to *Set free units* on page 65 |
| C6.7.10 mass | kg; t; mg; g; lb; ST; LT; oz;<br>free unit (set factor and text in the next two functions, sequence see below) |
| C6.7.11 Text free unit | For text to be specified refer to *Set free units* on page 65: |
| C6.7.12 [kg]*factor | Specification of the conversion factor, based on kg: |
| | xxx.xxx refer to *Set free units* on page 65 |
| C6.7.13 flow speed | m/s; ft/s |
| C6.7.14 density | kg/L; kg/$m^3$; lb/cf; lb/gal;<br>free unit (set factor and text in the next two functions, sequence see below) |
| C6.7.15 Text free unit | For text to be specified refer to *Set free units* on page 65: |
| C6.7.16 [kg/$m^3$]*factor | Specification of the conversion factor, based on kg/$m^3$: |
| | xxx.xxx refer to *Set free units* on page 65 |

| Function | Setting / Description |
|---|---|
| **C setup - C6 device** | |
| C6.7.17 conductivity | S/m; µS/cm |

### C6.8 quick setup

| | |
|---|---|
| Activate quick access in menu "quick setup"; default setting: "quick setup" is active (yes)<br>Select: yes (activated) / no (not activated) | |
| C6.8.1 reset counter 1 | Reset counter 1 in menu "quick setup". |
| | Select: yes (activated) / no (not activated) |
| C6.8.2 reset counter 2 | Reset counter 2 in menu "quick setup". |
| | Select: yes (activated) / no (not activated) |
| C6.8.3 process input | Activate quick access to the important process input parameters. |
| | Select: yes (activated) / no (not activated) |

**Table 6-12: Description of menu "C setup - C6 device"**

## 6.4.4 Set free units

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

**Table 6-13: Sequences to set texts and factors**

## 6.5 Description of functions

### 6.5.1 Reset counter in the menu "quick setup"

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

| Key | Function | Description |
|---|---|---|
| > | A quick setup | Press and hold for 2.5 s, then release the key. |
| > | A1 language | - |
| 3 x ↓ | A4 reset | - |
| > | A4.1 reset errors | - |
| ↓ | A4.2 counter 1 | Select desired counter. |
| ↓ | A4.3 counter 2 | |
| > | Query: reset counter?<br>Select: no | - |
| ↓ or ↑ | Query: reset counter?<br>Select: yes | - |
| ↵ | A4.2 counter 1 or A4.3 counter 2 | Counter has been reset. |
| 3 x ↵ | Measuring mode | - |

Table 6-14: Reset counter in the menu "quick setup"

### 6.5.2 Deleting error messages in the menu "quick setup"

*INFORMATION!*
*For the detailed list of the possible error messages refer to Status messages and diagnostic information on page 67.*

| Key | Function | Description |
|---|---|---|
| > | A quick setup | Press and hold for 2.5 s, then release the key. |
| > | A1 language | - |
| 3 x ↓ | A4 reset | - |
| > | A4.1 reset errors | - |
| > | Query: reset errors?<br>Select: no | - |
| ↓ or ↑ | Query: reset errors?<br>Select: yes | - |
| ↵ | A4.1 reset errors | Error has been reset. |
| 3 x ↵ | Measuring mode | - |

Table 6-15: Deleting error messages in the menu "quick setup"

### 6.5.3 Conductivity measurement

The included conductivity measurement is also used to detect empty pipes.
The measurement is done by measurement of the real part of the electrode impedance.
The measurement is developed for a range from 1 to 1000 µS/cm at electrode factor EF = 3 mm.
The measurement is limited to about 10000 µS/cm at EF = 3 mm on the high limit. The limitation to the low limit is depending on the cable length between the electronics and the flow sensor.

| Cable length between electronics and flow sensor | Field frequency setting (C1.1.13) | Low conductivity limit |
|---|---|---|
| Compact version | 1/4 and above | 0.3 µS/cm |
| | 1/2 | 1 µS/cm |
| Remote version: 10 m / 32.8 ft signal cable | 1/4 and above | 3 µS/cm |
| | 1/2 | 10 µS/cm |
| Remote version: 100 m / 328 ft signal cable | 1/4 and above | 30 µS/cm |
| | 1/2 | 100 µS/cm |

Table 6-16: Low conductivity limit

## 6.6 Status messages and diagnostic information

The diagnostic messages are displayed in accordance with NAMUR standard NE 107.

Each status message (= status signal) has a specific symbol, determined by NAMUR, which is displayed with the message. The length of each message is limited to one line.
The symbols are shown in the top left corner of the display on every screen.

| Symbol | Symbol background colour | Letter | Status signal | Description and consequence |
|---|---|---|---|---|
|  | white | **F** (bold) | Error in device | No measurement possible. |
| | blue | F | Application error | No measurement possible due to process/application conditions. The device is still OK. |
|  | blue | S | Out of specification | Measurements are available but are no longer sufficiently accurate and should be checked. |
|  | blue | M | Maintenance required | Measurements are still accurate but this could soon change |
|  | blue | C | Checks in progress | A test function is active. The displayed or transferred measured value does not correspond to the actual measured value. |
| - | - | I | Information | No direct influence on the measurements. |
| - | - | - | No message | - |

Table 6-17: Description of the icons for the status level

| 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 | Error 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 (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 configuration | Invalid configuration: display software, bus parameter or main software do not match existing 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 flow sensor electronics. Parameter or hardware error. No measurement possible. | Defective, replace electronic unit. |
| F sensor global | Data error in the global data of the flow sensor electronic equipment. | Load settings (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 flow 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 output A | Error, operational fault in current output. Parameter or hardware error. No measurement possible. | Defective, replace electronic unit. |
| F current output C | | |
| F software user interface | Fault revealed by CRC check of operation software. | Replace electronic unit. |
| F hardware settings | The set hardware parameters do not match the identified hardware. A dialogue appears in the display. | Answer queries in dialogue mode, follow directions.<br>Defective, replace electronic unit. |
| F hardware detection | Existing hardware cannot be identified. | Defective, replace electronic unit. |
| F RAM/ROM error IO1 | A RAM or ROM error is detected during the CRC check. | Defective, replace electronic unit. |

**Table 6-18: Operational faults in device**

| Messages on the display | Description | Actions |
|---|---|---|
| **Status: F _ _ _ _ _** | **Application-dependent 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 C1.3.2. Check installation. Or electrodes completely insulated e.g. by oil film. Clean! |
| F flow exceeding limit | Measuring range exceeded, filter setting limits measured values. No message if empty pipe. | Limitation 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 "C1.1.14 settling time" is set to "manual", increase value in C1.1.15. If "standard" is set, set the field frequency in C1.1.13 according to the 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 converter, check the connection of the signal cable. |
| F open circuit A | Load on current output A too high, effective current too low. | Current not correct, mA output cable has open circuit or load too high. Check cable, reduce load (set < 750 Ω). |
| F open circuit C | | |
| F over range A | The current or the corresponding measured value is limited by a filter setting. | Check with "C2.1 hardware" or the sticker in the terminal compartment, which output is connected to the terminal.<br>If current output: extend "C2.x.6 range" and "C2.x.8 limitation".<br>If frequency output: extend values in "C2.x.5" and "C2.x.7". |
| F over range C | | |
| F over range D | The pulse rate or the corresponding measured value is limited by a filter setting. Or the demanded pulse rate is too high. | |
| 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 | | |

Table 6-19: Application error

| 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 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 C1.3.2. Check installation. Or electrodes completely insulated e.g. by oil film. Clean! |
| 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 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 overflow counter 1 | This is counter 1. Counter has overrun and started again at zero. | - |
| S overflow counter 2 | This is counter 2. 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 replacing electronics. Save the data to the backplane again (Service). |
| S field frequency too high | The field frequency is set so high that the field current cannot settle. The measured values displayed are too low. | Set field frequencey lower; refer to C1.1.13. |

Table 6-20: Measurements out of specification

| 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. |
| C test sensor | Test function of the flow sensor electronics is active. | - |

Table 6-21: Simulation of the measured values

| Messages on the display | Description | Actions |
|---|---|---|
| Status: I _ _ _ _ _ | Information (current measurement OK) | |
| I counter 1 stopped | This is counter 1. The counter has stopped. | If counter to continue counting, activate "yes" in "C2.y.9 start counter". |
| I counter 2 stopped | This is counter 2. The counter has stopped. | |
| I power fail | The device was not in operation for an unknown period of time, because the power was switched off. This message is for information only. | Temporary power failure. Counters did not run during it. |
| I over range display 1 | 1st line on page 1 (2) of display limited by filter setting. | Menu display C4.3 and/or C4.4, select 1st or 2nd meas. page and increase values in "C4.z.3 range" and/or "C4.z.4 limitation". |
| I over range display 2 | | |
| I over range conductivity | The limits for the conductivity measurement have been exceeded (>10000 µS/cm) or are lower than permitted (<0.1 µS/cm). | If the flow sensor has been properly connected and filled with medium, this does not affect the flow measurement. The conductivity measured values cannot be used. |
| 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 generated 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 conductivity off | Conductivity measurement switched off. | Changing of settings in C1.3.1. |
| I 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 C1.3.2. Check installation. Or electrodes completely insulated e.g. by oil film. Clean! |
| I diagnosis channel off | Diagnosis value switched off. | Changing of settings in C1.3.17. |

Table 6-22: Information

## 7.1 Spare parts availability

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

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

## 7.2 Availability of services

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



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

## 7.3 Returning the device to the manufacturer

### 7.3.1 General information

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



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

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



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

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

### 7.3.2 Form (for copying) to accompany a returned device



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

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

## 7.4 Disposal



*LEGAL NOTICE!*
*Disposal must be carried out in accordance with legislation applicable in your country.*

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



According to the directive 2012/19/EU or UK Regulation 2013 No. 3113, the monitoring and control instruments marked with the WEEE symbol and reaching their end-of-life **must not be disposed of with other waste**.
The user must dispose of the WEEE to a designated collection point for the recycling of WEEE or send them back to our local organisation or authorised representative.

## 8.1 Measuring principle

An electrically conductive fluid flows inside an electrically insulated 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 flowmeter

The signal voltage U is picked off by electrodes and is proportional to the mean flow velocity v and thus the flow rate Q. A signal converter is used to amplify the signal voltage, filter it and convert it into signals for totalizing, recording and output processing.

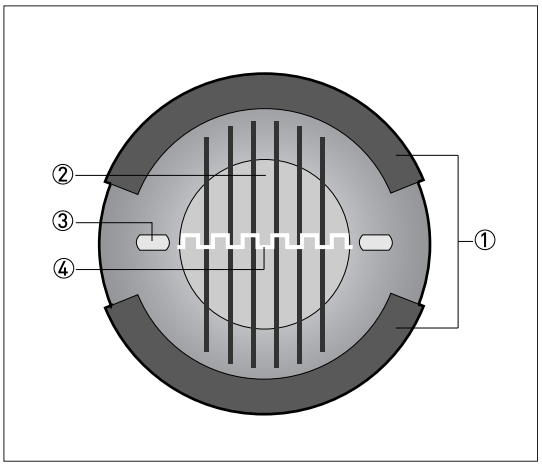



**Figure 8-1: Measuring principle**

① Field coils
② Magnetic field
③ Electrodes
④ Induced voltage (proportional to flow velocity)

## 8.2 Technical data

*INFORMATION!*

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

### Measuring system

| | |
|---|---|
| Measuring principle | 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 flow sensor |

### Design

| | |
|---|---|
| Modular construction | The measuring system consists of a flow sensor and a signal converter. |
| **Flow sensor** | |
| OPTIFLUX 1000 | DN10...150 / 3/8...6" |
| OPTIFLUX 2000 | DN25...1200 / 1...48" |
| OPTIFLUX 4000 | DN10...1200 / 3/8...48" |
| OPTIFLUX 5000 | Flange: DN15...300 / 1/2...12"<br>Sandwich: DN2.5...100 / 1/10...4" |
| OPTIFLUX 6000 | DN10...150 / 3/8...6" |
| WATERFLUX 3000 | DN25...600 / 1...24" |
| **Signal converter** | |
| Compact version (C) | IFC 050 C |
| Remote version (W) | IFC 050 W |
| **Options** | |
| Outputs | Current output (including HART®), pulse output, frequency output, status output and/or limit switch |
| | Note: It's not possible to use the pulse/frequency output with the status output at the same time! |
| Counter | 2 internal counters with a max. of 10 counter places (e.g. for counting volume and/or mass units) |
| Verification | Integrated verification, diagnostic functions: measuring device, empty pipe detection, stabilisation |
| Communication interfaces | HART® |
| | Modbus |

| | |
|---|---|
| **Display and user interface** | |
| Graphic display | LC display, backlit white |
| | Size: 128 x 64 pixels, corresponds to 59 x 31 mm = 2.32" x 1.22" |
| | Ambient temperatures below -25°C / -13°F may affect the readability of the display. |
| Operating elements | 4 push buttons for operating the signal converter when the housing is open. |
| | 4 magnet keys for operating the signal converter when the housing is closed. |
| Remote control | Only generic and not device-specific DDs and DTMs available! |
| | PACTware™ (including 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 measuring pages, 1 status page, 1 graphic 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, Finnish, Norwegian |
| | Southern Europe: English, Turkish |
| | China: English, German, Chinese |
| | Russia: English, German, Russian |
| Units | Metric, British and US units selectable as required from lists for volume / mass flow and counting, flow velocity, electrical conductivity, temperature |

## Measuring accuracy

| | |
|---|---|
| Reference conditions | Depending on the flow sensor version. |
| | Refer to the technical data of the flow sensor. |
| Maximum measuring error | **Standard:**<br>±0.5% of the measured value ± 1 mm/s, depending on the flow sensor. |
| | **Option (optimised accuracy with extended calibration):**<br>±0.25% of the measured value ± 1.5 mm/s, depending on the flow sensor. |
| | For further information refer to the technical data of the respective flow sensor. |
| | Special calibrations are available on request. |
| | Current output electronics: ±10 µA; ±100 ppm/°C (typically: ±30 ppm/°C) |
| Repeatability | ±0.1% |

## Operating conditions

| | |
|---|---|
| **Temperature** | |
| Process temperature | Refer to the technical data of the flow sensor. |
| Ambient temperature | Depending on the version and combination of outputs. |
| | It is advised to protect the signal converter from external heat sources such as direct sunlight as higher temperatures reduce the life cycle of all electronic components. |
| | -40...+65°C / -40...+149°F |
| | Ambient temperatures below -25°C / -13°F may affect the readability of the display. |
| Storage temperature | -40...+70°C / -40...+158°F |
| **Pressure** | |
| Medium | Refer to the technical data of the flow sensor. |
| Ambient pressure | Atmosphere: altitude up to 2000 m / 6561.7 ft above sea level |
| **Chemical properties** | |
| Electrical conductivity | All media except for water: ≥ 5 µS/cm<br>(also refer to the technical data of the flow sensor) |
| | Water: ≥ 20 µS/cm |
| Type of measurement | Electrical conductive liquids |
| Solid content (volume) | ≤ 10% |
| Gas content (volume) | ≤ 3% |
| Flow rate | For detailed information, refer to chapter "Flow tables". |
| **Other conditions** | |
| Ingress protection | IP66/67, NEMA 4/4X |

## Installation conditions

| | |
|---|---|
| Installation | For detailed information, refer to chapter "Installation". |
| Inlet / outlet sections | Refer to the technical data of the flow sensor. |
| Dimensions and weight | For detailed information refer to chapter "Dimensions and weight". |

## Materials

| | |
|---|---|
| Signal converter housing | Aluminum with a polyester topcoat |
| Flow sensor | For housing materials, process connections, liners, grounding electrodes and gaskets, refer to the technical data of the flow 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 specifications. |
| Power supply | 100...230 VAC (-15% / +10%), 50/60 Hz;<br>240 VAC + 5% is included in the tolerance range. |
| | 24 VDC (-30% / +30%) |
| Power consumption | AC: 15 VA |
| | DC: 5.6 W |
| Signal cable | Only necessary for remote versions. |
| | **DS 300 (type A)**<br>Max. length: 600 m / 1968 ft (depending on electrical conductivity and flow sensor version) |
| Cable entries | Standard: M20 x 1.5 (8...12 mm) |
| | Option: 1/2 NPT, PF 1/2 |

## 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 abbreviations | $V_{ext}$ = external voltage; $R_L$ = load + resistance;<br>$V_0$ = terminal voltage; $I_{nom}$ = nominal current |

| | |
|---|---|
| **Current output** | |
| Output data | Flow |
| Settings | **Without HART®** |
| | Q = 0%: 0...20 mA; Q = 100%: 10...21.5 mA |
| | Error identification: 20...22 mA |
| | **With HART®** |
| | Q = 0%: 4...20 mA; Q = 100%: 10...21.5 mA |
| | Error identification: 3...22 mA |
| **Operating data** | **Basic I/O** |
| Active | Observe connection polarity. |
| | $V_{int, nom}$ = 20 VDC<br>I ≤ 22 mA<br>$R_L$ ≤ 750 Ω |
| | HART® at terminals A |
| Passive | Observe connection polarity. |
| | $V_{ext}$ ≤ 32 VDC<br>I ≤ 22 mA<br>$V_0$ ≤ 2 V at I = 22 mA<br>$R_{L, max} = (V_{ext} - V_0) / I_{max}$ |
| | HART® at terminals A |
| **HART®** | |
| Description | HART® protocol via active and passive current output |
| | HART® version: 5 |
| | Universal Common Practice HART® parameter: completely supported |
| Load | ≥ 230 Ω at HART® test point;<br>Note maximum load for current output! |
| Multi-drop mode | Yes, current output = 4 mA |
| | Multi-drop address adjustable in operation menu 1...15 |

| | |
|---|---|
| **Pulse output or frequency output** | |
| Output data | Flow |
| Function | Can be set as a pulse output 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/O + Modbus** |
| Active | This output is intended to drive mechanical or electronic counters directly. |
| | $V_{int, nom} \leq 20$ V<br>$R_V = 1$ kΩ<br>C = 1000 µF |
| | **High current mechanical counter**<br>$f_{max} \leq 1$ Hz |
| | **Low current mechanical counter**<br>I ≤ 20 mA<br>$R_L \leq 10$ kΩ for f ≤ 1 kHz<br>$R_L \leq 1$ kΩ for f ≤ 10 kHz<br>closed:<br>$V_0 \geq 12.5$ V at I = 10 mA<br>open:<br>I ≤ 0.05 mA at $V_{nom} = 20$ V |
| Passive | Independent of connection polarity. |
| | $V_{ext} \leq 32$ VDC |
| | $f_{max}$ in operating menu set to $f_{max} \leq 100$ Hz:<br>I ≤ 100 mA<br>open:<br>I ≤ 0.05 mA at $V_{ext} = 32$ VDC<br>closed:<br>$V_{0, max} = 0.2$ V at I ≤ 10 mA<br>$V_{0, max} = 2$ V at I ≤ 100 mA |
| | $f_{max}$ in operating menu set to 100 Hz < $f_{max} \leq 10$ kHz:<br>I ≤ 20 mA<br>open:<br>I ≤ 0.05 mA at $V_{ext} = 32$ VDC<br>closed:<br>$V_{0, max} = 1.5$ V at I ≤ 1 mA<br>$V_{0, max} = 2.5$ V at I ≤ 10 mA<br>$V_{0, max} = 5.0$ V at I ≤ 20 mA |

| | |
|---|---|
| **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 seconds. |
| | 0...100 seconds |
| **Status output / limit switch** | |
| Function 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/O + Modbus** |
| Passive | Independent of connection polarity. |
| | $V_{ext} \leq 32$ VDC<br><br>$I \leq 100$ mA<br><br>open:<br>$I \leq 0.05$ mA at $V_{ext} = 32$ VDC<br><br>closed:<br>$V_0 = 0.2$ V at $I \leq 10$ mA<br>$V_0 = 2$ V at $I \leq 100$ mA |
| **Modbus** | |
| Description | Modbus RTU, Master / Slave, RS485 |
| Address range | 1...247 |
| Broadcast | Supported with function code 16 |
| Supported Baud rate | 1200, 2400, 3600, 4800, 9600, 19200, 38400, 57600, 115200 Baud |

## Approvals and certificates

| | |
|---|---|
| Declaration of conformity | This device fulfils the statutory requirements of the relevant directives.<br>The manufacturer certifies successful testing of the product by applying the conformity mark on the device. |
| | For more information on the directives, standards and the approved certifications, please refer to the declaration of conformity supplied with the device or downloadable from the manufacturer's website. |
| **Marine certificate** | |
| EU RO MR Type Approval | Certificate mutually recognized by: ABS, BV, CCS, CRS, DNG-GL, IRS, KR, ClassNK, PRS, RINA, RS |
| | For certificate and details refer to the manufacturer website. |
| **Other standards and approvals** | |
| Vibration resistance | Tested according to IEC 60068-2-64 |
| NAMUR | NE 21, NE 43, NE 53 |

## 8.3 Dimensions and weight

### 8.3.1 Housing

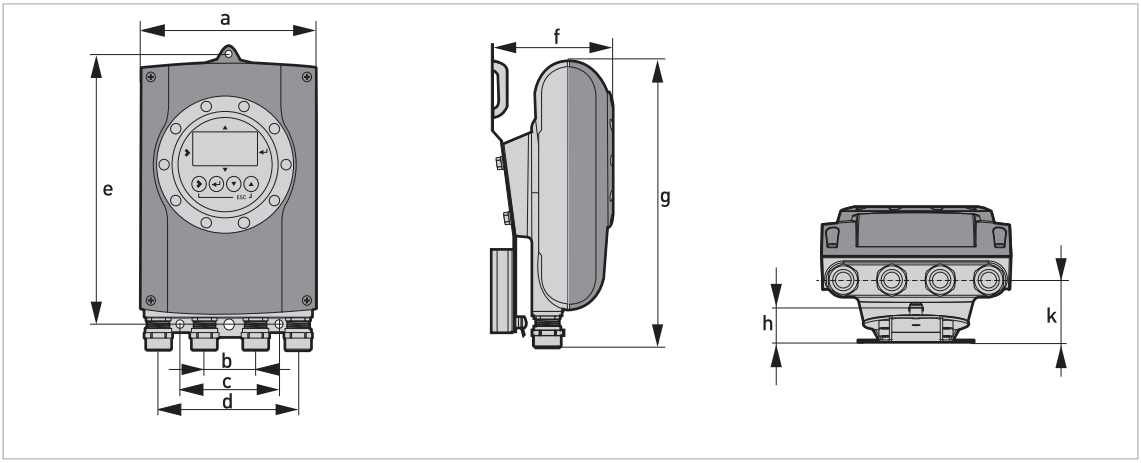



Figure 8-2: Dimensions of wall version

| | Dimensions [mm] | | | | | | | | | Weight [kg] |
|---|---|---|---|---|---|---|---|---|---|---|
| | a | b | c | d | e | f | g | h | k | |
| Version with & without display | 157 | 40 | 80 | 120 | 248 | 111.7 | 260 | 28.4 | 51.3 | 1.9 |

Table 8-1: Dimensions and weight in mm and kg

| | Dimensions [inch] | | | | | | | | | Weight [lb] |
|---|---|---|---|---|---|---|---|---|---|---|
| | a | b | c | d | e | f | g | h | k | |
| Version with & without display | 6.18 | 1.57 | 3.15 | 4.72 | 9.76 | 4.39 | 10.24 | 1.12 | 2.02 | 4.2 |

Table 8-2: Dimensions and weight in inch and lb

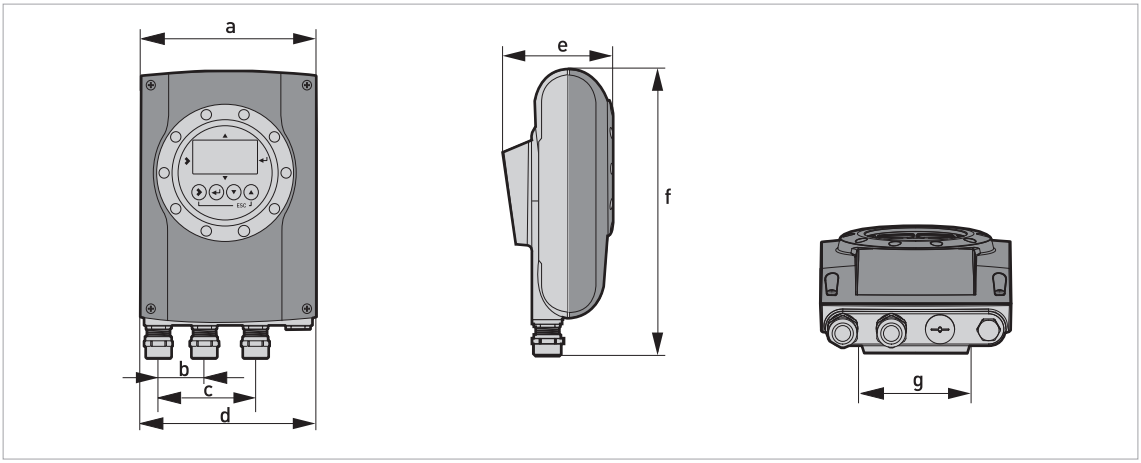



Figure 8-3: Dimensions of compact version

| | Dimensions [mm] | | | | | | | Weight [kg] |
|---|---|---|---|---|---|---|---|---|
| | a | b | c | d | e | f | g | |
| Version with & without display | 157 | 40 | 80 | 148.2 | 101 | 260 | 95.5 | 1.8 |

Table 8-3: Dimensions and weight in mm and kg

| | Dimensions [inch] | | | | | | | Weight [lb] |
|---|---|---|---|---|---|---|---|---|
| | a | b | c | d | e | f | g | |
| Version with & without display | 6.18 | 1.57 | 3.15 | 5.83 | 3.98 | 10.24 | 3.76 | 4.0 |

Table 8-4: Dimensions and weight in inch and lb

## 8.3.2 Mounting plate, wall version

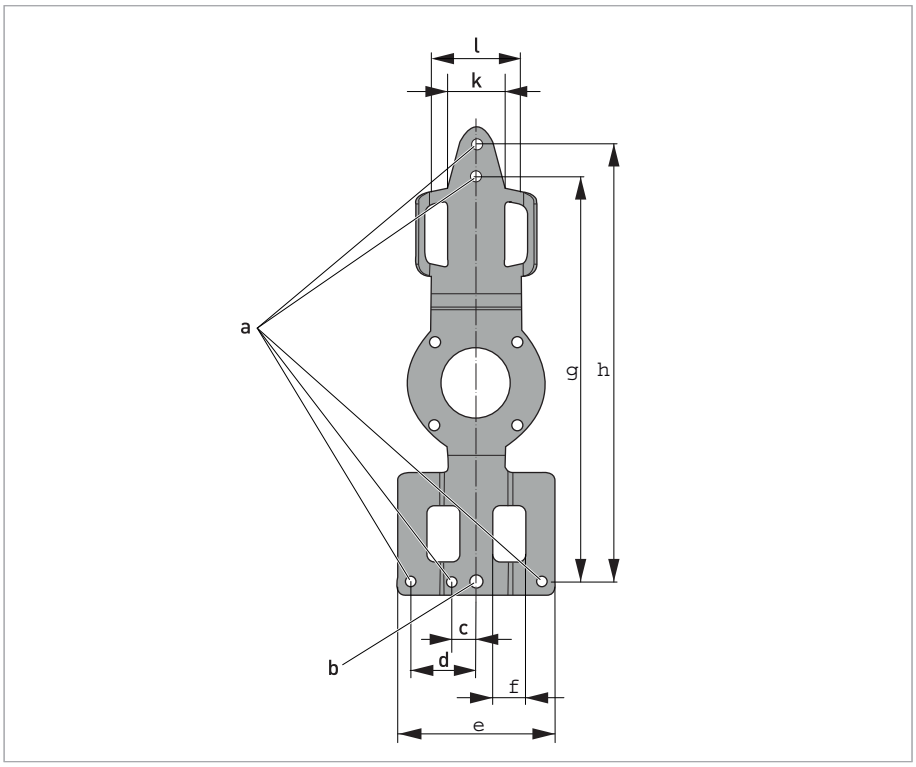



Figure 8-4: Dimensions of mounting plate, wall version

| | [mm] | [inch] |
|---|---|---|
| a | Ø6.5 | Ø0.26 |
| b | Ø8.1 | Ø0.3 |
| c | 15 | 0.6 |
| d | 40 | 1.6 |
| e | 96 | 3.8 |
| f | 20 | 0.8 |
| g | 248 | 9.8 |
| h | 268 | 10.5 |
| k | 35 | 1.4 |
| l | 55 | 2.2 |

Table 8-5: Dimensions in mm and inch

## 8.4 Flow tables

| | $Q_{100\ \%}$ in $m^3/h$ | | | |
|---|---|---|---|---|
| v [m/s] | 0.3 | 1 | 3 | 12 |
| DN [mm] | Minimum flow | Nominal flow | | Maximum 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 |

Table 8-6: Flow rate in m/s and $m^3/h$

| | $Q_{100\ \%}$ in US gallons/min | | | |
|---|---|---|---|---|
| v [ft/s] | 1 | 3.3 | 10 | 40 |
| NPS [inch] | Minimum flow | Nominal flow | | Maximum flow |
| 1/10 | 0.02 | 0.09 | 0.23 | 0.93 |
| 1/6 | 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 |

Table 8-7: Flow rate in ft/s and US gallons/min

## 9.1 General description

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

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

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

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

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

## 9.2 Software history

| Release date | Electronic revision (ER) | HART® | |
|---|---|---|---|
| | | Device revision | DD revision |
| 2012 | ER 3.0.x_ | 1 | 1 and up |
| 2021 | ER 3.1.x_ | 1 | 1 and up |

**Table 9-1: Software history for HART® interface**

| | |
|---|---|
| Manufacturer ID: | 69 (0x45) |
| Device Type Code: | 203 (0xCB) |
| Device revision: | 1 |
| DD revision: | 1 and up |
| HART® Universal Revision: | 5 |
| FDT version: | ≥ 1.2 |

**Table 9-2: HART® identification codes and revision numbers**

## 9.3 Connection variants

The signal converter is a 4-wire device which is available in a variant with 4...20 mA current output and HART® interface.
Depending on the version, the settings and the wiring, the current output can operate as passive or active output.

- Multi-drop mode is supported
  In a multi-drop communication system, more than 2 devices are connected to a common transmission cable.
- Burst mode is not supported
  In the Burst mode a slave device transfers cyclic pre-defined response telegrams, to get a higher rate of data transfer.



*INFORMATION!*

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

There are two ways of using the HART® communication:

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

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

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

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

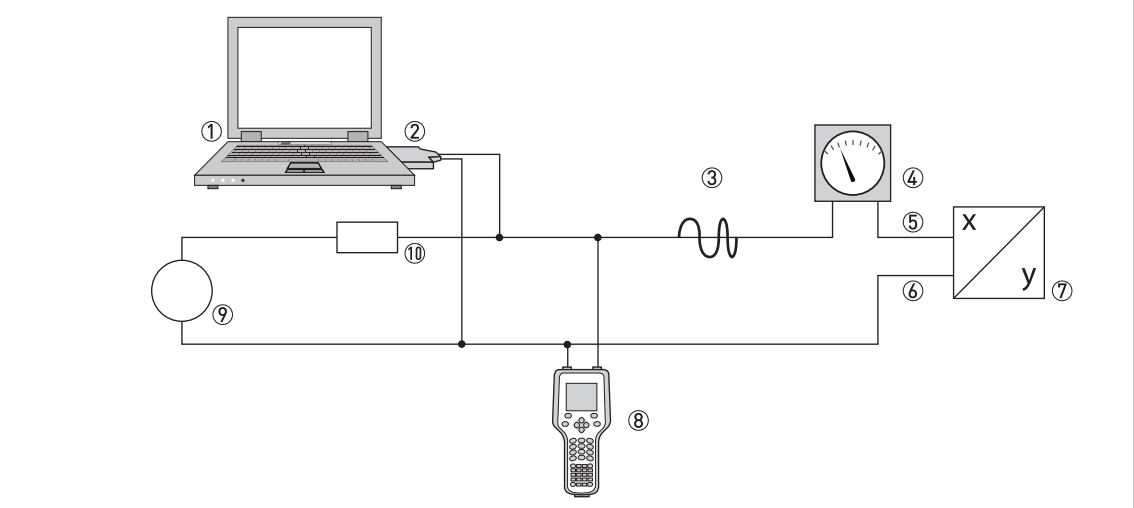



Figure 9-1: Point-to-Point connection

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

## 9.3.2 Multi-drop connection (2-wire connection)

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

The current outputs of the devices must be passive!

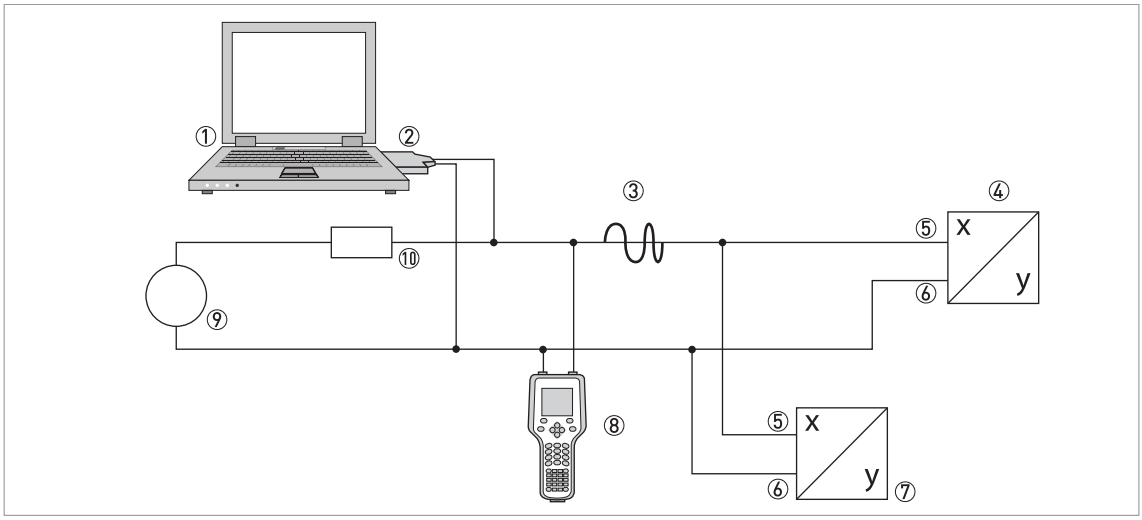



Figure 9-2: Multi-Drop connection (2-wire connection)

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

### 9.3.3 Multi-drop connection (3-wire connection)

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

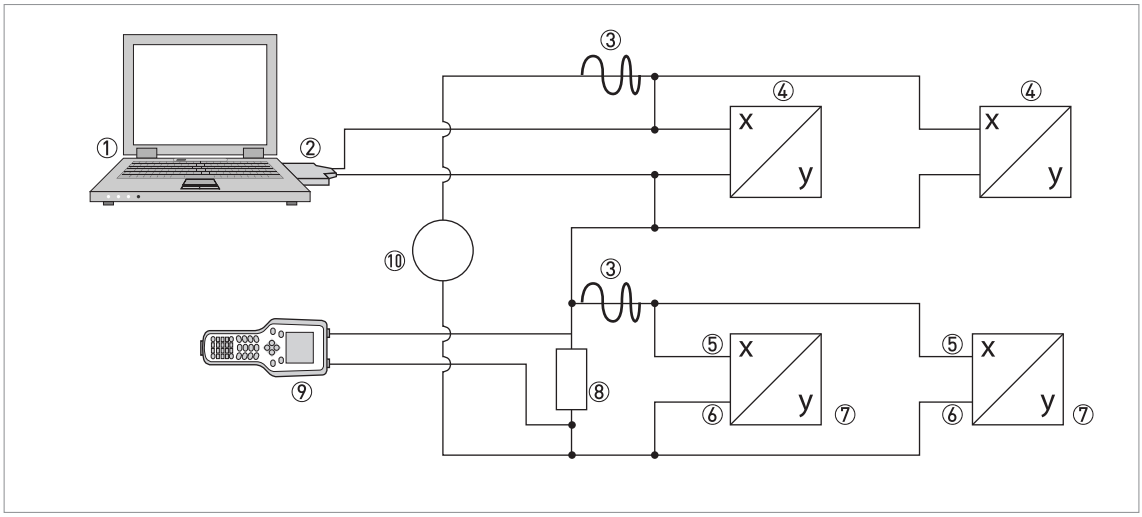



**Figure 9-3: Multi-Drop connection (3-wire connection)**

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

## 9.4 Inputs/outputs and HART dynamic variables and device variables

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

The connection of the terminals A and D to the HART® dynamic variables PV, SV, TV and 4V depends on the device version.

PV = Primary Variable; SV = Secondary Variable; TV = Third Variable; 4V = Fourth Variable

| Signal converter version | HART® dynamic variable | | | |
|---|---|---|---|---|
| | PV | SV | TV | 4V |
| Basic I/O, connection terminals | A | D | - | - |

**Table 9-3: Connection of the terminals to the HART® dynamic variables**

The signal converter can provide up to 8 measurement-related values. The measured values are accessible as so-called HART® device variables and can be connected to the HART® dynamic variables. The availability of these variables depends on the device versions and the settings.

Code = device variable code

| HART® device variable | Code | Type | Explanations |
|---|---|---|---|
| flow speed | 20 | Linear | - |
| volume flow | 21 | Linear | |
| mass flow | 22 | Linear | |
| conductivity | 24 | Linear | |
| coil temperature | 23 | Linear | |
| counter 1 | 6 | Counter | - |
| counter 2 | 14 | Counter | |
| diagnosis value | 25 | Linear | Function and availability depends on diagnosis value setting. |
| operating hours | 1 | Counter | - |

**Table 9-4: Description of the HART® device variables**

For the dynamic variables connected to the linear analogue outputs for current and/or frequency, the assignment of the device variables takes place by selecting the linear measurement for these outputs under the appropriate function of the signal converter. It follows that the dynamic variables connected to current or frequency outputs can only be assigned to the linear HART® device variables.

The HART® dynamic variable PV is always connected to the HART® current output which is, for example, assigned to the volume flow.

A totaliser device variable can thus not be assigned to the dynamic variable PV because the PV is always connected to the HART® current output.

Such correlations do not exist for dynamic variables not connected to linear analogue outputs. Both linear and totaliser device variables can be assigned.

The totaliser device variables can only be assigned to the dynamic variables SV, TV and 4V if the connected output is not a current or frequency output.



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