MFC 300 Handbook

Signal converter for mass flowmeters

Electronic revision:
ER 3.3.xx
(SW.REV. 3.4x)

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

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1.1 Software History

The "Electronic Revision" (ER) is consulted to document the revision status of electronic equipment according to NE 53 for all GDC 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.

Changes and effect on compatibility

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

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

Release date	Electronic Revision	Changes and compatibility	Documentation
2006-11-06	ER 3.1.0x (SW.REV. 3.10 (2.21))	-	-
2006-12-12	ER 3.1.1x (SW.REV. 3.11 (2.21))	1; 2-P; 2-M	MA MFC 300 R02
2007-02-07	ER 3.1.2x (SW.REV. 3.11 (2.21))	1; 2-M	MA MFC 300 R02
2007-03-12	ER 3.1.3x (SW.REV. 3.11 (2.21))	1; 2-H	MA MFC 300 R02
2007-06-27	ER 3.1.4x (SW.REV. 3.11 (2.22))	1	MA MFC 300 R02
2007-04-02	ER 3.2.0x (SW.REV. 3.20 (2.22))	1; 2-X; 2-P; 2-F	MA MFC 300 R02
2007-05-04	ER 3.2.1x (SW.REV. 3.20 (2.22))	1	MA MFC 300 R02
2007-05-25	ER 3.2.2x (SW.REV. 3.20 (2.22))	1; 3-I	MA MFC 300 R02

Release date	Electronic Revision	Changes and compatibility	Documentation
2007-06-27	ER 3.2.3x (SW.REV. 3.20 (2.22))	1	MA MFC 300 R02
2007-07-16	ER 3.2.4x (SW.REV. 3.20 (2.22))	1; 2-F	MA MFC 300 R02
2008-08-01	ER 3.3.0x (SW.REV. 3.30 (3.02))	1; 2-X; 4	MA MFC 300 R02
2008-08-25	ER 3.3.1x (SW.REV. 3.30 (3.03))	1	MA MFC 300 R02
2008-10-23	ER 3.3.2x (SW.REV. 3.30 (3.03))	2-M	MA MFC 300 R02
2009-05-13	ER 3.3.3x (SW.REV. 3.30 (3.03))	2-F	MA MFC 300 R02
2009-10-29	ER 3.3.4x (SW.REV. 3.30 (3.03))	1	MA MFC 300 R02
2009-12-07	ER 3.3.5x (SW.REV. 3.30 (3.03))	2-F; 2-X	MA MFC 300 R02
2011-03	ER 3.3.6x (SW.REV. 3.40 (3.04))	1; 2-F	MA MFC 300 R02
2011-06	ER 3.3.7x (SW.REV. 3.40 (3.04))	1	MA MFC 300 R03

1.2 Intended Use

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

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

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

1.3 Certifications

CE marking

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

- Low Voltage Directive 2006/95/EC
- EMC Directive 2004/108/EC

as well as

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

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

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

1.4 Safety instructions from the manufacturer

1.4.1 Copyright and data protection

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

1.4.2 Disclaimer

The manufacturer will not be liable for any damage of any kind by using its product, including, but not limited to direct, indirect 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 and operation of the devices (systems) will cause the warranty to be void. The respective "Standard Terms and Conditions" which form the basis for the sales contract shall also apply.

1.4.4 Information concerning the documentation

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

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

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

1.4.5 Warnings and symbols used

Safety warnings are indicated by the following symbols.

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

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

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

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

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

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

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

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

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

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

1.5 Safety instructions for the operator

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

2.1 Scope of delivery

INFORMATION!
Inspect the cartons carefully for 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.

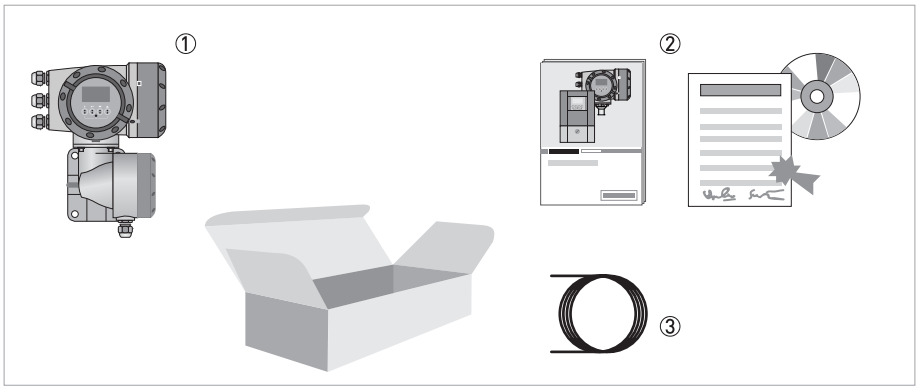


Figure 2-1: Scope of delivery

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

Signal converter / measuring sensor combination possibilities

Measuring sensor	Signal converter MFC 300			
	Compact	Remote field housing	Remote wall-mounted housing	Remote rack-mounted housing
OPTIMASS 1000	OPTIMASS 1300 C	OPTIMASS 1300 F	OPTIMASS 1300 W	OPTIMASS 1300 R
OPTIMASS 2000	OPTIMASS 2300 C	OPTIMASS 2300 F	OPTIMASS 2300 W	OPTIMASS 2300 R
OPTIMASS 3000	OPTIMASS 3300 C	OPTIMASS 3300 F	OPTIMASS 3300 W	OPTIMASS 3300 R
OPTIMASS 7000	OPTIMASS 7300 C	OPTIMASS 7300 F	OPTIMASS 7300 W	OPTIMASS 7300 R
OPTIMASS 8000	OPTIMASS 8300 C	OPTIMASS 8300 F	OPTIMASS 8300 W	OPTIMASS 8300 R

2.2 Device description

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

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

The following versions are available:

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

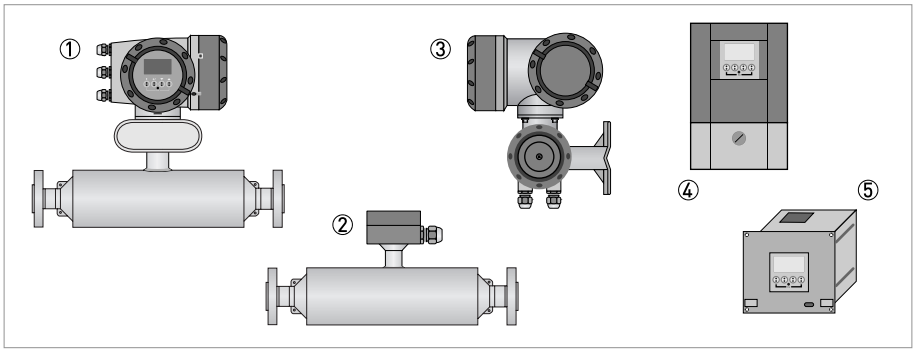


Figure 2-2: Device versions

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

2.2.1 Field housing

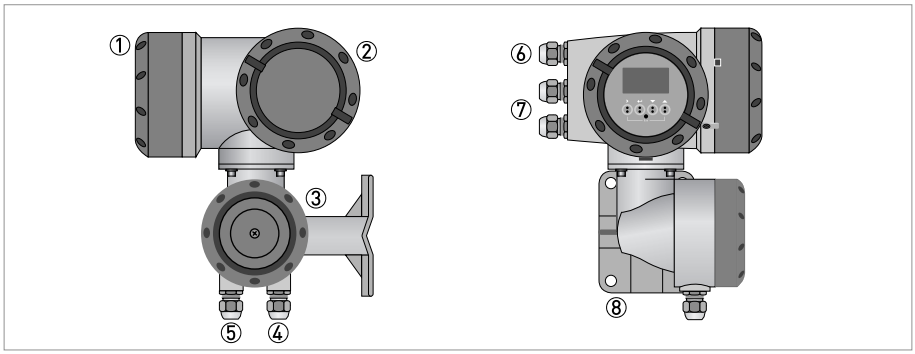


Figure 2-3: Construction of the field housing

① Cover for electronics and display
② Cover for power supply and inputs/outputs terminal compartment
③ Cover for measuring sensor terminal compartment with locking screw
④ Cable entry for measuring sensor signal cable
⑤ Cable entry for measuring sensor field current cable
⑥ Cable entry for power supply
⑦ Cable entry for inputs and outputs
⑧ Mounting plate for pipe and wall mounting

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

2.2.2 Wall-mounted housing

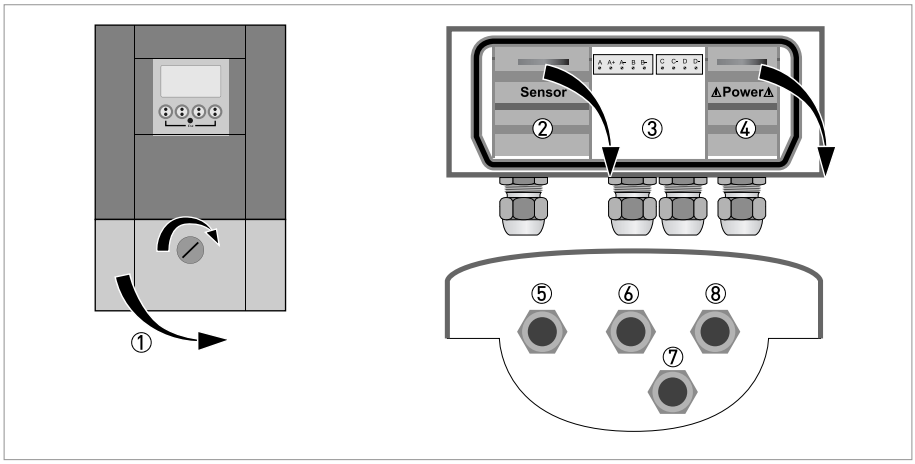


Figure 2-4: Construction of wall-mounted housing

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

① Turn lock to the right and open the cover.

2.3 Nameplates

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

2.3.1 Compact version (example)

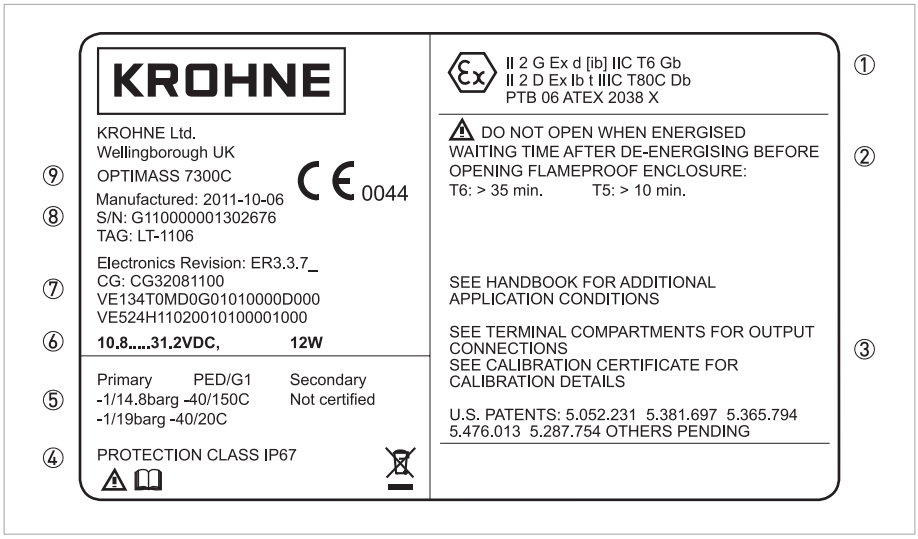


Figure 2-5: Example of nameplate for the compact version

① Approvals-related information: Ex approval, EC type test certificate, hygienic approvals, etc.
② Approvals-related thresholds
③ Additional information on documentation, calibration and patents
④ Protection category
⑤ Approvals-related pressure and temperature thresholds
⑥ Electrical connection data
⑦ Software and hardware revision (Electronics Revision), CG number, order number for signal converter and measuring sensor
⑧ Manufacturing date, serial number and TAG number
⑨ Product description

2.3.2 Remote version (example)

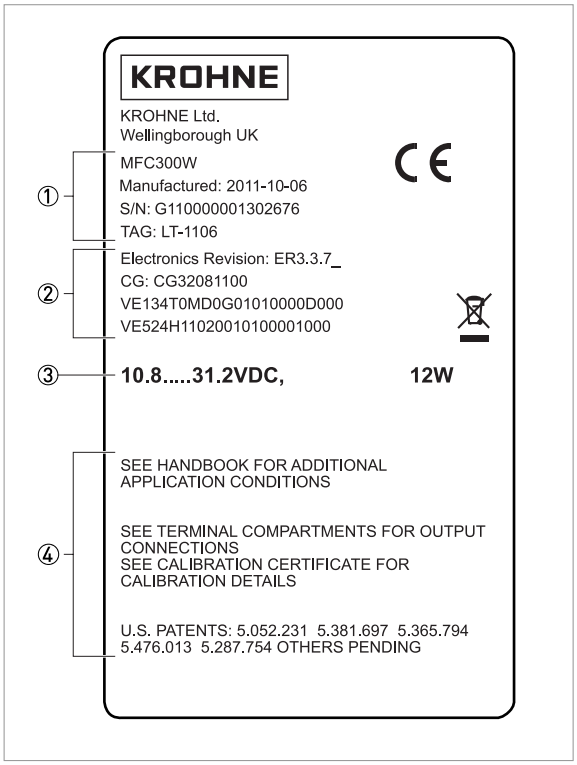


Figure 2-6: Example of a nameplate for the remote version

① Product designation, manufacturing date, serial number and TAG number
② Software and hardware revision (Electronics Revision), CG number, order number for signal converter and measuring sensor
③ Electrical connection data
④ Additional information on documentation, calibration and patents

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

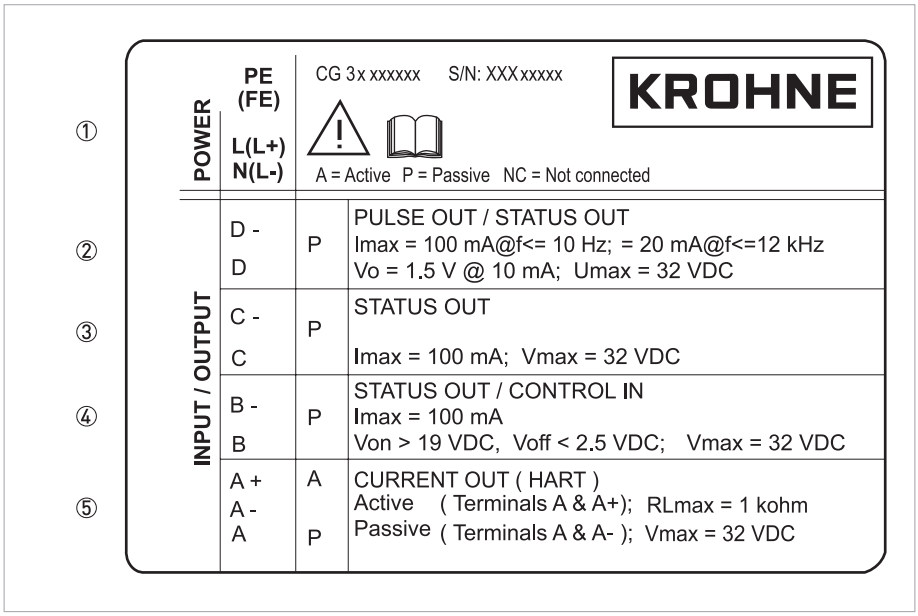


Figure 2-7: Example of a nameplate for electrical connection data of inputs and outputs

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

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

3.1 Notes on installation

INFORMATION!
Inspect the cartons carefully for 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: -50...+70°C / -58...+158°F

3.3 Transport

Signal converter

- No special requirements.

Compact version

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

3.4 Installation specifications

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

- *Make sure that there is adequate space to the sides.*
- *Protect the signal converter from direct sunlight and install a sun shade if necessary.*
- *Signal converters installed in control cabinets require adequate cooling, e.g. by fan or heat exchanger.*
- *Do not expose the signal converter to intense vibration. The flowmeters are tested for a vibration level in accordance with IEC 68-2-3.*

3.5 Mounting of the compact version

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

3.6 Mounting the field housing, remote version

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

3.6.1 Pipe mounting

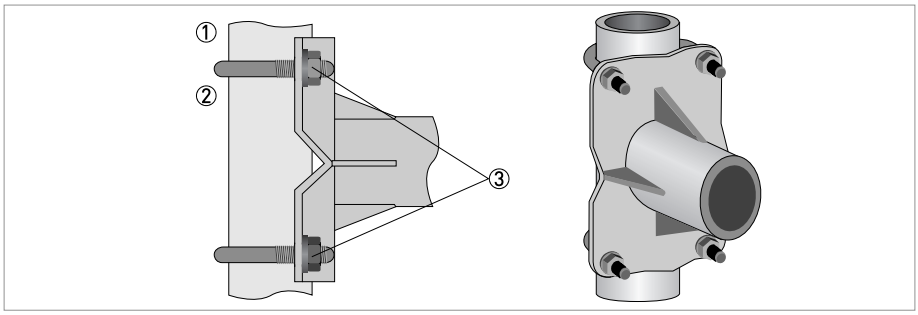


Figure 3-1: Pipe mounting of the field housing

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

3.6.2 Wall mounting

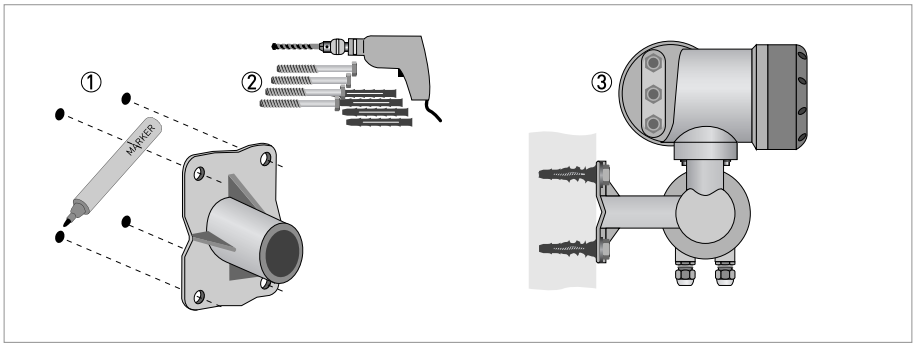
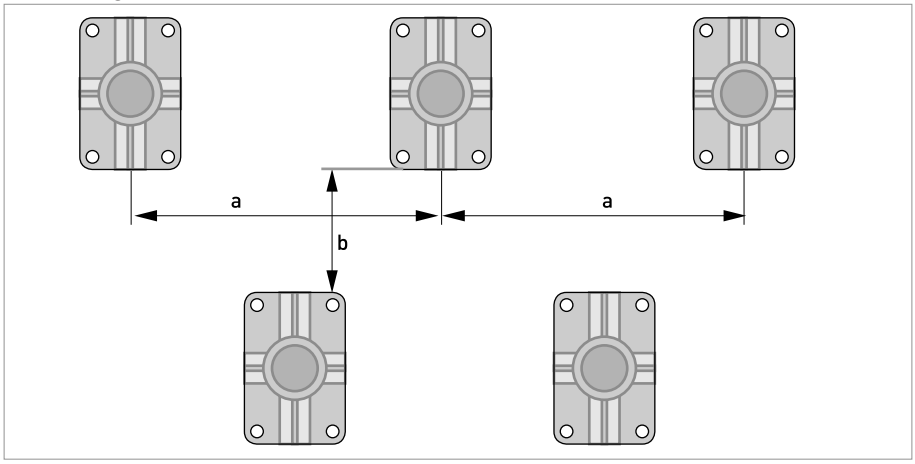


Figure 3-2: Wall mounting of the field housing

① Prepare the holes with the aid of the mounting plate. For further information refer to *Mounting plate, field housing* on page 146.
② Use the mounting material and tools in compliance with the applicable occupational health and safety directives.
③ Fasten the housing securely to the wall.

Mounting multiple devices next to each other



a ≥ 600 mm / 23.6"
b ≥ 250 mm / 9.8"

3.6.3 Turning the display of the field housing version

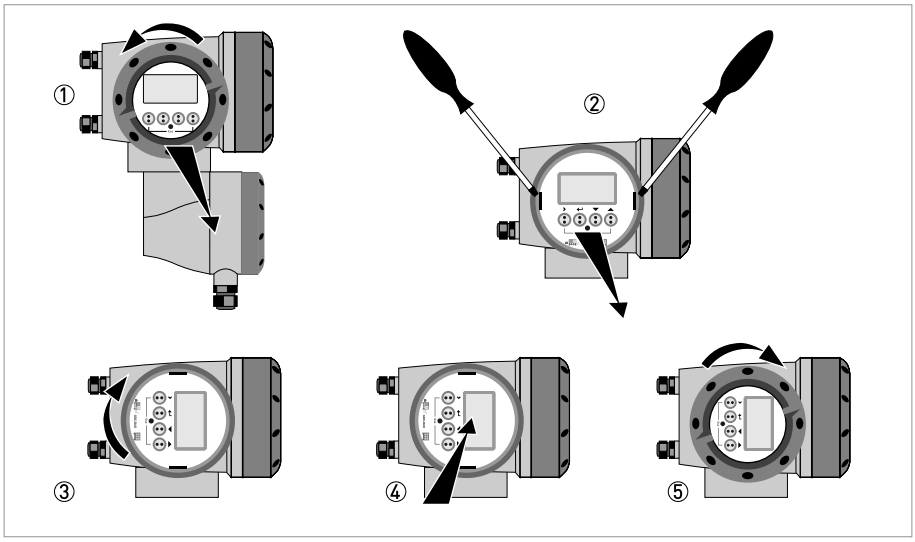


Figure 3-3: Turning the display of the field housing version

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

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

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

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

3.7 Mounting the wall-mounted housing, remote version

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

3.7.1 Pipe mounting

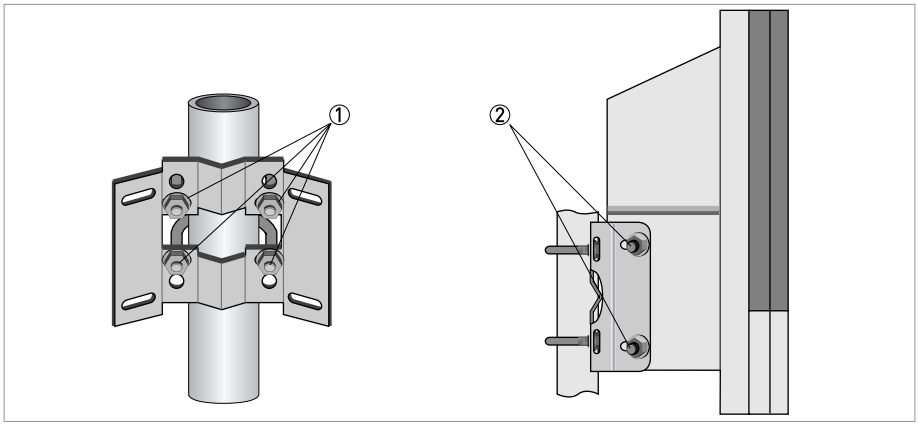


Figure 3-4: Pipe mounting of the wall-mounted housing

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

3.7.2 Wall mounting

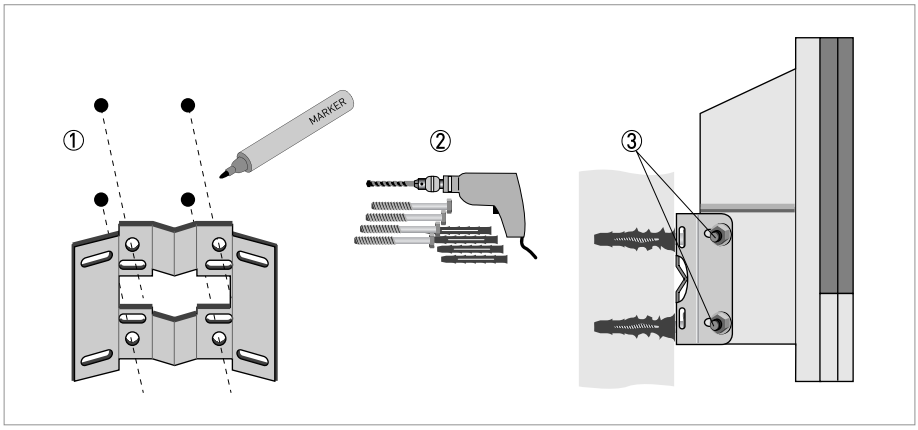
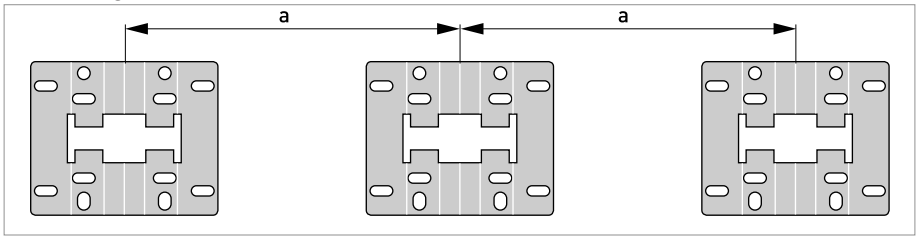


Figure 3-5: Wall mounting of the wall-mounted housing

① Prepare the holes with the aid of the mounting plate. For further information refer to *Mounting plate, wall-mounted housing* on page 146.
② Fasten the mounting plate securely to the wall.
③ Screw the signal converter to the mounting plate with the nuts and washers.

Mounting multiple devices next to each other



a ≥ 240 mm / 9.4"

4.1 Safety instructions

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

DANGER!
Observe the national regulations for electrical installations!

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

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

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

4.2 Important notes on electrical connection

DANGER!
Electrical connection is carried out in conformity with the VDE 0100 directive "Regulations for electrical power installations with line voltages up to 1000 V" or equivalent national regulations.

CAUTION!
- *Use suitable cable entries for the various electrical cables.*
- *The measuring sensor and signal converter have been configured together at the factory. For this reason, please connect the devices in pairs.*

4.3 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:

Specifications for standard signal cables

- 2 twisted double wire circuits
- 20 AWG twisted, tinned copper conductors (19 mm / 0.2")
- Completely tinned copper shielding
- Casing colour: grey
- Colour of wires:
  Pair 1: black / red
  Pair 2 : green / white
- Test voltage: ≥ 500 VAC RMS (750 VDC)
- Temperature range: -20...+105°C / -4...+221°F
- Capacity: ≤ 200 pF/m / 61 pF/ft
- Inductance: ≤ 0.7 µH/m / 0.2 µH/ft

Specifications for cables in hazardous areas

- 2 shielded twisted double wire circuits
- 20 AWG twisted, tinned copper conductors (19 mm / 0.2")
- Casing colour: blue
- Colour of wires:
  Pair 1: black / red
  Pair 2 : green / white
- Test voltage: ≥ 500 VAC RMS (750 VDC)
- Temperature range: -20...+105°C / -4...+221°F
- Capacity: ≤ 200 pF/m / 61 pF/ft
- Inductance: ≤ 0.7 µH/m / 0.2 µH/ft

4.4 Connecting the signal cables

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

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

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

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

4.4.1 Connection of signal cable, field housing

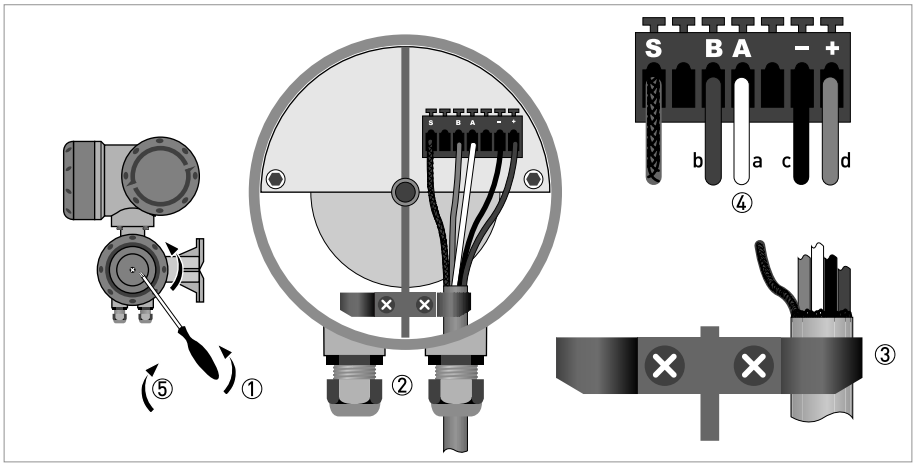


Figure 4-1: Electrical connection of the signal cables, field housing

a = white
b = green
c = black
d = red

① Remove the locking screw and open the housing cover.
② Pass the prepared signal cable through the cable entry.
③ Secure the signal cable using the clip.
④ Connect the electrical conductors as shown. The shielding is connected to terminal S.
⑤ Close the housing cover and secure it with the locking screw.

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

4.4.2 Connection of signal cable, wall-mounted housing

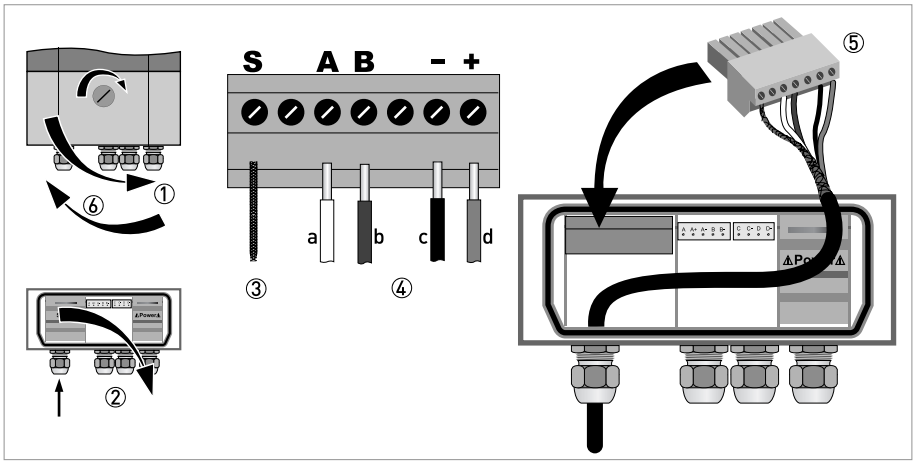


Figure 4-2: Electrical connection of signal cable, wall-mounted housing

a = white
b = green
c = black
d = red

① Open the housing cover.
② Open the cover and guide the prepared signal cable through the cable entry.
③ Connect the twisted shielding to terminal S.
④ Connect the electrical conductors to terminals +, -, A, B.
⑤ Press the plug into the connector.
⑥ Close the cover and the housing cover.

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

4.4.3 Connection of signal cable, 19" rack-mounted housing

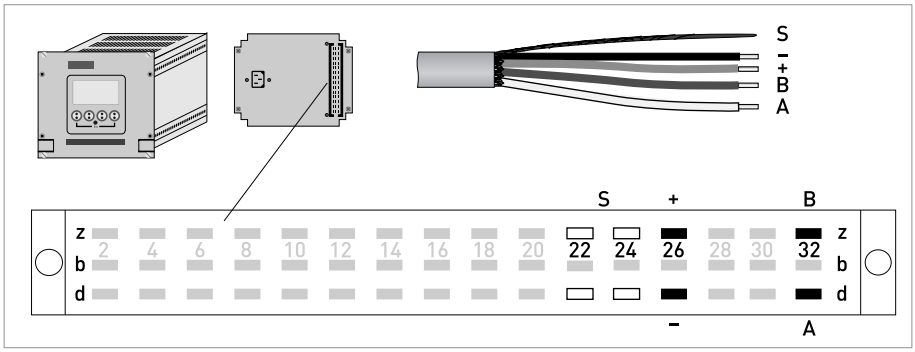


Figure 4-3: Electrical connection of signal cable, 19" rack-mounted housing

- Connect the conductor to the multipolar plug according to the illustration.
- The shielding of the signal cable can be connected to 22z, 22d, 24z or 24d.
- Press the plug into the connector.

4.4.4 Connection box of measuring sensor

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

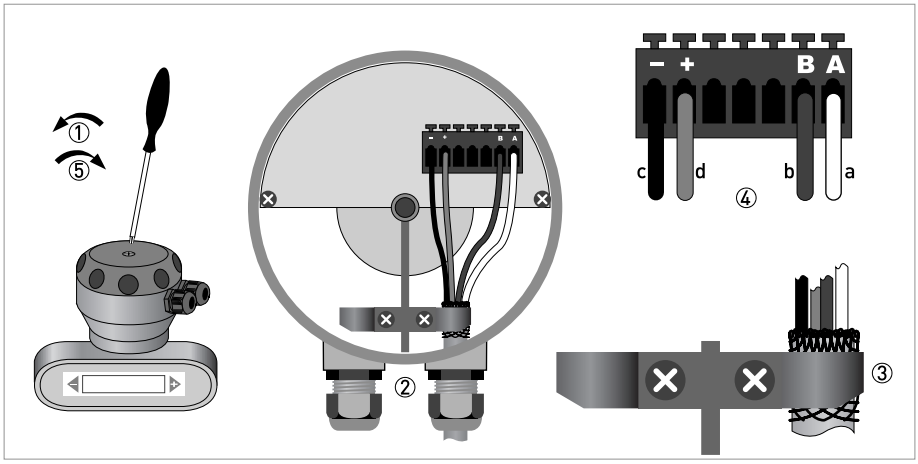


Figure 4-4: Electrical connection to connection box of the sensor

a = white
b = green
c = black
d = red

① Remove the locking screw and open the housing cover.
② Pass the prepared signal cable through the cable entry.
③ Secure the signal cable using the spring terminal. The shielding **MUST** also be connected to the spring terminal.
④ Connect the electrical conductors as shown.
⑤ Close the housing cover and secure it with the locking screw.

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

4.4.5 Connection diagram

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

Wall housing

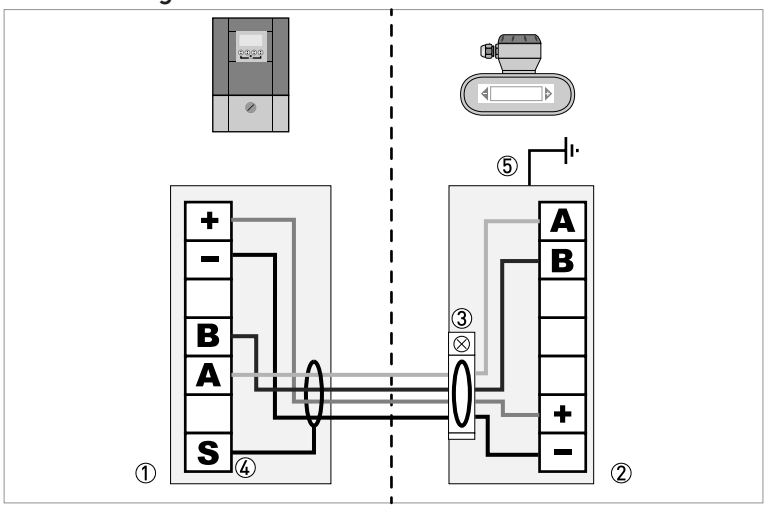


Figure 4-5: Connection diagram for remote versions, wall housing

① Terminal compartment for signal converter
② Terminal compartment for measuring sensor
③ Connect shielding to spring terminal
④ Connect shielding to terminal S
⑤ Functional ground

Field housing

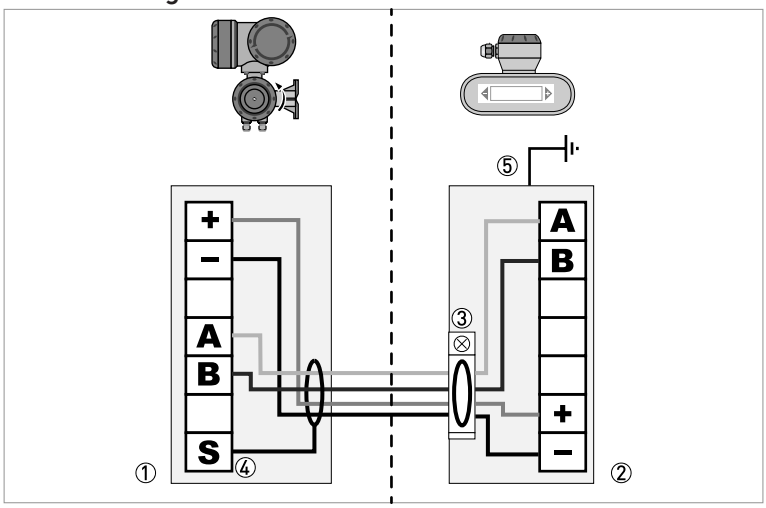


Figure 4-6: Connection diagram for remote versions, field housing

① Terminal compartment for signal converter
② Terminal compartment for measuring sensor
③ Connect shielding to spring terminal
④ Connect shielding to terminal S
⑤ Functional ground

19" rack-mounted housing

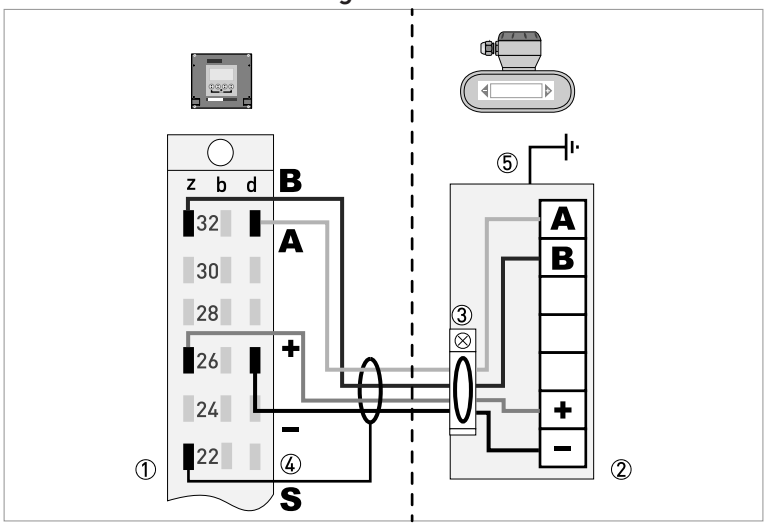


Figure 4-7: Connection diagram for remote versions, 19" rack-mounted housing

① Terminal compartment for signal converter
② Terminal compartment for measuring sensor
③ Connect shielding to spring terminal
④ Connect shielding to terminal S
(The shielding can be connected to 22z, 22d, 24z or 24d)
⑤ Functional ground

4.5 Grounding the measuring sensor

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

- The measuring sensor must be properly grounded.
- The grounding cable should not transmit any interference voltages.
- Do not use the grounding cable to connect more than one device to ground.
- The measuring sensors are connected to ground by means of a functional grounding conductor FE.
- In hazardous areas, grounding is used at the same time for equipotential bonding. Additional grounding instructions are provided in the separate "Ex documentation", which are only supplied together with hazardous area equipment.

4.6 Connecting power, all housing variants

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

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

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

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

- Note the power supply voltage and frequency (50...60 Hz) on the nameplate.
- The protective ground terminal PE of the power supply must be connected to the separate U-clamp terminal in the terminal compartment of the signal converter
  For the 19" rack-mounted housing please refer to the connection diagrams.

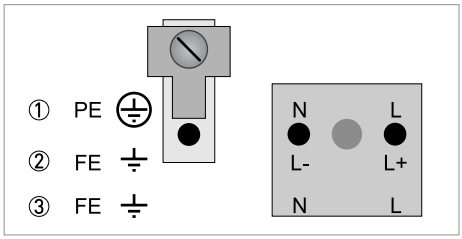
INFORMATION!
240 VAC+5% is included in the tolerance range.

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

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

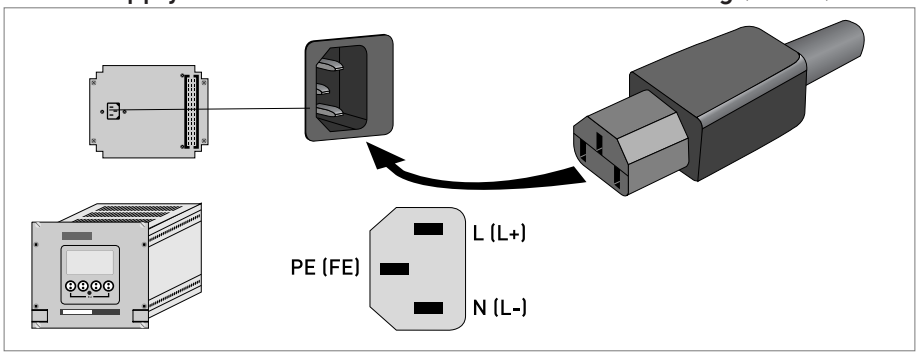
INFORMATION!
For 24 VDC, 12 VDC-10% is included in the tolerance range.

Power supply connection (excluding 19" rack-mounted housing)



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

Power supply connection for 19" rack-mounted housing (28 TE)



4.7 Inputs and outputs, overview

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

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

Basic version

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

Ex i version

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

Modular version

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

Bus systems

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

Ex option

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

4.7.2 Description of the CG number

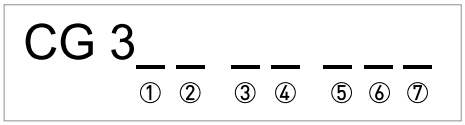


Figure 4-8: Marking (CG number) of the electronics module and input/output variants

① ID number: 2
② ID number: 0 = standard; 9 = special
③ Power supply option
④ Display (language versions)
⑤ Input/output version (I/O)
⑥ 1st optional module for connection terminal A
⑦ 2nd optional module for connection terminal B

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

Examples for CG number

CG 320 11 100	100...230 VAC & standard display; basic I/O: I_a or I_p & S_p/C_p & S_p & P_p/S_p
CG 320 11 7FK	100...230 VAC & standard display; modular I/O: I_a & P_N/S_N and optional module P_N/S_N & C_N
CG 320 81 4EB	24 VDC & standard display; modular I/O: I_a & P_a/S_a and optional module P_p/S_p & I_p

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

Abbreviation	Identifier for CG No.	Description
I_a	A	Active current output
I_p	B	Passive current output
P_a / S_a	C	Active pulse output, frequency output, status output or limit switch (changeable)
P_p / S_p	E	Passive pulse output, frequency output, status output or limit switch (changeable)
P_N / S_N	F	Passive pulse output, frequency output, status output or limit switch acc. to NAMUR (changeable)
C_a	G	Active control input
C_p	K	Passive control input
C_N	H	Active control input to NAMUR Signal converter monitors cable breaks and short circuits acc. to EN 60947-5-6. Errors indicated on LC display. Error messages possible via status output.
IIn_a	P	Active current input
IIn_p	R	Passive current input
-	8	No additional module installed
-	0	No further module possible

4.7.3 Fixed, non-alterable input/output versions

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

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

CG no.	Connection terminals								
	A+	A	A-	B	B-	C	C-	D	D-
Basic I/Os (standard)									
1 0 0		I_p + HART® passive ①		S_p / C_p passive ②		S_p passive		P_p / S_p passive ②	
	I_a + HART® active ①								
Ex i IOs (option)									
2 0 0						I_a + HART® active		P_N / S_N NAMUR ②	
3 0 0						I_p + HART® passive		P_N / S_N NAMUR ②	
2 1 0		I_a active		P_N / S_N NAMUR C_p passive ②		I_a + HART® active		P_N / S_N NAMUR ②	
3 1 0		I_a active		P_N / S_N NAMUR C_p passive ②		I_p + HART® passive		P_N / S_N NAMUR ②	
2 2 0		I_p passive		P_N / S_N NAMUR C_p passive ②		I_a + HART® active		P_N / S_N NAMUR ②	
3 2 0		I_p passive		P_N / S_N NAMUR C_p passive ②		I_p + HART® passive		P_N / S_N NAMUR ②	
PROFIBUS PA (Ex i) (option)									
D 0 0						PA+	PA-	PA+	PA-
						FISCO Device		FISCO Device	
D 1 0		I_a active		P_N / S_N NAMUR C_p passive ②		PA+	PA-	PA+	PA-
						FISCO Device		FISCO Device	
D 2 0		I_p passive		P_N / S_N NAMUR C_p passive ②		PA+	PA-	PA+	PA-
						FISCO Device		FISCO Device	

FOUNDATION Fieldbus (Ex i) (option)

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

① function changed by reconnecting
② changeable

4.7.4 Alterable input/output versions

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

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

CG no.	Connection terminals								
	A+	A	A-	B	B-	C	C-	D	D-
Modular IOs (option)									
4 _ _		max. 2 optional modules for term. A + B				I_a + HART® active		P_a / S_a active ①	
8 _ _		max. 2 optional modules for term. A + B				I_p + HART® passive		P_a / S_a active ①	
6 _ _		max. 2 optional modules for term. A + B				I_a + HART® active		P_p / S_p passive ①	
B _ _		max. 2 optional modules for term. A + B				I_p + HART® passive		P_p / S_p passive ①	
7 _ _		max. 2 optional modules for term. A + B				I_a + HART® active		P_N / S_N NAMUR ①	
C _ _		max. 2 optional modules for term. A + B				I_p + HART® passive		P_N / S_N NAMUR ①	
PROFIBUS PA (option)									
D _ _		max. 2 optional modules for term. A + B				PA+ (2)	PA- (2)	PA+ (1)	PA- (1)
FOUNDATION Fieldbus (option)									
E _ _		max. 2 optional modules for term. A + B				V/D+ (2)	V/D- (2)	V/D+ (1)	V/D- (1)
PROFIBUS DP (option)									
F _ 0		1 optional module for term. A		Terminati on P	RxD/TxD-P(2)	RxD/TxD-N(2)	Terminati on N	RxD/TxD-P(1)	RxD/TxD-N(1)
Modbus (option)									
G _ _ ②		max. 2 optional modules for term. A + B					Common	Sign. B (D1)	Sign. A (D0)
H _ _ ③		max. 2 optional modules for term. A + B					Common	Sign. B (D1)	Sign. A (D0)

① changeable
② not activated bus terminator
③ activated bus terminator

4.8 Description of the inputs and outputs

4.8.1 Current output

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

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

INFORMATION!
For further information refer to Connection diagrams of inputs and outputs on page 49 and refer to *Technical data on page 134*.

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

4.8.2 Pulse and frequency output

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

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

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

INFORMATION!
For further information refer to Connection diagrams of inputs and outputs on page 49 and refer to *Technical data on page 134*.

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

4.8.3 Status output and limit switch

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

- The status outputs / limit switches are electrically isolated from each other and from all other circuits.
- The output stages of the status outputs/limit switches during simple active or passive operation behave like relay contacts and can be connected with any polarity.
- All operating data and functions can be adjusted.
- Passive mode: external power supply required:
  $U_{ext} \leq 32$ VDC; $I \leq 100$ mA
- Active mode: use of the internal power supply:
  $U_{nom} = 24$ VDC; $I \leq 20$ mA
- NAMUR mode: passive in accordance with EN 60947-5-6
- For information on the adjustable operating states refer to *Function tables* on page 79.

INFORMATION!
For further information refer to Connection diagrams of inputs and outputs on page 49 and refer to *Technical data on page 134*.

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

4.8.4 Control input

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

- All control inputs are electrically isolated from each other and from all other circuits.
- All operating data and functions can be adjusted.
- Passive mode: external power supply required:
  $U_{ext} \leq 32$ VDC
- Active mode: use of the internal power supply:
  $U_{nom} = 24$ VDC
- NAMUR mode: in accordance with EN 60947-5-6
  (Active control input to NAMUR EN 60947-5-6: signal converter monitors cable breaks and short circuits acc. to EN 60947-5-6. Errors indicated on LC display. Error messages possible via status output.
- For information on the adjustable operating states refer to *Function tables* on page 79.

INFORMATION!
For further information refer to Connection diagrams of inputs and outputs on page 49 and refer to *Technical data on page 134*.

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

4.9 Electrical connection of the inputs and 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.

4.9.1 Field housing, electrical connection of the inputs and outputs

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

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

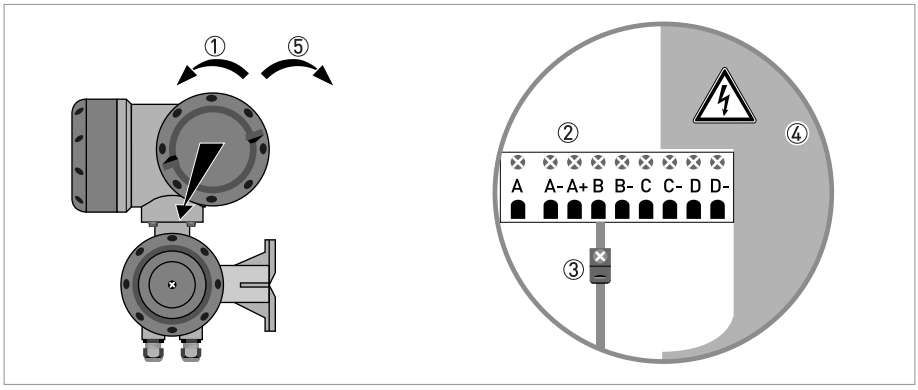


Figure 4-9: Terminal compartment for inputs and outputs in field housing

① Open the housing cover.
② Push the prepared cable through the cable entry and connect the necessary conductors.
③ Connect the shield if necessary.
④ Close the touch guard.
⑤ Close the housing cover.

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

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

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

INFORMATION!
Use shielded cables for frequencies above 100 Hz. The electrical connection of the shielding must take place using 6.3 mm / 0.25" blade receptacles (insulation as per DIN 46 245) in the I/O terminal compartment.

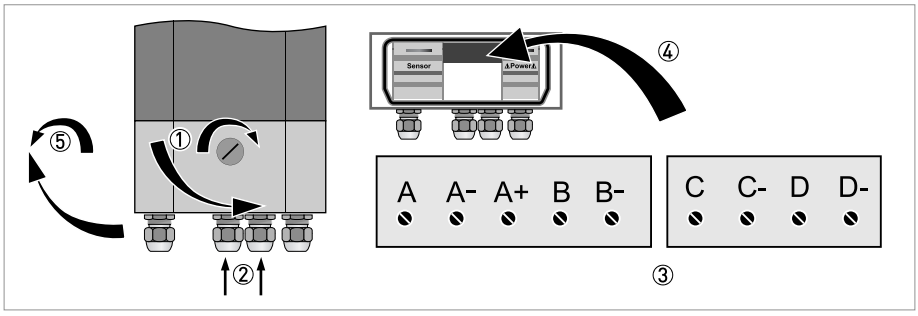


Figure 4-10: Terminal compartment for inputs and outputs in wall-mounted housing

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

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

4.9.3 19" rack-mounted housing (28 TE), electrical connection of the inputs and outputs

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

- For frequencies above 100 Hz, shielded cables are to be used in order to reduce effects from electrical interferences (EMC).
- Terminal A+ is only operable in the basic version.

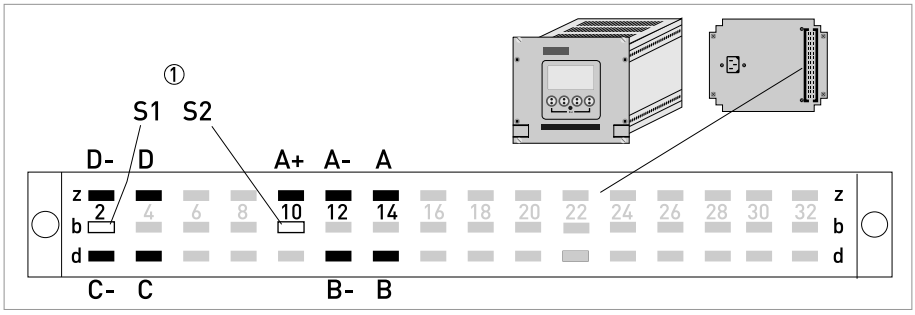


Figure 4-11: Terminal compartment for inputs and outputs in rack-mounted housing

① Shielding

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

4.9.4 Laying electrical cables correctly

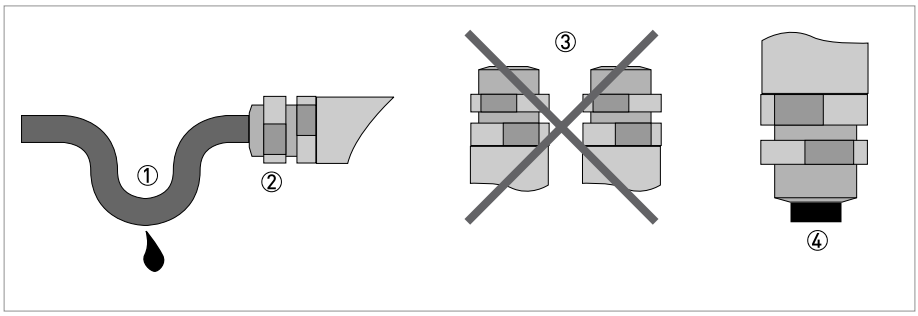


Figure 4-12: Protect housing from dust and water

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

4.10 Connection diagrams of inputs and outputs

4.10.1 Important notes

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

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

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

Description of the used abbreviations

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

4.10.2 Description of the electrical symbols

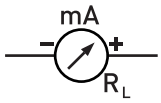
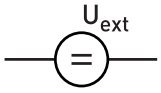
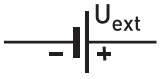
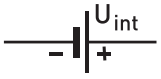
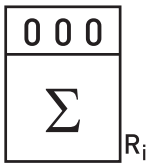
	mA meter 0...20 mA or 4...20 mA and other R_L is the internal resistance of the measuring point including the cable resistance
	DC voltage source (U_{ext}), external power supply, any connection polarity
	DC voltage source (U_{ext}), observe connection polarity according to connection diagrams
	Internal DC voltage source
	Controlled internal power source in the device
	Electronic or electromagnetic counter At frequencies above 100 Hz, shielded cables must be used to connect the counters. R_i Internal resistance of the counter
	Button, NO contact or similar

Table 4-1: Description of symbols

4.10.3 Basic inputs/outputs

CAUTION!
Observe connection polarity.

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

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

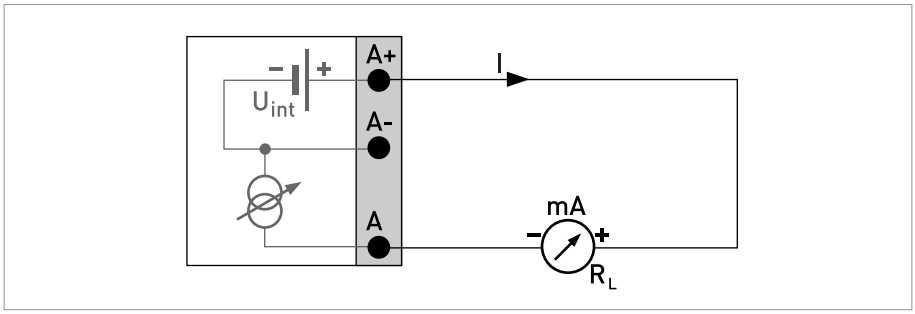


Figure 4-13: Current output active I_a

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

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

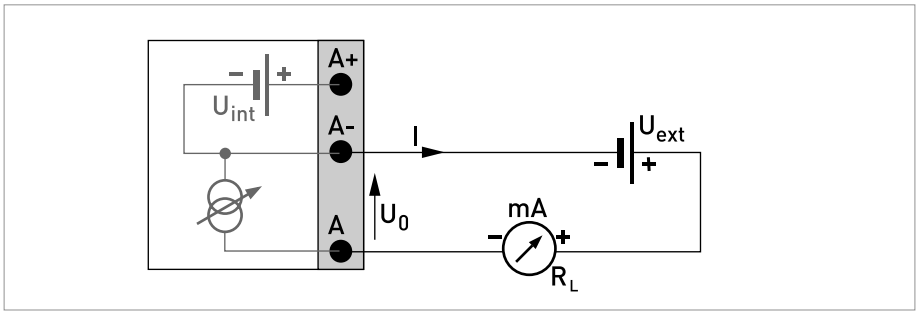


Figure 4-14: Current output passive I_p

INFORMATION!

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

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

Pulse/frequency output passive, basic I/Os

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

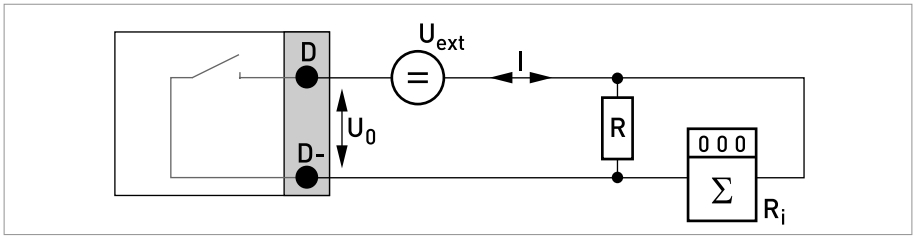


Figure 4-15: Pulse/frequency output passive P_p

INFORMATION!
- *Any connection polarity.*

Status output / limit switch passive, basic I/Os

- $U_{ext} \leq 32$ VDC
- $I \leq 100$ mA
- $R_{L, max} = 47\ k\Omega$
  $R_{L, min} = (U_{ext} - U_0) / I_{max}$
- open:
  $I \leq 0.05$ mA at $U_{ext} = 32$ VDC
  closed:
  $U_{0, max} = 0.2$ V at $I \leq 10$ mA
  $U_{0, max} = 2$ V at $I \leq 100$ mA
- The output is open when the device is de-energized.
- X stands for the terminals B, C or D. The functions of the connection terminals depend on the settings refer to *Function tables* on page 79.

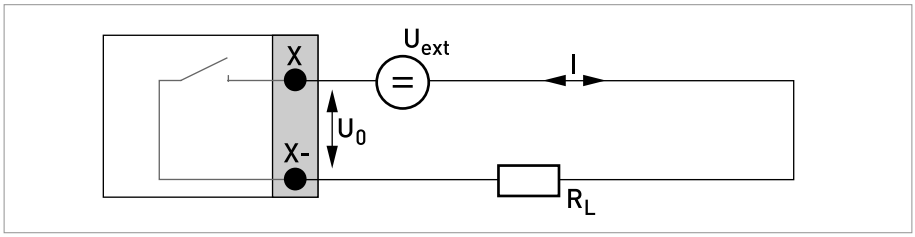


Figure 4-16: Status output / limit switch passive S_p

Control input passive, basic I/Os

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

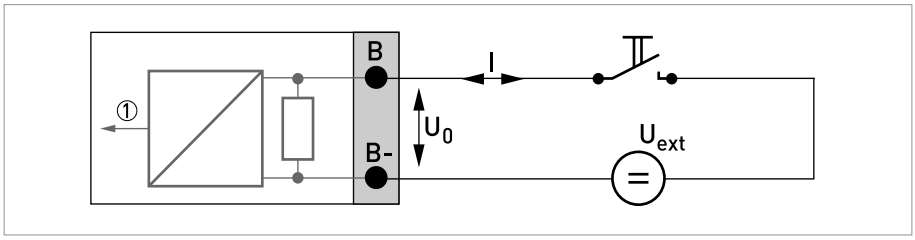


Figure 4-17: Control input passive C_p

① Signal

4.10.4 Modular inputs/outputs and bus systems

CAUTION!
Observe connection polarity.

INFORMATION!
- *For further information on electrical connection refer to Description of the inputs and outputs on page 42.*
- *For the electrical connection of bus systems, please refer to the separate documentation for the respective bus systems.*

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

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

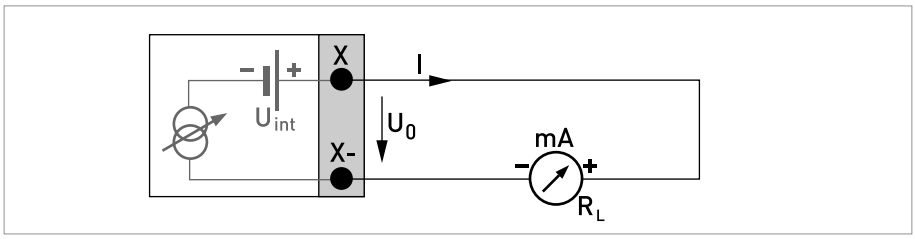


Figure 4-18: Current output active I_a

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

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

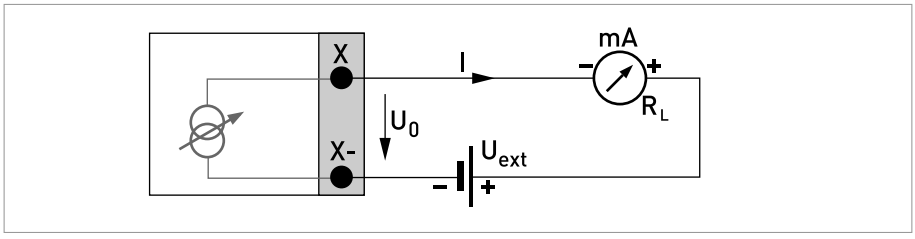


Figure 4-19: Current output passive I_p

INFORMATION!

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

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

Pulse/frequency output active, modular I/Os

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

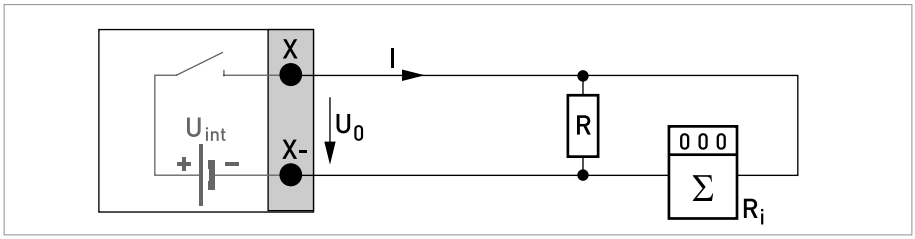


Figure 4-20: Pulse / frequency output active P_a

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

Pulse/frequency output passive, modular I/Os

- $U_{ext} \leq 32$ VDC
- f_{max} in the operating menu set to $f_{max} \leq 100$ Hz:
  $I \leq 100$ mA
  open:
  $I \leq 0.05$ mA at $U_{ext} = 32$ VDC
  closed:
  $U_{0, max} = 0.2$ V at $I \leq 10$ mA
  $U_{0, max} = 2$ V at $I \leq 100$ mA
- f_{max} in operating menu set to 100 Hz < $f_{max} \leq 10$ kHz:
  open:
  $I \leq 0.05$ mA at $U_{ext} = 32$ VDC
  closed:
  $U_{0, max} = 1.5$ V at $I \leq 1$ mA
  $U_{0, max} = 2.5$ V at $I \leq 10$ mA
  $U_{0, max} = 5$ V at $I \leq 20$ mA
- If the following maximum load impedance $R_{L, max}$ is exceeded, the load impedance R_L must be reduced accordingly by parallel connection of R:
  $f \leq 100$ Hz: $R_{L, max} = 47$ kΩ
  $f \leq 1$ kHz: $R_{L, max} = 10$ kΩ
  $f \leq 10$ kHz: $R_{L, max} = 1$ kΩ
- The minimum load impedance $R_{L, min}$ is calculated as follows:
  $R_{L, min} = (U_{ext} - U_0) / I_{max}$
- Can also be set as status output; refer to status output connection diagram.
- X designates the connection terminals A, B or D, depending on the version of the signal converter.

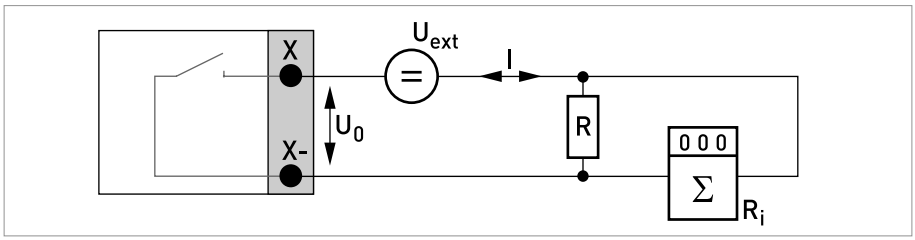


Figure 4-21: Pulse frequency output passive P_p

INFORMATION!

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

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

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

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

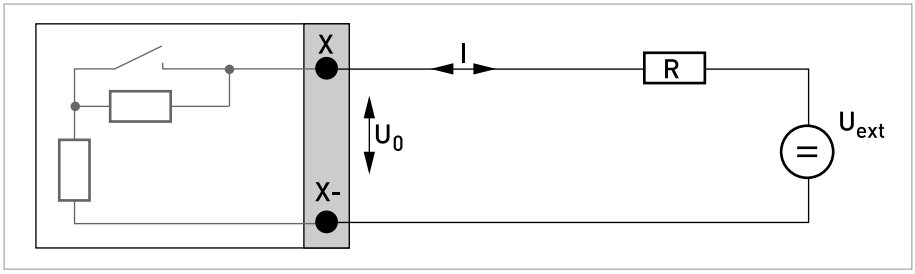


Figure 4-22: Pulse and frequency output passive P_N to NAMUR EN 60947-5-6

Status output / limit switch active, modular I/Os

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

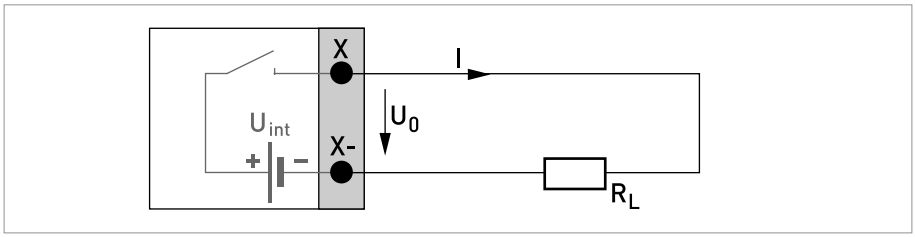


Figure 4-23: Status output / limit switch active S_a

Status output / limit switch passive, modular I/Os

- Any connection polarity.
- U_{ext} = 32 VDC
- I ≤ 100 mA
- $R_{L, max}$ = 47 kΩ
  $R_{L, min} = (U_{ext} - U_0) / I_{max}$
- open:
  I ≤ 0.05 mA at U_{ext} = 32 VDC
  closed:
  $U_{0, max}$ = 0.2 V at I ≤ 10 mA
  $U_{0, max}$ = 2 V at I ≤ 100 mA
- The output is open when the device is de-energized.
- X designates the connection terminals A, B or D, depending on the version of the signal converter.

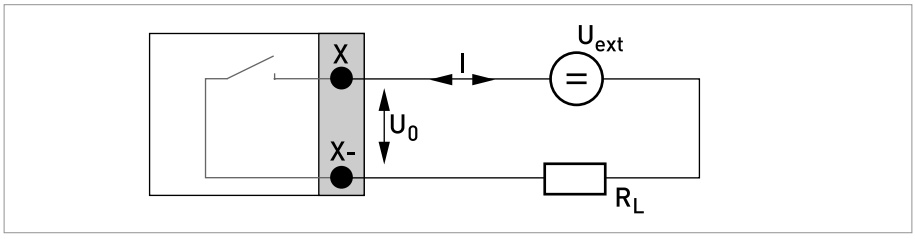


Figure 4-24: Status output / limit switch passive S_p

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

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

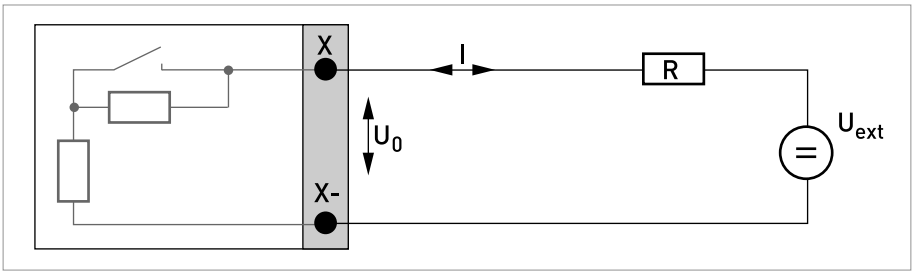


Figure 4-25: Status output / limit switch S_N to NAMUR EN 60947-5-6

CAUTION!
Observe connection polarity.

Control input active, modular I/Os

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

Control input passive, modular I/Os

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

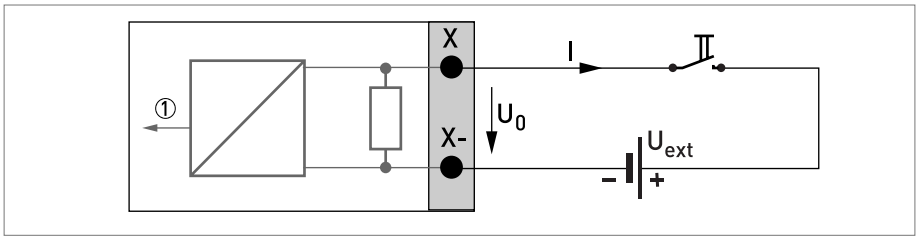


Figure 4-26: Control input passive C_p

① Signal

CAUTION!
Observe connection polarity.

Control input active C_N NAMUR, modular I/Os

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

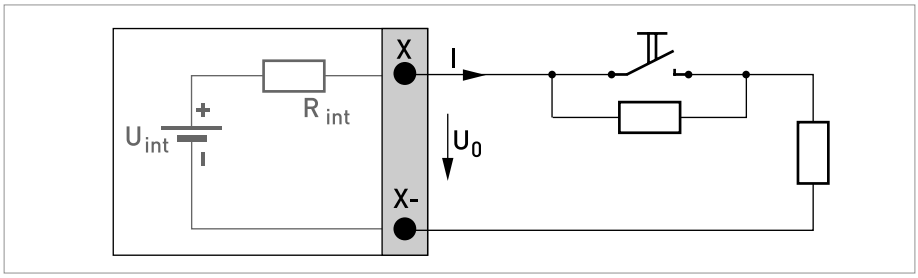


Figure 4-27: Control input active C_N to NAMUR EN 60947-5-6

4.10.5 Ex i inputs/outputs

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

INFORMATION!
For further information on electrical connection refer to Description of the inputs and outputs on page 42.

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

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

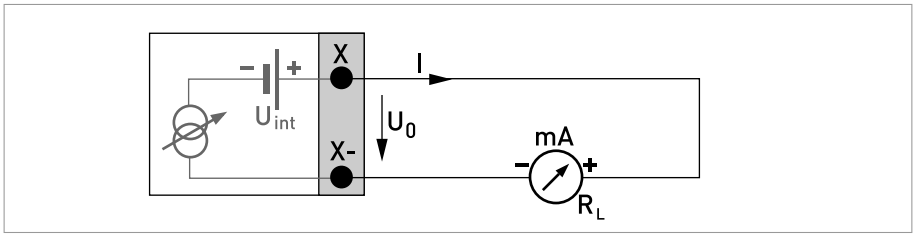


Figure 4-28: Current output active I_a Exi

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

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

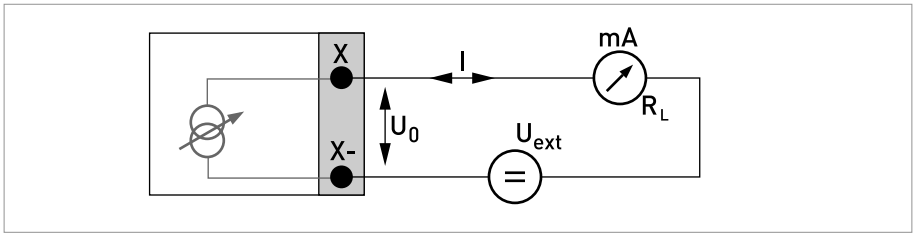


Figure 4-29: Current output passive I_p Exi

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

INFORMATION!

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

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

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

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

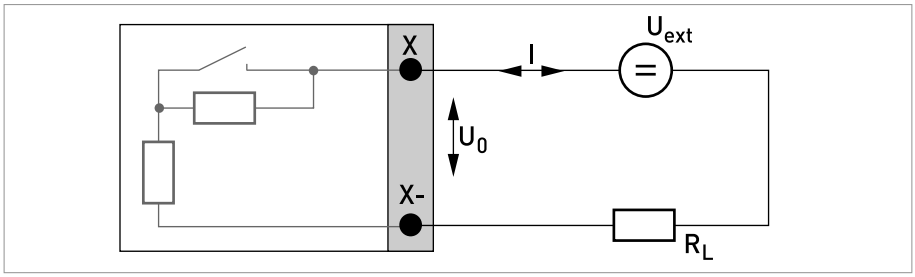


Figure 4-30: Pulse and frequency output passive P_N as per NAMUR EN 60947-5-6 Exi

INFORMATION!

- *Any connection polarity.*

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

- Connection acc. to EN 60947-5-6
- open:
  I_{nom} = 0,43 mA
  closed:
  I_{nom} = 4,5 mA
- The output is closed when the device is de-energized.
- X designates the connection terminals B or D, depending on the version of the signal converter.

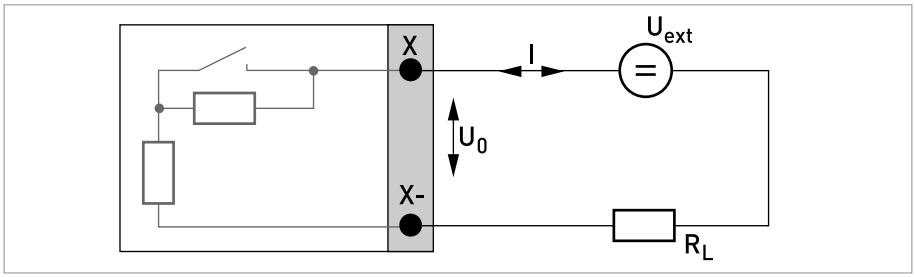


Figure 4-31: Status output/limit switch S_N to NAMUR EN 60947-5-6 Exi

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

INFORMATION!
- *Any connection polarity.*

Control input passive, Ex i I/Os

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

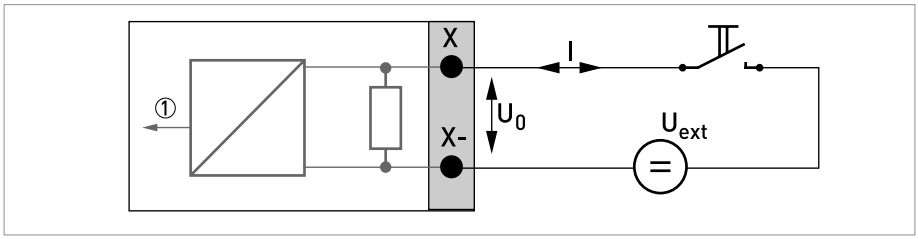


Figure 4-32: Control input passive C_p Exi

① Signal

4.10.6 HART® connection

INFORMATION!

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

HART® connection active (point-to-point)

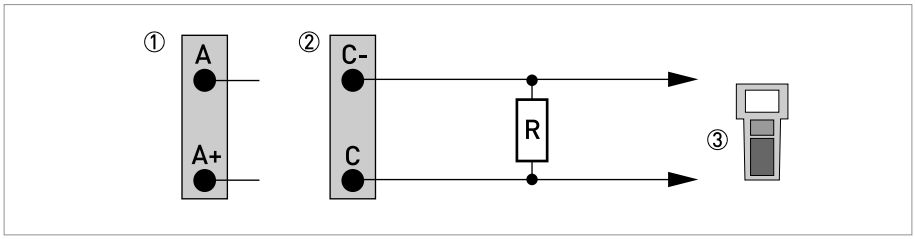


Figure 4-33: HART® connection active (I_a)

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

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

HART® connection passive (Multi-Drop mode)

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

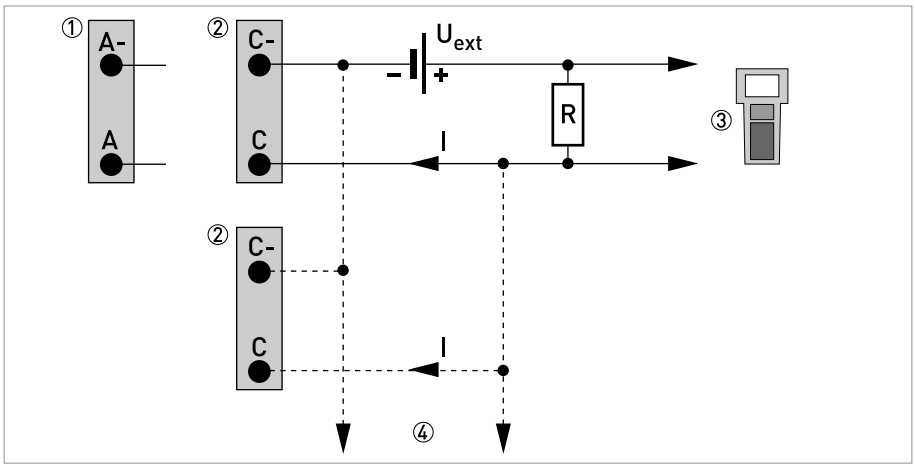


Figure 4-34: HART® connection passive (I_p)

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

5.1 Switching on the power

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

- The device must be mechanically safe and mounted in compliance with the regulations.
- The power connections must have been made in compliance with the regulations.
- The electrical terminal compartments must be secured and the covers have been screwed on.
- Check that the electrical operating data of the power supply are correct.

- Switching on the power.

5.2 Starting the signal converter

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

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

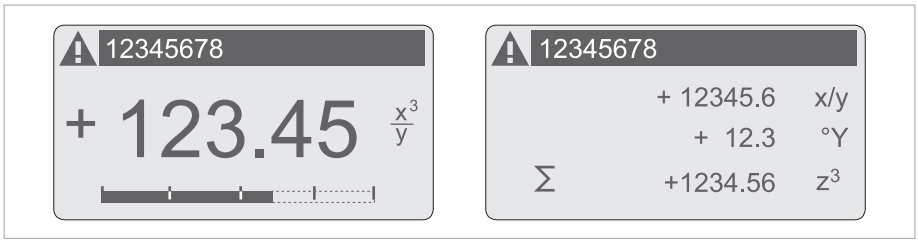


Figure 5-1: Displays in measuring mode (examples for 2 or 3 measured values)
x, y and z denote the units of the measured values displayed

It is possible to change between the two measured value windows, the trend display and the list with the status messages by pressing the keys ↑ and ↓. For information about possible status messages, their meaning and cause refer to *Status messages and diagnostic information* on page 113.

6.1 Display and operating elements

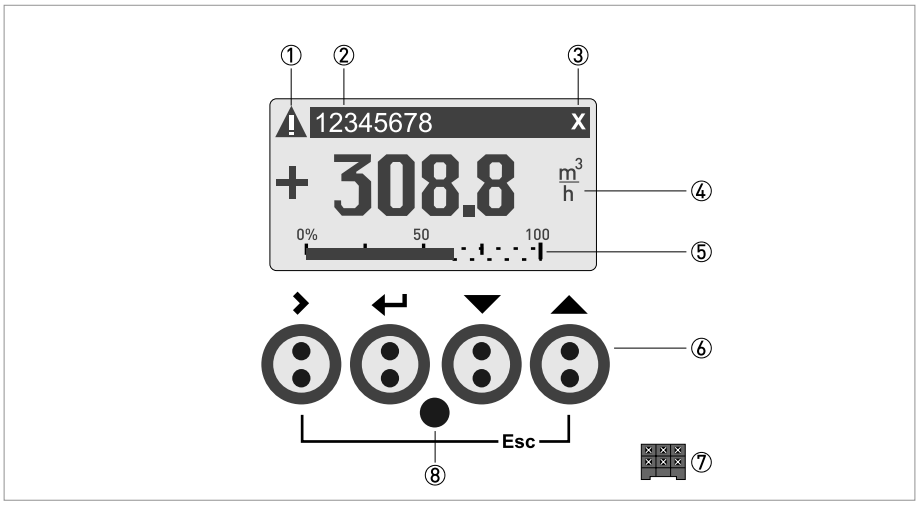


Figure 6-1: Display and operating elements (Example: flow indication with 2 measuring values)

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

CAUTION!
The use of a jumper is only permitted for custody transfer devices to lock the access to custody transfer relevant parameters. For non custody transfer devices (i.e. process instruments) this jumper must not be used!

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

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

Table 6-1: Description of key functionality

6.1.1 Display in measuring mode with 2 or 3 measured values

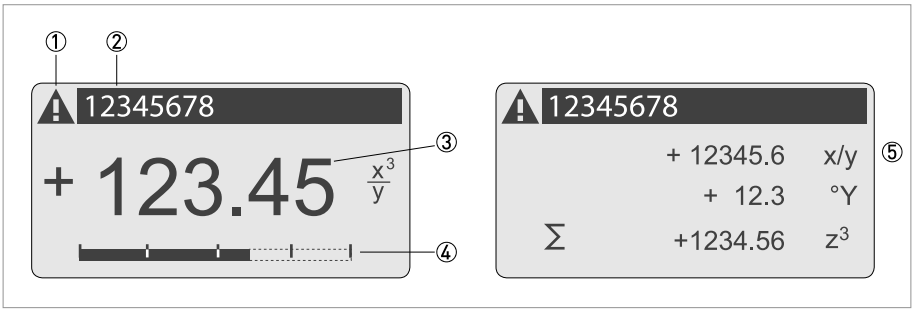


Figure 6-2: Example for display in measuring mode with 2 or 3 measured values

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

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

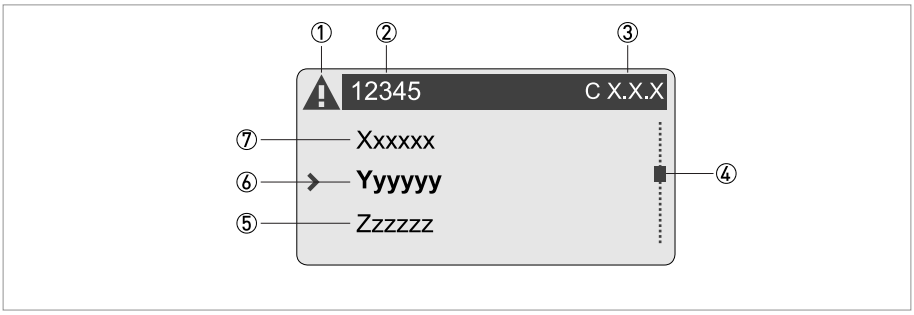


Figure 6-3: Display for selection of sub-menu and functions, 3 lines

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

6.1.3 Display when setting parameters, 4 lines

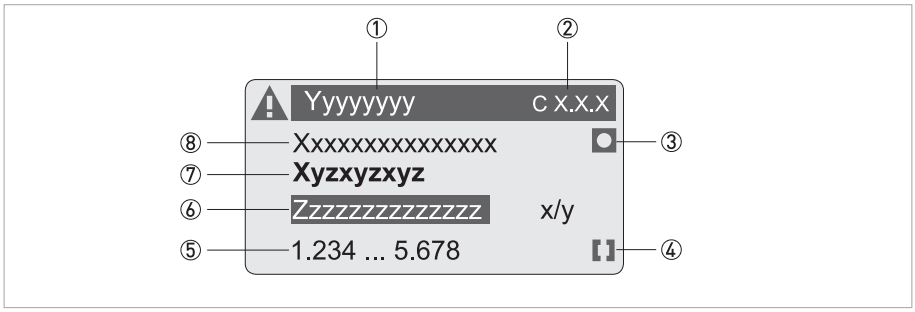


Figure 6-4: Display when setting parameters, 4 lines

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

6.1.4 Display when changing parameters, 4 lines

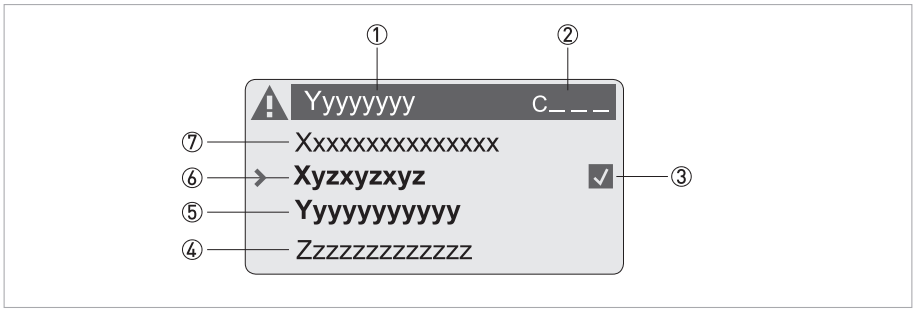


Figure 6-5: Display when changing parameters, 4 lines

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

6.1.5 Using an IR interface (option)

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

INFORMATION!

- *This device is not part of the scope of delivery.*
- *For more information about activation with the functions A6 or C6.6.6 refer to Function tables on page 79.*

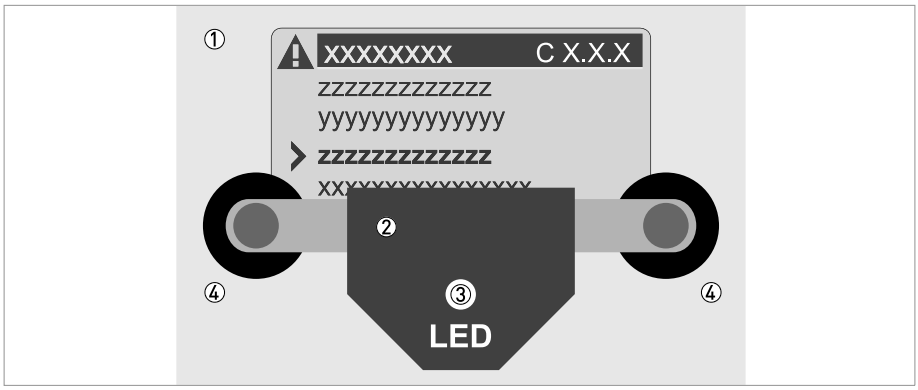


Figure 6-6: IR interface

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

Timeout function

Following activation of the IR interface in Fct. A6 or C6.6.6 the interface must be properly positioned and attached to the housing with the suction cups within 60 seconds. If this does not happen within the specified time period, the device can be operated using the optical keys again. Upon activation, the LED ③ lights up and the optical keys no longer function.

6.2 Zero calibration (menu C1.1.1)

Following installation, perform zero calibration prior to commissioning the device. Finalise the installation before performing zero calibration. Changes (pipe system or calibration factor) made after the zero calibration may affect the accuracy, making it necessary to perform zero calibration again.

Observe the following for reliable zero calibration:

- The measuring sensor should be completely filled with the product at the expected process pressure and temperature.
- The product may contain no air or gas, especially when it comes to horizontal installations. Prior to zero calibration, it is recommended that the product be flushed at a high flow rate (>50%), for 2 minutes.
- After flushing, re-establish zero flow by closing off the corresponding valves.

Set zero calibration automatically or manually using the operating controls. The converter cover must be installed on the display for automatic calibration.

A) Automatic calibration

Key	Display		Description and setting
>	A	Quick Setup	Press and hold for 2.5 s, then release the key.
2 x ↓	C	Setup	
3 x >	C1.1.1	Zero Calibration	
>		Calibrate Zero? Break	
↓		Calibrate Zero? Automatic	
↵		Please wait countdown from 40 s	
		Zero Calibration +XX.XXX%	Display of measured zero calibration in %. (Warning, value can be changed!)
5 x ↵		Save Configuration? Yes	
↵		Display page	

B) Manual calibration

Key	Display		Description and setting
>	A	Quick Setup	Press and hold for 2.5 s, then release the key.
2 x ↓	C	Setup	
3 x >	C1.1.1	Zero Calibration	
>		Calibrate Zero? Break	
3 x ↓		Calibrate Zero? Manual	
		Zero Calibration +XX.XXX%	Display currently stored zero calibration in %. (Warning, value can be changed!)
			Possible manual entry of zero calibration.
			Storing the displayed zero calibration.
5 x ↵		Save Configuration? Yes	
↵		Display page	

Under certain conditions, zero calibration is not possible and will be cancelled:

- The product is still flowing. The shut-off valves are not closed tightly enough.
- There are still gas bubbles in the fluid.
  Remedy: Flush sensor and repeat calibration

With some media, it may be difficult to perform zero calibration. In such cases, there are various methods to still achieve good zero calibration:

Medium	Possible solutions
Media that tend to evaporate or outgas	Increase pressure.
Two-phase media (slurries), that contain solids that may fall out.	Only fill the sensor with the carrier medium.
Two-phase media in which the solids or gas-forming components cannot be separated.	Fill sensor with another liquid, e.g. water.

6.3 Menu structure

INFORMATION!
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 Tag				
				A3 Reset	> ↵	3.1 Error Reset		
						3.2 Reset Totaliser 1		
						3.3 Reset Totaliser 2		
						3.4 Reset Totaliser 3		
				A4 Analogue Outputs		4.1 Measurement		
						4.2 Unit		
						4.3 Range		
						4.4 Low Flow Cutoff		
						4.5 Time Constant		
				A5 Digital Outputs		5.1 Measurement		
						5.2 Pulse Value Unit		
						5.3 Value p. Pulse		
						5.4 Low Flow Cutoff		
				A6 GDC IR interface				
				A7 Zero Calibration				
				A8 Operation Mode				
		↓ ↑		↓ ↑		↓ ↑		↓ ↑ >

Measuring Mode		Select menu	↓ ↑	Select menu and/or sub-menu ↓ ↑				Select function and set data ↓ ↑ >
↵	Press > 2.5 s							
	B Test		> ↵	B1 Simulation	> ↵	1.1 Mass Flow	> ↵	
						1.2 Density		
						1.3 Temperature		
						1.☐ Current Output X		
						1.☐ Status Output X		
						1.☐ Status Output X		
						1.☐ Pulse Output X		
				B2 Actual Values	> ↵	2.1 Operating Hours		
						2.2 Mass Flow		
						2.3 Volume Flow		
						2.4 Velocity		
						2.5 Density		
						2.6 Temperature		
						2.7 Strain MT		
						2.8 Strain IC		
						2.9 Tube Frequency		
						2.10 Drive Level		
						2.11 Sensor A Level		
						2.12 Sensor B Level		
						2.13 2 Phase Signal		
						2.14 SE PCB Temperature		
						2.15 BE PCB Temperature		
						2.16 Act. Operat. Mode		
				B3 Information	> ↵	3.1 C Number		
						3.2 Sensor Electronics		
						3.3 SW.Rev.MS		
						3.4 SW.Rev.UIS		
						3.5 Electronic Revision ER		
		↓ ↑		↓ ↑		↓ ↑		↓ ↑ >

Measuring Mode		Select menu	↓ ↑	Select menu and/or sub-menu ↓ ↑				Select function and set data ↓ ↑ >
↵	Press > 2.5 s							
	C Setup		> ↵	C1 Process Input	> ↵	1.1 Calibration	> ↵	
						1.2 Density		
						1.3 Filter		
						1.4 System Control		
						1.5 Self Test		
						1.6 Information		
						1.7 Factory Calib.		
						1.8 Simulation		
			> ↵	C2 Concentration			> ↵	
↵			> ↵	C3 I/O (Inputs/Outputs)	> ↵	3.1 Hardware	> ↵	
						3.☐ Current Output X		
						3.☐ Frequency Output X		
						3.☐ Pulse Output X		
						3.☐ Status Output X		
						3.☐ Limit Switch X		
						3.☐ Control Input X		
↵			> ↵	C4 I/O Totalisers	> ↵	4.1 Totaliser 1	> ↵	
						4.2 Totaliser 2		
						4.3 Totaliser 3		
↵			> ↵	C5 I/O HART	> ↵	5.1 PV is	> ↵	
						5.2 SV is		
						5.3 TV is		
						5.4 4V is		
						5.5 HART Units		
↵			> ↵	C6 Device	> ↵	6.1 Device Info	> ↵	
						6.2 Display		
						6.3 1. Meas. Page		
						6.4 2nd Meas. Page		
						6.5 Graphic Page		
						6.6 Special Functions		
						6.7 Units		
						6.8 HART		
						6.9 Quick Setup		
		↓ ↑		↓ ↑		↓ ↑		↓ ↑ >

6.4 Function tables

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

6.4.1 Menu A, Quick Setup

No.	Function	Settings / descriptions
A1 Language		
A1	Language	Language selection depends on the device version.
A2 Tag		
A2	Tag	Measuring point identifier (Tag no.) (also for HART® operation), appears in the LC display header (up to 8 digits).
A3 Reset?		
A3	Reset?	
A3.1	Error Reset	Reset Errors? Select: no/yes
A3.2	Reset Totaliser 1	Reset Totaliser? Select: no / yes (available if activated in C6.9.1)
A3.3	Reset Totaliser 2	Reset Totaliser? Select: no / yes (available if activated in C6.9.2)
A3.4	Reset Totaliser 3	Reset Totaliser? Select: no / yes (available if activated in C6.9.3)
A4 Analogue Outputs (only for HART®)		
A4	Analogue Outputs	Applicable to all current outputs (terminals A, B and C), frequency outputs (terminals A, B and D), limit switch (terminals A, B, C, and / or D) and the 1st display page / line 1.
A4.1	Measurement	Select measurement: volume flow / mass flow / temperature / density / velocity /diagnosis 1 / diagnosis 2 / Depending on the settings for the concentration measurement, the following measurements are possible: diagnosis 3 / concentration 1 / concentration 2 / concentration flow 1 / concentration flow 2
		2) Use for all outputs? (also use this setting for Fct. A4.2...A4.5!) Setting: no (applies only to the main current output) / yes (applies to all analogue outputs)
A4.2	Unit	Selection of the unit from a list, depending on the measurement.
A4.3	Range	1) Setting for main current output (range: 0...100%) Setting: 0...x.xx (format and unit, depending on measurement, see A4.1 and A4.2 above)
		2) Use for all outputs? Make setting, see Fct. A4.1 above!
A4.4	Low Flow Cutoff	1) Setting for main current output (sets output value to "0") Setting: x.xxx ± x.xxx% (range: 0.0...20%) (1st value = switching point / 2nd value = hysteresis), condition: 2nd value ≤ 1st value
		2) Use for all outputs? Make setting, see Fct. A4.1 above!
A4.5	Time Constant	1) Setting for main current output (applicable to all flow measurements) Setting: xxx.x s (range: 000.1...100 s)
		2) Use for all outputs? Make setting, see Fct. A4.1 above!

No.	Function	Settings / descriptions

A4 Station Address

A4	Station Address	For Profibus / FF / Modbus devices.

A5 Digital Outputs

A5	Digital Outputs	Valid for all pulse outputs (terminals A, B and/or D) and totaliser 1.
A5.1	Measurement	1) Select measurement: volume flow / mass flow / concentration flow 1
		2) Use for all outputs? (also use this setting for Fct. A5.2...A5.5!) Setting: no (only for pulse output D) / yes (for all digital outputs)
A5.2	Pulse Value Unit	Selection of the unit from a list, depending on the measurement.
A5.3	Value p. Pulse	1) Setting for pulse output D (volume or mass value per pulse) Setting: xxx.xxx in l/s or kg/s
		2) Use for all outputs? Make setting, see Fct. A5.1 above!
A5.4	Low Flow Cutoff	1) Setting for pulse output D (sets output value to "0") Setting: x.xxx ± x.xxx% (range: 0.0…20%) (1st value = switching point / 2nd value = hysteresis), condition: 2nd value ≤ 1st value
		2) Use for all outputs? Make setting, see Fct. A5.1 above!

A6 GDC IR interface

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

A7 Zero Calibration

A7	Zero Calibration	Zero calibration, calibration sequence as described in Fct. C1.1.1...1.1.4

A8 Operation Mode

A8	Operation Mode	Set the operating mode.
		Setting: measure / stop / standby
		For detailed information refer to *Mode (menu A8)* on page 98.

6.4.2 Menu B, Test

No.	Function	Settings / descriptions

B1 Simulation

B1	Simulation	Displayed values are simulated.
B1.1	Mass Flow	Simulation of mass flow
		Set value (range and units depend on measurement)
		break (exit function without simulation)
		Query: start simulation?
		Settings: no (exit function without simulation) / yes (start simulation)
B1.2	Density	Sequence and settings similar to B1.1, see above! X stands for one of the connection terminals A, B, C or D ☐ stands for Fct. B1.4...1.7
B1.3	Temperature	
B1.☐	Current Output X	Simulation X X stands for one of the connection terminals A, B, C or D Sequence and settings similar to B1.1, see above! For pulse output a set number of pulses are output in 1 s!
B1.☐	Pulse Output X	
B1.☐	Frequency Output X	
B1.☐	Control Input X	
B1.☐	Limit Switch X	
B1.☐	Status Output X	

B2 Actual Values

B2	Actual Values	Display of current values; Exit the displayed function by pressing the ↵ key.
B2.1	Operating Hours	Device operating hours
B2.2	Mass Flow	Current unfiltered mass flow
B2.3	Volume flow	Current unfiltered volume flow
B2.4	Velocity	Current unfiltered flow velocity
B2.5	Density	Current unfiltered density
B2.6	Temperature	Current unfiltered temperature
B2.7	Strain MT	Current value for the measuring tube strain
B2.8	Strain IC	Current value for the inner cylinder strain
B2.9	Tube Frequency	Current vibration frequency of the measuring tube
B2.10	Drive Level	Current drive level to activate vibration
B2.11	Sensor A Level	Current vibration amplitude
B2.12	Sensor B Level	
B2.13	2 Phase Signal	2 phase indicator value
B2.14	SE PCB Temperature	Temperature of sensor electronics
B2.15	BE PCB Temperature	Temperature of signal converter
B2.16	Act. Operat. Mode	Current operating mode

B3 Information

B3	Information	
B3.1	C Number	CG number, cannot be changed (input/output version)
B3.2	Sensor Electronics	
B3.3	SW.REV.MS	LC display: 1st line: ID No. of the circuit board 2nd line: software version 3rd line: production date
B3.4	SW.REV.UIS	
B3.5	"Bus interface"	Only appears with Profibus, Modbus and FF.
B3.6	Electronic Revision ER	LC display see Fct. B3.3 and B3.4

6.4.3 Menu C, Setup

No.	Function	Settings / descriptions

C1 Process Input

C1.1 Calibration

C1.1	Calibration	
C1.1.1	Zero Calibration	Display of current zero calibration value.
		Query: calibrate zero?
		Setting: break (return with ↵) / standard (factory setting) / manual (display last value; set new value, range: -10...+10%) / automatic (shows the current value as the new zero calibration value)
C1.1.2	Zero Add. Offset	Direct setting of zero offset
C1.1.3	Pipe Diameter	Set the pipe diameter in mm to calculate flow velocity
C1.1.4	Flow Correction	Defines additional correction for mass flow; Range: -100...+100%

C1.2 Density

C1.2.1	Density Calib.	Start density calibration
		For detailed information refer to *Density calibration (menu C1.2.1)* on page 99.
C1.2.2	Density	Density mode selection: Actual (back key ↵) / fixed (a fixed value is used for the density (e.g. standard density)) / Reference (calculates process density based on a reference temperature)
C1.2.3	Fixed Density Value	Set the fixed value (e.g. standard density) for the density.
		Appears only if density mode "fixed" has been selected in Fct. C1.2.2.
C1.2.3	Density Ref. Temp.	Set the reference temperature for the reference density option
		Appears only if density mode "reference" has been selected in Fct. C1.2.2.
C1.2.4	Ref. Density Slope	Set the slope for the reference density option
		Appears only if density mode "reference" has been selected in Fct. C1.2.2.

C1.3 Filter

C1.3	Filter	
C1.3.1	Flow Direction	Define polarity of flow direction.
		Forwards (according to the arrow on the measuring sensor) or backwards (in the opposite direction to the arrow)
C1.3.2	Press. Supp. Time	Set the pressure suppression time, range: 0.0...20.0 s
C1.3.3	Press. Supp. Cutoff	Cutoff settings for the pressure suppression; range: 0.0...10.0%
C1.3.4	Density Averaging	Set the time constant for the density measurements; range: 1.0...20.0 s
C1.3.5	Low Flow Cutoff	Set the low flow cutoff; range: 00.0...10.0%

C1.4 System Control

C1.4	System Control	
C1.4.1	Function	Set the system control. Select: inactive (off) / flow = 0 (flow to zero)
C1.4.2	Sys. Ctrl. Condition	Set the condition for activating the system control. Selection: density or temperature
C1.4.3	Sys. Ctrl. Max Limit	Defines the upper limit for the condition selected in C1.4.2
C1.4.4	Sys. Ctrl. Min Limit	Defines the lower limit for the condition selected in C1.4.2

C1.5 Self Test

C1.5	Self Test	
C1.5.1	Max. Rec. Temp.	Display of maximum recorded sensor temperature
C1.5.2	Min. Rec. Temp.	Display of minimum recorded sensor temperature
C1.5.3	2 Ph. Threshold	Defines the process-dependent sensitivity for 2 phase signal error message.
C1.5.4	Diagnosis 1	Defines the parameter for the respective diagnostic value. Select: off (goes to zero) / sensor average (sensor amplitude A+B) / sensor deviation / drive level / MT frequency / strain MT / strain IC / 2 phase signal
C1.5.5	Diagnosis 2	
C1.5.6	Diagnosis 3	

C1.6 Information

C1.6	Information	
C1.6.2	V No. Sensor	Shows the order number of the measuring sensor.
C1.6.3	SE Serial No.	Displays the serial number of the sensor electronics
C1.6.4	SE Version	Displays the version of the sensor electronics
C1.6.5	SE Interface	Displays the interface version of the sensor electronics

C1.7 Factory Calib.

C1.7	Factory Calib.	
C1.7.1	Sensor Type	Displays the sensor type
C1.7.2	Sensor Size	Displays the nominal size of the sensor
C1.7.3	Sensor Material	Displays the material of the sensor
C1.7.4	Max. Allowed Temp.	Displays the maximum permitted temperature for the sensor
C1.7.5	Min. Allowed Temp.	Displays the minimum permitted temperature for the sensor
C1.7.6... 1.7.30	CF1...CF27	Displays the sensor calibration coefficients (not CF9 or CF10)

C1.8 Simulation

C1.8	Simulation	
C1.8.1	Mass Flow	As in B1.1
C1.8.2	Density	As in B1.2
C1.8.3	Temperature	As in B1.3

No.	Function	Settings / descriptions

C2 Concentration

C2	Concentration	See supplementary concentration manual

C3 I/O (Inputs/Outputs)

C3.1 Hardware

C3.1	Hardware	Assignment of connection terminals dependent on signal converter version: active / passive / NAMUR
C3.1.1	Terminal A	Select: Off (switched off) / Current Output / Frequency Output / Pulse Output / Status Output / Limit Switch / Control Input
C3.1.2	Terminal B	Select: Off (switched off) / Current Output / Frequency Output / Pulse Output / Status Output / Limit Switch / Control Input
C3.1.3	Terminal C	Select: Off (switched off) / Current Output / Status Output / Limit Switch
C3.1.4	Terminal D	Select: Off (switched off) / Frequency Output / Pulse Output / Status Output / Limit Switch

C3.☐ Current Output X

C3.☐	Current Output X	X stands for one of the connection terminals A, B or C ☐ stands for Fct. no. C3.2 (A) / C3.3 (B) / C3.4 (C)
C3.☐.1	Range 0%...100%	HART® current output: 4...20 mA
		Current range for the selected measurement, e.g. 4...20 mA, corresponds to 0...100%
		Note: with a 0...20 mA current output, HART in Fct. C6.8.1 must be shut off!
		xx.x ... xx.x mA; range: 0.00...20 mA (condition: 0 mA ≤ 1st value ≤ 2nd value ≤ 20 mA)
C3.☐.2	Extended Range	Defines the min. and max. limits.
		xx.x ... xx.x mA; range: 03.5...21.5 mA (condition: 0 mA ≤ 1st value ≤ 2nd value ≤ 21.5 mA)
C3.☐.3	Error Current	Specify error current.
		xx.x mA; range: 3...22 mA (condition: outside of extended range)
C3.☐.4	Error Condition	The following error conditions can be selected.
		Select: error in device (error category [F]) / application error (error category [F]) / out of specification (error category [S])
C3.☐.5	Measurement	Measurements for activating the output.
		Select measurement: Volume Flow / Mass Flow / Temperature / Density / Velocity / Diagnosis 1 / Diagnosis 2 / Depending on the settings for the concentration measurement, the following measurements are possible: Diagnosis 3 / Concentration 1 / Concentration 2 / Concentration Flow 1 / Concentration Flow 2
C3.☐.6	Range	0...100% of the measurement set in Fct. C3.☐.5
		0...xx.xx _ _ _ (format and unit depend on the measurement, see above)
C3.☐.7	Polarity	Set polarity, please note Flow Direction in C1.3.1!
		Select: both polarities (plus and minus values are displayed) / positive polarity (display for negative values = 0) / negative polarity (display for positive values = 0) / absolute value (use for the output)
C3.☐.8	Limitation	Limitation before applying the time constant.
		±xxx ... ±xxx%; range: -150...+150%
C3.☐.9	Low Flow Cutoff	Sets output value to "0"
		x.xxx ± x.xxx%; range: 0.0...20%
		(1st value = switching point / 2nd value = hysteresis), condition: 2nd value ≤ 1st value
C3.☐.10	Time Constant	Range: 000.1...100 s
C3.☐.11	Special Function	Automatic Range; select:
		Off (switched off)
		Automatic range (range is changed automatically, extended lower range, only makes sense together with a status output)
		External range (change by control input, extended lower range, control input must also be activated)

C3.☐.12	Threshold	Appears only when Fct. C3.☐.11 threshold is activated between extended and normal range. The automatic range function always changes from the extended to the normal range when the 100% current is reached.
		The upper 100% value of the hysteresis is then = 0. The threshold is then the hysteresis value, instead of "threshold ± hysteresis" as shown in the display.
		Range: 5.0…80%
		(1st value = switching point / 2nd value = hysteresis), condition: 2nd value ≤ 1st value
C3.☐.13	Information	Serial no. of the I/O board, software version no. and production date of the circuit board
C3.☐.14	Simulation	Sequence see B1.☐ Current Output X
C3.☐.15	4mA Trimming	Trimming of the current at 4 mA
		Reset to 4 mA restores the factory calibration.
		Used for HART® setting.
C3.☐.16	20mA Trimming	Trimming of the current at 20 mA
		Reset to 20 mA restores the factory calibration.
		Used for HART® setting.

C3.☐ Frequency Output X

C3.☐	Frequency Output X	X stands for one of the connection terminals A, B or D ☐ stands for Fct. no. C3.2 (A) / C3.3 (B) / C3.5 (D)
C3.☐.1	Pulse Shape	Specify the pulse shape.
		Select: symmetric (about 50% on and 50% off) / automatic (constant pulse with about 50% on and 50% off at 100% pulse rate) / fixed (fixed pulse rate, setting see below Fct. C3.☐.3 100% pulse rate)
C3.☐.2	Pulse Width	Only available if set to "fixed" in Fct. C3.☐.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
C3.☐.3	100% Pulse Rate	Pulse rate for 100% of the measuring range
		Range: 0.0…10000 1/s
		Limitation 100% pulse rate ≤ 100/s: I_{max} ≤ 100 mA Limitation 100% pulse rate > 100/s: I_{max} ≤ 20 mA
C3.☐.4	Measurement	Measurements for activating the output.
		Select measurement: Volume Flow / Mass Flow / Temperature / Density / Velocity / Diagnosis 1 / Diagnosis 2 / Depending on the settings for the concentration measurement, the following measurements are possible: Diagnosis 3 / Concentration 1 / Concentration 2 / Concentration Flow 1 / Concentration Flow 2
C3.☐.5	Range	0…100% of the measurement set in Fct. C3.☐.4
		0…xx.xx _ _ _ (format and unit depend on the measurement, see above)
C3.☐.6	Polarity	Set measured value polarity, please note flow direction in C1.3.2!
		Select: both polarities (plus and minus values are displayed) / positive polarity (display for negative values = 0) / negative polarity (display for positive values = 0) / absolute value (use for the output)
C3.☐.7	Limitation	Limitation before applying the time constant.
		±xxx … ±xxx%; range: -150…+150%

C3.☐.8	Low Flow Cutoff	Sets output value to "0":
		x.xxx ± x.xxx%; range: 0.0…20%
		(1st value = switching point / 2nd value = hysteresis), condition: 2nd value ≤ 1st value
C3.☐.9	Time Constant	Range: 000.1…100 s
C3.☐.10	Invert Signal	Select: Off (activated output generates a high current at the output, switch closed) / On (activated output generates a low current at the output, switch open)
C3.☐.11	Phase Shift w.r.t. B	Only available when configuring the A or D terminal and only if output B is a pulse or frequency output. If setting in Fct. C2.5.6 is "Both Polarities", the phase shift is prefixed by a symbol, e.g. -90° and +90°.
		Select: off (no phase shift) / 0° phase shift (between outputs A or D and B, inversion possible) / 90° phase shift (between outputs A or D and B, inversion possible) / 180° phase shift (between outputs A or D and B, inversion possible)
C3.3.11	Special Functions	This function is only available at the terminal B frequency output. At the same time, 2 frequency outputs must be available: 1st output at terminal A or D / 2nd output at terminal B
		The B output is operated as a slave output, controlled and set using master output A or D
		Selection: off (no phase shift) / phase shift w.r.t. D or A (slave output is B and master output is D or A)
C3.☐.12	Information	Serial no. of the I/O board, software version no. and production date of the circuit board
C3.☐.13	Simulation	Sequence see B1.☐ Frequency Output X

C3.☐ Pulse Output X

C3.☐	Pulse Output X	X stands for one of the connection terminals A, B or D ☐ stands for Fct. no. C3.2 (A) / C3.3 (B) / C3.5 (D)
C3.☐.1	Pulse Shape	Specify the pulse shape.
		Select: Symmetric (about 50% on and 50% off) / Automatic (constant pulse with about 50% on and 50% off at 100% pulse rate) / Fixed (fixed pulse rate, setting see below Fct. C3.☐.3 100% pulse rate)
C3.☐.2	Pulse Width	Only available if set to "fixed" in Fct. C3.☐.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
C3.☐.3	Max. Pulse Rate	Pulse rate for 100% of the measuring range
		Range: 0.0…10000 1/s
		Limitation 100% pulse rate ≤ 100/s: I_{max} ≤ 100 mA Limitation 100% pulse rate > 100/s: I_{max} ≤ 20 mA
C3.☐.4	Measurement	Measurements for activating the output.
		Select: Volume Flow / Mass Flow
C3.☐.5	Pulse Value Unit	Selection of the unit from a list, depending on the measurement.
C3.☐.6	Value p. Pulse	Set value for volume or mass per pulse.
		xxx.xxx, range in [l] or [kg] (volume or mass for current output C3.☐.6)
		At max. pulse rate see above 3.☐.3 Pulse Output.
C3.☐.7	Polarity	Set polarity, please note Flow Direction in C1.3.2!
		Select: both polarities (plus and minus values are displayed) / positive polarity (display for negative values = 0) / negative polarity (display for positive values = 0) / absolute value (use for the output)

C3.☐.8	Low Flow Cutoff	Sets output value to "0"
		x.xxx ± x.xxx%; range: 0.0…20%
		(1st value = switching point / 2nd value = hysteresis), condition: 2nd value ≤ 1st value
C3.☐.9	Time Constant	Range: 000.1…100 s
C3.☐.10	Invert Signal	Select: Off (activated output generates a high current at the output, switch closed) / On (activated output generates a low current at the output, switch open)
C3.☐.11	Phase Shift w.r.t. B	Only available when configuring the A or D terminal and only if output B is a pulse or frequency output. If setting in Fct. C2.5.6 is "Both Polarities", the phase shift is prefixed by a symbol, e.g. -90° and +90°.
		Select: off (no phase shift) / 0° phase shift (between outputs A or D and B, inversion possible) / 90° phase shift (between outputs A or D and B, inversion possible) / 180° phase shift (between outputs A or D and B, inversion possible)
C3.3.11	Special Functions	This function is only available at the pulse output of terminal B. At the same time, 2 pulse outputs must be available: 1st output at terminal A or D / 2nd output at terminal B
		The B output is operated as a slave output, controlled and set using master output A or D
		Selection: off (no phase shift) / phase shift w.r.t. D or A (slave output is B and master output is D or A)
C3.☐.12	Information	Serial no. of the I/O board, software version no. and production date of the circuit board
C3.☐.13	Simulation	Sequence see B1.☐ pulse output X

C3.☐ Status Output X

C3.☐	Status Output X	X (Y) stands for one of the connection terminals A, B, C or D ☐ stands for Fct. no. C3.2 (A) / C3.3 (B) / C3.4 (C) / C3.5 (D)
C3.☐.1	Mode	The output shows the following measuring conditions:
		out of specification (output activated, signals application error or error in device refer to *Status messages and diagnostic information* on page 113 / application error (output activated, signals application error or error in device refer to *Status messages and diagnostic information* on page 113 / polarity flow (polarity of the current flow) / over range flow (over range of the flow) / totaliser 1 preset (activates when totaliser X preset value is reached) / totaliser 2 preset (activates when totaliser X preset value is reached) / totaliser 3 preset (activates when totaliser X preset value is reached) / output A (activated by the status of output Y, additional output data see below) / output B (activated by the status of output Y, additional output data see below) / output C (activated by the status of output Y, additional output data see below) / output D (activated by the status of output Y, additional output data see below) / off (switched off) / empty pipe (when pipe empty, output activated) / Error in device (when error, output activated)
C3.☐.2	Current Output Y	Only appears if output A...C is set under "mode" (see above), and this output is a "current output".
		Polarity (is signalled)
		Over Range (is signalled)
		Automatic Range signals lower range
C3.☐.2	Frequency Output Y and Pulse Output Y	Only appears if output A, B or D is set under "mode" (see above), and this output is a "frequency/pulse output".
		Polarity (is signalled)
		Over Range (is signalled)
C3.☐.2	Status Output Y	Only appears if output A...D is set under "mode" (see above), and this output is a "status output".
		Same signal (like other connected status output, signal can be inverted, see below)
C3.☐.2	Limit Switch Y and Control Input Y	Only appears if output A...D / input A or B is set under "mode" (see above), and this output / input is a "limit switch / control input".
		Status off (is always selected here if status output X is connected with a limit switch / control input Y.
C3.☐.2	Off	Only appears if output A...D is set under "mode" (see above) and this output is switched off.
C3.☐.3	Invert Signal	Off (activated output supplies a high current, switch closed)
		On (activated output supplies a low current, switch open)
C3.☐.4	Information	Serial no. of the I/O board, software version no. and production date of the circuit board
C3.☐.5	Simulation	Sequence see B1.☐ status output X

C3.☐ Limit Switch X

C3.☐	Limit Switch X	X stands for one of the connection terminals A, B, C or D ☐ stands for Fct. no. C3.2 (A) / C3.3 (B) / C3.4 (C) / C3.5 (D)
C3.☐.1	Measurement	Select: Volume Flow / Mass Flow / Diagnosis 1...3 / Flow Velocity / Temperature / Concentration Flow 1 / Density
C3.☐.2	Threshold	Switching level, set threshold with hysteresis
		xxx.x ±x.xxx (format and unit depend on the measurement, see above)
		(1st value = threshold / 2nd value = hysteresis), condition: 2nd value ≤ 1st value
C3.☐.3	Polarity	Set polarity, please note Flow Direction in C1.3.2!
		Select: both polarities (plus and minus values are displayed) / positive polarity (display for negative values = 0) / negative polarity (display for positive values = 0) / absolute value (use for the output)
C3.☐.4	Time Constant	Range: 000.1...100 s
C3.☐.5	Invert Signal	Select:
		Off (activated output generates a high current, switch closed)
		On (activated output generates a low current, switch open)
C3.☐.6	Information	Serial no. of the I/O board, software version no. and production date of the circuit board
C3.☐.7	Simulation	Sequence see B1.☐ limit switch X

C3.☐ Control Input X

C3.☐	Control Input X	
C3.☐.1	Mode	X stands for connection terminal A or B ☐ stands for Fct. no. C3.2 (A) / C3.3 (B)
		Off (control input switched off) / hold all outputs (hold current values, not display and totalisers) / output Y (hold current values) / all outputs to zero (current values = 0%, not display and totalisers) / output Y to zero (current value = 0%) / all totalisers (reset all totalisers to "0") / totaliser "Z" reset (set totaliser 1, (2 or 3) to "0") / stop all totalisers / stop totaliser "Z" (stops totaliser 1, (2 or 3) / zero outp.+stop Tot. (all outputs 0%, stop all totalisers, not the display) / external range Y (control input for external range of current output Y) - also make this setting on current output Y (no check if current output Y is available) / Error reset (all resettable errors are deleted) Zero Calibration
C3.☐.2	Invert Signal	off (control input is activated when a current is applied at the input by voltage to passive inputs or a low-value resistor to active inputs)
		on (control input is activated when no current is applied at the input, low voltage to passive inputs or a high-value resistor to active inputs)
C3.☐.3	Information	Serial no. of the I/O board, software version no. and production date of the circuit board
C3.☐.4	Simulation	Sequence see B 1.☐ control input X

No.	Function	Settings / descriptions

C4 I/O Totalisers

C4.1	Totaliser 1	Set function of totaliser ☐ ☐ stands for 1, 2, 3 (= totaliser 1, 2, 3) The basic version (standard) has only 2 totaliser!
C4.2	Totaliser 2	
C4.3	Totaliser 3	
C4.☐.1	Totaliser Function	Select: Absolute Total (counts positive and negative values) / +totaliser (counts only the positive values) / -totaliser (counts only the negative values) / off (totaliser is switched off)
C4.☐.2	Measurement	Selection of the measurement for totaliser ☐
		Select: volume flow / mass flow / conc. flow 1 (depends on the settings for the concentration measurement)
C4.☐.3	Low Flow Cutoff	Sets output value to "0"
		Range: 0.0…20%
		(1st value = switching point / 2nd value = hysteresis), condition: 2nd value ≤ 1st value
C4.☐.4	Time Constant	Range: 000.1…100 s
C4.☐.5	Preset Value	If this value is reached, positive or negative, a signal is generated that can be used for a status output at which "preset totaliser X" has to be set.
		Preset value (max. 8 digits) x.xxxxx in selected unit, see C6.7.10 + 13
C4.☐.6	Reset Totaliser	Sequence see Fct. A3.2, A3.3 und A3.4
C4.☐.7	Set Totaliser	Set totaliser ☐ to the desired value.
		Select: break (exit function) / set value (opens the editor to make the entry)
		Query: set totaliser?
		Select: no (exit function without setting the value) / yes (sets the totaliser and exits the function)
C4.☐.8	Stop Totaliser	Totaliser ☐ stops and holds the current value.
		Select: no (exits the function without stopping the totaliser) / yes (stops the totaliser and exits the function)
C4.☐.9	Start Totaliser	Start totaliser ☐ after that totaliser is stopped.
		Select: no (exits the function without starting the totaliser) / yes (starts the totaliser and exits the function)
C4.☐.10	Information	Serial number of the I/O circuit board, software version number and production date of the circuit board.

No.	Function	Settings / descriptions

C5 I/O HART

C5	I/O HART	Selection / display of the 4 dynamic variables (DV) for HART®.
		The HART® current output (terminal A basic I/Os or terminal C modular I/Os) always has a fixed link to the primary variables (PV). Fixed links of the other DVs (1-3) are only possible if additional analogue outputs (current and frequency) are available; if not, the measurement can be freely selected from the following list: in Fct. A4.1 "measurement".
		☐ stands for 1, 2, 3 or 4 X stands for connection terminals A...D
C5.1	PV is	Current output (primary variable)
C5.2	SV is	(secondary variable)
C5.3	TV is	(tertiary variable)
C5.4	4V is	(4th variable)
C5.5	HART Units	Changes units of DVs (dynamic variables) in the display
		Break: return with ↵ key
		HART display®: copies the settings for the display units to the settings for DVs
		Standard: sets factory defaults for DVs
C5.☐.1	Current Output X	Shows the current analogue measured value of the linked current output. The measurement cannot be changed!
C5.☐.1	Frequency Output X	Shows the current analogue measured value of the linked frequency output, if present. The measurement cannot be changed!
C5.☐.1	HART Dynamic Var.	Measurements of the dynamic variables for HART®.
		Linear measurements: Volume Flow / Mass Flow / Diagnosis Value / Fow Velocity
		Digital measurements: Totaliser 1 / Totaliser 2 / Totaliser 3 / Operating hours

No.	Function	Settings / descriptions

C6 Device

C6.1 Device Info

C6.1	Device Info	
C6.1.1	Tag	Settable characters (max. 8 digits): A...Z; a...z; 0...9; / - , .
C6.1.2	C Number	CG number, non-alterable (I/O version)
C6.1.3	Device Serial No.	Serial no. of the system, cannot be changed
C6.1.4	BE Serial No.	Serial no. of the electronic assembly, cannot be changed.
C6.1.5	SW.REV.MS	Serial no. of the circuit board, version no. of the main software, production date of the circuit board
C6.1.6	Electronic Revision ER	Shows ID no., electronic revision no. and production date; Contains all hardware and software changes.

C6.2 Display

C6.2	Display	
C6.2.1	Language	Language selection depends on the device version.
C6.2.2	Contrast	Adjust display contrast for extreme temperatures. Setting: -9…0…+9
		This change takes place immediately, not just when setting mode is exited!
C6.2.3	Default Display	Specification of the default display page that is returned to after a short delay period.
		Select: none (the current page is always active) / 1. meas. page (show this page) / 2. meas. page (show this page) / status page (show only status messages) / graphic page (trend display of the 1st measurement)
C6.2.4	Self Test	Not available at this time.
C6.2.5	SW.REV.UIS	Serial no. of the circuit board, version no. of user software, production date of the circuit board

C6.3 and C6.4 1st Meas. Page and 2nd Meas. Page

C6.3	1st Meas. Page	☐ stands for 3 = meas. page 1 and 4 = meas. page 2
C6.4	2nd Meas. Page	
C6.☐.1	Function	Specify number of measured value lines (font size)
		Select: one line / two lines / three lines
C6.☐.2	1st Line Variable	Specify 1st Line Variable.
		Select measurement: Volume Flow / Mass Flow / Temperature / Density / Velocity / Diagnosis 1 / Diagnosis 2 / Depending on the settings for the concentration measurement, the following measurements are possible: Diagnosis 3 / Concentration 1 / Concentration 2 / Concentration Flow 1 / Concentration Flow 2
C6.☐.3	Range	0…100% of the measurement set in Fct. C5.☐.2
		0…xx.xx _ _ _ (format and unit depend on the measurement)
C6.☐.4	Limitation	Limitation before applying the time constant.
		xxx%; Range: -150…+150%
C6.☐.5	Low Flow Cutoff	Sets output to "0": x.xxx ± x.xxx %; range: 0.0…20%
		(1st value = switching point / 2nd value = hysteresis), condition: 2nd value ≤ 1st value
C6.☐.6	Time Constant	Range: 000.1…100 s
C6.☐.7	1st Line Format	Specify decimal places.
		Select: automatic (adaptation is automatic) / X (= none) …X.XXXXXXXX (max. 8 digits) depends on size of font
C6.☐.8	2nd Line Variable	Specify 2nd Line Variable (only available if this 2nd line is activated)
		Select: Bar Graph (for measurement selected in the 1st line) / Volume Flow / Mass Flow / Temperature / Density / Velocity / Bar Graph / Totaliser 1 / Totaliser 2 / Totaliser 3 / Operating Hours / Diagnosis 1 / Diagnosis 2 Depending on the settings for the concentration measurement, the following measurements are possible: Diagnosis 3 / Concentration 1 / Concentration 2 / Concentration Flow 1 / Concentration Flow 2
C6.☐.9	2nd Line Format	Specify decimal places.
		Select: automatic (adaptation is automatic) / X (= none) …X.XXXXXXXX (max. 8 digits) depends on size of font

C6.☐.10	3rd Line Variable	Specify 3rd Line Variable (only available if this 3rd line is activated)
		Select: Volume Flow / Mass Flow / Temperature / Density / Velocity / Totaliser 1 / Totaliser 2 / Totaliser 3 / Operating Hours / Diagnosis 1 / Diagnosis 2 Depending on the settings for the concentration measurement, the following measurements are possible: Diagnosis 3 / Concentration 1 / Concentration 2 / Concentration Flow 1 / Concentration Flow 2
C6.☐.11	3rd Line Format	Specify decimal places.
		Select: automatic (adaptation is automatic) / X (= none) ...X.XXXXXXXX (max. 8 digits) depends on size of font

C6.5 Graphic Page

C6.5	Graphic Page	
C6.5.1	Select Range	Graphic page always shows trend curve of the measurement of the 1st page / 1st line, see Fct. C6.3.2
		Select: Manual (set range in Fct. C6.5.2) / Automatic (automatic depiction based on the measured values) 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 Functions

C6.6	Special Functions	
C6.6.1	Reset Errors	Reset Errors?
		Select: no/yes
C6.6.2	Save Settings	Save current settings. Select: cancel (exit function without saving) / backup 1 (save in storage location 1) / backup 2 (save in storage location 2).
		Query: continue copy? (cannot be done afterwards) Select: no (exit function without saving) / yes (copy current settings to storage backup 1 or backup 2)
C6.6.3	Load Settings	Load saved settings. Select: break (exit function without loading) / factory settings (load in state as delivered) / backup 1 (load data from storage location 1) / backup 2 (load data from storage location 2)
		Query: continue copy? (cannot be done afterwards) Select: no (exit the function without saving) / yes (load data from the selected storage location)
C6.6.4	Password Quick Set	Password required to change data in the quick setup menu.
		0000 (= to Quick Setup menu without password)
		xxxx (password required); range 4 digits: 0001...9999
C6.6.5	Password Setup	Password required to change data in the setup menu
		0000 (= to Quick Setup menu without password)
		xxxx (password required); range 4 digits: 0001...9999

C6.6.6	GDC IR Interface	After this function has been activated an optical GDC adapter can be connected to the LC display. If approximately 60 seconds pass without a connection being established or after the adapter is removed, then the function is exited and the optical keys are active once again.
		Break (exit function without connection)
		Activate (the IR interface adapter and interrupt the optical keys)
		If approximately 60 seconds pass without a connection being established, then the function is exited and the optical keys are active once again.

C6.7 Units

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); IG/s; IG/min; IG/h ft^3/h; ft^3/min; ft^3/s; gal/h; gal/min; gal/s; barrel/h; barrel/day free unit (set factor and text in the next two functions, sequence see below)
C6.7.2	Text free unit	For text to be specified refer to *Set free units* on page 96:
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 96
C6.7.4	Mass Flow	kg/s; kg/min; kg/h; t/min; t/h; g/s; g/min; g/h; lb/s; lb/min; lb/h; ST/min; ST/h (ST = Short Ton); LT/h (LT = Long Ton); free unit (set factor and text in the next two functions, sequence see below)
C6.7.5	Text free unit	For text to be specified refer to *Set free units* on page 96:
C6.7.6	[kg/s]*factor	Specification of the conversion factor, based on kg/s:
		xxx.xxx refer to *Set free units* on page 96
C6.7.7	Velocity	m/s; ft/s
C6.7.9	Temperature	°C; K; °F
C6.7.10	volume	m^3; l (litres); hl; ml; gal; IG; in^3; ft^3; yd^3; barrel 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 96:
C6.7.12	$[m^3]$*factor	Specification of the conversion factor, based on m^3:
		xxx.xxx refer to *Set free units* on page 96
C6.7.13	Mass	kg; t; mg; g; lb; ST; LT; oz; free unit (set factor and text in the next two functions, sequence see below)
C6.7.14	Text free unit	For text to be specified refer to *Set free units* on page 96:
C6.7.15	[kg]*factor	Specification of the conversion factor, based on kg:
		xxx.xxx refer to *Set free units* on page 96
C6.7.16	Density	kg/l; kg/m^3; lb/ft^3; lb/gal; SG free unit (set factor and text in the next two functions, sequence see below)
C6.7.17	Text free unit	For text to be specified refer to *Set free units* on page 96:
C6.7.18	$[kg/m^3]$*factor	Specification of the conversion factor, based on kg/m^3:
		xxx.xxx refer to *Set free units* on page 96
C6.7.19	Pressure	Pa; kPa; bar; mbar; psi (no free units possible); only if current input available.

C6.8 HART

C6.8	HART	
C6.8.1	HART	Switch HART® communication on/off:
		Select: HART on (HART® activated) current = 4…20 mA / HART off (HART® not activated) current = 0…20 mA
C6.8.2	Address	Set address for HART® operation:
		Select: 00 (point-to-point operation, current output has normal function, current = 4…20 mA) / 01…15 (multidrop operation, current output has a constant setting of 4 mA)
C6.8.3	Message	Set required text:
		A…Z ; a…z ; 0…9 ; / - + , . *
C6.8.4	Description	Set required text:
		A…Z ; a…z ; 0…9 ; / - + , . *

C6.9 Quick Setup

C6.9	Quick setup	Activate quick access in Quick Setup menu:
		Select: yes (switched on) / no (switched off)
C6.9.1	Reset Totaliser 1	Reset Totaliser 1 in Quick Setup menu?
		Select: yes (activated) / no (switched off)
C6.9.2	Reset Totaliser 2	Reset Totaliser 2 in Quick Setup menu?
		Select: yes (activated) / no (switched off)
C6.9.3	Reset Totaliser 3	Reset Totaliser 3 in Quick Setup menu?
		Select: yes (activated) / no (switched off)

6.4.4 Set free units

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

6.5 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	Display	Description and setting
>	quick setup	Press and hold for 2.5 s, then release the key.
>	language	-
2 x ↓	reset	-
>	reset errors	-
↓	counter 1	Select desired counter. (Counter 3 is optional)
↓	counter 2	
↓	counter 3	
>	reset counter no	-
↓ or ↑	reset counter yes	-
↵	counter 1,2 (or 3)	Counter has been reset.
3 x ↵	Measuring mode	-

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 113.

Key	Display	Description and setting
>	quick setup	Press and hold for 2.5 s, then release the key.
>	language	-
2 x ↓	reset	-
>	reset errors	-
>	reset? no	-
↓ or ↑	reset? yes	-
↵	reset errors	Error has been reset.
3 x ↵	Measuring mode	-

6.5.3 Mode (menu A8)

The device can be switched to "standby". In this mode, all flow values are set to zero and the counter values are "frozen". The temperature and density values are displayed normally and output via the outputs. The "standby" indicator on the display shows either the "frozen" counter value or simply "standby". In this mode, the measuring tubes continue to vibrate and the device can immediately return to "measuring" mode if necessary.

There is also a "stop" mode. In this mode, the sensor is switched off and is no longer vibrating. To return to measuring mode from this mode, the measuring device **must** go through the complete "start-up" phase again before measurement continues.

The measuring device can be switched into "standby" mode either using the optical keys on the display or using the control input. You can only switch to "stop" mode using the optical keys.

Setting the mode (from measuring mode):

Key	Display		Description and setting
>	A	Quick Setup	Press and hold for 2.5 s, then release the key.
> ↑	A8	Mode Measuring	
>		Mode Measuring	
↑		Mode Standby	
↑		Mode Stop	
3 x ↵		Save Configuration? Yes	
↵		Display page	

If "standby" or "stop" is selected, the device immediately switches to this operating state. To return to the measuring mode, go to menu A8 and select "measure".

INFORMATION!
When changing from the "stop" to "standby" mode, the device goes through the entire start-up phase.

In addition to the "standby" mode, the system control function also allows you to switch to a comparable "standby" status completely automatically depending on the current operating temperature or density.

6.5.4 Density calibration (menu C1.2.1)

Mass flowmeters are calibrated for density in the factory. Density calibration is based on 2 calibration points. In the factory, air and water are used under reference conditions. The result of this calibration is saved in the converter electronics and stored in the factory settings. Regardless, various applications require maximum accuracy which can only be achieved with on-site calibration.

Available options:

Option	Explanation
1 Point Calibration	One of the 2 saved calibration points is replaced by customer calibration. The signal converter decides which of the 2 calibration points is modified.
2 Point Calibration	The user recalibrates both calibration points.
Default	The signal converter reactivates the factory settings for the density calibration.
Manual	The user can read the current density calibration points and enter them if necessary (according to sensor calibration certificate).

Example of 1 point calibration with town water

Key	Display		Description and setting
>	A	Quick Setup	Press and hold for 2.5 s, then release the key.
2 x ↓	C	Setup	
2 x >	C1.1	Calibration	
↓	C1.2	Density	
2 x >	C1.2.1	Density Calib. Break	Press ↵ to exit density calibration menu.
↓	C1.2.1	Density Calibration? Default	Press ↵ for density calibration. Factory calibration on OK (6 x ↵).
↓	C1.2.1	Density Calibration? Manual	Press ↵ to read or change the current density calibration value.
↓	C1.2.1	Density Calibration? 2 Point Calibration	Press ↵ to start 2 point calibration.
↓	C1.2.1	Density Calibration? 1 Point Calibration	Press ↵ to start 1 point calibration.
↵	C1.2.1	DCF1 XXXXXXXXX	Press ↓ until you reach town water.
Press ↓ until	C1.2.1	DCF1 Town Water	Press ↵ to start town water calibration.
↵	C1.2.1	Single Pt. Calib. Break	
↓	C1.2.1	Single Pt. Calib. OK	Press ↵ to start single point calibration.
↵	C1.2.1	Perform Calibration Passed	
5 x ↵		Save Configuration? Yes	
↵		Measuring Mode	

On-site density calibration:

- Ensure that the device has been properly installed and functions smoothly.
- If air (empty) is used as the medium, the measuring tube must be completely dry and free of liquids and solids. If possible, blow dry air into the measuring tube to empty it.
- If liquids are used, flush for a few minutes at a high flow rate to remove gas bubbles.
- Set the flow rate to a typical value (50% of the nominal flow is ideal).
- If the process temperature is higher than the ambient temperature, wait until the system has stabilised.
- When it comes to 1 point and 2 point calibration, you can choose from the options "empty", "pure water", "town water" and "other". The reference values for the specified products are stored in the converter.

Density calibration has failed if "calib. error." is displayed. There are several possible reasons for this:

- The device is not in "measuring" mode.
- The calibration points are too close together.
- One or more calibration points did not pass the plausibility test.
- Flow, pressure, temperature or system are not stable?
- Please check your system and try again.
- If this results in another failed calibration, please contact the manufacturer.

1 Point Calibration

- See examples for "Calibration with town water and other".
- Select the function using ↓ and ↑ and then confirm with ↵.
- If "Other" is selected, the product density must be entered in kg/m^3.
- 1 point calibration is generally sufficient for most applications, such as adapting the density measurement to a new installation.

2 Point Calibration

- In this case, both reference points are recalibrated (with the products of the system).
- With 2 point calibration, ensure that both calibration points entered by the user are accepted.
- If the first point has not been calibrated, the device continues normally as with 1 point calibration.
- Once the first point has been calibrated, select whether to continue with the second point, calibrate the first point again or discontinue 2 point calibration. The same options as before are then available once again.

If the 2nd point cannot be calibrated immediately after the first one, because the 2nd product is not yet available, the device continues to function normally as after the 1 point calibration. In other words, there can be weeks or even months between the calibration of the two measuring points.

Manual

- If manual calibration is selected, point 1 type DCF1 is displayed.
- Press the ↵ key to go to the next DCF option or press the ↑ and ↓ keys to enter values according to the manufacturer's calibration certificate.
- After the last DCF you are prompted to accept the values or to exit the menu without saving.

6.5.5 Temperature/density tables

Temperature		Density		Temperature		Density	
°C	°F	kg/m³	lb/ft³	°C	°F	kg/m³	lb/ft³
0	32	999.8396	62.41999	0.5	32.9	999.8712	62.42197
1	33.8	999.8986	62.42367	1.5	34.7	999.9213	62.42509
2	35.6	999.9399	62.42625	2.5	36.5	999.9542	62.42714
3	37.4	999.9642	62.42777	3.5	38.3	999.9701	62.42814
4	39.2	999.972	62.42825	4.5	40.1	999.9699	62.42812
5	41	999.9638	62.42774	5.5	41.9	999.954	62.42713
6	42.8	999.9402	62.42627	6.5	43.7	999.9227	62.42517
7	44.6	999.9016	62.42386	7.5	45.5	999.8766	62.4223
8	46.4	999.8482	62.42053	8.5	47.3	999.8162	62.4185
9	48.2	999.7808	62.41632	9.5	49.1	999.7419	62.41389
10	50	999.6997	62.41125	10.5	50.9	999.6541	62.40840
11	51.8	999.6051	62.40535	11.5	52.7	999.5529	62.40209
12	53.6	999.4975	62.39863	12.5	54.5	999.4389	62.39497
13	55.4	999.3772	62.39112	13.5	56.3	999.3124	62.38708
14	57.2	999.2446	62.38284	14.5	58.1	999.1736	62.37841
15	59	999.0998	62.3738	15.5	59.9	999.0229	62.36901
16	60.8	998.9432	62.36403	16.5	61.7	998.8607	62.35887
17	62.6	998.7752	62.35354	17.5	63.5	998.687	62.34803
18	64.4	998.596	62.34235	18.5	65.3	998.5022	62.3365
19	66.2	998.4058	62.33047	19.5	67.1	998.3066	62.32428
20	68	998.2048	62.31793	20.5	68.9	998.1004	62.31141
21	69.8	997.9934	62.30473	21.5	70.7	997.8838	62.29788
22	71.6	997.7716	62.29088	22.5	72.5	997.6569	62.28372
23	73.4	997.5398	62.27641	23.5	74.3	997.4201	62.26894
24	75.2	997.2981	62.26132	24.5	76.1	997.1736	62.25355
25	77	997.0468	62.24563	25.5	77.9	996.9176	62.23757
26	78.8	996.7861	62.22936	26.5	79.7	996.6521	62.22099
27	80.6	996.5159	62.21249	27.5	81.5	996.3774	62.20384
28	82.4	996.2368	62.19507	28.5	83.3	996.0939	62.18614
29	84.2	995.9487	62.17708	29.5	85.1	995.8013	62.16788
30	86	995.6518	62.15855	30.5	86.9	995.5001	62.14907
31	87.8	995.3462	62.13947	31.5	88.7	995.1903	62.12973
32	89.6	995.0322	62.11986	32.5	90.5	994.8721	62.10987

33	91.4	994.71	62.09975	33.5	92.3	994.5458	62.08950
34	93.2	994.3796	62.07912	34.5	94.1	994.2113	62.06861
35	95	994.0411	62.05799	35.5	95.9	993.8689	62.04724
36	98.6	993.6948	62.03637	36.5	97.7	993.5187	62.02537
37	98.6	993.3406	62.01426	37.5	99.5	993.1606	62.00302
38	100.4	992.9789	61.99168	38.5	101.3	992.7951	61.98020
39	102.2	992.6096	61.96862	39.5	103.1	992.4221	61.95692
40	104	992.2329	61.9451	40.5	104.9	992.0418	61.93317
41	105.8	991.8489	61.92113	41.5	106.7	991.6543	61.90898
42	107.6	991.4578	61.89672	42.5	108.5	991.2597	61.88434
43	109.4	991.0597	61.87186	43.5	110.3	990.8581	61.85927
44	111.2	990.6546	61.84657	44.5	112.1	990.4494	61.83376
45	113	990.2427	61.82085	45.5	113.9	990.0341	61.80783
46	114.8	989.8239	61.79471	46.5	115.7	989.6121	61.78149
47	116.6	989.3986	61.76816	47.5	117.5	989.1835	61.75473
48	118.4	988.9668	61.7412	48.5	119.3	988.7484	61.72756
49	120.2	988.5285	61.71384	49.5	121.1	988.3069	61.70
50	122	988.0839	61.68608	50.5	122.9	987.8592	61.67205
51	123.8	987.6329	61.65793	51.5	124.7	987.4051	61.64371
52	125.6	987.1758	61.62939	52.5	126.5	986.945	61.61498
53	127.4	986.7127	61.60048	53.5	128.3	986.4788	61.58588
54	129.2	986.2435	61.57118	54.5	130.1	986.0066	61.5564
55	131	985.7684	61.54153	55.5	131.9	985.5287	61.52656
56	132.8	985.2876	61.5115	56.5	133.7	985.0450	61.49636
57	134.6	984.8009	61.48112	57.5	135.5	984.5555	61.4658
58	136.4	984.3086	61.45039	58.5	137.3	984.0604	61.43489
59	138.2	983.8108	61.41931	59.5	139.1	983.5597	61.40364
60	140	983.3072	61.38787	60.5	140.9	983.0535	61.37203
61	141.8	982.7984	61.35611	61.5	142.7	982.5419	61.34009
62	143.6	982.2841	61.324	62.5	144.5	982.0250	61.30783
63	145.4	981.7646	61.29157	63.5	146.3	981.5029	61.27523
64	147.2	981.2399	61.25881	64.5	148.1	980.9756	61.24231
65	149	980.7099	61.22573	65.5	149.9	980.4432	61.20907

66	150.8	980.1751	61.19233	66.5	151.7	979.9057	61.17552
67	152.6	979.6351	61.15862	67.5	153.5	979.3632	61.14165
68	154.4	979.0901	61.1246	68.5	155.3	978.8159	61.10748
69	156.2	978.5404	61.09028	69.5	157.1	978.2636	61.07300
70	158	977.9858	61.05566	70.5	158.9	977.7068	61.03823
71	159.8	977.4264	61.02074	71.5	160.7	977.145	61.00316
72	161.6	976.8624	60.98552	72.5	162.5	976.5786	60.96781
73	163.4	976.2937	60.95002	73.5	164.3	976.0076	60.93216
74	165.2	975.7204	60.91423	74.5	166.1	975.4321	60.89623
75	167	975.1428	60.87816	75.5	167.9	974.8522	60.86003
76	168.8	974.5606	60.84182	76.5	169.7	974.2679	60.82355
77	170.6	973.9741	60.80520	77.5	171.5	973.6792	60.7868
78	172.4	973.3832	60.76832	78.5	173.3	973.0862	60.74977
79	174.2	972.7881	60.73116	79.5	175.1	972.489	60.71249
80	176	972.188	60.69375				

6.5.6 Density mode (menu C1.2.2)

There are 3 available operating modes for density that can be set here:

- Process:
  The device measures and displays the current operating density of the product.
- Fixed:
  The device displays a fixed density value. This value must be entered in menu item C1.2.3.
- Reference:
  The device calculates the density based on a set reference temperature.

The following equation is used:

$p_r = p_a + a\ (t_a - t_r)$

p_r = Density at reference temperature
p_a = Current measured operating density at current operating temperature
a = Programmed temperature coefficient/density gradient
t_a = Current measured operating temperature
t_r = Reference temperature

The reference temperature must be entered in menu item C1.2.3. The density gradient is set in C1.2.4.

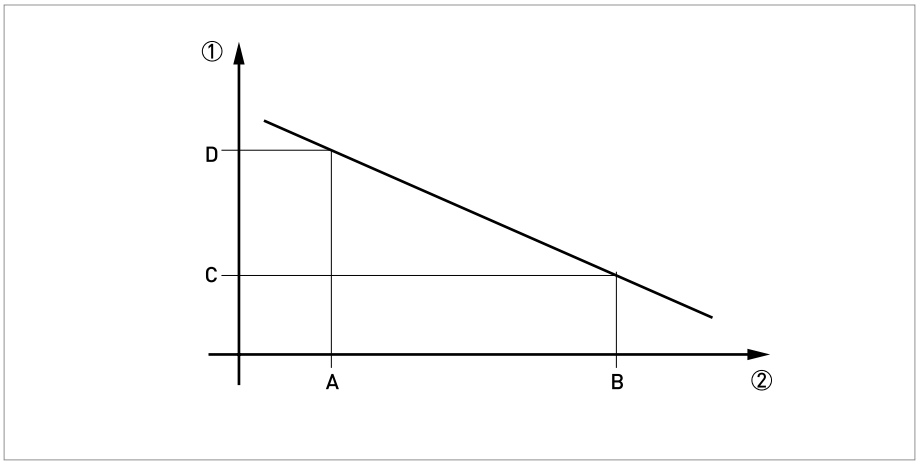


Figure 6-7: Calculating the density gradient

① Density
② Temperature

The following equation is used to calculate the density gradient:

$a = (p_D - p_C) / (T_B - T_A)$

The value for the density gradient is generally positive as an increase in temperature usually reduces the measured density(exception: water anomaly).

6.5.7 Pipe diameter (menu C1.1.3)

The converter can also provide the flow velocity based on a pipe diameter which the customer can freely program. This value can either be the inner diameter of the measuring tube (factory default) or the inner diameter of the process pipe.

6.5.8 Concentration measurement (menu C2)

This menu is used to enter the password to activate concentration measurement (in case the concentration option is purchased) after the meter is delivered.

INFORMATION!
Please refer to the separate concentration manual for further details of concentration measurement.

6.5.9 Flow direction (menu C1.3.1)

This function allows the operator to set the direction of flow in relation to the arrow on the sensor electronics housing. If "forward" is selected, the flow direction corresponds to the "+" arrow and with "backwards" the flow direction corresponds to the "-" arrow on the sensor electronics housing.

6.5.10 Pressure suppression

The pressure suppression eliminates any disruption in the measurement in the event of an abrupt flow switch-off e.g. when valves are suddenly closed. In such cases, surges may occur in the pipe and in the measuring device which could lead to over-vibration. The flow then "swings" back and forth before a stable zero flow is established, as shown in the figure below. This effect occurs mainly in high pressure applications.

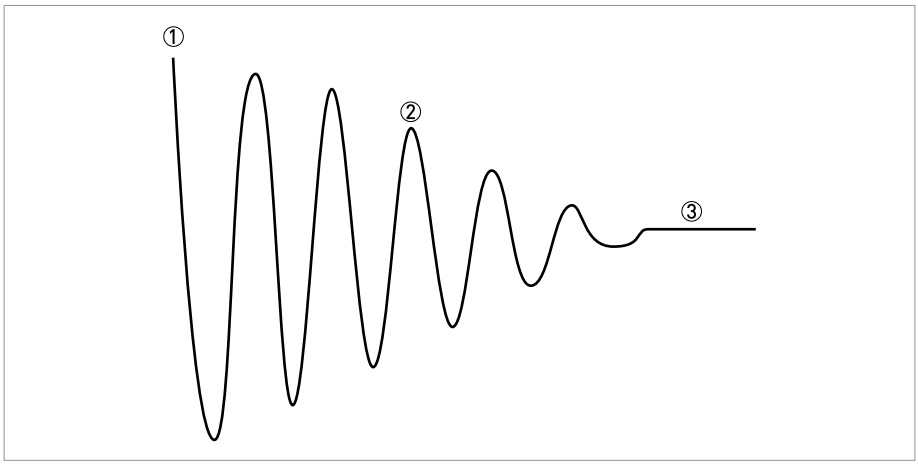


Figure 6-8: Vibration behaviour during pressure suppression

① Flow switched off
② Sinusoidal vibration ("over-vibration")
③ Stable zero flow

In most cases, the amplitude of this vibration is below the low flow cutoff and thus does not affect the measurement. In very few cases, the amplitude is greater than the low flow cutoff (over-vibration) and can cause errors with the counter values.

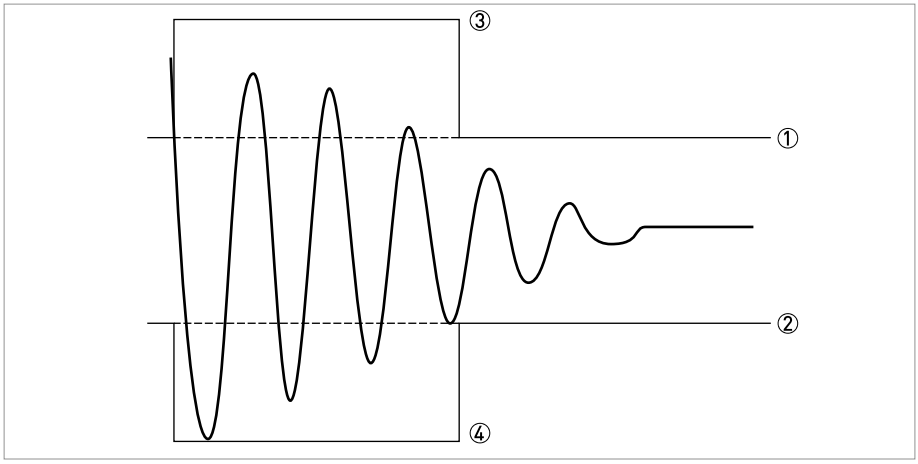


Figure 6-9: Amplitude behaviour

① Low flow cutoff
② Low flow cutoff
③ Pressure suppression
④ Pressure suppression

The pressure suppression function eliminates this effect by activating a larger low flow cutoff level for a short period of time. The pressure suppression is activated when the flow falls below the standard low flow cutoff level for the first time. For a programmable period of time, (can be programmed in menu C1.3.2), the pressure suppression threshold is added to the standard low flow threshold (can be set in menu C1.3.3).

The optimal setting values for pressure suppression depend on the current operating conditions and can thus only be determined on-site through testing.

6.5.11 Process control

Menu C1.4.1 - Function

This menu makes it possible to switch off certain measuring functions depending on a programmable process state. When this process state occurs (as set in Fct. C1.4.2), the following options can be activated:

- Inactive: Process control is off
- Flow = 0: Flow set to zero

Menu C1.4.2 - Condition

Selecting the process size which activates the process control. Density and temperature can be selected.

Menu C1.4.3 – Max Limit
Menu C1.4.4 – Min Limit

Setting the limit values to activate the process control. Current measuring values outside of this range activate this function.

6.5.12 2 phase threshold (Menu C1.5.3)

The threshold for the 2 phase signal can be set in this menu item. This makes it possible to output a status signal indicating the presence of gas bubbles in the process. There are no default values for this threshold. This means that the operator must adapt this value to suit his application. This can be done, for example, by programming the 2 phase signal at the current output and registering which threshold makes sense for the respective process for a certain time period.

Example regarding the detection and notification of a two-phase disturbed flow (e.g. gas bubbles in paints):

Fct.	Display	Description and setting
B2.13	2 Phase Signal	The 2-phase signal value can be read and transferred to Diagnosis 1.
C1.5.3	2 Ph. Threshold	Only input a value here if an error message is to be generated. This error message be output via the status outputs. The error message is then indicated on the display as **S: Out of specification** and **S: 2 phase flow**. Warning: Take into account the setting of the error conditions of the current output!
C1.5.4	Diagnosis 1	Set "2 Phase Signal".
C3.1.3	Terminals C	Set "Limit Switch".
C3.4.1	Measurement	Set "Diagnosis 1".
C3.4.2	Threshold	e.g. set to "2.0 ± 0.2%".
C3.4.3	Polarity	e.g. Set "Absolute Value".
C3.4.4	Time Constant	Set as needed.
C3.4.4	Invert Signal	Set as needed.
C6.4.1	2nd Meas. Page	Set "Three Lines".
C6.4.10	3rd Line Variable	Set "Diagnosis 1".
C6.4.11	3rd Line Format	Set "X.XX".

The 2 phase signal is displayed on the 2nd measuring page at the bottom with e.g.: 0.02%. If the threshold is exceeded (C3.4.2), a message is sent via terminals C.

6.5.13 Diagnosis values (menu C1.5.4...C1.5.6)

Selection of diagnosis values to appear on the display or to be programmed on the outputs.

6.5.14 Graphic page (menu C6.5)

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

- Menu C6.5.1 defines the range for the trend indicator (manual or automatic).
- Menu C6.5.2 defines the range for manual setting.
- Menu C6.5.3 defines the time span for the trend indicator.

6.5.15 Save settings (menu C6.6.2)

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

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

6.5.16 Load settings (menu C6.6.3)

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

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

6.5.17 Passwords (Menu 6.6.4 Quick Set; Menu 6.6.5 Setup)

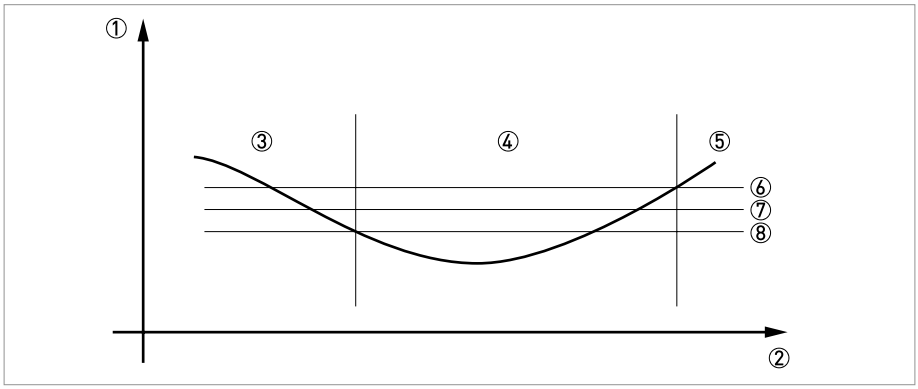
To create a password for the Quick Set menu or Setup menu, you must enter a 4-digit code into the menu. You are then prompted for this password every time changes are to be made to the corresponding menus. There is a hierarchy. The Setup password can also be used to perform changes in the Quick Setup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

6.5.18 Low flow cutoff

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

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

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



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

6.5.19 Time constant

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

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

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

6.5.20 Dual phase pulse output

A dual phase pulse or frequency output is often required for custody transfer applications. This operating mode requires 2 terminal pairs. Terminal pairs A and B or D and B can be used.

In this case, perform the following settings:

- C3.3.11: Phase shift to D or shift to A
- All functions for output B are set using output D or output A.
- C3.5.11: Setting phase shift from output B relative to D, if terminal pair D was selected in C3.3.11. 0°, 90° or 180° are offered as options.
- C3.2.11: Setting the phase shift from output B relative to A, if terminal pair A was selected in C3.3.11 0°, 90° or 180° are offered as options.

6.5.21 Timeouts in programming mode

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

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

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

6.5.22 Output hardware

Depending on the hardware modules used (see CG number), it may be possible to change the output options on terminals A, B, C or D in the menus C3.1.x. For example: A pulse output to a frequency output or a status output to a control input.

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

6.6 Status messages and diagnostic information

Operational faults in device

Messages on the display	Description	Actions
Status: F _ _ _ _ _	**Operational fault in device, mA output ≤ 3.6 mA or set fault current (depending on the seriousness of the fault), status output open, pulse / frequency output: no pulses**	**Repair necessary.**
F Device Error	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 (Fct. C6.6.3) (Backup 1, Backup 2 or Factory Settings). If status message still does not disappear, replace electronic unit.
F Parameter	Error, operational fault of data manager, electronic unit, parameter or hardware error. Parameters no longer usable.	
F IO 2	Error, operational fault in IO 2. Parameter or hardware error. No measurement possible.	
F configuration (also when changing modules)	Invalid configuration: display software, bus parameter or main software do not match existing configuration. This error also occurs when a module has been added or removed without confirming the configuration change.	After module change, confirm query for changed configuration. If device configuration unchanged: defective, replace electronic unit.
F display	Error, operational fault in display. Parameter or hardware error. No measurement possible.	Defective, replace electronic unit.
F SE Defective	Error, operational fault in sensor electronics (SE). Parameter or hardware error. No measurement possible.	Defective, replace electronic unit.
F Sensor: Global Data Error	Data error in the global data of the measuring sensor electronic equipment.	Load Settings (Fct. C6.6.3) (Backup 1, Backup 2 or Factory Settings). If status message still does not disappear, replace electronic unit.
F Sensor: Local Data Error	Data error in the local data of the measuring sensor electronic equipment.	Defective, replace electronic unit.
F SE Data Error	Data error in sensor electronics (SE).	Load Settings (Fct. C6.6.3) (Backup 1, Backup 2 or Factory Settings). If status message still does not disappear, replace electronic unit.
F Current Out A	Error, operational fault in current output for terminals A/B/C. Parameter or hardware error. No measurement possible.	Defective, replace electronic unit or input/output module (I/O module).
F Current Out B		
F Current Out C		
F SW User Interface	Fault revealed by CRC check of operation software.	Replace electronic unit.

Messages on the display	Description	Actions
Status: F _ _ _ _ _	**Operational fault in device, mA output ≤ 3.6 mA or set fault current (depending on the seriousness of the fault), status output open, pulse / frequency output: no pulses**	**Repair necessary.**
F SE Data Different	Sensor electronics (SE) and converter electronics (BE) have different parameters. The electronic insert has probably been replaced.	Copy the parameters from SE to BE or vice versa in Fct. C1.6.3. For detailed information refer to *Replacing the sensor or converter electronics* on page 122.
F SE Drive Failure	Error in sensor electronics (SE), drive amplitude no longer controllable.	Replace electronic unit.
F SE Wiring Error	Fault in wiring (remote version)	Check wiring and rectify.
F Interface PCB Failure	RAM or ROM error detected.	Replace electronic unit.
F Hardware Settings (also when changing modules)	The set hardware parameters do not match the identified hardware. A dialogue appears in the display.	Answer queries in dialogue mode, follow directions. After module change, confirm query for changed configuration. If device configuration unchanged: defective, replace electronic unit.
F Hardware Detection	Existing hardware cannot be identified. Defective or unknown modules.	Replace electronic unit.
F RAM/ROM error IO1	A RAM or ROM error is detected during the CRC check.	Defective, replace electronic unit or input/output module (I/O module).
F RAM/ROM error IO2		
F Fieldbus	Malfunction of the Fieldbus interface.	Defective, replace electronic unit or input/output module (I/O module).

Application Error

Messages on the display	Description	Actions
Status: F _ _ _ _ _	**Application fault, device OK, but measured values affected.**	**Application test or operator action necessary.**
F Application Error	Application-dependent fault, but device is OK.	Group message, when errors as described below or other application errors occur.
F Sensor Exceeding Limit	Mass flow is greater than max. flowrate. Accuracy is not guaranteed!	Reduce flowrate or increase meter size.
F Open Circuit A	Load on current output A/B/C too high, effective current too low.	Current not correct, mA output cable has open circuit or load too high. Check cable, reduce load (set < 1000 ohm).
F Open Circuit B		
F Open Circuit C		
F Over Range A	The current or the corresponding measured value is limited by a filter setting.	Check with Fct. C3.1 hardware or sticker in terminal compartment, which output is connected to the terminal. If current output: extend Fct. C3.x.6 range and Fct. C3.x.8 limitation. If frequency output: extend values in Fct. C3.x.5 and Fct. C3.x.7.
F Over Range B		
F Over Range C		
F Over Range D		
F Over Range A	The pulse rate or the corresponding measured value is limited by a filter setting. Or the demanded pulse rate is too high.	
F Over Range B		
F Over Range C		
F Over Range D		
F Wiring A	Wiring error.	Check connections at terminals A or B.
F Wiring B		
F Stop Mode	Device is in stop mode.	Check Fct A8.

Messages on the display	Description	Actions
Status: F _ _ _ _ _	**Application fault, device OK, but measured values affected.**	**Application test or operator action necessary.**
F SE Comms. Failure	Communication error with sensor electronics (SE). No measurement data available.	Check wiring and grounding. Replace electronics.
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		

Measurements out of specification

Messages on the display	Description	Actions
Status: S _ _ _ _ _	**Out of specification, measurement continues, accuracy possibly less.**	**Maintenance required.**
S Out Of Specification	Device maintenance necessary; measured values only conditionally usable.	Group message, when errors as described below or other influences occur.
S Overflow Totaliser 1	This is totaliser 1 or FB2 (with Profibus). Totaliser has overrun and started again at zero.	Check totaliser format.
S Overflow Totaliser 2	This is totaliser 2 or FB3 (with Profibus). Totaliser has overrun and started again at zero.	
S Overflow Totaliser 3	This is totaliser 3 or FB4 (with Profibus). Not available without IO2. Totaliser 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 SE PCB Temperature	Temperature on SE PCB is exceeding maximum limit.	Check process and ambient temperature. Check wiring. Exchange the sensor electronics (SE).
S Startup	The device is in startup mode. If the system cannot start from start-up mode or came into the startup mode from the measurement function, the message "F application error" also appears.	Check process conditions (air). Check device settings C1.7.1...C1.7.3. Check sensor resistances.
S Power Fail	For custody transfer applications. Indicates a failure of power supply. No measurement is possible during power failure.	
S Tube Temperature	Process temperature is outside limits of sensor. Failure of sensor may occur if prolonged.	Check settings C1.7.4 and C1.7.5. Reduce process temperature.
S Density	Process density is over range.	Check process conditions.
S Sensor Signal Error	DC component of measuring sensor signal is too high.	Check sensor resistances. Replace sensor.
S Res. Circ. Defective	Pt500 sensor is defective. Temperature measurement and compensation is unreliable.	Check sensor resistances. Replace sensor.
S Sensor Levels	Tube vibration amplitude too low.	Check the process conditions (air).

Messages on the display	Description	Actions
Status: S _ _ _ _ _	**Out of specification, measurement continues, accuracy possibly less.**	**Maintenance required.**
S 2 Phase Flow	2 phase signal is above the programmed threshold.	Check the process conditions (air).
S Interface PCB Fault	Error detected during self-monitoring of interface card. Possible causes: temperature in converter housing too high or blown fuse.	Check whether the converter is exposed to direct sunlight. Check the temperature in Fct. B2.15. Replace electronic unit.

Simulation of the measured values

Messages on the display	Description	Actions
Status: C _ _ _ _ _	**Output values partially simulated or fixed**	**Maintenance required.**
C Checks In Progress	Test mode of the device. Measured values are possibly simulated values or values with fixed settings.	Message depending on the situation via HART® or FDT. Depiction via display if outputs are held by control input or set to zero.
C Test XXXXX	Test of relevant unit activated.	
C Standby Mode	Device is in standby mode.	Check control input settings in A8.
C Sensor Electronics	A test function in the sensor electronics (SE) has been activated.	
C Zero Calibration	Zero calibration performed. Flow measurement interrupted.	

Information

Messages on the display	Description	Actions
Status: I _ _ _ _ _	**Information (current measurement OK)**	
I Totaliser 1 Stopped	This is totaliser 1 or FB2 (with Profibus). The totaliser has stopped.	If totaliser to continue counting, activate "yes" in Fct. C4.y.9 (start totaliser).
I Totaliser 2 Stopped	This is totaliser 2 or FB3 (with Profibus). The totaliser has stopped.	
I Totaliser 3 Stopped	This is totaliser 3 or FB4 (with Profibus). The totaliser 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. Totaliser did not run during it.
I Control Input A act.	This message appears when the control input is active. This message is for information only.	
I Control Input B act.		
I Over Range Display 1	1st line on page 1 (2) of display limited by filter setting.	Menu display Fct. C6.3 and/or C6.4, select 1st or 2nd meas. page and increase values in functions C6.z.3 range and/or C6.z.4 limitation
I Backplane Sensor	The data on the backplane are not usable because they have been generated with an incompatible version.	
I Backplane Settings	The global settings on the backplane are not usable because they have been 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 Optical Interface	The optical interface is being used. The keys on the local display are not in operation.	The keys are ready for operation again approx. 60 sec. after the end of the data transfer/removal of the optical interface.
I Write Cycles Overfl.	The maximum number of write cycles of the EEPROM or FRAMS on the Profibus DP PCB has been exceeded.	
I Baudrate Search	The baudrate of the Profibus DP interface is searched for.	
I No Data Exchange	There is no data exchange between the signal converter and the Profibus.	

6.7 Function tests and troubleshooting

Min. and max. recorded temperature (menu C1.5.1 / C1.5.2)

Stores the minimum and maximum value for the temperature occurring during sensor operating time.

Sensor type	Operating temperature	
	Minimum	Maximum
OPTIMASS 1000	-40°C / -40°F	130°C / 266°F
OPTIMASS 2000		
OPTIMASS 3000 (Stainless steel or Hastelloy®)	-30°C / -22°F	150°C / 302°F
OPTIMASS 7000 (titanium)	-40°C / -40°F	150°C / 302°F
OPTIMASS 7000 (Hastelloy®/tantalum)	0°C / 32°F	100°C / 212°F
OPTIMASS 7000 (stainless steel)	0°C / 32°F	100°C / 212°F 130°C / 266°F
OPTIMASS 8000 (depends on version)	-195°C / -310°F	230°C / 446°F

Application problems that may indicate errors in the signal converter:

- An improperly closed shut-off valve during zero calibration results in high calibration values
- Air/gas bubbles result in high energy levels and high calibration values
- Product deposits on the inside of the measuring tube lead to higher/lower density indications and high calibration values

Common errors (with corresponding symptoms):

- Slightly eroded or corroded measuring tube
  - Erroneous density measurement
  - High frequency
  - Measurement error at low mass flow
- Eroded or corroded measuring tube (product in the housing)
  - Measuring tube does not start
  - Low resistance to earth with conducting product
- Open circuits from activation and sensor coils, resistance thermometers (RTD) or strain gauge
  - Can be measured with ohmmeter

Typical frequency values (at 20°C / 68°F)

Size	Titanium		Stainless steel		Hastelloy®		Tantalum	
	Empty	Water	Empty	Water	Empty	Water	Empty	Water
1000 - 15			438±10	412±10				
1000 - 25			605±20	523±20				
1000 - 40			494±10	414±10				
1000 - 50			583±10	453±10				
2000 - 100			341±6	267±6				
2000 - 150			330±6	259±6				
2000 - 250			299±6	227±6				
3000 - 01			258±6	251±6	266±6	258±6		
3000 - 03			320±6	310±6	320±6	310±6		
3000 - 04			455±6	435±6	455±6	435±6		
7000 - 06	316±10	301±10	374±10	362±10				
7000 - 10	406±10	371±10	441±10	417±10	439±10	416±10	348±10	330±10
7000 - 15	502±10	432±10	578±10	519±10	566±10	509±10	430±10	394±10
7000 - 25	614±10	483±10	692±10	580±10	687±10	581±10	515±10	449±10
7000 - 40	462±10	367±10	558±10	467±10	556±10	468±10	417±10	360±10
7000 - 50	488±10	357±10	514±10	418±10	539±10	431±10	403±10	333±10
7000 - 80	480±10	338±10	490±10	370±10	493±10	381±10		
8000 - 15			226±3	202±3				
8000 - 25			280±3	242±3				
8000 - 40			271±3	238±3				
8000 - 80			241±3	22±3				
8000 - 100			264±3	228±3				

Problems with zero calibration

① Stop the flow.
② Set the counter in Fct. C3.y.1 to totaliser.
③ Set the low flow cutoff in Fct. C3.y.3 to zero.
④ Perform automatic zero calibration.
⑤ Reset totaliser and count for 2 minutes.
⑥ Compare the added value to the specified zero calibration stability.

INFORMATION!
For best results, perform zero calibration with the medium at operating temperature.

Possible causes of poor zero calibration:

- Valves not completely closed, air or gas bubbles or deposits on measuring tube

6.8 Diagnostic functions

The following diagnostic functions are available in test menu B2.

6.8.1 Temperature (menu B2.6)

Temperature display in °C or °F. This value should be steadily displayed.

6.8.2 Strain (menu B2.7 strain MT / B2.8 strain IC)

Resistance of strain gauge (strain) in ohms. For value range refer to *Driver or sensor coil fault* on page 125.
If strain values fluctuate greatly even after setting a relatively constant temperature, the strain gauge may have detached itself as a result of constant use of the device at excessive temperatures (Contact the manufacturer's service department).

6.8.3 Frequency (menu B2.9)

- Fluctuation in the first decimal places indicate gas or air bubbles in the product.
- Worn or eroded measuring tube: frequency increases by around 2...4 Hz; recalibration required.
- A build-up of deposits can also change the vibration frequency.
- Large fluctuations in frequency occur in the "start-up" phase.

6.8.4 Drive level (menu B2.10)

Display of the drive energy in percent.

Typical values for drive energy in water and with no gas inclusions

OPTIMASS 1000	All sizes	0...6
OPTIMASS 2000	All sizes	0...5
OPTIMASS 3000	All sizes	0...5
OPTIMASS 7000	06...40	0...6
	50...80	4...10
OPTIMASS 8000	All sizes	0...5

INFORMATION!
Higher values for drive energy can occur when the product contains air or gas bubbles or when measuring products with high viscosity or density.

6.8.5 Sensor levels A and B (menu B2.11, B2.12)

Normal display values:

- 80% for OPTIMASS 7000 - sizes 06...40 and OPTIMASS 1000 - sizes 15...40
- 60% for OPTIMASS 7000 - sizes 50...80
- 60% for OPTIMASS 1000 - size 50
- 60% for OPTIMASS 2000 - size 100
- 60% for OPTIMASS 8000 - all sizes
- 50% for OPTIMASS 2000 - size 150 and 250
- 40% for OPTIMASS 3000 - all sizes

INFORMATION!
The sensor levels for A and B should not differ by more than 2%.

6.8.6 2 phase signal (menu B2.13)

The value of the 2 phase signal can be read in this function. For applications that must detect 2 phase flow, an alarm level can be programmed. This alarm level depends on the application and the process and can thus only be set on-site under current operating conditions during flow. For detailed information refer to *2 phase threshold (Menu C1.5.3)* on page 109.

6.8.7 SE board or BE board temperature (menu B2.14 or B2.15)

SE board temperature: indicates the temperature of the sensor electronics.
BE board temperature: indicates the temperature of the converter electronics

7.1 Replacing the sensor or converter electronics

DANGER!
*The power supply **MUST be switched off** before replacing the electronics.*

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.

DANGER!
Observe the waiting period for Ex devices.

INFORMATION!
To make replacement easier, a complete copy of the calibration coefficients saved in the sensor electronics is also stored in the converter (back end). This means that the replacement can take place without having to enter the calibration coefficients again or having to recalibrate.

7.1.1 Replacing the sensor electronics (SE)

- Remove the 4 screws at the rear of the sensor electronics.
- Take the sensor electronics straight off **WITHOUT** tilting it or tipping it from side to side as this could damage the plugs and sockets and connections.
  Do not lose the seal for the sensor electronics.
- Put the seal back in clean and when putting back the sensor electronics ensure that the connectors glide into one another easily before pressing the sensor electronics on.
  Do not damage the connector.
- Screw the sensor electronics back on properly.
  We recommend applying Loctite or a similar adhesive to the screws.

7.1.2 Replacing the signal converter electronics (BE)

DANGER!
Work on the signal converter electronics may only be performed when disconnected from the power supply.

- Remove the front panel. Use a small screwdriver to open the plastic clips that hold the display.
- Remove the 2 locking screws.
- Remove the electronics by pulling sideways on the plastic housing.

➲ The signal converter electronics slide out easily once they have become detached from the backplane PCB.

- To insert the new electronics, slide them back into the housing, retighten the two screws and attach the display.

The measuring system recognises the hardware replacement when the power supply is switched on. Following replacement of the sensor electronics (SE), or the entire sensor including electronics or the signal converter electronics (BE), the device indicates a "fatal" error status. In this case, the menu features various options depending on the status detected.

Message	Cause	Troubleshooting actions
SE Data Invalid	The calibration data stored in the sensor electronics (SE) is invalid. Possible causes: - The SE is unconfigured, containing only factory default settings - Corrupt data set	**No action:** Same situation following restart **Copy BE data:** Copy data saved in BE to SE. If the data does not belong to the connected measuring sensor, enter this data prior to copying.
BE Data Invalid	The calibration data stored in the signal converter (BE) is invalid. New electronics have been inserted.	**No action:** Same situation following restart **Copy SE data:** If the calibration data in the SE does not belong to the connected measuring sensor, do not use "Copy SE data". You **MUST** enter the correct data into the BE. This requires a restart afterwards and the status message reads: "SE Data Invalid".
SE Data Different	The calibration data from SE are different from those in BE. It is most likely that a new measuring sensor with new SE has been installed but it could also be that a new SE was installed that has already been programmed for a different measuring sensor.	**No action:** Same situation following restart **Copy SE data:** The calibration data stored in SE are copied to the device. This should be the standard procedure in the event that a measuring sensor including SE is replaced. Upon confirmation, the system restarts and uses the calibration data of the new measuring sensor as calibration data. **Delete SE data:** Program the SE as "unconfigured". Upon confirmation, the system restarts and displays the message "SE Data Invalid".

INFORMATION!
Under certain circumstances, 2 confirmations are necessary (e.g.: "SE Data Invalid" and then "Copy BE Data"). This is in place to prevent the correct data from being inadvertently overwritten.

7.2 Driver or sensor coil fault

Typical inductance and resistance values

7.2.1 OPTIMASS 1000

The specified values are for guidance only.

Size	Resistance (Ohm)	
	Driver	Sensor A/B
15	220	78
25	220	64
40	163	78
50	163	64
15-Ex	220	78
25-Ex	220	64
40-Ex	94	78
50-Ex	94	64

- Driver = black and grey
- Sensor A = white and yellow
- Sensor B = green and violet
- Pt500 = red and blue (530...550 Ω) at ambient temperature
- Strain values measuring tube = 420...560 Ω
- Resistance values outside of the ranges specified above may indicate a circuit error. The device may be in "start-up" mode or indicate measuring errors.
- All circuits should be isolated with respect to earth (device housing) and each other >20 MΩ.
- An exciter/sensor coil short circuit may cause the meter to be in "start-up" mode.

INFORMATION!
Failure of two or more of the upper circuits may indicate a measuring tube error. There may be product in the housing. If this is the case, ***depressurise*** *the process line and immediately remove the measuring device from the process line.*

7.2.2 OPTIMASS 2000

The specified values are for guidance only.

Size	Resistance (Ohm)	
	Driver	Sensor A/B
100	105	108
150	105	78
250	105	78

- Driver = black and grey
- Sensor A = white and yellow
- Sensor B = green and violet
- Pt500 = red and blue (530…550 Ω) at ambient temperature
- Strain values measuring tube = 420...560 Ω
- Resistance values outside of the ranges specified above may indicate a circuit error. The device may be in "start-up" mode or indicate measuring errors.
- All circuits should be isolated with respect to earth (device housing) and each other >20 MΩ.
- An exciter/sensor coil short circuit may cause the meter to be in "start-up" mode.

INFORMATION!
Failure of two or more of the upper circuits may indicate a measuring tube error. There may be product in the housing. If this is the case, ***depressurise*** *the process line and immediately remove the measuring device from the process line.*

7.2.3 OPTIMASS 3000

The specified values are for guidance only.
Damaged magnetic coil: inductance values in parentheses.

Size	Inductance (mH)		Resistance (Ohm)	
	Driver	Sensor A/B	Driver	Sensor A/B
01	1.2 (0.6)	7.4	57	107
03 / 04	2.4 (1.2)	10.1	47	135

- Driver = black/violet and grey/orange
- Sensor A = white and yellow
- Sensor B = green and yellow
- Pt500 = red and blue (530...550 Ω) at ambient temperature
- Resistance values outside of the ranges specified above may indicate a circuit error. The device may be in "start-up" mode or indicate measuring errors.
- All circuits should be isolated with respect to earth (device housing) and each other >20 MΩ.
- An exciter/sensor coil short circuit may cause the meter to be in "start-up" mode.

INFORMATION!
Failure of two or more of the upper circuits may indicate a measuring tube error. There may be product in the housing. If this is the case, ***depressurise*** *the process line and immediately remove the measuring device from the process line.*

7.2.4 OPTIMASS 7000

The specified values are for guidance only.

Size	Resistance (Ohm)	
	Driver	Sensor A/B
06 / 10	40	142
15	49	142
25	41	142
40 / 50 / 80	100	142

- Driver = black and grey
- Sensor A = white and yellow
- Sensor B = green and violet
- Pt500 = red and blue (530…550 Ω) at ambient temperature
- Resistance values outside of the ranges specified above may indicate a circuit error. The device may be in "start-up" mode or indicate measuring errors.
- All circuits should be isolated with respect to earth (device housing) and each other >20 MΩ.
- An exciter/sensor coil short circuit may cause the meter to be in "start-up" mode.

Strain MT = red and brown	OPTIMASS 7000 - all sizes	420...560 Ω at ambient temperature
Strain IC = brown and orange	OPTIMASS 7000 - 06...10	225...275 Ω at ambient temperature
	OPTIMASS 7000 - 15...80	Short circuited

INFORMATION!
Failure of two or more of the upper circuits may indicate a measuring tube error. There may be product in the housing. If this is the case, ***depressurise*** *the process line and immediately remove the measuring device from the process line.*

7.2.5 OPTIMASS 8000k

The specified values are for guidance only.

Size	Resistance (Ohm)	
	Driver	Sensor A/B
15	65	123
25	117	110
40	80	110
80	80	140
100	120	110

- Driver = black and grey
- Sensor A = white and yellow
- Sensor B = violet and green
- Pt500 = red and violet (530...550 Ω) at ambient temperature
- Resistance values outside of the ranges specified above may indicate a circuit error. The device may be in "start-up" mode or indicate measuring errors.
- All circuits should be isolated with respect to earth (device housing) and each other >20 MΩ.
- An exciter/sensor coil short circuit may cause the meter to be in "start-up" mode.

INFORMATION!
Failure of two or more of the upper circuits may indicate a measuring tube error. There may be product in the housing. If this is the case, ***depressurise*** *the process line and immediately remove the measuring device from the process line.*

7.3 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.

7.4 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 representative.

7.5 Returning the device to the manufacturer

7.5.1 General information

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

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

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

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

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

7.5.2 Form (for copying) to accompany a returned device

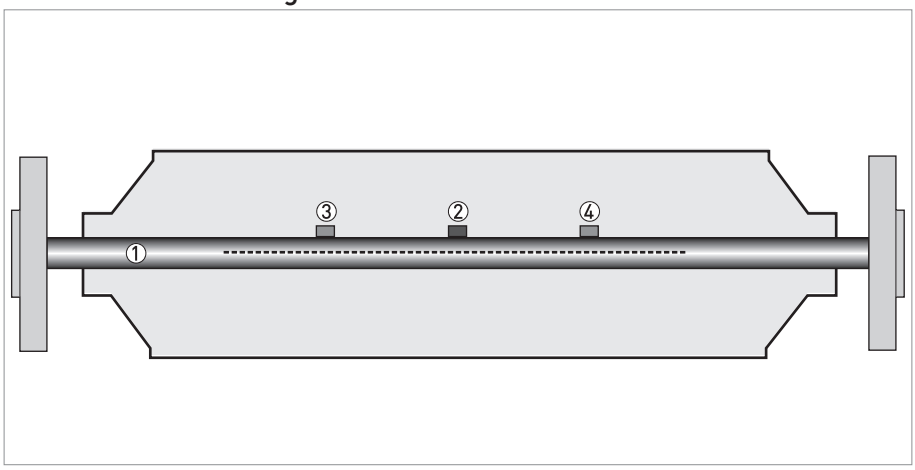
Company:		Address:
Department:		Name:
Tel. no.:		Fax no.:
Manufacturer's order no. or serial no.:		
The device has been operated with the following medium:		
This medium is:		water-hazardous
		toxic
		caustic
		flammable
		We checked that all cavities in the device are free from such substances.
		We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

7.6 Disposal

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

8.1 Measuring principle (single tube)

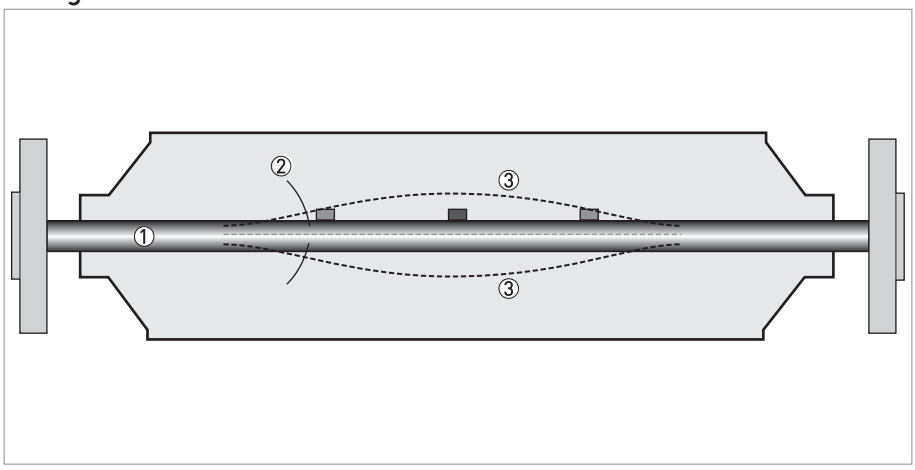
Static meter not energised and with no flow



① Measuring tube
② Drive coil
③ Sensor 1
④ Sensor 2

A Coriolis single tube mass flowmeter consists of a single measuring tube ① a drive coil ② and two sensors (③ and ④) that are positioned either side of the drive coil.

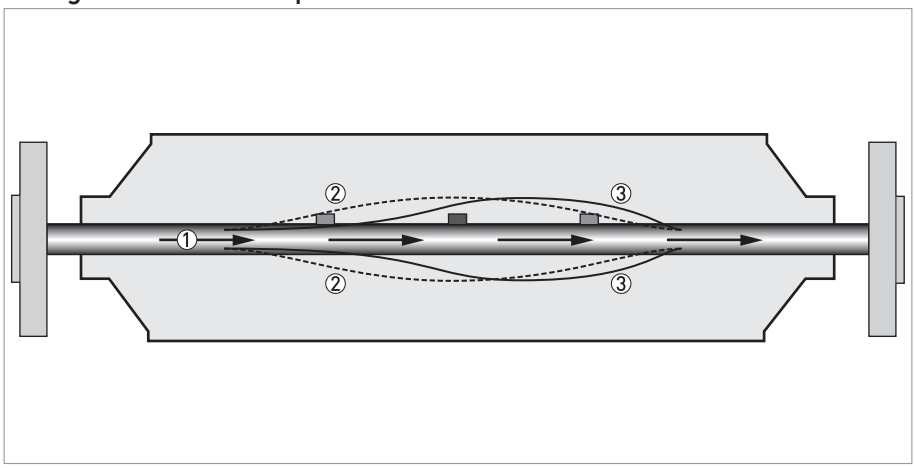
Energised meter



① Measuring tubes
② Direction of oscilation
③ Sine wave

When the meter is energised, the drive coil vibrates the measuring tube causing it to oscillate and produce a sine wave ③. The sine wave is monitored by the two sensors.

Energised meter with process flow



① Process flow
② Sine wave
③ Phase shift

When a fluid or gas passes through the tube, the coriolis effect causes a phase shift in the sine wave that is detected by the two sensors. This phase shift is directly proportional to the mass flow.

Density measurement is made by evaluation of the frequency of vibration and temperature measurement is made using a Pt500 sensor.

8.2 Technical data

INFORMATION!

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

Measuring system

Measuring principle	Coriolis principle
Application range	Measurement of mass flow, density, temperature, volume flow, flow velocity, concentration

Design

Modular construction	The measuring system consists of a measuring sensor and a signal converter.
Measuring sensor	
OPTIMASS 1000	DN15…50 / ½…2"
OPTIMASS 2000	DN100...250 / 4...10"
OPTIMASS 3000	DN01…04 / 1/25...4/25"
OPTIMASS 7000	DN06…80 / ¼…3"
OPTIMASS 8000	DN15…100 / ½…4"
	All measuring sensors are also available as Ex versions.
Signal converter	
Compact version (C)	OPTIMASS x300 C (x = 1, 2, 3, 7 or 8)
Field housing (F) - remote version	MFC 300 F
Wall-mounted housing (W) - remote version	MFC 300 W
19" rack-mounted housing (R) - remote version	MFC 300 R
	Compact and field housing versions are also available as Ex versions.
Options	
Outputs / inputs	Current output (incl. HART®), pulse output, frequency output, and/or status output, limit switch and/or control input (depending on the I/O version)
Counters	2 (optional 3) internal counters with a max. of 8 counter places (e.g. for counting volume and/or mass units)
Verification	Integrated verification, diagnostic functions: measuring device, process, measured value, stabilisation
Concentration measurement	Concentration and concentration flow
Communication interfaces	Foundation Fieldbus, Profibus PA and DP, Modbus, HART®

Display and user interface	
Graphic display	LC display, backlit white.
	Size: 128x64 pixels, corresponds to 59x31 mm = 2.32"x1.22"
	Display turnable in 90° steps.
	Ambient temperatures below -25°C / -13°F may affect the readability of the display.
Operating elements	4 optical keys for operator control of the signal converter without opening the housing.
	Infrared interface for reading and writing all parameters with IR interface (option) without opening the housing.
Remote control	PACTware® (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 measured value pages, 1 status page, 1 graphics page (measured values and graphics are freely adjustable)
Language display texts (as language package)	Standard: English, French, German, Dutch, Portuguese, Swedish, Spanish, Italian
	Eastern Europe (in preparation): English, Slovenian, Czech, Hungarian
	Northern Europe (in preparation): English, Danish, Polish
	China (in preparation): English, Chinese
	Russia: English, Russian
Measurement functions	**Units:** Metric, British and US units selectable as desired from lists for volume/mass flow and counting, velocity, temperature, pressure
	Measured values: Mass flow, total mass, temperature, density, volume flow, total volume, velocity, flow direction (not displayed unit – but available via outputs), BRIX, Baume, NaOH, Plato, API, mass concentration, volume concentration
Diagnostic functions	**Standards:** according to VDI / NAMUR / WIB 2650 (pending) and functions going beyond that
	Status messages: Output of status messages optional via display, current and/or status output, HART® or bus interface
	Sensor diagnostics: Sensor values, drive level, measuring tube frequency, MT (measuring tube) strain, IC (inner cylinder) strain, sensor electronics/board electronics temperature, 2-phase flow signal

Measurement accuracy

Reference conditions	Medium: water
	Temperature: 20°C / 68°F
	Pressure: 1 bar / 14.5 psi
Maximum measuring error	±0.10% of the measured value ± zero point stability (depending on the measuring sensor)
	Current output electronics: ±5 µA
Repeatability	±0.05% ± zero point stability (depending on the measuring sensor)

Operating conditions

Temperature	
Process temperature	Refer to technical data for the measuring sensor.
Ambient temperature	Depending on the version and combination of outputs.
	It is a good idea to protect the 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
	Stainless steel housing: -40...+55°C / -40...+131°F
	Ambient temperatures below -25°C / -13°F may affect the readability of the display.
Storage temperature	-50...+70°C / -58...+158°F
Pressure	
Medium	Refer to technical data for the measuring sensor.
Ambient pressure	Atmosphere
Media properties	
State of aggregation	Liquids, gases and slurries
Flow rate	Refer to technical data for the measuring sensor.
Other conditions	
Protection category acc. to IEC 529/ EN 60529	C (compact version) & F (field housing): IP66/67 (acc. to NEMA 4/4X)
	W (wall-mounted housing): IP 65 (acc. to NEMA 4/4x)
	R (19" rack-mounted housing): IP20 (acc. to NEMA 1)

Installation conditions

Installation	For detailed information, refer to chapter "Installation conditions".
Dimensions and weights	For detailed information refer to section "Dimensions and weights".

Materials

Signal converter housing	**Standard**
	Versions C and F: die-cast aluminium (polyurethane coated)
	Version W: polyamide-polycarbonate
	Version R: aluminium, stainless steel and aluminium sheet, partially polyester-coated
	Option
	Versions C and F: stainless steel 316 L (1.4408)
Measuring sensor	For housing material, process connections, measuring tubes, accessories and gaskets, refer to technical data for the measuring sensor.

Electrical connection

General	Electrical connection is carried out in conformity with the VDE 0100 directive "Regulations for electrical power installations with line voltages up to 1000 V" or equivalent national regulations.
Power supply	Standard: 100...230 VAC (-15% / +10%), 50/60 Hz
	Option 1: 24 VDC (-55% / +30%)
	Option 2: 24 VAC/DC (AC: -15% / +10%, 50/60 Hz; DC: -25% / +30%)
Power consumption	AC: 22 VA
	DC: 12 W
Signal cable	Only for remote versions.
	4 core shielded cable. Detailed specifications available on request.
	Length: max. 300 m / 1000 ft
Cable entries	Standard: M20 x 1.5 (8...12 mm)
	Option: ½" NPT, PF ½

Inputs and outputs

General	All outputs are electrically isolated from each other and from all other circuits.		
	All operating data and output values can be adjusted.		
Description of abbreviations	U_{ext} = external voltage; R_L = load + resistance; U_o = terminal voltage; I_{nom} = nominal current Safety limit values (Ex i): U_i = max. input voltage; I_i = max. input current; P_i = max. input power rating; C_i = max. input capacity; L_i = max. input inductivity		
Current output			
Output data	Volume flow, mass flow, temperature, density, flow velocity, diagnostic value, 2-phase signal		
	Concentration and concentration flow are also possible with available concentration measurement (optional).		
Temperature coefficient	Typically ±30 ppm/K		
Settings	**Without HART®**		
	Q = 0%: 0…20 mA; Q = 100%: 10…20 mA		
	Error identification: 3…22 mA		
	With HART®		
	Q = 0%: 4…20 mA; Q = 100%: 10…20 mA		
	Error identification: 3…22 mA		
Operating data	**Basic I/Os**	**Modular I/Os**	**Ex i**
Active	$U_{int, nom}$ = 24 VDC I ≤ 22 mA R_L ≤ 1 kΩ		$U_{int, nom}$ = 20 VDC I ≤ 22 mA R_L ≤ 450 Ω
			U_0 = 21 V I_0 = 90 mA P_0 = 0.5 W C_0 = 90 nF / L_0 = 2 mH C_0 = 110 nF / L_0 = 0.5 mH
Passive	U_{ext} ≤ 32 VDC I ≤ 22 mA U_0 ≤ 1.8 V R_L ≤ (U_{ext} - U_0) / I_{max}		U_{ext} ≤ 32 VDC I ≤ 22 mA U_0 ≤ 4 V R_L ≤ (U_{ext} - U_0) / I_{max}
			U_i = 30 V I_i = 100 mA P_i = 1 W C_I = 10 nF L_i ~ 0 mH

HART®			
Description	HART® protocol via active and passive current output		
	HART® version: V5		
	Universal HART® parameter: completely integrated		
Load	≥ 250 Ω at HART® test point; Note maximum load for current output!		
Multidrop operation	Yes, current output = 4 mA		
	Multidrop addresses adjustable in operation menu 1...15		
Device driver	Available for FC 375, AMS, PDM, FDT/DTM		
Registration (HART Communication Foundation)	Yes		
Pulse or frequency output			
Output data	Pulse output: volume flow, mass flow, mass or volume of dissolved substance during activated concentration measurement		
	Frequency output: flow velocity, mass flow, temperature, density, diagnostic value Optional: concentration, flow of the dissolved substance		
Function	Can be set as a pulse output or frequency output		
Pulse rate/frequency	0.01...10000 pulses/s or Hz		
Settings	Mass or volume per pulse or max. frequency for 100% flow		
	Pulse width: setting automatic, symmetric or fixed (0.05...2000 ms)		
Operating data	**Basic I/Os**	**Modular I/Os**	**Ex-i**
Active	-	U_{nom} = 24 VDC	-
		f_{max} in operating menu set to $f_{max} \leq 100$ Hz: I ≤ 20 mA open: I ≤ 0.05 mA closed: $U_{0, nom}$ = 24 V at I = 20 mA	
		f_{max} in operating menu set to 100 Hz < $f_{max} \leq$ 10 kHz: I ≤ 20 mA open: I ≤ 0.05 mA closed: $U_{0, nom}$ = 22.5 V at I = 1 mA $U_{0, nom}$ = 21.5 V at I = 10 mA $U_{0, nom}$ = 19 V at I = 20 mA	

Passive	$U_{ext} \leq 32$ VDC		-
	f_{max} in operating menu set to $f_{max} \leq 100$ Hz: $I \leq 100$ mA open: $I \leq 0.05$ mA at $U_{ext} = 32$ VDC closed: $U_{0, max} = 0.2$ V at $I \leq 10$ mA $U_{0, max} = 2$ V at $I \leq 100$ mA		
	f_{max} in operating menu set to 100 Hz < $f_{max} \leq 10$ kHz: $I \leq 20$ mA open: $I \leq 0.05$ mA at $U_{ext} = 32$ VDC closed: $U_{0, max} = 1.5$ V at $I \leq 1$ mA $U_{0, max} = 2.5$ V at $I \leq 10$ mA $U_{0, max} = 5.0$ V at $I \leq 20$ mA		
NAMUR	-	Passive to EN 60947-5-6 open: $I_{nom} = 0.6$ mA closed: $I_{nom} = 3.8$ mA	Passive to EN 60947-5-6 open: $I_{nom} = 0.43$ mA closed: $I_{nom} = 4.5$ mA
			$U_i = 30$ V $I_i = 100$ mA $P_i = 1$ W $C_i = 10$ nF $L_i \sim 0$ mH
Low flow cut off			
Function	Switching point and hysteresis separately adjustable for each output, counter and the display		
Switching point	Set in increments of 0.1.		
	0…20% (current output, frequency output)		
Hysteresis	Set in increments of 0.1.		
	0…5% (current output, frequency output)		
Time constant			
Function	The time constant corresponds to the elapsed time until 67% of the end value has been reached according to a step function.		
Settings	Set in increments of 0.1.		
	0…100 s		

Status output / limit switch			
Function and settings	Adjustable as automatic measuring range conversion, display of flow direction, overflow, error, switching point		
	Valve control with activated dosing function		
	Status and/or control: ON or OFF		
Operating data	**Basic I/Os**	**Modular I/Os**	**Ex i**
Active	-	U_{int} = 24 VDC I ≤ 20 mA open: I ≤ 0.05 mA closed: $U_{0, nom}$ = 24 V at I = 20 mA	-
Passive	U_{ext} ≤ 32 VDC I ≤ 100 mA open: I ≤ 0.05 mA at U_{ext} = 32 VDC closed: $U_{0, max}$ = 0.2 V at I ≤ 10 mA $U_{0, max}$ = 2 V at I ≤ 100 mA	U_{ext} = 32 VDC I ≤ 100 mA $R_{L, max}$ = 47 kΩ $R_{L, min}$ = (U_{ext} - U_0) / I_{max} open: I ≤ 0.05 mA at U_{ext} = 32 VDC closed: $U_{0, max}$ = 0.2 V at I ≤ 10 mA $U_{0, max}$ = 2 V at I ≤ 100 mA	-
NAMUR	-	Passive to EN 60947-5-6 open: I_{nom} = 0.6 mA closed: I_{nom} = 3.8 mA	Passive to EN 60947-5-6 open: I_{nom} = 0.43 mA closed: I_{nom} = 4.5 mA
			U_i = 30 V I_i = 100 mA P_i = 1 W C_i =10 nF L_i = 0 mH

Control input			
Function	Hold value of the outputs (e.g. for cleaning work), set value of the outputs to "zero", counter and error reset, stop counter, range conversion, zero calibration		
	Start of dosing when dosing function is activated.		
Operating data	**Basic I/Os**	**Modular I/Os**	**Ex i**
Active	-	U_{int} = 24 VDC Ext. contact open: $U_{0, nom}$ = 22 V Ext. contact closed: I_{nom} = 4 mA Contact closed (On): $U_0 \geq$ 12 V with I_{nom} = 1.9 mA Contact open (Off): $U_0 \leq$ 10 V with I_{nom} = 1.9 mA	-
Passive	8 V ≤ U_{ext} ≤ 32 VDC I_{max} = 6.5 mA at $U_{ext} \leq$ 24 VDC I_{max} = 8.2 mA at $U_{ext} \leq$ 32 VDC Contact closed (On): $U_0 \geq$ 8 V with I_{nom} = 2.8 mA Contact open (Off): $U_0 \leq$ 2.5 V with I_{nom} = 0.4 mA	3 V ≤ U_{ext} ≤ 32 VDC I_{max} = 9.5 mA at $U_{ext} \leq$ 24 V I_{max} = 9.5 mA at $U_{ext} \leq$ 32 V Contact closed (On): $U_0 \geq$ 3 V with I_{nom} = 1.9 mA Contact open (Off): $U_0 \leq$ 2.5 V with I_{nom} = 1.9 mA	$U_{ext} \leq$ 32 VDC I ≤ 6 mA at U_{ext} = 24 V I ≤ 6.6 mA at U_{ext} = 32 V On: $U_0 \geq$ 5.5 V or I ≥ 4 mA Off: $U_0 \leq$ 3.5 V or I ≤ 0.5 mA U_i = 30 V I_i = 100 mA P_i = 1 W C_i = 10 nF L_i = 0 mH
NAMUR	-	Active to EN 60947-5-6 Terminals open: $U_{0, nom}$ = 8.7 V Contact closed (On): $U_{0, nom}$ = 6.3 V with I_{nom} > 1.9 mA Contact open (Off): $U_{0, nom}$ = 6.3 V with I_{nom} < 1.9 mA Detection of cable break: $U_0 \geq$ 8.1 V with I ≤ 0.1 mA Detection of cable short circuit: $U_0 \leq$ 1.2 V with I ≥ 6.7 mA	-

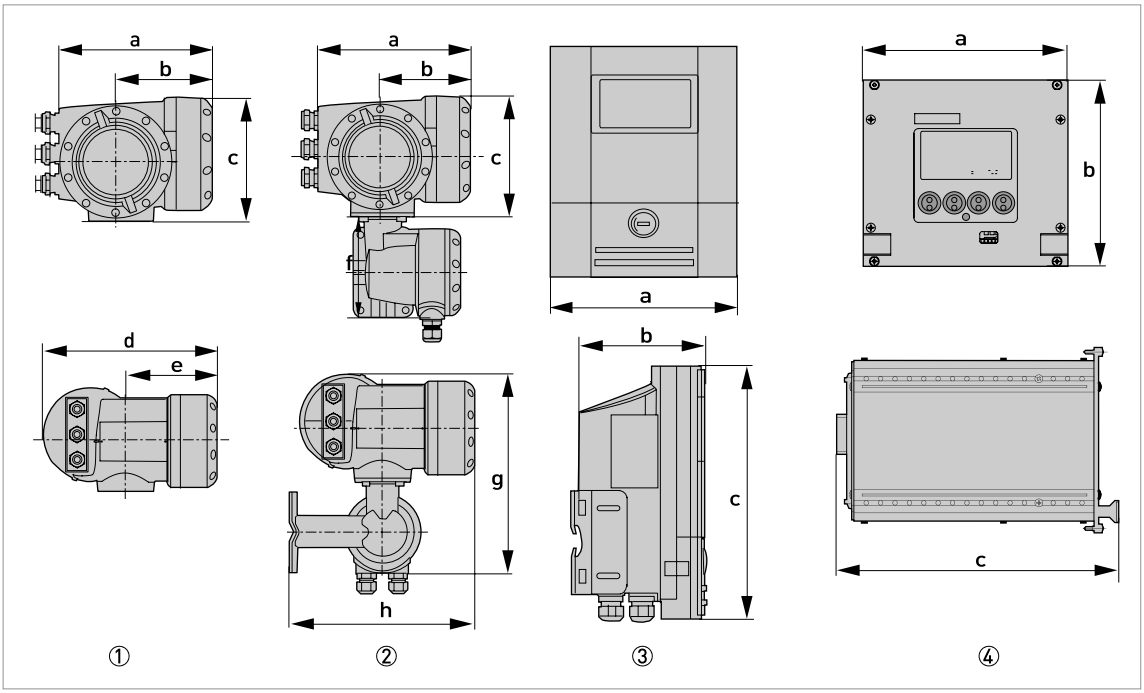
PROFIBUS DP	
Description	Galvanically isolated acc. to IEC 61158
	Profile version: 3.01
	Automatic data transmission rate recognition (max. 12 MBaud)
	Bus address adjustable via local display at the measuring device
Function blocks	8 x analogue input, 3 x totaliser
Output data	Mass flow, volume flow, mass counter 1 + 2, volume counter, product temperature, several concentration measurements and diagnostic data
PROFIBUS PA	
Description	Galvanically isolated acc. to IEC 61158
	Profile version: 3.01
	Current consumption: 10.5 mA
	Permissible bus voltage: 9...32 V; in Ex application: 9...24 V
	Bus interface with integrated reverse polarity protection
	Typical error current FDE (Fault Disconnection Electronic): 4.3 mA
	Bus address adjustable via local display at the measuring device
Function blocks	8 x analogue input, 3 x totaliser
Output data	Mass flow, volume flow, mass counter 1 + 2, volume counter, product temperature, several concentration measurements and diagnostic data
FOUNDATION Fieldbus	
Description	Galvanically isolated acc. to IEC 61158
	Current consumption: 10.5 mA
	Permissible bus voltage: 9...32 V; in Ex application: 9...24 V
	Bus interface with integrated reverse polarity protection
	Link Master function (LM) supported
	Tested with Interoperable Test Kit (ITK) version 5.1
Function blocks	6 x analogue Input, 3 x integrator, 1 x PID
Output data	Mass flow, volume flow, density, temperature of tube, several concentration measurements and diagnostic data
MODBUS	
Description	Modbus RTU, Master / Slave, RS485
Address range	1…247
Supported function codes	01, 03, 04, 05, 08, 16
Broadcast	Supported with function code 16
Supported Baudrate	1200, 2400, 4800, 9600, 19200, 38400, 57600, 115200 Baud

Approvals and certificates

CE	The device fulfils the statutory requirements of the EC directives. The manufacturer certifies that these requirements have been met by applying the CE marking.
Non-Ex	Standard
Hazardous areas	
Option (only version C)	
ATEX	II 2 G Ex d [ib] IIC T6....T1
	II 2 G Ex de [ib] IIC T6....T1
	II 2 D Ex tD A21 IP6x T160°C (dep. on the measuring sensor) without heating jacket or sensor insulation
	II 2 D Ex tD A21 IP6x T170°C (dep. on the measuring sensor) with heating jacket and sensor insulation
	II 2(1) G Ex d [ia/ib] IIC T6....T1
	II 2(1) G Ex de [ia/ib] IIC T6....T1
	II 2(1) D Ex tD [iaD] A21 IP6x T160°C (dep. on the measuring sensor) without heating jacket or sensor insulation
	II 2(1) D Ex tD [iaD] A21 IP6x T170°C (dep. on the measuring sensor) with heating jacket and sensor insulation
Option (F version only)	
ATEX	II 2 G Ex d [ib] IIC T6
	II 2 G Ex de [ib] IIC T6
	II 2(1) G Ex d [ia/ib] IIC T6
	II 2(1) G Ex de [ia/ib] IIC T6
	II 2 D Ex tD [ibD] A21 IP6x T80°C
	II 2(1) G Ex tD [iaD/ibD] A21 IP6x T80°C
Nepsi	Ex de ib [ia/ib] IIC T6
	Ex d ib [ia/ib] IIC T6
Option (only versions C and F)	
FM / CSA	Class I, Div 1 groups B, C, D
	Class II, Div 1 groups E, F, G
	Class III, Div 1 hazardous areas
	Class I, Div 2 groups B, C, D
	Class II, Div 2 groups F, G
	Class III, Div 2 hazardous areas
IECEx	Ex zone 1 + 2
TIIS (in preparation)	Zone 1/2
Custody transfer	
None	Standard
Option	Liquids other than water 2004/22/EC (MID) acc. to OIML R 117-1
Other standards and approvals	
Shock and vibration resistance	IEC 68-2-3
Electromagnetic compatibility (EMC)	2004/108/EC in conjunction with EN 61326-1 (A1, A2)
European Pressure Equipment Directive	PED 97/23 (only for compact versions)
NAMUR	NE 21, NE 43, NE 53

8.3 Dimensions and weights

8.3.1 Housing



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

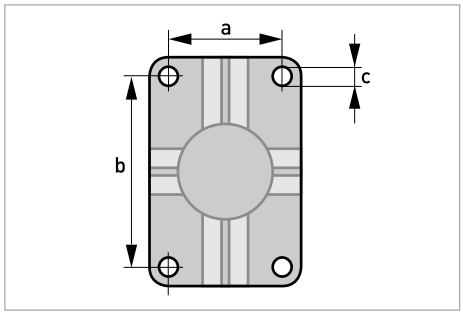
Dimensions and weights in mm and kg

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

Dimensions and weights in inch and lb

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

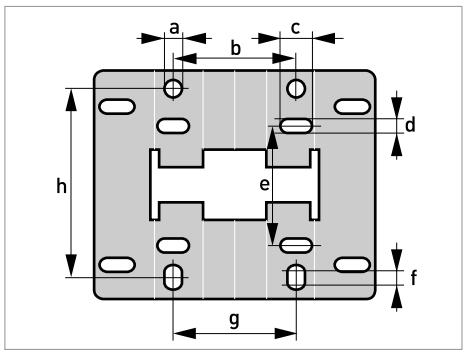
8.3.2 Mounting plate, field housing



Dimensions in mm and inch

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

8.3.3 Mounting plate, wall-mounted housing



Dimensions in mm and inch

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

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 sensors, 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 transferring the analogue signals.

When it comes to the field devices and manual control units, the FSK or HART® modem is integrated. With a PC, however, communication takes place via an external modem which must be connected to the serial interface. There are also other connection variants, as shown in the following connection diagrams.

9.2 Software history

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

Release date	Electronic Revision	SW.REV.UIS	SW.REV.MS	HART®	
				Device Revision	DD Revision
-	-	2.x.x	1.x.x	1	1 (only AMS)
-	-	2.x.x	1.x.x	1	2
2008-06-20	3.3.x	3.3.x	3.0.x	2	3

HART® identification codes and revision numbers

Manufacturer ID:	69 (0x45)
Device:	221 (0xDD)
Device Revision:	2
DD Revision	3
HART® Universal Revision:	5
FC 375/475 system SW.Rev.:	≥ 1.8
AMS version:	≥ 7.0
PDM version:	≥ 6.0
FDT version:	≥ 1.2

9.3 Connection variants

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

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

INFORMATION!

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

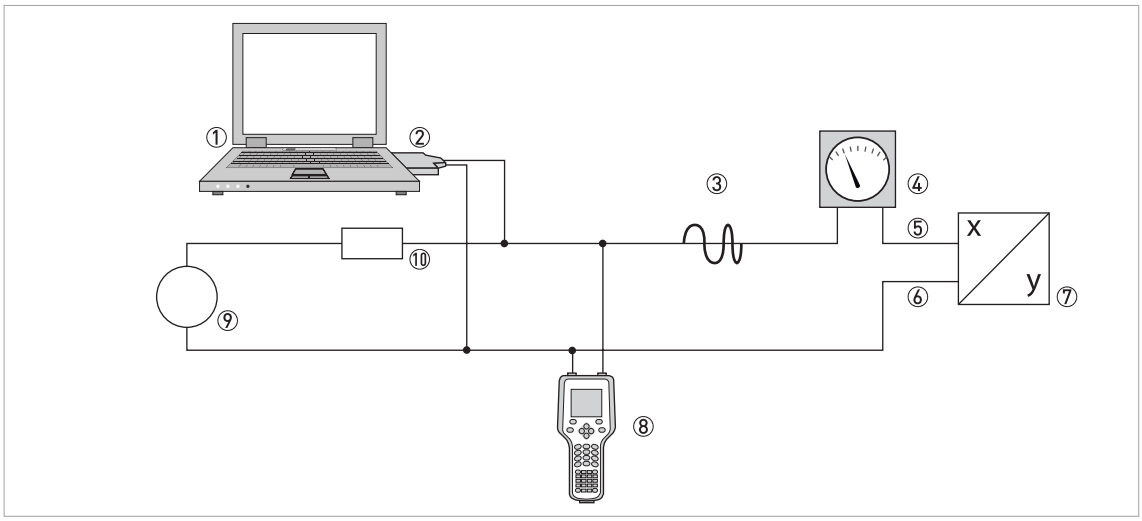
There are two ways of using the HART® communication:

- as Point-to-Point connection and
- as Multi-Drop connection with 2-wire connection or
  as Multi-Drop connection with 3-wire connection.

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

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

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

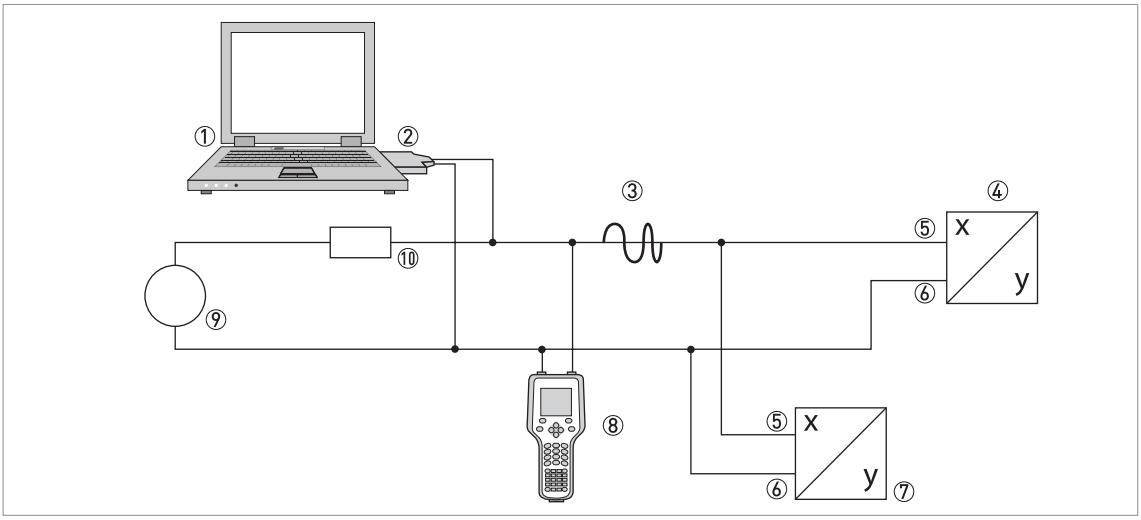


① Primary Master
② FSK modem or HART® modem
③ HART® signal
④ Analogue display
⑤ Signal converter terminals A (C)
⑥ Signal converter terminals A- (C-)
⑦ Signal converter with address = 0 and passive or active current output
⑧ Secondary Master
⑨ Power supply for devices (slaves) with passive current output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

9.3.2 Multi-Drop connection (2-wire connection)

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

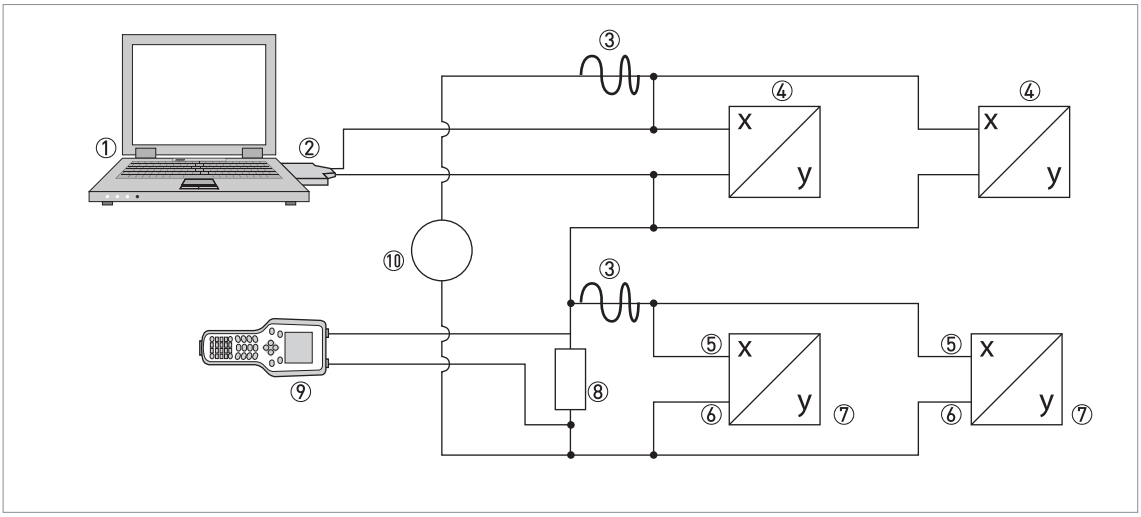
The current outputs of the devices must be passive!



① Primary Master
② HART® modem
③ HART® signal
④ Other HART® devices or this signal converter (see also ⑦)
⑤ Signal converter terminals A (C)
⑥ Signal converter terminals A- (C-)
⑦ Signal converter with address > 0 and passive current output, connection of max. 15 devices (slaves) with 4...20 mA
⑧ Secondary Master
⑨ Power supply
①⓪ Load ≥ 250 Ω (Ohm)

9.3.3 Multi-Drop connection (3-wire connection)

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



① Primary Master
② HART® modem
③ HART® signal
④ 2-wire external devices (slaves) with 4...20 mA, addresses > 0, powered by current loop
⑤ Signal converter terminals A (C)
⑥ Signal converter terminals A- (C-)
⑦ Connection of active or passive 4-wire devices (slaves) with 4...20 mA, addresses > 0
⑧ Load ≥ 250 Ω (Ohm)
⑨ Secondary Master
⑩ Power supply

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

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

The connection of the terminals A...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	-	-
Modular I/O and Ex i I/O, connection terminals	C	D	A	B

The signal converter can provide up to 14 measured 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

Device variables

HART® device variable	Code	Type	Explanations
Flow Velocity	20	linear	
Volume Flow	21	linear	
Mass Flow	22	linear	
Temperature	23	linear	
Density	24	linear	
Concentration 1	25	linear	Only when concentration measurement available and concentration function 1 not switched off.
Concentration 2 / Diagnosis 3	26	linear	**Concentration 2**: only when concentration measurement available and concentration function 2 not switched off. **Diagnosis 3**: only available when diagnosis value 3 not switched off and concentration function 2 switched off.
Concentration Flow 1	27	linear	Only available when concentration measurement switched on and concentration function 1 not switched off.
Concentration Flow 2	28	linear	Only available when concentration measurement switched on and concentration function 2 not switched off.
Diagnosis 1	29	linear	Available when diagnosis value 1 not switched off.

HART® device variable	Code	Type	Explanations
Diagnosis 2	30	linear	Available when diagnosis value 2 not switched off.
Totaliser 1 (C)	6	Totaliser	Valid for Basic I/O option only.
Totaliser 1 (B)	13	Totaliser	Valid for Modular I/O and Ex i I/O options only.
Totaliser 2 (D)	14	Totaliser	-
Totaliser 3 (A)	12	Totaliser	Valid for Modular I/O and Ex i I/O options only.

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.

A totalizer 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.

9.5 Parameter for the basic configuration

There are parameters, such as Totaliser 1…2 (optional 3) and a selection of the diagnosis values, that require a warm start for the device following data changes in order to update, for example, dependent unit parameters before other parameters may be written.

Depending on the characteristic of the HART® host system, e.g. online/offline mode, these parameters are treated differently. See the following section for more detailed information.

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

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

9.6.1 Installation

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

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

9.6.2 Operation

INFORMATION!
For more detailed information see Appendix A, Menu tree for Basic DD.

Operating the signal converter via the Field Communicator is very similar to manual device control using the keyboard.

The online help for each parameter contains its function number as a reference to the local device display.

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

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

9.6.3 Parameter for the basic configuration

In online mode, counter measurements and the diagnosis value can be set using special methods, see Appendix A. In offline mode, these parameters are read-only. However, when transferring the offline configuration, this data is also written to the device.

9.7 Asset Management Solutions (AMS)

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

9.7.1 Installation

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

For installation with the Installation Kit refer to the "AMS Intelligent Device Manager Books Online" section "Basic AMS Functionality / Device Configurations / Installing Device Types / Procedures /Install device types from media".

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

9.7.2 Operation

INFORMATION!
For more detailed information see Appendix B, Menu tree for AMS.

Due to AMS requirements and conventions, there are differences when operating the signal converter with AMS and operating using the local keyboard. The online help for each parameter contains its function number as a reference to the local device display.

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

9.7.3 Parameter for the basic configuration

In online mode, the measurements for counters and diagnosis values can be changed by using the appropriate methods in the basic configuration menu. These parameters are read-only in offline mode.

9.8 Field Device Manager (FDM)

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

9.8.1 Installation

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

See the section regarding Managing DDs in the FDM User Guide for information on installing the Device Descriptions in binary format.

9.8.2 Operation

INFORMATION!
For more detailed information see Appendix A, Menu tree for Basic DD.

Operating the signal converter via the Field Device Manager is very similar to manual device control using the keyboard.

Limitation: The Service Menu parameters for the device are not supported and a simulation is only possible for current outputs. The online help for each parameter contains its function number as a reference to the local device display.

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

9.9 Process Device Manager (PDM)

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

9.9.1 Installation

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

For installation under PDM V 5.2, see PDM manual, section 11.1 - Install device / Integrate device into SIMATIC PDM with Device Install.

For installation under PDM V 6.0, see PDM manual, Section 13 - Integrating devices.

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

9.9.2 Operation

INFORMATION!
For more detailed information see Appendix C, Menu tree for PDM.

Due to PDM requirements and conventions, there are differences when operating the signal converter with PDM and operating using the local keyboard. The online help for each parameter contains its function number as a reference to the local device display.

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

9.9.3 Parameter for the basic configuration

The counter measurements and the diagnosis values can be set directly in the PDM offline table. The dependent unit parameters are automatically updated. However, automatic updating is not possible in online dialogues of the PDM parameter table.

9.10 Field Device Tool / Device Type Manager (FDT / DTM)

A Field Device Tool Container (FDT Container) is basically a PC program used to configure HART®, PROFIBUS and Foundation Fieldbus devices. To adapt to different devices, an FDT container uses a so-called Device Type Manager (DTM).

9.10.1 Installation

If the Device Type Manager for the signal converter has not yet been installed on the Field Device Tool Container, setup is required and is available for download from the website or on CD-ROM. See the supplied documentation for information on how to install and set up the DTM.

9.10.2 Operation

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

9.11 Appendix A: HART® menu tree for Basic-DD

INFORMATION!
The numbering in the following table may change depending on the version of the signal converter!

Abbreviations of the following tables:

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

9.11.1 Overview Basic-DD menu tree (positions in menu tree)

1 Dynam. Variable	1 Measurements	
	2 IO (Inputs/Outputs)	
2 Test	1 Simulation	
	2 Actual Values	
	3 Information	
3 Setup	1 Process Input	1 Calibration
		2 Density
		3 Filter
		4 System Control
		5 Self Test
		6 Information
		7 Factory Calib.
		8 Simulation
		9 Sensor Limits
		10 Operation Mode
	2 Concentration	1 Concentration
		2 Conc. Data Sel.
		3 Concentration 1
		4 Concentration 2
		5 Conc. Data 1
		6 Conc. Data 2
	3 I/O	1 Hardware
		2 (terminals) A
		3 (terminals) B
		4 (terminals) C
		5 (terminals) D
	4 I/O Totalisers	1 Totaliser 1
		2 Totaliser 2
		3 Totaliser 3[Opt]
	5 I/O HART	1 PV is [Rd]
		2 SV is
		3 TV is
		4 4V is
		5 D/A Trim
		6 Apply Values
	6 Device	1 Device Info
		2 Display
		3 1st Meas. Page
		4 2nd Meas. Page
		5 Graphic Page
		6 Special Functions
		7 Units (device)

3 Setup	7 HART	1 Device Info
		2 Units (HART)
		3 Formats (HART)
		4 Preambles
4 Service	1 Service Access	1 Access Level HART
		2 Service Access

9.11.2 Basic-DD menu tree (details for settings)

1 Dynam. Variable

1 Measurements	1 Volume Flow / 2 Mass Flow / 3 Flow Velocity / 4 Temperature / 5 Density / 6 Diagnosis 1 Opt / 7 Diagnosis 2 Opt / 8 Concentration 1 Opt / 9 Concentration 2 or Diagnosis 3 Opt / 10 Concentration Flow 1 Opt / 11 Concentration Flow 2 Opt / 12 Totaliser 1 Opt / 13 Totaliser 2 Opt / 14 Totaliser 3 Opt
2 IO (Inputs/Outputs)	1 A Opt / 2 % Range A Opt / 3 B Opt / 4 % Range B Opt / 5 C Opt / 6 % Range C Opt / 7 D Opt / 8 % Range D Opt

1 Test

1 Simulation	1 Simul. Mass Flow Cust / 2 Simul. Density Cust / 3 Simul. Temperature Cust / 4 Simulation A Cust / 5 Simulation B Cust / 6 Simulation C Cust / 7 Simulation D Cust
2 Actual Values	1 Operating Hours / 2 Mass Flow / 3 Volume Flow / 4 Velocity / 5 Density / 6 Temperature / 7 Strain MT / 8 Strain IC / 9 MT Frequency / 10 Drive Level / 11 Sensor A Level/ 12 Sensor B Level/ 13 2 Phase Signal / 14 SE PCB Temperature / 15 BE PCB Temperature / 16 Act. Operat. Mode
3 Information	1 C Number / 2 SE Version / 3 Information Device / 4 Information Display

3 Setup

1 Process Input	1 Calibration	1 Zero Calibration Cust / 2 Zero Add. Offset Cust / 3 Pipe Diameter Cust / 4 Flow Correction Cust	
	2 Density	1 Density Cust / 2 Fixed Density Value Cust / 2 Density Ref. Temp. Cust / 3 Ref. Density Slope Cust /	
		4 Density Calib.	1 1 Pt. Dens. Cal. Cust / 2 2 Pt. Dens. Cal. Cust / 3 Manual Dens. Cal. Cust / 4 Standard Dens. Cal. Cust / 5 DCF1 Rd / ... / 12 DCF8 Rd
	3 Filter	1 Flow Direction Cust / 2 Press. Supp. Time Cust / 3 Press. Supp. Cutoff Cust / 4 Density Averaging Cust / 5 Low Flow Cutoff Cust	

1 Process Input	4 System Control	1 Function Cust / 2 Sys. Ctrl. Condition Cust / 3 Sys. Ctrl. Max. Dens. Cust, Opt / 4 Sys. Ctrl. Max. Temp. Cust, Opt / 5 Sys. Ctrl. Min. Dens. Cust, Opt / 6 Sys. Ctrl. Min. Temp. Cust, Opt	
	5 Self Test	1 Max. Rec. Temp. Rd / 2 Min. Rec. Temp. Rd / 3 2 Ph. Threshold Rd / 4 Diagnosis 1 Rd / 5 Select Diagnosis 1 / 6 Diagnosis 2 Rd / 7 Select Diagnosis 2 / 8 Diagnosis 3 Rd / 9 Select Diagnosis 3 Opt	
	6 Information	1 V No. Sensor Rd / 2 SE Serial No. Rd / 3 SE Version Rd / 4 SE Interface Rd	
	7 Factory Calib.	1 Sensor Type Rd / 2 Sensor Size Rd / 3 Sensor Material Rd / 4 Max. Allowed Temp. Rd / 5 Min. Allowed Temp. Rd / 6 CF1 Rd / ... / 13 CF8 Rd / 14 CF11 Rd / ... / 30 CF27 Rd	
	8 Simulation	1 Simul. Mass Flow Cust / 2 Simul. Density Cust / 3 Simul. Temp.	
	9 Sensor Limits	1 Volume Flow	1 Upper Snsr Limit Rd / 2 Lower Snsr Limit Rd / 3 Minimum Span Rd
		2 Mass Flow	
		3 Flow Velocity	
		4 Temperature	
		5 Density	
		6 Diagnosis 1	
		7 Diagnosis 2	
		8 Concentration 1	
		9 Conc. 2 / Diagn. 3	
		10 Concentration Flow 1	
		11 Concentration Flow 2	
	10 Operation Mode Cust		
2 Concentration	1 Concentration Rd		
	2 Conc. Data Sel.		
	3 Concentration 1	1 Conc. Function / 2 Select Modus / 3 Conc. Offset / 4 Conc. Product	
	4 Concentration 2		
	5 Conc. Data 1	1 CCF01 / ... / 12 CCF12	
	6 Conc. Data 2		

3 I/O	1 Hardware	1 Terminals A Cust / 2 Terminals B Cust / 3 Terminals C Cust / 4 Terminals D Cust
	2 A 3 B 4 C 5 D	**A / B / C / D** Opt **Current Output Opt**: 1 Range 0% Cust / 2 Range 100% Cust / 3 Extended Range Min Cust / 4 Extended Range Max Cust / 5 Error Current Cust / 6 Error Condition Cust / 7 Measurement Cust / 8 Range Min Cust / 9 Range Max Cust / 10 Polarity Cust / 11 Limitation Min Cust / 12 Limitation Max Cust / 13 LFC Threshold Cust / 14 LFC Hysteresis Cust / 15 Time Constant Cust / 16 Special Function Cust / 17 Rc Threshold Opt, Cust / 18 Rc Hysteresis Opt, Cust / 19 Information / 20 Simulation
		A / B / C / D Opt **Frequency Output Opt**: 1 Pulse Shape Cust / 2 Pulse Width Cust / 3 100% Pulse Rate Cust / 4 Measurement Cust / 5 Range Min Cust / 6 Range Max Cust / 7 Polarity Cust / 8 Limitation Min Cust / 9 Limitation Max Cust / 10 LFC Threshold Cust / 11 LFC Hysteresis Cust / 12 Time Constant / 13 Invert Signal Cust / 14 Special Function Opt, Cust / 15 Phase Shift w.r.t. B Opt, Cust / 16 Information / 17 Simulation
		A / B / C / D Opt **Pulse Output Opt**: 1 Pulse Shape Cust / 2 Pulse Width Cust / 3 Max. Pulse Rate Cust / 4 Measurement Cust / 5 Pulse Value Unit Cust / 6 Value Per Pulse Cust / 7 Polarity Cust / 8 LFC Threshold Cust / 9 LFC Hysteresis Cust / 10 Time Constant / 11 Invert Signal Cust / 12 Special Function Opt, Cust / 13 Phase Shift w.r.t. B Opt, Cust / 14 Information / 15 Simulation
		A / B / C / D Opt **Status Output Opt**: 1 Mode / 2 Output A Opt / 2 Output B Opt / 2 Output C Opt / 2 Output D Opt / 3 Invert Signal / 4 Information / 5 Simulation
		A / B / C / D Opt **Limit Switch Opt**: 1 Measurement / 2 Threshold / 3 Hysteresis / 4 Polarity / 5 Time Constant / 6 Invert Signal / 7 Information / 8 Simulation
		A / B / C / D Opt **Control Input Opt**: 1 Mode Cust / 2 Invert Signal / 3 Information / 4 Simulation

4 I/O Totalisers	1 Totaliser 1	1 Totaliser Function Cust / 2 Measurement Cust / 3 Select Measurement Opt, Cust / 4 LFC Threshold Cust / 5 LFC Hysteresis Cust / 6 Time Constant Cust / 7 Preset Value Opt, Cust / 8 Reset Totaliser Opt, Cust / 9 Set Totaliser Opt, Cust / 10 Stop Totaliser Opt, Cust / 11 Start Totaliser Opt, Cust / 12 Information
	2 Totaliser 2	
	3 Totaliser 3 Opt	
5 I/O HART	1 PV is / 2 SV is / 3 TV is / 4 4V is / 5 D/A Trim / 6 Apply Values	
6 Device	1 Device Info	1 Tag / 2 C Number Rd / 3 Device Serial No. Rd / 4 Electronic Serial No. Rd / 5 Information Device / 6 PCB Information
	2 Display	1 Language / 2 Default Display Cust / 3 Information Display
	3 1st Meas. Page 4 2nd Meas. Page	1 Function Cust / 2 1st Line Variable / 3 Range Min. Cust / 4 Range Max. Cust / 5 Limitation Min / 6 Limitation Max / 7 LFC Threshold / 8 LFC Hysteresis / 9 Time Constant / 10 Format 1st Line / 11 Measurement 2nd Line Opt, Cust / 12 Format 2nd Line Opt, Cust / 13 Measurement 3rd Line Opt, Cust / 14 Format 3rd Line Opt, Cust
	5 Graphic Page	1 Select Range / 2 Range Centre / 3 Range +/- / 4 Time Scale
	6 Special Functions	1 List Errors / 2 Reset Errors / 3 Warmstart
	7 Units (device)	1 Volume Flow Cust / 2 Mass Flow Cust / 3 Flow Velocity Cust / 4 Temperature Cust / 5 Volume Cust / 6 Mass Cust / 7 Density Cust / 8 Pulse Value Unit (M) Cust / 9 Value Per Pulse (V) Cust

7 HART	1 Device Info	1 HART / 2 Address / 3 Tag / 4 Description / 5 Message / 6 Date / 7 Write Protect [Rd] / 8 Manufacturer [Rd] / 9 Model [Rd] / 10 Device ID [Rd] / 11 Final Assembly No. / 12 Reset Device / 13 Reset Config. Flag / 14 Prepare Download /	
		15 Revisions No.	1 Universal Rev. [Rd] 2 Device Rev. [Rd] 3 Software Rev. [Rd] 4 Hardware Rev. [Rd]
	2 Units (HART)	1 Volume Flow / 2 Mass Flow / 3 Flow Velocity / 4 Temperature / 5 Density / 6 Diagnosis 1 [Opt] / 7 Diagnosis 2 [Opt] / 8 Concentration 1 [Opt] / 9 Concentration 2 or Diagnosis 3 [Opt] / 10 Concentration Flow 1 [Opt] / 11 Concentration Flow 2 [Opt] / 12 Totaliser 1 / 13 Totaliser 2 / 14 Totaliser 3 [Opt]	
	3 Formats (HART)	1 Volume Flow / 2 Mass Flow / 3 Flow Velocity / 4 Temperature / 5 Density / 6 Diagnosis 1 [Opt] / 7 Diagnosis 2 [Opt] / 8 Concentration 1 [Opt] / 9 Concentration 2 or Diagnosis 3 [Opt] / 10 Concentration Flow 1 [Opt] / 11 Concentration Flow 2 [Opt] / 12 Totaliser 1 / 13 Totaliser 2 / 14 Totaliser 3 [Opt]	
	4 Preambles	1 Request Preams [Rd] / 2 Response Preams	

4 Service

1 Service Access	1 Access Level HART / 2 Service Access

9.12 Appendix B: HART® menu tree for AMS

Abbreviations of the following tables:

- [Opt] Optional, depending on device version and configuration
- [Rd] Read only
- [Cust] Custody lock protection
- [Loc] Local AMS, affects only AMS views

9.12.1 Overview AMS menu tree (positions in menu tree)

Configuration	Sensor	
	Factory Calib.	
	Calibration / Filter	
	Density	
	System Control / Self Test / Info	
	Concentration	
	Conc. Data Sel.	
	I/O Terminals A/B/C/D	Current Output
		Frequency Output
		Pulsed Output
		Status Output
		Limit Switch
		Control Input
	Totaliser	Totaliser 1
		Totaliser 2
		Totaliser 3
	Device	
	1st Meas. Page / Graphic Page / 2nd Meas. Page	
	HART	
	HART Units	
	HART Format	
	Service	
Compare		
Clear Offline		
Status	Overview	
	Failure (device)	
	Failure (application)	
	Out of specification	
	Check request & Information	
	Actual Values & Self Test	
	Information (Service)	
Process Variables	Process Values	
	Concentration / Diagnosis	
	Totaliser	
	Outputs	
	Device	
	HART	
Scan Device		
Calibration Management		
Diagnostics and Test		
Calibrate		
Set / Reset		

Basic Configuration
Parameter Protection
Service
Rename
Unassign
Assign / Replace
Audit Trail
Record Manual Event
Drawings / Notes
Help...

9.12.2 AMS menu tree (details for settings)

Configuration

Sensor	Limits for...	Mass Flow	Upper Snsr Limit [Rd] / Lower Snsr Limit [Rd] / Minimum Span [Rd]
		Volume Flow	
		Flow Velocity	
		Density	
		Temperature	
Factory Calib.	Sensor Type [Rd] / Sensor Size [Rd] / Sensor Material [Rd] / Max. Allowed Temp. [Rd] / Min. Allowed Temp. [Rd] / CF1 [Rd] / ... / CF8 [Rd] / CF11 [Rd] / ... / CF27 [Rd]		
Calibration / Filter	Calibration	Zero Add. Offset [Cust] / Pipe Diameter [Cust] / Flow Correction [Cust]	
	Filter	Flow Direction [Cust] / Press. Supp. Time [Cust] / Press. Supp. Cutoff [Cust] / Density Averaging [Cust] / Low Flow Cutoff [Cust]	
Density	Density	Density [Cust] / Fixed Density Value [Cust, Opt] / Density Ref. Temp. [Cust, Opt] / Ref. Density Slope [Opt, Cust]	
	Density Calib.	DCF1 [Rd] / ... / DCF8 [Rd]	
System Control / Self Test / Info	System Control	Function [Cust] / Sys. Ctrl. Condition [Cust] / Sys. Ctrl. Max. Dens. [Cust, Opt] / Sys. Ctrl. Max. Temp. [Cust, Opt] / Sys. Ctrl. Min. Dens. [Cust, Opt] / Sys. Ctrl. Min. Temp. [Cust, Opt]	
	Self Test	Ph. Threshold [Rd] / Diagnosis 1 [Rd] / Diagnosis 2 [Rd] / Diagnosis 3 [Rd]	
	Information	V No. Sensor [Rd]	
Concentration	Concentration	Concentration [Rd] / Conc. Data Sel.	
	Concentration 1	Conc. Mode / Conc. Offset / Conc. Product	
	Concentration 2		
Conc. Data Sel.	Conc. Data 1	CCF01 / ... / CCF12	
	Conc. Data 2		

I/O Terminals A/B/C/D	Current Output [Opt]:	Range 0% [Cust] / Range 100% [Cust] / Extended Range Min [Cust] / Extended Range Max [Cust] / Error Current [Cust] / Error Condition [Cust] / Measurement [Cust] / Range Min [Cust] / Range Max [Cust] / Polarity [Cust] / Limitation Min [Cust] / Limitation Max [Cust] / LFC Threshold [Cust] / LFC Hysteresis [Cust] / Time Constant [Cust] / Special Function [Cust] / Rc Threshold [Opt, Cust] / Rc Hysteresis [Opt, Cust]
	Frequency Output [Opt]	Pulse Shape [Cust] / Pulse Width [Cust] / 100% Pulse Rate [Cust] / Measurement [Cust] / Range Min [Cust] / Range Max [Cust] / Polarity [Cust] / Limitation Min [Cust] / Limitation Max [Cust] / LFC Threshold [Cust] / LFC Hysteresis [Cust] / Time Constant / Invert Signal [Cust] / Special Function [Opt, Cust] / Phase Shift w.r.t. B [Opt, Cust]
	Pulse Output [Opt]	Pulse Shape [Cust] / Pulse Width [Cust] / Max. Pulse Rate [Cust] / Measurement [Cust] / Pulse Value Unit [Rd, Cust] / Value Per Pulse [Cust] / Polarity [Cust] / LFC Threshold [Cust] / LFC Hysteresis [Cust] / Time Constant / Invert Signal [Cust] / Special Function [Opt, Cust] / Phase Shift w.r.t. B [Opt, Cust]
	Status Output [Opt]	Mode / Output A [Opt] / Output B [Opt] / Output C [Opt] / Output D [Opt] / Invert Signal
	Limit Switch [Opt]	Measurement / Threshold / Hysteresis / Polarity / Time Constant / Invert Signal
	Control Input [Opt]	Mode [Cust] / Invert Signal
Totaliser	Totaliser 1	Function [Cust] / Measurement [Opt, Cust] / LFC Threshold [Opt, Cust] / LFC Hysteresis [Opt, Cust] / Time Constant [Opt, Cust] / Preset Value [Opt, Cust]
	Totaliser 2	
	Totaliser 3 [Opt]	
Device	Device Info	Tag / C Number [Rd] / Device Serial No. [Rd] / Electronic Serial No. [Rd]
	Display	Language / Default Display [Cust]
	Units	Volume Flow [Cust] / Mass Flow [Cust] / Flow Velocity / Temperature [Cust] / Volume [Cust] / Mass [Cust] / Density [Cust] / Pulse Value Unit (M) / Pulse Value Unit (V)
1st and 2nd Meas. Page Graphic Page	1st and 2nd Meas. Page	Function [Cust] / 1st Line Variable / Range Min [Cust] / Range Max [Cust] / Limitation Min / Limitation Max / LFC Threshold / LFC Hysteresis / Time Constant / Format 1st Line / Measurement 2nd Line [Cust] / Format 2nd Line [Cust] / Measurement 3rd Line [Cust] / Format 3rd Line [Cust]
	Graphic Page	Select Range / Range Centre / Range +/- / Time Scale

HART	Identification	Manufacturer Rd / Model Rd / Device ID Rd / Address / Tag / Date / Message / Description / Write Protect Rd / Final Assembly No. / Sensor Serial No.
	Revision Numbers	Universal Rev. Rd / Device Rev. Rd / Software Rev. Rd / Hardware Rev. Rd
	Preambles	Request Preams Rd / Response Preams
	Dynamic Variables	PV is Rd / SV is / TV is / 4V is
HART units	Units	Volume Flow / Mass Flow / Flow Velocity / Conductivity / Temperature / Totaliser 1 / Totaliser 2 / Totaliser 3 Opt / Concentration 1 Opt / Concentration 2 or Diagnosis 3 Opt / Concentration Flow 1 Opt / Concentration Flow 2 Opt / Diagnosis 1 Opt / Diagnosis 2 Opt
HART Format	Display Formats	Volume Flow Loc / Mass Flow Loc / Flow Velocity Loc / Density Loc / Temperature Loc / Totaliser 1 Loc / Totaliser 2 Loc / Totaliser 3 Opt, Loc / Concentration 1 Loc / Concentration 2 or Diagnosis 3 Loc / Concentration Flow 1 Loc / Concentration Flow 2 Loc / Diagnosis 1 Loc / Diagnosis 2 Loc
Service	Access Level HART Rd	

Compare and Clear Offline

Status / Conditions

Overview	Standard	Primary variable out of limits
		Non-primary variable out of limits
		Primary variable analog output saturated
		Primary variable analog output fixed
		Field Device Cold Start
		Malfunction
		Configuration changed
Failure (device)	F Device Error / F I01 / F Parameter / F I02 / F Configuration / F Display / F Sensor: Global Data Error / Sensor: Local Data Error / F SE Data Error / F SE Drive Failure / F SE Hardware Failure / F SE Data Different / F SE Defective / F Interface PCB Failure / F SE Wiring Error / F 2 Phase Flow / F Fieldbus / F Current Output A / F Current Output B / F Current Output C / F SW User Interface / F Hardware Settings / F Hardware Detection / F RAM/ROM Error I01 / F RAM/ROM Error I02	
Failure (application)	F Application Error / F Tube Not Oscillating / F System Control / F Open Circuit A / F Open Circuit B / F Open Circuit C / F Wiring A / F Wiring B / F Sensor: Under Range / F Stop Mode / F Sensor: System Error / F SE Comms. Failure / F Over Range A (Current) / F Over Range B (Current) / F Over Range C / F Over Range A (Pulse) / F Over Range B (Pulse) / F Over Range D / F Active Settings / F Factory Settings / F Backup 1 Settings / F Backup 2 Settings	

Out of specification	S Out Of Specification / S Tube Asymmetry / S System Control / S Startup / S Power Fail / S 2 Phase Flow / S Excessive Noise / S External Vibration / S Sensor Levels / S Res. Circ. Defective / S SE Defective / S Interface PCB Failure / S Density / S Density Calib. Failed / S Sensor Signal Error / S Temperature Drift / S BE PCB Temperature / S SE PCB Temperature / S Tube Temperature / S Overflow Totaliser 1 / S Overflow Totaliser 2 / S Overflow Totaliser 3 / S Backplane Invalid	
Check request & Information	Check request	C Checks In Progress / C Sensor Electronics / C Standby Mode / C Zero Calibration
	Information	I Totaliser 1 Stopped/ I Totaliser 2 Stopped / I Totaliser 3 Stopped / I Power Fail / I Control Input A act. / I Control Input B act. / I Over Range Display 1 / I Over Range Display 2 / I Backplane Sensor / I Backplane Settings / I Backplane Difference / I Optical Interface
Actual Values & Self Test	Operating Hours / Mass Flow / Volume Flow / Velocity / Density / Temperature / Strain MT / Strain IC / MT Frequency / Drive Level / Sensor A Level / Sensor B Level / 2 Phase Signal / SE PCB Temperature / BE PCB Temperature / Act. Operat. Mode Max. Rec. Temp. / Min. Rec. Temp.	
Information (Service)		

Process Variables

Process Values	Volume Flow / Mass Flow / Flow Velocity / Density / Tube Temperature
Concentration / Diagnosis	Diagnosis 1 ^{Opt} / Diagnosis 2 ^{Opt} / Concentration 1 ^{Opt} / Concentration 2 or Diagnosis 3 ^{Opt} / Concentration Flow 1 ^{Opt} / Concentration Flow 2 ^{Opt}
Totaliser	Totaliser 1 ^{Opt} / Totaliser 2 ^{Opt} / Totaliser 3 ^{Opt}
Outputs	A ^{Opt} / % Range A ^{Opt} / B ^{Opt} / % Range B ^{Opt} / C ^{Opt} / % Range C ^{Opt} / D ^{Opt} / % Range D ^{Opt}
Device	Tag Rd / Description Rd
HART	Polling address Rd / Device IDRd

Scan Device

Calibration Management

Diagnostics and Test

	Simulation Mass Flow [Cust] / Simulation Density [Cust] / Simulation Temperature [Cust] / Simulation A [Opt] / Simulation B [Opt] / Simulation C[Opt] / Simulation D [Opt] / PCB Information / SE Serial No.

Calibrate

	Zero Calibration [Cust] / D/A Trim [Cust] / Apply Values [Cust] /	
	Density Calib. Failed	1 Pt. Dens. Cal. [Cust] / 2 Pt. Dens. Cal. [Cust] / Manual Dens. Cal. [Cust] / Standard Dens. Cal. [Cust]

Set / Reset

	Reset Error / Reset Configuration Change Flag / Master Reset / Warmstart / Reset Totaliser 1 [Opt, Cust] / Set Totaliser 1 [Opt, Cust] / Stop Totaliser 1 [Opt, Cust] / Start Totaliser 1 [Opt, Cust] / Reset Totaliser 2 [Opt, Cust] / Set Totaliser 2 [Opt, Cust] / Stop Totaliser 2 [Opt, Cust] / Start Totaliser 2 [Opt, Cust] / Reset Totaliser 3 [Opt, Cust] / Set Totaliser 3 [Opt, Cust] / Stop Totaliser 3 [Opt, Cust] / Start Totaliser 3 [Opt, Cust]

Basic Configuration

	Select Measurement Totaliser 1 / Select Measurement Totaliser 2 / Select Measurement Totaliser 3 [Opt] / Select Diagnosis 1 / Select Diagnosis 2 / Select Diagnosis 3 [Opt] / Select Concentration Mode 1 [Opt] / Select Concentration Mode 2 [Opt]

Parameter Protection

	Allow Service Access / Lock Service Access

Service

	MUX Mode [Opt] / Temp. Password [Opt] / Read GDC Object [Opt] / Write GDC Object [Opt]

Rename

Unassign

Assign / Replace

Audit Trail

Record Manual Event

Drawings / Notes

Help...

9.13 Appendix C: HART® menu tree for PDM

Abbreviations of the following tables:

- Opt Optional, depending on device version and configuration
- Rd Read only
- Cust Custody lock protection
- Loc Local PDM, affects only PDM views

9.13.1 Overview PDM menu tree (positions in menu tree)

Overview: Menu Device

Communication Path
Load To Device
Load To PG/PC
Update Diagnosis Status
Set Address
Basic Configuration
Test
Reset
Calibration
HART
Parameter Protection

Overview: Menu View

Display	Display
	Totaliser
	Diagnosis Values
	Concentration Values
Yt diagram	
Outputs	Current Output/Frequency Output A Opt
	Current Output/Frequency Output B Opt
	Current Output C Opt
	Frequency Output D Opt
Actual Values	
Device Status	Device
	HART
	Standard (overview)
	Failure (device)
	Failure (application)
	Out Of Specification / Function Control / Information
	Process Input
	Information
PCB Information	
Toolbar	
Status Bar	
Update	

Overview: PDM parameter table

Identification	Operation Unit	
	Devices	
Input	Calibration	
	Density	
	Filter	
	System Control	
	Self Test	
	Information	
	Factory Calib.	
	Concentration	
	Measuring Limits	Volume Flow
		Mass Flow
		Flow Velocity
		Density
		Temperature
I/O	A Opt	
	B Opt	
	C Opt	
	D Opt	
	Totaliser 1	
	Totaliser 2	
	Totaliser 3 Opt	
Display and user interface	Local Display	1st and 2nd Meas. Page
		Graphic Page
	Units (device)	
	Units (HART)	
	Formats (HART)	

9.13.2 PDM menu tree (details for settings)

Menu Device

Communication Path		
Load To Device		
Load To PG/PC		
Update Diagnosis Status		
Set Address		
Basic Configuration	Totaliser 1	Measurement / <Select Measurement Totaliser 1> Cust
	Totaliser 2	Measurement / <Select Measurement Totaliser 2> Cust
	Totaliser 3 Opt	Measurement / <Select Measurement Totaliser 3> Cust
	Diagnosis 1	Diagnosis 1 / <Select Value Diagnosis 1>
	Diagnosis 2	Diagnosis 2 / <Select Value Diagnosis 2>
	Diagnosis 3 Opt	Diagnosis 3 / <Select Value Diagnosis 3>
	Concentration 1 Opt	Concentration Mode / <Select Concentration Mode>
	Concentration 2 Opt	
Test	<Simulation Mass Flow> Cust	
	<Simulation Density> Cust	
	<Simulation Temperature> Cust	
	<Simulation A> Opt	
	<Simulation B> Opt	
	<Simulation C> Opt	
	<Simulation D> Opt	
Reset	<Reset Errors>	
	<Reset Configuration Changed Flag>	
	<Reset Device>	
	<Warmstart>	
	<Reset Totaliser 1> Opt, Cust	
	<Set Totaliser 1> Opt, Cust	
	<Stop Totaliser 1> Opt, Cust	
	<Start Totaliser 1> Opt, Cust	
	<Reset Totaliser 2> Opt, Cust	
	<Set Totaliser 2> Opt, Cust	
	<Stop Totaliser 2> Opt, Cust	
	<Start Totaliser 2> Opt, Cust	
	<Reset Totaliser 3> Opt, Cust	
	<Set Totaliser 3> Opt, Cust	
	<Stop Totaliser 3> Opt, Cust	
	<Start Totaliser 3> Opt, Cust	

Calibration	Calibration	<Zero Calibration> Cust
	Density Calib. Opt	<1 Pt. Dens. Cal.> Cust
		<2 Pt. Dens. Cal> Cust
		<Manual Dens. Cal.> Cust
		<Standard Dens. Cal.> Cust
HART	Preambles	Request Preams Rd / Response Preams
	Dynamic Variables Settings	PV is Rd / SV is / TV is / 4V is
Parameter Protection	Access Level HART	
	<Service Access>	

Menu View

Display Values	Volume Flow / Mass Flow / Flow Velocity / Temperature / Density / Device Status	
Concentration Values	Concentration 1 Opt / Concentration 2 or Diagnosis 3 Opt / Concentration Flow 1 Opt / Concentration Flow 2 Opt	
Diagnosis Values	Diagnosis 1 Opt / Diagnosis 2 Opt / Concentration 2 or Diagnosis 3 Opt	
Totaliser	Totaliser 1 (B) Opt / Totaliser 1 (C) Opt / Totaliser 2 (D) Opt / Totaliser 3 (A) Opt	
Yt diagram	Mass Flow / Temperature / Density	
Outputs	Current Output/Frequency Output A Opt	Measured Value Opt / A Opt / % Range A Opt
	Current Output/Frequency Output B Opt	Measured Value Opt / B Opt / % Range BOpt
	Current Output C Opt	Measured Value Opt / C Opt / % Range C Opt
	Frequency Output D Opt	Measured Value Opt / D Opt / % Range D Opt
Actual Values	Operating Hours / Mass Flow / Volume Flow / Velocity / Density / Temperature / Strain MT / Strain IC / MT Frequency / Drive Level / Sensor A Level / Sensor B Level / 2 Phase Signal / SE PCB Temperature / BE PCB Temperature / Act. Operat. Mode	

Device Status	Device	C Number Rd / Device Serial No. Rd / Electronic Serial No. Rd
	HART	Tag / Manufacturer Rd / Write Protect Rd / Model Rd / Device ID Rd / Universal Rev. Rd / Device Rev. Rd / Software Rev. Rd / Hardware Rev. Rd / Date Rd / Final Assembly No. Rd / Sensor Serial No. Rd / Access Level HART
	Standard (overview)	Primary variable out of limits
		Non-primary variable out of limits
		Primary variable analog output saturated
		Primary variable analog output fixed
		More status information available
		Field Device Cold Start
		Configuration changed
		Malfunction
	Failure (device)	F Device Error / F IO1 / F Parameter / F IO2 / F Configuration / F Display / F Sensor: Global Data Error / Sensor: Local Data Error / F SE Data Error / F SE Drive Failure / F SE Hardware Failure / F SE Data Different / F SE Defective / F Interface PCB Failure / F SE Wiring Error / F 2 Phase Flow / F Fieldbus / F Current Output A / F Current Output B / F Current Output C / F SW User Interface / F Hardware Settings / F Hardware Detection / F RAM/ROM Error IO1 / F RAM/ROM Error IO2
	Failure (application)	F Application Error / F Tube Not Oscillating / F System Control / F Open Circuit A / F Open Circuit B / F Open Circuit C / F Wiring A / F Wiring B / F Sensor: Under Range / F Stop Mode / F Sensor: System Error / F SE Comms. Failure / F Over Range A (Current) / F Over Range B (Current) / F Over Range C / F Over Range D / F Over Range A (Pulse) / F Over Range B (Pulse) / F Active Settings / F Factory Settings / F Backup 1Settings / F Backup 2 Settings
	Out of specification	S Out Of Specification / S Tube Asymmetry / S System Control / S Startup / S Power Fail / S 2 Phase Flow / S Excessive Noise / S External Vibration / S Sensor Levels / S Res. Circ. Defective / S SE Defective / S Interface PCB Failure / S Density / S Density Calib. Failed / S Sensor Signal Error / S Temperature Drift / S BE PCB Temperature / S SE PCB Temperature / S Tube Temperature / S Overflow Totaliser 1 / S Overflow Totaliser 2 / S Overflow Totaliser 3 / S Backplane Invalid
	Check request	C Checks In Progress / C Sensor Electronics / C Standby Mode / C Zero Calibration
	Information	I Totaliser 1 Stopped/ I Totaliser 2 Stopped / I Totaliser 3 Stopped / I Power Fail / I Control Input A act. / I Control Input B act. / I Over Range Display 1 / I Over Range Display 2 / I Backplane Sensor / I Backplane Settings / I Backplane Difference / I Optical Interface
Process Input	Self Test	Max. Rec. Temp. Rd / Min. Rec. Temp. Rd /
	Information	V No. Sensor Rd / <SE Serial No.>

PCB Information

Toolbar

Status Bar

Update

PDM parameter table

Identification

Operation Unit	Tag / Description / Message
Device	C Number [Rd] / Device Serial No. [Rd] / Electronic Serial No. [Rd] / Manufacturer [Rd] / Model [Rd] / Device ID [Rd] / Universal Rev. [Rd] / Device Rev. [Rd] / Software Rev. [Rd] / Hardware Rev. [Rd] / Date / Final Assembly No. / Sensor Serial No. / Write Protect / Access Level HART

Input

Input	Operation Mode [Cust]	
Calibration	Zero Add. Offset [Cust] / Pipe Diameter [Cust] / Flow Correction [Cust]	
Density	Density [Cust] / Fixed Density Value [Cust, Opt] / Density Ref. Temp. [Cust, Opt] / Ref. Density Slope [Opt, Cust]	
Density Calib.	DCF1 [Rd] / ... / DCF8 [Rd]	
Filter	Flow Direction [Cust] / Press. Supp. Time [Cust] / Press. Supp. Cutoff [Cust] / Density Averaging [Cust] / Low Flow Cutoff [Cust]	
System Control	Function [Cust] / Condition [Cust] / Sys. Ctrl. Max. Dens. [Cust, Opt] / Sys. Ctrl. Max. Temp. [Cust, Opt] / Sys. Ctrl. Min. Dens. [Cust, Opt] / Sys. Ctrl. Min. Temp. [Cust, Opt]	
Self Test	Ph. Threshold [Rd] / Diagnosis 1 / Diagnosis 2 / Diagnosis 3	
Information	V No. Sensor [Rd]	
Factory Calib.	Sensor Type [Rd] / Sensor Size [Rd] / Sensor Material [Rd] / Max. Allowed Temp. [Rd] / Min. Allowed Temp. [Rd] / CF1 [Rd] / ... / CF8 [Rd] / CF11 [Rd] / ... / CF27 [Rd]	
Concentration	Concentration [Rd] / Conc. Data Sel.	
Concentration 1	Conc. Mode / Conc. Offset / Conc. Product	
Concentration 2		
Conc. Data 1	CCF01 / ... / CCF12	
Conc. Data 2		
Measuring limits for ...	... Volume Flow	Upper Sensr Limit [Rd] / Lower Sensr Limit [Rd] / Minimum Span [Rd]
	... Mass Flow	
	... Flow Velocity	
	... Temperature	
	... Density	

I/O

I/O	Terminals A Cust / Terminals B Cust / Terminals C Cust / Terminals D Cust		
A / B / C / D Opt	Current Output Opt	Range 0% Cust / Range 100% Cust / Extended Range Min Cust / Extended Range Max Cust / Error Current Cust / Error Condition Cust / Measurement Cust / Range Min Cust / Range Max Cust / Polarity Cust / Limitation Min Cust / Limitation Max Cust / LFC Threshold Cust / LFC Hysteresis Cust / Time Constant Cust / Special Function Cust / Rc Threshold Opt, Cust / Rc Hysteresis Opt, Cust	
	Frequency Output Opt	Pulse Shape Cust / Pulse Width Cust / 100% Pulse Rate Cust / Measurement Cust / Range Min Cust / Range Max Cust / Polarity Cust / Limitation Min Cust / Limitation Max Cust / LFC Threshold Cust / LFC Hysteresis Cust / Time Constant / Invert Signal Cust / Special Function Opt, Cust / Phase Shift w.r.t. B Opt, Cust	
	Pulse Output Opt	Pulse Shape Cust / Pulse Width Cust / Max. Pulse Rate Cust / Measurement Cust / Pulse Value Unit / Value Per Pulse / Polarity Cust / LFC Threshold Cust / LFC Hysteresis Cust / Time Constant / Invert Signal Cust / Special Function Opt, Cust / Phase Shift w.r.t. B Opt, Cust	
	Status Output Opt	Mode / Output A Opt / Output B Opt / Output C Opt / Output D Opt / Invert Signal /	
	Limit Switch Opt	Measurement / Threshold / Hysteresis / Polarity / Time Constant / Invert Signal	
	Control Input Opt	Mode Cust / Invert Signal	
	Totaliser	Totaliser 1	Function Cust / Measurement Opt / LFC Threshold Opt / LFC Hysteresis Opt / Time Constant Opt / Preset Value Opt
		Totaliser 2	
		Totaliser 3 Opt	

Display and user interface

Local Display	Language / Default Display [Cust]	
1st and 2nd Meas. Page	Function [Cust] / Measurement 1st Line [Cust] / Range Min [Cust] / Range Max [Cust] / Limitation Min / Limitation Max / LFC Threshold / LFC Hysteresis / Time Constant / Format 1st Line / Measurement 2nd Line [Opt, Cust] / Format 2nd Line [Opt, Cust] / Measurement 3rd Line [Opt, Cust] / Format 3rd Line [Opt, Cust]	
Graphic Page	Select Range / Range Centre / Range +/- / Time Scale	
Units (device)	Units	Volume Flow [Cust] / Mass Flow [Cust] / Flow Velocity / Temperature [Cust] / Volume [Cust] / Mass [Cust] / Density [Cust] / Pulse Value Unit (M) [Cust] / Value Per Pulse (V) [Cust]
Units (HART)	Units	Volume Flow / Mass Flow / Flow Velocity / Density / Temperature / Totaliser 1 / Totaliser 2 / Totaliser 3 [Opt] / Concentration 1 [Opt] / Concentration 2 or Diagnosis 3 [Opt] / Concentration Flow 1 [Opt] / Concentration Flow 2 [Opt] / Diagnosis 1 [Opt] / Diagnosis 2 [Opt]
Formats (HART)	Formats	Volume Flow [Loc] / Mass Flow [Loc] / Flow Velocity [Loc] / Density [Loc] / Temperature [Loc] / Totaliser 1 [Loc] / Totaliser 2 [Loc] / Totaliser 3 [Opt, Loc] / Concentration 1 [Loc] / Concentration 2 or Diagnosis 3 [Loc] / Concentration Flow 1 [Loc] / Concentration Flow 2 [Loc] / Diagnosis 1 [Loc] / Diagnosis 2 [Loc]

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