

# CoriolisMaster FCB400, FCH400

## Coriolis mass flowmeter



Device firmware version: 01.11.00

Measurement made easy

—  
CoriolisMaster FCB430 / 450  
CoriolisMaster FCH430 / 450

### Introduction

With no up or downstream piping requirements the compact Coriolis flowmeters can be installed in the tightest spaces, enabling applications not possible before.

#### CoriolisMaster FCB400

The compact Coriolis mass flowmeters from the CoriolisMaster FCB400 series offer low pressure drop, high capacity, an intuitive ABB display featuring a standardized design and cross-product compatibility, five modular inputs and outputs as well as HART communication.

#### CoriolisMaster FCH400

The compact Coriolis mass flowmeters for hygienic applications from the CoriolisMaster FCH400 series additionally offer EHEDG certified cleanability; all wetted materials are polished.

### Additional Information

Additional documentation on CoriolisMaster FCB400, FCH400 is available for download free of charge at [www.abb.com/flow](http://www.abb.com/flow). Alternatively simply scan this code:



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# 1 Safety

## General information and instructions

These instructions are an important part of the product and must be retained for future reference.

Installation, commissioning, and maintenance of the product may only be performed by trained specialist personnel who have been authorized by the plant operator accordingly. The specialist personnel must have read and understood the manual and must comply with its instructions.

For additional information or if specific problems occur that are not discussed in these instructions, contact the manufacturer.

The content of these instructions is neither part of nor an amendment to any previous or existing agreement, promise or legal relationship.

Modifications and repairs to the product may only be performed if expressly permitted by these instructions.

Information and symbols on the product must be observed.

These may not be removed and must be fully legible at all times.

The operating company must strictly observe the applicable national regulations relating to the installation, function testing, repair and maintenance of electrical products.

## Warnings

The warnings in these instructions are structured as follows:

### **DANGER**

The signal word '**DANGER**' indicates an imminent danger. Failure to observe this information will result in death or severe injury.

### **WARNING**

The signal word '**WARNING**' indicates an imminent danger. Failure to observe this information may result in death or severe injury.

### **CAUTION**

The signal word '**CAUTION**' indicates an imminent danger. Failure to observe this information may result in minor or moderate injury.

### **NOTICE**

The signal word '**NOTICE**' indicates possible material damage.

### **Note**

'**Note**' indicates useful or important information about the product.

## ... 1 Safety

### Intended use

This device is intended for the following uses:

- To convey liquids and gases (including unstable measuring media).
- To meter mass flow directly.
- To meter volumetric flow (indirectly via mass flow and density).
- To measure the density of the measuring medium.
- To measure the temperature of the measuring medium.

The device has been designed for use exclusively within the technical limit values indicated on the identification plate and in the data sheets.

When using measuring media, the following points must be observed:

- Measuring media may only be used if, based on the state of the art or the operating experience of the user, it can be assured that the chemical and physical properties necessary for operational security of the materials of the wetted parts of the flowmeter sensor will not be adversely affected during the operating time.
- Media containing chloride in particular can cause corrosion damage to stainless steels which, although not visible externally, can damage wetted parts beyond repair and lead to the measuring medium escaping. It is the operator's responsibility to check the suitability of these materials for the respective application.
- Measuring media with unknown properties or abrasive measuring media may only be used if the operator is able to perform regular and suitable tests to ensure the safe condition of the device

### Improper use

The following are considered to be instances of especially improper use of the device:

- Operation as a flexible compensating adapter in piping, for example for compensating pipe offsets, pipe vibrations, pipe expansions, etc.
- For use as a climbing aid, for example for mounting purposes.
- For use as a bracket for external loads, for example as a support for piping, etc.
- Material application, for example by painting over the housing, name plate or welding/soldering on parts.
- Material removal, for example by spot drilling the housing.

### Cyber security disclaimer

This product is designed to be connected to and to communicate information and data via a network interface. It is operator's sole responsibility to provide and continuously ensure a secure connection between the product and your network or any other network (as the case may be).

Operator shall establish and maintain any appropriate measures (such as but not limited to the installation of firewalls, application of authentication measures, encryption of data, installation of anti-virus programs, etc.) to protect the product, the network, its system and the interface against any kind of security breaches, unauthorized access, interference, intrusion, leakage and/or theft of data or information.

ABB and its affiliates are not liable for damages and/or losses related to such security breaches, any unauthorized access, interference, intrusion, leakage and/or theft of data or information.

### Software downloads

By visiting the web pages indicated below, you will find notifications about newly found software vulnerabilities and options to download the latest software. It is recommended that you visit this web pages regularly:

[www.abb.com/cybersecurity](http://www.abb.com/cybersecurity)

[ABB-Library – CoriolisMaster FCx400 – Software Downloads](#)



## Warranty provisions

Using the device in a manner that does not fall within the scope of its intended use, disregarding this manual, using underqualified personnel, or making unauthorized alterations releases the manufacturer from liability for any resulting damage. This renders the manufacturer's warranty null and void.

## Manufacturer's address

### ABB AG

#### Measurement & Analytics

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32425 Minden

Germany

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Fax: +49 571 830-1806

## Service address

### Customer service center

Tel: 0180 5 222 580

Email: [automation.service@de.abb.com](mailto:automation.service@de.abb.com)

## 2 Use in potentially explosive atmospheres

### Note

Further information on the Ex-Approval of devices can be found in the type examination certificates or the relevant certificates at [www.abb.com/flow](http://www.abb.com/flow).

### Device overview

#### ATEX, IECEx and UKEX

	Standard / No explosion protection		Zone 2, 21, 22		Zone 1, 21 (Zone 0)	
<b>Model number</b>	FCx4xx Y0		FCx4xx A2, U2		FCx4xx A1, U1	
Integral mount design						
<ul style="list-style-type: none"> <li>Standard</li> <li>Zone 2, 21, 22</li> <li>Zone 1, 21</li> <li>Zone 0</li> </ul>						
<b>Model number</b>	FCT4xx Y0	FCx4xx Y0	FCT4xx A2	FCx4xx A2	FCT4xx A1	FCx4xx A1
Remote mount design						
Transmitter and flowmeter sensor <ul style="list-style-type: none"> <li>Standard</li> <li>Zone 2, 21, 22</li> <li>Zone 1, 21</li> <li>Zone 0</li> </ul>						
<b>Model number</b>	FCT4xx Y0		FCT4xx A2		FCx4xx A1	
Remote mount design						
Transmitter <ul style="list-style-type: none"> <li>Standard</li> <li>Zone 2, 21, 22</li> </ul> Sensor <ul style="list-style-type: none"> <li>Zone 1, 21</li> <li>Zone 0</li> </ul>						
<b>Model number</b>	—		FCT4xx A2		FCx4xx A1	
Remote mount design	—					
Transmitter <ul style="list-style-type: none"> <li>Zone 2, 21, 22</li> </ul> Sensor <ul style="list-style-type: none"> <li>Zone 1, 21</li> </ul>						

- ① Single-compartment housing
- ② Dual-compartment housing
- ③ Zone 0 within the meter tube

**cFMus**

	Standard / No explosion protection	Class I Div. 2 / Zone 2	Class I Div. 1 / Zone 1 (Zone 0)			
<b>Model number</b>	<b>FCx4xx Y0</b>	<b>FCx4xx F2</b>	<b>FCx4xx F1</b>			
Integral mount design						
<ul style="list-style-type: none"> <li>• Standard</li> <li>• Div. 2 / Zone 2</li> <li>• Div. 1 / Zone 1 (Zone 0)</li> </ul>						
<b>Model number</b>	<b>FCT4xx Y0</b>	<b>FCx4xx Y0</b>	<b>FCT4xx F2</b>	<b>FCx4xx F2</b>	<b>FCT4xx F1</b>	<b>FCx4xx F1</b>
Remote mount design						
Transmitter and flowmeter sensor <ul style="list-style-type: none"> <li>• Div. 2 / Zone 2</li> <li>• Div. 1 / Zone 1 (Zone 0)</li> </ul>						
<b>Model number</b>	<b>FCT4xx Y0</b>	<b>FCT4xx F2</b>	<b>FCx4xx F1</b>			
Remote mount design						
Transmitter <ul style="list-style-type: none"> <li>• Standard</li> </ul> Sensor <ul style="list-style-type: none"> <li>• Div. 2 / Zone 2</li> <li>• Div. 1 / Zone 1 (Zone 0)</li> </ul>						
<b>Model number</b>	—	<b>FCT4xx F2</b>	<b>FCx4xx F1</b>			
Remote mount design	—					
Transmitter <ul style="list-style-type: none"> <li>• Div. 2 / Zone 2</li> </ul> Sensor <ul style="list-style-type: none"> <li>• Div. 1 / Zone 1 (Zone 0)</li> </ul>	—					

- ① Single-compartment housing
- ② Dual-compartment housing
- ③ Zone 0 within the meter tube

## ... 2 Use in potentially explosive atmospheres

### Ex marking

#### Description of model numbers

Each device design has a specific model number. The parts of the model number relating to explosion protection are listed in the following table. The complete key to model numbers is described in the device data sheet.

Basic model	FCa4c	d	m	f	g	h	i	j	k	l	m
<b>Explosion protection</b>											
Without		Y0									
ATEX / IECEx (Zone 2 / 22)		A2									
ATEX / IECEx (Zone 1 / 21)		A1									
cFMus version Class 1 Div. 2		F2									
cFMus version, Class 1, Div. 1 (Zone 1 / 21)		F1									
NEPSI (Zone 2 / 22)		S2									
NEPSI (Zone 1 / 21)		S1									
UKEX (Zone 2 / 22)		U2									
UKEX (Zone 1 / 21)		U1									
<b>Design / terminal box material / cable glands</b>											
Integral mount - see transmitter housing			Y0								
Remote mount / aluminum / 1 × M20 × 1.5			U1								
Remote mount / aluminum / 1 × NPT ½ in			U2								
Remote mount / stainless steel / 1 × M20 × 1.5			A1								
Remote mount / stainless steel / 1 × NPT ½ in			A2								
<b>Nominal diameter / nominal connection diameter</b>				xxxxx							
<b>Process connection</b>						xx					
<b>Material for wetted parts</b>											
Stainless steel						A1					
Polished stainless steel						H1					
Nickel alloy						C1					
<b>Flow rate calibration</b>								x			
<b>Density calibration</b>								x			

Basic model	FCa4c	d	m	f	g	h	i	j	k	l	m
<b>Connection Design / Transmitter Housing Type / Transmitter Housing Type / Cable</b>											
<b>Glands</b>											
Integral mount / dual-compartment housing / aluminum / 3 × M20 × 1.5										D1	
Integral mount / dual-compartment housing / aluminum / 3 × NPT ½ in										D2	
Integral mount / dual-compartment housing / aluminum / 3 × M20 × 1.5 (Ex d / XP)										D5	
Integral mount / dual-compartment housing / aluminum / 3 × NPT ½ in (Ex d / XP)										D6	
Integral mount / dual-compartment housing / stainless steel / 3 × M20 × 1.5										D3	
Integral mount / dual-compartment housing / stainless steel / 3 × NPT ½ in										D4	
Integral mount / dual-compartment housing / stainless steel / 3 × M20 × 1.5 (Ex d / XP)										D7	
Integral mount / dual-compartment housing / stainless steel / 3 × NPT ½ in (Ex d / XP)										D8	
Integral mount / single-compartment housing / aluminum / 3 × M20 × 1.5										S1	
Integral mount / single-compartment housing / aluminum / 3 × NPT ½ in										S2	
Remote mount / dual-compartment housing / aluminum / 3 × M20 × 1.5										R1	
Remote mount / dual-compartment housing / aluminum / 3 × NPT ½ in										R2	
Remote mount / dual-compartment housing / aluminum / 3 × M20 × 1.5 (Ex d / XP)										R5	
Remote mount / dual-compartment housing / aluminum / 3 × NPT ½ in (Ex d / XP)										R6	
Remote mount / dual-compartment housing / stainless steel / 3 × M20 × 1.5										R3	
Remote mount / dual-compartment housing / stainless steel / 3 × NPT ½ in										R4	
Remote mount / dual-compartment housing / stainless steel / 3 × M20 × 1.5 (Ex d / XP)										R7	
Remote mount / dual-compartment housing / stainless steel / 3 × NPT ½ in (Ex d / XP)										R8	
Remote mount / single-compartment housing, wall mounting / aluminum / 4 × M20 × 1.5										W1	
Remote / Single compartment, wall mounted / Aluminium / 4 × NPT ½ in										W2	
Remote mount / not specified										Y0	
<b>Outputs</b>											
Current output 1 (active or passive), digital output 1 & 2 (passive), HART®, PROFIBUS DP®										D1	
Current output 1 (active), digital output 1 & 2 (passive), HART®, Modbus®										M1	
Current output 1 (active / passive), digital output 1 & 2 (passive), digital output 3 (active), HART, Modbus										M6	
Current output 1 (active / passive), digital output 1 & 2 (passive), HART®, 1 Port Ethernet										E2*	
Current output 1 (active / passive), digital output 1 & 2 (passive), HART®, 2 Port Ethernet										E3*	
Current output 1 (active / passive), digital output 1 & 2 (passive), HART®, 1 Port Ethernet + POE										E4*	
Current output 1 (active / passive), digital output 1 & 2 (passive), HART										G0	
Current output 1 (active / passive), digital output 1 & 2 (passive), 24 V DC transmitter loop power supply, HART®										G1	
Current output 1 (active / passive), digital output 1 & 2 (passive), current output 2 (passive), HART®										G2	
Current output 1 (active / passive), digital output 1 & 2 (passive), current output 2 (passive), current output 3 (passive), HART®										G3	
Current output 1 (active / passive), digital output 1 & 2 (passive), current output 2 (passive), 24 V DC transmitter loop power supply, HART®										G4	
Without										Y0	
<b>Power supply</b>											
100 to 230 V AC											A
11 to 30 V DC											C
Without											Y

\* Available with single-compartment housing only in 'Not Ex' or 'Zone 2' or 'Div 2' execution.

## ... 2 Use in potentially explosive atmospheres

### ... Ex marking

Additional ordering information	FCa4cdefghijklm	XXX	XXX	XX
<b>Option card 1</b>				
2 port Ethernet (various protocols)		DR6*		
1 × active digital output		DRH		
<b>Option card 2</b>				
Power over Ethernet module / Modbus			DS8*	
1 × active digital output			DSH	
<b>Connection type</b>				
Without				U0
1 × M 12 plug connector for Ethernet 1 Port (4 signal lines)				UE*
2 × M 12 plug connector for Ethernet 2 Port (4 signal lines)				UF*
1 × M 12 plug connector for Ethernet 1 Port (8 signal lines)				UG*
1 × RJ45 connector with 5 m cable length attached (4 signal lines)				U5*
2 × RJ45 connector with 5 m cable length attached (4 signal lines)				UB*
1 × RJ45 connector with 5 m cable length attached (8 signal lines)				UC*
1 × RJ45 connector with 10 m cable length attached (4 signal lines)				U6*
2 × RJ45 connector with 10 m cable length attached (4 signal lines)				DU*
1 × RJ45 connector with 10 m cable length attached (8 signal lines)				UH*
1 × RJ45 connector with 15 m cable length attached (4 signal lines)				U7*
2 × RJ45 connector with 15 m cable length attached (4 signal lines)				UJ*
1 × RJ45 connector with 15 m cable length attached (8 signal lines)				UK*
1 × RJ45 connector with 20 m cable length attached (4 signal lines)				U8*
2 × RJ45 connector with 20 m cable length attached (4 signal lines)				UN*
1 × RJ45 connector with 20 m cable length attached (8 signal lines)				UP*

\* Only available with single-compartment housing and Ethernet

### DANGER

#### Risk of injury caused by live parts!

When using the outputs of the M6 option digital output or the DRH/DSH option active digital output option cards, all the option cards used and all pre-installed output circuits must use the 'Increased safety' (Ex-e) IP rating.

- The 'Intrinsic safety' (Ex i) IP rating is not permitted.

**ATEX, IECEx and UKEX****Note**

- A specific marking applies, depending on the design.
- ABB reserves the right to modify the Ex-marking. Refer to the name plate for the exact marking.

Model number for use in Zone 2, 21	Ex marking	Certificate
<b>FCa4c – A2Y0fghijD; FCa4c – U2Y0fghijD</b> Integral mount design with dual-compartment housing	II3G Ex ec IIC T6...T1 Gc II2D Ex tb IIIC T80°C...Tmedium Db	<b>ATEX:</b> FM15ATEX0014X, FM15ATEX0016X
<b>FCa4c – A2efghijY; FCa4c – U2efghijY</b> Sensor in remote mount design with dual-compartment housing		<b>IECEx:</b> IECEx FME 15.0005X
<b>FCT4c – A2R; FCT4c – U2R</b> Transmitter in remote mount design with dual-compartment housing	II3G Ex ec IIC T6 Gc II2D Ex tb IIIC T80°C Db	<b>UKEX:</b> FM22UKEX0095X, FM22UKEX0097X

Model number for use in Zone 1, 21	Ex marking	Certificate
<b>FCa4c – A1Y0fghijDx; FCa4c – U1Y0fghijDx (x = 1 to 4)</b> Integral mount design with dual-compartment housing	II 1/2 (1) G Ex db eb ia mb [ia Ga] IIC T6...T1 Gb II 2 (1) D Ex ia tb [ia Da] IIIC T80°C Db	<b>ATEX:</b> FM15ATEX0015X
<b>FCa4c – A1Y0fghijDx; FCa4c – U1Y0fghijDx (x = 5 to 8)</b> Integral mount design with dual-compartment housing (flameproof enclosure 'Ex d')	II 1/2 (1) G Ex db ia mb [ia Ga] IIB+H2 T6...T1 Gb II 2 (1) D Ex ia tb [ia Da] IIIC T80°C Db	<b>IECEx:</b> IECEx FME 15.0005X
<b>FCa4cA1Y0fghM6jDx; FCa4cU1Y0fghM6jDx (x = 1 to 4) or DRH or DSH option card</b> Integral mount design with dual-compartment housing and active digital output option card	II 1/2 G Ex db eb mb ia IIC T6...T1 Gb II 2 D Ex ia tb IIIC T80°C Db	<b>UKEX:</b> FM22UKEX0096X
<b>FCa4c – A1efghijY; FCa4c – U1efghijY</b> Sensor in remote mount design with dual-compartment housing	II 1/2 G Ex eb ia mb IIB+H2 T6...T1 Ga/Gb II 2 D Ex ia tb IIIC T80°C Db	
<b>FCa4cA1Y0fghM6jDx; FCa4cU1Y0fghM6jDx (x = 5 to 8) or DRH or DSH option card</b> Integral mount design with dual-compartment housing (flameproof enclosure 'Ex d') and active digital output option card	II 1/2 G Ex db mb ia IIB+H2 T6...T1 Gb II 2 D Ex ia tb IIIC T80°C Db	
<b>FCT4c – A1R; FCT4c – U1R (x = 1 to 4)</b> Transmitter in remote mount design with dual-compartment housing	II 2 (1) G Ex db e ia mb [ia Ga] IIC T6...T1 Gb II 2 (1) D Ex ia mb tb [ia Da] IIIC T80°C Db	
<b>FCT4c – A1R; FCT4c – U1R (x = 5 to 8)</b> Transmitter in remote mount design with dual-compartment housing (flameproof enclosure 'Ex d')	II 2 (1) G Ex db ia mb [ia Ga] IIB+H2 T6...T1 Gb II 2 (1) D Ex ia tb [ia Da] IIIC T80°C Db	
<b>FCT4c – A1R; FCT4c – U1R (x = 1 to 4) fghM6 or DRH or DSH option card</b> Transmitter in remote mount design with dual-compartment housing and active digital output option card	II 2 G Ex db eb mb IIC T6...T1 Gb II 2 D Ex mb tb IIIC T80°C Db	
<b>FCT4c – A1R; FCT4c – U1R (x = 5 to 8) fghM6 or DRH or DSH option card</b> Transmitter in remote mount design with dual-compartment housing (flameproof enclosure 'Ex d') and active digital output option card	II 2 G Ex db mb IIB+H2 T6...T1 Gb II 2 D Ex tb IIIC T80°C Db	

## ... 2 Use in potentially explosive atmospheres

### ... Ex marking

#### cFMus

##### Note

- A specific marking applies, depending on the design.
- ABB reserves the right to modify the Ex-marking. Refer to the name plate for the exact marking.

Model number for use in Division 2	Ex marking	
	Certificate: FM18US0160X	Certificate: FM18CA0073X
<b>FCa4c – F2Y0fghjD</b> Integral mount design with dual-compartment housing	NI: CL I,II,III Div 2, GPS ABCDEFG, T6...T1 CL I, ZN 2, AEx ec IIC T6...T1	DIP: CL II,III, Div 1, GPS EFG, T6 ZN 21, AEx ia tb IIIC T80°C
<b>FCa4c – F2efghjY</b> Sensor in remote mount design with dual-compartment housing Design in accordance with ANSI / ISA 12.27.01 as 'Single Seal Device' or as 'Dual Seal Device' (option TE2)	CL I, ZN 2, Ex ec IIC T6...T1	ZN21,Ex ia tb IIIC T80°C
<b>FCT4c – F2R</b> Transmitter in remote mount design with dual-compartment housing	See handbook for temperature class information	
<b>FCT4c – F2W</b> Sensor in remote mount design with single-compartment housing	NI: CL I,II,III Div 2, GPS ABCDEFG, T6...T1	DIP: CL II,III, Div 1, GPS EFG, T6
	See handbook for temperature class information	
Model number for use in Division 1	Ex marking	
	Certificate: FM18US0160X	Certificate: FM18CA0073X
<b>FCa4c – F1Y0fghjDx (x = 1 to 4)</b> Integral mount design with dual-compartment housing	XP-IS: CL I, Div 1, GPS ABCD,T6...T1 (USA) DIP: CL II,III, Div 1, GPS EFG,T6	XP-IS: CL I, Div 1, GPS BCD,T6...T1 (CAN) ZN21, AEx ia tb IIIC T80°C
<b>FCa4c – F1Y0fghjDx (x = 5 to 8)</b> Integral mount design with dual-compartment housing (Explosionproof 'XP'). Design in accordance with ANSI / ISA 12.27.01 as 'Single Seal Device' or as 'Dual Seal Device' (option TE2).	CL I, ZN 1, AEx db ia IIB+H2 T6...T1 CL I, ZN 1, Ex db ia IIB+H2 T6...T1	ZN21, Ex ia tb IIIC T80°C
<b>FCa4c – F1Y0fghM6jDx (x = 1 to 4) or DRH or DSH option card</b> Integral mount design with dual-compartment housing	XP-IS: CL I, Div 1, GPS ABCD,T6...T1 (USA) DIP: CL II,III, Div 1, GPS EFG,T6	XP-IS: CL I, Div 1, GPS BCD,T6...T1 (CAN) ZN21, AEx ia tb IIIC T80°C
<b>FCa4c – F1Y0fghM6jDx (5 to 8) or DRH or DSH option card</b> Integral mount design with dual-compartment housing (Explosionproof „XP“).	CL I, ZN 1, AEx db ia IIB+H2 T6...T1 CL I, ZN 1, Ex db ia IIB+H2 T6...T1	ZN21, Ex ia tb IIIC T80°C
	See handbook for temperature class information and installation drawing 3KXF000028G0009	
<b>FCa4c – F1efghjY</b> Sensor in remote mount design with dual-compartment housing Design in accordance with ANSI / ISA 12.27.01 as 'Single Seal Device' or as 'Dual Seal Device' (option TE2).	XP-IS: CL I, Div 1, GPS BCD T6...T1 CL I, ZN 1, AEx db ia IIB+H2 T6...T1 CL I, ZN 1, Ex db ia IIB+H2 T6...T1	DIP: CL II,III, Div 1, GPS EFG,T6 ZN 21, AEx ia tb IIIC T80°C ZN21, Ex ia tb IIIC T80°C
	See handbook for temperature class information and installation drawing 3KXF000028G0009	
<b>FCT4c – F1Rx (x = 1 to 4)</b> Transmitter in remote mount design with dual-compartment housing	XP-IS: CL I, Div 1, GPS BCD,T6...T1 (USA) DIP: CL II,III, Div 1, GPS EFG, T6	XP-IS: CL I, Div 1, GPS BCD,T6...T1 (CAN) ZN 21, AEx ia tb IIIC T80°C
<b>FCT4c – F1Rx (x = 5 to 8)</b> Sensor in remote mount design with dual-compartment housing (Explosionproof 'XP').	CL I, ZN 1, AEx db ia IIB+H2 T6...T1 CL I, ZN 1, Ex db ia IIB+H2 T6...T1	ZN21,Ex ia tb IIIC T80°C
	See handbook for temperature class information and installation drawing 3KXF000028G0009	
<b>FCT4c – F1Rx (x = 1 to 4) fghM6 or DRH or DSH option card</b> Transmitter in remote mount design with dual-compartment housing	XP-IS: CL I, Div 1, GPS BCD,T6...T1 (USA) DIP: CL II,III, Div 1, GPS EFG, T6	XP-IS: CL I, Div 1, GPS BCD,T6...T1 (CAN) ZN 21, AEx tb IIIC T80°C
<b>FCT4c – F1Rx (x = 5 to 8) fghM6 or DRH or DSH option card</b> Sensor in remote mount design with dual-compartment housing (Explosionproof 'XP').	CL I, ZN 1, AEx db IIB+H2 T6...T1 CL I, ZN 1, Ex db IIB+H2 T6...T1	ZN21,Ex tb IIIC T80°C
	See handbook for temperature class information and installation drawing 3KXF000028G0009	

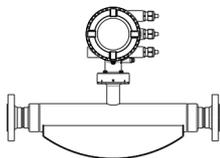
## Temperature data

### Temperature resistance for the connecting cable

The temperature at the cable entries of the device depends on the design, the measuring medium temperature  $T_{\text{medium}}$  and the ambient temperature  $T_{\text{amb.}}$ .

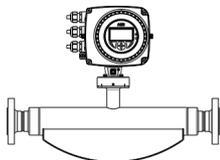
For the electric connection of the device, use only cables with sufficient temperature resistance in accordance with the following table.

### Devices in integral mount design with dual-compartment housing



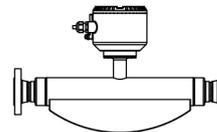
$T_{\text{amb.}}$	Temperature resistance
$\leq 50\text{ °C}$ ( $\leq 122\text{ °F}$ )	$\geq 70\text{ °C}$ ( $\geq 158\text{ °F}$ )
$\leq 60\text{ °C}$ ( $\leq 140\text{ °F}$ )	$\geq 80\text{ °C}$ ( $\geq 176\text{ °F}$ )
$\leq 70\text{ °C}$ ( $\leq 158\text{ °F}$ )	$\geq 90\text{ °C}$ ( $\geq 194\text{ °F}$ )

### Devices in integral mount design with single-compartment housing



$T_{\text{amb.}}$	Temperature resistance
$\leq 50\text{ °C}$ ( $\leq 122\text{ °F}$ )	$\geq 75\text{ °C}$ ( $\geq 167\text{ °F}$ )
$\leq 60\text{ °C}$ ( $\leq 140\text{ °F}$ )	$\geq 85\text{ °C}$ ( $\geq 185\text{ °F}$ )
$\leq 70\text{ °C}$ ( $\leq 158\text{ °F}$ )	$\geq 95\text{ °C}$ ( $\geq 203\text{ °F}$ )

### Sensor in remote mount design



$T_{\text{amb.}}$	Temperature resistance
$\leq 50\text{ °C}$ ( $\leq 122\text{ °F}$ )	$\geq 105\text{ °C}$ ( $\geq 221\text{ °F}$ )
$\leq 60\text{ °C}$ ( $\leq 140\text{ °F}$ )	$\geq 110\text{ °C}$ ( $\geq 230\text{ °F}$ )
$\leq 70\text{ °C}$ ( $\leq 158\text{ °F}$ )	$\geq 120\text{ °C}$ ( $\geq 248\text{ °F}$ )

For sensors in remote mount design, the wires in the connection box must be additionally insulated with the enclosed silicone hoses starting from ambient temperatures of  $T_{\text{amb.}} \geq 60\text{ °C}$  ( $\geq 140\text{ °F}$ ).

### Environmental and process conditions for model FCx4xx...

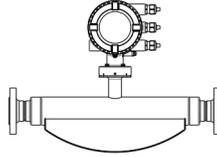
Ambient temperature $T_{\text{amb.}}$	-20 to 70 °C (-4 to 158 °F)
	-40 to 70 °C* (-40 to 158 °F)*
Measuring medium temperature	-40 to 205 °C (-40 to 400 °F)
$T_{\text{medium}}$	(-40 to 400 °F)
IP rating / NEMA rating	IP 65, IP 67 / NEMA 4X, Type 4X

\* Optional, with order code 'Ambient temperature range – TA9'

## ... 2 Use in potentially explosive atmospheres

### ... Temperature data

Measuring medium temperature for sensors in integral mount design with dual-compartment housing



#### Model FCx4xx-A1..., Model FCx4xx-U1... and FCx4xx-F1... in Zone 1, Division 1

The table shows the maximum permissible measuring medium temperature as a function of ambient temperature and temperature class.

Ambient temperature $T_{amb}$	Temperature class					
	T1	T2	T3	T4	T5	T6
$\leq 30\text{ °C}$ ( $\leq 86\text{ °F}$ )	205 °C (400 °F)*	205 °C (400 °F)*	195 °C (383 °F)*	130 °C (266 °F)	95 °C (203 °F)	80 °C (176 °F)
	130 °C (266 °F)	130 °C (266 °F)	130 °C (266 °F)			
$\leq 40\text{ °C}$ ( $\leq 104\text{ °F}$ )	205 °C (400 °F)*	205 °C (400 °F)*	195 °C (383 °F)*	130 °C (266 °F)	95 °C (203 °F)	80 °C (176 °F)
	130 °C (266 °F)	130 °C (266 °F)	130 °C (266 °F)			
$\leq 50\text{ °C}$ ( $\leq 122\text{ °F}$ )	205 °C (400 °F)*	205 °C (400 °F)*	195 °C (383 °F)*	130 °C (266 °F)	95 °C (203 °F)	80 °C (176 °F)
	130 °C (266 °F)	130 °C (266 °F)	130 °C (266 °F)			
$\leq 60\text{ °C}$ ( $\leq 140\text{ °F}$ )	205 °C (400 °F)*	205 °C (400 °F)*	195 °C (383 °F)*	130 °C (266 °F)	95 °C (203 °F)	80 °C (176 °F)
	130 °C (266 °F)	130 °C (266 °F)	130 °C (266 °F)			
$\leq 70\text{ °C}$ ( $\leq 158\text{ °F}$ )	205 °C (400 °F)*	205 °C (400 °F)*	195 °C (383 °F)*	130 °C (266 °F)	95 °C (203 °F)	80 °C (176 °F)
	130 °C (266 °F)	130 °C (266 °F)	130 °C (266 °F)			

\* Only with the 'Extended tower length – TE1, TE2 or TE3' order option

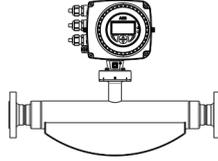
#### Model FCx4xx-A2..., Model FCx4xx-U2... and FCx4xx-F2... in Zone 2, Division 2

The table shows the maximum permissible measuring medium temperature as a function of ambient temperature and temperature class.

Ambient temperature $T_{amb}$	Temperature class					
	T1	T2	T3	T4	T5	T6
$\leq 30\text{ °C}$ ( $\leq 86\text{ °F}$ )	205 °C (400 °F)	205 °C (400 °F)	195 °C (383 °F)*	130 °C (266 °F)	95 °C (203 °F)	80 °C (176 °F)* 50 °C (122 °F)
$\leq 40\text{ °C}$ ( $\leq 104\text{ °F}$ )	205 °C (400 °F)	205 °C (400 °F)	195 °C (383 °F)*	130 °C (266 °F)	95 °C (203 °F)	—
$\leq 50\text{ °C}$ ( $\leq 122\text{ °F}$ )	205 °C (400 °F)	205 °C (400 °F)	195 °C (383 °F)*	130 °C (266 °F)	—	—
$\leq 60\text{ °C}$ ( $\leq 140\text{ °F}$ )	205 °C (400 °F)	205 °C (400 °F)	195 °C (383 °F)*	130 °C (266 °F)	—	—
$\leq 70\text{ °C}$ ( $\leq 158\text{ °F}$ )	205 °C (400 °F)*	205 °C (400 °F)*	195 °C (383 °F)*	130 °C (266 °F)	—	—
	130 °C (266 °F)	130 °C (266 °F)	130 °C (266 °F)			

\* Only with the 'Extended tower length – TE1, TE2 or TE3' order option

### Measuring medium temperature for sensors in integral mount design with single-compartment housing



#### Model FCx4xx-A2..., Model FCx4xx-U2... and FCx4xx-F2... in Zone 2, Division 2

The table shows the maximum permissible measuring medium temperature as a function of ambient temperature and temperature class.

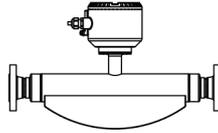
Ambient temperature $T_{amb}$	Temperature class					
	T1	T2	T3	T4	T5	T6
$\leq 30\text{ °C}$ ( $\leq 86\text{ °F}$ )	205 °C (400 °F)	205 °C (400 °F)	195 °C (383 °F)	130 °C (266 °F)	95 °C (203 °F)	80 °C (176 °F)
$\leq 40\text{ °C}$ ( $\leq 104\text{ °F}$ )	205 °C (400 °F)	205 °C (400 °F)	195 °C (383 °F)	130 °C (266 °F)	95 °C (203 °F)	—
$\leq 50\text{ °C}$ ( $\leq 122\text{ °F}$ )	205 °C (400 °F)	205 °C (400 °F)	195 °C (383 °F)	130 °C (266 °F)	95 °C (203 °F)	—
$\leq 60\text{ °C}$ ( $\leq 140\text{ °F}$ )	205 °C (400 °F)	205 °C (400 °F)	195 °C (383 °F)	130 °C (266 °F)	—	—
$\leq 70\text{ °C}$ ( $\leq 158\text{ °F}$ )	205 °C (400 °F)	205 °C (400 °F)	195 °C (383 °F)	130 °C (266 °F)	—	—

\* Only with the 'Extended tower length – TE1, TE2 or TE3' order option

## ... 2 Use in potentially explosive atmospheres

### ... Temperature data

#### Measuring medium temperature for sensors in remote mount design



#### Model FCx4xx-A1..., Model FCx4xx-U1... and FCx4xx-F1... in Zone 1

The table shows the maximum permissible measuring medium temperature as a function of ambient temperature and temperature class.

Ambient temperature $T_{amb}$	Temperature class					
	T1	T2	T3	T4	T5	T6
$\leq 30\text{ °C}$ ( $\leq 86\text{ °F}$ )	205 °C (400 °F)	205 °C (400 °F)	195 °C (383 °F)	130 °C (266 °F)	95 °C (203 °F)	80 °C (176 °F)
$\leq 40\text{ °C}$ ( $\leq 104\text{ °F}$ )	205 °C (400 °F)	205 °C (400 °F)	195 °C (383 °F)	130 °C (266 °F)	95 °C (203 °F)	80 °C (176 °F)
$\leq 50\text{ °C}$ ( $\leq 122\text{ °F}$ )	205 °C (400 °F)	205 °C (400 °F)	195 °C (383 °F)	130 °C (266 °F)	95 °C (203 °F)	80 °C (176 °F)
$\leq 60\text{ °C}$ ( $\leq 140\text{ °F}$ )	205 °C (400 °F)	205 °C (400 °F)	195 °C (383 °F)	130 °C (266 °F)	95 °C (203 °F)	80 °C (176 °F)
$\leq 70\text{ °C}$ ( $\leq 158\text{ °F}$ )	205 °C (400 °F)	205 °C (400 °F)	195 °C (383 °F)	130 °C (266 °F)	95 °C (203 °F)	80 °C (176 °F)

#### Model FCx4xx-A2..., Model FCx4xx-U2... and FCx4xx-F2... in Zone 2, Division 2

The table shows the maximum permissible measuring medium temperature as a function of ambient temperature and temperature class.

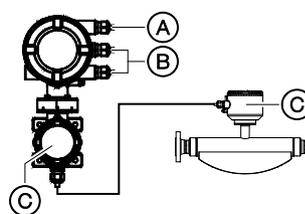
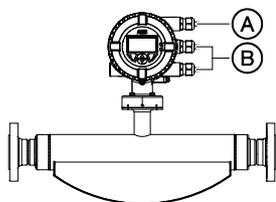
Ambient temperature $T_{amb}$	Temperature class					
	T1	T2	T3	T4	T5	T6
$\leq 30\text{ °C}$ ( $\leq 86\text{ °F}$ )	205 °C (400 °F)*	205 °C (400 °F)*	195 °C (383 °F)*	130 °C (266 °F)*	95 °C (203 °F)*	80 °C (176 °F)
	195 °C (383 °F)	195 °C (383 °F)	130 °C (266 °F)	95 °C (203 °F)	80 °C (176 °F)	
$\leq 40\text{ °C}$ ( $\leq 104\text{ °F}$ )	205 °C (400 °F)*	205 °C (400 °F)*	195 °C (383 °F)*	130 °C (266 °F)*	95 °C (203 °F)*	—
	180 °C (356 °F)	180 °C (356 °F)	130 °C (266 °F)	95 °C (203 °F)	80 °C (176 °F)	
$\leq 50\text{ °C}$ ( $\leq 122\text{ °F}$ )	205 °C (400 °F)*	205 °C (400 °F)*	130 °C (266 °F)*	130 °C (266 °F)*	80 °C (176 °F)*	—
	140 °C (284 °F)	140 °C (284 °F)	130 °C (266 °F)	95 °C (203 °F)	60 °C (140 °F)	
$\leq 60\text{ °C}$ ( $\leq 140\text{ °F}$ )	205 °C (400 °F)*	205 °C (400 °F)*	130 °C (266 °F)*	130 °C (266 °F)*	—	—
	120 °C (248 °F)	120 °C (248 °F)	120 °C (248 °F)	95 °C (203 °F)		
$\leq 70\text{ °C}$ ( $\leq 158\text{ °F}$ )	180 °C (356 °F)*	180 °C (356 °F)*	130 °C (266 °F)*	130 °C (266 °F)*	—	—
	80 °C (176 °F)	80 °C (176 °F)	80 °C (176 °F)	80 °C (176 °F)		

\* Only with the 'Extended tower length – TE1, TE2 or TE3' order option

## Electrical data

### Overview

Standard / No explosion protection	Zone 2, 21 Division 2 and Zone 2, 21	Zone 1, 21 (Zone 0) Division 2 and Zone 1, 21
<b>ATEX:</b> –	<b>ATEX / UKEX:</b> II 3 G & II 2 D	<b>ATEX / UKEX:</b> II 1/2 (1) G & II 2 (1) D
<b>IECEX:</b> –	<b>IECEX:</b> Gc & Db	<b>IECEX:</b> (Ga) Gb & (Da) Db Ga/Gb & Db (Ga) Gb & (Da) Db
<b>USA:</b> –	<b>USA:</b> NI & DIP	<b>USA:</b> XP-IS & DIP
<b>Canada:</b> –	<b>Canada:</b> AEx ec & AEx tb Non-Incendive & Dust Ignition Proof Ex ec & Ex tb	<b>Canada:</b> AEx db ia & AEx ia tb XP-IS & DIP Ex db ia & Ex ia tb



#### (A) Power supply

- Type of protection ATEX / UKEX / IECEX: Increased safety 'Ex e'
- Type of protection USA / Canada: 'non IS'
- Maximum 250 Vrms
- Terminals: 1+, 2-, L, N, 

#### (B) Inputs / outputs, communication

- Type of protection ATEX / UKEX / IECEX: Either increased safety 'Ex e' or intrinsically safe 'Ex ia'
- Type of protection USA / Canada: Either 'non IS' or 'intrinsically safe IS'.
- When installing in 'Ex ia' or 'IS', suitable intrinsically safe isolation amplifiers must be used for the connection.
- Terminals: 31, 32, Uco, V1, V2, V3, V4, 41, 42, 51, 52

#### (C) Signal cable (remote mount design only)

- Terminals: A, B, UFE, GRN
- Type of protection ATEX / UKEX / IECEX: Increased safety 'Ex e'
- Type of protection USA / Canada: 'non IS'

### Note

When installing in 'Ex ia' or 'IS' type of protection, the type of protection is determined by the type of electrical connection. The information in **Changing the type of protection** on page 28 must be observed when changing the type of protection!

## ... 2 Use in potentially explosive atmospheres

### ... Electrical data

Zone 2, 21 and Division 2 – Model: FCx4xx-A2..., FCx4xx-U2... and FCx4xx-F2...

Outputs on basic device	Operating values (general)		Type of protection – 'nA' / 'NI'	
	$U_N$	$I_N$	$U_N$	$I_N$
<b>Current / HART output 31 / <math>U_{CO}</math>, active</b> Terminals 31 / $U_{CO}$	30 V	30 mA	30 V	30 mA
<b>Current / HART output 31 / 32, passive</b> Terminals 31 / 32	30 V	30 mA	30 V	30 mA
<b>Digital output 41 / 42, active*</b> Terminals 41 / 42 and V1 / V2*	30 V	30 mA	30 V	30 mA
<b>Digital output 41 / 42, active**</b> Terminals 41 / 42 and $U_{CO}$ / 32**	30 V	30 mA	30 V	30 mA
<b>Digital output 41 / 42, passive</b> Terminals 41 / 42	30 V	25 mA	30 V	25 mA
<b>Digital output 51 / 52, active*</b> Terminals 51 / 52 and V1 / V2*	30 V	30 mA	30 V	30 mA
<b>Digital output 51 / 52, passive</b> Terminals 51 / 52	30 V	30 mA	30 V	30 mA

All outputs are electrically isolated from each other and from the power supply.

Digital outputs 41 / 42 and 51 / 52 are not electrically isolated from each other. Terminals 42 / 52 have the same potential.

\* Only in conjunction with additional '24 V DC loop power supply (blue)' plug-in card in slot OC1.

\*\* Only in conjunction with current output  $U_{CO}$  / 32 in 'Powermode', see **Current output  $U_{CO}$  / 32 as loop power supply for digital output 41 / 42 or 51 / 52** on page 57.

Inputs and outputs with optional plug-in cards	Operating values (general)		Type of protection – 'nA' / 'NI'	
	U <sub>N</sub>	I <sub>N</sub>	U <sub>N</sub>	I <sub>N</sub>
<b>Current output V3 / V4, active*</b> Terminals V3 / V4 and V1 / V2*	30 V	30 mA	30 V	30 mA
<b>Current output V1 / V2, passive**</b> <b>Current output V3 / V4, passive**</b> Terminals V1 / V2** or V3 / V4**	30 V	30 mA	30 V	30 mA
<b>Digital output V3 / V4, active*</b> Terminals V3 / V4 and V1 / V2*	30 V	25 mA	30 V	25 mA
<b>Digital output V1 / V2, passive**</b> <b>Digital output V3 / V4, passive**</b> Terminals V1 / V2** or V3 / V4**	30 V	30 mA	30 V	30 mA
<b>Digital input V3 / V4, active*</b> Terminals V3 / V4 and V1 / V2	30 V	3,45 mA	30 V	3,45 mA
<b>Digital input V1 / V2, passive**</b> <b>Digital input V3 / V4, passive**</b> Terminals V1 / V2** or V3 / V4**	30 V	3,45 mA	30 V	3,45 mA
<b>Digital output V1 / V2, active*</b> <b>Digital output V3 / V4, active*</b> Terminals V1 / V2** or V3 / V4**	24 V	22,5 mA	30 V	30 mA
<b>Modbus® / PROFIBUS DP®</b> Terminals V1 / V2	30 V	30 mA	30 V	30 mA
<b>Ethernet card</b> Ethernet (various protocols) Port 1 / Port 2	57 V	417 mA	57 V	417 mA
<b>Ethernet card in connection with Power over Ethernet (POE card)</b> Ethernet (various protocols) Port 1 / Port 2	57 V	417 mA	57 V	417 mA

\* Only in conjunction with additional '24 V DC loop power supply (blue)' plug-in card in slot OC1.

\*\* The terminal assignment depends on the model number or the slot assignments. For connection examples, see **Connection examples** on page 61.

## ... 2 Use in potentially explosive atmospheres

### ... Electrical data

Zone 1 ,21 and Division 1 – Model: FCx4xx-A1..., FCx4xx-U1... and FCx4xx-F1...

Type of protection	'e' / 'XP'		'ia' / 'IS'											
	U <sub>M</sub> [V]	I <sub>M</sub> [A]	U <sub>O</sub> [V]	U <sub>I</sub> [V]	I <sub>O</sub> [mA]	I <sub>I</sub> [mA]	P <sub>O</sub> [mW]	P <sub>I</sub> [mW]	C <sub>O</sub> [nF]	C <sub>I</sub> [nF]	C <sub>OPA</sub> [nF]	C <sub>IPA</sub> [nF]	L <sub>O</sub> [mH]	L <sub>I</sub> [mH]
<b>Outputs on basic device</b>														
<b>Current / HART output 31 / U<sub>CO</sub>, active</b> Terminals 31 / U <sub>CO</sub>	30	0.2	30	30	115	115	815	815	10	10	5	5	0.08	0.08
<b>Current / HART output 31 / 32, passive</b> Terminals 31 / 32	30	0.2	—	30	—	115	—	815	—	27	—	5	0.08	0.08
<b>Digital output 41 / 42, active*</b> Terminals 41 / 42 and V1 / V2*	30	0.1	27.8	30	119	30	826	225	20	20	29	29	0.22	0.22
<b>Digital output 41 / 42, active**</b> Terminals 41 / 42 and U <sub>CO</sub> / 32**	30	0.1	30	30	115	115	826	225	16	16	10	10	0.08	0.08
<b>Digital output 41 / 42, passive</b> Terminals 41 / 42	30	0.1	—	30	—	30	—	225	—	27	—	5	—	0.08
<b>Digital output 51 / 52, active*</b> Terminals 51 / 52 and V1 / V2*	30	0.1	27.8	30	119	30	826	225	20	20	29	29	0.22	0.22
<b>Digital output 51 / 52, passive</b> Terminals 51 / 52	30	0.1	—	30	—	30	—	225	—	27	—	5	—	0.08

All outputs are electrically isolated from each other and from the power supply.

Digital outputs 41 / 42 and 51 / 52 are not electrically isolated from each other. Terminals 42 / 52 have the same potential.

\* Only in conjunction with additional '24 V DC loop power supply (blue)' plug-in card in slot OC1.

\*\* Only in conjunction with current output U<sub>CO</sub> / 32 in 'power mode', see **Current output U<sub>CO</sub> / 32 as loop power supply for digital output 41 / 42 or 51 / 52** on page 57.

Type of protection	'e' / 'XP'		'ia' / 'IS'											
	U <sub>M</sub> [V]	I <sub>M</sub> [A]	U <sub>O</sub> [V]	U <sub>I</sub> [V]	I <sub>O</sub> [mA]	I <sub>I</sub> [mA]	P <sub>O</sub> [mW]	P <sub>I</sub> [mW]	C <sub>O</sub> [nF]	C <sub>I</sub> [nF]	C <sub>OPA</sub> [nF]	C <sub>IPA</sub> [nF]	L <sub>O</sub> [mH]	L <sub>I</sub> [mH]
<b>Inputs and outputs with optional plug-in cards</b>														
<b>Current output V3 / V4, active*</b> Terminals V3 / V4 and V1 / V2*	30	0.1	27.8	30	119	30	826	225	29	29	117	117	0.4	0.4
<b>Current output V1 / V2, passive**</b> <b>Current output V3 / V4, passive**</b> Terminals V1 / V2** or V3 / V4**	30	0.1	—	30	—	68	—	510	—	45	—	59	—	0.27
<b>Digital output V3 / V4, active*</b> Terminals V3 / V4 and V1 / V2*	30	0.1	27.8	30	119	68	826	225	17	17	31	31	0.4	0.4
<b>Digital output V1 / V2, passive**</b> <b>Digital output V3 / V4, passive**</b> Terminals V1 / V2** or V3 / V4**	30	0.1	—	30	—	30	—	225	—	13	—	16	—	0.27
<b>Digital input V3 / V4, active*</b> Terminals V3 / V4 and V1 / V2	30	0.1	27.8	30	119	3.45	826	25.8	17	17	31	31	0.4	0.4
<b>Digital output V1 / V2, active***</b> <b>Digital output V3 / V4, active***</b> Terminals V1 / V2** or V3 / V4	30	0.7	—	—	—	—	—	—	—	—	—	—	—	—
<b>Digital input V1 / V2, passive*</b> <b>Digital input V3 / V4, passive*</b> Terminals V1 / V2** or V3 / V4**	30	0.1	—	30	—	3.45	—	25.8	—	13	—	16	—	0.27
<b>Modbus® / PROFIBUS DP®</b> Terminals V1 / V2	30	0.1	4.2	4.2	150	150	150	150	5300	5300	0.06	0.06	0.14	0.14

\* Only in conjunction with additional '24 V DC loop power supply (blue)' plug-in card in slot OC1.

\*\* The terminal assignment depends on the model number or the slot assignments. For connection examples, see **Connection examples** on page 61.

\*\*\* Not available as intrinsically safe version.

## ... 2 Use in potentially explosive atmospheres

### ... Electrical data

#### Special connection conditions

##### Note

The AS plug-in card (24 V DC loop power supply) may only be used to power the internal inputs and outputs on the device. It must not be used to power external circuits!

##### Note

If the protective earth (PE) is connected in the flowmeter's terminal box, you must ensure that no dangerous potential difference can arise between the protective earth (PE) and the potential equalization (PA) in areas with explosion risk.

##### Note

- For devices with a power supply of 11 to 30 V DC, on-site external overvoltage protection must be provided.
- You must make sure that the overvoltage is limited to 140 % (= 42 V DC) of the maximum operating voltage.

##### Note

The safety requirements for intrinsically safe circuits in the EC type examination certificate of the device must be complied with.

The output circuits are designed so that they can be connected to both intrinsically-safe and non-intrinsically-safe circuits.

- Combining intrinsically safe and non-intrinsically safe circuits is not permitted.
- On intrinsically safe circuits, potential equalization should be established along the entire length of the cable used for the signal outputs.
- The rated voltage of the non-intrinsically safe circuits is  $U_M = 30 \text{ V}$ .
- Intrinsic safety is preserved If the rated voltage  $U_M = 30 \text{ V}$  is not up-scaled when connections are established to non-intrinsically safe external circuits.
- The information in **Changing the type of protection** on page 28 must be observed when changing the type of protection.

Devices connected to the relevant equipment must not be operated at over 250  $V_{\text{rms}}$  AC or 250 V DC to ground.

Installation in accordance with ATEX/IECEX or UKEX must comply with the applicable national and international standards and directives.

Installation in the USA or Canada must comply with ANSI / ISA RP 12.6, 'Installation of intrinsically safe systems for hazardous (classified) locations', the 'National Electrical Code (ANSI / NFPA 70), sections 504, 505' and the 'Canadian electrical code (C22.1-02)'.

Apparatus connected to the flowmeter must have appropriate explosion protection approval in accordance with the Entity concept.

The apparatus must have intrinsically safe circuits.

The apparatus must be installed and connected in accordance with the relevant manufacturer documentation.

The electrical specifications in **Electrical data** on page 19 must be observed.

#### Active digital output

### DANGER

#### Risk of injury caused by live parts!

Option cards for the active digital output are intended only for use in potentially explosive atmospheres as the 'increased safety' (Ex-e) IP rating and therefore may not be used as an intrinsically safe circuit.

If these optional active plug-in cards are used in combination with other option cards, all the option cards used and all pre-installed output current circuits must also use the 'Increased safety' (Ex-e) IP rating.

The option of changing of IP rating is not permitted in connection with Active Pulse option cards.

### Ethernet communication

#### **DANGER**

##### **Explosion hazard due to improper installation!**

Ethernet Option Cards are designed only for use in hazardous applications Zone 2 / Division 2.

The output circuits are designed so that different topologies such as daisy chain or point to point can be connected. See Installation diagram for detailed information.

- It is not permitted to combine both topologies.
- Ethernet communication is only available for installations in Zone 2/Division 2.
- The rated voltage of these non-intrinsically safe circuits are UM = 57 V.

## Installation instructions

### **ATEX, IECEx and UKEX**

The installation, commissioning, maintenance and repair of devices in potentially explosive atmospheres must only be carried out by appropriately trained personnel. Works may be carried out only by persons, whose training has included instructions on different types of protection and installation techniques, concerned rules and regulations as well as general principles of zoning.

The person must possess the appropriate competences for the type of work to be conducted.

The safety instructions for electrical apparatus in potentially explosive areas must be in accordance with Directive 2014/34/EU (ATEX) or British Regulations (UKEX) and IEC 60079-14 (Installation of electrical equipment in potentially explosive areas).

Comply with the applicable regulations for the protection of employees to ensure safe operation.

### **cFMus**

The installation, commissioning, maintenance and repair of devices in areas with explosion hazard must only be carried out by appropriately trained personnel.

The operator must strictly observe the applicable national regulations with regard to installation, function tests, repairs, and maintenance of electrical devices. (e. g. NEC, CEC).

### **Use in areas exposed to combustible dust**

When using the device in areas exposed to combustible dusts (dust ignition), EN 60079-31 as well as the following points must be observed:

- The maximum surface temperature of the device may not up-scale 85 °C (185 °F).
- The process temperature of the attached piping may up-scale 85 °C (185 °F).
- Approved dust-proof cable glands must be used when operating in Zone 21, 22 or in Class II, Class III.

### **Sensor insulation**

Observe the notes in **Sensor insulation** on page 39 if the sensor should be insulated.

Observe the information in **Temperature data** on page 15 regarding temperature class and cable specification.

### **Opening and closing the housing**

#### **DANGER**

##### **Danger of explosion if the device is operated with the transmitter housing or terminal box open!**

Before opening the transmitter housing or the terminal box, note the following points:

- A valid fire permit must be present.
- Make sure that there is no explosion hazard.
- Switch off the power supply and wait for  $t > 20$  minutes before opening.

#### **WARNING**

##### **Risk of injury due to live parts!**

When the housing is open, contact protection is not provided and EMC protection is limited.

- Before opening the housing, switch off the power supply.

See also **Opening and closing the housing** on page 45.

Only original spare parts must be used to seal the housing.

### **Note**

Spare parts can be ordered from ABB Service.

[www.abb.com/contacts](http://www.abb.com/contacts)

## ... 2 Use in potentially explosive atmospheres

### ... Installation instructions

#### Cable entries in accordance with ATEX/IECEX and UKEX

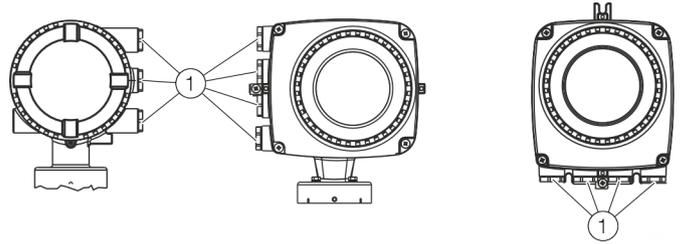
The devices are supplied with cable glands installed (certified in accordance with ATEX or IECEx).

- The use of standard cable glands and closures is prohibited.
- The black plugs in the cable glands are intended to provide protection during transport.
- The outside diameter of the connection cable must measure between 6 mm (0.24 in) and 12 mm (0.47 in) to guarantee the required tightness.
- Black cable glands are installed by default when the device is supplied. If signal outputs are connected to intrinsically safe circuits, replace the black cap on the corresponding cable gland with the blue one supplied.
- Any unused cable entries must be sealed before commissioning in accordance with the applicable standards.

#### Note

Low-temperature version devices (optional, up to  $-40\text{ }^{\circ}\text{C}$  ( $-40\text{ }^{\circ}\text{F}$ ) ambient temperature) are supplied with metal cable glands due to the required temperature resistance.

#### Cable entries in accordance with cFMus



① Transport protection plugs

Figure 1: Cable entry

The devices are delivered with  $\frac{1}{2}$  in NPT threads with transport protection plugs.

- Unused cable entries must be sealed off prior to commissioning using either approved pipe fittings or cable glands in accordance with national regulations (NEC, CEC).
- Make sure that the pipe fittings, cable glands and, if applicable, sealing plugs are installed properly and are leak-tight.
- If the device is to be operated in areas with combustible dusts, a threaded pipe connection or cable gland with suitable approval must be used.
- The use of standard cable glands and closures is prohibited.

#### Note

Devices which are certified for use in North America are supplied with a  $\frac{1}{2}$  in NPT thread only and without cable glands.

#### Specific Conditions of Use

### ⚠ WARNING

#### Special conditions for safe use!

The painted surface of the CoriolisMaster Flowmeters may store electrostatic charge and become a source of ignition in applications with a low relative humidity ( $< \sim 30\%$  relative humidity) even where the painted surface is relatively free of surface contamination such as dirt, dust, or oil.

- Guidance on protection against the risk of ignition due to electrostatic discharge can be found in PD CLC/TR 60079-32-1 and IEC TS 60079-32-1.
- Cleaning of the painted surface should only be done with a damp cloth.
- The instruction manual for the CoriolisMaster details the permitted Temperature Classification and Ambient Temperature ratings as influenced by the Process Medium temperature.
- Contact the manufacturer for specific flamepath joint details during repair of flameproof Ex d apparatus.
- For models with option m = C provision shall be made external to the equipment, to provide the transient protection device to be set at a level not exceeding 140% of the peak rated voltage value of 42V.

## Electrical connections

### Note

The temperature at the cable entries of the device depends on the design, the measuring medium temperature  $T_{\text{medium}}$  and the ambient temperature  $T_{\text{amb}}$ .

For the electric connection of the device, use only cables with sufficient temperature resistance in accordance with the tables at **Temperature resistance for the connecting cable** on page 15.

### Grounding

The sensor must be grounded in accordance with the applicable international standards.

For remote mount design, the sensor and the transmitter housing must be connected via potential equalization.

Perform grounding of the device in accordance with **Terminal assignment** on page 55.

In accordance with NEC standards, an internal ground connection is present in the device between the sensor and the transmitter.

Perform grounding of the device in accordance with **Terminal assignment** on page 55.

### Power supply terminal cover

Make sure that the power supply terminal cover is closed tightly, see also **Connection on the device** on page 64.

## Process sealing

In accordance with 'North American Requirements for Process Sealing between Electrical Systems and Flammable or Combustible Process Fluids'.

### Note

The device is suitable for use in Canada.

- For use in Class II, Groups E, F and G, a maximum surface temperature of 165 °C (329 °F) may not be up-scaled.
- All cable (conduits) should be sealed from the device within a distance of 18 in (457 mm).

ABB flowmeters are designed for the worldwide industrial market and are suitable for functions such as the measurement of flammable and combustible liquids and can be installed in process pipes.

Connecting devices with cable (conduits) to the electric installation makes it possible for measuring media to reach the electric system.

To prevent measuring media from seeping into the electric installation, the devices are equipped with process gaskets which meet requirements in accordance with ANSI / ISA 12.27.01.

Coriolis mass flowmeters are designed as 'Single Seal Devices'. With the TE2 order option, 'Extended tower length - insulation capacity with dual gasket', the devices can be used as a 'Dual Seal Devices'.

In accordance with the requirements of standard ANSI / ISA 12.27.01, the existing operating limits of temperature, pressure and pressure bearing parts must be reduced to the following limit values:

Limit values	
Flange or pipe material	No limitations
Nominal sizes	DN 15 to DN 150 (½ to 6 in)
Operating temperature	-50 °C to 205 °C (-58 °F to 400 °F)
Process pressure	PN 100 / Class 600

## ... 2 Use in potentially explosive atmospheres

### Operating instructions

#### Protection against electrostatic discharges

#### **⚠ DANGER**

##### Explosion hazard due to electrostatic charging!

The painted surface of the device can store electrostatic charges.

As a result, the housing can form an ignition source due to electrostatic discharges in the following conditions:

- The device is operated in environments with a relative humidity of  $\leq 30\%$ .
- The painted surface of the device is thereby relatively free from impurities such as dirt, dust or oil.
- Instructions on avoiding ignition in potentially explosive environments due to electrostatic discharges in accordance with PD CLC/TR 60079-32-1 and IEC TS 60079-32-1 must be complied with!

#### Instructions on cleaning

The painted surface of the device must be cleaned only using a moist cloth.

#### Changing the type of protection

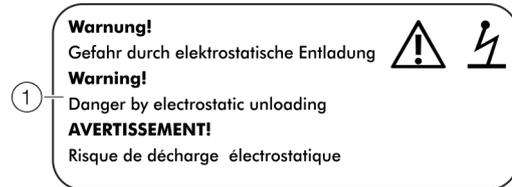
If you are installing in Zone 1 / Div. 1, the current outputs and digital outputs of models FCB430/450 and FCH430/450 can be operated with different types of protection:

- Current output and digital output in the 'intrinsically safe ia / IS' design
- Current output and digital output in non-intrinsically safe design

If a device that is already operational is operated with a different type of protection, the following measures must be implemented/insulation checks performed in accordance with applicable standards.

Original installation	New installation	Necessary test steps
<b>Zone 1 / Div. 1:</b> Current outputs and digital outputs in non-intrinsically safe design	<b>Zone 1 / Div. 1:</b> Current outputs and digital outputs in intrinsically safe ia / IS design	<ul style="list-style-type: none"> <li>• 500 V AC/1min or <math>500 \times 1.414 = 710</math> V DC/1min</li> <li>• Test between terminals A / B, <math>U_{FE}</math>, /GND, <math>U_{CO}</math> / 32, 31 / 32, 41 / 42, 51 / 52, V1 / V2 and V3 / V4, and terminals A, B, <math>U_{FE}</math>, GND, <math>U_{CO}</math>, 31, 32, 41, 42, 51, 52, V1, V2, V3, V4 and the housing.</li> <li>• When this test is performed, no voltage flashover is permitted in or on the device.</li> <li>• Optical evaluation particularly of the electronic circuit boards, no visible damage or evidence of explosion.</li> </ul>
<b>Zone 1 / Div. 1:</b> Current outputs and digital outputs in intrinsically safe ia(ib) / IS design	<b>Zone 1 / Div. 1:</b> Current outputs and digital outputs in non-intrinsically safe design	<ul style="list-style-type: none"> <li>• Visual inspection, no damage visible on the threads (cover, <math>\frac{1}{2}</math> in NPT cable glands).</li> </ul>

Devices which are approved for use in potentially explosive atmospheres have an additional warning plate.



① **WARNING!** – Danger due to electrostatic discharge.

Figure 2: Additional warning plate

#### Repair

Devices of type of protection 'd / XP' are equipped with flameproof joints in the housing. Contact ABB before commencing repair work.

### 3 Use in hazardous areas in accordance with EAC TR-CU-012

#### Note

- An additional document with information on EAC-Ex certification is available for measuring systems that are used in potentially explosive atmospheres in accordance with EAC TR-CU-012.
- The information on EAC-Ex certification is an integral part of this instruction. As a result, it is crucial that the installation guidelines and connection values it lists are also observed. The icon on the name plate indicates the following:



Information on EAC-Ex certification is available for free download at the following link. Alternatively simply scan the QR code.



<INF/FCX100/FCX400/EAC-Ex-X8>

## 4 Design and function

### General

The ABB CoriolisMaster operates according to the Coriolis principle.

The construction features conventional parallel meter tubes and is characterized in particular by its space-saving, sturdy design, wide range of nominal diameters and minimal pressure loss.

### Measuring principle

If mass flows through a vibrating pipe, Coriolis forces are generated which bend or twist the pipe. These very small measurement pipe deformations are picked up by optimally mounted sensors and electronically evaluated. Because the measured phase shift of the sensor signals is proportional to the mass flow, the mass conveyed by the measuring device can be recorded directly using the Coriolis mass flowmeter. The metering principle is independent of the density, temperature, viscosity, pressure and conductivity of the fluid.

The meter tubes always vibrate at resonance. This arising resonant frequency is a function of the meter tube geometry, the characteristics of the materials and the mass of the medium in the resonating meter tube. It provides an accurate measure of the density of the measuring medium.

An integrated temperature sensor records the measuring medium temperature and is utilized for corrections to temperature-dependent device parameters. In summary, it is possible to simultaneously measure mass flow, density and temperature with the Coriolis Mass Flowmeter. Other measurement values can be derived from these values, e.g. volume flow rate or concentration.

### Function for calculating Coriolis force

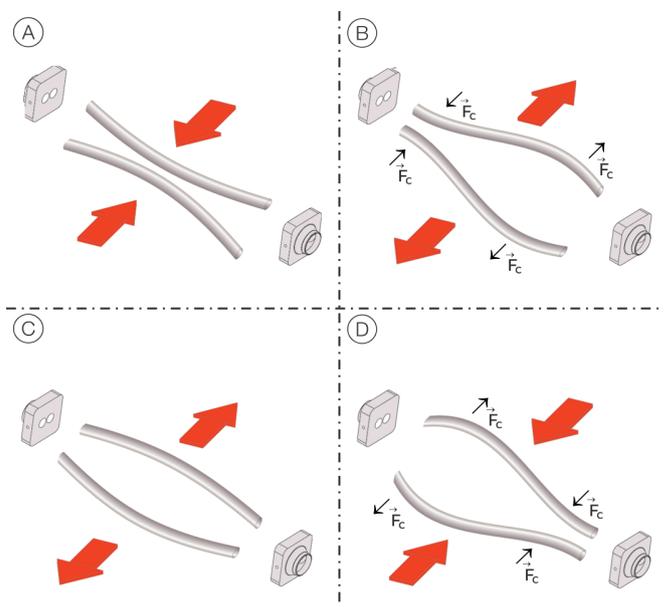
$$\vec{F}_C = -2m(\vec{\omega} \times \vec{v})$$

$\vec{F}_C$  Coriolis force

$\vec{\omega}$  Angular velocity

$\vec{v}$  Velocity of the mass

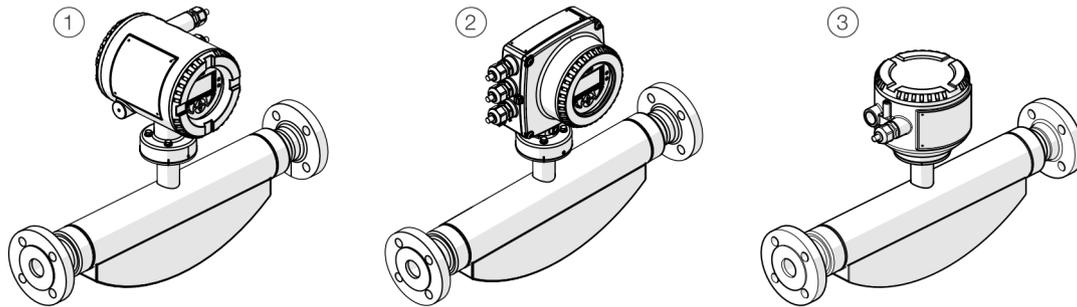
m Mass



- (A) Movement of the pipes inward, no flow
- (B) Direction of the Coriolis force with flow and movement of the pipes outward
- (C) Movement of the pipes outward, no flow
- (D) Direction of the Coriolis force with flow and movement of the pipes inward

Figure 3: Simplified representation of Coriolis forces

## Device designs



- ① Sensor (integral mount design, dual-compartment housing)  
 ② Sensor (integral mount design, single-compartment housing)  
 ③ Sensor (remote mount design)

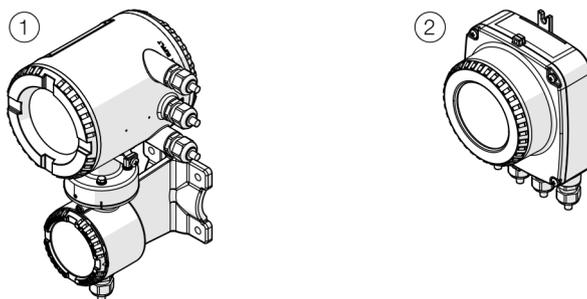
Figure 4: Designs

Sensor				
Model	FCB400 standard design		FCH400 hygienic design	
Chassis	Integral mount design, remote mount design			
Measuring accuracy for liquids	FCB430	FCB450	FCH430	FCH450
Mass flow*	0.4 %, 0.25 % and 0.2 %	0.1 % and 0.15 %	0.4 %, 0.25 % and 0.2 %	0.1 % and 0.15 %
Volume flow*	0.4 %, 0.25 % and 0.2 %	0.15 % and 0.11 %	0.4 %, 0.25 % and 0.2 %	0.15 % and 0.11 %
Density	0.01 kg/l	<ul style="list-style-type: none"> <li>0.002 kg/l</li> <li>0.001 kg/l (optional)</li> <li>0.0004 kg/l (optional)</li> </ul>	0.01 kg/l	<ul style="list-style-type: none"> <li>0.002 kg/l</li> <li>0.001 kg/l (optional)</li> <li>0.0004 kg/l (optional)</li> </ul>
Temperature	1 K	0,5 K	1 K	0,5 K
Measuring accuracy for gases*	1 %	0,5 %	1 %	0,5 %
Permissible measuring medium temperature $T_{\text{medium}}$	-50 to 160 °C (-58 to 320 °F)	-50 to 205 °C (-58 to 400 °F)	-50 to 160 °C (-58 to 320 °F)	-50 to 205 °C (-58 to 400 °F)
Process connection				
Flange DIN 2501 / EN 1092-1	DN 10 to 200; PN 40 to PN 160		—	
Flange ASME B16.5	DN ½ to 8 in; CL150 to CL1500		—	
JIS flange	DN 10 to 200; JIS 10K to 20K		—	
Pipe fitting DIN 11851	DN 10 to 100 (¾ to 4 in)		DN 20 to 100 (½ to 4 in)	
Pipe fitting SMS 1145	DN 25 to 80 (1 to 3 in)		—	
Tri-clamp DIN 32676 (ISO 2852)	DN 15 to 100 (¼ to 4 in)		DN 20 to 100 (¼ to 4 in)	
Tri-clamp BPE	DN ¾ to 4 in		DN ¾ to 4 in	
Female thread DIN ISO 228 and ASME B 1.20.1	DN 15; PN 100		—	
Other connections	On request		On request	
Wetted material	Stainless steel 1.4435 or 1.4404 (AISI 316L), nickel alloy C4 / C22		Stainless steel, polished 1.4404 (AISI 316L) or 1.4435 (AISI 316L)	
IP rating	<ul style="list-style-type: none"> <li>Integral mount design: IP 65 / IP 67, NEMA 4X</li> <li>Remote mount design: IP 65 / IP 67 / IP 68 (sensor only, immersion depth: 5 m), NEMA 4X</li> </ul>			
Approvals				
Explosion protection	ATEX / IECEx / UKEX / cFMus / EAC-Ex		ATEX / IECEx / UKEX / cFMus / EAC-Ex	
Hygiene approvals	—		FDA compliant	
Legal metrology	OIML R117, MID, devices for legal metrology in accordance with API / AGA			
Further approvals	At <a href="http://www.abb.com/flow">www.abb.com/flow</a> or upon request.			

\* Indication of accuracy in % of the measured value

## ... 4 Design and function

### ... Device designs



① Dual-compartment housing

② Single-compartment housing

Figure 5: Transmitter with remote mount design

Transmitter	
<b>Chassis</b>	Integral mount design (see Figure 4, pos. ① and ②), remote mount design (see Figure 5, pos. ① and ②).
<b>IP rating</b>	IP 65 / IP 67, NEMA 4X
<b>Cable length</b>	Maximum 200 m (656 ft), with remote mount design only
<b>Power supply</b>	100 to 240 V AC, 50 / 60 Hz 11 to 30 V DC, nominal voltage: 24 V DC
<b>Outputs in basic version</b>	Current output: 4 to 20 mA active or passive Digital output 1: passive, configurable as pulse, frequency or switch output Digital output 2: passive, configurable as pulse or switch output
<b>Additional optional outputs</b>	The transmitter has two slots in which plug-in cards can be inserted to provide additional inputs and outputs. The following plug-in cards are available: <ul style="list-style-type: none"> <li>• Current output (maximum two plug-in cards simultaneously)</li> <li>• Active or passive digital output (maximum one plug-in card)</li> <li>• Digital input (maximum one plug-in card)</li> <li>• Modbus or PROFIBUS DP interface (maximum of one plug-in card)</li> <li>• 24 V DC loop power supply for active outputs (maximum one plug-in card)</li> <li>• Ethernet card</li> <li>• Power Over Ethernet - POE card</li> </ul>
<b>External output zero return</b>	Yes
<b>External totalizer reset</b>	Yes
<b>Forward / reverse flow metering</b>	Yes
<b>Counter</b>	Yes
<b>Communication</b>	HART® protocol 7.1, Modbus® or PROFIBUS DP® (via plug-in card), EtherNet/IP™, PROFINET®, Modbus® TCP, Webservice over Ethernet*
<b>Empty pipe detection</b>	Yes, via configurable density alarm
<b>Self-monitoring and diagnosis</b>	Yes
<b>Local indicator</b>	Yes
<b>Field optimization for flow and density</b>	Yes
<b>Concentration measurement 'DensiMass'</b>	Yes, optional on models FCB450 and FCH450
<b>'FillMass' filling function</b>	Yes, optional on models FCB450 and FCH450
<b>'VeriMass' function</b>	Yes, optional
<b>'Enhanced Coriolis Control (ECC)' function</b>	Yes, optional

\* EtherNet/IP™, Modbus® TCP and PROFINET®, web server via Ethernet available only with the single-compartment housing

## 5 Product identification

### Name plate

#### Note

The name plates displayed are examples. The device identification plates affixed to the device can differ from this representation.

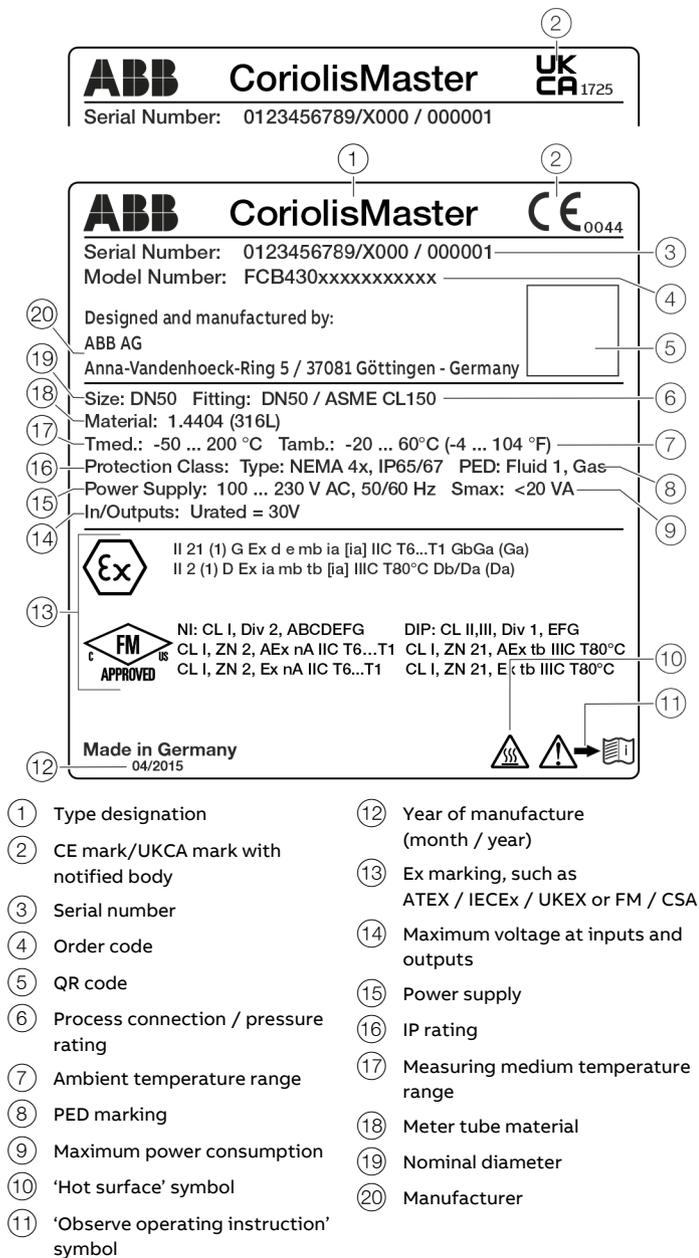


Figure 6: Name plate (sample)

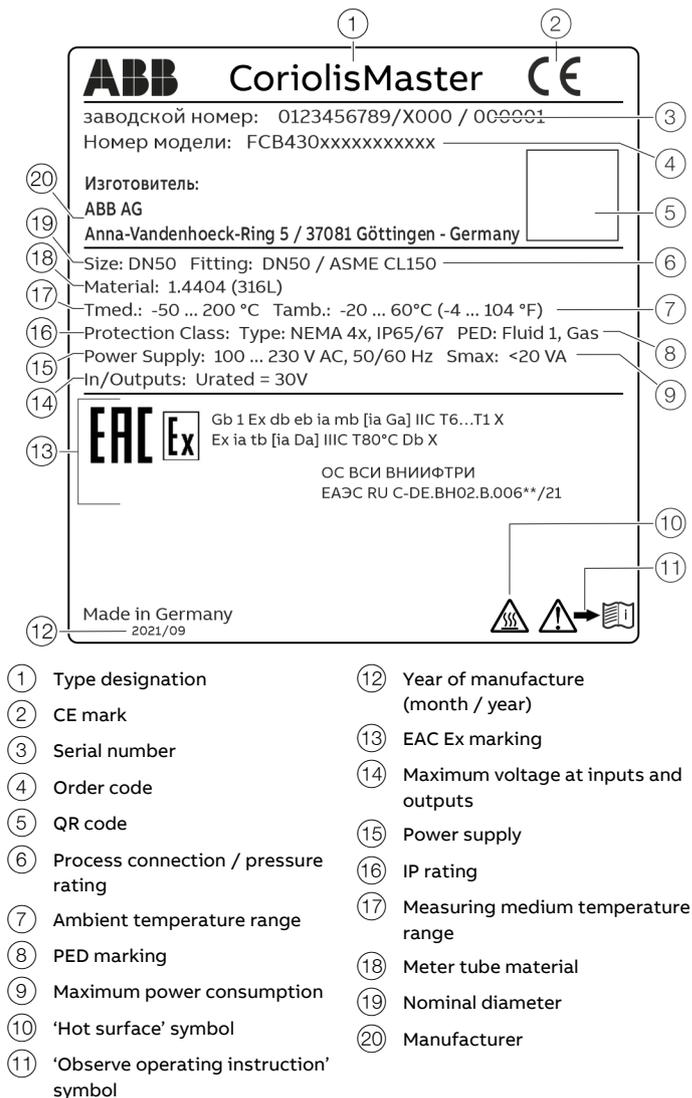


Figure 7: EAC-Ex name plate (example)

## ... 5 Product identification

### ... Name plate

The marking is provided on the name plate and on the sensor itself in accordance with the Pressure Equipment Directive (PED).

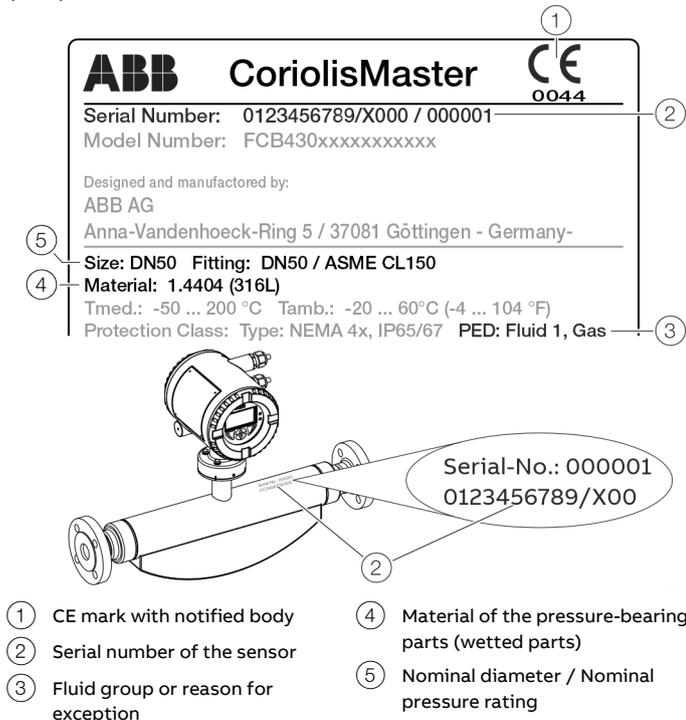


Figure 8: PED marking (example)

The marking is dependent on the nominal diameter (> DN 25 or ≤ DN 25) of the sensor (also refer to Pressure Equipment Directive 2014/68/EU).

#### Pressure equipment within the scope of the Pressure Equipment Directive

The number of the notified body is specified underneath the CE mark to confirm that the device meets the requirements of the Pressure Equipment Directive.

The respective fluid group in accordance with the Pressure Equipment Directive is indicated under PED.

Example: Fluid group 1 = hazardous fluids, gaseous.

#### Pressure equipment beyond the scope of the Pressure Equipment Directive

In PED the exception to Article 4 (3) of the Pressure Equipment Directive is specified.

The pressure equipment is classified in the SEP (= Sound Engineering Practice) 'Good Engineering Practice' category.

## 6 Transport and storage

Observe the following instructions:

- Do not expose the device to humidity during transport. Pack the device accordingly.
- Pack the device so that it is protected against vibrations during transport, for example, by using air-cushioned packing.

### Inspection

Check the devices immediately after unpacking for possible damage that may have occurred from improper transport. Details of any damage that has occurred in transit must be recorded on the transport documents. All claims for damages must be submitted to the shipper without delay and before installation.

### Transporting the device

#### **⚠ DANGER**

**Life-threatening danger due to suspended loads.**

In the case of suspended loads, a danger of the load falling exists.

- Standing under suspended loads is prohibited.

#### **⚠ WARNING**

**Risk of injury due to device slipping.**

The device's center of gravity may be higher than the harness suspension points.

- Make sure that the device does not slip or turn during transport.
- Support the device laterally during transport.

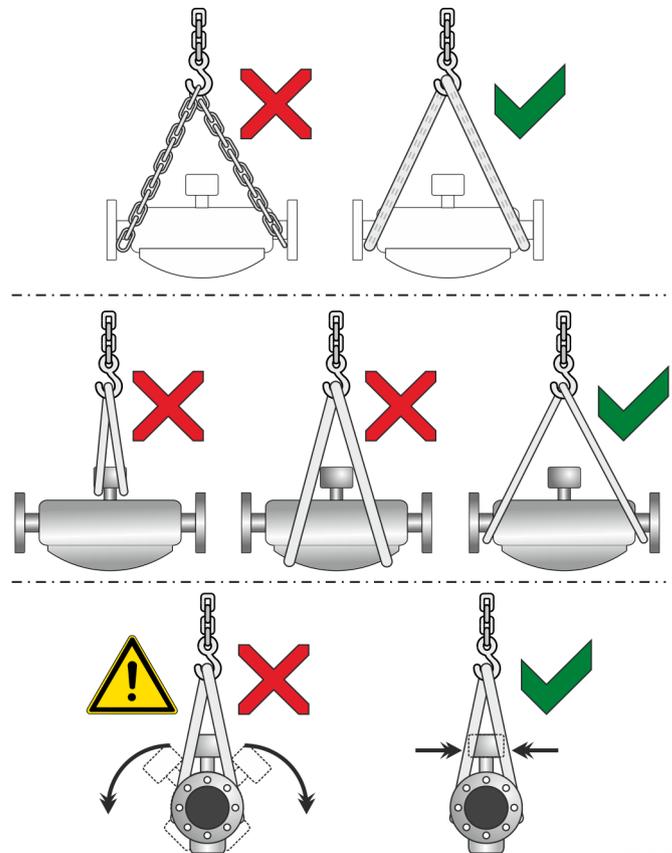


Figure 9: Transport instructions

Observe the following when transporting the device to the measuring location:

- Observe the weight details of the device in the data sheet.
- Use only approved hoisting slings for crane transport.
- Do not lift devices by the transmitter housing or terminal box.
- The center of gravity of the device may be located above the harness suspension points.

## ... 6 Transport and storage

### Storing the device

Bear the following points in mind when storing devices:

- Store the device in its original packaging in a dry and dust-free location.
- Observe the permitted ambient conditions for transport and storage.
- Avoid storing the device in direct sunlight.
- In principle, the devices may be stored for an unlimited period. However, the warranty conditions stipulated in the order confirmation of the supplier apply.

### Ambient conditions

The ambient conditions for the transport and storage of the device correspond to the ambient conditions for operation of the device.

Adhere to the device data sheet!

### Returning devices

For the return of devices, follow the instructions in **Repair** on page 169.

## 7 Installation

### General installation conditions

#### Installation location and assembly

Note the following points when selecting the installation location and when mounting the sensor:

- The ambient conditions (IP rating, ambient temperature range  $T_{\text{ambient}}$ ) of the device must be adhered to at the installation location.
- Sensors and transmitters must not be exposed to direct sunlight. If necessary, provide a suitable means of sun protection on site. The limit values for ambient temperature  $T_{\text{ambient}}$  must be adhered to.
- On flange devices, ensure that the counterflanges of the piping are aligned plane parallel. Only install flange devices with suitable gaskets.
- Prevent the sensor from coming into contact with other objects.
- The device is designed for industrial applications. No special EMC protective measures are required if the electromagnetic fields and interference at the installation location of the device comply with 'Best Practice' (in accordance with the standards listed in the declaration of conformity).  
Maintain a suitable distance from electromagnetic fields and interference that extend beyond the usual dimensions.

#### Seals

Users are responsible for selecting and mounting suitable gaskets (material, shape).

Note the following points when selecting and mounting gaskets:

- Use gaskets made from a material that is compatible with the measuring medium and measuring medium temperature.
- Gaskets must not extend into the flow area, since possible turbulence may influence the accuracy of the device.

#### Calculating pressure loss

Pressure loss depends on the properties of the medium and the flow rate.

A good aid for pressure loss calculation is the Online ABB Product Selection Assistant (PSA) for flow at

[www.abb.com/flow-selector](http://www.abb.com/flow-selector).

### Brackets and supports

No special supports or damping are required for the device when the device is used and installed as intended.

In systems designed in accordance with 'Best Practice', the forces acting on the device are already sufficiently absorbed. This is also true of devices installed in series or in parallel.

For heavier devices, it is advisable to use additional supports / brackets on site. Doing this prevents damage to the process connections and piping from lateral forces.

Please observe the following points:

- Mount two supports or brackets symmetrically in the immediate vicinity of the process connections.
- Do not fasten any supports or brackets to the housing of the flowmeter sensor.

### Note

For increased vibration load, such as for example on ships, the use of the 'CL1' marine design is recommended.

### Inlet section

The sensor does not require any inlet section.

The devices can be installed directly before/after manifolds, valves or other equipment, provided that no cavitation is caused by this equipment.

## Mounting position

The flowmeter operates in any mounting position.

Depending on the measuring medium (liquid or gas) and the measuring medium temperature, certain mounting positions are preferable to others. For this purpose, consider the following examples.

The preferred flow direction is indicated by the arrow on the sensor. The flow will be displayed as positive.

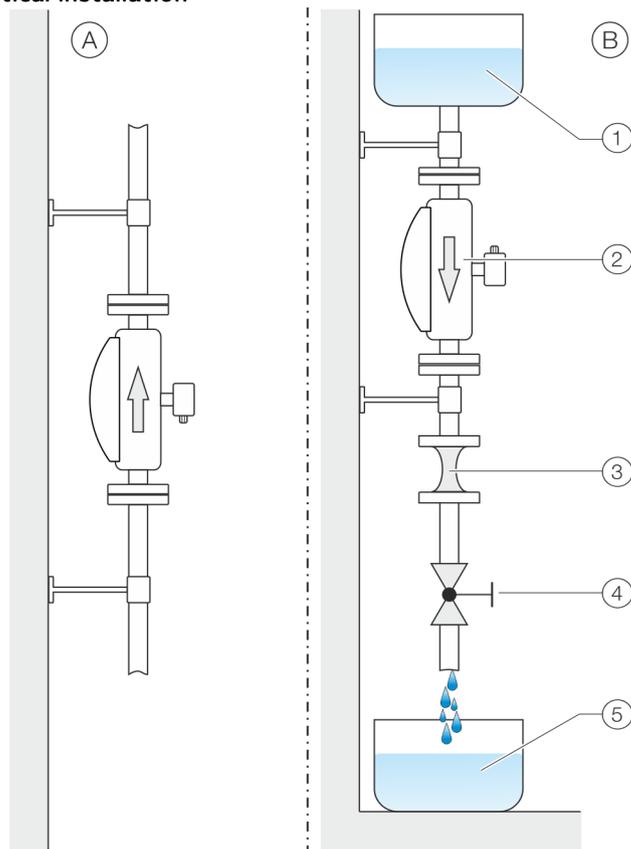
The specified measuring accuracy can be achieved only in the calibrated flow direction (for forward flow calibration, this is only in the direction of the arrow; for the optional forward flow and reverse flow calibration, this can be in both flow directions).

### Liquid measuring media

Observe the following points to avoid measuring errors:

- The meter tubes must always be completely filled with the measuring medium.
- The gases dissolved in the measuring medium must not leak out. To safeguard this, a minimum back pressure of 0.2 bar (2.9 psi) is recommended.
- The minimum vapor pressure of the measuring medium must be maintained when there is negative pressure in the meter tube or when liquids are gently simmering.
- During operation, there must be no phase transitions in the measuring medium.

### Vertical installation



- ① Supply tank
- ② Sensor
- ③ Piping constriction / orifice

- ④ Turn-off device
- ⑤ Filling tank

Figure 10: Vertical installation

## ... 7 Installation

### ... General installation conditions

- (A) For vertical installation in a riser, no special measures are required.
- (B) For vertical installation in a downpipe, a piping constriction or an orifice must be installed below the sensor. Doing this prevents the sensor from draining during the measurement.

#### Horizontal installation

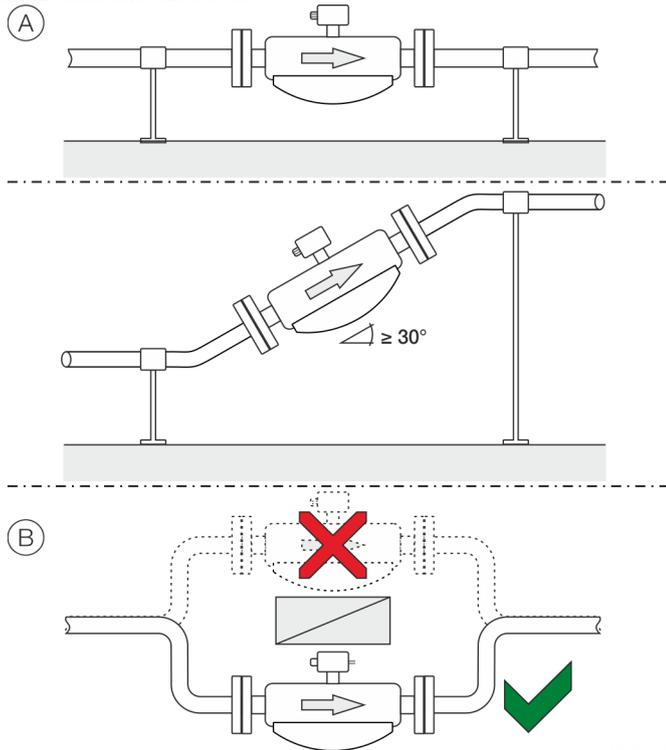


Figure 11: Horizontal installation

- (A) For liquid measuring media and horizontal installation, the transmitter and terminal box must point upward. If a self-draining installation is required, the sensor must be mounted at an incline of  $\geq 30^\circ$ .
- (B) Installing the sensor at the highest point of the piping leads to an increased number of measuring errors due to the accumulation of air or the formation of gas bubbles in the meter tube.

#### Gaseous measuring media

Observe the following points to avoid measuring errors:

- Gases must be dry and free of liquids and condensates.
- Avoid the accumulation of liquids and the formation of condensate in the meter tube.
- During operation, there must be no phase transitions in the measuring medium.

If there is a risk of condensate formation when using gaseous measuring media, note the following:

Ensure that condensates cannot accumulate in front of the sensor.

If this cannot be avoided, we recommend that the sensor is installed vertically with a downward flow direction.

#### Vertical installation

For vertical installation, no special measures are required.

#### Horizontal installation

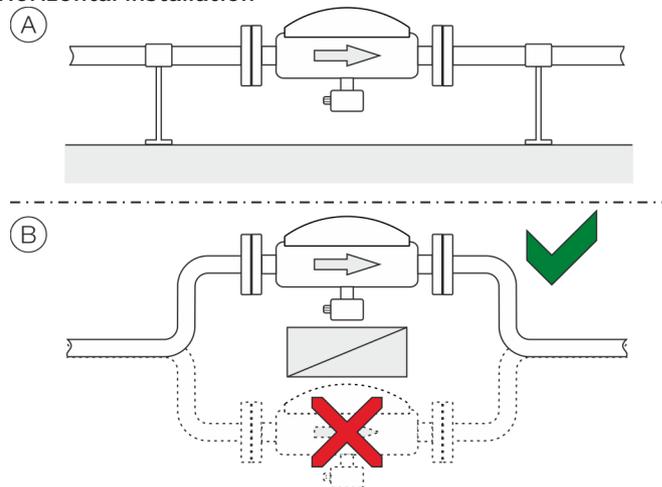


Figure 12: Horizontal installation

- (A) For gaseous measuring media and horizontal installation, the transmitter and terminal box must point downward.
- (B) Installing the sensor at the lowest point of the piping leads to an increased number of measuring errors due to the accumulation of liquid or the formation of condensates in the meter tube.

### Turn-off devices for the zero point adjustment

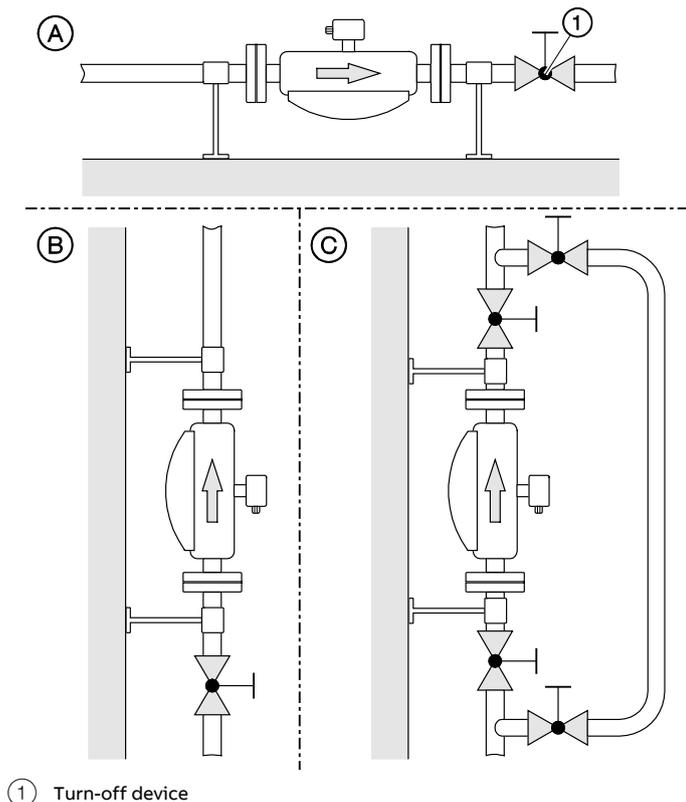


Figure 13: Mounting options for turn-off devices (example)

To guarantee the conditions for zero point balancing under operating conditions, turn-off devices are required in the piping:

- Ⓐ At least on the outlet side when the transmitter is mounted in horizontal position
- Ⓑ At least on the inlet side when the transmitter is mounted in vertical position.
- Ⓒ In order to perform balancing during an ongoing process, it is advisable to mount a bypass pipe.

### Sensor insulation

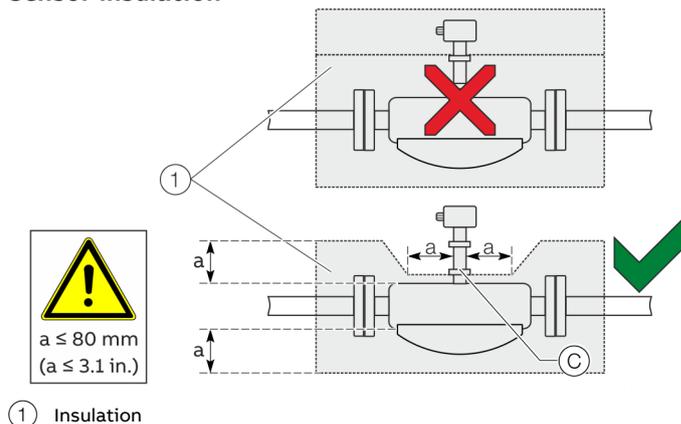


Figure 14: Installation at  $T_{\text{medium}} -50^{\circ}\text{C}$  to  $205^{\circ}\text{C}$  ( $-58$  to  $400^{\circ}\text{F}$ )

The sensor may only be insulated in conjunction with the option TE1 'Extended tower length for sensor insulation' or TE2 'Extended tower length – insulation capacity with dual gasket,' as shown in Figure 14.

### Heat tracing of the sensor

When operating the sensor in conjunction with heat tracing, the temperature at point Ⓒ (Figure 14)  $100^{\circ}\text{C}$  ( $212^{\circ}\text{F}$ ) may not be exceeded at any time!

### Installation in EHEDG-compliant installations

#### ⚠ WARNING

##### Risk of poisoning!

Bacteria and chemical substances can contaminate or pollute pipeline systems and the materials they are made of.

- In EHEDG-compliant installations, the instructions below must be observed.
- The required self-draining functionality of the sensor can only be guaranteed when the vertical mounting position or horizontal mounting position at a  $30^{\circ}$  incline is used. Refer to **Liquid measuring media** on page 37.
- The combination of process connections and gaskets selected by the operator may comprise only EHEDG-compliant components. Please note the information in the latest version of the EHEDG Position Paper: 'Hygienic Process connections to use with hygienic components and equipment' in this regard.

## ... 7 Installation

### ... General installation conditions

#### Devices for legal metrology

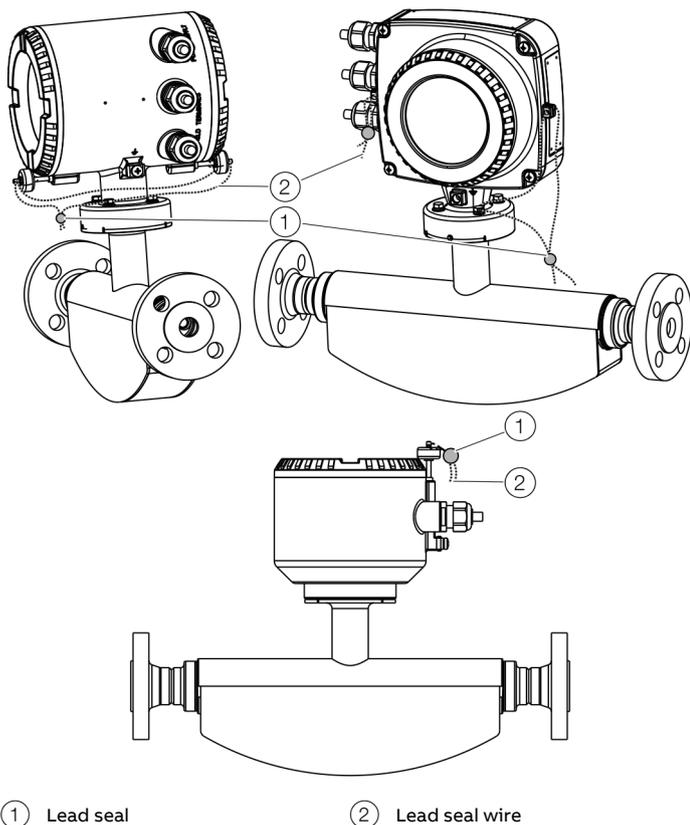


Figure 15: Sealing in accordance with MID / OIML R117 (example)

On devices for legal metrology, the hardware write protection must be activated after commissioning in many cases.

This prevents a change in the parameterization of the devices.

**Hardware settings** on page 81

To prevent deactivation of the hardware write protection or other manipulations during operation, the transmitter housing and the sensor housing connection box (with remote mount design) must be sealed.

For this purpose, a seal kit is available at ABB.

For the assembly of the seal, please observe the separate 'IN/FCX100/FCX400/MID/OIML-XA' instructions.

### Process conditions

#### Temperature limits °C (°F)

##### Note

When using the device in potentially explosive atmospheres, note the additional temperature data in **Temperature data** on page 15!

#### Measuring medium temperature $T_{\text{medium}}$

- FCx430: -50 to 160 °C (-58 to 320 °F)
- FCx450: -50 to 205 °C (-58 to 401 °F)

In devices with order code 'Extended tower length – TE3', the measuring medium temperature must be limited to a maximum of 140 °C (284 °F) from an ambient temperature of  $\geq 65$  °C (149 °F).

#### Temperature Data

	Standard	Optional
Ambient temperature	-20 to 70 °C (-4 to 158 °F)	-40 to 70 °C (-40 to 158 °F)
Storage temperature	-20 to 70 °C (-4 to 158 °F)	—

##### Note

When operating below -20 °C (-4 °F), the LCD display can no longer be read and the electronics should be operated with as few vibrations as possible.

Full functionality is assured at temperatures above -20 °C (-4 °F).

Storage temperature of the devices in the 'Standard' version without cable glands is also -40 to 70 °C (-40 to 158°F).

### Pressure ratings

The maximum permissible operating pressure is determined by the respective process connection, the temperature of the medium to be measured, the screws, and the gasket material. For an overview of available pressure ratings, see **Device designs** on page 31.

### Housing as a protective device (optional)

#### Order code PR5

Maximum burst pressure 60 bar (870 psi)

#### Optional order code PR6 and PR7 on request

- Increased burst pressures up to 100 bar (1450 psi), possible for nominal diameters DN 15 to 100 (½ to 4 in.).
- Increased burst pressures up to 150 bar (2175 psi), possible for nominal diameters DN 15 to 80 (½ to 3 in.).
- Purge connections are available on request.

### Pressure Equipment Directive

Conformity assessment in accordance with Category III, fluid group 1, gas. The pressure equipment is designed for load changes in accordance with the AD2000 specification sheet S1 Chapter 1.4 a) and b).

Note the corrosion resistance of the meter tube materials in relation to the measuring medium.

## Material load for process connections

### Note

You can reference the availability of the different process connections in the Online ABB Product Selection Assistant (PSA) for flow [www.abb.com/flow-selector](http://www.abb.com/flow-selector).

- Not all connections shown here are available in all the devices and designs.
- The permissible material load of the device can additionally differ from the material load of the connection. The permissible limit values (pressure rating / measuring medium temperature  $T_{\text{medium}}$ ) can be found on the name plate.

Design	Nominal diameter	PS <sub>max</sub>	TS <sub>max</sub>	TS <sub>min</sub>
Pipe fitting (DIN 11851)	DN 15 to DN 40 (½ to 1½ in)	40 bar (580 psi)	140 °C (284 °F)	-40 °C (-40 °F)
	DN 50 to DN 100 (2 to 4 in)	25 bar (363 psi)	140 °C (284 °F)	-40 °C (-40 °F)
Pipe fitting (SMS 1145)	DN 25 to DN 80 (1 to 3 in)	6 bar (87 psi)	140 °C (284 °F)	-40 °C (-40 °F)
Tri-Clamp (DIN 32676)	DN 15 to DN 50 (½ to 2 in)	16 bar (232 psi)	140 °C (284 °F)	-40 °C (-40 °F)
	DN 65 to DN 100 (2½ to 4 in)	10 bar (145 psi)	140 °C (284 °F)	-40 °C (-40 °F)
ASME BPE Clamp	< DN 80 (< 3 in)	17,1 bar (248 psi)	121 °C (249,8 °F)	-40 °C (-40 °F)
	DN 80 (< 3 in)	15,5 bar (224,8 psi)	121 °C (249,8 °F)	-40 °C (-40 °F)
	DN 100 (< 4 in)	12,9 bar (187,1 psi)	121 °C (249,8 °F)	-40 °C (-40 °F)
NPT female thread	DN15 stainless steel 1.4404	179 bar (2596,2 psi)	150 °C (302 °F)	-40 °C (-40 °F)
	DN15 stainless steel 1.4404	163 bar (2364,1 psi)	205 °C (401 °F)	-40 °C (-40 °F)
	DN15 HC22 2.4602	267 bar (3872,5 psi)	150 °C (302 °F)	-40 °C (-40 °F)
	DN15 HC22 2.4602	243 bar (3524,4 psi)	205 °C (401 °F)	-40 °C (-40 °F)

# ... 7 Installation

## ... Material load for process connections

### Material load curves for flange devices

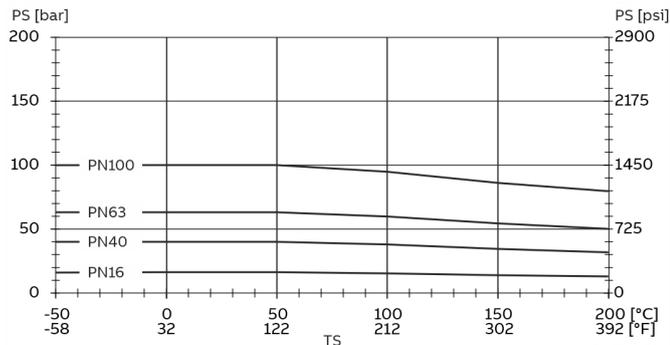


Figure 16: Stainless steel DIN flange 1.4404 (316L) up to DN 200 (8 in.)

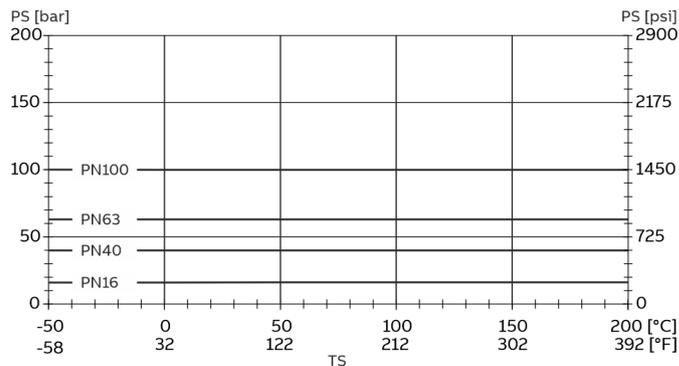


Figure 18: Nickel alloy DIN flange up to DN 200 (8 in.)

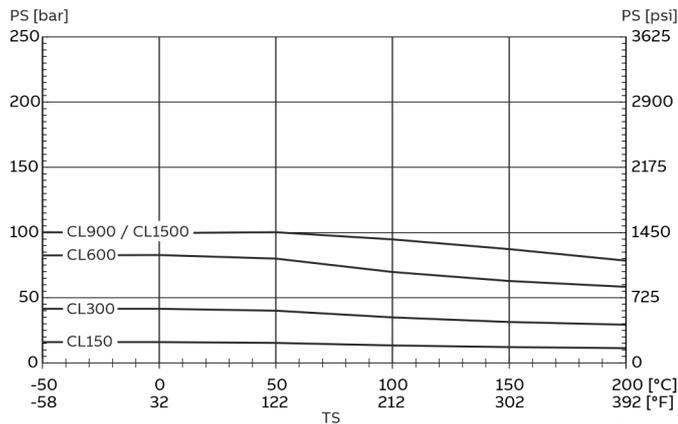


Figure 17: Stainless steel ASME flange 1.4404 (316L) up to DN 200 (8 in.)

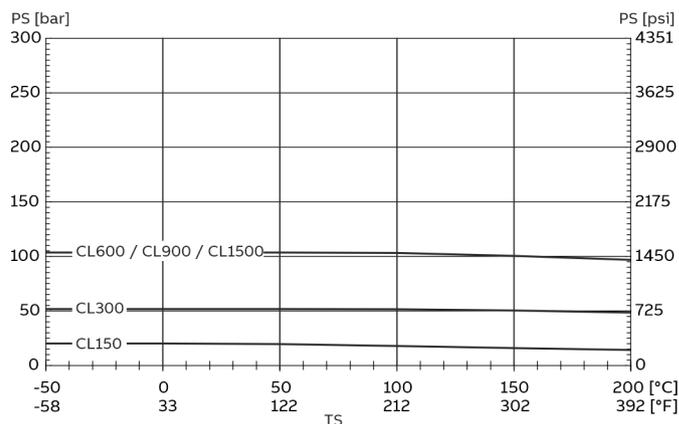


Figure 19: Nickel alloy ASME flange up to DN 200 (in.)

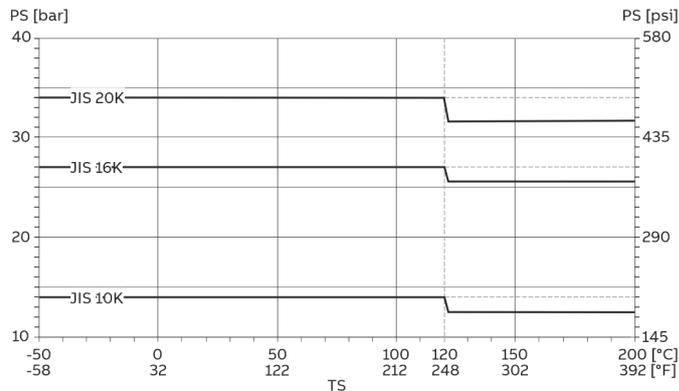


Figure 20: Stainless steel JIS B2220 flange 1.4435 or 1.4404 (AISI 316L) or nickel alloy

## Installing the sensor

Before installation in the piping, observe the installation conditions and instructions on the mounting position!

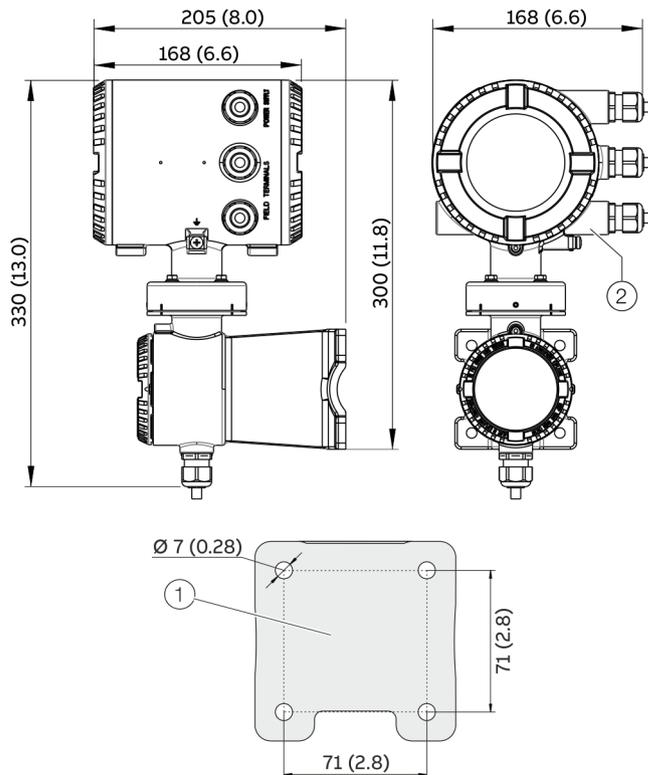
1. Insert the sensor into the piping centrally and positioned coplanar. Use suitable gaskets to seal the process connections.
2. Tighten flange screws by working on each in a crosswise manner with the maximum permissible torque.
3. Check the seal integrity of the process connections.

## Installing the transmitter in the remote mount design

When selecting a location for the transmitter, consider the following points:

- Observe the information concerning maximum ambient temperature and IP rating on the name plate
- The location must be mostly free from vibration.
- The location must not be exposed to direct sunlight. If necessary provide a sun screen on site.
- Do not up-scale the maximum signal cable length between the transmitter and the sensor.

1. Drill mounting holes at mounting location.
2. Attach transmitter securely to the mounting location using suited fasteners for the base material.



- ① Hole pattern for mounting holes
- ② Female thread (either 1/2 in NPT or M20 x 1.5), see model coding. In the case of a 1/2 in NPT, there is a plug instead of a cable gland.

Figure 21: Mounting dimensions dual-compartment housing

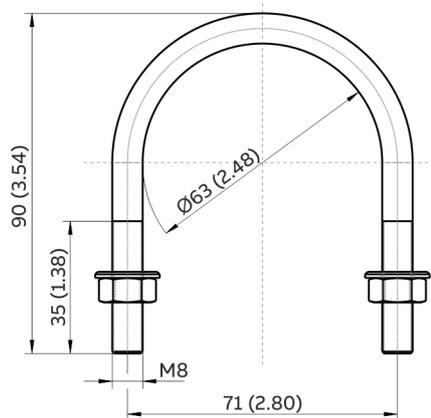
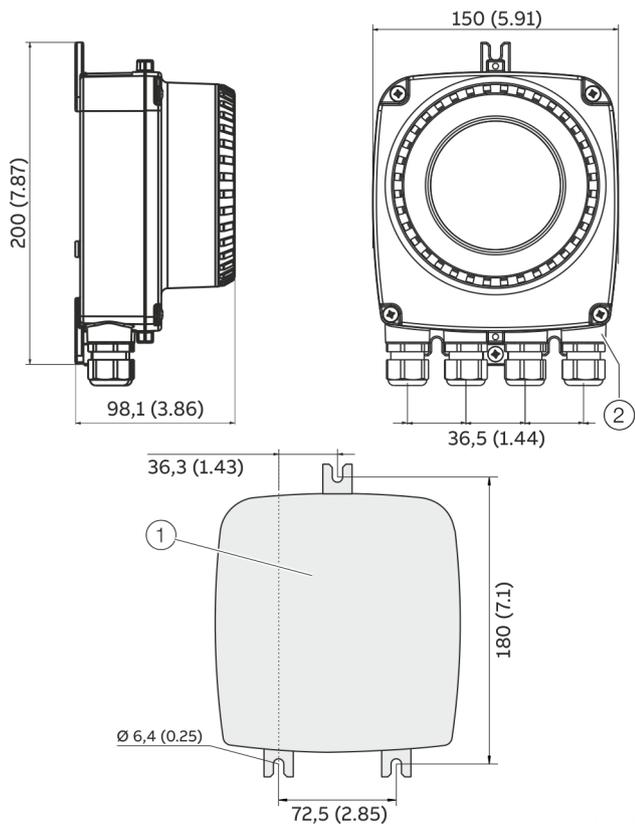


Figure 22: Assembly set for 2" pipe mounting

## ... 7 Installation

### ... Installing the transmitter in the remote mount design



- ① Hole pattern for mounting holes
- ② Female thread (either  $\frac{1}{2}$  in NPT or M20  $\times$  1.5), see model coding. In the case of a  $\frac{1}{2}$  in NPT, there is a plug instead of a cable gland.

Figure 23: Mounting dimensions single-compartment housing

## Opening and closing the housing

### **⚠ DANGER**

**Danger of explosion if the device is operated with the transmitter housing or terminal box open!**

Before opening the transmitter housing or the terminal box, note the following points:

- A valid fire permit must be present.
- Make sure that there is no explosion hazard.
- Switch off the power supply and wait for  $t > 20$  minutes before opening.

### **⚠ WARNING**

**Risk of injury due to live parts!**

When the housing is open, contact protection is not provided and EMC protection is limited.

- Before opening the housing, switch off the power supply.

### **NOTICE**

**Potential adverse effect on the IP rating**

- Check the O-ring gasket for damage and replace it if necessary before closing the housing cover.
- Check that the O-ring gasket is properly seated when closing the housing cover.

### Dual- compartment housing

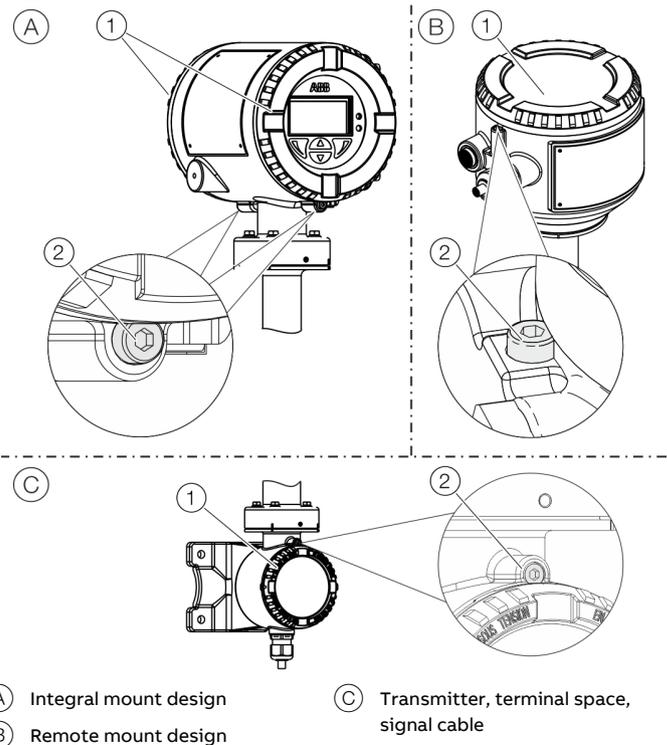


Figure 24: Cover lock (example)

#### Open the housing:

1. Release the cover lock by screwing in the Allen screw (1).
2. Unscrew cover (2).

#### Close the housing:

1. Screw on the cover (1).
2. After closing the housing, lock the cover by unscrewing the Allen screw (2).

## ... 7 Installation

### ... Opening and closing the housing

#### Single-compartment housing

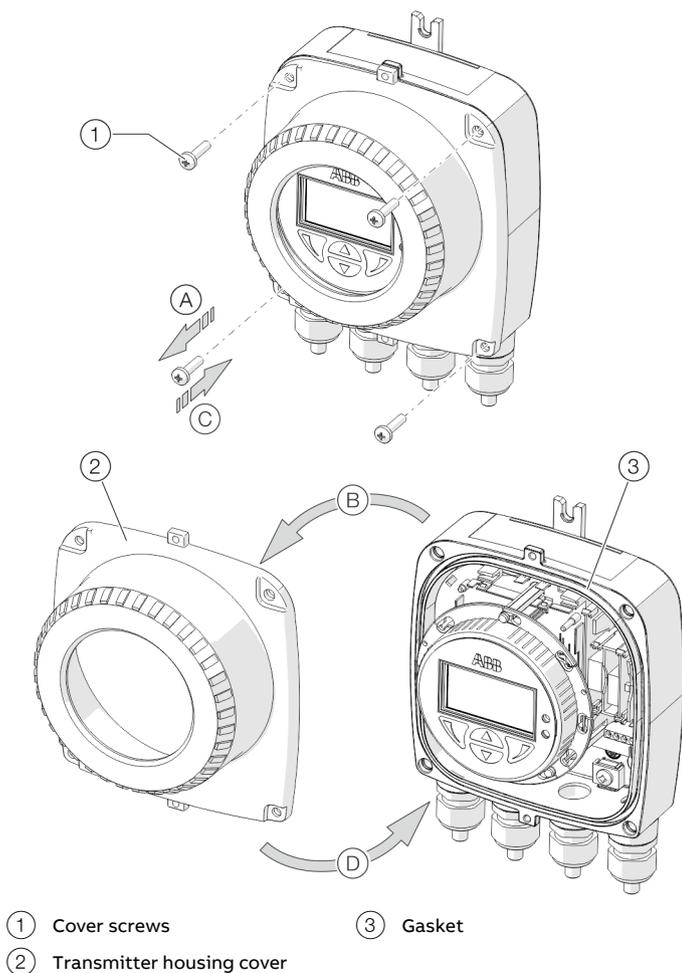


Figure 25: Open / close single-compartment housing

#### Open the housing:

- Perform steps (A) and (B).

#### Close the housing:

- Perform steps (C) and (D).

### Adjusting the transmitter position

Depending on the installation position, the transmitter housing or LCD display can be rotated to enable horizontal readings.

#### Transmitter housing

#### **⚠ DANGER**

##### **Damaging the device carries a risk of explosion!**

When the screws for the transmitter housing are loosened, the explosion protection is suspended.

- Tighten all screws prior to commissioning.
- Never disconnect the transmitter housing from the sensor.
- Loosen only the screws indicated when rotating the transmitter housing!

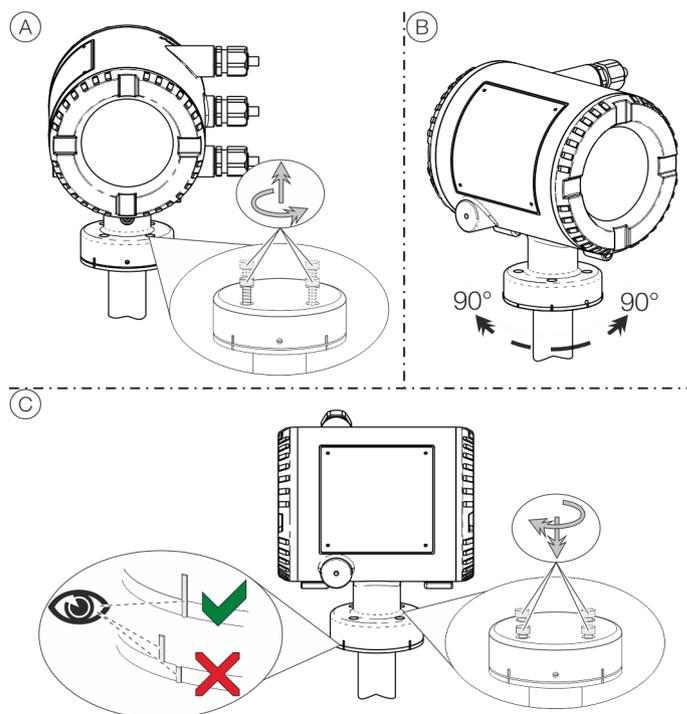


Figure 26: Rotate transmitter housing

#### Rotate the housing:

- Perform steps (A) to (C).

### Rotate LCD indicator – dual-compartment housing

The LCD indicator can be rotated in three increments of 90° each.

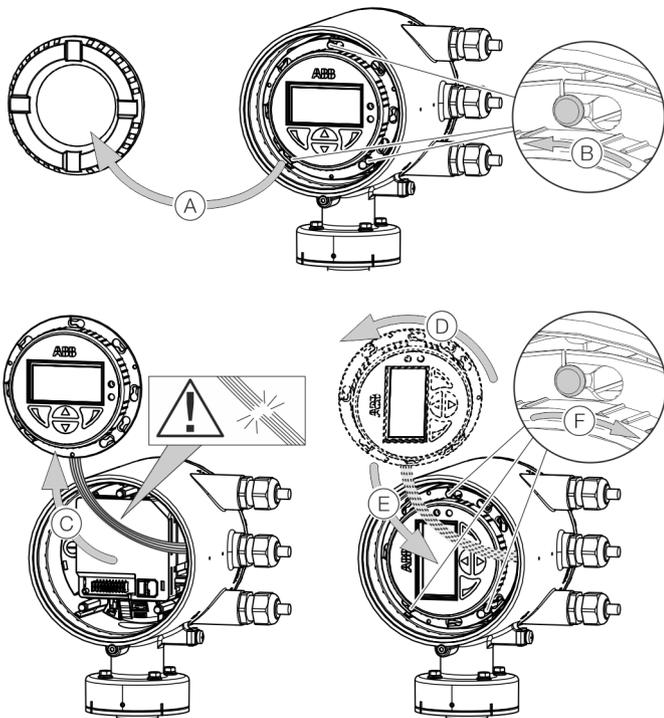


Figure 27: Rotating the LCD indicator

#### Turn the LCD indicator:

1. Open housing (A), see **Opening and closing the housing** on page 45.
2. Perform steps (B) to (F).

### Rotate LCD indicator – single-compartment housing

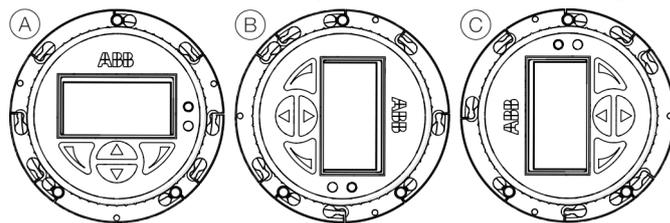


Figure 28: Possible positions of LCD indicator

The LCD indicator can be rotated to the (A), (B) and (C) positions. The 'upside down' position is not possible. To correct the display for the 'upside down' position, use the menu 'Display / Display Rotation'. This allows the display to be rotated 180° by software.

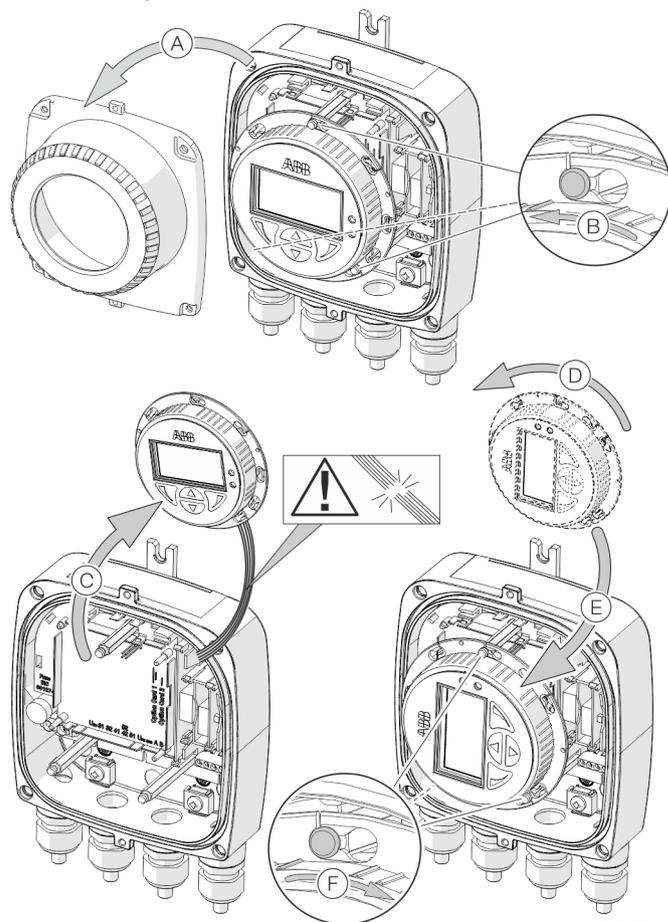


Figure 29: Rotating the LCD indicator

#### Turn the LCD indicator:

1. Open housing (A), see **Opening and closing the housing** on page 45.
2. Perform steps (B) to (F).

## ... 7 Installation

### Installing the plug-in cards

#### **⚠ WARNING**

##### **Loss of Ex Approval!**

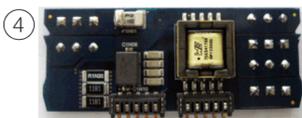
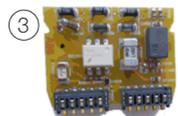
Loss of Ex Approval due to retrofitting of plug-in cards on devices for use in potentially explosive atmospheres.

- Devices for use in potentially explosive atmospheres may not be retrofitted with plug-in cards.
- If devices are to be used in potentially explosive atmospheres, the required plug-in cards must be specified when the order is placed.

#### **Optional plug-in cards**

The transmitter has two slots (OC1, OC2) into which plug-in cards can be inserted to extend inputs and outputs. The slots are located on the transmitter motherboard and can be accessed after removing the front housing cover.

#### **Plug-in cards**



Pos.	Description	Quantity*
①	Current output, 4 to 20 mA passive (red) Order number: 3KQZ400035U0100	2
②	Passive digital output (green) Order no.: 3KQZ400030U0100	1**
③	Passive digital input (yellow) Order no.: 3KQZ400032U0100	2
④	Loop power supply 24 V DC (blue) Order no.: 3KQZ400031U0100	1
⑤	Modbus RTU RS485 (white) Order no.: 3KQZ400028U0100	1
⑥	Profibus DP (white) Order no.: 3KQZ400027U0100	1
⑦	Ethernet Order no.: 3KQZ400037U0100	1
⑧	Power over Ethernet (POE) Order no.: 3KQZ400039U0100	1
⑨	Active digital output (white) Order no.: 3KQZ400056U0100	1**

\* The 'Number' column indicates the maximum number of plug-in cards of the same type that can be used.

\* Only one plug-in card of the active digital output type or passive digital output type can be inserted in Pos. ②.

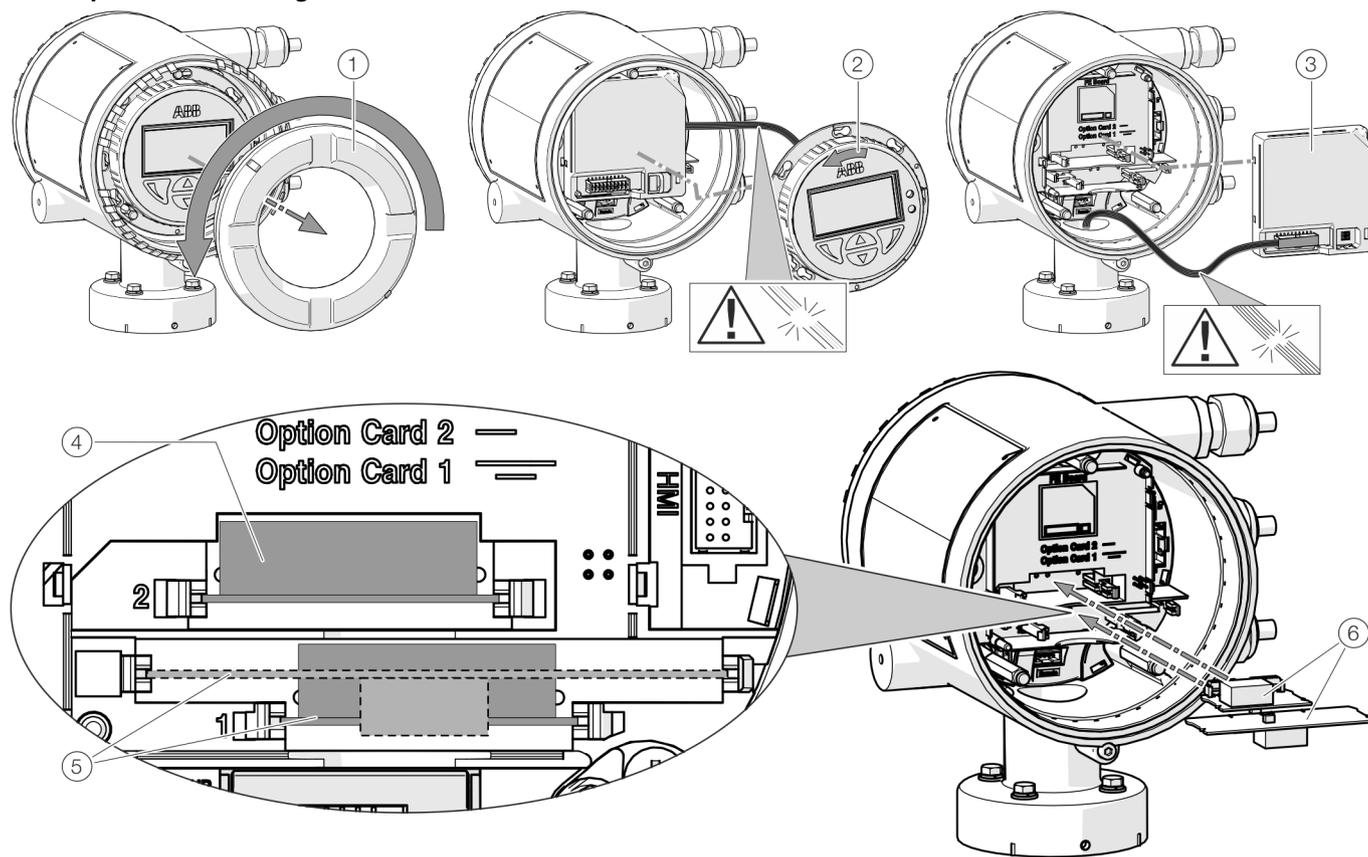
The following table provides an overview of the possible plug-in card combinations that can be selected when ordering the device. Because of the wide variety of options, not all combinations can be presented. Possible combinations are presented in our Online ABB Product Selection Assistant (PSA) for flow at [www.abb.com/flow](http://www.abb.com/flow).

Main ordering information (outputs)	Additional ordering information		Slot OC1	Slot OC2
	Additional output 1	Additional output 2	Terminals V1 / V2	Terminals V3 / V4
G0	-	-	-	-
G1	-	-	Loop power supply 24 V DC (blue)	-
G2	-	-	-	Current output, 4 to 20 mA passive (red)
G3	-	-	Current output, 4 to 20 mA passive (red)	Current output, 4 to 20 mA passive (red)
G4	-	-	Loop power supply 24 V DC (blue)	Passive current output (red)
D1	-	-	Profibus DP, RS485 (white)	
M1	-	-	Modbus RTU RS485 (white)	
M6	-	-	Modbus RTU RS485 (white)	Active digital output (white)
E2	-	-	Ethernet (green)	
E3	-	-	Ethernet (green)	
E4	-	-	Ethernet (green)	Power over Ethernet (green)
G0	DRT	-	Loop power supply 24 V DC (blue)	-
G0	DRT	DSN	Loop power supply 24 V DC (blue)	Passive digital input (yellow)
G0	DRT	DSG	Loop power supply 24 V DC (blue)	Passive digital output (green)
G0	DRT	DSA	Loop power supply 24 V DC (blue)	Current output, 4 to 20 mA passive (red)
G0	DRN	-	Passive digital input (yellow)	-
G0	DRN	DSG	Passive digital input (yellow)	Passive digital output (green)
G0	DRN	DSA	Passive digital input (yellow)	Current output, 4 to 20 mA passive (red)
G0	DRG	DSN	Passive digital output (green)	Passive digital input (yellow)
G0	DRG	DSA	Passive digital output (green)	Current output, 4 to 20 mA passive (red)
G0	DRA	DSA	Current output, 4 to 20 mA passive (red)	Current output, 4 to 20 mA passive (red)
G0	DRN	DSH	Passive digital input (yellow)	Active digital output (white)
G0	DRA	DSG	Current output, 4 to 20 mA passive (red)	Passive digital output (green)
G0	DRA	DSN	Current output, 4 to 20 mA passive (red)	Passive digital input (yellow)
G0	DRM	-	Modbus RTU RS485 (white)	-
G0	DRA	DSH	Current output, 4 to 20 mA passive (red)	Active digital output (white)
G0	DRD	-	Profibus DP, RS485 (white)	-
G0	DRM	DSN	Modbus RTU RS485 (white)	Passive digital input (yellow)
G0	DRM	DSG	Modbus RTU RS485 (white)	Passive digital output (green)
G0	DRD	DSN	Profibus DP, RS485 (white)	Passive digital input (yellow)
G0	DRA	DSH	Modbus RTU RS485 (white)	Active digital output (white)
G0	DRD	DSG	Profibus DP, RS485 (white)	Passive digital output (green)
G0	DR6	-	Ethernet	-
G0	DR6	DS8	Ethernet (green)	Power over Ethernet (green)
G0	DR6	DSN	Ethernet (green)	Passive digital input (yellow)
G0	DR6	DSG	Ethernet (green)	Passive digital output (green)

## ... 7 Installation

### ... Installing the plug-in cards

#### Dual-compartment housing



- |                                                         |                 |
|---------------------------------------------------------|-----------------|
| ① Cover                                                 | ④ Slot OC2      |
| ② LCD indicator                                         | ⑤ Slot OC1      |
| ③ Frontend board (FEB, with integral mount design only) | ⑥ Plug-in cards |

Figure 30: Installation of plug-in cards (example, dual-compartment housing)

### **⚠ WARNING**

#### **Risk of injury due to live parts!**

When the housing is open, contact protection is not provided and EMC protection is limited.

- Before opening the housing, switch off the power supply.

### **NOTICE**

#### **Damage to components!**

The electronic components of the printed circuit board can be damaged by static electricity (observe ESD guidelines).

- Make sure that the static electricity in your body is discharged before touching electronic components.

1. Switch off the power supply.
2. Unscrew / remove the cover.
3. Remove the LCD indicator. Ensure that the cable harness is not damaged.  
Insert the LCD indicator into the bracket (only for single-compartment housings)
4. Remove frontend board (only in integral mount design and dual-compartment housing). Ensure that the cable harness is not damaged.
5. Insert the plug-in card in the corresponding slot and engage. Ensure that the contacts are aligned correctly.
6. Attach the frontend board, insert the LCD indicator and screw on / replace the cover.
7. Connect outputs V1 / V2 and V3 / V4 in accordance with **Electrical connections** on page 53.
8. After powering up the power supply, configure the plug-in card functions.

## Single-compartment housing

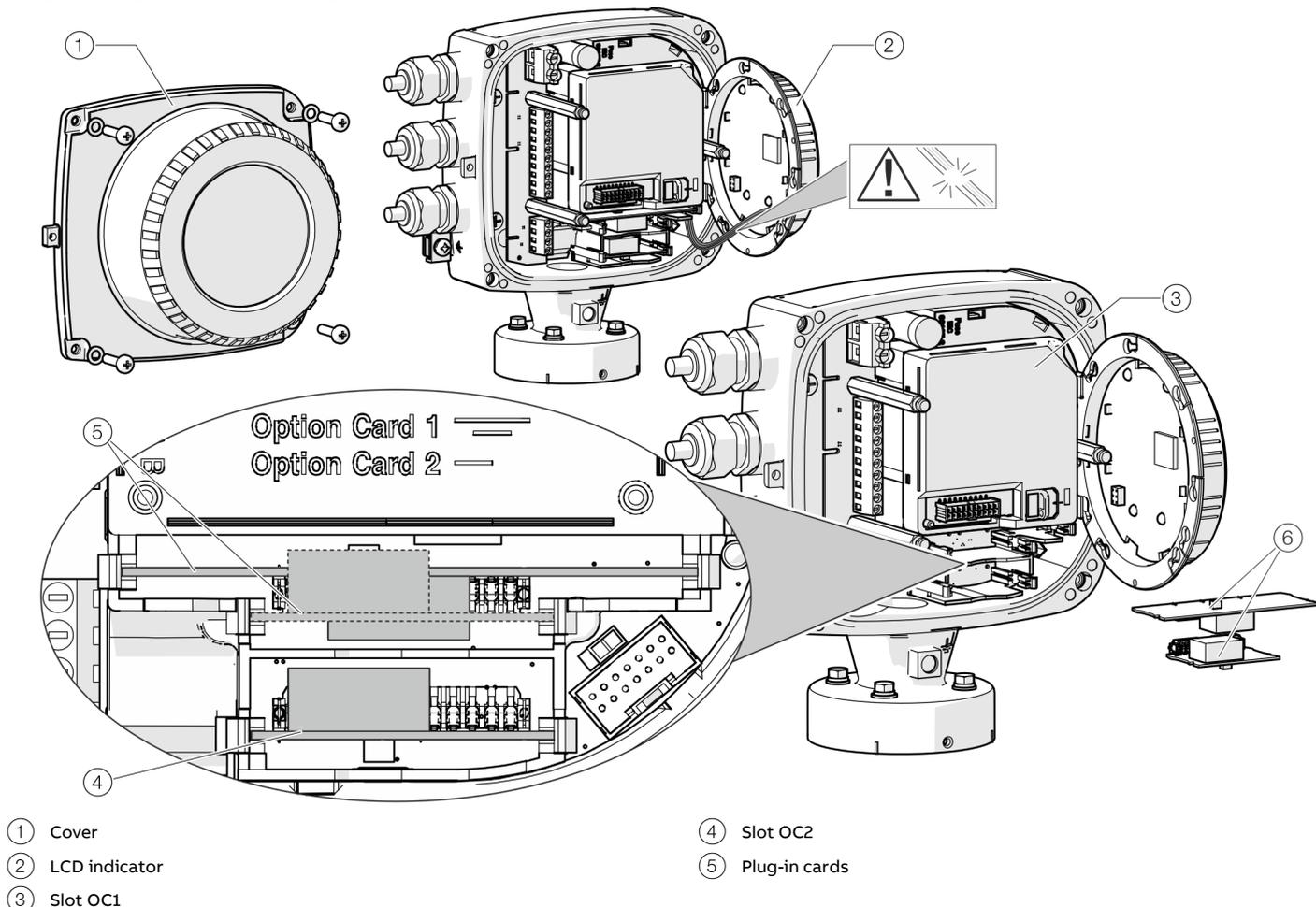


Figure 31: Installation of plug-in cards (example, single-compartment housing)

### **WARNING**

#### **Risk of injury due to live parts!**

When the housing is open, contact protection is not provided and EMC protection is limited.

- Before opening the housing, switch off the power supply.

### **NOTICE**

#### **Damage to components!**

The electronic components of the printed circuit board can be damaged by static electricity (observe ESD guidelines).

- Make sure that the static electricity in your body is discharged before touching electronic components.

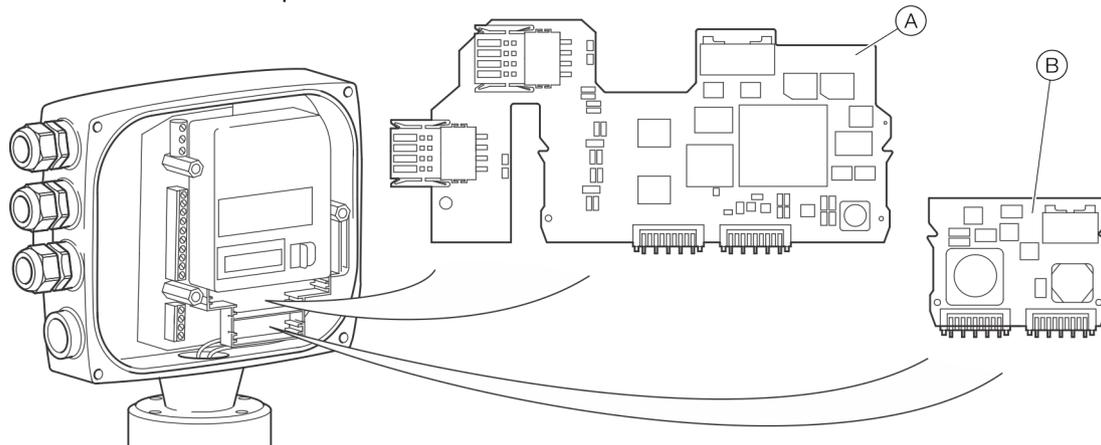
1. Switch off the power supply.
2. Unscrew / remove the cover.
3. Remove the LCD indicator. Ensure that the cable harness is not damaged.  
Insert the LCD indicator into the bracket (only for single-compartment housings)
4. Remove frontend board (only in integral mount design and dual-compartment housing). Ensure that the cable harness is not damaged.
5. Insert the plug-in card in the corresponding slot and engage. Ensure that the contacts are aligned correctly.
6. Attach the frontend board, insert the LCD indicator and screw on / replace the cover.
7. Connect outputs V1 / V2 and V3 / V4 in accordance with **Electrical connections** on page 53.
8. After powering up the power supply, configure the plug-in card functions.

## ... 7 Installation

### ... Installing the plug-in cards

#### Ethernet card

The Flowmeter has two slots for the components that follow:



(A) Ethernet card (part number 3KQZ400037U0100)

(B) Power over Ethernet (PoE) card (part number 3KQZ400039U0100)

Figure 32: Install the plug-in cards

#### **⚠ DANGER**

##### **Explosion hazard due to improper installation!**

Ethernet Option Cards are designed only for use in hazardous applications Zone 2 / Division 2.

#### **⚠ WARNING**

##### **Risk of injury due to live parts!**

When the housing is open, contact protection is not provided and EMC protection is limited.

- Before opening the housing, switch off the power supply.

#### **NOTICE**

##### **Damage to components!**

The electronic components of the printed circuit board can be damaged by static electricity (observe ESD guidelines).

- Make sure that the static electricity in your body is discharged before touching electronic components.

1. Switch off the power supply.
2. Unscrew / remove the cover.
3. Remove the LCD indicator. Ensure that the cable harness is not damaged.
  - Insert the LCD indicator into the bracket.
4. Insert the plug-in card in the corresponding slot and engage. Ensure that the contacts are aligned correctly.
5. Attach the frontend board, insert the LCD indicator and screw on / replace the cover.
6. Connect the Ethernet plug in card in accordance with **EtherNet/IP™ and PROFINET® communication** on page 72.
7. After powering up the power supply, configure the plug-in card functions.

#### **Note**

For detailed instructions how to plug in and connect the Power over Ethernet (PoE) card, please contact ABB.

## 8 Electrical connections

### Safety instructions

#### **WARNING**

##### **Risk of injury due to live parts.**

Improper work on the electrical connections can result in electric shock.

- Connect the device only with the power supply switched off.
- Observe the applicable standards and regulations for the electrical connection.

The electrical connection may only be established by authorized specialist personnel and in accordance with the connection diagrams.

The electrical connection information in this manual must be observed; otherwise, the IP rating may be adversely affected. Ground the measurement system according to requirements.

### Power supply

#### **Note**

- Adhere to the limit values of the power supply in accordance with the information on the name plate.
- Observe the voltage drop for large cable lengths and small conductor cross-sections. The voltage at the terminals of the device may not down-scale the minimum value required in accordance with the information on the name plate.

The power supply is connected to terminal L (phase), N (zero), or 1+, 2-, and PE.

A circuit breaker with a maximum rated current of 16 A must be installed in the power supply line.

The wire cross-sectional area of the power supply cable and the circuit breaker used must comply with VDE 0100 and must be dimensioned in accordance with the current consumption of the flowmeter measuring system. The cables must comply with IEC 227 and/or IEC 245.

The circuit breaker must be located near the device and marked as being associated with the device.

Connect the transmitter and sensor to functional earth.

## ... 8 Electrical connections

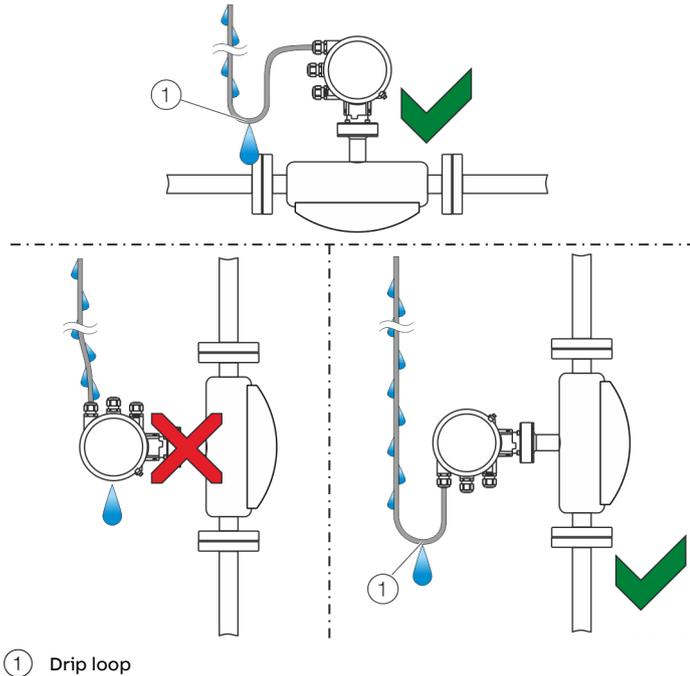
### Installing the connection cables

#### General information on cable installation

Ensure that a drip loop (water trap) is used when installing the connecting cables for the sensor.

When mounting the sensor vertically, position the cable entries at the bottom.

If necessary, rotate the transmitter housing accordingly.



① Drip loop

Figure 33: Laying the connection cable

#### Signal cable specification

The signal cable used for the connection of the transmitter and sensor must fulfill at least the following technical specifications.

##### Cable specification

Impedance	100 to 120 $\Omega$
Withstand voltage	120 V
Outer diameter	6 to 12 mm (0.24 to 0.47 in)
Cable design	Two wire pairs as a star-quad cable
Conductor cross-section	Length-dependent
Shield	Copper braid with approximately 85 % coverage
Temperature range	Application-dependent, for use in potentially explosive atmospheres, observe the information in <b>Temperature resistance for the connecting cable</b> on page 15!

##### Maximum signal cable length

0.25 mm <sup>2</sup> (AWG 24)	50 m (164 ft)
0.34 mm <sup>2</sup> (AWG 22)	100 m (328 ft)
0.5 mm <sup>2</sup> (AWG 20)	150 m (492 ft)
0.75 mm <sup>2</sup> (AWG 19)	200 m (656 ft)

#### Recommended cables

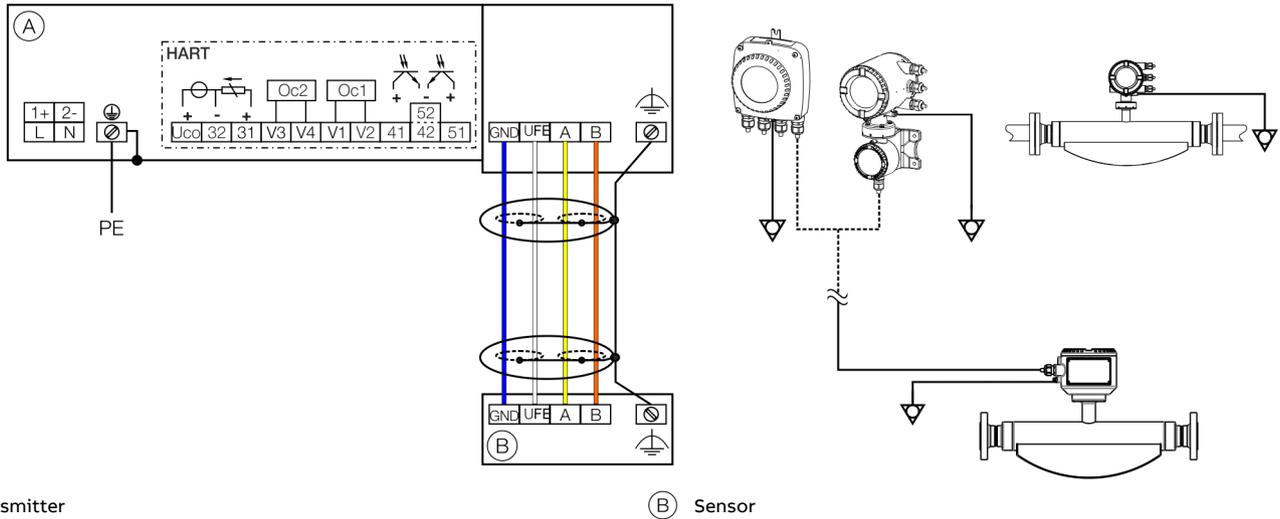
It is recommended to use an ABB signal cable for standard applications. The ABB signal cable fulfills the above-mentioned cable specification and can be utilized unrestrictedly up to an ambient temperature of  $T_{amb.} = 80\text{ }^{\circ}\text{C}$  (176  $^{\circ}\text{F}$ ).

ABB signal cable	Ordering number
5 m (16 ft)	3KQZ407123U0500
10 m (33 ft)	3KQZ407123U1000
20 m (65 ft)	3KQZ407123U2000
50 m (164 ft)	3KQZ407123U5000
100 m (328 ft)	3KQZ407123U1H00
150 m (492 ft)	3KQZ407123U1F00
200 m (656 ft)	3KQZ407123U2H00

For marine applications, an appropriate certified signal cable must be used.

ABB recommends the cable HELKAMA RFE-FRHF 2×2×0,75 QUAD 250V (HELKAMA order number 20522).

## Terminal assignment



(A) Transmitter

(B) Sensor

Figure 34: Electrical connection

### Connections for the power supply

AC voltage	
Terminal	Function / comments
L	Phase
N	Neutral conductor
PE / ⊕	Protective earth (PE)
▽	Potential equalization

DC voltage	
Terminal	Function / comments
1+	+
2-	-
PE / ⊕	Protective earth (PE)
▽	Potential equalization

### Connections for inputs and outputs

Terminal	Function / comments
Uco / 32	Current output 4 to 20 mA- / HART® output, active or
31 / 32	Current output 4 to 20 mA- / HART® output, passive
41 / 42	Passive digital output DO1
51 / 52	Passive digital output DO2
V1 / V2	Plug-in card, slot OC1
V3 / V4	Plug-in card, slot OC2

For details, see **Optional plug-in cards** on page 48.

### Connecting the signal cable

Only for remote mount design.

The sensor housing and transmitter housing must be connected to potential equalization.

Terminal	Function / comments
U <sub>FE</sub>	Sensor power supply
GND	Ground
A	Data line
B	Data line
⊕	Functional earth / Shielding

## ... 8 Electrical connections

### ... Terminal assignment

#### Electrical data for inputs and outputs

##### Note

When using the device in potentially explosive atmospheres, note the additional temperature data in **Use in potentially explosive atmospheres** on page 8!

#### Power supply L / N, 1+ / 2-

AC voltage	
Terminals	L / N
Operating voltage	100 to 240 V AC, 50 / 60 Hz
Power consumption	< 20 VA

DC voltage	
Terminals	1+ / 2-
Operating voltage	19 to 30 V DC
Power consumption	< 20 W

#### Requirements for inputs and outputs

For reasons of electromagnetic compatibility (EMC), shielded cables should be used in certain output configurations; this is presented in the table below.

The cable shielding must be inserted in the device, see

**Connection to integral mount design** on page 64 and

**Connection to remote mount design** on page 66.

#### Use of shielded cables

Transmitter	Plug-in card used	Terminal				
		Uco/31/32	41/42	51/52	V1/V2	V3/V4
<b>Dual-compartment housing</b>	Active digital output V1/V2	—	—	—	X	—
	Active digital output V3/V4	—	—	—	—	X
	Modbus V1/V2	—	—	—	X	—
	Profibus DP V1/V2	—	—	—	X	—
<b>Single-compartment housing</b>	Active digital output V1/V2	X	X	X	—	X
	Active digital output V3/V4	X	X	X	X	—
	Modbus V1/V2*	—	—	—	X	—
	Profibus DP V1/V2*	—	—	—	X	—
	Ethernet V1/V2	X	X	X	X	X
	Ethernet V1/V2, POE V3/V4	X	X	X	X	X

X Use shielded cables

\* Use in remote mount design only

#### Current output 32 / Uco, 31 / 32 (basic device)

Can be configured for outputting mass flow, volume flow, density and temperature via on-site software.

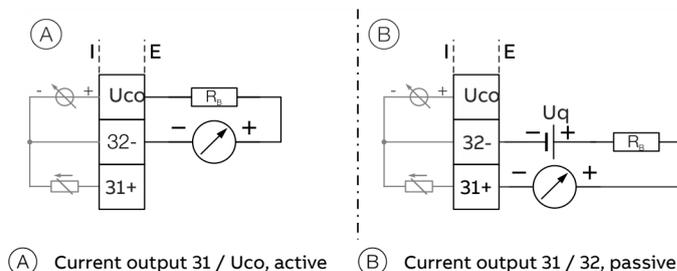
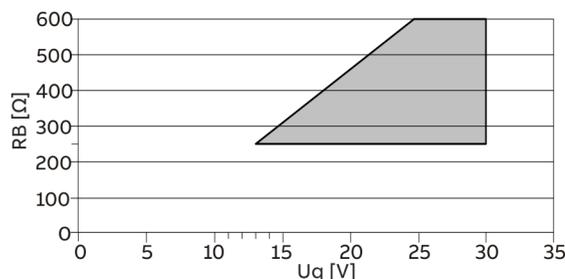


Figure 35: (I = internal, E = external, RB = load)



Permissible source voltage  $U_q$  for passive outputs in relation to load resistance  $R_B$  where  $I_{max} = 22 \text{ mA}$ . ■ = Permissible range

Figure 36: Source voltage for passive outputs

Current output	Active	Passive
Terminals	Uco / 32	31 / 32
Output signal	4 to 20 mA or 4 to 12 to 20 mA switchable	
Load $R_B$	$250 \Omega \leq R_B \leq 300 \Omega$	$250 \Omega \leq R_B \leq 600 \Omega$
Source voltage $U_q^*$	—	$13 \text{ V} \leq U_q \leq 30 \text{ V}$
Measuring error	< 0.1 % of measured value	
Resolution	0.4 $\mu\text{A}$ per digit	

\* The source voltage  $U_q$  is dependent of the load  $R_B$  and must be placed in an additional area.

For information on communication via the HART protocol, refer to **HART® Communication** on page 69.

**Current output  $U_{co} / 32$  as loop power supply for digital output 41 / 42 or 51 / 52**

In the case of digital communication via Modbus / PROFIBUS DP, the current output  $U_{co} / 32$  can be switched to the 'Power Mode' operating mode through the software.

The current output 31/32/ $U_{co}$  is set permanently to 22.6 mA and no longer follows the selected process variable. HART communication is deactivated.

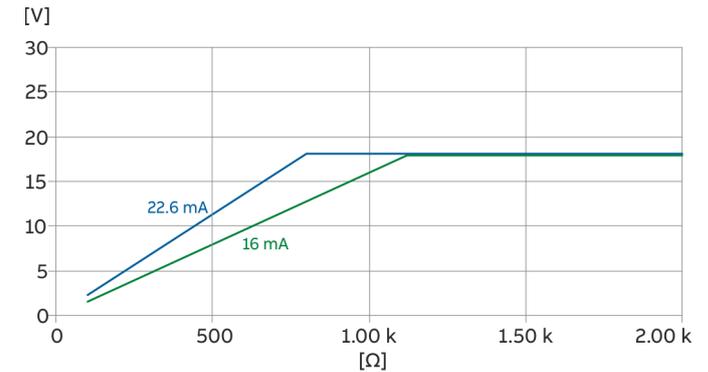
As a result, the passive digital outputs 41 / 42 or 51 / 52 can also be operated as active digital outputs.

The load resistance  $R_B$  needs to be integrated by the customer outside of the transmitter housing.

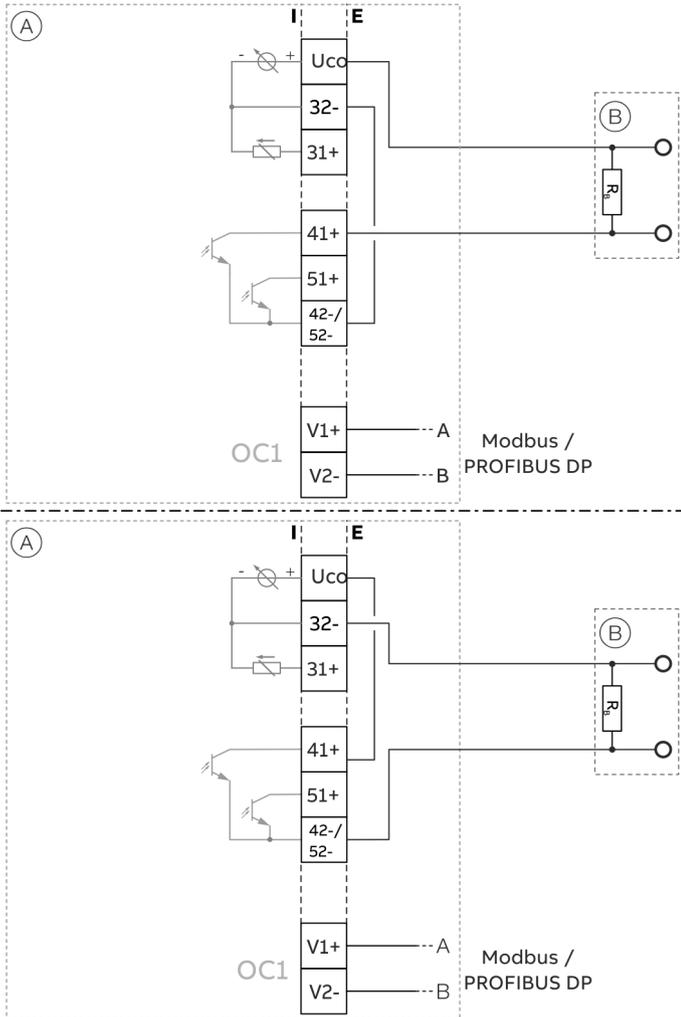
**Loop power supply 24 V DC operating mode**

Terminals	$U_{co} / 32$
Function	For active connection of passive outputs
Output Voltage	Load dependent, see Figure 38.
Load rating $I_{max}$	22.6 mA, permanently short circuit-proof

**Table 1: Specification current output  $U_{co} / 32$  in power mode**



**Figure 38: Output voltage dependent on load resistance**



- (A) Transmitter FCx400
- (B) Customer wiring
- OC1 Modbus / PROFIBUS DP plug-in card
- $R_B$  Load resistance

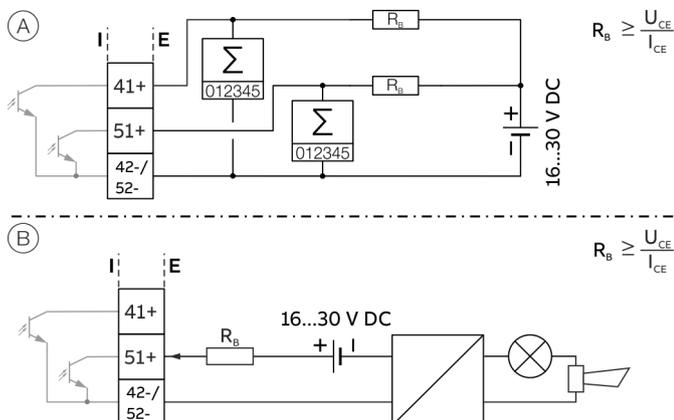
**Figure 37: Current output  $U_{co} / 32$  in power mode**

## ... 8 Electrical connections

### ... Terminal assignment

#### Digital output 41 / 42, 51 / 52 (basic device)

Can be configured as pulse, frequency or binary output via on-site software.



(A) Digital output 41 / 42, 51 / 52 passive as a pulse or frequency output  
 (B) Passive digital output 51 / 52 as binary output

Figure 39: (I = internal, E = external, R<sub>B</sub> = load)

Pulse / frequency output (passive)	
Terminals	41 / 42, 51 / 52
Output 'closed'	0 V ≤ U <sub>CEL</sub> ≤ 3 V For f < 2.5 kHz: 2 mA < I <sub>CEL</sub> < 30 mA For f > 2.5 kHz: 10 mA < I <sub>CEL</sub> < 30 mA
Output 'open'	16 V ≤ U <sub>CEH</sub> ≤ 30 V DC 0 mA ≤ I <sub>CEH</sub> ≤ 0.2 mA
f <sub>max</sub>	10.5 kHz
Pulse width	0.05 to 2000 ms

Binary output (passive)	
Terminals	41 / 42, 51 / 52
Output 'closed'	0 V ≤ U <sub>CEL</sub> ≤ 3 V 2 mA ≤ I <sub>CEL</sub> ≤ 30 mA
Output 'open'	16 V ≤ U <sub>CEH</sub> ≤ 3 V DC 0 mA ≤ I <sub>CEH</sub> ≤ 0.2 mA
Switching function	Can be configured using software. See <b>Menu: Input/Output</b> on page 130.

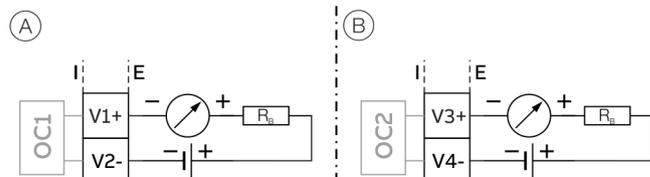
#### Note

- Terminals 42 / 52 have common grounding. Digital outputs 41 / 42 and 51 / 52 are not electrically isolated from each other. An electrically isolated digital output can be made using a plug-in module.
- If using a mechanical counter, it is advisable to set a pulse width of ≥ 30 ms and a maximum frequency of f<sub>max</sub> ≤ 3 kHz.

#### Current output V1 / V2, V3 / V4 (plug-in module)

Up to two additional plug-in modules can be implemented via the 'Passive current output (red)' option module.

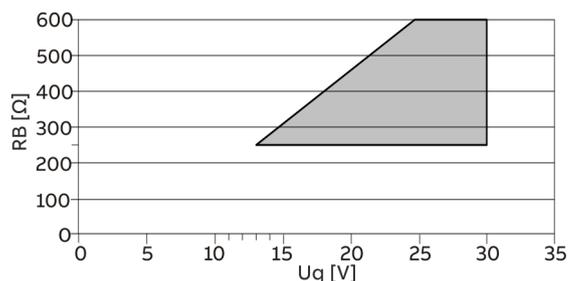
Can be configured for outputting mass flow, volume flow, density and temperature via on-site software.



(A) Current output V1 / V2, passive (B) Current output V3 / V4, passive

Figure 40: (I = internal, E = external, R<sub>B</sub> = load)

The plug-in module can be used in slot OC1 and OC2.



Permissible source voltage U<sub>q</sub> for passive outputs in relation to load resistance R<sub>B</sub> where I<sub>max</sub> = 22 mA. ■ = Permissible range

Figure 41: Source voltage for passive outputs

Passive current output	
Terminals	V1 / V2, V3 / V4
Output signal	4 to 20 mA
Load R <sub>B</sub>	250 Ω ≤ R <sub>B</sub> ≤ 600 Ω
Source voltage U <sub>q</sub> *	13 V ≤ U <sub>q</sub> ≤ 30 V
Measuring error	< 0.1 % of measured value
Resolution	0.4 μA per digit

\* The source voltage U<sub>q</sub> is dependent of the load R<sub>B</sub> and must be placed in an additional area.

**Passive digital output V1 / V2, V3 / V4 (plug-in card)**

An additional binary output can be implemented via the ‘Passive digital output (green)’ plug-in module.

Can be configured as an output for flow direction signaling, alarm output etc. via on-site software.

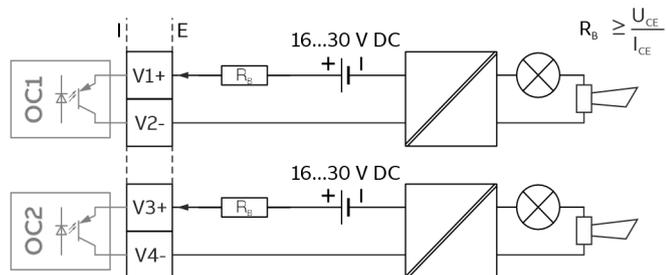


Figure 42: Plug-in card as binary output (I = internal, E = external, R<sub>B</sub> = load)

The plug-in module can be used in slot OC1 or OC2.

**Binary output (passive)**

Terminals	V1 / V2, V3 / V4
Output ‘closed’	0 V ≤ U <sub>CEL</sub> ≤ 3 V 2 mA < I <sub>CEL</sub> < 30 mA
Output ‘open’	16 V ≤ U <sub>CEH</sub> ≤ 30 V DC 0 mA ≤ I <sub>CEH</sub> ≤ 0.2 mA
Switching function	Can be configured using software. See <b>Menu: Input/Output</b> on page 130.

**Active digital output V1 / V2, V3 / V4 (plug-in card)**

An additional binary output can be implemented via the ‘Active digital output (white)’ plug-in card.

Can be configured on-site as a logical output for V1 / V2 (flow direction signaling, alarm output, etc.) via software.

Can be configured on-site for V3 / V4 as a frequency output, pulse output or logical output via software.

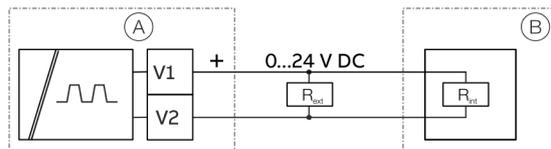


Figure 43: Plug-in card V1 / V2

or

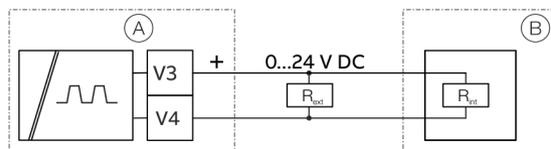


Figure 44: Plug-in card V3 / V4

The plug-in module can be used in slot OC1 or OC2.

External voltage cannot be connected to the active binary output.

Only one of the two digital output plug-in cards (passive or active) will be supported at the same time.

**Note**

**Requirements for inputs and outputs**

For reasons of electromagnetic compatibility (EMC), shielded cables should be used in certain output configurations; this is presented in Table **Use of shielded cables** on page 56.

## ... 8 Electrical connections

### ... Terminal assignment

Dependency of the output voltage  $U$  from the load  $R_B$ .

Load  $R_B$  is the parallel connection of the internal resistance  $R_{int}$  and optional external resistance  $R_{ext}$ .

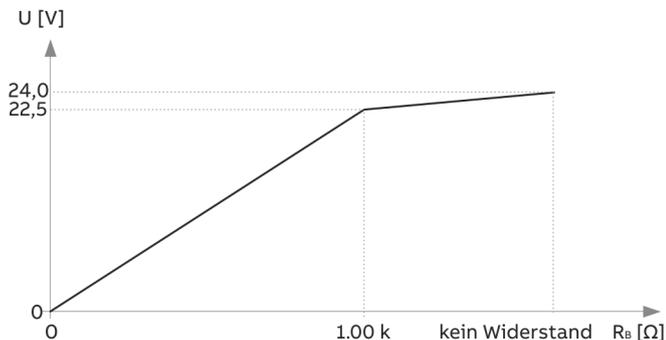
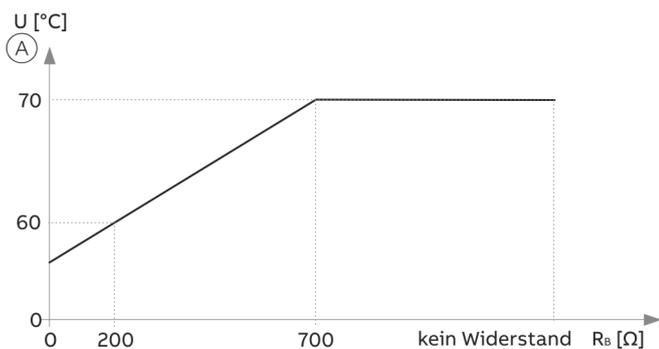


Figure 45: Dependency of the output voltage  $U$  from the load  $R_B$ .

Permissible ambient temperature single-compartment housing:  
70 °C

Permissible ambient temperature dual-compartment housing  
dependent on the load  $R_B$ :



(A) Ambient temperature (°C)

Figure 46: Permissible ambient temperature dual-compartment housing

#### Binary output (active)

Terminals	V1 / V2, V3 / V4
'Off' output	$U_L \leq 200 \text{ mV}$ $I_L < 0 \text{ mA}$
'On' output	$0 \text{ V} \leq U_H \leq 24 \text{ V}$ (dependent on $R_B$ ) $0 \text{ mA} \leq I_H \leq 22.5 \text{ mA}$ (dependent on $R_B$ )

#### For pulse/frequency output

Terminals	V3 / V4
'Off' output	$U_L \leq 200 \text{ mV}$ $I_L < 0 \text{ mA}$
'On' output	$0 \text{ V} \leq U_H \leq 24 \text{ V}$ (dependent on $R_B$ ) $0 \text{ mA} \leq I_H \leq 22.5 \text{ mA}$ (dependent on $R_B$ )
$f_{max}$	10.5 kHz
Pulse width	0.05 to 2000 ms

#### Digital input V1 / V2, V3 / V4 (plug-in module)

A digital input can be implemented via the 'Passive digital input (yellow)' plug-in module.

Can be configured as an input for external counter reset, external output deactivation etc. via on-site software.

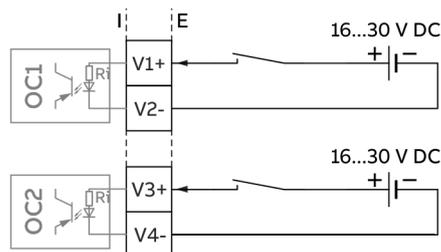


Figure 47: Plug-in card as digital input (I = internal, E = external)

The plug-in module can be used in slot OC1 or OC2.

#### Digital input

Terminals	V1 / V2, V3 / V4
Input 'On'	$16 \text{ V} \leq U_{KL} \leq 30 \text{ V}$
Input 'Off'	$0 \text{ V} \leq U_{KL} \leq 3 \text{ V}$
Internal resistance $R_i$	6.5 kΩ
Function	Can be configured using software. <b>Use of shielded cables</b> on page 56

**24 V DC loop power supply (plug-in card)**

Use of the ‘loop power supply (blue)’ plug-in card allows a passive output on the transmitter to be used as an active output. See also **Connection examples** on page 61.

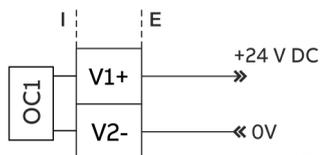


Figure 48: (I = Internal, E = External)

The plug-in card can only be used in slot OC1.

Loop power supply 24 V DC	
Terminals	V1 / V2
Function	For active connection of passive outputs
Output Voltage	24 V DC at 0 mA, 17 V DC at 25 mA
Load rating $I_{max}$	25 mA, permanently short circuit-proof

**Note**

If the device is used in potentially explosive atmospheres, the plug-in card for the loop power supply may only be used to supply a passive output. It is not allowed, to connect it to multiple passive outputs!

**Modbus® / PROFIBUS DP® interface V1 / V2 (plug-in card)**

A Modbus or PROFIBUS DP interface can be implemented by using the ‘Modbus RTU, RS485 (white)’ or ‘PROFIBUS DP, RS485 (white)’ plug-in cards.

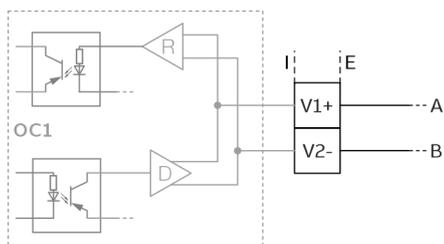


Figure 49: Plug-in card as a Modbus / PROFIBUS DP interface (I = internal, E = external)

The corresponding plug-in card can only be used in slot OC1.

For information on communication through the Modbus or PROFIBUS DP protocols, refer to chapters **Modbus® communication** on page 69 and **PROFIBUS DP® communication** on page 70.

**Connection examples**

Input and output functions are configured via the device software in accordance with the desired application.

**Parameterization of the device** on page 83

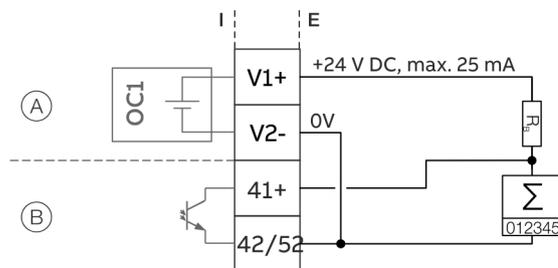
**Digital output 41 / 42, 51 / 52, V3 / V4 active**

When the ‘loop power supply 24 V DC (blue)’ plug-in card is used, the digital outputs on the basic device and on the option modules can also be wired as active digital outputs.

**Note**

Each ‘loop power supply (blue)’ plug-in card must only power one output.

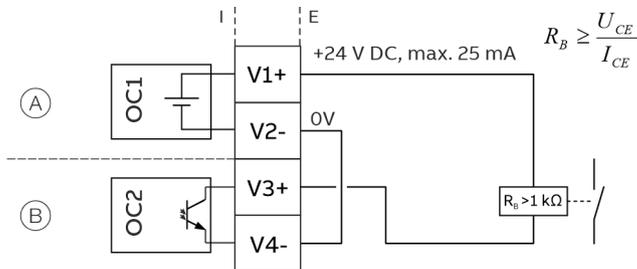
It must not be connected to two outputs (for example digital output 41 / 42 and 51 / 52)!



- (A) ‘Loop power supply (blue)’ plug-in card in slot 1
- (B) Digital output, digital output 41 / 42

Figure 50: Active digital output 41 / 42 (example)

The connection example shows usage for digital output 41 / 42; the same applies to usage for digital output 51 / 52.



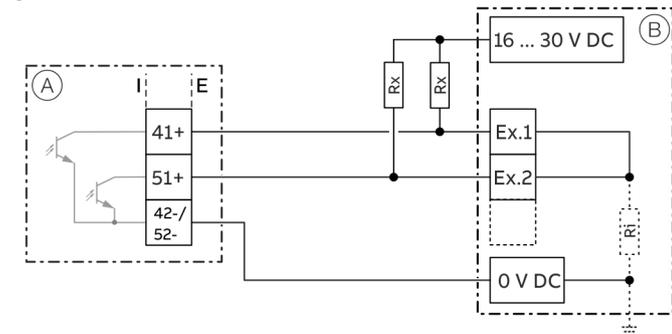
- (A) ‘Loop power supply (blue)’ plug-in card in slot 1
- (B) ‘Digital output (green)’ plug-in card in slot 2

Figure 51: Active digital output V3 / V4 (example)

## ... 8 Electrical connections

### ... Terminal assignment

Digital output 41 / 42, 51 / 52 passive on distributed control system



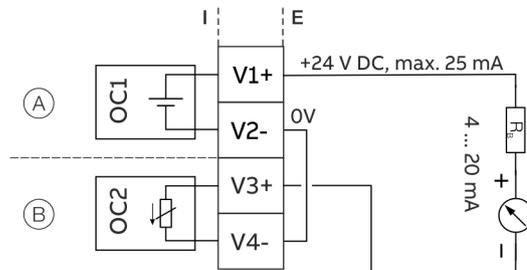
- (A) Transmitter
- (B) Distributed control system / Memory programmable controller
- Ex. 1 Input 1
- Ex. 2 Input 2
- $R_x$  Resistor for current limitation
- $R_i$  Distributed control system internal resistance

Figure 52: Digital output 41 / 42 on distributed control system (example)

The  $R_x$  resistors limit the maximum current through the optoelectronic coupler of the digital outputs in the transmitter. The maximum permissible current is 25 mA. An  $R_x$  value of 1000  $\Omega$  / 1 W is recommended at a voltage level of 24 V DC. The input on the distributed control system is reduced from 24 V DC to 0 V DC (falling edge) with '1' at the digital output.

Current output V3 / V4 active

When the 'loop power supply 24 V DC, blue' plug-in card is used, the current output on the plug-in card can also be wired as the active current output.

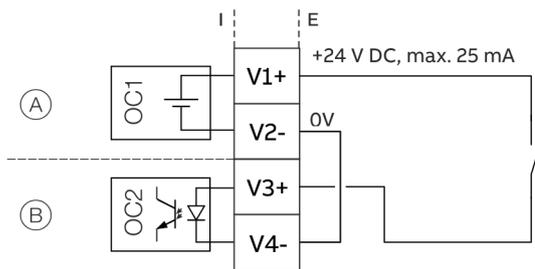


- (A) 'Loop power supply (blue)' plug-in card in slot 1
- (B) 'Passive current output (red)' plug-in card in slot 2

Figure 53: Active current output V3 / V4 (example)

Digital input V3 / V4 active

When the 'loop power supply 24 V DC, blue' plug-in card is used, the current output on the plug-in card can also be wired as the active current output.



- (A) 'Loop power supply (blue)' plug-in card in slot 1
- (B) 'Passive digital input (yellow)' plug-in card in slot 2

Figure 54: Active digital output V3 / V4 (example)

### Connection versions digital output 41 / 42, 51 / 52

Depending on the wiring of digital outputs DO 41 / 42 and 51 / 52, they can be used parallel or only individually. The electrical isolation between the digital outputs also depends on the wiring.

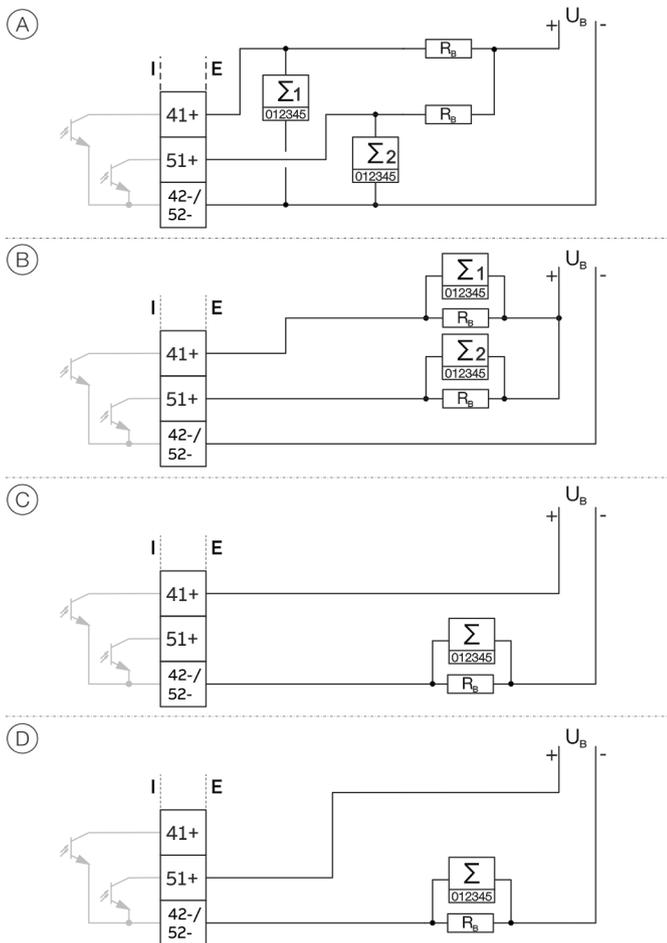


Figure 55: Connection versions digital output 41 / 42 and 51 / 52

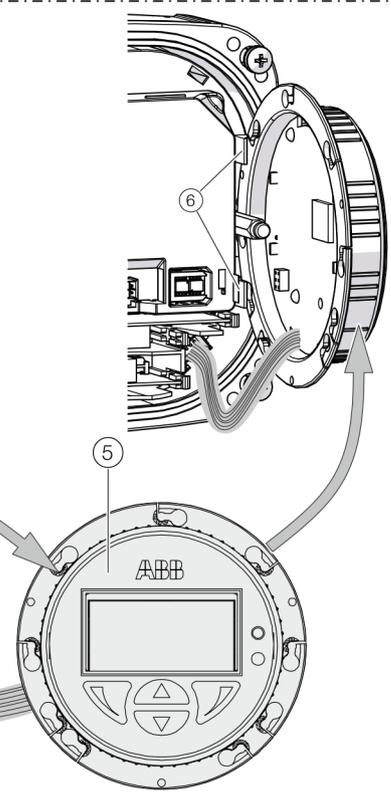
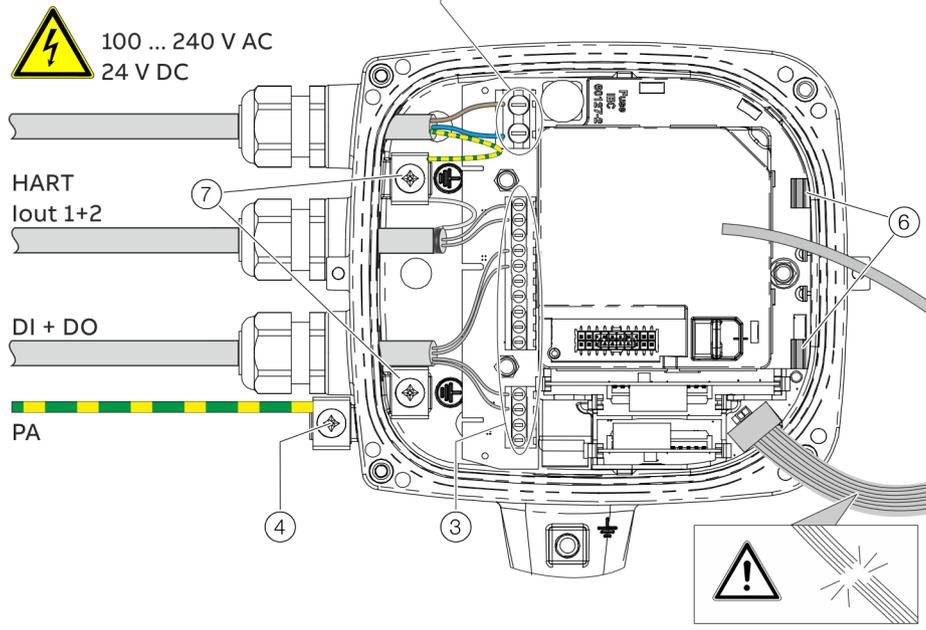
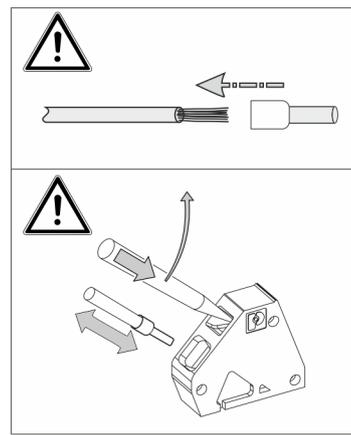
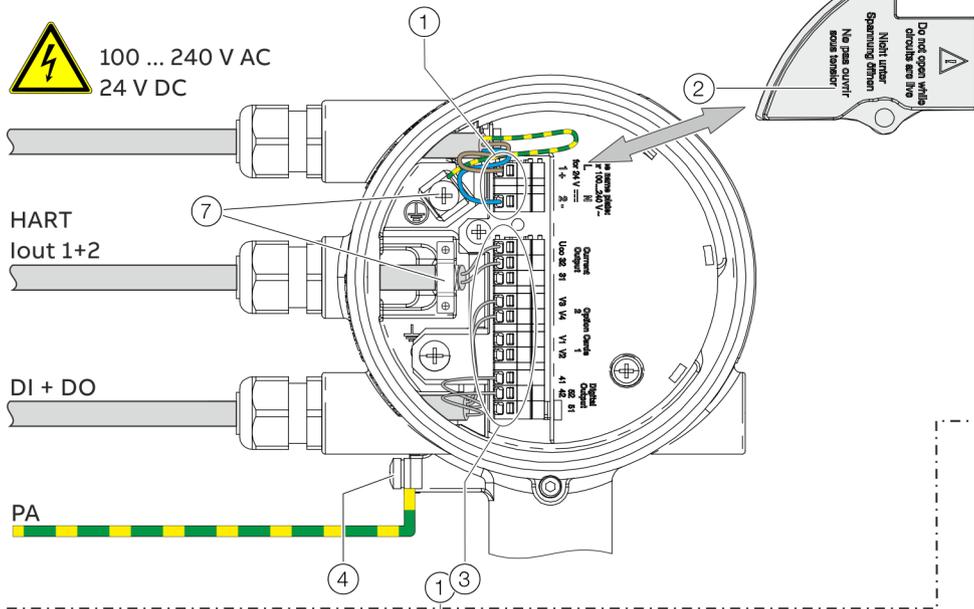
	DO 41 / 42 and 51 / 52 can be used parallel	DO 41 / 42 and 51 / 52 electrically isolated
(A)	Yes	No
(B)	Yes	No
(C)	No, only DO 41 / 42 can be used	No
(D)	No, only DO 51 / 52 can be used	No

# ... 8 Electrical connections

## Connection on the device

### Connection to integral mount design

#### Dual- compartment housing



#### Single-compartment housing

- ① Terminals for power supply
- ② Cover for power supply terminals
- ③ Terminals for inputs and outputs
- ④ Terminal for potential equalization
- ⑤ LCD indicator
- ⑥ Bracket for LCD indicator (park position)
- ⑦ Terminal for protective earth / cable shields

Figure 56: Connection to device (example), PA = potential equalization

## NOTICE

**If the O-ring gasket is seated incorrectly or damaged, this may have an adverse effect on the housing protection class.**

Follow the instructions in **Opening and closing the housing** on page 45 to open and close the housing safely.

Observe the following points when connecting to an electrical supply:

- Lead the power supply cable into the housing through the top cable entry.
- Lead the cables for signal inputs and signal outputs into the housing through the middle and, where necessary, bottom cable entries.
- Connect the cables in accordance with the electrical connection. If present, connect the cable shielding to the earthing clamp provided.
- Use wire end ferrules when connecting.
- After connecting the power supply to the dual-compartment housing, terminal cover ② must be installed.
- Close unused cable entries using suited plugs.

# ... 8 Electrical connections

## ... Connection on the device

### Connection to remote mount design

#### Transmitter

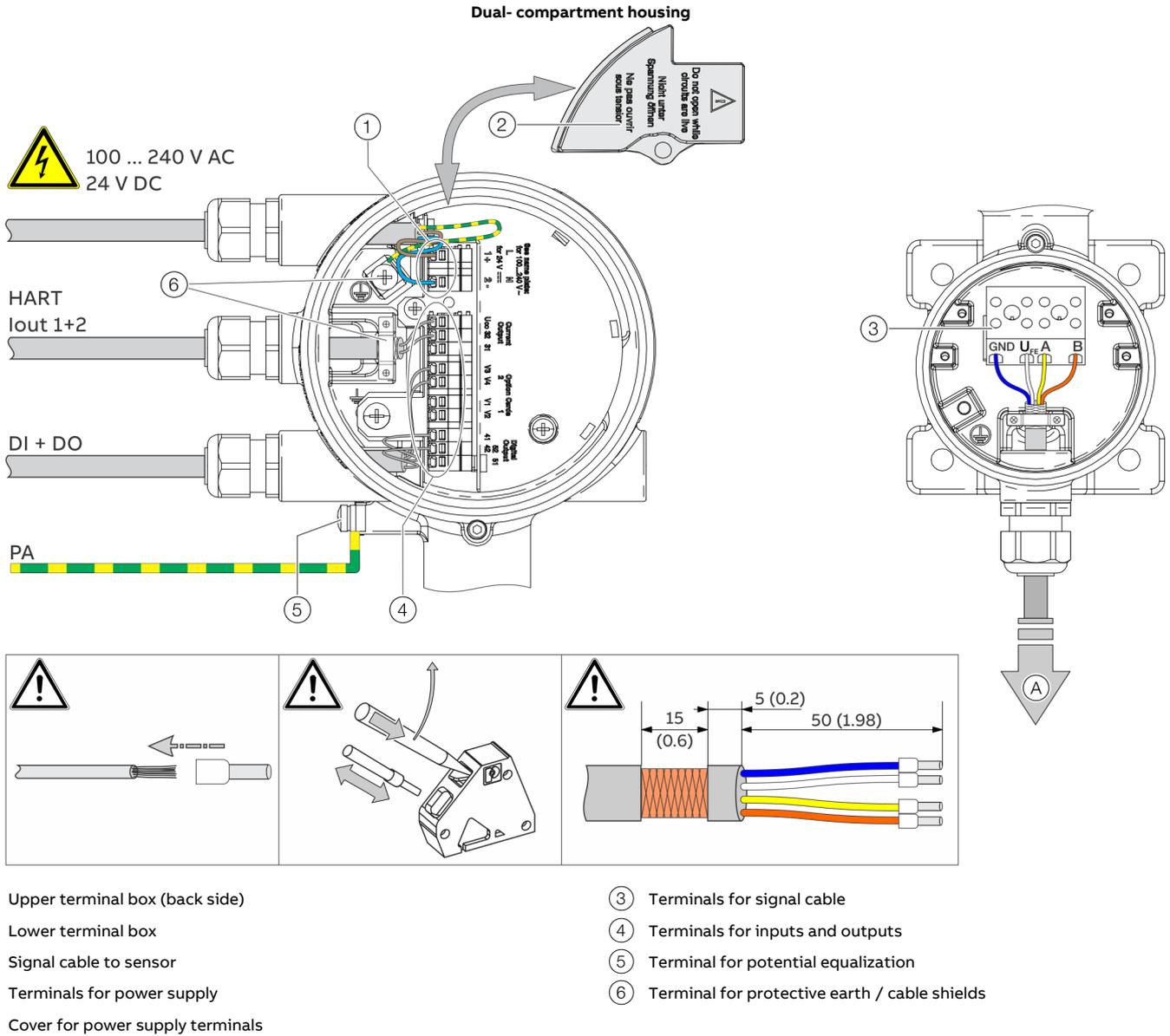


Figure 57: Electrical connection to transmitter in remote mount design [example, dimensions in mm (in)]

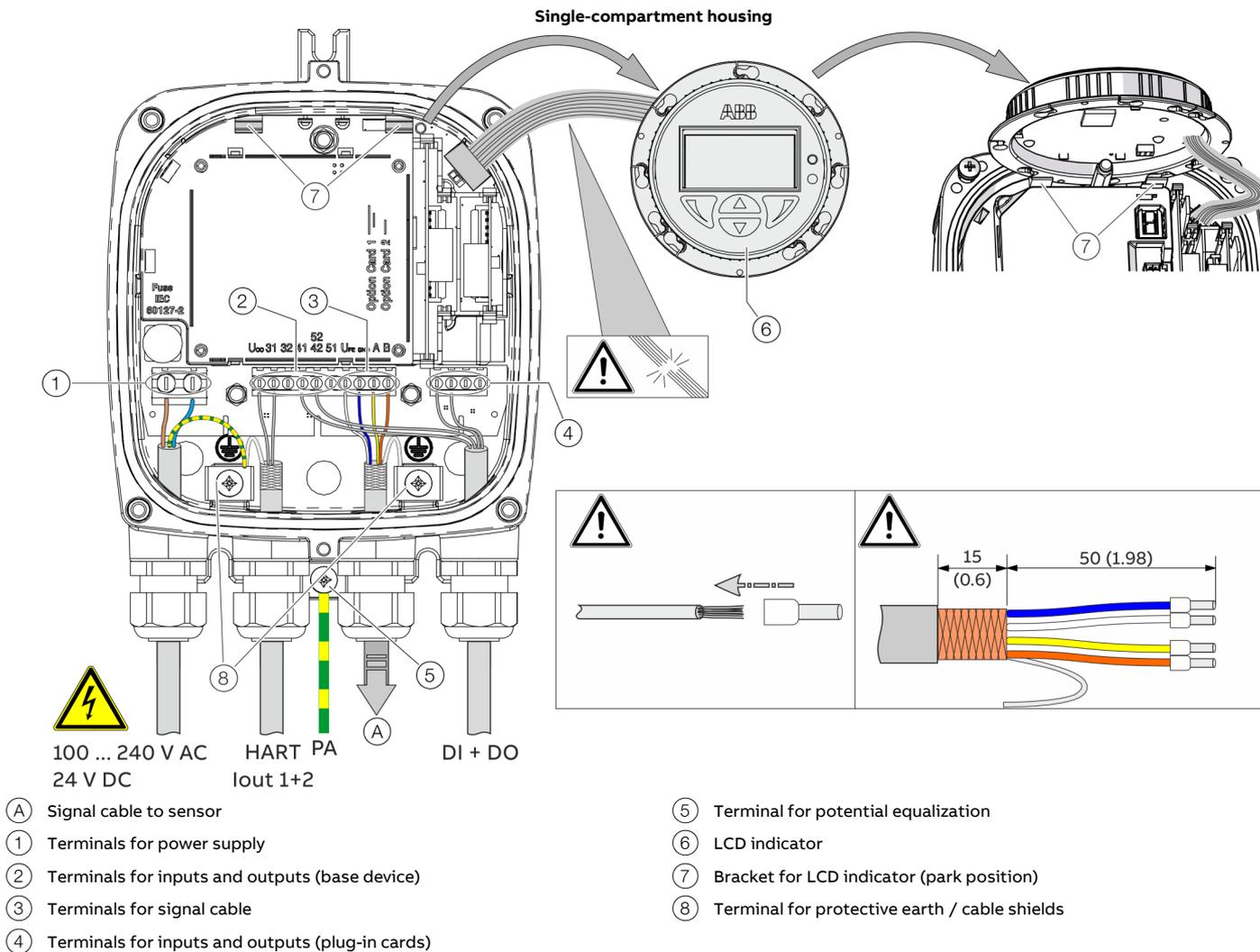


Figure 58: Electrical connection to transmitter in remote mount design [example, dimensions in mm (in)]

## NOTICE

If the O-ring gasket is seated incorrectly or damaged, this may have an adverse effect on the housing protection class. Follow the instructions in **Opening and closing the housing** on page 45 to open and close the housing safely.

Terminal	ABB signal cable 3KQZ407123U0100	HELKAMA signal cable 20522
GND	Blue	Blue (4)
U <sub>FE</sub>	White	white (3)
A	Yellow	Blue (2)
B	Orange	white (1)

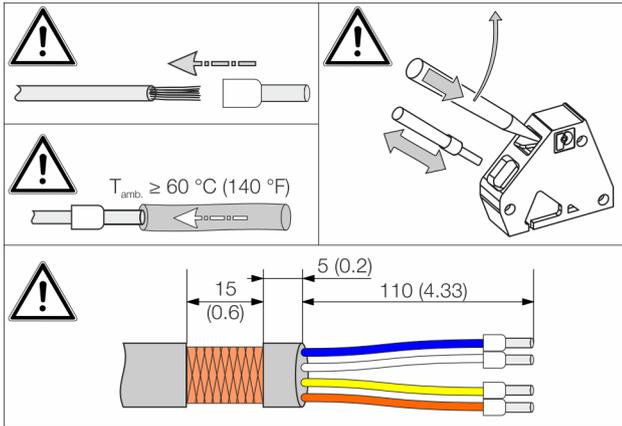
Observe the following points when connecting to an electrical supply:

- Lead the cable for the power supply and the signal inputs and outputs into the housing as shown.
- The signal cable to the sensor is connected in the lower connection area of the transmitter.
- Connect the cables in accordance with the electrical connection diagram. If present, connect the cable shielding to the earthing clamp provided.
- Use wire end ferrules when connecting.
- After connecting the power supply, terminal cover (2) must be installed.
- Close unused cable entries using suitable plugs.

## ... 8 Electrical connections

### ... Connection on the device

#### Flowmeter sensor

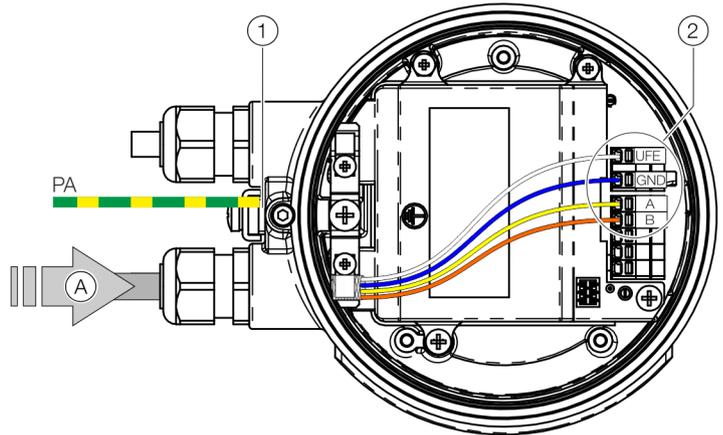


- (A) Signal cable from the sensor
- (1) Terminal for potential equalization

Figure 59: Connection to sensor in remote mount design (example)

**NOTICE**  
 If the O-ring gasket is seated incorrectly or damaged, this may have an adverse effect on the housing protection class. Follow the instructions in **Opening and closing the housing** on page 45 to open and close the housing safely.

Terminal	ABB signal cable 3KQZ407123U0100	HELKAMA signal cable 20522
GND	Blue	Blue (4)
U <sub>FE</sub>	White	white (3)
A	Yellow	Blue (2)
B	Orange	white (1)



- (2) Terminals for signal cable

Observe the following points when connecting to an electrical supply:

- Lead the signal cable into the housing as shown.
- Connect the cables in accordance with the electrical connection. If present, connect the cable shielding to the earthing clamp provided.
- Use wire end ferrules when connecting.
- From an ambient temperature of  $T_{amb} \geq 60 \text{ °C}$  ( $\geq 140 \text{ °F}$ ) additionally insulate the wires with the enclosed silicone hoses.
- Close unused cable entries using suited plugs.

## 9 Digital communication

### HART® Communication

#### Note

The HART® protocol is an unsecured protocol, as such the intended application should be assessed to ensure that these protocols are suitable before implementation.

In connection with the DTM (Device Type Manager) available to the device, communication (configuration, parameterization) can be carried out FDT 0.98 or 1.2.

Other tool or system integrations (e.g. Emerson AMS / Siemens PCS7) on request.

The necessary DTMs and other files can be downloaded from [www.abb.com/flow](http://www.abb.com/flow).

#### HART output

Terminals	Active: Uco / 32 Passive: 31 / 32
Protocol	HART 7.1
Transmission	FSK modulation on current output 4 to 20 mA in accordance with the Bell 202 standard
Baud rate	1200 baud
Signal amplitude	Maximum 1.2 mAss

#### Factory setting of the HART process variables

HART process variable	Process value
Primary Value (PV)	$Q_m$ – Mass flow
Secondary Value (SV)	$Q_v$ – Volume flow rate
Tertiary Value (TV)	$\rho$ – Density
Quaternary Value (QV)	$T_m$ – Measuring medium temperature

The process values of the HART variables can be set in the device menu.

### Modbus® communication

#### Note

The Modbus® protocol is an unsecured protocol, as such the intended application should be assessed to ensure that these protocols are suitable before implementation.

Modbus is an open standard owned and administrated by an independent group of device manufacturers styled the Modbus Organization ([www.modbus.org/](http://www.modbus.org/)).

Using the Modbus protocol allows devices made by different manufacturers to exchange information via the same communication bus, without the need for any special interface devices to be used.

#### Modbus protocol

Terminals	V1 / V2
Configuration	Via the Modbus interface or via the local operating interface in connection with a corresponding Device Type Manager (DTM)
Transmission	Modbus RTU - RS485 serial connection
Baud rate	2400, 4800, 9600, 19200, 38400, 56000, 57600, 115200 baud Factory setting: 9600 baud
Parity	None, even, odd Factory setting: odd
Stop bit	One, two Factory setting: One
IEEE format	Little endian, big endian Factory setting: Little endian
Typical response time	< 100 ms
Response delay time	0 to 200 milliseconds Factory setting: 10 milliseconds

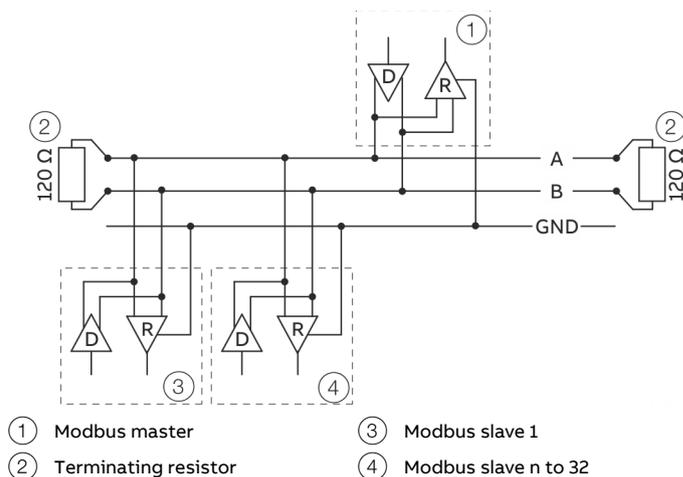


Figure 60: Communication with the Modbus protocol

## ... 9 Digital communication

### ... Modbus® communication

#### Cable specification

The maximum permissible length is dependent on the baud rate, the cable (diameter, capacity and surge impedance), the number of loads in the device chain, and the network configuration (2-core or 4-core).

- At a baud rate of 9600 and with a conductor cross-section of at least 0.14 mm<sup>2</sup> (AWG 26), the maximum length is 1000 m (3280 ft).
- When using a 4-core cable as a 2-wire wiring system, the maximum length must be halved.
- The spur lines must be short, a maximum of 20 m (66 ft).
- When using a distributor with 'n' connections, each branch must have a maximum length of 40 m (131 ft) divided by 'n.'

The maximum cable length depends on the type of cable used.

The following standard values apply:

- Up to 6 m (20 ft):  
cable with standard shielding or twisted-pair cable.
- Up to 300 m (984 ft):  
double twisted-pair cable with overall foil shielding and integrated earth cable.
- Up to 1200 m (3937 ft):  
double twisted-pair cable with individual foil shielding and integrated earth cables. Example: Belden 9729 or equivalent cable.

A category 5 cable can be used for Modbus RS485 up to a maximum length of 600 m (1968 ft). For the symmetrical pairs in RS485 systems, a surge impedance of more than 100 Ω is preferred, especially at a baud rate of 19200 and above.

### PROFIBUS DP® communication

#### Note

The PROFIBUS DP® protocol is an unsecured protocol, as such the intended application should be assessed to ensure that these protocols are suitable before implementation.

#### PROFIBUS DP interface

Terminals	V1 / V2
Configuration	Via the PROFIBUS DP interface or via the local operating interface in connection with a corresponding Device Type Manager (DTM)
Transmission	Based on IEC 61158-2
Baud rate	9.6 kbps, 19.2 kbps, 45.45 kbps, 93.75 kbps, 187.5 kbps, 500 kbps, 1.5 Mbps The baud rate is automatically detected and does not need to be configured manually
Device profile	PA Profile 3.02
Bus address	Address range 0 to 126 Factory setting: 126

For commissioning purposes, you will need a device driver in EDD (Electronic Device Description) or DTM (Device Type Manager) format plus a GSD file.

You can download EDD, DTM and GSD from [www.abb.com/flow](http://www.abb.com/flow).

The files required for operation can also be downloaded from [www.profibus.com](http://www.profibus.com).

ABB provides three different GSD files which can be integrated in the system.

ID number	GSD file name	
0x9741	PA139741.gsd	2xAI, 1xTOT
0x9742	PA139742.gsd	3xAI, 1xTOT
0x3434	ABB_3434.gsd	8xAI, 3xTOT, 2xAO, 1xDI, 3xDO

Users decide at system integration whether to install the full range of functions or only part. Switching is made using the 'Ident Nr. Selector' parameter.

Refer to **Ident Nr. Selector** on page 141.

### Limits and rules when using ABB fieldbus accessories

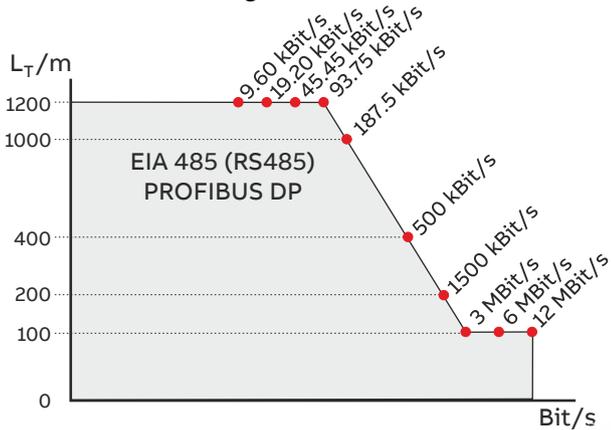


Figure 61: Bus cable length depends on the transmission rate

#### Pro PROFIBUS Line

(Line = Starts at DP Master and goes to last DP/PA Slave)

- Approximately 4 to 8 DP segments through the repeater (see repeater data sheets)
- Recommended DP transfer rate 500 to 1500 kBit/s
- The slowest DP node determines the transfer rate of the DP line
- Number of PROFIBUS DP and PA nodes  $\leq 126$  (addresses 0 to 125)

#### Per PROFIBUS DP segment

- Number of DP nodes  $\leq 32$   
(Node = Devices with / without PROFIBUS address)
- Bus termination required at the beginning and end of each DP segment!
- Trunk cable length ( $L_T$ ) see diagram (length dependent on transfer rate)
- Cable length of at least 1 m between two DP nodes at  $\geq 1500$  kBit/s!
- Spur cable length ( $L_S$ ), at  $\leq 1500$  kBit/s:  $L_S \leq 0.25$  m,  
at  $> 1500$  kBit/s:  $L_S = 0.00$  m!
- At 1500 kBit/s and ABB DP cable type A:
  - Sum of all spur cable lengths ( $L_S$ )  $\leq 6.60$  m, trunk cable length ( $L_T$ )  $> 6.60$  m, total length =  $L_T + (\sum L_S) \leq 200$  m, maximum 22 DP nodes (=  $6.60$  m /  $(0.25$  m +  $0.05$  m spare))

## ... 9 Digital communication

### EtherNet/IP™ and PROFINET® communication

#### Note

You will find detailed information regarding the “Ethernet” in the interface description “COM/FCB400/FCH400/E/MB”.

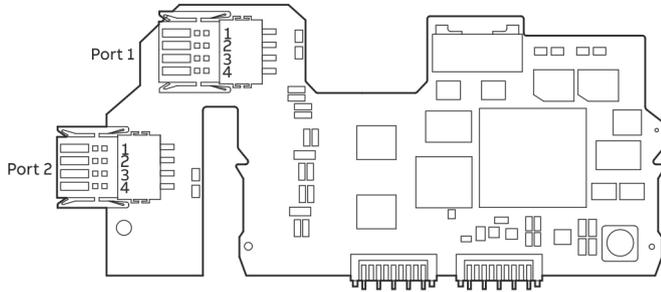


Figure 62: Plug-in card for Ethernet communication

#### Dual port connection without Power over Ethernet

##### Terminal designation:

Connection	Pin	Function	Color codes
1	Pin 1	RD+	White / Orange
	Pin 2	RD-	Orange
	Pin 3	TD+	White / Green
	Pin 4	TD-	Green
2	Pin 1	RD+	White / Orange
	Pin 2	RD-	Orange
	Pin 3	TD+	White / Green
	Pin 4	TD-	Green

#### Single port connection without Power over Ethernet

Standard Ethernet 10/100 BASE-T/TX (IEEE802.3) Single port connection.

##### Terminal designation:

Connection	Pin	Function	Color codes
1	Pin 1	RD+	White / Orange
	Pin 2	RD-	Orange
	Pin 3	TD+	White / Green
	Pin 4	TD-	Green

#### Single port connection with Power over Ethernet

Standard Ethernet 10/100 BASE-T/TX (IEEE802.3) Single port connection.

##### Terminal designation:

Connection	Pin	Function	Color codes
1	Pin 1	RD+	White / Orange
	Pin 2	RD-	Orange
	Pin 3	TD+	White / Green
	Pin 4	TD-	Green
2	Pin 1	PWR+	White / Blue
	Pin 2	PWR+	Blue
	Pin 3	PWR-	White / Brown
	Pin 4	PWR-	Brown

## Ethernet Communication

The CoriolisMaster is equipped with an Ethernet card has 2 Ethernet connections that support ring, star or daisy chain network configurations.

In addition to the Ethernet card, a plug-in card for 'Power over Ethernet' is available. Using this card, the 24 V DC version of the flowmeter can be supplied with power via the Ethernet without any additional power supply.

## EtherNet/IP™ and PROFINET® protocol

### Note

The protocol as such is not secure. The application should be assessed before implementation to determine the suitability of the protocol.

Cyclic communication is supported in the implemented CoriolisMaster Ethernet/IP and PROFINET protocol. Process variables, diagnosis data and information on the device status can be cyclically accessed.

Both protocols support DHCP (Dynamic Host Configuration Protocol), only PROFINET also supports DCP (Discovery and Configuration Protocol).

A web server is available for device configuration with full access to all parameters and diagnosis data.

Ethernet/IP interface	
Configuration	Via the web server or the local operating interface (display).
Ethernet/IP product code	5001
EDS data	FCB4_FCH4_01_01.eds
Device profile	Profile 0x43, generic device (can be set individually).
Support standards and protocols	Common Industrial Protocol (CIP™) Vol1, Ed. 3.25 EtherNet/IP™ CIP™ adaptation, Vol2, Ed. 1.23
Cable	Cat 5

### PROFINET interface

Configuration	Via the web server or the local operating interface (display).
Device profile	Manufacturer-specific and PA Profile 4.02MU1*
GSDML data	GSDML-V2.42-ABB_001A-3436_FLOW_CORIOLIS-20230127.xml
Device ID	ABB 0x3436 (manufacturer-specific) or PNO 0xB333 (PA Profile)
Support standards and protocols	Common Industrial Protocol (CIP™) Vol1, Ed. 3.25 EtherNet/IP™ CIP™ adaptation, Vol2, Ed. 1.23 PROFINET PNIO_Version V2.42

\* The standard for this PA Profile has currently not yet been released; the device can however work with the GSDML PA Profile.

## Additional Ethernet communications protocols

### Note

The device support the following security modes:

Secure protocol	Non-secure protocol
<b>Websserver https</b>	<b>EtherNet/IP, Modbus TCP and PROFINET</b>
<ul style="list-style-type: none"> <li>Ports used by the web server: TCP 443</li> <li>Security based on .x509 certificates</li> </ul>	<ul style="list-style-type: none"> <li>Ports used by EtherNet/IP: TCP 44818, UDP 2222</li> <li>Ports used by Modbus TCP: TCP 502</li> <li>Ports used by PROFINET: UDP 34964, 49152</li> </ul>

All the protocols can be activated / deactivated in the HMI Menu.

### Note

For EMC reasons, if an Ethernet output and a current or digital output are used simultaneously, a shielded cable must also be used for the current or digital output. The shield of the cable must be connected in the unit., see **Connection to integral mount design** on page 64 and **Connection to remote mount design** on page 66.

## ... 9 Digital communication

### ... EtherNet/IP™ and PROFINET® communication

#### Wiring with different network topologies

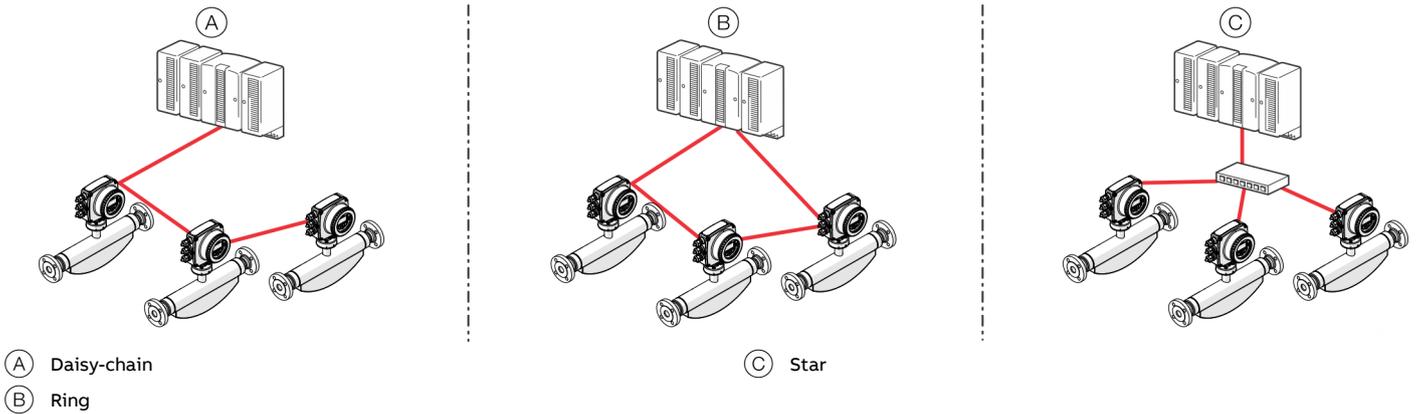


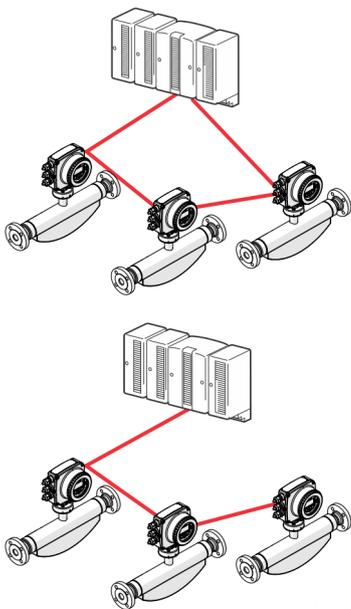
Figure 63: Connection topologies

Ethernet Option Cards are designed only for use in hazardous applications Zone 2 / Division 2 or general purpose areas. The output circuits are designed so that different topologies such as daisy chain or point to point can be connected. See Installation diagram for detailed information.

- It is not permitted to combine both topologies.
- Ethernet communication is only available for installations in Zone 2/Division 2 or general purpose
- The rated voltage of these non-intrinsically safe circuits are UM = 57 V.

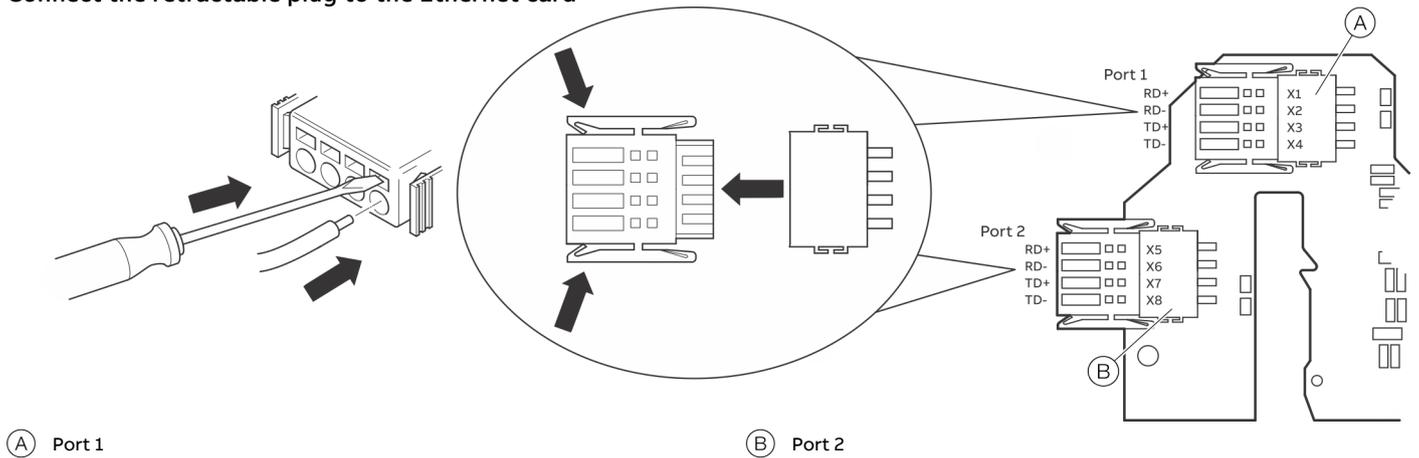
Topology	No. Ethernet cables connected	No. wires in Ethernet cable	PoE	Port	Clamp	Function	Cable
	1	4	No	1	1	RD+	white / orange
						RD-	orange
						TD+	white / green
						TD-	green
	1	8	No	1	1	RD+	white / orange
						RD-	orange
						TD+	white / green
						TD-	green
					2	Spare 1+	white / blue
						Spare 1-	blue
						Spare 2+	white / brown
						Spare 2-	brown
1	4	Yes	1	1	Recommendation: Use cable with 8 wires		
					2		
					3		
					4		
1	8	Yes	1	1	RD+	white / orange	
					RD-	orange	
					TD+	white / green	
					TD-	green	
				2	Spare 1+	white / blue	
					Spare 1-	blue	
					Spare 2+	white / brown	
					Spare 2-	brown	

Topology	No. Ethernet cables connected	No. wires in Ethernet cable	PoE	Port	Clamp	Function	Cable
Ring or daisy-chain	2	4*	No	1	1	RD+	white / orange
					2	RD-	orange
					3	TD+	white / green
					4	TD-	green
				2	1	RD+	white / orange
					2	RD-	orange
					3	TD+	white / green
					4	TD-	green



\* If you use 8-wire cables, 4 wires will not be connected.

**Connect the retractable plug to the Ethernet card**



**Figure 64: Ethernet card connection**

## ... 9 Digital communication

### ... EtherNet/IP™ and PROFINET® communication

Preparing the EtherNet Cat5e cable

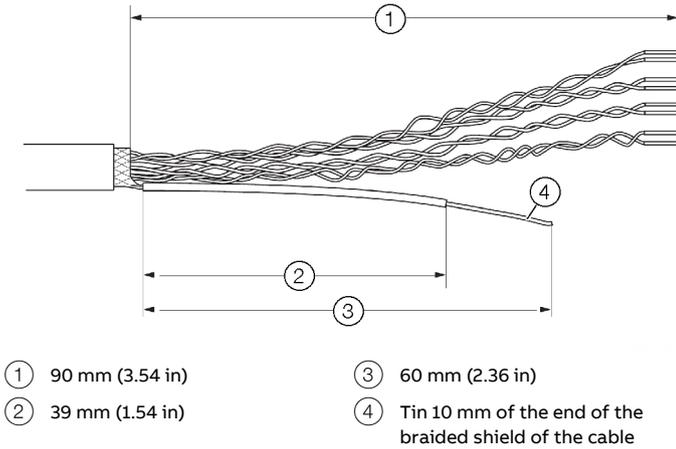


Figure 65: Preparing the EtherNet Cat5e cable

#### Ground the Ethernet connection cable

Connect the outer shield of the Ethernet cable to the screw terminal.

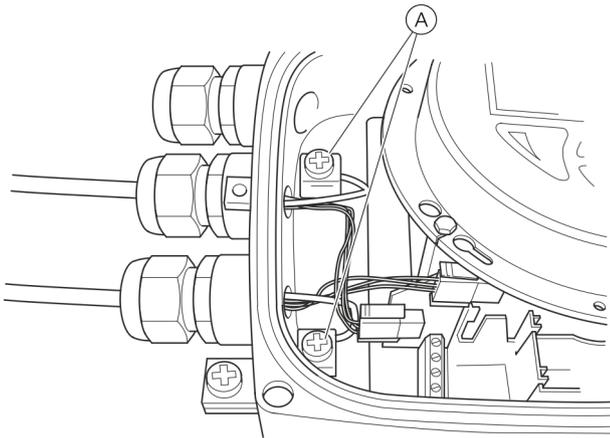


Figure 66: Ground the Ethernet connection cable

#### M12 connector (optional)

A variety of options are available for the M12 connector through the model code:

- Flowmeter equipped with 1 × M12 (four-wire, connection to Port 1)
- Flowmeter equipped with 2 × M12 (four-wire, connection to Port 1 and 2)
- Flowmeter equipped with 1 × M12 (eight-wire, connection to Port 1 and 2)

These options enable connection to various network topologies:

Topology	Four-wire	Four-wire	Four-wire	Eight-wire
	1 x M12 (four-wire)	2 x M12 (four-wire)	1 x M12 (eight-wire)	
Star	Y	Y	Y	
Ring or daisy chain	N	Y	N	
PoE	N	N	Y	

#### Electrical connections

You can reference the internal wiring in the transmitter and the corresponding pin assignment in the M12 connector in the following table:

Wiring inside the transmitter	M12 connector pin	Color	Ethernet plug-in card Connector/pin
<p>M12 connector four-wire</p>	1	Yellow	Port 1 X1
	2	Orange	Port 1 X2
	3	White	Port 1 X3
	4	Blue	Port 1 X4
<p>M12 connector eight-wire</p>	1	White	Port 1 X1
	2	Blue	Port 1 X2
	3	Brown	Port 1 X3
	4	Green	Port 1 X4
	5	Pink	Port 1 X5
	6	Yellow	Port 1 X6
	7	Grey	Port 1 X7
	8	Red	Port 1 X8

**Use in Potentially Explosive Atmospheres**

**⚠ WARNING**

There are limitations to the M12 connector in combination with an ATEX / IECEx / EAC-Ex approved flowmeter.

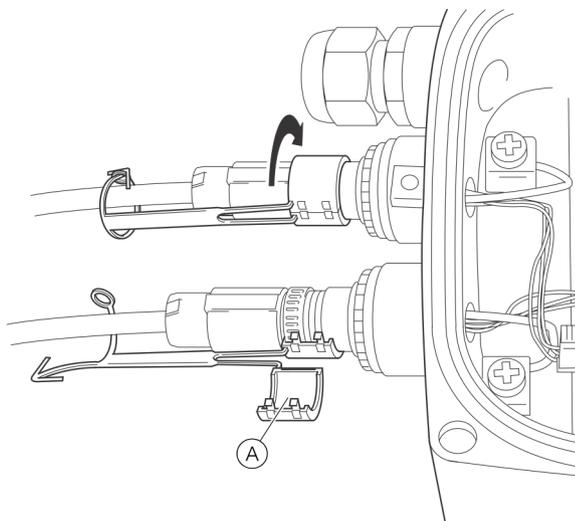
	No Ex area	ATEX/IECEx/ EAC-Ex Zone 2	Div 2
Ethernet cable connected directly to the terminals of the Ethernet plug-in card	Y	Y	Y
Ethernet cable connected to the M12 connector on the transmitter housing	Y	Y	N

**Locking clip**

**⚠ WARNING**

A locking clip must be attached when using the M12 connector in combination with an ATEX / IECEx / EAC-Ex approved flowmeter.

- Use or operation of the device without the M12 locking clip is not permitted.



(A) Locking clip

Figure 67: Fastening the locking clip

**⚠ DANGER**

**Explosion hazard**

Explosion hazard caused by connecting or disconnecting the M12 connector when the device is in live state.

- Connect or disconnect the M12 connector only if the device is de-energized.

1. Remove the sealing cap of the M12 metal connector on the transmitter housing when delivered.
2. Connect the customer-provided M12 connector cable.
3. Place the enclosed locking clip around the M12 connector and close it until the locking clip engages, then secure the locking clip by closing the pin and pin boss.

**RJ45 connector (optional)**

A variety of options are available for the RJ45 connector through the model code: The RJ45 connector is equipped with an Ethernet cable of a specific length, depending on the model code.

The flowmeter is supplied with an Ethernet cable, which is connected to the terminals in the transmitter at the factory.

- Flowmeter equipped with 1 x RJ45 (four-wire, connection to Port 1)
- Flowmeter equipped with 2 x RJ45 (four-wire, connection to Port 1 and 2)
- Flowmeter equipped with 1 x RJ45 (eight-wire, connection to Port 1 and 2)

These options enable connection to various network topologies:

Topology	Four-wire	Four-wire	Four-wire	Eight-wire
	1 x RJ45 (four-wire)	2 x M12 (four-wire)		1 x RJ45 (eight-wire)
Star	Y	Y	Y	Y
Ring or daisy chain	N	Y	Y	N
PoE	N	N	N	Y

## ... 9 Digital communication

### ... EtherNet/IP™ and PROFINET® communication

#### Electrical connections

You can reference the in the transmitter and the corresponding pin assignment in the RJ45 connector in the following table:

Wiring inside the transmitter	Color	Ethernet plug-in card Port/pin
RJ45 four-wire	Yellow	Port 1 X1
	Orange	Port 1 X2
	White	Port 1 X3
	Blue	Port 1 X4
RJ45 eight-wire	White/orange	Port 1 X1
	Orange	Port 1 X2
	White/Green	Port 1 X3
	Green	Port 1 X4
	White/blue	Port 2 X5
	Blue	Port 2 X6
	White/brown	Port 2 X7
	Brown	Port 2 X8

#### Use in potentially explosive atmospheres

### WARNING

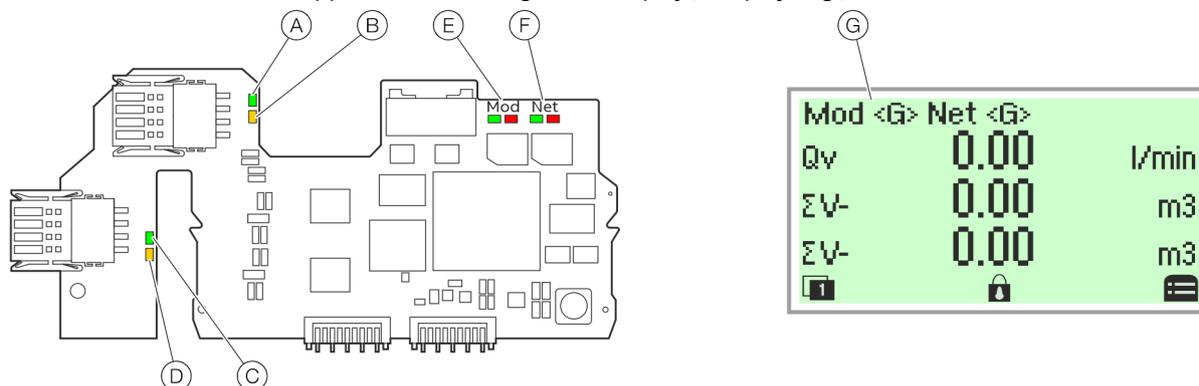
There are limitations to the RJ45 connector in combination with an ATEX / IECEx / EAC-Ex approved flowmeter.

	No Ex area	ATEX/IECEx/E	Div 2
		AC-Ex	
		Zone 2	
Ethernet cable with RJ45 connector mounted to the transmitter housing	Y	Y	N

### Ethernet card status LEDs

The 8 LEDs on the Ethernet card indicate the status of each port and the network.

To enable card status indication in the upper HMI Line, navigate to 'Display / Display Tag / Ethernet Status'.



- (A) Link port 1
- (B) Activity 1
- (C) Link port 2
- (D) Activity 2
- (E) Module Status (Mod)
- (F) Network Status (Net)
- (G) Card status indication on LCD indicator (example)

Figure 68: Ethernet card status LEDs

### EtherNet/IP™ communication

LED	Status	HMI display	Description
(A) Port 1	ON		Network connection (link up)
	OFF		No network
(B) Activity 1	Flashing or ON		Traffic
	OFF		No traffic
(C) Port 2	ON		Network connection (link up)
	OFF		No network
(D) Activity 2	Flashing or ON		Traffic
	OFF		No traffic
(E) Module Status (Mod)	green, ON	Mod showing <G> continuously	Device ready for Operation. Working properly
	green, Flashing (1 Hz)	Mod changing between <G> and <>	Standby. Device not configured yet
	green/ red, Flashing (1Hz)		Device performs "Power-On" Test
	red, Flashing (1 Hz)	Mod changing between <R> and <>	A fixable configuration error. For example: an incorrect or incomplete configuration.
	red, ON	Mod showing <R> continuously	Major Error. Non removable serious error, please contact service
	OFF	Mod showing <> continuously	No Power
(F) Network Status (Net)	green, ON	Net showing <G> continuously	Connected. Device has at least one established connection
	green, Flashing (1 Hz)	Net changing between <G> and <>	No Connection. Device did not establish any connections, but was assigned an IP address
	green/ red, Flashing (1Hz)		Device performs "Power-On" Test
	red, ON	Net showing <R> continuously	Duplicated IP address. Device has detected that the device IP address is already in use
	OFF	Net showing <> continuously	No supply voltage or IP Address.
	red, flashing (1 Hz)	Mod changing between <R> and <>	Connection timeout

## ... 9 Digital communication

### ... EtherNet/IP™ and PROFINET® communication

#### PROFINET® communication

LED	Status	HMI display	Description
Ⓐ Port 1	ON		Network connection (link up)
	OFF		No network
Ⓑ Activity 1	Flashing or ON		Traffic
	OFF		No traffic
Ⓒ Port 2	ON		Network connection (link up)
	OFF		No network
Ⓓ Activity 2	Flashing or ON		Traffic
	OFF		No traffic
Ⓔ Module Status (Mod)	green, ON	Mod showing <G> continuously	PROFINET configuration complete
	green, Flashing (1 Hz)	Mod changing between <G> and < >	Blink Test (Profinet)
	green/ red, Flashing (1Hz)		Device performs "Power-On" Test
	red, Flashing (1 Hz)	Mod changing between <R> and < >	A fixable configuration error. For example: an incorrect or incomplete configuration.
	red, ON	Mod showing <R> continuously	Major Error. Non removable serious error, please contact service
	OFF	Mod showing < > continuously	Startup or Device is turned off. No supply voltage.
	OFF		
Ⓕ Network-Status (Net)	green, ON	Net showing <R> continuously	PLC connected
	green, Flashing (1 Hz)	Net changing between <G> and < >	No Connection. Device did not establish any connections, but was assigned an IP address
	green/ red, Flashing (1Hz)		Device performs "Power-On" Test
	red, ON	Net showing <R> continuously	Duplicated IP address. Device has detected that the device IP address is already in use
	OFF	Net showing < > continuously	No supply voltage or IP Address. Device does not have IP Address or is turned off.
	OFF		
	red, flashing (1 Hz)	Mod changing between <R> and < >	No PLC connection

## 10 Commissioning

### Safety instructions

#### **⚠ DANGER**

##### Explosion hazard

Improper installation and commissioning of the device carries a risk of explosion.

- For use in potentially explosive atmospheres, observe the information in **Use in potentially explosive atmospheres** on page 8!

#### **⚠ CAUTION**

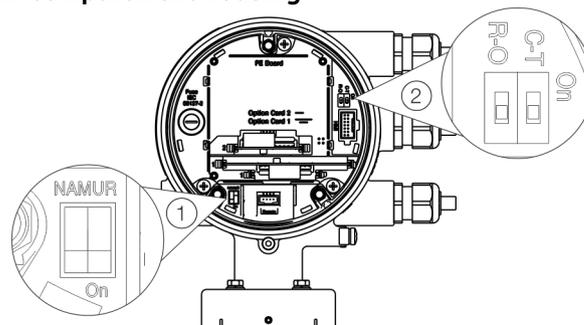
##### Risk of burns due to hot measuring media

The device surface temperature may exceed 70 °C (158 °F), depending on the measuring medium temperature!

- Before starting work on the device, make sure that it has cooled sufficiently.

### Hardware settings

#### Dual- compartment housing



① NAMUR DIP switch

② Write protection DIP switch

Figure 69: Position of the DIP switches

DIP switches are located behind the front housing cover. The DIP switches are used to configure specific hardware functions. The power supply to the transmitter must be briefly interrupted in order for the modified setting to take effect.

#### Write-protect switch

When write protection is activated, device parameterization cannot be changed via the LCD indicator. Activating and sealing the write protection switch protects the device against tampering.

Number	Function
On	Write protection active
Off	Write protection deactivated.

#### Configuration of digital outputs 41 / 42 and 51 / 52

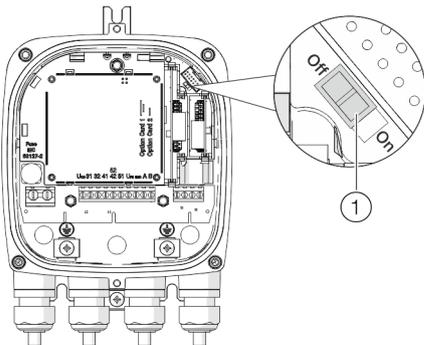
The configuration (NAMUR, optoelectronic coupler) for the digital outputs on the basic device is set via DIP switches in the transmitter.

Number	Function
On	Digital output 41 / 42 and 51 / 52 as NAMUR output.
Off	Digital output 41 / 42 and 51 / 52 as optoelectronic coupler output.

# ... 10 Commissioning

## ... Hardware settings

### Single-compartment housing



① DIP switch, Write protection

Figure 70: Position of the DIP switch

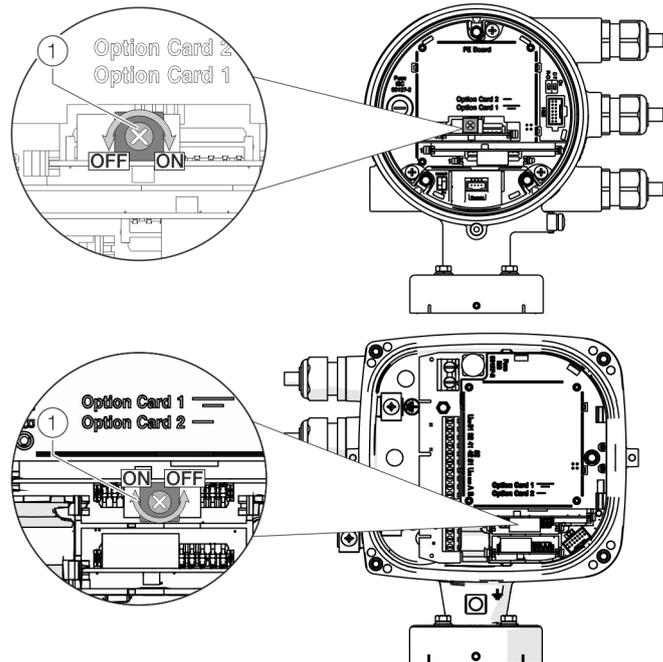
The DIP switches are used to configure specific hardware functions. The power supply to the transmitter must be briefly interrupted or the device reset in order for the modified setting to take effect.

#### Write-protect switch

When write protection is activated, device parameterization cannot be changed via the LCD indicator. Activating and sealing the write protection switch protects the device against tampering.

Number	Function
On	Write protection active
Off	Write protection deactivated.

### Configuration of digital outputs V1 / V2 or V3 / V4



① NAMUR rotary switch

Figure 71: Position of rotary switch on the plug-in card

The configuration (NAMUR, optoelectronic coupler) for the digital output on the plug-in card is set via a rotary switch on the plug-in card.

Number	Function
On	Digital output V1 / V2 or V3 / V4 as NAMUR output.
Off	Digital output V1 / V2 or V3 / V4 as optoelectronic coupler output.

## Checks prior to commissioning

The following points must be checked before commissioning the device:

- Correct wiring in accordance with **Electrical connections** on page 53.
- Correct grounding of the device.
- The ambient conditions must meet the requirements set out in the specification.
- The power supply must meet the requirements set out on the name plate.

## Switching on the power supply

- Switch on the power supply.

The LCD display shows the following display during the startup process:



The process display is displayed after the startup process.

## Parameterization of the device

The CoriolisMaster FCB400, FCH400 can be commissioned and operated via the integral LCD display (see **Menu: Easy Setup** on page 86).

Alternatively, the CoriolisMaster FCB400, FCH400 can also be commissioned and operated via standard HART tools. These include:

- ABB HART handheld terminal DHH805 (FCB4xx EDD)
- ABB Field Information Manager (FIM) combined with the ABB CoriolisMaster Field Device Information Package (FDI package).
- ABB 800xA control system (FCB4xx DTM)
- Other tools supporting standard HART EDDs or DTMs (FDT1.2)

### Note

Not all tools and frame applications support DTMs or EDDs at the same level. In particular, optional or advanced EDD / DTM functions may not be available on all tools. ABB provides frame applications supporting the full range of functions and performance.

# ... 10 Commissioning

## ... Parameterization of the device

### Installation of the ABB Field Information Manager (FIM)



Download the ABB Field Information Manager (FIM) using the adjacent download link.



Download the ABB FDI package using the adjacent download link.

Installation of the software and connection to the flowmeter:

1. Install ABB Field Information Manager (FIM).
2. Unpack the ABB FDI package into the c:\temp folder.
3. Connect the flowmeter with the PC / laptop, see chapter **Parameterization via the infrared service port adapter** on page 85 or **Parameterization via HART®** on page 85.
4. Power-up the power supply for the flowmeter and start the ABB Field Information Manager (FIM).
5. Drag and drop the 'ABB.FCXxxx.01.00.00.HART.fdx' file to the ABB Field Information Manager (FIM). No special view is needed for this.
6. Right-click ① as shown in **Figure 72**.

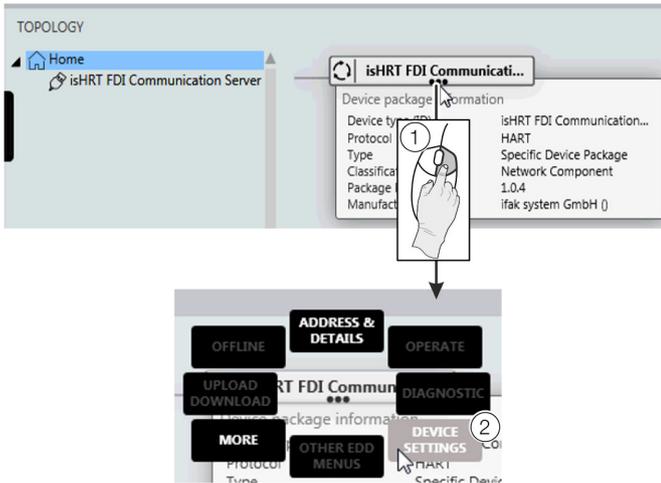


Figure 72: Select FIM – 'Device Settings'

7. Select 'DEVICE SETTINGS' ② as shown in **Figure 72**.

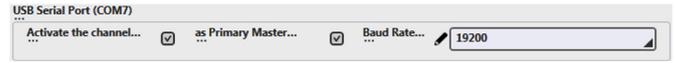


Figure 73: Select FIM – COM-Port

8. Select the corresponding COM port. Close the menu by clicking on 'send'.
9. By using the [Menu] menu button on the left side, the flowmeter is displayed under 'TOPOLOGY'.

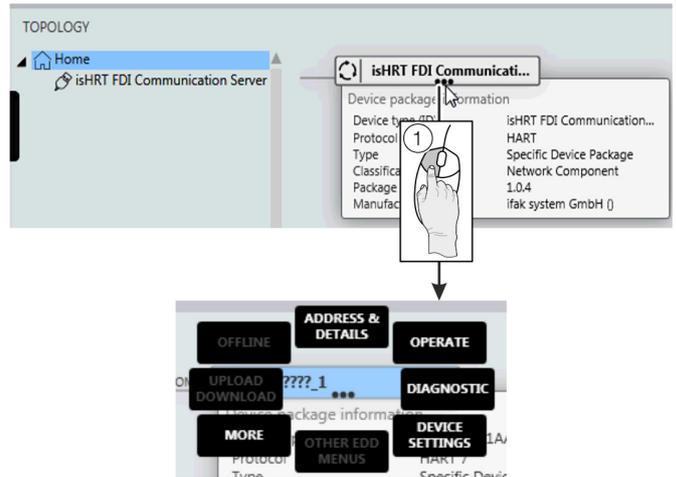


Illustration74:

All the submenus can be accessed by clicking the three points below the tag name of the flowmeter with the left mouse button ①.

### Parameterization via the infrared service port adapter

Configuration via the infrared service port adapter on the device requires a PC / notebook and the FZA100 infrared service port adapter.

By combining the FDI package available at [www.abb.com/flow](http://www.abb.com/flow) and the ABB Field Information Manager (FIM), all parameters can be set even without a HART connection.

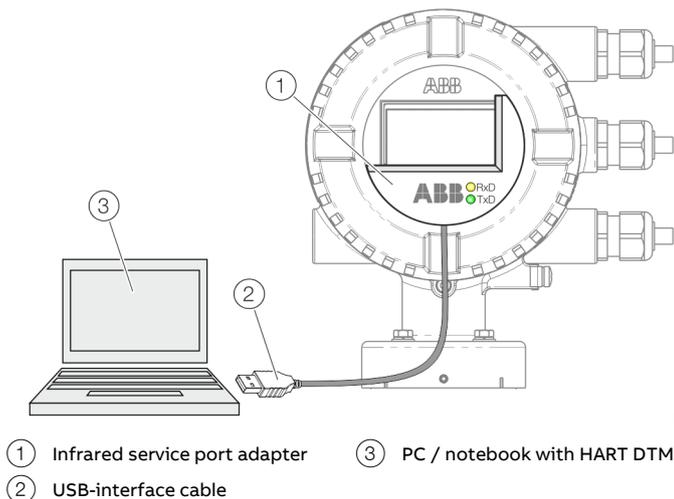


Figure 75: Infrared service port adapter on the transmitter (example)

1. Position the infrared service port adapter on the front plate of the transmitter as shown
2. Insert USB interface cable into a free USB female connector on the PC / notebook.
3. Switch on the device power supply.
4. Start the ABB Field Information Manager (FIM) and perform parameterization of the device.

### Parameterization via HART®

Configuration via the HART interface of the device requires a PC / Notebook and a suited HART® Modem.

By combining the HART DTM available at [www.abb.com/flow](http://www.abb.com/flow) and the ABB Field Information Manager (FIM), all parameters can also be set via the HART protocol.

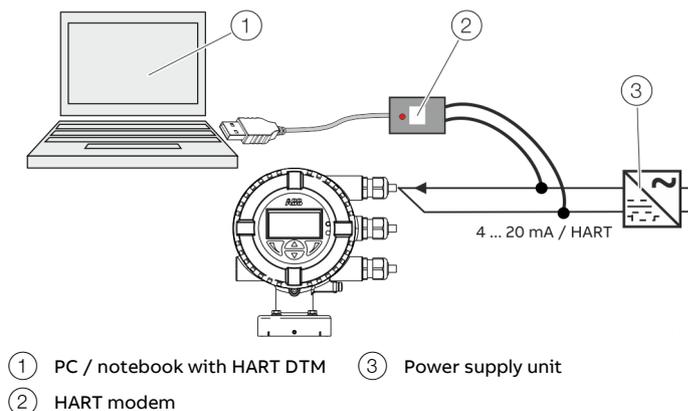


Figure 76: HART Modem on the transmitter (example)

For more detailed information on operating the software and the HART modem, please refer to the relevant operating instructions and the DTM online help.

## ... 10 Commissioning

### Basic Setup

The device can be factory parameterized to customer specifications upon request. If no customer information is available, the device is delivered with factory settings.

Settings for the most common parameters are summarized in the 'Easy Setup' menu.

This menu is the quickest way to perform the initial configuration of the device.

For information on navigating through the transmitter menu, see **Menu navigation** on page 90.

For a detailed description of all menus / parameters see **Parameter descriptions** on page 115.

#### Menu: Easy Setup

Menu / parameter	Description
<b>Easy Setup</b>	
Language	Selection of menu language.
Unit Massflow Qm	Selection of the unit for mass flow rate (for example for the $Q_{mMax}$ / $Q_{mMaxDN}$ parameters and for the corresponding process value). See <b>Table 2: Units for the mass flow</b> on page 97.
Unit Volumeflow Qv	Selection of the unit for volume flow rate (for example for the $Q_{vMax}$ / $Q_{vMaxDN}$ parameters and for the corresponding process value). See <b>Table 1: Units for the volume flow</b> on page 97.
Unit Density	Selection of the unit for the density (e.g. for the associated parameters and the corresponding process values). See <b>Table 3: Density units</b> on page 97.
Unit Temperature	Selection of unit for temperature (e.g. for the associated parameters and the corresponding process values). See <b>Table 4: Temperature units</b> on page 97.
Unit Mass Totalizer	Selection of the unit for the mass counters and the pulse outputs. See <b>Table 6: Units for the mass totalizer</b> on page 98.
Unit Vol. Totalizer	Selection of the unit for the volume totalizers and the pulse outputs. See <b>Table 7: Units for the volume totalizer</b> on page 98.
Curr.Out 31 / 32 / Uco	Selection of the process value issued via the current output.
Curr.Out V1/V2	The current outputs V1 / V2 and V3 / V4 are only available if the corresponding plug-in cards are present!
Curr.Out V3/V4	See <b>Available process variables</b> on page 99.
Dig.Out 41 / 42 Mode	Selection of the operating mode for the digital output 41 / 42. <ul style="list-style-type: none"> <li>• Off: Digital output 41 / 42 deactivated.</li> <li>• Logic: Digital output 41 / 42 as a binary output (e.g. as an alarm output).</li> <li>• Pulse: Digital output 41 / 42 as a pulse output. In pulse mode, pulses per unit are output (e.g. 1 pulse per m<sup>3</sup>).</li> <li>• Frequency: Digital output 41 / 42 as a frequency output. In frequency mode, a frequency is issued that is proportional to the flow rate. The maximum frequency can be configured in accordance with the upper range value.</li> </ul>

Menu / parameter	Description
Dig.Out 51 / 52 Mode	<p>Selection of the operating mode for the digital output 51 / 52.</p> <ul style="list-style-type: none"> <li>• Off: Digital output deactivated.</li> <li>• Logic: Digital output functions as binary output (for function see parameter '...Setup Logic Output').</li> <li>• Frequency: Digital output 51 / 52 as a frequency output. In frequency mode, a frequency is issued that is proportional to the flow rate. The maximum frequency can be configured in accordance with the upper range value.</li> <li> <ul style="list-style-type: none"> <li>• Follow DO 41/42: The digital output 51 / 52 follows the function of digital output 41 / 42. Depending on the setting of the parameter 'Input/Output / ...Dig.Out 41/42 / Outp. Flow Direction', digital output 51 / 52 is operated in pulse mode as follows: <ul style="list-style-type: none"> <li>– No pulses are issued if 'Forward &amp; Reverse' is selected. Only digital output 41 / 42 is active.</li> <li>– If 'Forward' is selected, pulses for forward flow are issued on digital output 41 / 42, while pulses for reverse flow are issued on digital output 51 / 52.</li> <li>– When "Reverse" is selected, pulses for reverse flow are output on digital output 41 / 42, while pulses for forward flow are output on digital output 51 / 52.</li> </ul> </li> <li>• 90° Shift: Output of the same pulses as for digital output 41 / 42, phase shifted by 90°. Only if digital output 41 / 42 has been configured as a pulse or frequency output.</li> <li>• 180° Shift: Output of the same pulses as for digital output 41 / 42, phase shifted by 180°. Only if digital output 41 / 42 has been configured as a pulse or frequency output.</li> <li> <ul style="list-style-type: none"> <li>• Follow DO 41/42 (Frequency): The digital output 51 / 52 follows digital output 41 / 42. Digital output 51 / 52 then also works as a frequency output, the settings under "... / Dig.Out 41 / 42 / ...Setup Freq Output" are accepted. The output of the frequency at digital output 51 / 52 is dependent on the setting of the register "Outp. Flow Direction" for digital output 41 / 42: <ul style="list-style-type: none"> <li>– When "Forward" is selected, a frequency for forward flow is output at digital output 41 / 42 and a frequency for reverse flow is output at digital output 51 / 52</li> <li>– When "Reverse" is selected, a frequency for reverse flow is output at digital output 41 / 42 and a frequency for forward flow is output at digital output 51 / 52</li> </ul> </li> <li>• 180° Shift (Frequency): Output of the same frequency as for digital output 41 / 42, phase shifted by 180°</li> </ul> </li> </ul> <p><b>Note</b></p> <p>If digital output 41 / 42 has been configured as pulse or frequency output, digital output 51 / 52 can be configured separately as binary or frequency output.</p> <p>However, digital output 51 / 52 cannot be configured as a second independent pulse output.</p> </li></ul>

## ... 10 Commissioning

### ... Basic Setup

Menu / parameter	Description
<b>Easy Setup</b>	
Dig.Out V1 / V2 Mode	<p>Selection of the operating mode for digital output V1 / V2.</p> <p>Digital output V1 / V2 is only available if the corresponding plug-in card is present!</p> <ul style="list-style-type: none"> <li>• Off: Digital output V1 / V2 deactivated.</li> <li>• Logic: Digital output V1 / V2 as a binary output (for example, as an alarm output).</li> </ul>
Dig.Out V3 / V4 Mode	<p>Selection of the operating mode for digital output V3 / V4.</p> <p>Digital output V3 / V4 is only available if the corresponding plug-in card is present!</p> <ul style="list-style-type: none"> <li>• Off: Digital output V3 / V4 deactivated.</li> <li>• Logic: Digital output V3 / V4 as a binary output (for example, as an alarm output).</li> </ul>
Dig.Out 51/52 Freq.	<p>The operating modes are available with an APO card only. When these operating modes are selected, DO51 / 52 is mirrored to V3 / V4.</p> <ul style="list-style-type: none"> <li>• Frequency: Digital output V3 / V4 as a frequency output. In frequency mode, a frequency is issued that is proportional to the flow rate. The maximum frequency can be configured in accordance with the upper range value.</li> <li>• Follow DO 41/42: Digital output V3 / V4 follows the function of digital output 41 / 42. Depending on the setting of the 'Input/Output / ...Dig.Out 41/42 / Outp. Flow Direction' parameter, digital output V3 / V4 is operated in pulse mode as follows: <ul style="list-style-type: none"> <li>– No pulses are issued if 'Forward &amp; Reverse' is selected. Only digital output 41 / 42 is active.</li> <li>– When 'Forward' is selected, pulses for forward flow are output on digital output 41 / 42, while pulses for reverse flow are output on digital output V3 / V4.</li> <li>– When 'Reverse' is selected, pulses for reverse flow are output on digital output 41 / 42, while pulses for forward flow are output on digital output V3 / V4.</li> </ul> </li> <li>• 90° Shift: Output of the same pulses as for digital output 41 / 42, phase shifted by 90°. Only if digital output 41 / 42 has been configured as a pulse or frequency output.</li> <li>• 180° Shift: Output of the same pulses as for digital output 41 / 42, phase shifted by 180°. Only if digital output 41 / 42 has been configured as a pulse or frequency output.</li> <li>• Follow DO 41/42 (Frequency): Digital output V3 / V4 follows digital output 41 / 42. Digital output V3 / V4 then also works as a frequency output, the settings under '... / Dig.Out 41 / 42 / ...Setup Freq Output' are accepted. The output of the frequency at digital output V3 / V4 is dependent on the setting of the register 'Outp. Flow Direction' for digital output 41 / 42: <ul style="list-style-type: none"> <li>– When 'Forward' is selected, a frequency for forward flow is output at digital output 41 / 42 and a frequency for reverse flow is output at digital output V3 / V4</li> <li>– When 'Reverse' is selected, a frequency for reverse flow is output at digital output 41 / 42 and a frequency for forward flow is output at digital output V3 / V4</li> </ul> </li> <li>• 180° Shift (Frequency): Output of the same frequency as for digital output 41 / 42, phase shifted by 180°</li> </ul> <p><b>Note</b></p> <p>Digital output V3 / V4 cannot be configured as an additional independent frequency output (operating mode 'Frequency (=51 / 52)'). Digital output V3 / V4 can be configured separately as a binary or frequency output. However, digital output V3 / V4 cannot be configured as a second independent pulse output.</p>

Menu / parameter	Description
DO 41/42 Freq.	Selection of process value issued via the frequency or pulse output.
Dig.Out 41/42 Pulse	Only if digital output 41 / 42 has been configured as a frequency or pulse output.
Dig.Out 51/52 Freq.	See <b>Available process variables</b> on page 99.
FrequencyV3 / V4	
Dig.Out 41 / 42 Logic	Selection of the output function for the relevant binary output.
Dig.Out 51 / 52 Logic	<ul style="list-style-type: none"> <li>• F / R Signal: The binary output signals the flow direction.</li> <li>• Dual Range: The binary output is activated when measuring range 2 (QmMax 2 / QvMax 2) is selected. This selection is only available if the parameter 'Range Mode Config' has been configured to Qm or Qv.</li> <li>• Batch End Contact: The binary output is activated when the set fill quantity is reached (only if the FillMass function is activated).</li> </ul>
Dig.Out V1 / V2 Logic	Only if the relevant digital output has been configured as a binary output.
Dig.Out V3 / V4 Logic	
Qm Max	Sets the upper range value for the mass flow for forward and reverse flow. The value is also used to calculate the corresponding percentage value.
Qv Max	Setting of the upper measuring range value 1 for the volume flow for feed flow and reverse flow. The value is also used to calculate the corresponding percentage value.
Density Max	Sets the maximum / minimum density to be measured. This value is used to calculate the percentage density value. These parameters are only available if the density output 'Density [unit]' was selected when configuring the power and digital outputs.
Density Min	
Pulses per Unit	Set pulses per volume or per mass flow unit, and the pulse width for the digital output operating mode 'Pulse'. Only available if a digital output has been configured as a pulse output, and the volume flow or mass flow has been selected as the process variable to be output.
Pulse Width	
Upper Frequency41 / 42	Sets the upper range value frequency for the digital output operating mode 'Frequency'. The entered value corresponds to 100 % flow.
Upper Frequency51 / 52	
Upper FrequencyV3 / V4	Only available if a digital output has been configured as a frequency output, and the volume flow or mass flow has been selected as the process variable to be output.
System Zero	Starts the automatic zero point balancing using  . Automatic zero point balancing takes approx. 60 seconds. <b>Note</b> Prior to starting the zero point adjustment, make sure that: <ul style="list-style-type: none"> <li>• There is no flow through the sensor (close all valves, shut-off devices etc.)</li> <li>• The sensor must be filled completely with measuring medium for measurement.</li> </ul>

# 11 Operation

## Safety instructions

### ⚠ CAUTION

#### Risk of burns due to hot measuring media

The device surface temperature may exceed 70 °C (158 °F), depending on the measuring medium temperature!

- Before starting work on the device, make sure that it has cooled sufficiently.

If there is a chance that safe operation is no longer possible, take the device out of operation and secure it against unintended startup.

## Menu navigation

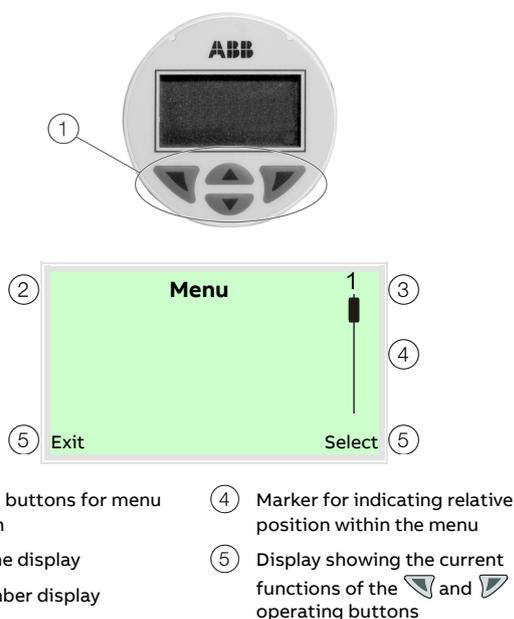


Figure 77: LCD display

The LCD indicator has capacitive operating buttons. These enable you to control the device through the closed housing cover.

### Note

The transmitter automatically calibrates the capacitive buttons on a regular basis. If the cover is opened during operation, the sensitivity of the buttons is firstly increased to enable operating errors to occur. The button sensitivity will return to normal during the next automatic calibration.

You can use the or operating buttons to browse through the menu or select a number or character within a parameter value.

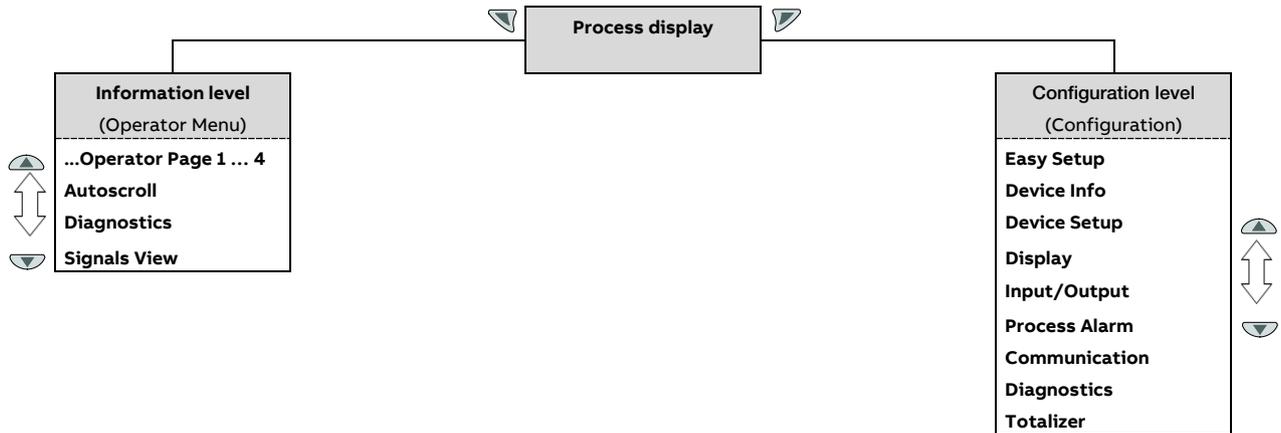
Different functions can be assigned to the and operating buttons. The function ⑤ that is currently assigned to them is shown on the LCD display.

### Control button functions

	Meaning
Exit	Exit menu
Back	Go back one submenu
Cancel	Cancel a parameter entry
Next	Select the next position for entering numerical and alphanumeric values

	Meaning
Select	Select submenu / parameter
Edit	Edit parameter
OK	Save parameter entered

## Menu levels



### Process display

The process display shows the current process values.

From the level of the process display, you can branch out into two menu levels (information level, configuration level).

### Information level (Operator Menu)

The information level contains the parameters and information that are relevant for the operator.

The device configuration cannot be changed on this level.

### Configuration level (Configuration)

The configuration level contains all the parameters required for device commissioning and configuration. The device configuration can be changed on this level. For additional information on the parameters, see **Parameter descriptions** on page 115.

## ... 11 Operation

### Process display

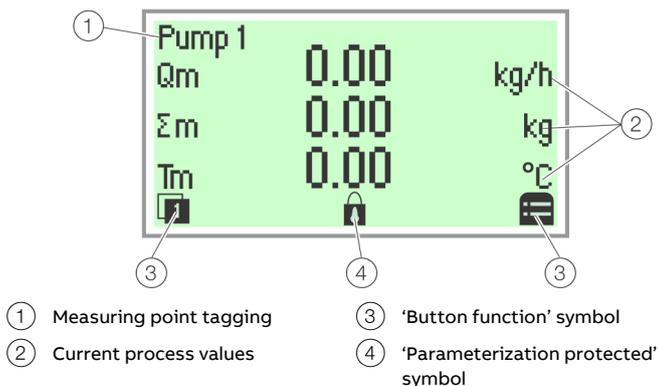


Figure 78: Process display (example)

The process display appears on the LCD display when the device is powered on. It shows information about the device and current process values.

The way in which the current process values are shown can be adjusted on the configuration level.

The symbols at the bottom of the process display are used to indicate the functions of the operating buttons  and , in addition to other information.

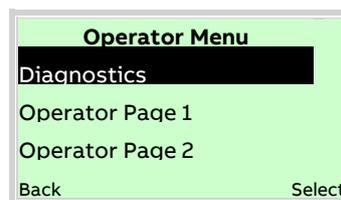
Symbol	Description
 / 	Call up information level. When Autoscroll mode is activated, the  icon appears here and the operator pages are automatically displayed one after the other.
	Call up configuration level.
	The device is protected against changes in the parametrization.

### Switching to the information level

On the information level, the operator menu can be used to display diagnostic information and choose which operator pages to display.



1. Open the  using Operator Menu.



2. Select the desired submenu using  / .

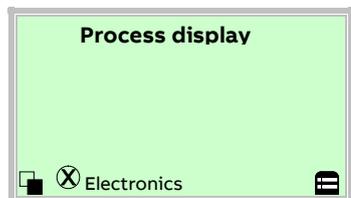
3. Confirm the selection with .

Menu	Description
... / Operator Menu	
<b>Diagnostics</b>	Selection of sub-menu 'Diagnostics'; see also <b>Error messages on the LCD display</b> on page 93.
Operator Page 1 to n	Selection of operator page to be displayed.
Autoscroll	When 'Autoscroll' is activated, automatic switching of the operator pages is initiated on the process screen.
<b>Signals View</b>	Selection of submenu 'Signals View' (only for service purposes).

## Error messages on the LCD display

In the event of an error, a message consisting of a symbol and text (e.g. Electronics) appears at the bottom of the process screen.

The text displayed provides information about the area in which the error has occurred.



The error messages are divided into four groups in accordance with the NAMUR classification scheme. The group assignment can only be changed using a DTM or EDD:

Symbol	Description
	Error / failure
	Function check
	Outside of the specification
	Maintenance required

The error messages are also divided into the following areas:

Range	Description
Operation	Error / alarm due to the current operating conditions.
Sensor	Error / alarm of the flowmeter sensor.
Electronics	Error / alarm of the electronics.
Configuration	Error / alarm due to device configuration.

### Note

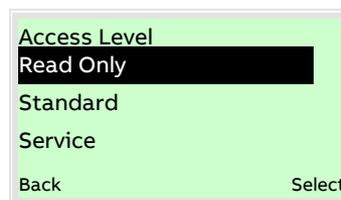
For a detailed description of errors and troubleshooting instructions, please see **Diagnosis / error messages** on page 162.

## Switching to the configuration level (parameterization)

The device parameters can be displayed and changed on the configuration level.



1. Switch to the configuration level with .



2. Select the desired level of access using / .
3. Confirm the selection with .

### Note

There are three levels of access. A password can be defined for level 'Standard'.

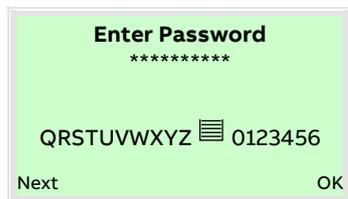
- There is no factory default password. For security reasons it is recommended to set a password.
- The password prevents access to the parameterization via the buttons on the device. For further access protection via DTM or EDD (HART®, PROFIBUS®, Modbus®) the hardware write protection switch must be set (see **Hardware settings** on page 81).

Access Level	Description
Read Only	All parameters are locked. Parameters are read only and cannot be modified.
Standard	All the parameters can be changed.
Service	Only ABB Customer Service has access to the Service menu.

## ... 11 Operation

### ... Switching to the configuration level (parameterization)

Once you have logged on to the corresponding access level, you can edit or reset the password. Reset (status 'no password defined') by selecting '☰' as a password.



- Enter the appropriate password. No password is preset in the factory settings. Users can switch to the configuration level without entering a password. The selected access level remains active for 3 minutes. Within this time period you can toggle between the process display and the configuration level without re-entering the password.
- Use  to confirm the password.

The LCD display now indicates the first menu item on the configuration level.

- Select a menu using  / .
- Confirm the selection with .

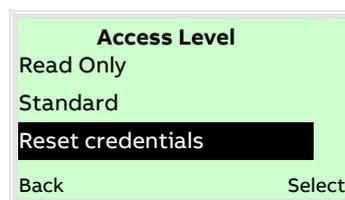
#### Resetting the customer password

If the set password has been forgotten, the password can be reset and reassigned.

A one-time password is needed for this purpose and can be generated by ABB Service upon request.

To reset the password, the password has to be entered incorrectly once for the 'Standard' user level. When the configuration level is called up again, a new entry 'Reset credentials' then appears in the list of access levels.

- Switch to the configuration level with .



- Use  /  to select the 'Reset credentials' entry.
- Confirm the selection with .



- Contact ABB Service and request a one-time password, stating the 'ID' and 'Pin' shown.
- Enter the one-time password.

#### Note

The one-time password is only valid once and needs to be separately requested with each password reset.

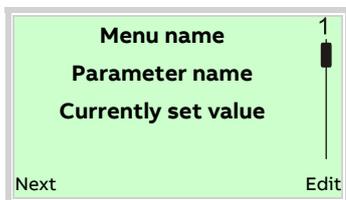
- Confirm the input with .

After the one-time password has been entered, the password for the 'Standard' access level is reset and can be reassigned.

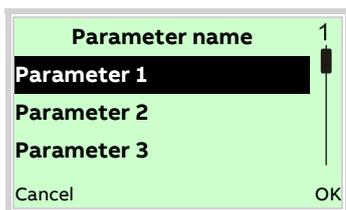
## Selecting and changing parameters

### Entry from table

When an entry is made from a table, a value is selected from a list of parameter values.



1. Select the parameters you want to set in the menu.
2. Use to call up the list of available parameter values. The parameter value that is currently set is highlighted.

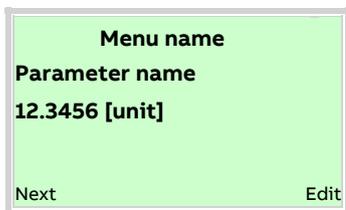


3. Select the desired value using / .
4. Confirm the selection with .

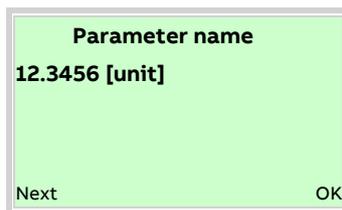
This concludes the procedure for selecting a parameter value.

### Numerical entry

When a numerical entry is made, a value is set by entering the individual decimal positions.



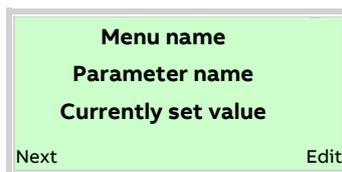
1. Select the parameters you want to set in the menu.
2. Use to call up the parameter for editing. The decimal place that is currently selected is highlighted.



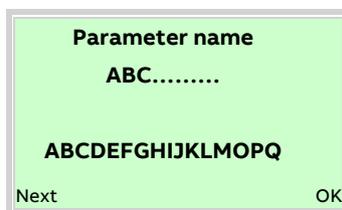
3. Use to select the decimal place to change.
  4. Use / to set the desired value.
  5. Use to select the next decimal place.
  6. If necessary select and set additional decimal places in accordance with steps 3 to 4.
  7. Use to confirm your setting.
- This concludes the procedure for changing a parameter value.

### Alphanumeric entry

When an alphanumeric entry is made, a value is set by entering the individual decimal positions.



1. Select the parameters you want to set in the menu.
2. Use to call up the parameter for editing. The decimal place that is currently selected is highlighted.



3. Use to select the decimal place to change.
  4. Use / to set the desired value.
  5. Use to select the next decimal place.
  6. If necessary select and set additional decimal places in accordance with steps 3 to 4.
  7. Use to confirm your setting.
- This concludes the procedure for changing a parameter value.

## ... 11 Operation

### ... Selecting and changing parameters

#### Exiting the setup

For some menu items, values must be entered. If you don't want to change the parameter, you can exit the menu as described below.

1. Pressing  (Next) repeatedly moves the cursor to the right. Once the cursor reaches the end position, 'Cancel' is displayed in the lower right of the screen.
2.  terminates editing and exits the menu item. Use  to return to the start.

#### Note

The LCD display automatically returns to the process display three minutes after the last button has been actuated.

## Available units

For certain parameters it is possible to choose among the following units.

### Note

The 'Code' column indicates the value to which the corresponding parameter must be set, e.g. using the communications interface.

**Table 1: Units for the volume flow**

Selection	Code	Description
m <sup>3</sup> /s	13	Cubic meters per second
m <sup>3</sup> /min	14	Cubic meters per minute
m <sup>3</sup> /h	15	Cubic meters per hour
m <sup>3</sup> /d	16	Cubic meters per day
ft <sup>3</sup> /s	29	Cubic feet per second
ft <sup>3</sup> /min	30	Cubic feet per minute
ft <sup>3</sup> /h	31	Cubic feet per hour
ft <sup>3</sup> /d	32	Cubic feet per day
ml/s	46	Milliliters per second
ml/min	47	Milliliters per minute
l/s	48	Liters per second
l/min	49	Liters per minute
l/h	50	Liters per hour
l/d	51	Liters per day
hl/h	54	Hectoliters per hour
kl/d	62	Megaliters per day
ugal/s	71	US gallons per second
ugal/min	72	US gallons per minute
ugal/h	73	US gallons per hour
ugal/d	74	US gallons per day
Mugal/d	82	Mega US gallons per day
igal/s	91	Imperial gallons per second
igal/min	92	Imperial gallons per minute
igal/h	93	Imperial gallons per hour
igal/d	94	Imperial gallons per day
bbl/s	112	Oil barrels per second
bbl/min	113	Oil barrels per minute
bbl/h	114	Oil barrels per hour
bbl/d	115	Oil barrels per day
bls/s	130	Brew barrels per second
bls/min	131	Brew barrels per minute
bls/h	132	Brew barrels per hour
bls/d	133	Brew barrels per day
xx/yy	254	Customer unit (user-defined)

**Table 2: Units for the mass flow**

Selection	Code	Description
g/s	1	Grams per second
g/min	2	Grams per minute
g/h	3	Grams per hour
g/d	4	Grams per day
kg/s	5	Kilograms per second
kg/min	6	Kilograms per minute
kg/h	7	Kilograms per hour
kg/d	8	Kilograms per day
lb/s	9	Pounds (avdp) per second
lb/min	10	Pounds (avdp) per minute
lb/h	11	Pounds (avdp) per hour
lb/d	12	Pounds (avdp) per day
t/min	30	Metric tons per minute
t/h	31	Metric tons per hour
t/d	32	Metric tons per day
xx/yy	254	Customer unit (user-defined)

**Table 3: Density units**

Selection	Code	Description
g/cm <sup>3</sup>	1	Grams per cubic centimeter
kg/m <sup>3</sup>	4	Grams per cubic meter
g/ml	7	Grams per milliliter
g/l	10	Grams per liter
kg/l	11	Kilograms per liter
lb/ft <sup>3</sup>	13	Pounds (avdp) per cubic foot
lb/ugal	14	Pounds (avdp) per gallon
SG	17	Specific gravity
xx/yy	254	Customer unit (user-defined)

**Table 4: Temperature units**

Selection	Code	Description
K	1	Kelvin
°C	2	Celsius
°F	3	Fahrenheit
xx/yy	254	Customer unit (user-defined)

## ... 11 Operation

### ... Available units

**Table 5: Concentration units**

Selection	Code	Description
%	57	Concentration in %
Brix	101	Brix concentration
Variable Matrix	240	The concentration is calculated with the variables matrix
Baume	241	Baume concentration
API	104	Crude oil density in API degrees

**Table 6: Units for the mass totalizer**

Selection	Code	Description
kg	2	Kilograms
g	3	Grams
t	5	Tons (metric)
Pound	8	Pounds (advp)
xx/yy	254	Customer unit (user-defined)

**Table 7: Units for the volume totalizer**

Selection	Code	Description
m <sup>3</sup>	4	Cubic meters
ft <sup>3</sup>	7	Cubic feet
ml	11	Milliliters
l	13	Liters
hl	14	Hectoliters
ugal	20	US gallons
igal	21	Imperial gallons
bbl	22	Barrels (petroleum, USA)
bls	31	Barrels (beer, USA)
xx/yy	254	Customer unit (user-defined)

**Table 8: Pressure units**

Selection	Code	Description
Pa	1	Pascals
kPa	4	Kilopascals
Bar	8	Bar
mBar	9	Millibar
psi	65	Pounds per square inch

**Table 9: Pulses per flow unit**

Selection	Code	Description
1/kg	2	Per kilogram
1/g	3	Per gram
1/m <sup>3</sup>	4	Per cubic meter
1/t	5	Per metric ton
1/ft <sup>3</sup>	7	Per cubic foot
1/lb	8	Per pound
1/ml	11	Per milliliter
1/l	13	Per liter
1/hl	14	Per hectoliter
1/MI	16	Per megaliter
1/ugal	20	Per gallon (US)
1/igal	21	Per gallon (Imperial)
1/bbl	22	Per barrel (petroleum, USA)
1/Mugal	27	Per megagallon (US)
1/bls	31	Barrels (beer, USA)
1/xx	238	Per user-defined volume flow unit
1/yy	239	Per user-defined mass flow unit

## Available process variables

The process variables available in the software are listed in the table.

Process variables can be assigned to the display (HMI), the current outputs (CO), the frequency outputs (DO [f]), and the pulse outputs (DO [pulse]).

The “Code / Code [hex] PROFIBUS DP” column indicates the value to which the corresponding parameter must be set, e.g. using the communications interface.

Process variable	Modbus address	Code	Code [hex] PROFIBUS DP	Description	HMI	CO	DO [f]	DO [pulse]
Mass Flow [unit]	Qm	247	1	0x00 Mass flow in the selected mass flow unit	X	—	—	X
Mass Flow [%]	Qm	267	2	0x01 Mass flow in percent	X	X	X	—
Volume Flow [unit]	Qv	253	3	0x02 Volume flow in the selected volume unit	X	—	—	X
Volume Flow [%]	Qv	273	4	0x03 Volume flow in percent	X	X	X	—
Temperature [unit]	Tm	251	5	0x04 Temperature in the selected volume unit	X	—	—	—
Temperature [%]	Tm	271	6	0x05 Temperature in percent	X	X	X	—
Density [unit]	p	249	7	0x06 Density in the selected density unit	X	—	—	—
Density [%]	p	269	8	0x07 Density in percent	X	X	X	—
Net Mass Flow[unit]*	nQm	973	9	0x08 Net mass flow in the selected volume unit	X	—	—	X
Net Mass Flow [%]*	nQm	977	10	0x09 Net mass flow in percent	X	X	X	—
Net Vol. Flow [unit]*	nQv	979	11	0x0A Net volume flow in the selected volume unit	X	—	—	X
Net Volume Flow [%]*	nQv	983	12	0x0B Net volume flow in percent	X	X	X	—
Vol.Flow@Tref [unit]*	Q@T	967	13	0x0C Volume flow at a reference temperature.	X	—	—	X
Vol.Flow@Tref [%]*	Q@T	971	14	0x0D	X	X	X	—
Density@Tref [unit]*	p@T	963	15	0x0E Density at a reference temperature.	X	—	—	—
Density @ Tref [%]*	p@T	965	16	0x0F	X	X	X	—
Concentr.unit [%]*	β u	987	17	0x10 Concentration in the selected unit in percent	X	X	X	—
Concentr.unit [unit]*	β u	985	18	0x11 Concentration in the selected unit	X	—	—	—
Concentr.% [%]*	β %	989	19	0x12 Concentration in the selected unit	X	X	X	—

\* Process variable is only available if the DensiMass function is activated.

X Parameter available

— Parameter not available

# ... 11 Operation

## ... Available process variables

Process variable	Modbus address	Code	Code [hex]	Description	HMI	CO	DO	DO
Totalizer Qm Fwd	$\Sigma m+$ 851 (double) 259 (float)	20	0x13	Mass flow counter reading in the forward flow direction	X	—	—	—
Totalizer Qm Rev	$\Sigma m-$ 855 (double) 261 (float)	21	0x14	Mass flow counter reading in the reverse flow direction	X	—	—	—
Totalizer Qm Diff	$\Sigma m$ 859 (double) 255 (float)	22	0x15	Mass flow counter reading for forward flow / reverse flow difference	X	—	—	—
Totalizer Qv Fwd	$\Sigma v+$ 863 (double) 263 (float)	23	0x16	Volume flow counter reading in forward flow direction	X	—	—	—
Totalizer Qv Rev	$\Sigma v-$ 867 (double) 265 (float)	24	0x17	Volume flow counter reading in reverse flow direction	X	—	—	—
Totalizer Qv Diff	$\Sigma v$ 871 (double) 257 (float)	25	0x18	Volume flow counter reading for forward flow / reverse flow difference	X	—	—	—
Total. Net Qm Fwd*	$\Sigma M+$ 887 (double) 995 (float)	26	0x19	Net mass flow counter reading in forward flow direction	X	—	—	—
Total. Net Qm Rev*	$\Sigma M-$ 891 (double) 997 (float)	27	0x1A	Net mass flow counter reading in reverse flow direction.	X	—	—	—
Total. Net Qm Diff*	$\Sigma M$ 895 (double) 975 (float)	28	0x1B	Net mass flow counter reading for forward flow / reverse flow difference.	X	—	—	—
Total. Net Qv Fwd*	$\Sigma V+$ 899 (double) 999 (float)	29	0x1C	Net volume flow counter reading in forward flow direction.	X	—	—	—
Total. Net Qv Rev*	$\Sigma V-$ 903 (double) 1001 (float)	30	0x1D	Net volume flow counter reading in reverse flow direction.	X	—	—	—
Total. Net Qv Diff*	$\Sigma V$ 907 (double) 981 (float)	31	0x1E	Net volume flow counter reading for forward flow / reverse flow difference.	X	—	—	—
Total.Qv@Tref Fwd*	$\Sigma T+$ 875 (double) 991 (float)	32	0x1F	Volume flow counter reading in forward flow direction at a reference temperature.	X	—	—	—
Total.Qv@Tref Rev*	$\Sigma T-$ 879 (double) 993 (float)	33	0x20	Volume flow counter reading in reverse flow direction at a reference temperature.	X	—	—	—
Total.Qv@Tref Diff*	$\Sigma T$ 883 (double) 969 (float)	34	0x21	Volume flow counter reading for forward flow / reverse flow difference at a reference temperature.	X	—	—	—
Totalizer Qm Sum	$\Sigma m+-S$ 911 (double) 441 (float)	41	0x28	Absolute value from mass flow counter reading in the forward flow and reverse flow direction. The counter cannot be stopped or reset.	X	—	—	—
Totalizer Qv Sum	$\Sigma v+-S$ 915 (double) 443 (float)	42	0x29	Absolute value from volume flow counter reading in the forward flow and reverse flow direction. The counter cannot be stopped or reset.	X	—	—	—
Total. Net Qm Sum	$\Sigma M+-S$ 919 (double) 445 (float)	43	0x2A	Absolute value from net mass flow counter reading in forward flow and reverse flow direction. The counter cannot be stopped or reset.	X	—	—	—

\* Process variable is only available if the DensiMass function is activated.

\*\* Process variable is only available if the FillMass function is activated.

X Parameter available

— Parameter not available

Process variable	Modbus address	Code	Code [hex]	Description	HMI	CO	DO	DO
			PROFIBUS DP					
Total. Net Qv Sum	923 (double) 447 (float)	44	0x2B	Absolute value from net volume flow counter reading in forward flow and reverse flow direction. The counter cannot be stopped or reset.	X	—	—	—
Total. Qv @ Tref Sum	927 (double) 449 (float)	45	0x2C	Absolute value from volume flow counter reading in forward flow and reverse flow direction at a reference temperature. The counter cannot be stopped or reset.	X	—	—	—
Current Batch Total.**	847 (double)	35	0x22	Current fill quantity.	X	—	—	—
Current Batch Counts**	465	36	0x23	Number of fill operations.	X	—	—	—
Tube Frequency	PF 275	37	0x24	Meter tube frequency in Hz.	X	—	—	—
Driver Output	DOC 291	38	0x25	Driver current in mA.	X	—	—	—
Sensor Signal A	SSA 283	39	0x26	Sensor amplitude of sensor A in mV	X	—	—	—
Sensor Signal B	SSB 285	40	0x27	Sensor amplitude of sensor B in mV	X	—	—	—
Specific Gravity	SG 431	46	0x2D	Specific weight for liquids.	X	—	—	—
°API Gravity	API 433	47	0x2E	Crude oil density in API degrees	X	—	—	—
Variable 1	Va1 619 (float)	48	—	External fieldbus variable 1	X	—	—	—
Variable 2	Va2 621 (float)	49	—	External fieldbus variable 2	X	—	—	—
Electr. (FEB) Temp	Ttx 281 (float)	50	—	Temperature of the frontend board.	X	—	—	—
Sensor Housing Temp	Tsx 3500 (float)	51	—	Temperature in the sensor housing.	X	—	—	—

\* Process variable is only available if the DensiMass function is activated.

\*\* Process variable is only available if the FillMass function is activated.

X Parameter available

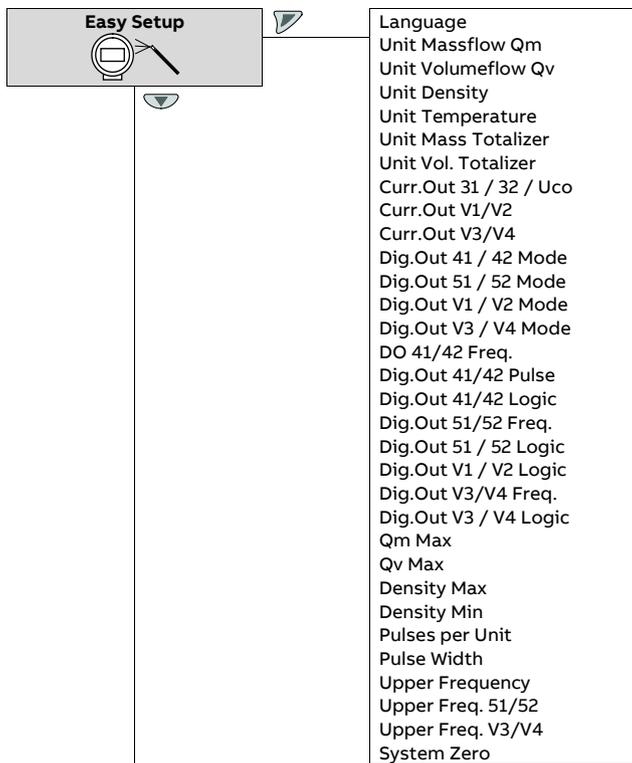
— Parameter not available

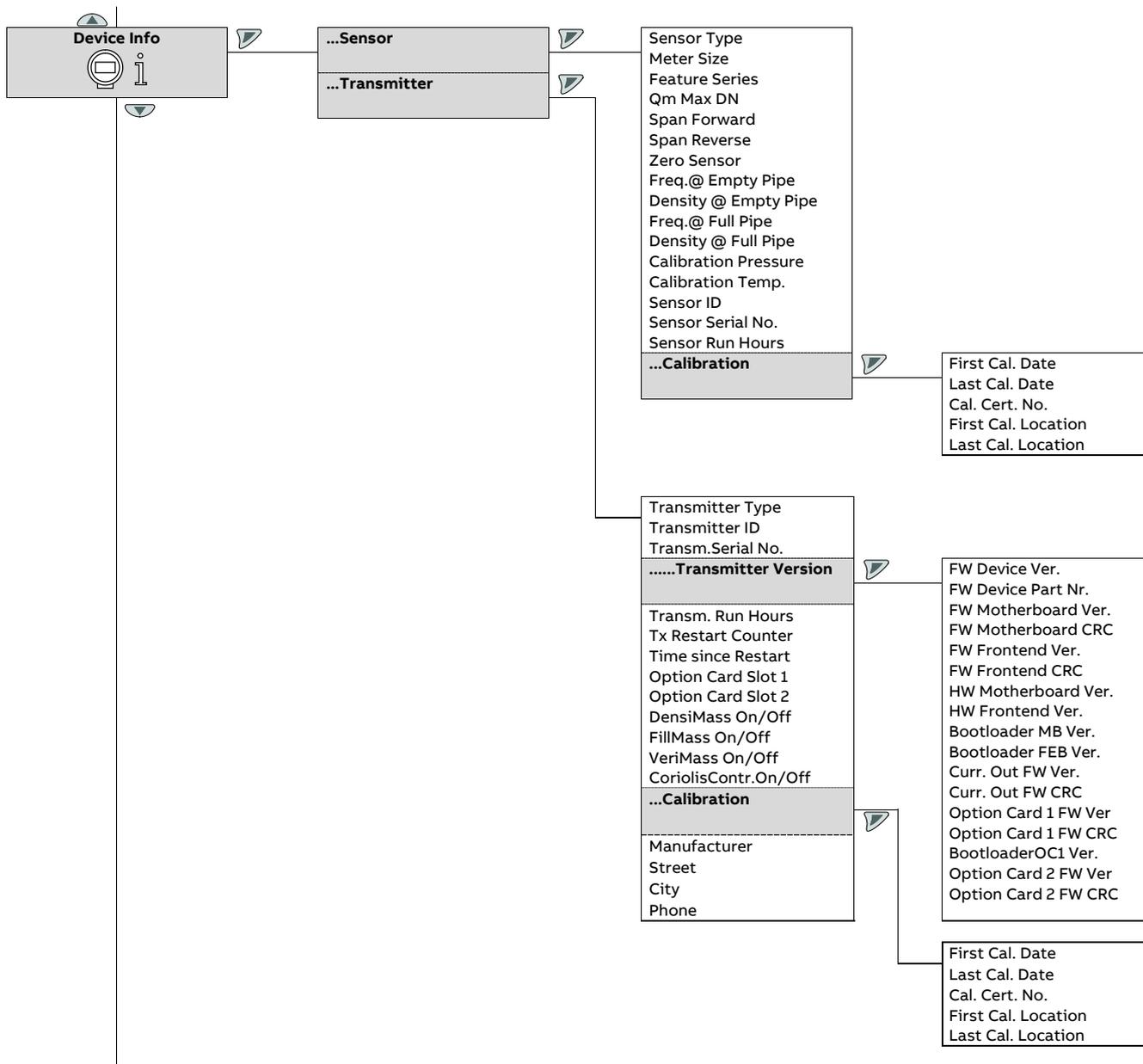
## ... 11 Operation

### Parameter overview

#### Note

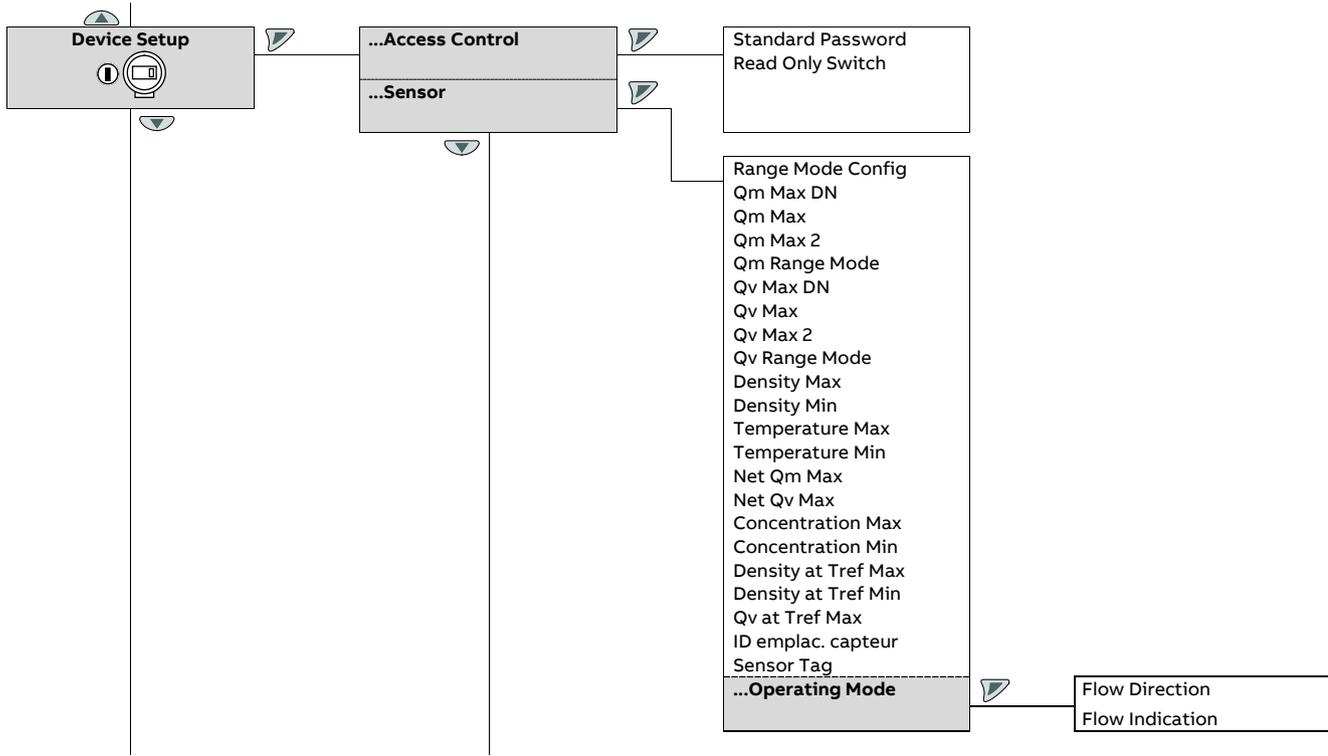
This overview of parameters shows all the menus and parameters available on the device. Depending on the version and configuration of the device, not all of the menus and parameters may be visible in it.

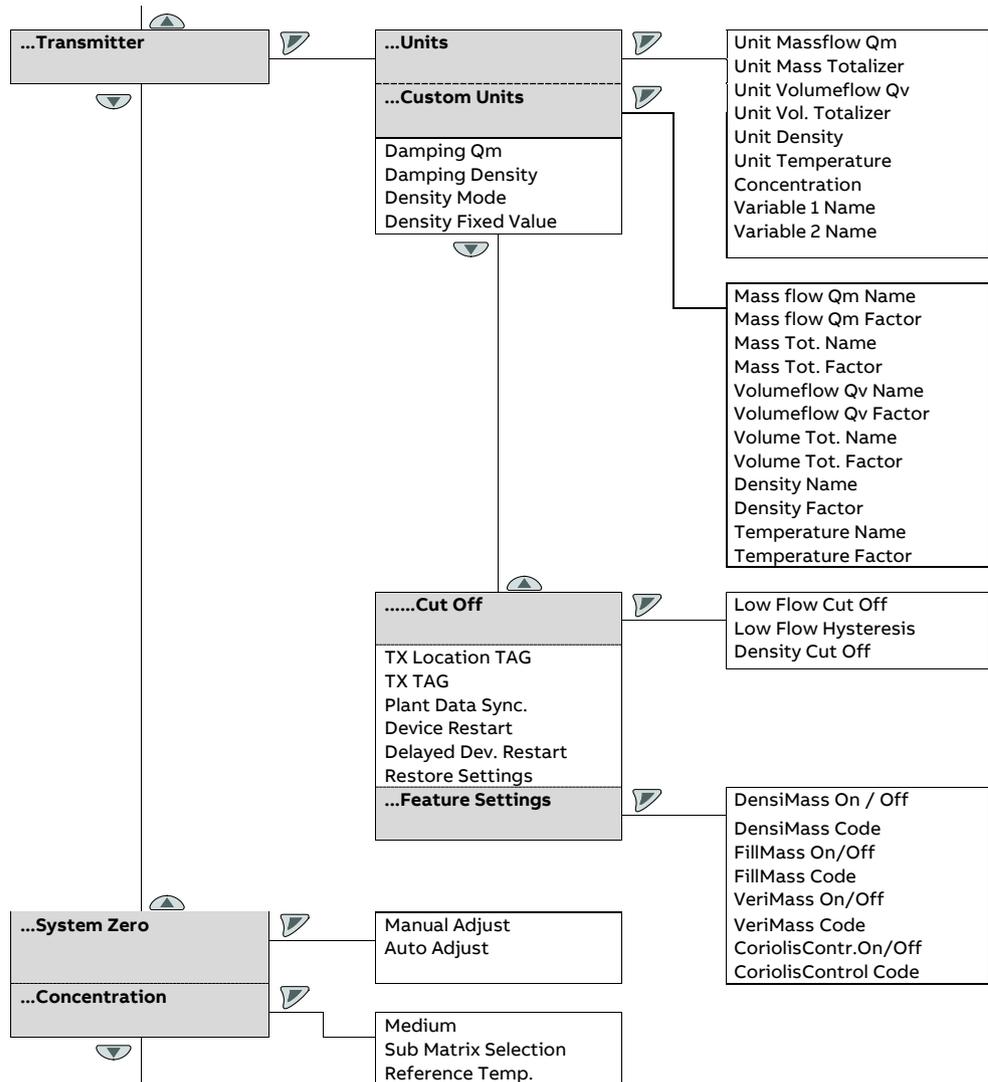




# ... 11 Operation

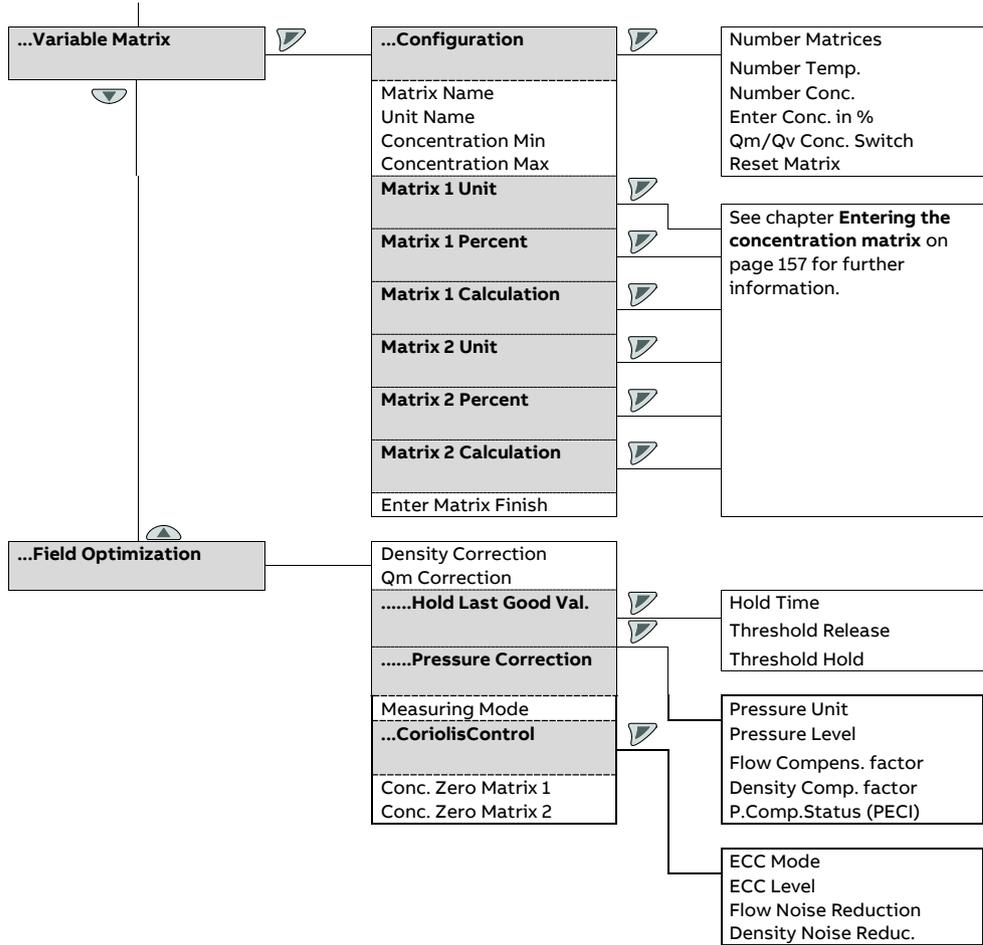
## ... Parameter overview

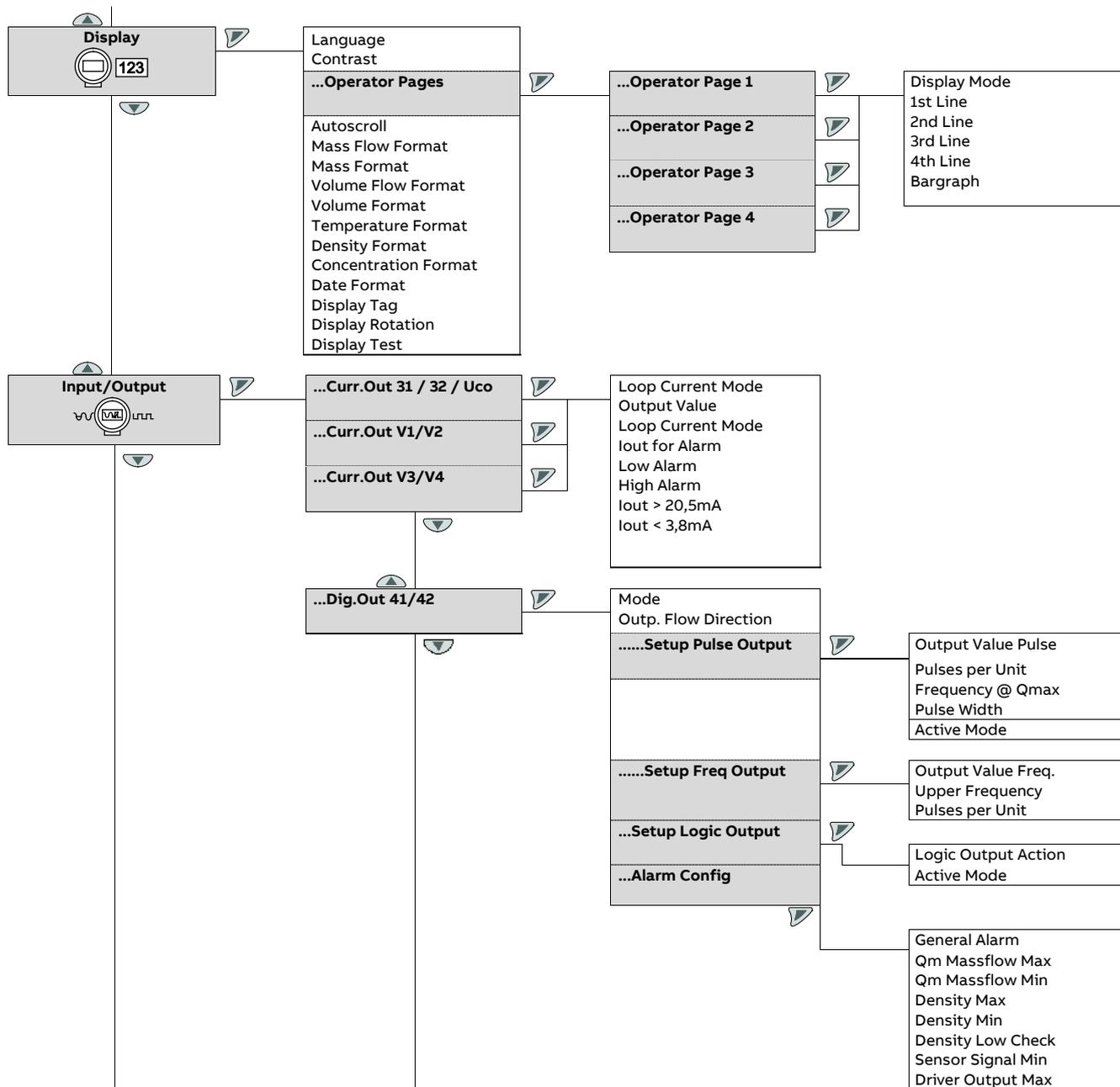




# ... 11 Operation

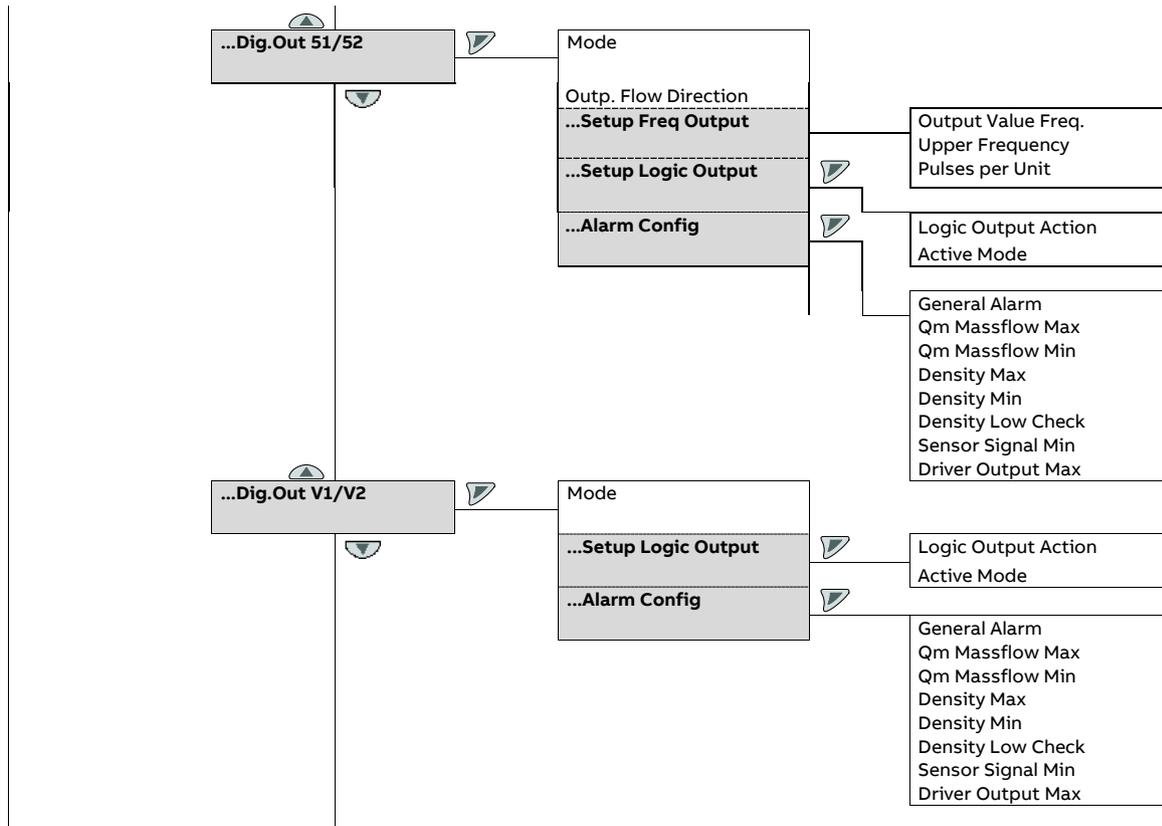
## ... Parameter overview

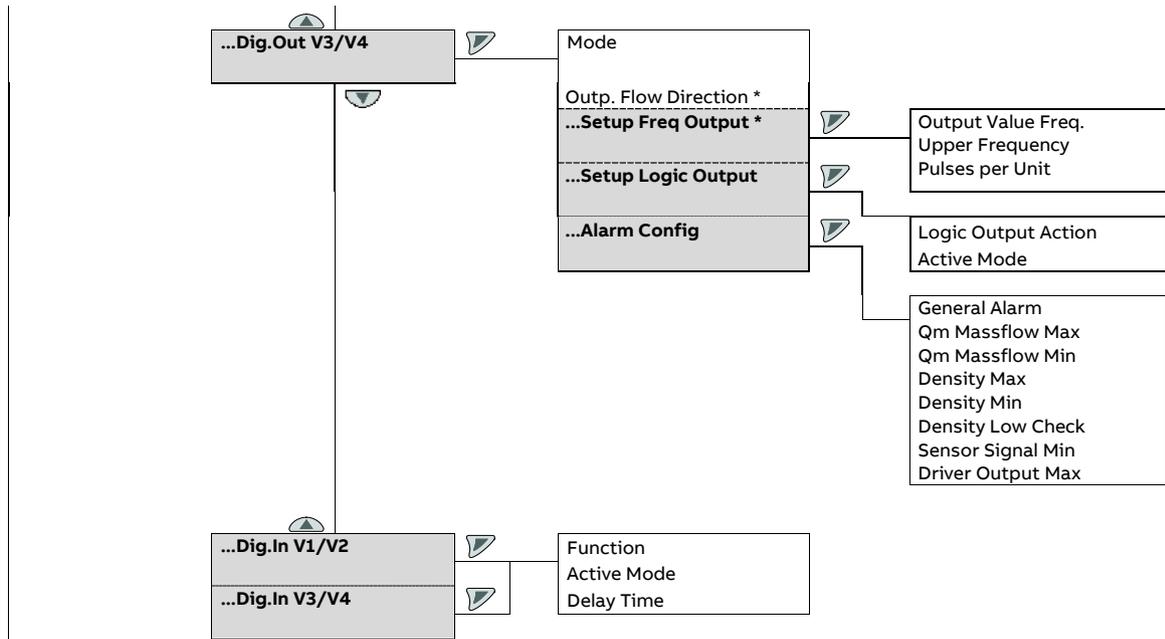




# ... 11 Operation

## ... Parameter overview

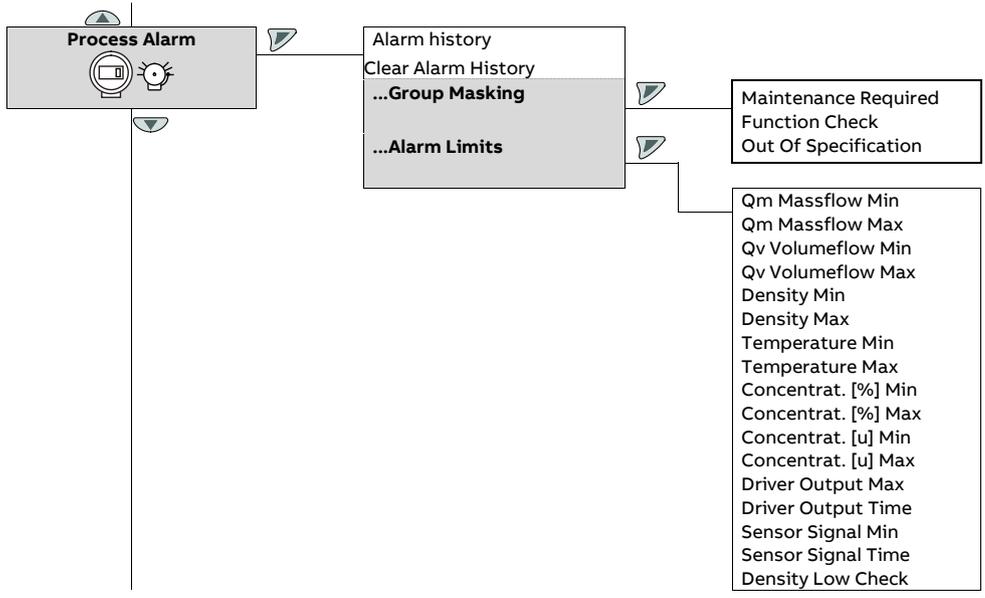


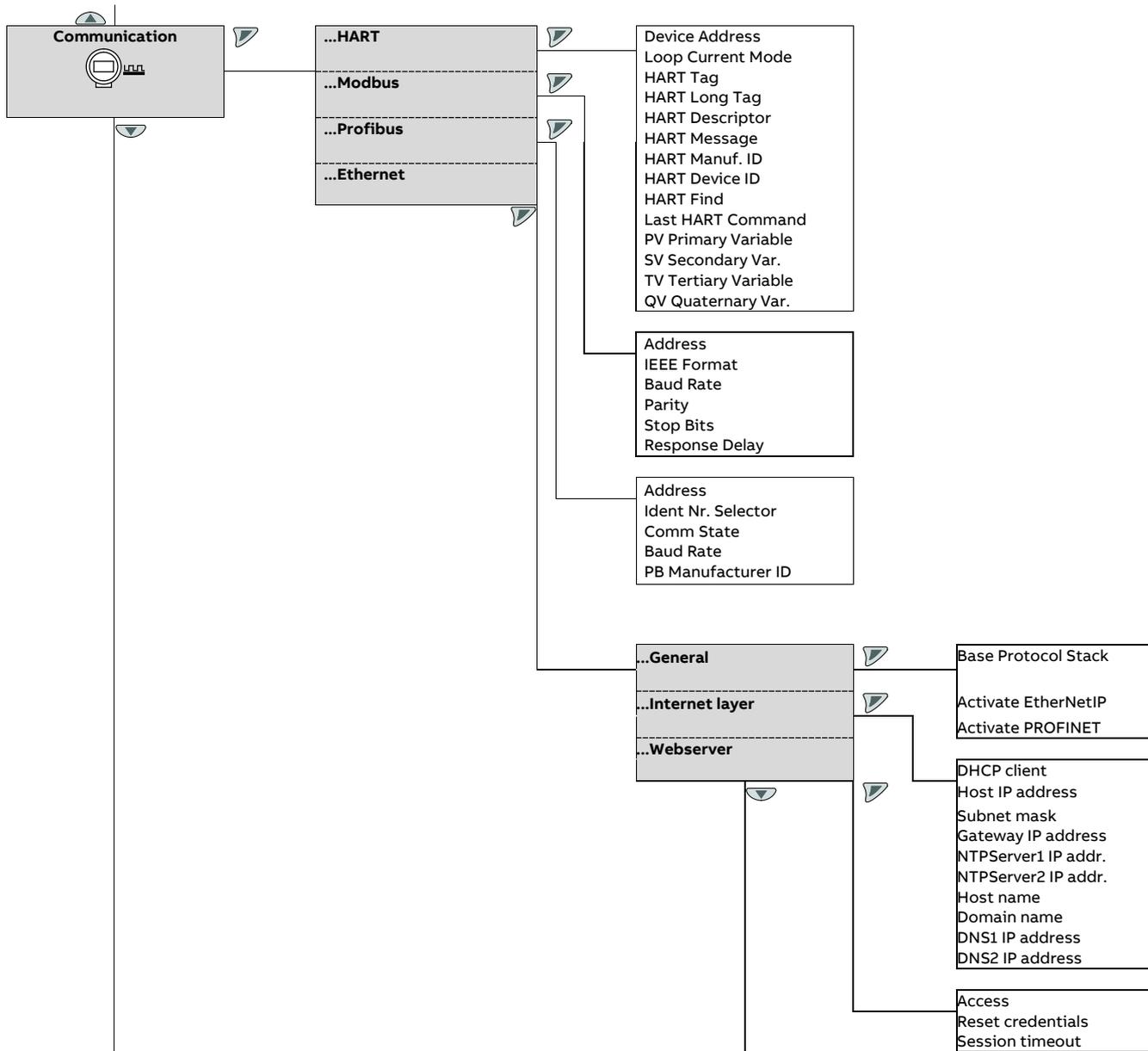


\* only with 'active digital output' plug-in card

# ... 11 Operation

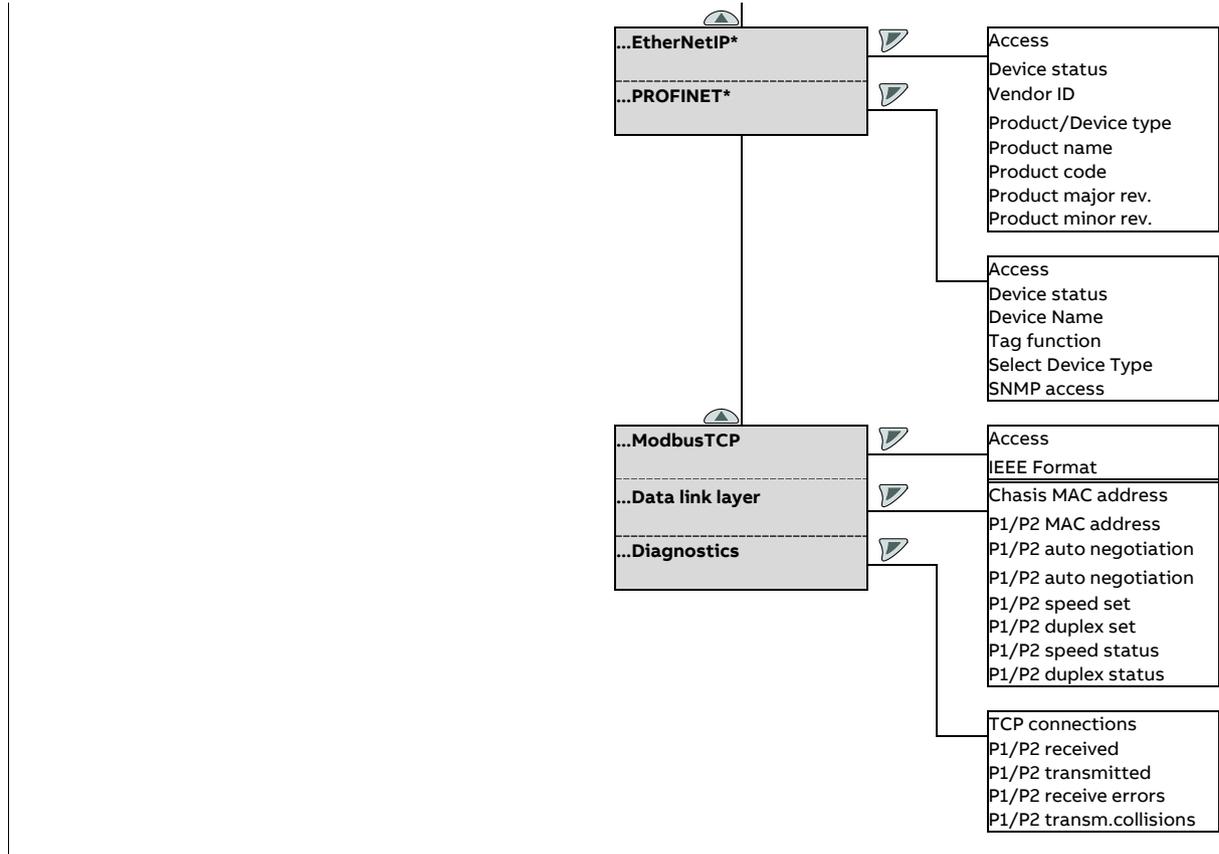
## ... Parameter overview



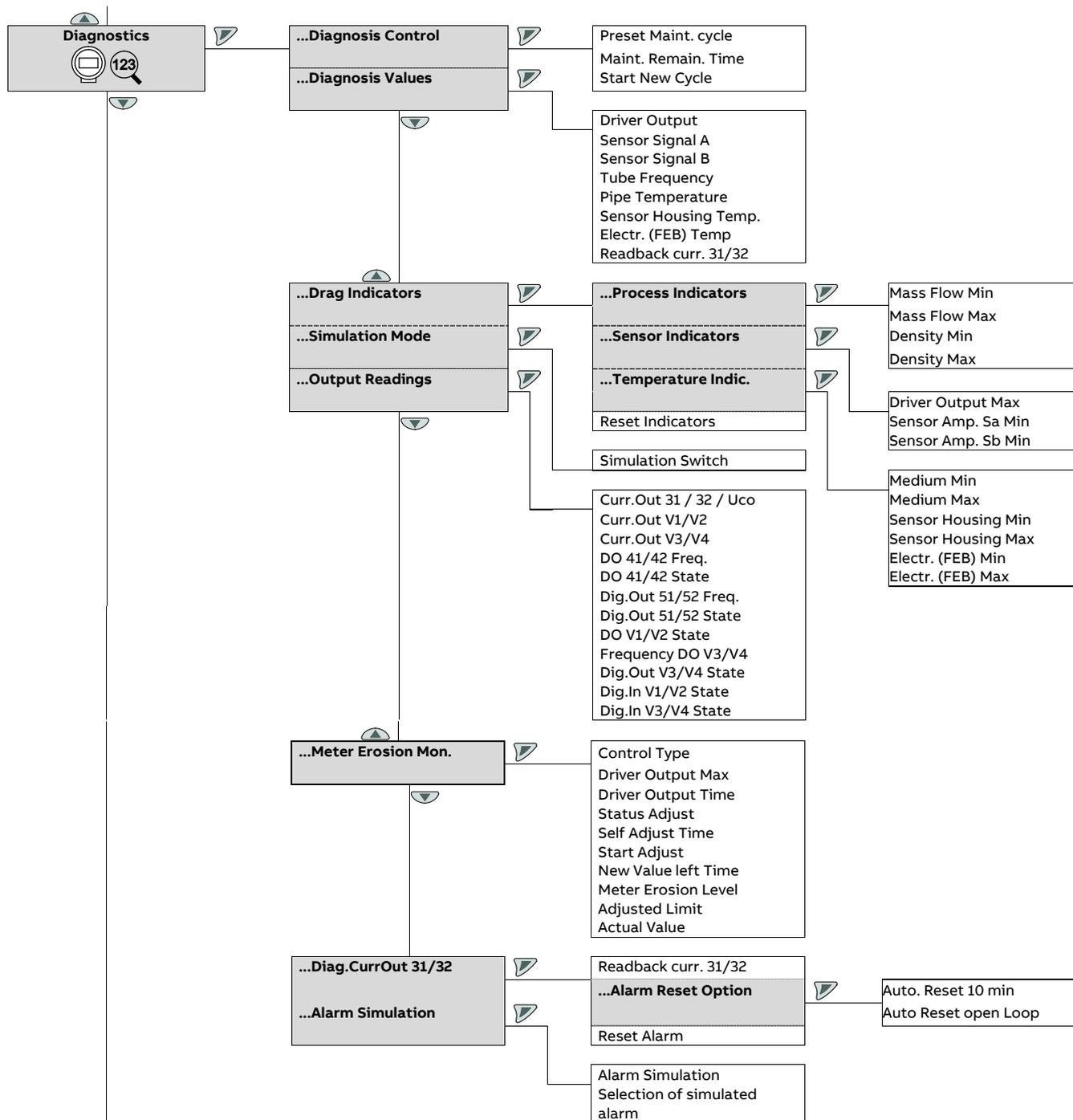


## ... 11 Operation

### ... Parameter overview

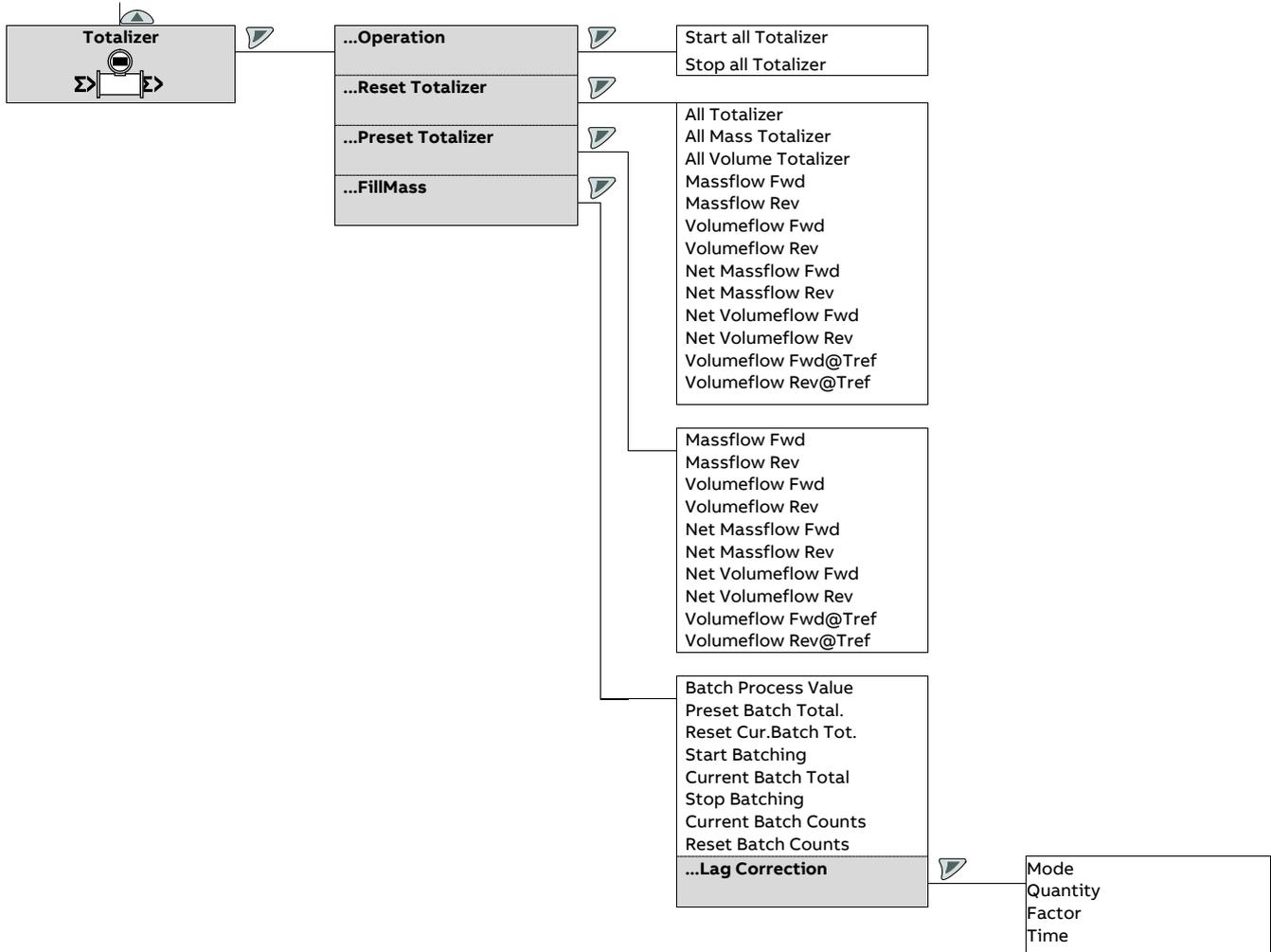


\* The EthernetIP and PROFINET® menu are visible only if the corresponding protocol stack has been selected.



# ... 11 Operation

## ... Parameter overview



## Parameter descriptions

### Menu: Easy Setup

Menu / parameter	Description
<b>Easy Setup</b>	
Language	Selection of menu language.
Unit Massflow Qm	Selection of the unit for mass flow rate (for example for the $Q_{m,Max}$ / $Q_{m,MaxDN}$ parameters and for the corresponding process value). See <b>Table 2: Units for the mass flow</b> on page 97.
Unit Volumeflow Qv	Selection of the unit for volume flow rate (for example for the $Q_{v,Max}$ / $Q_{v,MaxDN}$ parameters and for the corresponding process value). See <b>Table 1: Units for the volume flow</b> on page 97.
Unit Density	Selection of the unit for the density (e.g. for the associated parameters and the corresponding process values). See <b>Table 3: Density units</b> on page 97.
Unit Temperature	Selection of unit for temperature (e.g. for the associated parameters and the corresponding process values). See <b>Table 4: Temperature units</b> on page 97.
Unit Mass Totalizer	Selection of the unit for the mass counters and the pulse outputs. See <b>Table 6: Units for the mass totalizer</b> on page 98.
Unit Vol. Totalizer	Selection of the unit for the volume totalizers and the pulse outputs. See <b>Table 7: Units for the volume totalizer</b> on page 98.
Curr.Out 31 / 32 / Uco	Selection of the process value issued via the current output.
Curr.Out V1/V2	The current outputs V1 / V2 and V3 / V4 are only available if the corresponding plug-in cards are present!
Curr.Out V3/V4	See <b>Available process variables</b> on page 99.
Dig.Out 41 / 42 Mode	Selection of the operating mode for the digital output 41 / 42. <ul style="list-style-type: none"> <li>• Off: Digital output 41 / 42 deactivated.</li> <li>• Logic: Digital output 41 / 42 as a binary output (e.g. as an alarm output).</li> <li>• Pulse: Digital output 41 / 42 as a pulse output. In pulse mode, pulses per unit are output (e.g. 1 pulse per m<sup>3</sup>).</li> <li>• Frequency: Digital output 41 / 42 as a frequency output. In frequency mode, a frequency is issued that is proportional to the flow rate. The maximum frequency can be configured in accordance with the upper range value.</li> </ul>

## ... 11 Operation

### ... Parameter descriptions

Menu / parameter	Description
Dig.Out 51 / 52 Mode	<p>Selection of the operating mode for the digital output 51 / 52.</p> <ul style="list-style-type: none"> <li>• Off: Digital output deactivated.</li> <li>• Logic: Digital output functions as binary output (for function see parameter '...Setup Logic Output').</li> <li>• Frequency: Digital output 51 / 52 as a frequency output. In frequency mode, a frequency is issued that is proportional to the flow rate. The maximum frequency can be configured in accordance with the upper range value.</li> <li>• Follow DO 41/42: The digital output 51 / 52 follows the function of digital output 41 / 42. Depending on the setting of the parameter 'Input/Output / ...Dig.Out 41/42 / Outp. Flow Direction', digital output 51 / 52 is operated in pulse mode as follows: <ul style="list-style-type: none"> <li>– No pulses are issued if 'Forward &amp; Reverse' is selected. Only digital output 41 / 42 is active.</li> <li>– If 'Forward' is selected, pulses for forward flow are issued on digital output 41 / 42, while pulses for reverse flow are issued on digital output 51 / 52.</li> <li>– When "Reverse" is selected, pulses for reverse flow are output on digital output 41 / 42, while pulses for forward flow are output on digital output 51 / 52.</li> </ul> </li> <li>• 90° Shift: Output of the same pulses as for digital output 41 / 42, phase shifted by 90°. Only if digital output 41 / 42 has been configured as a pulse or frequency output.</li> <li>• 180° Shift: Output of the same pulses as for digital output 41 / 42, phase shifted by 180°. Only if digital output 41 / 42 has been configured as a pulse or frequency output.</li> <li>• Follow DO 41/42 (Frequency): The digital output 51 / 52 follows digital output 41 / 42. Digital output 51 / 52 then also works as a frequency output, the settings under "... / Dig.Out 41 / 42 / ...Setup Freq Output" are accepted. The output of the frequency at digital output 51 / 52 is dependent on the setting of the register "Outp. Flow Direction" for digital output 41 / 42: <ul style="list-style-type: none"> <li>– When "Forward" is selected, a frequency for forward flow is output at digital output 41 / 42 and a frequency for reverse flow is output at digital output 51 / 52</li> <li>– When "Reverse" is selected, a frequency for reverse flow is output at digital output 41 / 42 and a frequency for forward flow is output at digital output 51 / 52</li> </ul> </li> <li>• 180° Shift (Frequency): Output of the same frequency as for digital output 41 / 42, phase shifted by 180°</li> </ul> <p><b>Note</b></p> <p>If digital output 41 / 42 has been configured as pulse or frequency output, digital output 51 / 52 can be configured separately as binary or frequency output.</p> <p>However, digital output 51 / 52 cannot be configured as a second independent pulse output.</p>

Menu / parameter	Description
<b>Easy Setup</b>	
Dig.Out V1 / V2 Mode	<p>Selection of the operating mode for digital output V1 / V2.</p> <p>Digital output V1 / V2 is only available if the corresponding plug-in card is present!</p> <ul style="list-style-type: none"> <li>• Off: Digital output V1 / V2 deactivated.</li> <li>• Logic: Digital output V1 / V2 as a binary output (for example, as an alarm output).</li> </ul>
Dig.Out V3 / V4 Mode	<p>Selection of the operating mode for digital output V3 / V4.</p> <p>Digital output V3 / V4 is only available if the corresponding plug-in card is present!</p> <ul style="list-style-type: none"> <li>• Off: Digital output V3 / V4 deactivated.</li> <li>• Logic: Digital output V3 / V4 as a binary output (for example, as an alarm output).</li> </ul>
Dig.Out 51/52 Freq.	<p>The operating modes are available with an APO card only. When these operating modes are selected, DO51 / 52 is mirrored to V3 / V4.</p> <ul style="list-style-type: none"> <li>• Frequency: Digital output V3 / V4 as a frequency output. In frequency mode, a frequency is issued that is proportional to the flow rate. The maximum frequency can be configured in accordance with the upper range value.</li> <li>• Follow DO 41/42: Digital output V3 / V4 follows the function of digital output 41 / 42. Depending on the setting of the 'Input/Output / ...Dig.Out 41/42 / Outp. Flow Direction' parameter, digital output V3 / V4 is operated in pulse mode as follows: <ul style="list-style-type: none"> <li>– No pulses are issued if 'Forward &amp; Reverse' is selected. Only digital output 41 / 42 is active.</li> <li>– When 'Forward' is selected, pulses for forward flow are output on digital output 41 / 42, while pulses for reverse flow are output on digital output V3 / V4.</li> <li>– When 'Reverse' is selected, pulses for reverse flow are output on digital output 41 / 42, while pulses for forward flow are output on digital output V3 / V4.</li> </ul> </li> <li>• 90° Shift: Output of the same pulses as for digital output 41 / 42, phase shifted by 90°. Only if digital output 41 / 42 has been configured as a pulse or frequency output.</li> <li>• 180° Shift: Output of the same pulses as for digital output 41 / 42, phase shifted by 180°. Only if digital output 41 / 42 has been configured as a pulse or frequency output.</li> <li>• Follow DO 41/42 (Frequency): Digital output V3 / V4 follows digital output 41 / 42. Digital output V3 / V4 then also works as a frequency output, the settings under '... / Dig.Out 41 / 42 / ...Setup Freq Output' are accepted. The output of the frequency at digital output V3 / V4 is dependent on the setting of the register 'Outp. Flow Direction' for digital output 41 / 42: <ul style="list-style-type: none"> <li>– When 'Forward' is selected, a frequency for forward flow is output at digital output 41 / 42 and a frequency for reverse flow is output at digital output V3 / V4</li> <li>– When 'Reverse' is selected, a frequency for reverse flow is output at digital output 41 / 42 and a frequency for forward flow is output at digital output V3 / V4</li> </ul> </li> <li>• 180° Shift (Frequency): Output of the same frequency as for digital output 41 / 42, phase shifted by 180°</li> </ul> <p><b>Note</b></p> <p>Digital output V3 / V4 cannot be configured as an additional independent frequency output (operating mode 'Frequency (=51 / 52)'). Digital output V3 / V4 can be configured separately as a binary or frequency output. However, digital output V3 / V4 cannot be configured as a second independent pulse output.</p>

## ... 11 Operation

### ... Parameter descriptions

Menu / parameter	Description
DO 41/42 Freq.	Selection of process value issued via the frequency or pulse output.
Dig.Out 41/42 Pulse	Only if digital output 41 / 42 has been configured as a frequency or pulse output.
Dig.Out 51/52 Freq.	See <b>Available process variables</b> on page 99.
FrequencyV3 / V4	
Dig.Out 41 / 42 Logic	Selection of the output function for the relevant binary output.
Dig.Out 51 / 52 Logic	<ul style="list-style-type: none"> <li>• F / R Signal: The binary output signals the flow direction.</li> <li>• Dual Range: The binary output is activated when measuring range 2 (QmMax 2 / QvMax 2) is selected. This selection is only available if the parameter 'Range Mode Config' has been configured to Qm or Qv.</li> <li>• Batch End Contact: The binary output is activated when the set fill quantity is reached (only if the FillMass function is activated).</li> </ul>
Dig.Out V1 / V2 Logic	Only if the relevant digital output has been configured as a binary output.
Dig.Out V3 / V4 Logic	
Qm Max	Sets the upper range value for the mass flow for forward and reverse flow. The value is also used to calculate the corresponding percentage value.
Qv Max	Setting of the upper measuring range value 1 for the volume flow for feed flow and reverse flow. The value is also used to calculate the corresponding percentage value.
Density Max	Sets the maximum / minimum density to be measured. This value is used to calculate the percentage density value. These parameters are only available if the density output 'Density [unit]' was selected when configuring the power and digital outputs.
Density Min	
Pulses per Unit	Set pulses per volume or per mass flow unit, and the pulse width for the digital output operating mode 'Pulse'. Only available if a digital output has been configured as a pulse output, and the volume flow or mass flow has been selected as the process variable to be output.
Pulse Width	
Upper Frequency41 / 42	Sets the upper range value frequency for the digital output operating mode 'Frequency'. The entered value corresponds to 100 % flow.
Upper Frequency51 / 52	
Upper FrequencyV3 / V4	Only available if a digital output has been configured as a frequency output, and the volume flow or mass flow has been selected as the process variable to be output.
System Zero	Starts the automatic zero point balancing using  . Automatic zero point balancing takes approx. 60 seconds. <b>Note</b> Prior to starting the zero point adjustment, make sure that: <ul style="list-style-type: none"> <li>• There is no flow through the sensor (close all valves, shut-off devices etc.)</li> <li>• The sensor must be filled completely with measuring medium for measurement.</li> </ul>

**Menu: Device Info**

This menu is only used to display the device parameters. The parameters are displayed independently of the configured access level, but cannot be changed.

Menu / parameter	Description
<b>Device Info</b>	
...Sensor	Selection of submenu ' <b>...Sensor</b> ' using  .
...Transmitter	Selection of submenu ' <b>...Transmitter</b> ' using  .

**Device Info / ...Sensor**

Sensor Type	Sensor type.
Meter Size	Nominal diameter of sensor.
Feature Series	Sensor model. DensiMass and FillMass functions are only available in models FCB450 / FCH450.
Qm Max DN	The value specifies the maximum flow rate. The value is set automatically via the selected nominal diameter.
Span Forward	Calibration value (range) in the forward flow and return flow direction of the sensor.
Span Reverse	
Zero Sensor	Calibration value (zero point) of the sensor for the selected nominal diameter.
Freq.@ Empty Pipe	Meter tube frequency and density during calibration with an empty or full meter tube. Calibration with an empty meter tube is performed using air; calibration with a full meter tube is performed using water.
Density @ Empty Pipe	
Freq.@ Full Pipe	
Density @ Full Pipe	
Calibration Pressure	Measuring medium pressure in the selected pressure unit during calibration.
Calibration Temp.	Measuring medium temperature in °C during calibration.
Sensor ID	ID number of the sensor.
Sensor Serial No.	Serial number of the sensor.
Sensor Run Hours	Operating hours of the sensor.
...Calibration	Selection of submenu ' <b>...Calibration</b> ' using  .

**Device Info / ...Sensor / ...Calibration**

First Cal. Date	Date of first calibration of sensor (calibration of new device).
Last Cal. Date	Date of last calibration of sensor.
Cal. Cert. No.	Identification (number) of the relevant calibration certificate.
First Cal. Location	Place of first calibration of the sensor.
Last Cal. Location	Place of last calibration of sensor.

Menu / parameter	Description
<b>Device Info / ...Transmitter</b>	
Transmitter Type	Type of transmitter.
Transmitter ID	ID number of transmitter.
Transm.Serial No.	Serial number of transmitter.
...Transmitter Version	Selection of submenu ' <b>...Transmitter Version</b> ' using  .
Transm. Run Hours	Run hours of the transmitter.
Tx Restart Counter	Number of device restarts (switching the power supply off and on).
Time since Restart	Device operating hours since the last restart.
Option Card Slot 1	Type of plug-in card present in slot OC1 / OC2.
Option Card Slot 2	If the plug-in card is incorrectly detected or incompatible, a corresponding message will be issued.

## ... 11 Operation

### ... Parameter descriptions

Menu / parameter	Description
<b>Device Info / ...Transmitter</b>	
DensiMass On / Off	DensiMass function present? 0 - Off: No DensiMass function present. 1 - On: DensiMass function present.
Batchflow On / Off	FillMass function present? 0 - Off: No FillMass function present. 1 - On: FillMass function present.
VeriMass On/Off	VeriMass function present? 0 - Off: No VeriMass function present. 1 - On: VeriMass function present.
CoriolisContr.On/Off	CoriolisControl function present? 0 - Off: No CoriolisControl function present. 1 - On: CoriolisControl function present.
...Calibration	Selection of submenu ' <b>...Calibration</b> ' using  .
Manufacturer	Name of manufacturer.
Street	Manufacturer's address (street).
City	Manufacturer's address (city).
Phone	Manufacturer's address (phone number).

#### Device Info / ...Transmitter / ...Transmitter Version

FW Device Ver.	Version and item number of device software package.
FW Device Part Nr.	
FW Motherboard Ver.	Version and checksum (CRC) of motherboard (MB) software in transmitter.
FW Motherboard CRC	
FW Frontend Ver.	Version and checksum (CRC) of frontend board (FEB) software in sensor.
FW Frontend CRC	
HW Motherboard Ver.	Hardware version of motherboard (MB) in transmitter.
HW Frontend Ver.	Hardware version of frontend board (FEB) in sensor.
Bootloader MB Ver.	Version of motherboard (MB) bootloader in transmitter.
Bootloader FEB Ver.	Version of frontend board (FEB) bootloader in sensor.
Curr. Out FW Ver.	Current output module software version and checksum (CRC).
Curr. Out FW CRC	
Option Card 1 FW Ver	Version and test number (CRC) of the software of the optional plug-in cards.
Option Card 1 FW CRC	
BootloaderOC1 Ver.	
Option Card 2 FW Ver	
Option Card 2 FW CRC	

#### Device Info / ...Transmitter / ...Calibration

First Cal. Date	Date of first calibration of transmitter (calibration of new device).
Last Cal. Date	Date of last calibration of transmitter.
Cal. Cert. No.	Identification (number) of the relevant calibration certificate.
First Cal. Location	Place of first calibration of transmitter.
Last Cal. Location	Place of last calibration of transmitter.

**Menu: Device Setup**

Menu / parameter	Description
<b>Device Setup</b>	
...Access Control	Selection of submenu ' <b>...Access Control</b> ' using  .
...Sensor	Selection of submenu ' <b>...Sensor</b> ' using  .
...Transmitter	Selection of submenu ' <b>...Transmitter</b> ' using  .
...System Zero	Selection of submenu ' <b>...System Zero</b> ' using  .
...Concentration	Selection of submenu ' <b>...Concentration</b> ' using  The menu is only available if the DensiMass function is activated.
...Variable Matrix	Selection of submenu ' <b>...Variable Matrix</b> ' using  The menu is only available if the DensiMass function is activated.
...Field Optimization	Selection of submenu ' <b>...Field Optimization</b> ' using  .

**Device Setup / ...Access Control**

Standard Password	Entry / change of the password for the 'Standard' access level.
Read Only Switch	Indicator of the position of the write protection switch. For additional information, see <b>Hardware settings</b> on page 81.

**Device Setup / ...Sensor**

Range Mode Config	Activation of the second measuring range for the mass and volume flow. The setting can be performed separately for the mass flow rate (Qm) and volume flow (Qv). Thus you have the possibility to quickly switch between two measuring ranges (e.g. Qm Max and Qm Max2). Switching is performed via the parameters 'Qm Range Mode', 'Qv Range Mode' or via the correspondingly configured digital input. <ul style="list-style-type: none"> <li>• Disabled: Second measuring range for mass and volume flow rate deactivated.</li> <li>• Qm and Qv: Second measuring range for mass and volume flow rate activated.</li> <li>• Qm only: Second measuring range for mass flow activated.</li> <li>• Qv only: Second measuring range for volume flow rate activated.</li> </ul>
Qm Max DN	Maximum mass flow for the selected nominal diameter. The value is set automatically via the selected nominal diameter.
Qm Max	Setting of the upper measuring range value 1 for the mass flow for forward flow and reverse flow. The value is also used to calculate the corresponding percentage value. This parameter is only available if the mass flow output 'Mass Flow [unit]' was selected when configuring the power and digital outputs.
Qm Max 2	Setting of the upper measuring range value 2 for the mass flow for forward flow and reverse flow. The value is also used to calculate the corresponding percentage value. This parameter is only available if for the parameter 'Qm Range Mode' the value 'Qm Max 2' has been selected.
Qm Range Mode	Manual switchover between the measuring ranges (Qm Max / Qm Max 2) for the mass flow measurement. This parameter is only available if the value Qm and Qv or Qm only has been selected for the parameter 'Range Mode Config'.
Qv Max DN	Maximum volume flow for the selected nominal diameter. The value is set automatically via the selected nominal diameter.
Qv Max	Setting of the upper measuring range value 1 for the volume flow for feed flow and reverse flow. The value is also used to calculate the corresponding percentage value. This parameter is only available if the volume flow output 'Volume Flow [unit]' was selected when configuring the power and digital outputs.
Qv Max 2	Setting of the upper measuring range value 2 for the volume flow for feed flow and reverse flow. The value is also used to calculate the corresponding percentage value. This parameter is only available if for the parameter 'Qv Range Mode' the value 'Qv Max 2' has been selected.

## ... 11 Operation

### ... Parameter descriptions

Menu / parameter	Description
<b>Device Setup / ...Sensor</b>	
Qv Range Mode	Manual switchover between the measuring ranges (Qv Max / Qv Max 2) for the volume flow measurement. This parameter is only available if the value Qm and Qv or Qv only has been selected for the parameter 'Range Mode Config'.
Density Max	Sets the maximum / minimum density to be measured. This value is used to calculate the percentage density value. These parameters are only available if the density output 'Density [unit]' was selected when configuring the power and digital outputs.
Density Min	
Temperature Max	Sets the maximum / minimum temperature to be measured. This value is used to calculate the percentage temperature value. These parameters are only available if the temperature output 'Temperature [unit]' was selected when configuring the power and digital outputs.
Temperature Min	
Net Qm Max	Sets the maximum net mass flow and net volume flow. The values are also used to calculate the corresponding percentage value.
Net Qv Max	The parameters are only available when the DensiMass function is activated.
Concentration Max	Sets the minimum and maximum concentration of the measuring medium. The values are also used to calculate the corresponding percentage value. The value depends on the selected matrix.
Concentration Min	The parameters are only available when the DensiMass function is activated.
Density Max at Tref	Sets the minimum and maximum density of the measuring medium at the reference temperature $T_{ref}$ .
Density Min at Tref	The values are also used to calculate the corresponding percentage value. The parameters are only available when the DensiMass function is activated.
Qv Max at Tref	Sets the maximum volume flow of the measuring medium at the reference temperature Tref. The value is also used to calculate the corresponding percentage value. The parameter is only available when the DensiMass function is activated.
ID emplac. capteur	Entry of the measuring point tag for the sensor. Alphanumeric, max. 20 characters
Sensor Tag	Enter the TAG number for the measuring sensor. Alphanumeric, max. 20 characters.
<b>...Operating Mode</b>	Selection of submenu ' <b>...Operating Mode</b> ' using  .
<b>Device Setup / ...Sensor / ...Operating Mode</b>	
Flow Direction	Set the measuring direction for the sensor. As delivered, the device measures and counts in both flow directions. It is important to note that the accuracy also depends on whether the device has been calibrated in the forward flow direction only or in the forward flow and reverse flow directions. <ul style="list-style-type: none"> <li>• Forward &amp; Reverse: The device measures in both flow directions.</li> <li>• Forward only: The device measures only in the forward flow direction (the direction of flow corresponds to the arrow on the sensor).</li> <li>• Reverse only: The device measures only in the reverse flow direction (the direction of flow is opposite to the arrow on the sensor).</li> </ul>
Flow Indication	Inverts the flow direction displayed. It is important to note that the accuracy also depends on whether the device has been calibrated in the forward flow direction only or in the forward flow and reverse flow directions.

Menu / parameter	Description
<b>Device Setup / ...Transmitter</b>	
<b>...Units</b>	Selection of submenu ' <b>...Units</b> ' using  .
<b>...Custom Units</b>	Selection of submenu ' <b>...Custom Units</b> ' using  .
Damping Qm	Sets the damping for measuring mass flow. The value set here relates to 1 $\tau$ (Tau). The value refers to the response time for a stepwise mass flow change.
Damping Density	Sets the damping for measuring density. The value set here relates to 1 $\tau$ (Tau). The value refers to the response time for a stepwise density change.
Density Mode	Selection of operating mode for density measurement. <ul style="list-style-type: none"> <li>• Density Measured: The density of the measuring medium is calculated by the transmitter.</li> <li>• Density Fixed Value: The density of the measuring medium is specified as a constant in parameter 'Density Fixed Value'. The 'Density Fixed Value' operating mode can be used to enable standard volumes to be calculated. Refer to <b>Measurement of standard volumes</b> on page 152.</li> </ul>
Density Fixed Value	Sets the density of the measuring medium, for example, when measuring the standard volume of gases.
<b>.....Cut Off</b>	Selection of submenu ' <b>.....Cut Off</b> ' using  .
TX Location TAG	Entry of the measuring point tag for the transmitter. Alphanumeric, max. 20 characters
TX TAG	Entry of the TAG number for the transmitter. Alphanumeric, max. 20 characters
Plant Data Sync.	The transmitter saves its configuration in the 'SensorMemory'. The data is stored redundantly on the motherboard (MB) of the transmitter and on the frontend board (FEB) of the sensor. This means the configuration can be restored quickly if any components are replaced. <ul style="list-style-type: none"> <li>• FEB &gt; MB: Loading the configuration from the frontend board (FEB) of the sensor.</li> <li>• MB &gt; FEB: Loads the configuration from the motherboard (MB) of the transmitter.</li> </ul> Refer to <b>Replacing the frontend board</b> on page 172.
Device Restart	Restarts the device. Compensates for a short interruption of the power supply.
Delayed Dev. Restart	Restart of the device after the end of the set time.
Restore Settings	All user-accessible parameters will be reset to the factory default settings.
<b>...Feature Settings</b>	Selection of submenu ' <b>...Feature Settings</b> ' using  .

## ... 11 Operation

### ... Parameter descriptions

Menu / parameter	Description
<b>Device Setup / ...Transmitter / ...Units</b>	
Unit Massflow Qm	Selection of unit for mass flow. Refer to <b>Table 2: Units for the mass flow</b> on page 97. The selection applies to the display of the current mass flow, and for the parameters related to mass flow such as QmMax and QmMaxDN.
Unit Mass Totalizer	Selection of unit for the mass counters. Refer to <b>Table 6: Units for the mass totalizer</b> on page 98.
Unit Volumeflow Qv	Selection of unit for volume flow. Refer to <b>Table 1: Units for the volume flow</b> on page 97. The selection applies to the display of the current volume flow and for the parameters related to volume flow such as QvMax and QvMaxDN.
Unit Vol. Totalizer	Selection of unit for the volume totalizers. Refer to <b>Table 7: Units for the volume totalizer</b> on page 98.
Unit Density	Selection of unit for the density. Refer to <b>Table 3: Density units</b> on page 97.
Unit Temperature	Selection of unit for temperature. Refer to <b>Table 4: Temperature units</b> on page 97.
Concentration	Selection of unit for concentration measurement. Refer to <b>Table 5: Concentration units</b> on page 98.
Variable 1 Name	Selection of the unit for external process variables.
Variable 2 Name	The transmitter can show two external process variables in the display. The process variables can be transferred from the fieldbus master to the transmitter via the HART, Modbus or PROFIBUS DP protocol. You can configure the indicator through the 'Display' menu.
<b>Device Setup / ...Transmitter / ...Custom Units</b>	
Mass flow Qm Name	Sets the name or abbreviation of the user-defined unit for mass flow.
Mass flow Qm Factor	Sets the factor of the user-defined unit for mass flow in kg / seconds.
Mass Tot. Name	Sets the name or abbreviation of the user-defined unit for the mass counter.
Mass Tot. Factor	Sets the factor of the user-defined unit for the mass counter in kg.
Volumeflow Qv Name	Sets the name or abbreviation of the user-defined unit for volume flow.
Volumeflow Qv Factor	Sets the factor of the user-defined unit for volume flow in liters/seconds.
Volume Tot. Name	Sets the name or abbreviation of the user-defined unit for the volume totalizer.
Volume Tot. Factor	Sets the factor of the user-defined unit for the volume totalizer in liters.
Density Name	Sets the name or abbreviation for the user-defined density unit.
Density Factor	Sets the factor for the user-defined density unit in liters/seconds.
Temperature Name	Sets the name or abbreviation for the user-defined temperature unit.
Temperature Factor	Sets the factor for the user-defined temperature unit in °C.

Menu / parameter	Description
<b>Device Setup / ...Transmitter / .....Cut Off</b>	
Low Flow Cut Off	Sets the switching threshold for the low flow cut-off. It is specified in a percentage of the configurable $Q_m$ Max or $Q_m$ Max 2. If the flow rate is below the switching threshold, there is no flow measurement. The setting of 0 % deactivates the low flow cut-off. Factory setting: 0.5%
Low Flow Hysteresis	Sets the hysteresis for the low flow cut-off as it is defined in the parameter 'Low Flow Cut Off'. Factory setting: 20%
Density Cut Off	Sets the low flow for density. Factory setting: 0.2 g/cm <sup>3</sup>

**Example:**

With a set low flow of 0.5 %, the output is set to 0 as soon as the mass flow down-scales 0.5 % of  $Q_m$ Max.

With a low flow hysteresis of 20 %, the actual value is issued again as soon as the mass flow up-scales 0.6 % of  $Q_m$ Max.

**Device Setup / ...Transmitter / ...Feature Settings**

DensiMass On / Off*	Indicates whether the DensiMass function is active.
DensiMass Code	Enter the device-specific code for activating the DensiMass function. After entering the code, restart the device (e.g. using the 'Device Restart' parameter or by briefly switching off the power supply).
Batchflow On / Off*	Indicates whether the FillMass function is active.
Batchflow Code	Enter the device-specific code for activating the FillMass function. After entering the code, restart the device (e.g. using the 'Device Restart' parameter or by briefly switching off the power supply).
VeriMass On/Off*	Indicates whether the VeriMass function is active.
VeriMass Code	Enter the device-specific code for activating the VeriMass function. After entering the code, restart the device (e.g. using the 'Device Restart' parameter or by briefly switching off the power supply).
CoriolisContr.On/Off*	Indicates whether the CoriolisControl function is active.
CoriolisControl Code	Enter the device-specific code for activating the CoriolisControl function. After entering the code, restart the device (e.g. by setting the 'Device Restart' parameter or by briefly switching off the power supply).

\* To use this function subsequently, contact the ABB service team or sales organization.

Menu / parameter	Description
<b>Device Setup / ...System Zero</b>	
Manual Adjust	Sets the value for zero point adjustment in % of $Q_{max}$ DN
Auto Adjust	Starts the automatic zero point balancing using  . Automatic zero point balancing takes approx. 60 seconds. <b>Note</b> Prior to starting the zero point adjustment, make sure that: <ul style="list-style-type: none"> <li>• There is no flow through the sensor (close all valves, shut-off devices etc.)</li> <li>• The sensor must be filled completely with measuring medium for measurement.</li> </ul>

## ... 11 Operation

### ... Parameter descriptions

Menu / parameter	Description
<b>Device Setup / ...Concentration</b>	
The menu is only available if the DensiMass function is activated	
Medium	Selection of measuring medium for concentration measurement using the DensiMass function. <ul style="list-style-type: none"> <li>• Variable Matrix</li> <li>• Sodium Hydroxide</li> <li>• Alcohol Water</li> <li>• Wheat Starch</li> <li>• Corn Starch</li> <li>• Sugar in H<sub>2</sub>O</li> <li>• °API Gravity</li> </ul>
Sub Matrix Selection	Selection of sub-matrix for concentration measurement. Only available if the matrix selected from Medium has two sub-matrices.
Reference Temp.	Sets the reference temperature for calculating process variables Vol.Flow@Tref and Density@Tref [unit].
<b>Device Setup / Variable Matrix</b>	
<b>...Configuration</b>	Selection of submenu ' <b>...Configuration</b> ' using  .
Matrix Name	Entry of a name for the variable matrix.
Unit Name	Entry of a unit name for the variable matrix.
Concentration Min	Entry of the maximum permissible concentration.
Concentration Max	Entry of the minimum permissible concentration.
<b>...Matrix 1 Unit</b>	Selection of submenu ' <b>...Matrix 1 Unit</b> ' to enter Matrix 1 using  .
<b>...Matrix 1 Percent</b>	See chapter <b>Concentration measurement DensiMass</b> on page 156 for further information.
<b>...Matrix 1 Calculation</b>	
<b>...Matrix 2 Unit</b>	Selection of submenu ' <b>...Matrix 2 Unit</b> ' to enter Matrix 2 using  .
<b>...Matrix 2 Percent</b>	See chapter <b>Concentration measurement DensiMass</b> on page 156 for further information.
<b>...Matrix 2 Calculation</b>	
Enter Matrix Finish	
<b>Device Setup / Variable Matrix / ...Configuration</b>	
Number Matrices	Selection of number (1/2) of the matrices.
Number Temp.	Entry of the number of temperature values.
Number Conc.	Entry of the number of concentration values.
Enter Conc. in %	Selection of whether the concentration value must be entered in %. <ul style="list-style-type: none"> <li>• Yes: Entry of the concentration values in %</li> <li>• No: Entry of the concentration values in a selected unit.</li> </ul> <p><b>Note</b></p> <p>A net flow cannot be calculated if the concentration has only been entered in a unit. To enable the net flow to be calculated, the concentration must also be entered in %.</p>
Qm/Qv Conc. Switch	Selection of whether the entered concentration values are volume or mass concentration values. The values are used to calculate the mass flow or volume flow rate. <ul style="list-style-type: none"> <li>• Mass Concentration</li> <li>• Volume Concentration</li> </ul>
Reset Matrix	All entered matrix values are reset to '0'.

Menu / parameter	Description
<b>Device Setup / ...Field Optimization</b>	
Density Correction	<p>Sets the correction factor for field optimization of the density measurement.</p> <p>This factor can be used to perform optimization in the field in order to achieve a degree of accuracy in the density measurement that closely approximates a repeatability of 0.0001 g/ml.</p>
Qm Correction	<p>Sets the correction factor for field optimization of the mass flow measurement. The value is entered as a percentage of the current measured value.</p> <p>This factor can be used to perform optimization in the field in order to achieve a degree of accuracy in the flow measurement that closely approximates or even exceeds a repeatability of at least 0.1 % of the measured value.</p>
..... <b>Hold Last Good Val.</b>	Selection of submenu '..... <b>Hold Last Good Val.</b> ' using  .
..... <b>Pressure Correction</b>	Selection of submenu '..... <b>Pressure Correction</b> ' using  .
Measuring Mode	<p>Selection of the measurement mode (liquid / gas). The measurement method for liquids and gases can be optimized by selecting the measurement mode.</p> <ul style="list-style-type: none"> <li>• Automatic: Automatic detection of the measurement mode. Selection with changing measuring media.</li> <li>• Gas: Selection with pure gas measurement.</li> <li>• Liquids: Selection with pure liquid measurement.</li> </ul> <p>Optimization is necessary in the following cases only:</p> <ul style="list-style-type: none"> <li>• When filling liquids in which considerable gas content can appear at the beginning or end of the filling process (surge). In such cases, the dynamics are considerably increased if the measurement mode is set to 'Liquids'.</li> <li>• When measuring gases in which considerable liquid inclusions or liquid phases can appear at specific times. In such cases, the dynamics are considerably increased if the measurement mode is set to 'Gas'.</li> </ul> <p>In all other cases, the measurement mode can remain in the default setting of 'Automatic'.</p>
... <b>CoriolisControl</b>	Selection of submenu '... <b>CoriolisControl</b> ' using  .
Conc. Zero Matrix 1	Setting indicating the correction factor for concentration measurement.
Conc. Zero Matrix 2	<p>This factor can be used to perform optimization in the field in order to achieve a degree of accuracy in the concentration measurement that closely approximates or even exceeds the repeatability.</p> <p>This value acts as a correction value for the current concentration measured value. The correction factor is entered in the unit that is currently set for concentration. The correction value is based on the concentration matrix currently selected.</p> <p>In the case of one fixed matrix, only one correction value is available.</p> <p>In case of variable matrices, both correction values are available.</p> <p>The parameter is only available when the DensiMass function is activated.</p>

## ... 11 Operation

### ... Parameter descriptions

Menu / parameter	Description
<b>Device Setup / ...Field Optimization / .....Hold Last Good Val.</b>	
Hold Time	Entry of the time for the function 'Hold Last Value'. The function is deactivated by the setting of '0'.
Threshold Hold	Sets the switching threshold for the function 'Hold Last Value'. The current measured value is displayed if the sensor voltage is above the set value.
Threshold Release	Sets the switching threshold for the function 'Hold Last Value'. The last valid measured value for the duration of the set hold time is displayed if the sensor voltage is below the set value.
<b>Device Setup / ...Field Optimization / .....Pressure Correction</b>	
Pressure Unit	Selection of unit for pressure (e.g. for the associated parameters and the corresponding process values). Factory setting: bar
Pressure Level	Input of the process pressure of the medium in the meter tube. The value is used to compensate for the influence of pressure on the measurement of the mass flow and the density. ABB uses a special compensation algorithm that takes various influencing effects into account. This allows the pressure influence on the vibrations of the meter tube to be compensated. The compensation factors for mass and density measurement are continuously recalculated and updated.
Flow Compens. factor	Output of the current flow compensation factor used in the device to calculate the mass flow. Unit in % per selected pressure unit.
Density Comp. factor	Output of the current density compensation factor that will be used in the device to calculate mass flow. Unit in % per selected pressure unit.
P.Comp.Status (PECI)	Selection of the pressure compensation mode. According to the API, the following states can be set. <ul style="list-style-type: none"> <li>• 1: CT - compensation in the Coriolis flowmeter based on the actual pressure entered in the parameter 'Pressure Level'</li> <li>• 2: TD – compensation in the Coriolis flowmeter switched off – compensation is performed externally (tertiary device)</li> <li>• 3: OS - Compensation in the Coriolis flowmeter switched off – compensation is not performed on site (off site)</li> <li>• 4: NA – Compensation in the Coriolis flowmeter switched off – compensation is not considered necessary as the device operates at the pressure at which it was tested (proved).</li> </ul>
<b>Device Setup / ...Field Optimization / ...CoriolisControl</b>	
ECC Mode	Activate the “Extended Coriolis Control Mode” for applications with fast density changes, e.g. for gas bubbles in the measuring medium and filling applications
ECC Level	Selecting the interval for frequency estimation.
Flow Noise Reduction	Selecting the dead time for noise filters for mass measurement.
Density Noise Reduc.	Selecting the dead time for noise filters for density measurement.

**Menu: Display**

Menu / parameter	Description
<b>Display</b>	
Language	Selection of menu language. Available languages: English, Deutsch, Français, Español, Português, Italiano, Chinese
Contrast	Contrast setting for the LCD display.
<b>...Operator Pages</b>	Selection of submenu ' <b>...Operator Pages</b> ' using  . Up to four user-specific operator pages (layouts) can be configured for the process display. If multiple operator pages have been configured, these can be scrolled through manually on the information level. In the factory setting only Operator Page 1 is enabled.
Autoscroll	If Autoscroll is enabled, the 'Autoscroll' function can also be activated on the information level of the operator menu. In this function, operator pages are automatically displayed in succession on the process screen, changing every 10 seconds. Manual scrolling through pre-configured operator pages as described above is no longer necessary. When Auto scroll mode is enabled, the icon  is displayed in the lower left corner of the screen. Default setting: Disabled.
Mass Flow Format	Selection of number of decimal places (maximum 12) used to display the corresponding process variables.
Mass Format	
Volume Flow Format	
Volume Format	
Temperature Format	
Density Format	
Concentration Format	
Date / Time Format	Set the display format for the date and time.
Display Tag	Configuration of the top line in the display. Off, ID emplac. capteur, Bus Address, HART Address, Ethernet Status
Display Rotation	The display on the display can be rotated through software by 180°.
Display Test	Start the test of the LCD display with  . The display test lasts approx. 10 seconds. Various patterns are shown on the LCD display to check the display.
<b>Display / ...Operator Pages</b>	
<b>...Operator Page 1</b>	Selection of submenu ' <b>...Operator Page 1</b> ' using  .
<b>...Operator Page 2</b>	Selection of submenu ' <b>...Operator Page 2</b> ' using  .
<b>...Operator Page 3</b>	Selection of submenu ' <b>...Operator Page 3</b> ' using  .
<b>...Operator Page 4</b>	Selection of submenu ' <b>...Operator Page 4</b> ' using  .
<b>Display / ...Operator Pages / ...Operator Page 1 (n)</b>	
Display Mode	Configure each operator page. The following variants can be selected: Off, Graph View, 1x4, 1x6A, 1x6A bar, 1x9, 1x9 bar, 2x9, 2x9 bar, 3x9. Selecting 'Off' deactivates the corresponding operator page.
1st Line	Selection of process variable displayed in the respective row.
2nd Line	See table <b>Available process variables</b> on page 99.
3rd Line	
4th Line	
Bargraph	Selection of process variable displayed as a bar graph. <ul style="list-style-type: none"> <li>Mass Flow [%]: Mass flow in %</li> <li>Volume Flow [%]: Volume flow in %</li> </ul>

## ... 11 Operation

### ... Parameter descriptions

#### Menu: Input/Output

Menu / parameter	Description
<b>Input/Output</b>	
...Curr.Out 31 / 32 / Uco	Selection of submenu '...Curr.Out 31 / 32 / Uco' using  .
...Curr.Out V1/V2	Selection of submenu '...Curr.Out V1/V2' using  .
...Curr.Out V3/V4	Selection of submenu '...Curr.Out V3/V4' using  .
...Dig.Out 41/42	Selection of submenu '...Dig.Out 41/42' using  .
...Dig.Out 51/52	Selection of submenu '...Dig.Out 51/52' using  .
...Dig.Out V1/V2	Selection of submenu '...Dig.Out V1/V2' using  .
...Dig.Out V3/V4	Selection of submenu '...Dig.Out V3/V4' using  .
...Dig.In V1/V2	Selection of submenu '...Dig.In V1/V2' using  .
...Dig.In V3/V4	Selection of submenu '...Dig.In V3/V4' using  .

#### Input/Output / Curr.Out 31 / 32 / Uco

#### Input/Output / Curr.Out V1/V2

#### Input/Output / Curr.Out V3/V4

Loop Current Mode	<p>Selection of the operating mode for current output 31/32/Uco.</p> <ul style="list-style-type: none"> <li>• Multidrop Fixed: The current output 31/32/Uco supports the HART multi-drop mode, the current output is fixed to 3.6 mA and no longer follows the selected process variable. The process variables can be transferred via the HART protocol.</li> <li>• Normal Signaling: The current output 31/32/Uco transfers the selected process variables. In addition, the process variables can be transferred via the HART protocol.</li> <li>• Power Mode: The current output 31/32/Uco is set permanently to 22.6 mA and no longer follows the selected process variable. HART communication is deactivated. The current output 31/32/Uco works as a power supply unit for the operation of the digital output 41 / 42 as an active output. See chapter <b>Current output Uco / 32 as loop power supply for digital output 41 / 42 or 51 / 52</b> on page 57.</li> </ul>
Output Value	<p>Selection of process variable issued at the corresponding current output.</p> <p>See table <b>Available process variables</b> on page 99.</p> <p>The current outputs V1 / V2 and V3 / V4 are only available if the corresponding plug-in cards are present!</p>
Loop Current Mode	<p>Select the operating mode for the current output.</p> <ul style="list-style-type: none"> <li>• '4-20mA FWD': Output flow rate in the forward flow direction: 4 mA = no flow rate 20 mA = maximum flow rate).</li> <li>• '4-20mA REV': Output flow rate in the reverse flow direction: 4 mA = no flow rate 20 mA = maximum flow rate).</li> <li>• '4-12-20 mA': Output flow rate in forward and reverse flow direction: 4 mA = maximum flow rate in the reverse flow direction 12 mA = no flow rate 20 mA = maximum flow rate in the forward flow direction</li> <li>• '4-20mA FWD/REV': Output flow rate in the forward and reverse flow direction without differentiation of flow direction: 4 mA = no flow rate 20 mA = maximum flow rate).</li> </ul>

Menu / parameter	Description
Input/Output / Curr.Out 31 / 32 / Uco	
Input/Output / Curr.Out V1/V2	
Input/Output / Curr.Out V3/V4	
lout for Alarm	Selection of status of the current output in error condition. The output 'low' or 'high' current is set in the subsequent menu.
Low Alarm	Sets the current for Low Alarm.
High Alarm	Sets the current for High Alarm.
lout > 20,5mA	Behavior of current output if 20.5 mA is exceeded. <ul style="list-style-type: none"> <li>• Hold Last Value: The last measured value is retained and issued.</li> <li>• High Alarm: The high alarm current is issued.</li> <li>• Low Alarm: The low alarm current is issued.</li> </ul>
lout < 3,8mA	Behavior of the current output if 3.8 mA is not reached. <ul style="list-style-type: none"> <li>• Hold Last Value: The last measured value is retained and issued.</li> <li>• High Alarm: The high alarm current is issued.</li> <li>• Low Alarm: The low alarm current is issued.</li> </ul> <p>Parameter is not available if the parameter 'Loop Current Mode' 4-20mA FWD/REV has been selected.</p>
Input/Output / ...Dig.Out 41/42	
Mode	Selection of the operating mode for the digital output 41 / 42. <ul style="list-style-type: none"> <li>• Off: Digital output 41 / 42 is deactivated.</li> <li>• Logic: Digital output 41 / 42 is operating as a binary output (e.g. as an alarm output).</li> <li>• Pulse: Digital output 41 / 42 is operating as a pulse output. In pulse mode, pulses are output per unit (e.g. 1 pulse per m3).</li> <li>• Frequency: Digital output 41 / 42 is operating as a frequency output. In frequency mode, a frequency is issued that is proportional to the flow rate. The maximum frequency can be configured in accordance with the upper range value.</li> </ul>
Outp. Flow Direction	Selection of flow direction in which the pulse / frequency output issues the selected process value. The parameter is only available if the digital output has been configured as a pulse or frequency output. <ul style="list-style-type: none"> <li>• Forward &amp; Reverse: Pulses for both flow directions are issued via digital output 41 / 42.</li> <li>• Forward: Only pulses in the forward flow direction (flow in the direction of the arrow) are issued via digital output 41 / 42.</li> <li>• Reverse: Only pulses in the reverse flow direction (flow opposite of the direction of the arrow) are issued via digital output 41 / 42.</li> </ul>
.....Setup Pulse Output	Selection of submenu '.....Setup Pulse Output' using  . Only available if 'Mode' Pulse has been selected.
.....Setup Freq Output	Selection of submenu '.....Setup Freq Output' using  . Only available if 'Mode' Frequency has been selected.
.....Setup Logic Output	Selection of submenu '.....Setup Logic Output' using  . Only available if 'Mode' Logic has been selected.
...Alarm Config	Selection of submenu '...Alarm Config' using  . Only available when 'Mode' Logic is selected in the '...Setup Logic Output / Logic Output Action' Alarm Signal menu.

## ... 11 Operation

### ... Parameter descriptions

Menu / parameter	Description
<b>Input/Output / ...Dig.Out 41/42 / .....Setup Pulse Output</b>	
<b>Note</b>	
The pulse output can be classically configured via the pulse value ('Pulses per Unit' parameter), alternatively you can also enter the pulse frequency at 100 % flow rate ('Frequency @ Qmax' parameter).	
Output Value Pulse	Selection of process variable that is issued via the pulse output. See table <b>Available process variables</b> on page 99.
Pulses per Unit	Set the pulses per mass unit or volume unit (see table <b>Available units</b> on page 97) for the pulse output.
Frequency @ Qmax	Setting and output of the pulse frequency in pulses/s at 100 % flow rate (mass or volume flow) for the current configuration of the device. <b>Note</b> The value can be changed within the limits indicated. The 'Pulses per Unit' parameter is also adjusted in the process.
Pulse Width	Set the pulse width for the pulse output. The potential pulse width depends on the configured pulse value and is calculated dynamically. The 'Frequency @ Qmax' parameter is also adjusted in the process. Limitation of the maximum pulse width from 2000 to 1700 ms when selecting the 180 degree mode for Dig.Out 51/52 or dig. output V3/V4.
Active Mode	Selection of switching properties for the pulse output.
<b>Input/Output / ...Dig.Out 41/42 / .....Setup Freq Output</b>	
<b>Note</b>	
The frequency output can be classically configured via the frequency for 100 % flow rate ('Upper Frequency' parameter), alternatively you can also enter the pulse value at 100 % flow rate ('Pulses per Unit' parameter).	
Output Value Freq.	Selection of process variable that is issued via the frequency output. See table <b>Available process variables</b> on page 99.
Upper Frequency	Set / display the frequency for the upper range value. The entered value corresponds to 100 % flow.
Pulses per Unit	Set / display the pulse per flow unit. The value (in 1/unit) is calculated dynamically from the parameter "Upper Frequency", the mass or volume flow and $Q_{max}$ . <b>Note</b> <ul style="list-style-type: none"> <li>The value can be changed within the limits indicated. The 'Upper Frequency' parameter is also automatically adjusted in the process.</li> <li>The parameter is available only for the following process variables: Mass Flow [%], Volume Flow [%], Net Mass Flow [%], Net Vol. Flow [%], Vol. Flow @ Tref [%]</li> </ul>

Menu / parameter	Description
<b>Input/Output / ...Dig.Out 41/42 / ...Setup Logic Output</b>	
Logic Output Action	<p>Selection of binary output function.</p> <ul style="list-style-type: none"> <li>• F / R Signal: The binary output signals the flow direction.</li> <li>• Alarm Signal: The binary output indicates an active alarm. The alarm is selected in the '...Alarm Config' menu.</li> <li>• Dual Range: The binary output is activated when measuring range 2 (Qm Max 2 / Qv Max 2) is selected. This selection is only available if the parameter 'Dual Range' has been configured to Qm or Qv.</li> <li>• Batch End Contact: The binary output is activated when the set fill quantity is reached (only if the FillMass function is activated).</li> <li>• Conc. Matrix Select.: The binary output signals the selected concentration matrix (only with the DensiMass function activated and if the variable matrix has been selected).</li> </ul>
Active Mode	Select switching properties for the binary output.
<b>Input/Output / ...Dig.Out 41/42 / ...Alarm Config</b>	
General Alarm	Selection of error messages signaled via the binary output 41 / 42.
Qm Massflow Max	Only if the parameter 'Logic Output Action' is set to Alarm Signal.
Qm Massflow Min	
Density Max	
Density Min	
Density Low Check	
Sensor Signal Min	
Driver Output Max	

## ... 11 Operation

### ... Parameter descriptions

Menu / parameter	Description
<b>Input/Output / ...Dig.Out 51/52</b>	
Mode	<p>Selection of the operating mode for the digital output 51 / 52.</p> <p>The operating modes 'Follow DO 41/42, 90° Shift, 180° Shift' are available only if the digital output 41 / 42 has been configured as a pulse or frequency output.</p> <p><b>Note</b></p> <p>The digital output 51 / 52 menu is not shown if an 'active digital output' plug-in card is inserted in Slot 2 and the mode of DO V3 / V4 is set to</p> <ul style="list-style-type: none"> <li>• Frequency (=51/52)</li> <li>• Follow DO 41 / 42 pulse</li> <li>• 90° pulse</li> <li>• 180° pulse</li> <li>• Follow DO 41 / 42 frequency</li> <li>• 180° frequency</li> <li>•</li> <li>• Off: Digital output deactivated.</li> <li>• Logic: The digital output functions as a binary output (for function see parameter '...Setup Logic Output').</li> <li>• Frequency: Digital output 51 / 52 is operating as a frequency output. In frequency mode, a frequency is issued that is proportional to the flow rate. The maximum frequency can be configured in accordance with the upper range value.</li> <li>• Follow DO 41/42: The digital output 51 / 52 follows the function of digital output 41 / 42. Depending on the setting of the parameter 'Input/Output / ...Dig.Out 41/42 / Outp. Flow Direction', digital output 51 / 52 is operated in pulse mode as follows: <ul style="list-style-type: none"> <li>– When "Forward &amp; Reverse" is selected, digital output 51 / 52 follows digital output 41 / 42.</li> <li>– If 'Forward' is selected, pulses for forward flow are issued on digital output 41 / 42, while pulses for reverse flow are issued on digital output 51 / 52.</li> <li>– When "Reverse" is selected, pulses for reverse flow are output on digital output 41 / 42, while pulses for forward flow are output on digital output 51 / 52.</li> </ul> </li> <li>• 90° Shift: Output of the same pulses or frequency as for digital output 41 / 42, phase shifted by 90°. Only if digital output 41 / 42 has been configured as a pulse or frequency output.</li> <li>• 180° Shift: Output of the same pulses or frequency as for digital output 41 / 42, phase shifted by 180° Only if digital output 41 / 42 has been configured as a pulse or frequency output.</li> <li>• Follow DO 41/42 (Frequency): The digital output 51 / 52 follows digital output 41 / 42. Digital output 51 / 52 then also works as a frequency output, the settings under "... / Dig.Out 41 / 42 / ...Setup Freq Output" are accepted. The output of the frequency at digital output 51 / 52 is dependent on the setting of the register "Outp. Flow Direction" for digital output 41 / 42: <ul style="list-style-type: none"> <li>– When "Forward" is selected, a frequency for forward flow is output at digital output 41 / 42 and a frequency for reverse flow is output at digital output 51 / 52</li> <li>– When "Reverse" is selected, a frequency for reverse flow is output at digital output 41 / 42 and a frequency for forward flow is output at digital output 51 / 52</li> </ul> </li> <li>• 180° Shift (Frequency): Output of the same frequency as for digital output 41 / 42, phase shifted by 180°</li> </ul> <p><b>Note</b></p> <p>If digital output 41 / 42 has been configured as pulse or frequency output, digital output 51 / 52 can be configured separately as binary or frequency output.</p> <p>However, digital output 51 / 52 cannot be configured as a second independent pulse output.</p> <p>Limitation of the maximum pulse width from 2000 to 1700 ms when selecting the 180 degree mode for Dig.Out 51/52.</p>

Menu / parameter	Description
<b>Input/Output / ...Dig.Out 51/52</b>	
...Setup Freq Output	Selection of submenu '...Setup Logic Output' using  . Only available if 'Mode' Frequency has been selected.
...Setup Logic Output	Selection of submenu '...Setup Logic Output' using  . Only available if 'Mode' Logic has been selected.
...Alarm Config	Selection of submenu '...Alarm Config' using  . Only available if 'Mode' Logic has been selected.

Menu / parameter	Description
<b>Input/Output / ...Dig.Out 51/52 / ...Setup Freq Output</b>	
<b>Note</b>	
The frequency output can be classically configured via the frequency for 100 % flow rate ('Upper Frequency' parameter), alternatively you can also enter the pulse value at 100 % flow rate ('Pulses per Unit' parameter).	
Output Value Freq.	Selection of process variable that is issued via the frequency output. See table <b>Available process variables</b> on page 99.
Upper Frequency	Set / display the frequency for the upper range value. The entered value corresponds to 100 % flow.
Pulses per Unit	Set / display the pulse per flow unit. The value (in 1/unit) is calculated dynamically from the parameter "Upper Frequency", the mass or volume flow and $Q_{max}$ .
<b>Note</b>	
<ul style="list-style-type: none"> <li>The value can be changed within the limits indicated. The 'Upper Frequency' parameter is also automatically adjusted in the process.</li> <li>The parameter is available only for the following process variables: Mass Flow [%], Volume Flow [%], Net Mass Flow [%], Net Vol. Flow [%], Vol. Flow @ Tref [%]</li> </ul>	

<b>Input/Output / ...Dig.Out 51/52 / ...Setup Logic Output</b>	
Logic Output Action	Selection of binary output function. Refer to the description 'Input/Output / ...Dig.Out 41/42 / ...Setup Logic Output'.
Active Mode	Select switching properties for the binary output.

<b>Input/Output / ...Dig.Out 51/52 / ...Alarm Config</b>	
General Alarm	Selection of error messages signaled via the binary output 51 / 52.
Qm Massflow Max	Only if the parameter 'Logic Output Action' is set to Alarm Signal.
Qm Massflow Min	
Density Max	
Density Min	
Density Low Check	
Sensor Signal Min	
Driver Output Max	

<b>Input/Output / ...Dig.Out V1/V2</b>	
Mode	Selection of operating mode for the digital output V1 / V2 or V3 / V4. <ul style="list-style-type: none"> <li>Off: Digital output deactivated.</li> <li>Logic: Digital output functions as binary output (for function see parameter '.....Setup Logic Output').</li> </ul> The digital outputs V1 / V2 and V3 / V4 are only available if the corresponding plug-in cards are present!
.....Setup Logic Output	Selection of submenu '.....Setup Logic Output' using  . Only available if 'Mode' Logic has been selected.
...Alarm Config	Selection of submenu '...Alarm Config' using  . Only available if 'Mode' Logic has been selected.

# ... 11 Operation

## ... Parameter descriptions

Menu / parameter	Description
<b>Input/Output / ...Dig.Out V3/V4</b>	
Mode	<p>Selection of the operating mode for digital output V3 / V4.</p> <p>The operating modes 'Follow DO 41/42, 90° Shift, 180° Shift' are available only if the digital output 41 / 42 has been configured as a pulse or frequency output.</p> <p>Digital output V3/V4 is only available if the corresponding plug-in card is present!</p> <ul style="list-style-type: none"> <li>• Off: Digital output deactivated.</li> <li>• Logic: The digital output functions as a binary output (for function see parameter '....Setup Logic Output').</li> </ul> <p><b>Note</b></p> <p>The operating modes below the dashed line are only available with an 'active digital output' plug-in card. When these operating modes are selected, Dig.Out 51/52 is mirrored to V3 / V4. The 'Dig.Out 51/52' is no longer visible then and the settings from V3 / V4 are also accepted for Dig.Out 51/52 .</p> <hr style="border-top: 1px dashed black;"/> <ul style="list-style-type: none"> <li>• Frequency (=51 / 52): Digital output V3 / V4 is operating as a frequency output. In frequency mode, a frequency is issued that is proportional to the flow rate. The maximum frequency can be configured in accordance with the upper range value.</li> <li>• Follow DO 41/42: Digital output V3 / V4 follows the function of digital output 41 / 42. Depending on the setting of the 'Input/Output / ...Dig.Out 41/42 / Outp. Flow Direction' parameter, digital output V3 / V4 is operated in pulse mode as follows:             <ul style="list-style-type: none"> <li>– When 'Forward &amp; Reverse' is selected, digital output V3 / V4 follows digital output 41 / 42.</li> <li>– When 'Forward' is selected, pulses for forward flow are output on digital output 41 / 42, while pulses for reverse flow are output on digital output V3 / V4.</li> <li>– When 'Reverse' is selected, pulses for reverse flow are output on digital output 41 / 42, while pulses for forward flow are output on digital output V3 / V4.</li> </ul> </li> <li>• 90° Shift: Output of the same pulses or frequency as for digital output 41 / 42, phase shifted by 90°. Only if digital output 41 / 42 has been configured as a pulse or frequency output.</li> <li>• 180° Shift: Output of the same pulses or frequency as for digital output 41 / 42, phase shifted by 180° Only if digital output 41 / 42 has been configured as a pulse or frequency output.</li> <li>• Follow DO 41/42 (Frequency): Digital output V3 / V4 follows digital output 41 / 42. Digital output V3 / V4 then also works as a frequency output, the settings under '... / Dig.Out 41 / 42 / ...Setup Freq Output' are accepted. The output of the frequency at digital output V3 / V4 is dependent on the setting of the register 'Outp. Flow Direction' for digital output 41 / 42:             <ul style="list-style-type: none"> <li>– When 'Forward' is selected, a frequency for forward flow is output at digital output 41 / 42 and a frequency for reverse flow is output at digital output V3 / V4</li> <li>– When 'Reverse' is selected, a frequency for reverse flow is output at digital output 41 / 42 and a frequency for forward flow is output at digital output V3 / V4</li> </ul> </li> <li>• 180° Shift (Frequency): Output of the same frequency as for digital output 41 / 42, phase shifted by 180°</li> </ul> <p><b>Note</b></p> <p>Digital output V3 / V4 cannot be configured as an additional independent frequency output (operating mode Frequency (=51 / 52). Digital output V3 / V4 can be configured separately as a binary output. However, digital output V3 / V4 cannot be configured as a second independent pulse output.</p> <p>Limitation of the maximum pulse width from 2000 to 1700 ms when selecting the 180 degree mode for Dig.Out 51/52.</p>
<b>...Setup Freq Output</b>	<p>Selection of submenu '<b>...Setup Logic Output</b>' using  .</p> <p>Only available if 'Mode' Frequency has been selected.</p>
<b>...Setup Logic Output</b>	<p>Selection of submenu '<b>...Setup Logic Output</b>' using  .</p> <p>Only available if 'Mode' Logic has been selected.</p>
<b>...Alarm Config</b>	<p>Selection of submenu '<b>...Alarm Config</b>' using  .</p> <p>Only available if 'Mode' Logic has been selected.</p>

Menu / parameter	Description
<b>Input/Output / ...Dig.Out V3/V4 / ...Setup Freq Output</b>	
<b>Note</b>	
The frequency output can be classically configured via the frequency for 100 % flow rate ('Upper Frequency' parameter), alternatively you can also enter the pulse value at 100 % flow rate ('Pulses per Unit' parameter).	
Output Value Freq.	Selection of process variable that is issued via the frequency output. See table <b>Available process variables</b> on page 99.
Upper Frequency	Set / display the frequency for the upper range value. The entered value corresponds to 100 % flow.
Pulses per Unit	Set / display the pulse per flow unit. The value (in 1/unit) is calculated dynamically from the parameter "Upper Frequency", the mass or volume flow and $Q_{max}$ .
<b>Note</b>	
<ul style="list-style-type: none"> <li>The value can be changed within the limits indicated. The 'Upper Frequency' parameter is also automatically adjusted in the process.</li> <li>The parameter is available only for the following process variables: Mass Flow [%], Volume Flow [%], Net Mass Flow [%], Net Vol. Flow [%], Vol. Flow @ Tref [%]</li> </ul>	

Menu / parameter	Description
<b>Input/Output / ...Dig.Out V1/V2 / ...Setup Logic Output</b>	
<b>Input/Output / ...Dig.Out V3/V4 / ...Setup Logic Output</b>	
Logic Output Action	Selection of binary output function. See description '„Input/Output / ...Dig.Out 41/42 / ...Setup Logic Output'.
Active Mode	Select switching properties for the binary output.

<b>Input/Output / ...Dig.Out V1/V2 / ...Alarm Config</b>	
<b>Input/Output / ...Dig.Out V3/V4 / ...Alarm Config</b>	
General Alarm	Select error messages signaled via the binary output V1 / V2 or V3 / V4.
Qm Massflow Max	Only if the parameter 'Logic Output Action' is set to Alarm Signal.
Qm Massflow Min	
Density Max	
Density Min	
Density Low Check	
Sensor Signal Min	
Driver Output Max	

## ... 11 Operation

### ... Parameter descriptions

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Input/Output / ...Dig.In V1/V2

Input/Output / ...Dig.In V3/V4

Function	<p>Select a function for the digital input.</p> <ul style="list-style-type: none"> <li>• Off: No function.</li> <li>• Reset all Totalizer: Counter reset for all counters (forward flow, reverse flow and difference totalizer)</li> <li>• Stop all Totalizer: External counter stop for all counters (forward flow, reverse flow and difference totalizer)</li> <li>• Auto. Zero Adjust: Start external zero point balancing.</li> <li>• Set Flowrate to zero: Sets flow measurement to 0.</li> <li>• Batchflow On / Off: Start / stop fill operation (only when FillMass function is activated).</li> <li>• Dual Range Mass: Switchover Qm Max / Qm Max 2.</li> <li>• Dual Range Volume: Switchover Qv Max / Qv Max 2.</li> <li>• Submatrix 1 or 2: Switchover for concentration matrix (only when DensiMass function is activated).</li> </ul>
Active Mode	Select switching properties for the digital input.
Delay Time	<p>Selection of delay time for suppressing EMC faults on the digital input.</p> <p><b>Note</b></p> <p>If the digital input has been configured with the function 'Batchflow On / Off' the pulse for starting the filling process must fit at least for the set delay time!</p>

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**Menu: Process Alarm**

Menu / parameter	Description
<b>Process Alarm</b>	
Clear Alarm History	Reset of the alarm history.
...Group Masking	Selection of submenu ' <b>...Group Masking</b> ' using  .
...Alarm Limits	Selection of submenu ' <b>...Alarm Limits</b> ' using  .
<b>Process Alarm / ...Group Masking</b>	
Maintenance Required	Alarm messages are divided into groups.
Function Check	If masking is activated for a group (On), no alarm is issued.
Out Of Specification	For further information, see chapter <b>Diagnosis / error messages</b> on page 162.
<b>Process Alarm / ...Alarm Limits</b>	
Qm Massflow Min	Sets the minimum / maximum limit value for mass measurement. If the process value 'Mass Flow [unit]' exceeds or falls
Qm Massflow Max	below the limit value, an alarm is triggered.
Qv Volumeflow Min	Sets the minimum / maximum limit value for volume measurement. If the process value 'Volume Flow [unit]' exceeds or falls
Qv Volumeflow Max	below the limit value, an alarm is triggered.
Density Min	Sets the minimum / maximum limit value for density measurement. If the process value 'Density [unit]' exceeds or falls
Density Max	below the limit value, an alarm is triggered.
Temperature Min	Sets the minimum / maximum limit value for sensor temperature. If the process value 'Temperature [unit]' exceeds or falls
Temperature Max	below the limit value, an alarm is triggered.
Concentrat. [%] Min	Sets the minimum / maximum limit value for concentration measurement. If the process value 'Concentr.unit [%]' exceeds
Concentrat. [%] Max	or falls below the limit value, an alarm is triggered.
Concentrat. [u] Min	Sets the minimum / maximum limit value for concentration measurement. If the process value 'Concentr.unit [unit]' exceeds
Concentrat. [u] Max	or falls below the limit value, an alarm is triggered.
Driver Output Max	Sets the maximum limit value for driver current. If the driver current exceeds the limit value for the time set under the parameter 'Driver Output Time', an alarm is triggered.
Driver Output Time	Sets the delay time for alarm 'Sensor driver current to high.'
Sensor Signal Min	Sets the maximum limit value for the sensor amplitude. If the sensor amplitude exceeds the limit value for the time set under the parameter 'Sensor Signal Time', an alarm is triggered.
Sensor Signal Time	Sets the delay time for alarm 'Sensor amplitudeout of range.'
Density Low Check	Sets the alarm limit for the density alarm. If the density falls below the value set, process variables Qm and Qv are set to '0' and alarm 'Density to 1g/cm <sup>3</sup> ' is triggered.

## ... 11 Operation

### ... Parameter descriptions

#### Menu: Communication

Menu / parameter	Description
<b>Communication</b>	
...HART	Selection of submenu '...HART' using  .
...Modbus	Selection of submenu '...Modbus' with  .
...Profibus	Selection of submenu '...Profibus' with  .
...Ethernet	Selection of submenu '...Ethernet' with  .

#### Communication / ...HART

Device Address	<p>Selection of the HART® device address.</p> <p><b>Note</b></p> <ul style="list-style-type: none"> <li>The HART 5® protocol has provisions for creating a bus with up to 15 devices (1 to 15). If an address greater than 0 is set via the HART Command 6, the device operates automatically in multi-drop mode. The current loop mode cannot be changed with Command 6 for HART 5. The current output 31 / 32 / Uco is fixed to 3.6 mA. HART communication takes place through current output 31 / 32 / Uco.</li> <li>The HART 7® protocol has provisions for creating a bus with up to 63 devices (1 to 63). The address and current loop mode can be changed independently of each other via HART Command 6. Here it is not obligatory to have the current output fixed to 3.6 mA with an address larger than 0. If an address larger than 0 is set via the menu, there is <b>NO</b> automatic switchover to multi-drop mode. Switchover of the current loop mode is done independently.</li> </ul>
Loop Current Mode	<p>Selection of the operating mode for current output 31/32/Uco.</p> <ul style="list-style-type: none"> <li>Multidrop Fixed: The current output 31/32/Uco supports the HART multi-drop mode, the current output is fixed to 3.6 mA and no longer follows the selected process variable. The process variables can be transferred via the HART protocol.</li> <li>Normal Signaling: The current output 31/32/Uco transfers the selected process variables. In addition, the process variables can be transferred via the HART protocol.</li> <li>Power Mode: The current output 31/32/Uco is set permanently to 22.6 mA and no longer follows the selected process variable. HART communication is deactivated. The current output 31/32/Uco works as a power supply unit for the operation of the digital output 41 / 42 as an active output.</li> </ul>
HART Tag	<p>Entry of a HART® TAG number as unique identifier for the device.</p> <p>Alphanumeric, a maximum of 8 characters, upper case only, no special characters.</p>
HART Long Tag	<p>Entry of a HART® TAG number as unique identifier for the device.</p> <p>Alphanumeric, maximum of 32 characters, ASCII</p> <p>Only starting from HART® version 7!</p>
HART Descriptor	<p>Entry of a HART descriptor.</p> <p>Alphanumeric, a maximum of 16 characters, upper case only, no special characters.</p>
HART Message	Display of the alphanumeric TAG number.
HART Manuf. ID	Display of the HART manufacturer ID. ABB = 26
HART Device ID	Display of the HART device ID.
HART Find	<p>Select whether the transmitter must respond to the HART command 73 (Find Device).</p> <ul style="list-style-type: none"> <li>Off: The transmitter does not respond to command 73.</li> <li>Once: The transmitter responds once to command 73.</li> <li>Continuous: The transmitter always responds to command 73.</li> </ul>
Last HART Command	Display of the most recently sent HART command.
PV Primary Variable	Selection of process variables that are issued through the HART variables.
SV Secondary Var.	See table <b>Available process variables</b> on page 99.
TV Tertiary Variable	
QV Quaternary Var.	

Menu / parameter	Description
<b>Communication / ...Modbus</b>	
Address	Setting the Modbus® device address (1 to 127).
IEEE Format	Selection of the byte order for the Modbus communication. <ul style="list-style-type: none"> <li>Enabled: If the IEEE format is activated, the data words are sent in the 'little endian' format with the lowest value word first.</li> <li>Disabled: If the IEEE format is deactivated, the data words are sent in the standard Modbus 'bigendian' format.</li> </ul> Factory setting: Enabled.
Baud Rate	Selection of the transmission speed (baud rate) for the Modbus communication. Factory setting: 9600 baud.
Parity	Selection of the parity for the Modbus communication. Factory setting: Odd.
Stop Bits	Selection of the stop bits for the Modbus communication. Factory setting: One stop bit
Response Delay	Setting of the pause time in milliseconds after receiving a Modbus command. The device sends a response no earlier than expiration of the set pause time. Factory setting: 10 ms
<b>Communication / ...Profibus</b>	
Address	Set the PROFIBUS DP® device address (1 to 126).
Ident Nr. Selector	Display the PROFIBUS DP® identification number <ul style="list-style-type: none"> <li>0x9741: 2×AI + 1×TOT</li> <li>0x9742: 3×AI + 1×TOT</li> <li>0x3434: ABB specific</li> </ul>
Comm State	Display the PROFIBUS communication status. <ul style="list-style-type: none"> <li>Offline: No PROFIBUS® communication.</li> <li>Stop: Bus active, device not active.</li> <li>Clear: Device is being initialized.</li> <li>Operate: Cyclic communication is active.</li> </ul>
Baud Rate	Display the transmission speed (baud rate) for the PROFIBUS® communication. The baud rate is automatically detected and does not need to be configured manually.
PB Manufacturer ID	Display the PROFIBUS DP® manufacturer ID <ul style="list-style-type: none"> <li>26: ABB</li> </ul>

## ... 11 Operation

### ... Parameter descriptions

Menu / parameter	Description
<b>Communication / Ethernet</b>	
...General	Selection of submenu '...General' via  .
...Internet layer	Selection of submenu '...Internet layer' via  .
...Webserver	Selection of submenu '...Webserver' via  .
...EtherNetIP	Selection of submenu '...EtherNetIP' via  .
...PROFINET	Selection of submenu 'PROFINET' via  .
...ModbusTCP	Selection of submenu '...ModbusTCP' via  .
...Data link layer	Selection of submenu '...Data link layer' via  .
...Diagnostics	Selection of submenu '...Diagnostics' via  .

#### Communication / ...General

Base Protocol Stack	Displays the communications protocol for information purposes only. <ul style="list-style-type: none"> <li>Ethernet IP</li> <li>PROFINET</li> </ul>
EtherNetIP Flash	Sets the communications protocol to Ethernet/IP.
PROFINET Flash	Sets the communications protocol to PROFINET.

#### Communication / ...Internet layer

DHCP client	Factory setting: Enabled. If 'disabled-fixed IP' has been selected, the host IP address is 192.168.001.122 by default. <ul style="list-style-type: none"> <li>Enabled</li> <li>disabled-fixed IP</li> </ul> For PROFINET communication, the DHCP function (Dynamic Host Configuration Protocol) is not supported, the PROFINET DCP (Discovery and Configuration Protocol) is used instead.
Host IP address	Allows the IP address to be set. 192.168.001.122 is the factory setting, if the DHCP client is set to fixed IP.
Subnet mask	Factory setting: 255,255,255,000
Gateway IP address	Factory setting = 000.000.000.000 If you are dealing with a part of a subnet, the first block of numbers should identical with the HOST IP - for example, 192.168.001.xxx.
NTPServer1 IP addr.	Factory setting: 000,000,000,000
NTPServer2 IP addr.	Factory setting: 000,000,000,000
Host name	Factory setting: ABB-Flow-EMF
Domain name	Factory setting: my-domain
DNS1 IP address	automatically set at DHCP = ON: 000,000,000,000
DNS2 IP address	

#### Communication / ...Webserver

Access	Factory setting: full <ul style="list-style-type: none"> <li>Disabled</li> <li>read only</li> <li>full</li> </ul>
Reset credentials	Allows the reset of the web server password.
Session timeout	Time out period to close the web server session. Standard value: 30 minutes. Possible settings: Min.: 1 minute, Max. 99999 minutes.

Menu / parameter	Description
<b>Communication / EtherNetIP</b>	
Access	<p>Factory setting: full.</p> <p>Set to 'full' or 'read only' for Omron or Rockwell PLCs.</p> <ul style="list-style-type: none"> <li>• Disabled</li> <li>• read only</li> <li>• full</li> </ul>
Device status	<p>Mod&lt;G&gt; Net &lt;G&gt; P1</p> <ul style="list-style-type: none"> <li>• P1: Port 1 of the Ethernet card</li> <li>• Mod: Module status <ul style="list-style-type: none"> <li>– Mod constantly shows &lt;G&gt; = device is ready for operation. Functioning correctly.</li> <li>– Mod switches between &lt;G&gt; and &lt;&gt; = Standby. Device not configured yet</li> <li>– Mod switches between &lt;R&gt; and &lt;&gt; = simple errors that can be eliminated</li> <li>– Mod constantly shows &lt;R&gt; = Serious error. Serious error that cannot be eliminated</li> <li>– Mod continuously shows &lt;&gt; = No power</li> </ul> </li> <li>• Net: Network status. <ul style="list-style-type: none"> <li>– Net continuously shows &lt;G&gt; = Connected. Device has at least one existing connection.</li> <li>– Net switches between &lt;G&gt; and &lt;&gt; = No connection. Device has not connections established, but has been assigned an IP address.</li> <li>– Net constantly shows &lt;R&gt; = Duplicated IP address. The device has determined that the device IP address is already in use.</li> <li>– Net constantly shows &lt;&gt; = No supply voltage or IP address.</li> <li>– Net switches between &lt;R&gt; and &lt;&gt; = Connection time out</li> </ul> </li> </ul>
Vendor ID	46
Product/Device type	43
Product name	CoriolisMaster FCB4/FCH4
Product code	5002
Product major rev.	1
Product minor rev.	1

Menu / parameter	Description
<b>Communication / PROFINET</b>	
Access	<p>Factory setting: full.</p> <p>Set to 'full' or 'read only' for Omron or Rockwell PLC.</p> <ul style="list-style-type: none"> <li>• Disabled</li> <li>• read only</li> <li>• full</li> </ul>
Device status	Corresponds to the LEDs on the Ethernet plug-in card, see <b>Ethernet card status LEDs</b> on page 79.
Device Name	<p>PROFINET station name (can only be written via PROFINET)</p> <p>40 x ASCII characters</p>
Tag function	<p>Can only be written via PROFINET (e.g. I&amp;M1)</p> <p>32 x ASCII characters</p>
Select Device Type	<p>Selection of device profile</p> <ul style="list-style-type: none"> <li>• ABB 0x3436: Manufacturer-specific GSD (factory setting)</li> <li>• PA Profiles 0xB333: PNO Profile GSD</li> </ul>
SNMP access	<p>Activate / deactivate SNMP access.</p> <ul style="list-style-type: none"> <li>• Disabled</li> <li>• read only</li> <li>• full (Recommended for PROFINET)</li> </ul>

## ... 11 Operation

### ... Parameter descriptions

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#### Communication / ...ModbusTCP

Access	Factory setting: full. <ul style="list-style-type: none"> <li>• Disabled</li> <li>• read only</li> <li>• full</li> </ul>
IEEE Format	Factory setting: Enabled. <ul style="list-style-type: none"> <li>• Enabled</li> <li>• disabled</li> </ul>

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Menu / parameter	Description
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#### Communication / ...Data link layer

Chasis MAC address	Example: 00-24-59-11-00-69
P1 MAC address*	
P2 MAC address*	
P1 auto negotiation	<ul style="list-style-type: none"> <li>• Enabled</li> <li>• disabled</li> </ul>
P1 speed set	10 Mbit/s, 1000 Mbit/s, 1000 Mbit/s
P1 duplex set	<ul style="list-style-type: none"> <li>• Half Duplex</li> <li>• Full Duplex</li> </ul>
P1 speed status	Example: 100 Mbits/s
P1 duplex status	Example: Full Duplex
P2 auto negotiation	<ul style="list-style-type: none"> <li>• Enabled</li> <li>• disabled</li> </ul>
P2 speed set	10 Mbit/s, 1000 Mbit/s, 1000 Mbit/s
P2 duplex set	<ul style="list-style-type: none"> <li>• Half Duplex</li> <li>• Full Duplex</li> </ul>
P2 speed status	Example: 100 Mbits/s
P2 duplex status	Example: Full Duplex

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#### Communication / Diagnostics

TCP connections	Example: 14
P1 received	Example: 1207269 bytes
P1 transmitted	Example: 2001589 bytes
P1 receive errors	Example: 000000
P1 transm.collisions	Example: 000000
P2 received	Example: 000000 bytes
P2 transmitted	Example: 000000 bytes
P2 receive errors	Example: 000000
P2 transm.collisions	Example: 000000

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\* If base PROFINET protocol selected.

**Menu: Diagnostics**

Menu / parameter	Description
<b>Diagnostics</b>	
...Diagnosis Control	Selection of submenu '...Diagnosis Control' using  .
...Diagnosis Values	Selection of submenu '...Diagnosis Values' using  .
...Drag Indicators	Selection of submenu '...Drag Indicators' using  .
...Simulation Mode	Selection of submenu '...Simulation Mode' using  .
...Output Readings	Selection of submenu '...Output Readings' using  .
...Meter Erosion Mon.	Selection of submenu '...Meter Erosion Mon.' using  .
...Diag.CurrOut 31/32	Selection of submenu '...Diag.CurrOut 31/32' using  .
...Alarm Simulation	Selection of submenu '...Alarm Simulation' using  .

**Diagnostics / ...Diagnosis Control**

Preset Maint. cycle	Sets the service interval. After the maintenance interval has expired, the corresponding error message 'Maintenance interval is reached' is set. The setting '0' deactivates the maintenance interval.
Maint. Remain. Time	Time remaining in the maintenance interval until the error message 'Maintenance interval is reached' is set.
Start New Cycle	Resetting of the maintenance interval. The service interval is reset to the value set in 'Preset Maint. cycle'.

**Diagnostics / ...Diagnosis Values**

Driver Output	Display of the current driver current in mA.
Sensor Signal A	Display of the current amplitude (sensor voltage) for sensor A in mV.
Sensor Signal B	Display of the current amplitude (sensor voltage) for sensor B in mV.
Tube Frequency	Display of the current measuring tube frequency in Hz.
Pipe Temperature	Display of the current measuring tube temperature in °C.
Sensor Housing Temp.	Display of the current housing temperature in °C.
Electr. (FEB) Temp.	Display of the current frontend board temperature in °C.
Readback curr. 31/32	Display of the actual current in µA on current output 31 / 32.

**Diagnostics / ...Drag Indicators**

...Process Indicators	Selection of submenu '...Process Indicators' using  .
...Sensor Indicators	Selection of submenu '...Sensor Indicators' using  .
...Temperature Indic.	Selection of submenu '...Temperature Indic.' using  .
Reset Indicators	Reset all drag indicators.

**Diagnostics / ...Drag Indicators / ...Process Indicators**

Mass Flow Min	Display of the minimum / maximum mass flow measured value since the last reset of the drag indicators.
Mass Flow Max	
Density Min	Display of the minimum / maximum density measured value since the last reset of the drag indicators.
Density Max	

## ... 11 Operation

### ... Parameter descriptions

Menu / parameter	Description
<b>Diagnostics / ...Drag Indicators / ...Sensor Indicators</b>	
Driver Output Max	Display of the maximum transmitter driver current since the last reset of the drag indicators.
Sensor Amp. Sa Min	Display of the minimum transmitter sensor amplitude since the last reset of the drag indicators.
Sensor Amp. Sb Min	

<b>Diagnostics / ...Drag Indicators / ...Temperature Indic.</b>	
Medium Min	Display of the minimum / maximum measuring medium temperature since the last reset of the drag indicators.
Medium Max	
Sensor Housing Min	Display of the minimum / maximum sensor housing temperature since the last reset of the drag indicators.
Sensor Housing Max	
Electr. (FEB) Min	Display of the minimum / maximum frontend board temperature since the last reset of the drag indicators.
Electr. (FEB) Max	

<b>Diagnostics / ...Simulation Mode</b>	
Simulation Switch	Manual simulation of measured values. After selecting the value to be simulated, a corresponding parameter is displayed in the 'Diagnostics / .....Simulation Mode' menu. The simulation value can be set here.
Off	
Curr.Out 31 / 32 / Uco	The output values correspond to the simulated flowrate entered.
Curr.Out V1/V2*	Information 'Configuration' appears in the lower line of the display.
Curr.Out V3/V4*	Only one measured value / output can be selected for simulation.
DO 41/42 State	After power-up / restart of the device, the simulation is switched off.
DO 41/42 Freq.	
Dig.Out 41/42 Pulse	
Dig.Out 51/52 State	
Dig.Out 51/52 Freq.	
Dig.Out 51/52 Pulse	
Dig.Out 51/52 Freq. V3/V4**	
Dig.Out 51/52 Pulse V3/V4**	
Dig.In V1/V2 State*	
Dig.In V3/V4 State*	
Qm Massflow [unit]	
Qm Massflow [%]	
Qv Volumeflow [unit]	
Qv Volumeflow [%]	
Density [unit]	
Density [%]	
Temperature [unit]	
Temperature [%]	
Hart Frequency	

\* Only with plug-in card present.

\* Menu will be shown for the 'Dig.Out 51/52' simulation or 'Digital output V1/V2 V3/V4' simulation and corresponding operating mode (only if the 'Active digital output' plug-in card is inserted)

Menu / parameter	Description
<b>Diagnostics / ...Output Readings</b>	
Curr.Out 31 / 32 / Uco	Display the current values and statuses of the listed inputs and outputs.
Curr.Out V1/V2*	
Curr.Out V3/V4*	
DO 41/42 Freq.	
DO 41/42 State	
Dig.Out 51/52 Freq.	
Dig.Out 51/52 State	
DO V1/V2 State*	
Frequency DO V3/V4*	
Dig.Out V3/V4 State*	
Dig.In V1/V2 State*	
Dig.In V3/V4 State*	
* Only with plug-in card present.	
<b>Diagnostics / ...Meter Erosion Mon.</b>	
Control Type	<p>Selection of the operating mode for the erosion monitor.</p> <ul style="list-style-type: none"> <li>Manual: Manual input of limit values for the erosion monitor.</li> <li>Auto: The transmitter calculates the limit values for the erosion monitor automatically.</li> </ul> <p>Factory setting: Manual.</p>
Driver Output Max	<p>Sets the maximum limit value for driver current.</p> <p>If the driver current exceeds the limit value for the time set under the parameter 'Driver Output Time', alarm 'Density too low.Empty pipe, gas' is triggered.</p> <p>This parameter is only available if the value 'Control Type' has been selected for the parameter 'Manual'.</p>
Driver Output Time	<p>Sets the delay time for alarm 'Density too low.Empty pipe, gas'.</p> <p>This parameter is only available if the value 'Control Type' has been selected for the parameter 'Manual'.</p>
Status Adjust	<p>Indicates the status for automatic balancing of the erosion monitor.</p> <ul style="list-style-type: none"> <li>Outstanding: If the limit value is not set, the erosion monitoring is not active.</li> <li>Requested: Automatic adjustment of the erosion monitor is activated but has not yet been performed.</li> <li>Processing: Automatic balancing of the erosion monitor is active.</li> <li>Done: Automatic balancing of the erosion monitor is complete; erosion monitoring is active.</li> </ul> <p>This parameter is only available if the value 'Control Type' has been selected for the parameter 'Auto'.</p>
Self Adjust Time	<p>Sets the runtime for automatic adjustment of the erosion monitor.</p> <p>The setting depends on the application and should cover several days or, if necessary, weeks.</p>
Start Adjust	Start automatic calibration of the erosion monitor manually with  .
New Value left Time	Display the time remaining for the current automatic calibration of the erosion monitor.
Meter Erosion Level	Display the automatically calculated erosion value of the erosion monitor.
Adjusted Limit	Display the automatically calculated limit value of the erosion monitor. The limit value is calculated from the erosion value from the automatic adjustment process and a tolerance value.
Actual Value	Displays the current erosion value for comparison with the learned limit.

## ... 11 Operation

### ... Parameter descriptions

Menu / parameter	Description
<b>Diagnostics / ...Diag.CurrOut 31/32</b>	
Readback curr. 31/32	<p>Activate the monitoring function for current output 31 / 32.</p> <p>The transmitter measures the actual current and compares the measured value to the set point for the current output. If the measured value deviates from the set point by more than <math>\pm 2\%</math>, the current output on the alarm current of 3.3 mA is set and the 'CO 31/32 readbackcurrent deviates' error message is generated.</p> <p>Factory setting: Off.</p>
<b>...Alarm Reset Option</b>	Selection of submenu '...Alarm Reset Option' using  .
Reset Alarm	Manually resetting the 'CO 31/32 readbackcurrent deviates' error message using  .

#### Diagnostics / ...Diag.CurrOut 31/32 / ...Alarm Reset Option

Auto. Reset 10 min	<p>Automatic reset of the 'CO 31/32 readbackcurrent deviates' error message.</p> <ul style="list-style-type: none"> <li>Off: The error is permanently saved and must be reset manually. After the reset, the current output 31 / 32 is retested.</li> <li>On: The error is automatically reset after 10 minutes. After the reset, the current output 31 / 32 is retested.</li> </ul> <p>Factory setting: On.</p>
Auto Reset open Loop	<p>Behavior in the case of an open current output 31 / 32 (interruption of the current loop).</p> <ul style="list-style-type: none"> <li>Off: If the current loop is interrupted, the 'CO 31/32 readbackcurrent deviates' is generated. The reset of the error then depends on the setting of the 'Auto. Reset 10 min' parameter.</li> <li>On: If the current loop is closed again, the error will be automatically reset.</li> </ul> <p>Factory setting: On.</p>

#### Diagnostics / ...Alarm Simulation

Manual simulation of alarms / error messages.

The simulated alarm is selected by setting the parameter to the corresponding error.

See also chapter **Diagnosis / error messages** on page 162.

The following error messages can be simulated:

Off, Flow Mass Reached, Flow Volume Reached, Simulation Alarm, Flowrate to Zero, Maint. Cycle Time, Totalizer Stop, Totalizer Reset, Totalizer Rollover, Dev. not calibrated, NV defect on FEB, NV data defect, FEB not detected, FEB comm. error, Incompatible FEB, NV defect on MB, DO 41/42 Pulse max, CO 31/32 Saturated, CO Vx/Vy Saturated, CO 31/32 Comm. Error, Option 1 Comm. Error, Option 2 Comm. Error, CO 31/32 Safety, CO 31/32 Not Calibr., CO V1/V2 Not Calibr., CO V3/V4 Not Calibr., Volt. Monitoring MB, DSP Failed, Density Failed, Temp. Limit Exceeded, Temp. Sensor Failed, Sensor Ampl. Error, Sens. Driver Curr., Density Too Low, Flow Density Reached, Flow Temp. Reached, Density to One, Conc. Scaled Range, Conc. Unscal. Range, Volt. Monitor FEB, Fieldbus Card defec., CO 31/32 Readback, Sensor Ampl. Range

**Menu: Totalizer**

Menu / parameter	Description
<b>Totalizer</b>	
...Operation	Selection of submenu '...Operation' using  .
...Reset Totalizer	Selection of submenu '...Reset Totalizer' using  .
...Preset Totalizer	Selection of submenu '...Preset Totalizer' using  .
...FillMass	Selection of submenu '...FillMass' using  .

**Totalizer / ...Operation**

Start all Totalizer	Starts all counters.
Stop all Totalizer	Stops all counters.

**Totalizer / ...Reset Totalizer**

All Totalizer	Resets all totalizers to zero.
All Mass Totalizer	Reset all mass totalizers to zero.
All Volume Totalizer	Resets all volume totalizers to zero.
Massflow Fwd	Resets individual counters.
Massflow Rev	
Volumeflow Fwd	
Volumeflow Rev	
Net Massflow Fwd	
Net Massflow Rev	
Net Volumeflow Fwd	
Net Volumeflow Rev	
Volumeflow Fwd@Tref	
Volumeflow Rev@Tref	

**Totalizer / ...Preset Totalizer**

Massflow Fwd	Input from meter readings (e.g. when replacing the transmitter).
Massflow Rev	
Volumeflow Fwd	
Volumeflow Rev	
Net Massflow Fwd	
Net Massflow Rev	
Net Volumeflow Fwd	
Net Volumeflow Rev	
Volumeflow Fwd@Tref	
Volumeflow Rev@Tref	

## ... 11 Operation

### ... Parameter descriptions

Menu / parameter	Description
<b>Totalizer / ...FillMass</b>	
Batch Process Value	<p>Selection of process variable used during the filling process.</p> <p>The process variables 'Net Volumeflow Fwd' and 'Net Massflow Fwd' are only available when the DensiMass function is activated.</p> <ul style="list-style-type: none"> <li>• Off: Filler deactivated.</li> <li>• Volume Forward: Volume flow rate in forward flow direction.</li> <li>• Norm Volume Forward: Standard volume flow rate in forward flow direction.</li> <li>• Mass Forward: Mass flow in forward flow direction.</li> <li>• Net Volumeflow Fwd: Net volume flow rate in forward flow direction.</li> <li>• Net Massflow Fwd: Net mass flow in forward flow direction.</li> </ul>
Preset Batch Total.	<p>Sets the fill quantity using the selected unit.</p> <p>When the defined fill quantity is reached, the configured binary output is activated.</p> <p><b>Note</b></p> <p>Before setting the fill quantity, the corresponding process value must be selected with the parameter 'Batch Process Value'.</p>
Reset Cur.Batch Tot.	Resets the current fill quantity.
Start Batching	<p>Manual start of the filling function.</p> <p>Alternatively, the digital input can be configured for starting / stopping the fill operation.</p>
Current Batch Total	<p>Display of the current fill quantity.</p> <p>Once a fill operation has been started, the quantity already filled is shown here. The counter restarts at zero for each fill operation initiated and then counts up to the set fill quantity.</p>
Stop Batching	<p>Manual stop of the filling function.</p> <p>Alternatively, the digital input can be configured for starting / stopping the fill operation.</p>
Current Batch Counts	Display of the number of fill operations since the last reset.
Reset Batch Counts	Sets the parameter 'Batch Counts' to zero.
<b>...Quantity</b>	Select the ' <b>...Quantity</b> ' submenu.
<b>Totalizer / ...FillMass / ...Quantity</b>	
Mode	<p>Selection of overrun correction.</p> <p>Closing the fill valve takes some time and as a consequence more liquid is added, even though the fill quantity is reached and the contact for closing the valve is actuated.</p> <p>—Auto: The overrun quantity is calculated by the transmitter automatically.</p> <p>—Manual: The overrun quantity must be determined manually and entered in the selected unit via the parameter 'Quantity'.</p>
Quantity	Manual input of the overrun quantity / display of the overrun quantity detected automatically by the transmitter.
Factor	<p>Sets the weighting of the last filling process during automatic calculation of the overrun quantity.</p> <p>The calculation is based on the following formula:</p> $\text{New correction value} = \text{last correction value} + (\text{BatchAuto.Lag Corr.Factor} \times \text{correction value during the last fill operation})$ <p>— 0.0: No change to correction value.</p> <p>— 1.0: The correction value is immediately adjusted to the overrun quantity calculated during the last fill operation.</p>
Time	Sets the time for the overrun quantity correction after the fill valve is closed.

## Software history

In accordance with NAMUR recommendation NE53, ABB offers a transparent and traceable software history.

Device software package FCx4xx (Device Firmware Package)				
Version	Issue date	Type of change	Description	Ordering number
00.01.00	12.06.2015	New release	—	3KXF002043U0100
00.03.00	01.2016	Change	SIL2 Functionality and minor troubleshooting	3KXF002043U0100
00.04.00	11.2016	Change	Variety of minor changes, details in document MI/FCX400/FW/101	3KXF002043U0100
00.05.00	01.2018	Change	Variety of minor changes, details in document MI/FCx400/FW/102	3KXF002043U0100
01.05.01	12.2019	Change	Variety of minor changes, Easy Set-up revised details in document MI/FCX400/FW/103	3KXF002043U0100
01.06.00	03.2020	Change	ECC function added, EasySet-up revised, details in document MI/FCX400/FW/104.	3KXF002043U0100
01.07.00	04.2021	Change	Ethernet communication added.	3KXF002043U0100
01.08.00	06.2021	Change	Active digital output (plug-in card) added	3KXF002043U0100
01.09.00	02.2022	Change	Improvement of measuring rate in ECC mode and further diagnostic options	3KXF002043U0100
01.09.02	04.2022	Change	New DensiMass 'antifreeze' medium option	3KXF002043U0100
01.11.00	04.2023	Change	PROFINET communications protocol added.	3KXF002043U0100

## Zero point balance under operating conditions

Devices in the CoriolisMaster series do not necessarily require zero point adjustment. Performing a zero point adjustment is only recommended in the following cases:

- For measurements in the lower flow range (below 10 % of  $Q_{\max DN}$ ).
- If particularly high accuracies are required (0.1 % or better).
- If the operating conditions (pressure and temperature) deviate greatly from the reference conditions (see data sheet).

For zero point adjustment under operating conditions, make sure the following conditions are present:

- The meter tube is completely filled with the measuring medium.
- For liquid measuring media, no gas bubbles or air pockets may be present in the meter tube.
- For gaseous measuring media, no liquid components or condensates may be present in the meter tube.
- The pressure and the temperature in the meter tube correspond to standard operating conditions and are stable.

In case of an increased zero point (> 0.1 %), check the installation for 'best praxis' and make sure that no gas content is contained in liquids, or that there are no liquids or particles in gases.

See also **Turn-off devices for the zero point adjustment** on page 39.

Zero point balancing can be started either manually via the LCD indicator or using an appropriately configured digital input. See **Menu: Device Setup** on page 121 and **Menu: Input/Output** on page 130.

## ... 11 Operation

### Measurement of standard volumes

Coriolis mass flowmeters can only measure the mass flow of gaseous measuring media.

The operating density of gases is too low to be measured. Consequently the flowmeter is also unable to measure the operating volume.

However, an appropriate standard volume can be calculated by entering a fixed density for the measuring medium.

The transmitter uses the measured mass flow and the standard density entered to calculate the standard volume flow of the measuring medium.

(standard volume = mass / standard density).

#### Configuration of the standard volume measurement using the LCD indicator

Perform the following steps to activate the calculation of standard volumes for gases:

Menu / parameter	Setting	Description
1. ... / Device Setup / ...Transmitter / Density Mode	Density Fixed Value	Set the 'Density Mode' parameter to 'Density Fixed Value'.
2. ... / Device Setup / ...Transmitter / Density Fixed Value	e. g. 1.293 g/l for air	Set the parameter 'Density Fixed Value' to the standard density of the measuring medium.
3. ... / Device Setup / ...Transmitter / ...Units / Unit Volumeflow Qv	e. g. xx/yy for customer unit	Set the parameter 'Unit Volumeflow Qv' to the desired unit for volume flow. e. g. xx/yy for customer unit, see step 4.
... / Device Setup / ...Transmitter / ...Units / Unit Vol. Totalizer	e. g. xx/yy for customer unit	Set the parameter 'Unit Vol. Totalizer' to the desired unit for the volume totalizer. e. g. xx/yy for customer unit, see step 4.
... / Device Setup / ...Transmitter / ...Units / Unit Density	e.g. g/l	Set the parameter 'Unit Vol. Totalizer' to the desired density unit.
<b>Note</b>		
To differentiate between the "Fixed density" and "Standard volume calculation" operating modes, we recommend using a customer unit for the volume flow and volume totalizer units.		
4. ... / Device Setup / ...Transmitter / ...Custom Units / Volumeflow Qv Name	e. g. 'm3/h(qn)'	Set the parameter 'Volumeflow Qv Name' to the desired names for the standard volume flow. Maximum 8 characters!
... / Device Setup / ...Transmitter / ...Custom Units / Volumeflow Qv Factor	e. g. '3.6' with reference to l/s	Set the parameter 'Volumeflow Qv Factor' to the desired factor for the standard volume flow. The factor refers to the unit of liter/second (l/s)
... / Device Setup / ...Transmitter / ...Custom Units / Volume Tot. Name	e. g. 'm3(qn)'	Set the parameter 'Volume Tot. Name' to the desired names for the unit of the standard volume totalizer. Maximum 8 characters!
... / Device Setup / ...Transmitter / ...Custom Units / Volume Tot. Factor	e. g. '0.001' with reference to l	Set the parameter 'Volume Tot. Factor' to the desired factor for the unit of the standard volume totalizer. The factor refers to the unit of liter (l)
5. ... / Device Setup / ...Sensor / Qv Max	e. g. '1000 m3/h(qn)'	Set the parameter 'Volume Tot. Factor' to the desired upper range value.
6. ... / Input/Output / ...Curr.Out 31 / 32 / Uco / Output Value	e.g. 'Volume Flow [%]'	Allocate the process variables to the desired outputs of the transmitter. See <b>Menu: Input/Output</b> on page 130 for further information.
7. ... / Display / ...Operator Pages / ...Operator Page 1 / 1st Line	e.g. 'Volume Flow [unit]'	Allocate the process variables to the operator screens of the LCD display of the transmitter. See <b>Menu: Display</b> on page 129 for further information.
8. ... / Process Alarm / ...Alarm Limits / Density Max	Limit value < than parameter 'Density Fixed Value'	Set the parameter 'Density Max' to a value which is below the 'Density Fixed Value' parameter. This will prevent the 'Density exceeds min/max limits.' error message from appearing.

## Configuration of the standard volume measurement using the HART DTM

### Example

Calculation of standard cubic meters per day ( $\text{sm}^3/\text{d}$ )

Measured medium	Natural gas
Density in standard conditions	0.7168 $\text{kg}/\text{m}^3$
Measuring range	0 ... 10000 $\text{sm}^3/\text{d}$

The screenshot shows the HART DTM configuration interface. Key parameters are highlighted with red boxes and labeled with letters A through H:

- (A)** Unit Volume Qv: Custom Selectable
- (B)** Unit Name:  $\text{sm}^3/\text{d}$
- (C)** Unit Factor: 86.40
- (D)** Unit Density:  $\text{kg}/\text{m}^3$
- (E)** Unit Volume Total:  $\text{m}^3$
- (F)** Density Mode: Density fixed value
- (G)** Density fixed value: 0.71680  $\text{kg}/\text{m}^3$
- (H)** Density cut off: 0.50000  $\text{kg}/\text{m}^3$

- (A) Set the parameter 'Unit Volume Qv' to 'Custom Selectable'.
- (B) In parameter 'Unit Name', enter the desired names for the standard volume unit ' $\text{sm}^3/\text{d}$ '.
- (C) In parameter 'Unit Factor', enter the factor in l/s for the standard volume unit ' $\text{sm}^3/\text{d}$ ' (in the example 86.4 l/s).
- (D) Set the parameter 'Unit Density' to the desired density unit (in the example  $\text{kg}/\text{m}^3$ ).
- (E) Set the parameter 'Unit Density' to the desired unit for the volume totalizer (in the example  $\text{m}^3$ ).
- (F) Set the parameter 'Unit Density' to the desired density mode (in the example Density fixed value).
- (G) In parameter 'Density fixed value', enter the standard density of the measuring medium (in the example 0.71680  $\text{kg}/\text{m}^3$ ).
- (G) In parameter 'Density cut off', enter the density for the cutoff of the calculation (in the example 0.50  $\text{kg}/\text{m}^3$ ). Adjust the parameter 'Density Low Check' afterwards as needed (see page page 139).
- (G) Click on the 'Apply' button to apply the settings.

Figure 79: Screenshot from the HART DTM

## ... 11 Operation

### VeriMass erosion monitor

The integrated diagnosis function VeriMass allows the status of the meter tube to be monitored. This enables changes due to material erosion and the formation of deposits on the meter tube walls to be identified at an early stage.

If the set limit value is exceeded, an alarm is triggered, for example via the programmable digital output or HART, depending on the configuration.

The limit value for the erosion monitor can be set either automatically or manually.

#### Automatic adjustment

The transmitter monitors the sensor's driver current over a prolonged period and creates a 'fingerprint' for the relevant application. The transmitter generates a corresponding tolerance value for deviations in the driver current.

The transmitter compares the behavior of the driver current with the generated fingerprint and triggers the relevant error message in the event of prolonged deviations.

#### Manual adjustment

For applications where automatic adjustment of the erosion monitor does not provide a satisfactory result, the erosion monitor can be adjusted manually.

For more information, please contact ABB Service or the sales organization.

#### Setup

The following process conditions must be observed to ensure that the transmitter can perform the adjustment process successfully:

- The measuring medium has a viscosity similar to that of water and below 10 cP.
- For liquid measuring media, no gas bubbles or air pockets may be present in the meter tube.
- The pressure and temperature in the meter tube correspond to standard operating conditions.
- The process conditions during the adjustment period correspond to standard conditions for the selected application.

#### Automatic adjustment via the transmitter menu

The following steps must be performed when adjusting the erosion monitor automatically:

1. The VeriMass function must be active („Device Setup / ...Transmitter / ...Feature Settings menu, parameter 'VeriMass On/Off').
2. In the 'Diagnostics / ...Meter Erosion Mon.' menu, set the parameter 'Control Type' to 'Auto'.
3. In the 'Diagnostics / ...Meter Erosion Mon.' menu, set the parameter 'Self Adjust Time' to the required duration of the balancing process.

---

#### Recommended settings

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Self Adjust Time	Several days or weeks depending on the application
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4. In the 'Diagnostics / ...Meter Erosion Mon.' menu, start the automatic balancing process via the parameter 'Start Adjust'.

The transmitter now generates the 'fingerprint' for the erosion value and an appropriate tolerance value for the specified time. Once automatic adjustment is complete, the driver current is monitored constantly and compared with the 'fingerprint' generated.

### Manual adjustment via the transmitter menu

For more information, please contact ABB Service or the sales organization.

The following steps must be performed when adjusting the erosion monitor manually:

1. The VeriMass function must be active („Device Setup / ...Transmitter / ...Feature Settings menu, parameter 'VeriMass On/Off').
2. In the 'Diagnostics / ...Meter Erosion Mon.' menu, set the parameter 'Control Type' to 'Manual'.
3. In the 'Diagnostics / ...Meter Erosion Mon.' menu, set the parameters 'Driver Output Max' and 'Driver Output Time' to the required values.

---

### Recommended settings

Driver Output Max	Approx. 0.3 mA above the driver current under normal operating conditions
Driver Output Time	Several days or weeks depending on the application

---

### Adjustment via Device Type Manager (DTM)

Alternatively, the automatic and manual balancing processes for the erosion monitor can also be performed via the HART DTM on the CoriolisMaster FCB450 / FCH450.

### Note

Not all tools and frame applications support DTMs or EDDs at the same level. In particular, optional or advanced EDD / DTM functions may not be available on all tools.

ABB provides frame applications supporting the full range of functions and performance.

For further information, please consult the Device Type Manager documentation.

## Enhanced Coriolis Control (ECC)function

The Enhanced Coriolis Control (ECC)function has been specially developed for demanding applications, such as:

- Liquids with gas phase
- Liquids with rapidly changing densities
- Fill operations with surge phases at the beginning or end
- Liquids with high viscosity

After the ECC function is activated, the device applies a particularly quick control algorithm to control the oscillating tubes in the device and therefore provide significantly better behavior in the applications listed above.

In addition, the ECC function offers a special noise suppression filter for mass flow measurement and density measurement.

In the case of particularly demanding applications, disruptions can thus be actively filtered and the measurement can be implemented in a considerably more stable manner.

For the filters, a variety of time constants between 0.5 s and 8 s can be selected.

Since Coriolis mass flowmeters measure the mass flow and density separately, the CoriolisMaster features a separate filter each for mass flow measurement and density measurement.

## ... 11 Operation

### Applications in accordance with API (American Petroleum Institute)

For applications in accordance with API Chapter 5.6, the CoriolisMaster FCB400, FCH400 provides special parameters:

- Calibration Pressure: Measuring medium pressure at which the device was calibrated at ABB.
- Calibration Temp.: Measuring medium temperature at which the device was calibrated at ABB.
- Pressure Level: Parameters for entry of the current operating pressure in the device by the user.
- Flow Compens. factor: Display / output of the current compensation factor for mass flow calculation.
- Density Comp. factor: Display / output of the current compensation factor for density calculation.
- P.Comp.Status (PECI): In accordance with API, the user can set the following states:
  - 1: CT: Compensation in the Coriolis flowmeter based on the current pressure entered in the 'Pressure Level' parameter.
  - 2: TD: Compensation in the Coriolis flowmeter switched off – compensation is performed externally (Tertiary Device)
  - 3: OS: Compensation in the Coriolis flowmeter switched off – compensation is not performed on site (Off Site)
  - 4: NA: Compensation in the Coriolis flowmeter switched off – compensation is not deemed to be necessary, since the device is operating at a pressure for which the device has been proved.

### Concentration measurement DensiMass

The transmitter can calculate the current concentration from the measured density and temperature using concentration matrices.

The following concentration matrices are preconfigured in the transmitter as standard:

- Concentration of sodium hydroxide in water
- Concentration of alcohol in water
- Concentration of sugar in water
- Concentration of maize starch in water
- Concentration of wheat starch in water
- Concentration of antifreeze in water

In addition, the user can enter two user-defined matrices:

- Up to 100 values with one matrix
- Up to 50 values per matrix with two matrices

### Calculating standard volumes and standard densities of liquids

If a suitable matrix is available, the DensiMass function also allows the measured volume to be corrected for any selected temperature.

The measured density can also be corrected for a given temperature.

However, this is only possible when measuring liquids and after entering an appropriate matrix.

This correction can also be performed using the default matrices (see above).

The calculated standard volumes and standard densities can also be issued for all other process variables.

The software 'DensiMatrix' is available for the easy input of the matrix.

### Accuracy of the concentration measurement

The accuracy of the concentration measurement is determined in the first instance by the quality of the matrix data entered. However, as the calculation is based on temperature and density (the input variables), the accuracy of the concentration measurement is ultimately determined by the measuring accuracy of the temperature and the density.

#### Example:

Density of 0 % alcohol in water at 20 °C (68 °F): 998.23 g/l

Density of 100 % alcohol in water at 20 °C (68 °F): 789.30 g/l

Concentration	Density
100 %	208.93 g/l
0.48 %	1 g/l
0.96 %	2 g/l
0.24 %	0.5 g/l

Thus, the accuracy class of the density measurement directly determines the accuracy of the concentration measurement.

### Entering the concentration matrix

The concentration matrix for the DensiMass function can be created in three ways:

1. The desired ABB matrix is indicated when ordering the device. The device is then delivered with the corresponding preconfiguration.
2. The matrix is created using a special software and transferred to the device via the infrared service port adapter.
3. The matrix is entered into the device manually as described below.

For more information, please contact ABB Service or the sales organization.

#### Manual input of the matrix

Enter the concentration matrix via the menu 'Device Setup / ...Variable Matrix / ...Configuration'.

Data for the matrix must be available as described in chapter **Structure of the concentration matrix** on page 159.

#### Step 1:

Menu '... / ...Variable Matrix'.

Parameter	Description
Matrix Name	Entry of a name for the matrix. Alphanumeric, maximum 16 characters
Unit Name	Entry of a name for the matrix concentration unit. Alphanumeric, maximum 7 characters
Concentration Min	Entry of the minimum and maximum
Concentration Max	concentration limit for the matrix calculation.

## ... 11 Operation

### ... Concentration measurement DensiMass

#### Step 2:

Entry of the basic settings for the matrix in the menu '... / ...Variable Matrix / ...Configuration'.

Parameter	Description
Number Matrices	Selection of number of matrices.
Number Temp.	Entry of the number of temperature values for the matrix calculation.
Number Conc.	Entry of the number of the concentration values for the matrix calculation.
Enter Conc. in %	Selection of type of the concentration calculation. <ul style="list-style-type: none"> <li>• Yes: Calculation of concentration in %</li> <li>• No: Calculation of concentration in a selected unit</li> </ul>
Qm/Qv Conc. Switch	Selection of whether the volume concentration or mass concentration is calculated.

#### Step 3:

Entry of the matrices data in the menu '... / ...Variable Matrix'.

Parameter	Description
Matrix 1 Unit	Entry of the temperature, concentration and density values to calculate the concentration in the selected unit.
Matrix 2 Unit	
Matrix 1 Percent	Entry of the temperature, concentration and density values to calculate the concentration in %.
Matrix 2 Percent	

Once the data has been entered, select 'Calculate matrix' from the menu to calculate the matrix. Missing values are interpolated or extrapolated.

#### Step 4:

Saving the matrices in the menu '... / ...Variable Matrix' using the menu item 'Enter Matrix Finish'.

This completes the process to enter the matrices.

### Structure of the concentration matrix

The software supports two different concentration values:

- **Concentration in unit** (e. g.: % or °Bé)  
The range of values is not limited, the value can be provided at the current output, the value can be selected in the Units submenu.
- **Concentration in percent (%)**  
The range of values is limited to 0 to 103.125 %. This value is only used for the internal calculation of the net mass flow. The net mass flow can be output at the current and pulse outputs.

Concentration MIN / MAX limit: -5.0 to 105.0.

The matrix for calculating the concentration looks like this:

		Temperature 1	...	Temperature n
Value 1 concentration in %	Value 1 concentration in unit (e.g., % or °Bé)	Value 1, 1 density	...	Value n, 1 density
...	...	...	...	...
Value m concentration in %	Value m concentration in unit (e.g., % or °Bé)	Value 1, m density	...	Value n, m density

The following rules apply when entering values in the matrix:

- With one matrix:  $2 \leq N \leq 20$ ;  $2 \leq M \leq 20$ ;  $N * M \leq 100$
- With two matrices:  $2 \leq N \leq 20$ ;  $2 \leq M \leq 20$ ;  $N * M \leq 50$

The density values in a column must be in ascending order due to the algorithm used in the transmitter software.

Density  $x,1 < \dots < \text{Density } x,2 < \dots < \text{Density } x,M$  for  $1 \leq x \leq M$

The temperature values must be in ascending order from left to right due to the algorithm used in the transmitter software.

Temperature  $1 < \dots < \text{Temperature } x < \dots < \text{Temperature } N$  for  $1 \leq x \leq N$

The concentration values must be monotonically ascending or monotonically descending from top to bottom due to the algorithm used in the transmitter software.

Concentr.  $1 < \dots < \text{Concentr. } x < \dots < \text{Concentr. } N$  for  $1 \leq x \leq N$

or

Concentr.  $1 > \dots > \text{Concentr. } x > \dots > \text{Concentr. } N$  for  $1 \leq x \leq N$

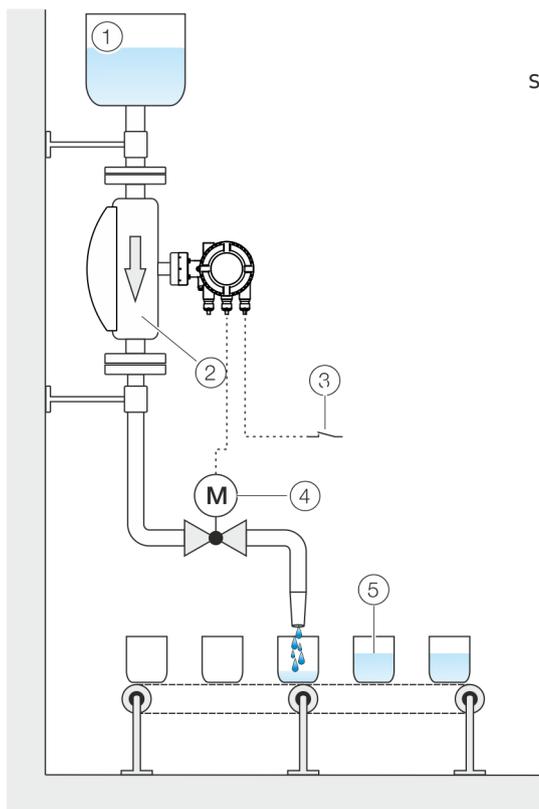
### Example:

		10 °C (50 °F)	20 °C (68 °F)	30 °C (86 °F)
0 %	0 °BRIX	0.999 kg/l	0.982 kg/l	0.979 kg/l
10 %	10 °BRIX	1.010 kg/l	0.999 kg/l	0.991 kg/l
40 %	30 °BRIX	1.016 kg/l	1.009 kg/l	0.999 kg/l
80 %	60 °BRIX	1.101 kg/l	1.018 kg/l	1.011 kg/l

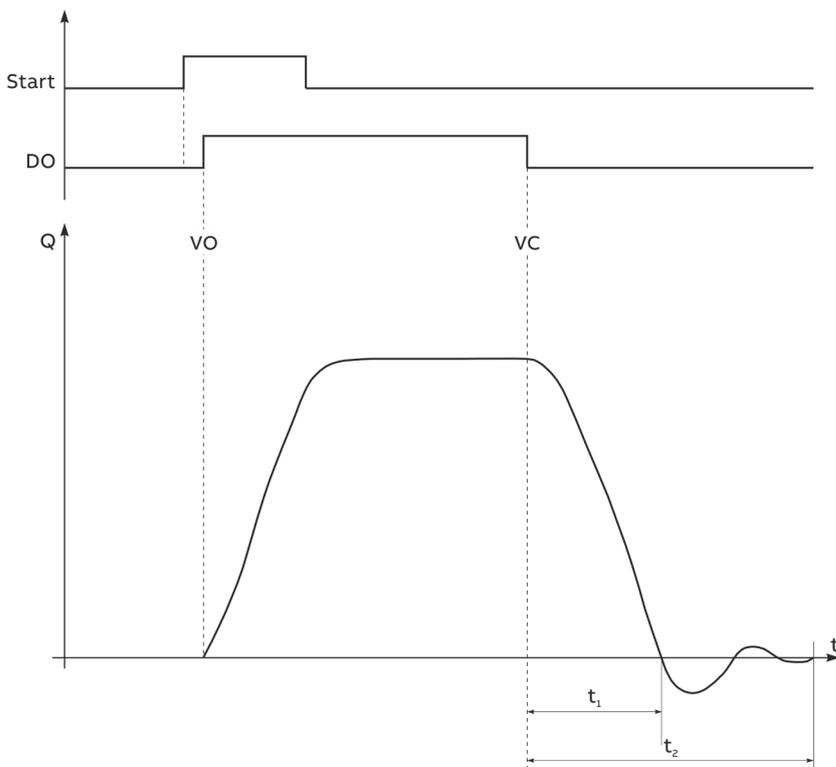
# ... 11 Operation

## FillMass batch function

Only for FCB450 / FCH450



- ① Supply tank
- ② Sensor
- ③ Start / stop fill operation (digital input or field bus)
- ④ Fill valve
- ⑤ Filling tank



- Start Start of the filling process via field bus or digital input
- DO State of the digital output for the fill valve
- Q Flow rate
- VO Valve open (filling started)
- VC Valve closed (fill quantity reached)
- $t_1$  Valve closing time
- $t_2$  Overrun time

Figure 80: FillMass fill function

The integrated FillMass fill function allows filling processes with filling times of > 3 seconds.

For this purpose, the filling quantity is given via an adjustable totalizer.

The fill function is controlled via the HART interface or via the digital input.

The valve is triggered via one of the digital outputs and closed again once the preset filling quantity is reached.

The transmitter measures the overrun quantity and calculates the overrun correction from this.

Additionally, the low flow cut-off can be activated if required.

## Setup

For the configuration of the fill mass function, the following steps must be performed:

1. The FillMass function must be active. See also the 'Device Setup / ...Transmitter / ...Feature Settings / ...' menu.
2. One digital output must be configured as a binary output with the function 'Batch End Contact'. See also the 'Input/Output / ...' menu. As an option, one digital input (plug-in card) can be configured with the function 'Batchflow On / Off' at the start of the filling process.
3. The parameters for the fill mass function must be configured. See also the 'Totalizer / ...FillMass / ...' menu.

## Notices on configuration

### Damping

During fast filling processes, the damping should be set to the minimum value to ensure the greatest possible accuracy of the fill quantity. See also the 'Device Setup / ...Transmitter / ...' menu.

### Delay until the valve is opened

The delay between the start pulse for the filling process and the activation of the binary output for opening the valve depends on the following factors:

- From the delay set for the digital input (see parameter **Delay Time** on page 138)
- From the device internal processing time of 200 ms

Total delay = 'Delay Time' + 200 ms.

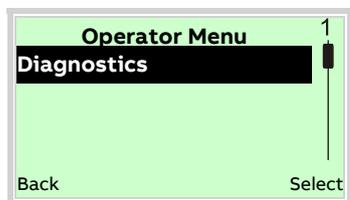
## 12 Diagnosis / error messages

### Calling up the error description

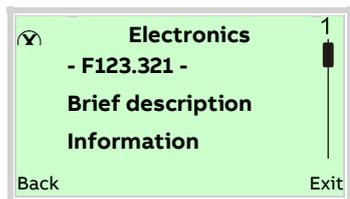
Additional details about the error that has occurred can be called up on the information level.



1. Use to switch to the information level (Operator Menu).



2. Use / to select the submenu 'Diagnostics'.
3. Confirm the selection with .



The error message is shown on the display according to priority.

The first line shows the area in which the error has occurred.

The second line shows the unique error number. It is made up of the priority (Fxxx) and the error position (.xxx)

The next lines show a brief description of the error and information on how to remedy it.

You absolutely need to scroll the display further to read the error message in more detail.

#### Note

For a detailed description of the error messages and information on troubleshooting, see the following pages.

### General

Errors encountered are itemized in tabular form on the following pages. The response of the transmitter on error detection is described therein.

The table lists all possible errors together with a description of their impact on the value of measurement variables, the properties of current outputs and the alarm output.

If no entry is indicated in the table field, there is no effect on the measurement variable or no alarm signal for the particular output. The sequence of the errors in the table corresponds to the error priorities.

The first entry has the highest priority and the last has the lowest.

If multiple errors are detected simultaneously, the error with the highest priority determines the alarm condition of the measurement variable and the current output. If an error with a higher priority does not affect the measurement variable or the output status, the error with the next highest priority determines the status of the measurement variable and the output.





## Error messages

Error code / error text	Description	NAMUR classification
F098.011 No Frontend Board detected	Communication error to frontend board (FEB) of the sensor. Frontend board defective. <ul style="list-style-type: none"> <li>For remote mount design: check signal cable connection between sensor and transmitter.</li> <li>Restart the device.</li> <li>Replace frontend board.</li> <li>Contact ABB Service.</li> </ul>	Failure
F096.029 DSP Failure on Frontend Board.	DSP error in frontend board (FEB) of the sensor. Frontend board defective. <ul style="list-style-type: none"> <li>Restart the device.</li> <li>Replace frontend board.</li> <li>Contact ABB Service.</li> </ul>	Failure
F093.033 Sensor amplitude out of range.	Gas bubbles in the measuring tube. Viscosity of the measuring medium is too high. Hardware error in sensor. <ul style="list-style-type: none"> <li>Reduce gas content, change measuring medium.</li> <li>Contact ABB Service.</li> </ul>	Failure
F092.041 FEB voltages outside range.	Frontend board power supply defective. Frontend board defective. <ul style="list-style-type: none"> <li>Replace frontend board.</li> <li>Contact ABB Service.</li> </ul>	Failure
F091.025 MB voltages outside range.	Motherboard power supply defective Faulty motherboard. <ul style="list-style-type: none"> <li>Contact ABB Service.</li> </ul>	Failure
F090.032 Sensor temperature measure error	Internal temperature sensor measuring error / defective. <ul style="list-style-type: none"> <li>Contact ABB Service.</li> </ul>	Failure
F088.012 FEB communication error. EMC disturbance.	Communication error to frontend board (FEB) of the sensor. Electro magnetic interference. <ul style="list-style-type: none"> <li>For remote mount design: check signal cable connection between sensor and transmitter.</li> <li>Restart the device.</li> <li>Contact ABB Service.</li> </ul>	Failure
F086.018 Curr.Out 31/32 com error.	Communication error to current output 31 / 32 / $U_{co}$ . Electro magnetic interference, faulty motherboard in transmitter. <ul style="list-style-type: none"> <li>Contact ABB Service.</li> </ul>	Failure
F084.010 NV data defect. Data storage irreparable.	Error in SensorMemory. Faulty memory module. <ul style="list-style-type: none"> <li>Contact ABB Service.</li> </ul>	Failure
F082.013 Incompatible Frontend Board.	Incompatible frontend board. The frontend board is not compatible with the motherboard in the transmitter. <ul style="list-style-type: none"> <li>Contact ABB Service.</li> </ul>	Failure
F080.030 Density failure	The resonant frequency of the measuring tube is outside the permissible limits. Damage to the measuring tube due to abrasion or deposit formation in the measuring tube. <ul style="list-style-type: none"> <li>Check setting of the density parameters.</li> <li>Check application, clean meter tube and check for damage due to abrasion.</li> <li>Contact ABB Service.</li> </ul>	Failure

## ... 12 Diagnosis / error messages

### ... Error messages

Error code / error text	Description	NAMUR classification
C078.003 Flowrate to zero	External switch-off active via digital input. <ul style="list-style-type: none"> <li>• Check status of digital input.</li> <li>• Check parameterization.</li> </ul>	Functional check
C076.005 All totalizer stopp.	External switch-off active via digital input. <ul style="list-style-type: none"> <li>• Check status of digital input.</li> <li>• Check parameterization.</li> </ul>	Functional check
C074.006 Totalizer reset. Reset of one or more Totalizer	Reset of one or more counters. <ul style="list-style-type: none"> <li>• Check status of digital input.</li> <li>• Check parameterization.</li> </ul>	Functional check
C072.002 Simulation is on. Simulating process/output value.	Simulation mode is active. <ul style="list-style-type: none"> <li>• Deactivate simulation mode in the 'Diagnostics / ...Simulation Mode' menu.</li> </ul>	Functional check
C070.026 An alarm is simulated.	The alarm simulation is active. <ul style="list-style-type: none"> <li>• Deactivate alarm simulation in the 'Diagnostics / ...Alarm Simulation' menu.</li> </ul>	Functional check
S065.028 CO 31/32 readbackcurrent deviates	Current loop error current output 31 / 32. <ul style="list-style-type: none"> <li>• Check current loop current output 31 / 32 (short-circuit / interruption).</li> <li>• Check load current output 31 / 32.</li> <li>• Check the power supply (voltage) of the transmitter.</li> </ul>	Out of specification
S060.034 Sensor driver current to high.	Gas bubbles in the measuring tube. <ul style="list-style-type: none"> <li>• Reduce gas content in the measuring medium.</li> <li>• Deactivate error message by setting the parameter 'Driver Output Max' in the 'Process Alarm / ...Alarm Limits' menu to '0'.</li> </ul>	Out of specification
S059.035 Density too low.Empty pipe, gas	Empty measuring tube. Gas bubbles in the measuring tube. <ul style="list-style-type: none"> <li>• Reduce gas content in the measuring medium.</li> <li>• Make sure that the meter tube is always completely full.</li> <li>• Deactivate error message by setting the parameter 'Density Low Check' in the 'Process Alarm / ...Alarm Limits' menu to '0'.</li> </ul>	Out of specification
S058.038 Density to 1g/cm <sup>3</sup>	Density has been set to 1 g/cm <sup>3</sup> by the transmitter due to an error message. <ul style="list-style-type: none"> <li>• Contact ABB Service.</li> </ul>	Out of specification
S057.031 Sensor temperature out max range	Ambient or measuring medium temperature is too high. <ul style="list-style-type: none"> <li>• Check ambient or measuring medium temperature.</li> </ul>	Out of specification
S054.042 Sensor amplitude out of ranges	The sensor amplitude is below or above the parameterized limit values 'Sensor Signal Min' and 'Sensor Signal Time'. Multi-phases measuring medium. Viscosity of the measuring medium is too high. <ul style="list-style-type: none"> <li>• Check the settings of the parameters in the 'Process Alarm / ...Alarm Limits' menu and adjust if necessary.</li> </ul>	Out of specification
S052.016 Curr.Out 31/32 is saturated.	Current output 31 / 32 overshoot. The flow rate or a corresponding set output value has up-scaled the set upper range value. <ul style="list-style-type: none"> <li>• Check the upper range value Qv Max, Qm Max in the 'Device Setup / ...Sensor' menu and correct if necessary.</li> </ul>	Out of specification
S051.017 Curr.Out V1/V2, V3/V4 saturated	Current output V1 / V2, V3 / V4 (plug-in card) overshoot. The flow rate or a corresponding set output value has up-scaled the set upper range value. <ul style="list-style-type: none"> <li>• Check the upper range value Qv Max, Qm Max in the 'Device Setup / ...Sensor' menu and correct if necessary.</li> </ul>	Out of specification

<b>Error code / error text</b>	<b>Description</b>	<b>NAMUR classification</b>
S049.019 Option Card 1 com error.	Communication error to plug-in card. <ul style="list-style-type: none"> <li>• Check that the plug-in card is installed correctly.</li> </ul>	Out of specification
S048.020 Option Card 2 com error.	<ul style="list-style-type: none"> <li>• Replace plug-in card if necessary.</li> <li>• Contact ABB Service.</li> </ul>	
S047.0015 Pulse output is cut off.	The pulse rate or the frequency at the pulse output is outside the permissible limits. <ul style="list-style-type: none"> <li>• Check configuration of the parameters for the pulse output.</li> </ul>	Out of specification
S046.000 Mass flowrate exceeds limits.	The mass flow is below or above the configured limit values 'Qm Massflow Min' and 'Qm Massflow Max'. <ul style="list-style-type: none"> <li>• Check the settings of the parameters in the 'Process Alarm / ...Alarm Limits' menu and adjust if necessary.</li> <li>• Check mass flow.</li> </ul>	Out of specification
S044.001 Volume flowrate exceeds limits.	The volume flow is below or above the configured limit values 'Qv Volumeflow Min' and 'Qv Volumeflow Max'. <ul style="list-style-type: none"> <li>• Check the settings of the parameters in the 'Process Alarm / ...Alarm Limits' menu and adjust if necessary.</li> <li>• Check volume flow rate.</li> </ul>	Out of specification
S043.036 Density exceeds min/max limits.	The density is below or above the configured limit values 'Density Min' and 'Density Max'. <ul style="list-style-type: none"> <li>• Check the settings of the parameters in the 'Process Alarm / ...Alarm Limits' menu and adjust if necessary.</li> <li>• Check density.</li> </ul>	Out of specification
S042.037 Medium temperat exceeds limits.	The measuring medium temperature is below or above the configured limit values 'Temperature Min' and 'Temperature Max'. <ul style="list-style-type: none"> <li>• Check the settings of the parameters in the 'Process Alarm / ...Alarm Limits' menu and adjust if necessary.</li> <li>• Check measuring medium temperature.</li> </ul>	Out of specification
S041.039 Concentration in unit exceeds	The concentration in units is below or above the configured limit values 'Concentrat. [u] Min' and 'Concentrat. [u] Max'. <ul style="list-style-type: none"> <li>• Check the settings of the parameters in the 'Process Alarm / ...Alarm Limits' menu and adjust if necessary.</li> <li>• Check concentration.</li> </ul>	Out of specification
S040.040 Concentration in percent exceeds	The concentration in % is below or above the configured limit values 'Concentrat. [%] Min' and 'Concentrat. [%] Max'. <ul style="list-style-type: none"> <li>• Check the settings of the parameters in the 'Process Alarm / ...Alarm Limits' menu and adjust if necessary.</li> <li>• Check concentration.</li> </ul>	Out of specification

## ... 12 Diagnosis / error messages

### ... Error messages

Error code / error text	Description	NAMUR classification
M038.09 Sensor memory defective.	SensorMemory in frontend board defective. <ul style="list-style-type: none"> <li>• Check if the SensorMemory is defective.</li> <li>• Contact ABB Service.</li> </ul>	Maintenance required
M037.014 NV chips defect on Motherboard.	SensorMemory in motherboard faulty. <ul style="list-style-type: none"> <li>• Check if the SensorMemory is defective.</li> <li>• Contact ABB Service.</li> </ul>	Maintenance required
M032.022 Curr.Out 31/32 not calibrated.	Current output 31 / 32, Uco not calibrated. <ul style="list-style-type: none"> <li>• Contact ABB Service.</li> </ul>	Maintenance required
M031.023 Curr.Out V1/V2 not calibrated.	Current output (plug-in card) V1 / V2 or V3 / V4 not calibrated. <ul style="list-style-type: none"> <li>• Check plug-in card and replace if necessary.</li> </ul>	Maintenance required
M030.024 Curr.Out V3/V4 not calibrated.	<ul style="list-style-type: none"> <li>• Contact ABB Service.</li> </ul>	Maintenance required
M028.007 Display value is <1600h at Qmax.	The current counter reading has exceeded the display resolution. <ul style="list-style-type: none"> <li>• Check the unit setting for the mass counters / volume totalizers and adjust if necessary.</li> </ul>	Maintenance required
M026.004 Maintenance interval is reached	Maintenance interval reached. <ul style="list-style-type: none"> <li>• Perform maintenance work.</li> <li>• Start new maintenance interval in the 'Diagnostics / ...Diagnosis Control' menu.</li> </ul>	Maintenance required
M024.008 Device not calibrated.	Contact ABB Service.	Maintenance required
M020.027 Communicat. card not responding	Fieldbus plug-in is not reacting. <ul style="list-style-type: none"> <li>• Plug-in card is defective.</li> <li>• Contact ABB Service.</li> </ul>	Maintenance required

## 13 Maintenance

### Safety instructions

#### **WARNING**

##### **Loss of Ex-approval!**

Loss of Ex approval due to replacement of components in devices for use in potentially explosive atmospheres.

- Devices for use in potentially explosive atmospheres may be serviced and repaired by qualified ABB personnel only.
- For measuring devices for potentially explosive atmospheres, observe the relevant operator guidelines. See also **Use in potentially explosive atmospheres** on page 8.

#### **CAUTION**

##### **Risk of burns due to hot measuring media**

The device surface temperature may exceed 70 °C (158 °F), depending on the measuring medium temperature!

- Before starting work on the device, make sure that it has cooled sufficiently.

### Sensor

The flowmeter essentially requires no maintenance.

The following items should be checked annually:

- Ambient conditions (air circulation, humidity),
- Tightness of the process connections,
- Cable entries and cover screws,
- Operational reliability of the power supply, lightning protection, and station ground.

#### **Repairs to the flowmeter**

If repairs to the flowmeter are required, observe **Repair** on page 169.

### Cleaning

When cleaning the exterior of meters, make sure that the cleaning agent used does not corrode the housing surface and the seals.

To avoid static charge, a damp cloth must be used for cleaning.

## 14 Repair

### Safety instructions

#### **DANGER**

##### **Danger of explosion if the device is operated with the transmitter housing or terminal box open!**

Before opening the transmitter housing or the terminal box, note the following points:

- A valid fire permit must be present.
- Make sure that there is no explosion hazard.
- Switch off the power supply and wait for  $t > 20$  minutes before opening.

#### **WARNING**

##### **Risk of injury due to live parts!**

When the housing is open, contact protection is not provided and EMC protection is limited.

- Before opening the housing, switch off the power supply.

#### **WARNING**

##### **Loss of Ex-approval!**

Loss of Ex approval due to replacement of components in devices for use in potentially explosive atmospheres.

- Devices for use in potentially explosive atmospheres may be serviced and repaired by qualified ABB personnel only.
- For measuring devices for potentially explosive atmospheres, observe the relevant operator guidelines. See also **Use in potentially explosive atmospheres** on page 8.

#### **CAUTION**

##### **Risk of burns due to hot measuring media**

The device surface temperature may exceed 70 °C (158 °F), depending on the measuring medium temperature!

- Before starting work on the device, make sure that it has cooled sufficiently.

#### **NOTICE**

##### **Damage to components!**

The electronic components of the printed circuit board can be damaged by static electricity (observe ESD guidelines).

- Make sure that the static electricity in your body is discharged before touching electronic components.

## ... 14 Repair

### Spare parts

Repair and maintenance activities may only be performed by authorized customer service personnel.  
When replacing or repairing individual components, use original spare parts.

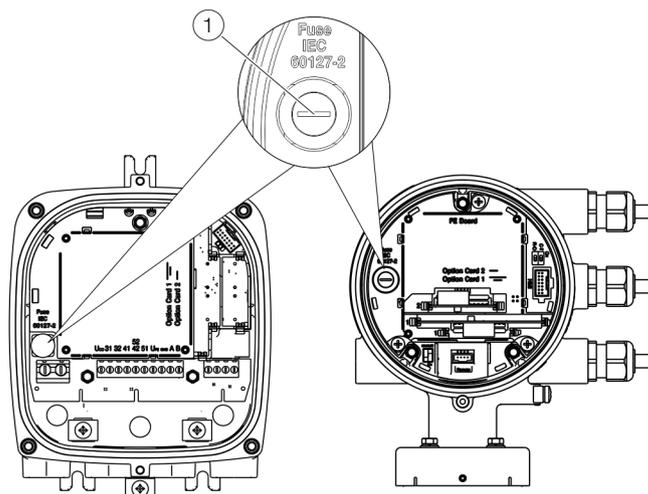
#### Note

Spare parts can be ordered from ABB Service.  
[www.abb.com/contacts](http://www.abb.com/contacts)

### Replacing the fuse

#### NOTICE

If the O-ring gasket is seated incorrectly or damaged, this may have an adverse effect on the housing protection class. Follow the instructions in **Opening and closing the housing** on page 45 to open and close the housing safely.



① Fuse holder

Figure 81: Fuse holder position

There is a fuse in the transmitter housing.

Power supply transmitter	11 to 30 V DC	100 to 240 V AC
Rated current of fuse	1.25 A	0.8 A
Nominal voltage of fuse	250 V AC	250 V AC
Design	Device fuse 5 x 20 mm	
Breaking capacity	1500 A at 250 V AC	
Ordering number	3KQR000757U0100	3KQR000757U0200

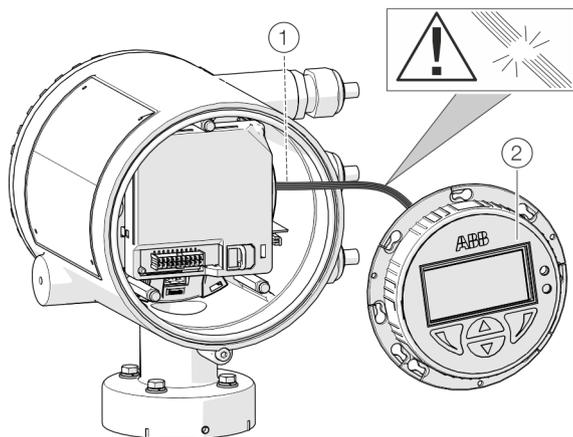
Perform the following steps to replace the fuse:

1. Switch off the power supply.
2. Open the transmitter housing.
3. Pull out the defective fuse and insert a new fuse.
4. Closing the transmitter housing.
5. Switch on the power supply.
6. Check that the device is working correctly.

If the fuse blows again on activation, the device is defective and must be replaced.

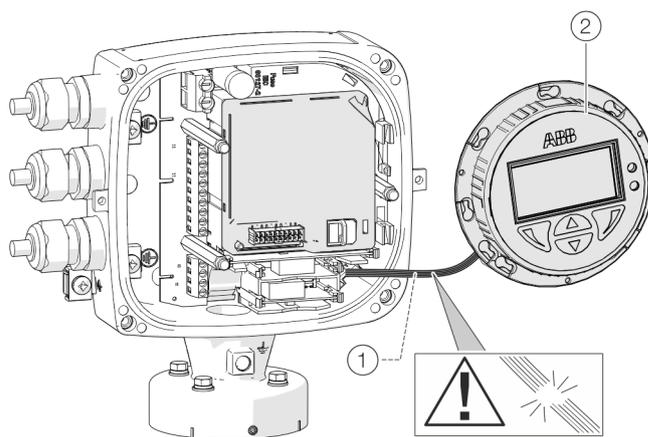
## Replacing the LCD indicator

Dual-compartment housing



① LCD indicator cable harness

Single-compartment housing



② LCD indicator

Figure 82: Replacing the LCD Indicator (example)

### NOTICE

If the O-ring gasket is seated incorrectly or damaged, this may have an adverse effect on the housing protection class. Follow the instructions in **Opening and closing the housing** on page 45 to open and close the housing safely.

The LCD indicator can be replaced in the event of a malfunction.

Component	Ordering number
LCD indicator (HMI)	3KQZ407125U0100
For integral mount and remote mount design	

Replace the LCD indicator by following the steps below:

1. Switch off the power supply.
2. Unscrew / remove the cover.
3. Loosen fixing screws for LCD indicator (only in integral mount design).
4. Remove the LCD indicator.
5. Pull the connector out of the motherboard.
6. Attach the connector on the new LCD indicator. Ensure that the cable harness is not damaged.
7. Insert the LCD indicator and tighten if necessary.
8. Unscrew / set down the cover once again
9. Switch on the power supply.

# ... 14 Repair

## Replacing the frontend board

Integral mount design

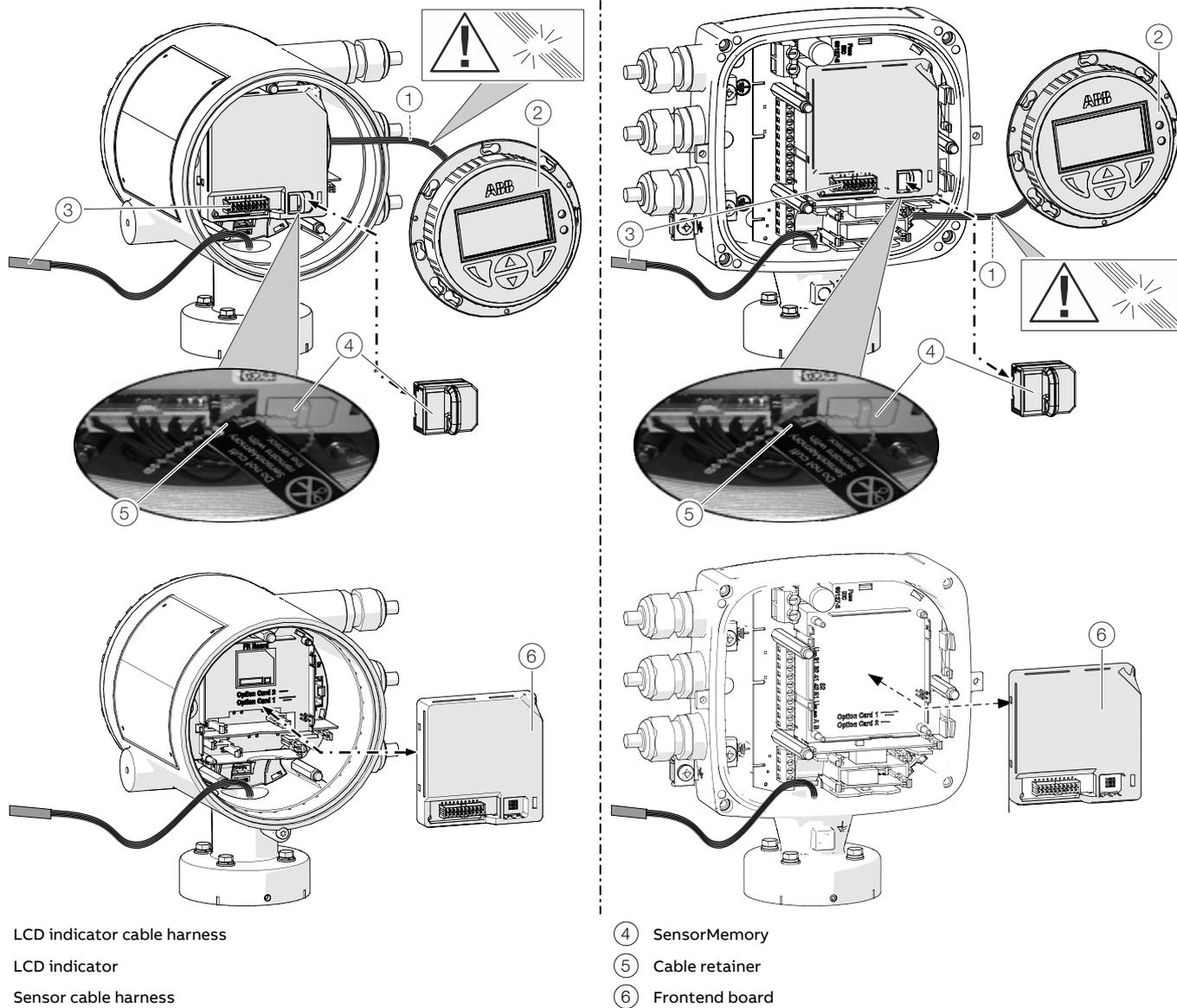


Figure 83: Replacing LCD indicator and frontend board (example)

**NOTICE**

**If the O-ring gasket is seated incorrectly or damaged, this may have an adverse effect on the housing protection class.**

Follow the instructions in **Opening and closing the housing** on page 45 to open and close the housing safely.

In the event of a fault, the frontend board can be replaced on flowmeters with an integral mount design.

Component	Ordering number
Frontend board (FEB)	3KXF002564U0100

Replace the frontend board as follows:

1. Switch off the power supply.
2. Unscrew / remove the cover.
3. Remove the LCD indicator. Ensure that the cable harness is not damaged.
4. Pull the connector out of the sensor cable harness.
5. Pull out the SensorMemory.

**Note**

The SensorMemory is assigned to the sensor. The SensorMemory is therefore fastened to the sensor cable harness with a cable retainer.

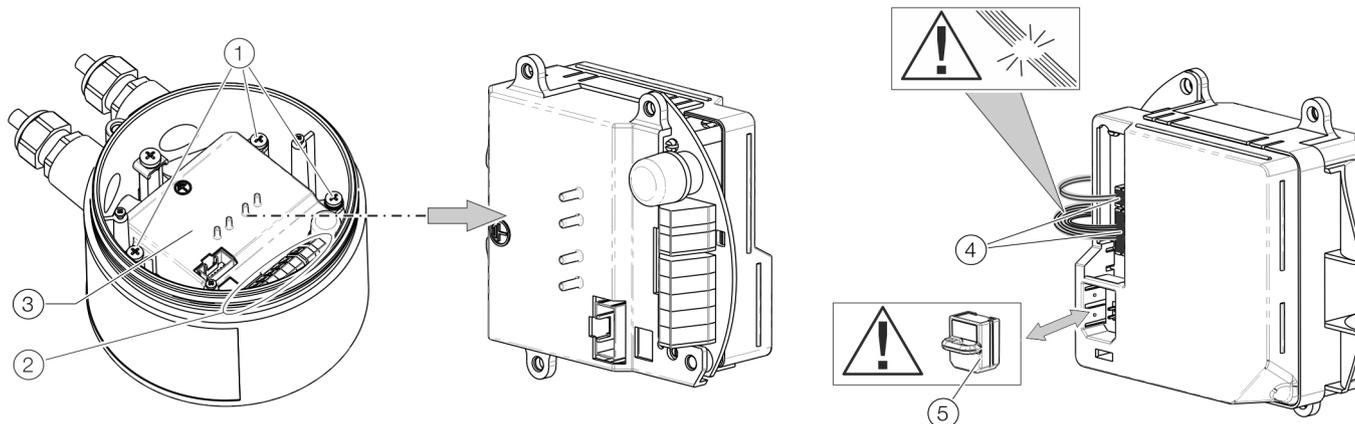
Ensure that the SensorMemory remains with the sensor and cannot be lost!

6. Pull the faulty frontend board out forwards.
7. Insert new frontend board.
8. Attach connector from the sensor cable harness.
9. Attach the SensorMemory.
10. Insert the LCD indicator and screw on / replace the cover.
11. Once the power supply is switched on, load the system data from the SensorMemory.

## ... 14 Repair

### ... Replacing the frontend board

#### Remote mount design



- ① Frontend board fixing screw
- ② Terminals
- ③ Frontend board

- ④ Connections for flowmeter sensor
- ⑤ SensorMemory

Figure 84: Replacing the frontend board (flowmeter sensor)

#### NOTICE

If the O-ring gasket is seated incorrectly or damaged, this may have an adverse effect on the housing protection class. Follow the instructions in **Opening and closing the housing** on page 45 to open and close the housing safely.

The frontend board can be replaced in the event of a malfunction.

Component	Ordering number
Frontend board (FEB)	3KXF002564U0100

Replace the frontend board as follows:

1. Switch off the power supply.
2. Unscrew / remove the cover.
3. Loosen the fixing screws (3×) at the frontend board.
4. Remove the faulty frontend board.
5. Pull the connector out of the sensor cable harness. Ensure that the cable harness is not damaged.
6. Pull out the SensorMemory.

#### Note

The SensorMemory is assigned to the sensor. Ensure that the SensorMemory remains with the sensor and cannot be lost!

7. Insert the SensorMemory into the new frontend board.
8. Connect the plug of the sensor cable harness.
9. Insert the new frontend board and secure it with the fixing screws (3×).
10. After powering up the power supply, the transmitter automatically replicates the system data from the SensorMemory.

## Replacing the sensor

### WARNING

#### Risk of injury due to process conditions.

The process conditions, for example high pressures and temperatures, toxic and aggressive measuring media, can give rise to hazards when working on the device.

- Before working on the device, make sure that the process conditions do not pose any hazards.
- If necessary, wear suited personal protective equipment when working on the device.
- Depressurize and empty the device / piping, allow to cool and purge if necessary.

### NOTICE

**If the O-ring gasket is seated incorrectly or damaged, this may have an adverse effect on the housing protection class.**

Follow the instructions in **Opening and closing the housing** on page 45 to open and close the housing safely.

#### Note

The frontend board of the replacement sensor has a SensorMemory module.

The calibration and system data of the sensor is stored in the SensorMemory.

After powering-up the power supply, the transmitter automatically replicates the system data from the SensorMemory.

Replace the sensor as described below:

1. Switch off the power supply.
2. Unscrew / remove the cover.
3. Disconnect the signal cable (if necessary, remove the potting compound).
4. Install the new sensor in accordance with **Installation** on page 36.
5. Complete the electrical connection in accordance with **Electrical connections** on page 53.
6. Unscrew / set down the cover once again
7. After powering-up the power supply, the transmitter automatically replicates the system data from the SensorMemory.

## Returning devices

Use the original packaging or a secure transport container of an appropriate type if you need to return the device for repair or recalibration purposes.

Fill out the return form (see **Return form** on page 177) and include this with the device.

In accordance with the EU Directive governing hazardous materials, the owner of hazardous waste is responsible for its disposal or must observe the following regulations for shipping purposes:

All devices delivered to ABB must be free from any hazardous materials (acids, alkalis, solvents, etc.).

Please contact Customer Center Service acc. to page 7 for nearest service location.

## 15 Dismounting and disposal

### Dismounting

#### WARNING

##### Risk of injury due to process conditions.

The process conditions, for example high pressures and temperatures, toxic and aggressive measuring media, can give rise to hazards when dismantling the device.

- If necessary, wear suited personal protective equipment during disassembly.
- Before disassembly, make sure that the process conditions do not pose any safety risks.
- Depressurize and empty the device / piping, allow to cool and purge if necessary.

Bear the following points in mind when dismantling the device:

- Switch off the power supply.
- Disconnect electrical connections.
- Allow the device / piping to cool and depressurize and empty. Collect any escaping medium and dispose of it in accordance with environmental guidelines.
- Use suited tools to disassemble the device, taking the weight of the device into consideration.
- If the device is to be used at another location, the device should preferably be packaged in its original packing so that it cannot be damaged.
- Observe the notices in **Returning devices** on page 175.

### Disposal

#### Note



Products that are marked with the adjacent symbol may **not** be disposed of as unsorted municipal waste (domestic waste).

They should be disposed of through separate collection of electric and electronic devices.

This product and its packaging are manufactured from materials that can be recycled by specialist recycling companies.

Bear the following points in mind when disposing of them:

- As of 8/15/2018, this product will be under the open scope of the WEEE Directive 2012/19/EU and relevant national laws (for example, ElektroG - Electrical Equipment Act - in Germany).
- The product must be supplied to a specialist recycling company. Do not use municipal waste collection points. These may be used for privately used products only in accordance with WEEE Directive 2012/19/EU.
- If there is no possibility to dispose of the old equipment properly, our Service can take care of its pick-up and disposal for a fee.

## 16 Specification

#### Note

The device data sheet is available in the ABB download area at [www.abb.de/flow](http://www.abb.de/flow).

## 17 Additional documents

#### Note

All documentation, declarations of conformity, and certificates are available in ABB's download area.

[www.abb.com/flow](http://www.abb.com/flow)

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## 18 Appendix

### Return form

#### Statement on the contamination of devices and components

Repair and/or maintenance work will only be performed on devices and components if a statement form has been completed and submitted.

Otherwise, the device/component returned may be rejected. This statement form may only be completed and signed by authorized specialist personnel employed by the operator.

#### Customer details:

Company: \_\_\_\_\_

Address: \_\_\_\_\_

Contact person: \_\_\_\_\_

Telephone: \_\_\_\_\_

Fax: \_\_\_\_\_

Email: \_\_\_\_\_

#### Device details:

Type: \_\_\_\_\_

Serial no.: \_\_\_\_\_

Reason for the return/description of the defect: \_\_\_\_\_

#### Was this device used in conjunction with substances which pose a threat or risk to health?

Yes  No

If yes, which type of contamination (please place an X next to the applicable items):

biological

corrosive / irritating

combustible (highly / extremely combustible)

toxic

explosive

other toxic substances

radioactive

Which substances have come into contact with the device?

1. \_\_\_\_\_

2. \_\_\_\_\_

3. \_\_\_\_\_

We hereby state that the devices/components shipped have been cleaned and are free from any dangerous or poisonous substances.

\_\_\_\_\_  
Town/city, date

\_\_\_\_\_  
Signature and company stamp

## Notes

## Notes

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**ABB Measurement & Analytics**

For your local ABB contact, visit:  
**[www.abb.com/contacts](http://www.abb.com/contacts)**

For more product information, visit:  
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