ABB MEASUREMENT & ANALYTICS | OPERATING INSTRUCTION

CoriolisMaster FCB400, FCH400

Coriolis mass flowmeter

Device firmware version: 00.05.00

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.
Alternatively simply scan this code:

Table of contents

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.

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 temperature 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.

Notes on data safety

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 Automation Products GmbH 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.

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 Automation Products GmbH
Measurement & Analytics
Dransfelder Str. 2
37079 Goettingen
Germany
Tel: +49 551 905-0
Fax: +49 551 905-777
Email: vertrieb.messtechnik-produkte@de.abb.com

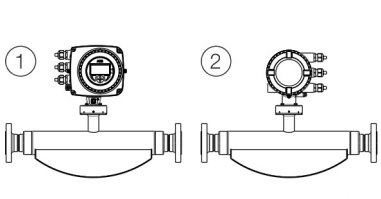
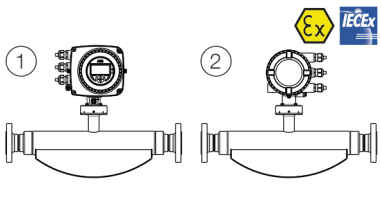
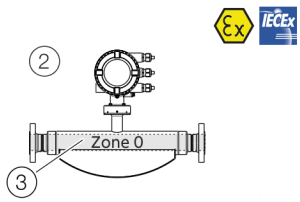
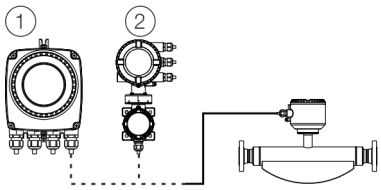
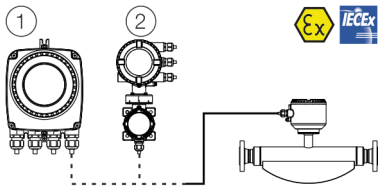
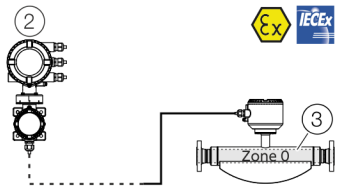
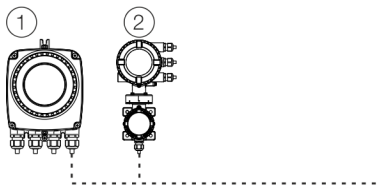
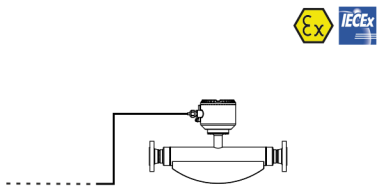
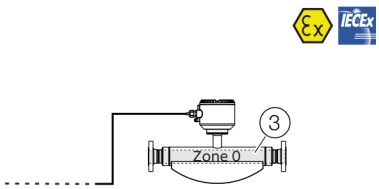
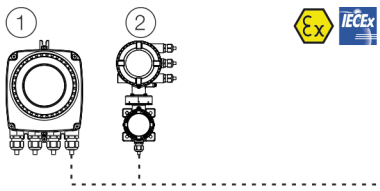
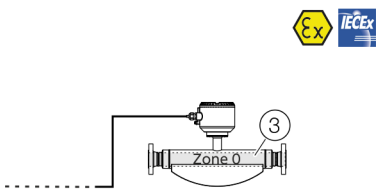
Customer service center
Tel: +49 180 5 222 580
Email: automation.service@de.abb.com

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 .

Device overview

ATEX / IECEx

	Standard / No explosion protection		Zone 2, 21, 22		Zone 1, 21 (Zone 0)	
Model number	**FCx4xx Y0**		**FCx4xx A2**		**FCx4xx A1**	
Integral mount design • Standard • Zone 2, 21, 22 • Zone 1, 21 • Zone 0						
Model number	**FCT4xx Y0**	**FCx4xx Y0**	**FCT4xx A2**	**FCx4xx A2**	**FCT4xx A1**	**FCx4xx A1**
Remote mount design Transmitter and flowmeter sensor • Standard • Zone 2, 21, 22 • Zone 1, 21 • Zone 0						
Model number	**FCT4xx Y0**		**FCT4xx A2**		**FCx4xx A1**	
Remote mount design Transmitter • Standard • Zone 2, 21, 22 Sensor • Zone 1, 21 • Zone 0						
Model number	—		**FCT4xx A2**		**FCx4xx A1**	
Remote mount design Transmitter • Zone 2, 21, 22 Sensor • Zone 1, 21	—					

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

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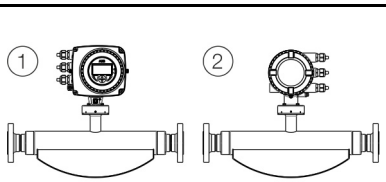
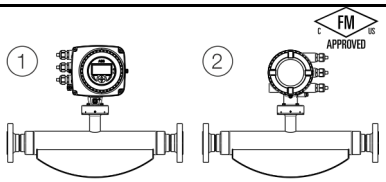
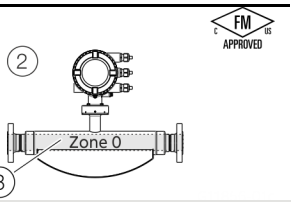
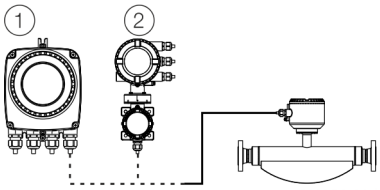
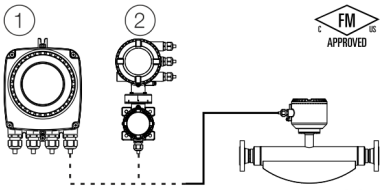
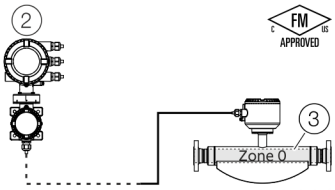
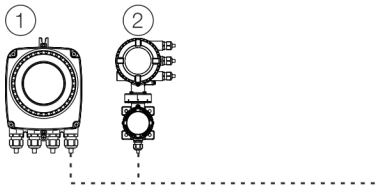
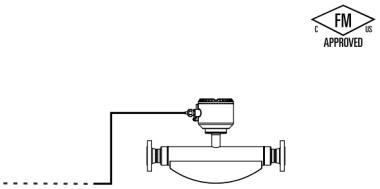
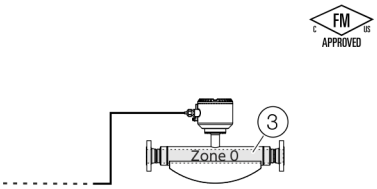
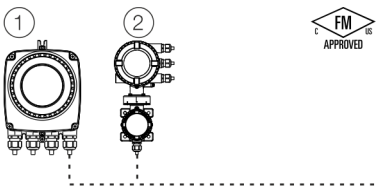
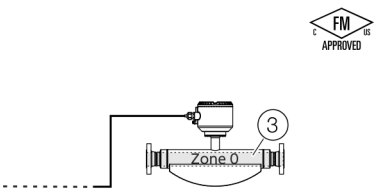
	Standard / No explosion protection	Class I Div. 2 / Zone 2	Class I Div. 1 / Zone 1 (Zone 0)
Model number	**FCx4xx Y0**	**FCx4xx F2**	**FCx4xx F1**
Integral mount design • Standard • Div. 2 / Zone 2 • Div. 1 / Zone 1 (Zone 0)			
Model number	**FCT4xx Y0** / **FCx4xx Y0**	**FCT4xx F2** / **FCx4xx F2**	**FCT4xx F1** / **FCx4xx F1**
Remote mount design Transmitter and flowmeter sensor • Div. 2 / Zone 2 • Div. 1 / Zone 1 (Zone 0)			
Model number	**FCT4xx Y0**	**FCT4xx F2**	**FCx4xx F1**
Remote mount design Transmitter • Standard Sensor • Div. 2 / Zone 2 • Div. 1 / Zone 1 (Zone 0)			
Model number	**—**	**FCT4xx F2**	**FCx4xx F1**
Remote mount design Transmitter • Div. 2 / Zone 2 Sensor • Div. 1 / Zone 1 (Zone 0)	—		

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
Explosion protection											
Without		Y0									
ATEX / IECEx (Zone 2 / 22)		A2									
ATEX / IECEx (Zone 1 / 21)		A1									
cFMus version, Class 1, Div. 2 (Zone 2 / 21)		F2									
cFMus version, Class 1, Div. 1 (Zone 1 / 21)		F1									
NEPSI (Zone 2 / 22)		S2									
NEPSI (Zone 1 / 21)		S1									
Design / terminal box material / cable glands											
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								
Nominal diameter / nominal connection diameter				xxxxx							
Process connection					xx						
Material for wetted parts											
Stainless steel						A1					
Polished stainless steel						H1					
Nickel alloy						C1					
Flow rate calibration							x				
Density calibration								x			

Basic model	**FCa4c**	d	m	f	g	h	i	j	**k**	**l**	**m**
Design / transmitter housing / transmitter housing material / cable gland											
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 mount / single-compartment housing, wall mounting / aluminum / 4 × NPT ½ in									W2		
Remote mount / not specified									Y0		
Outputs											
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), 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	
Power supply											
100 to 230 V AC											A
11 to 30 V DC											C
Without											Y

* The M1 design is identical in construction to the M5 design, as it can also be called in other locations

… 2 Use in potentially explosive atmospheres

… Ex marking

ATEX / IECEx

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
FCa4c – A2Y0fghijD Integral mount design with dual-compartment housing	II3G Ex ec IIC T6...T1 Gc II2D Ex tc IIIC T80°C...Tmedium Dc	**ATEX:** FM15ATEX0014X, FM15ATEX0016X **IECEx:** IECEx FME 15.0005X
FCa4c – A2efghijY Sensor in remote mount design with dual-compartment housing		
FCT4c – A2R Transmitter in remote mount design with dual-compartment housing	II3G Ex ec IIC T6 Gc II2D Ex tc IIIC T80°C Dc	

Model number for use in Zone 1, 21	Ex marking	Certificate
FCa4c – A1Y0fghijDx (x = 1 to 4) 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	**ATEX:** FM15ATEX0015X **IECEx:** IECEx FME 15.0005X
FCa4c – A1Y0fghijDx (x = 5 to 8) 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	
FCa4c – A1efghijY 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	
FCT4c – A1R (x = 1 to 4) 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	
FCT4c – A1R (x = 5 to 8) 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	

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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
FCa4c – F2Y0fghijD Integral mount design with dual-compartment housing	NI: CL I,II,III Div 2, GPS ABCDEFG, T6…T1 DIP: CL II,III, Div 1, GPS EFG, T6	**cFMus:** 3050239
FCa4c – F2efghijY 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, AEx ec IIC T6…T1 (USA) ZN 21, AEx ia tb IIIC T80°C (USA) CL I, ZN 2, Ex ec IIC T6...T1 (CAN) ZN21,Ex ia tb IIIC T80°C (CAN)	
FCT4c – F2R Transmitter in remote mount design with dual-compartment housing	See handbook for temperature class information	

Model number for use in Division 1	Ex marking	Certificate
FCa4c – F1Y0fghijDx (x = 1 to 4) Integral mount design with dual-compartment housing	XP-IS: CL I, Div 1, GPS ABCD,T6…T1 (USA) XP-IS: CL I, Div 1, GPS BCD,T6…T1 (CAN)	**cFMus:** 3050239
FCa4c – F1Y0fghijDx (x = 5 to 8) 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)	DIP: CL II,III, Div 1, GPS EFG,T6 CL I, ZN 1, AEx db ia IIB+H2 T6…T1 (USA) ZN21, AEx ia tb IIIC T80°C (USA) CL I, ZN 1, Ex db ia IIB+H2 T6…T1 (CAN) ZN21, Ex ia tb IIIC T80°C (CAN) See handbook for temperature class information and installation drawing 3KXF000028G0009	
FCa4c – F1efghijY 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 (USA) DIP: CL II,III, Div 1, GPS EFG,T6 CL I, ZN 1, AEx db ia IIB+H2 T6…T1 (USA) ZN 21, AEx ia tb IIIC T80°C (USA) CL I, ZN 1, Ex db ia IIB+H2 T6…T1 (CAN) ZN21, Ex ia tb IIIC T80°C (CAN) See handbook for temperature class information and installation drawing 3KXF000028G0009	
FCT4c – F1Rx (x = 1 to 4) Transmitter in remote mount design with dual-compartment housing	XP-IS: CL I, Div 1, GPS BCD,T6…T1 (USA) XP-IS: CL I, Div 1, GPS BCD,T6…T1 (CAN)	
FCT4c – F1Rx (x = 5 to 8) Sensor in remote mount design with dual-compartment housing (Explosionproof 'XP').	DIP: CL II,III, Div 1, GPS EFG, T6 CL I, ZN 1, AEx db ia IIB+H2 T6…T1 (USA) ZN 21, AEx ia tb IIIC T80°C (USA) CL I, ZN 1, Ex db ia IIB+H2 T6…T1 (CAN) ZN21,Ex ia tb IIIC T80°C (CAN) See handbook for temperature class information and installation drawing 3KXF000028G0009	

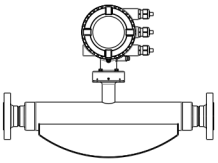
… 2 Use in potentially explosive atmospheres

Temperature data

Temperature resistance for the connecting cable

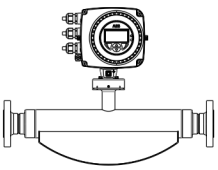
The temperature at the cable entries of the device depends on the design, the measuring medium temperature T_{medium} and the ambient temperature $T_{amb.}$.
For the electric connection of the device, use only cables with sufficient temperature resistance in accordance with the following table.

Devices in integral mount design with dual-compartment housing



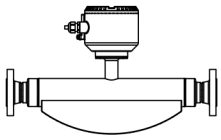
$T_{amb.}$	Temperature resistance
≤ 50 °C (≤ 122 °F)	≥ 70 °C (≥ 158 °F)
≤ 60 °C (≤ 140 °F)	≥ 80 °C (≥ 176 °F)
≤ 70 °C (≤ 158 °F)	≥ 90 °C (≥ 194 °F)

Devices in integral mount design with single-compartment housing



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

Sensor in remote mount design



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

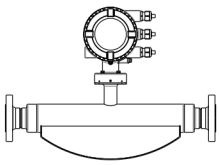
For sensors in remote mount design, the wires in the connection box must be additionally insulated with the enclosed silicone hoses starting from ambient temperatures of $T_{amb.}$ ≥ 60 °C (≥ 140 °F).

Environmental and process conditions for model FCx4xx…

Ambient temperature $T_{amb.}$	-20 to 70 °C
	(-4 to 158 °F)
	-40 to 70 °C*
	(-40 to 158 °F)*
Measuring medium temperature	-40 to 205 °C
T_{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**'

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



Model FCx4xx-A1... 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.

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

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

Model FCx4xx-A2... 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.

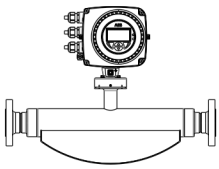
	Temperature class					
Ambient temperature $T_{amb.}$	**T1**	**T2**	**T3**	**T4**	**T5**	**T6**
≤ 30 °C (≤ 86 °F)	205 °C (400 °F)	205 °C (400 °F)	195 °C (383 °F)* 130 °C (266 °F)	130 °C (266 °F)	95 °C (203 °F)	80 °C (176 °F)* 60 °C (140 °F)
≤ 40 °C (≤ 104 °F)	205 °C (400 °F)	205 °C (400 °F)	195 °C (383 °F)* 130 °C (266 °F)	130 °C (266 °F)	95 °C (203 °F)	—
≤ 50 °C (≤ 122 °F)	205 °C (400 °F)	205 °C (400 °F)	195 °C (383 °F)* 130 °C (266 °F)	130 °C (266 °F)	—	—
≤ 60 °C (≤ 140 °F)	205 °C (400 °F)	205 °C (400 °F)	195 °C (383 °F)* 130 °C (266 °F)	130 °C (266 °F)	—	—
≤ 70 °C (≤ 158 °F)	205 °C (400 °F)* 130 °C (266 °F)	205 °C (400 °F)* 130 °C (266 °F)	195 °C (383 °F)* 130 °C (266 °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 integral mount design with single-compartment housing



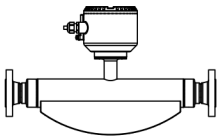
Model FCx4xx-A2… and FCx4xx-F2… in Zone 2, Division 2

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

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

Measuring medium temperature for sensors in remote mount design



Model FCx4xx-A1..., FCx4xx-F1... in Zone 1

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

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

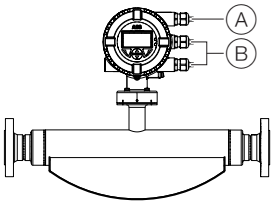
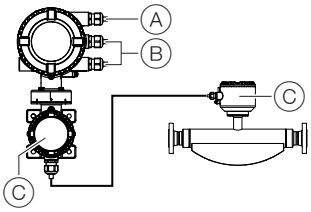
	Temperature class					
Ambient temperature $T_{amb.}$	**T1**	**T2**	**T3**	**T4**	**T5**	**T6**
≤ 30 °C (≤ 86 °F)	205 °C (400 °F)*	205 °C (400 °F)*	195 °C (383 °F)*	130 °C (266 °F)*	95 °C (203 °F)*	80 °C (176 °F)
	195 °C (383 °F)	195 °C (383 °F)	130 °C (266 °F)	95 °C (203 °F)	80 °C (176 °F)	
≤ 40 °C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

… 2 Use in potentially explosive atmospheres

Electrical data

Overview

Standard / No explosion protection	**Zone 2, 21**	**Zone 1, 21 (Zone 0)**
	Division 2 and Zone 2, 21	**Division 2 and Zone 1, 21**
ATEX: – **IECEx:** –	**ATEX:** II 3 G & II 2 D **IECEx:** Gc & Db	**ATEX:** II 1/2 (1) G & II 2 (1) D II 1/2 G & II 2 D II 2 (1) G & II 2 (1) D **IECEx:** (Ga) Gb & (Da) Db Ga/Gb & Db (Ga) Gb & (Da) Db
USA: – **Canada:** –	**USA:** NI & DIP AEx ec & AEx tb **Canada:** Non-Incendive & Dust Ignition Proof Ex ec & Ex tb	**USA:** XP-IS & DIP AEx db ia & AEx ia tb **Canada:** XP-IS & DIP Ex db ia & Ex ia tb
		
(A) Power supply	(B) Inputs / outputs, communication	(C) Signal cable (remote mount design only)
• Type of protection ATEX / IECEx: Increased safety ‘Ex e’ • Type of protection USA / Canada: ‘non IS’ • Maximum 250 Vrms • Terminals: 1+, 2-, L, N, ⏚	• Type of protection ATEX / 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	• Terminals: A, B, UFE, GRN • Type of protection ATEX / 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 24 must be observed when changing the type of protection!

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

Outputs on basic device	Operating values (general)		Type of protection – 'nA' / 'NI'	
	U_N	I_N	U_N	I_N
Current / HART output 31 / U_{CO}, active Terminals 31 / U_{CO}	30 V	30 mA	30 V	30 mA
Current / HART output 31 / 32, passive Terminals 31 / 32	30 V	30 mA	30 V	30 mA
Digital output 41 / 42, active* Terminals 41 / 42 and V1 / V2*	30 V	30 mA	30 V	30 mA
Digital output 41 / 42, active** Terminals 41 / 42 and U_{CO} / 32**	30 V	30 mA	30 V	30 mA
Digital output 41 / 42, passive Terminals 41 / 42	30 V	25 mA	30 V	25 mA
Digital output 51 / 52, active* Terminals 51 / 52 and V1 / V2*	30 V	30 mA	30 V	30 mA
Digital output 51 / 52, passive 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 Uco / 32 as loop power supply for digital output 41 / 42 or 51 / 52** on page 50.

Inputs and outputs with optional plug-in cards	Operating values (general)		Type of protection – 'nA' / 'NI'	
	U_N	I_N	U_N	I_N
Current output V3 / V4, active* Terminals V3 / V4 and V1 / V2*	30 V	30 mA	30 V	30 mA
Current output V1 / V2, passive** **Current output V3 / V4, passive**** Terminals V1 / V2** or V3 / V4**	30 V	30 mA	30 V	30 mA
Digital output V3 / V4, active* Terminals V3 / V4 and V1 / V2*	30 V	25 mA	30 V	25 mA
Digital output V1 / V2, passive** **Digital output V3 / V4, passive**** Terminals V1 / V2** or V3 / V4**	30 V	30 mA	30 V	30 mA
Digital input V3 / V4, active* Terminals V3 / V4 and V1 / V2	30 V	3.45 mA	30 V	3.45 mA
Digital input V1 / V2, passive* **Digital input V3 / V4, passive*** Terminals V1 / V2** or V3 / V4**	30 V	3.45 mA	30 V	3.45 mA
Modbus® / PROFIBUS DP® Terminals V1 / V2	30 V	30 mA	30 V	30 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 53.

… 2 Use in potentially explosive atmospheres

… Electrical data

Zone 1 ,21 und Division 1 – Model: FCx4xx-A1, FCx4xx-F1

Type of protection	**'e' / 'XP'**		**'ia' / 'IS'**											
Outputs on basic device	**U_M [V]**	**I_M [A]**	**U_O [V]**	**U_I [V]**	**I_O [mA]**	**I_I [mA]**	**P_O [mW]**	**P_I [mW]**	**C_O [nF]**	**C_I [nF]**	**C_{OPA} [nF]**	**C_{IPA} [nF]**	**L_O [mH]**	**L_I [mH]**
Current / HART output 31 / U_{CO}, active Terminals 31 / U_{CO}	30	0.2	30	30	115	115	815	815	10	10	5	5	0.08	0.08
Current / HART output 31 / 32, passive Terminals 31 / 32	30	0.2	—	30	—	115	—	815	—	27	—	5	0.08	0.08
Digital output 41 / 42, active* Terminals 41 / 42 and V1 / V2*	30	0.1	27.8	30	119	30	826	225	20	20	29	29	0.22	0.22
Digital output 41 / 42, active** Terminals 41 / 42 and U_{CO} / 32**	30	0.1	30	30	115	115	826	225	16	16	10	10	0.08	0.08
Digital output 41 / 42, passive Terminals 41 / 42	30	0.1	—	30	—	30	—	225	—	27	—	5	—	0.08
Digital output 51 / 52, active* Terminals 51 / 52 and V1 / V2*	30	0.1	27.8	30	119	30	826	225	20	20	29	29	0.22	0.22
Digital output 51 / 52, passive 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_{CO} / 32 in 'power mode', see **Current output Uco / 32 as loop power supply for digital output 41 / 42 or 51 / 52** on page 50.

Type of protection	**'e' / 'XP'**		**'ia' / 'IS'**											
Inputs and outputs with optional plug-in cards	**U_M [V]**	**I_M [A]**	**U_O [V]**	**U_I [V]**	**I_O [mA]**	**I_I [mA]**	**P_O [mW]**	**P_I [mW]**	**C_O [nF]**	**C_I [nF]**	**C_{OPA} [nF]**	**C_{IPA} [nF]**	**L_O [mH]**	**L_I [mH]**
Current output V3 / V4, active* Terminals V3 / V4 and V1 / V2*	30	0.1	27.8	30	119	30	826	225	29	29	117	117	0.4	0.4
Current output V1 / V2, passive** **Current output V3 / V4, passive**** Terminals V1 / V2** or V3 / V4**	30	0.1	—	30	—	68	—	510	—	45	—	59	—	0.27
Digital output V3 / V4, active* Terminals V3 / V4 and V1 / V2*	30	0.1	27.8	30	119	68	826	225	17	17	31	31	0.4	0.4
Digital output V1 / V2, passive** **Digital output V3 / V4, passive**** Terminals V1 / V2** or V3 / V4**	30	0.1	—	30	—	30	—	225	—	13	—	16	—	0.27
Digital input V3 / V4, active* 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
Digital input V1 / V2, passive* **Digital input V3 / V4, passive*** Terminals V1 / V2** or V3 / V4**	30	0.1	—	30	—	3.45	—	25.8	—	13	—	16	—	0.27
Modbus® / PROFIBUS DP® Terminals V1 / V2	30	0.1	4.2	4.2	150	150	150	150	1.5	1.5	6	6	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 53.

… 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.

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 V.
- Intrinsic safety is preserved If the rated voltage U_M = 30 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 24 must be observed when changing the type of protection.

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

Installation in accordance with ATEX or IECEx 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 16 must be observed.

… 2 Use in potentially explosive atmospheres

Installation instructions

ATEX / IECEx

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) 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), 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.

Opening and closing the housing

⚠ DANGER

Danger of explosion if the device is operated with the transmitter housing or terminal box open!
While using the device in potentially explosive atmospheres before opening the transmitter housing or the terminal box, note the following points:

- A valid fire permit must be present.
- Make sure that no flammable or hazardous atmospheres are present.

⚠ 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 38.

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

Note
Spare parts can be ordered from ABB Service.
www.abb.com/contacts

Cable entries in accordance with ATEX / IECEx

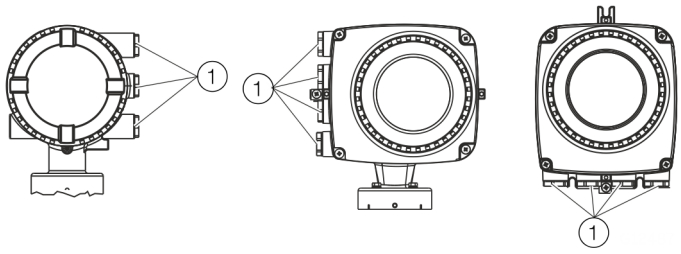
The devices are supplied with cable glands installed (certified in accordance with ATEX or IECEx).

- 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 °C (−40 °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 ½ 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 ½ in. NPT thread only and without cable glands.

… 2 Use in potentially explosive atmospheres

… Installation instructions

Electrical connections

Note
The temperature at the cable entries of the device depends on the design, the measuring medium temperature T_{medium} and the ambient temperature $T_{amb.}$.
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 12.

Grounding

The sensor must be grounded in accordance with the applicable international standards.
Perform grounding of the device in accordance with **Pin assignment** on page 48.

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 **Pin assignment** on page 48.

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

Operating instructions

Protection against electrostatic discharges

⚠ DANGER

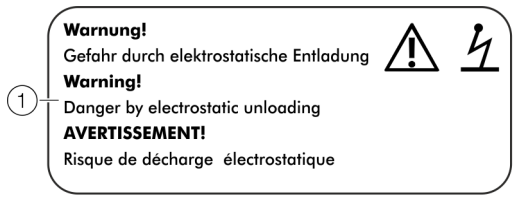
Risk of explosion!
The painted surface of the device can store electrostatic charges.
As a result, the housing can form an ignition source due to electrostatic discharges in the following conditions:

- The device is operated in environments with a relative humidity of ≤ 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.

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’ are equipped with flameproof joints in the housing. Contact ABB before commencing repair work.

… 2 Use in potentially explosive atmospheres

… Operating instructions

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
Zone 1 / Div. 1: Current outputs and digital outputs in non-intrinsically safe design	**Zone 1 / Div. 1:** Current outputs and digital outputs in intrinsically safe ia / IS design	• 500 V AC/1min or 500 × 1.414 = 710 V DC/1min Test between terminals A / B, U_{FE}, /GND, U_{CO} / 32, 31 / 32, 41 / 42, 51 / 52, V1 / V2 and V3 / V4, and terminals A, B, U_{FE}, GND, U_{CO}, 31, 32, 41, 42, 51, 52, V1, V2, V3, V4 and the housing. When this test is performed, no voltage flashover is permitted in or on the device. • Optical evaluation particularly of the electronic circuit boards, no visible damage or evidence of explosion.
Zone 1 / Div. 1: Current outputs and digital outputs in intrinsically safe ia(ib) / IS design	**Zone 1 / Div. 1:** Current outputs and digital outputs in non-intrinsically safe design	• Visual inspection, no damage visible on the threads (cover, ½ in NPT cable glands).

3 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.

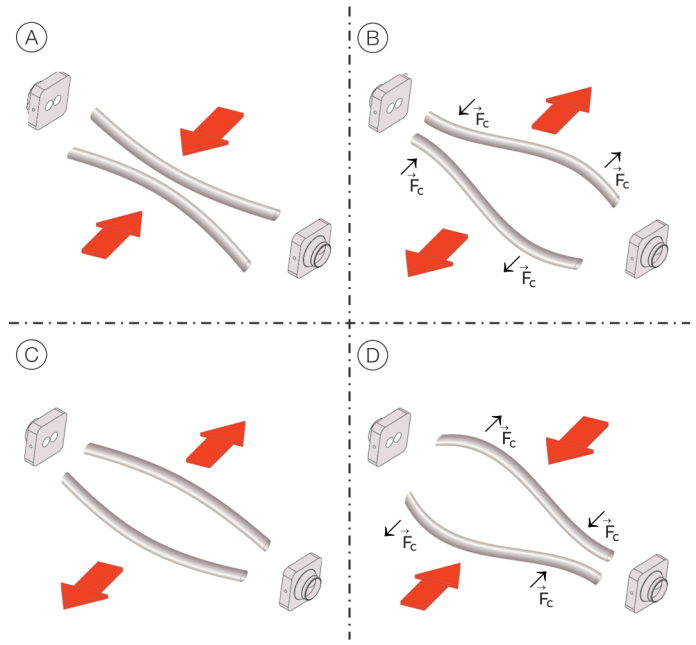
Measuring principle

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

$$\vec{Fc} = -2m\left(\vec{\omega} \times \vec{v}\right)$$

$\vec{Fc}$ Coriolis force
$\vec{\omega}$ Angular velocity
$\vec{v}$ Velocity of the mass
m Mass

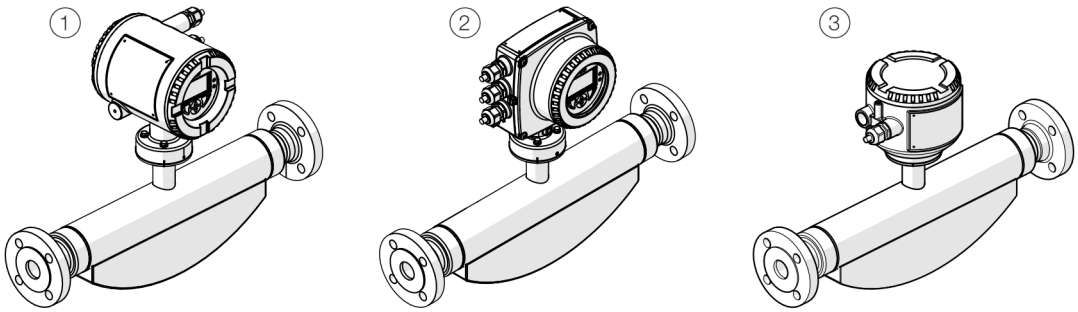


(A) Movement of the pipes inward, no flow
(B) Direction of the Coriolis force with flow and movement of the pipes outward
(C) Movement of the pipes outward, no flow
(D) Direction of the Coriolis force with flow and movement of the pipes inward

Figure 3: Simplified representation of Coriolis forces

… 3 Design and function

Device designs

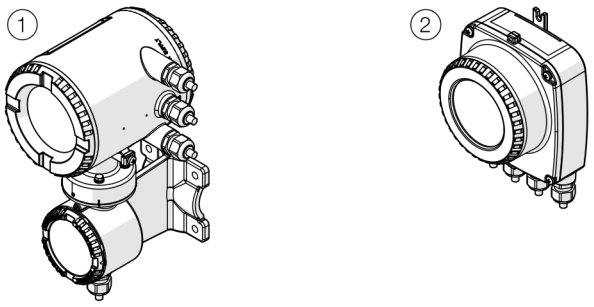


1 Sensor (integral mount design, dual-compartment housing)
2 Sensor (integral mount design, single-compartment housing)
3 Sensor (remote mount design)

Figure 4: Designs

Sensor				
Model	FCB400 standard design		FCH400 hygienic design	
Housing	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	• 0.002 kg/l • 0.001 kg/l (optional) • 0.0005 kg/l	0.01 kg/l	• 0.002 kg/l • 0.001 kg/l (optional) • 0.0005 kg/l
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_{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 (⅜ to 4 in)		DN 15 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 ⅜ to 4 in		DN ⅜ 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 (optional)		Stainless steel, polished 1.4404 (AISI 316L) or 1.4435 (AISI 316L)	
IP rating	• Integral mount design: IP 65 / IP 67, NEMA 4X • Remote mount design: IP 65 / IP 67 / IP 68 (sensor only, immersion depth: 5 m), NEMA 4X			
Approvals				
• Explosion protection	ATEX / IECEx / cFMus		ATEX / IECEx / cFMus	
• Hygiene approvals	—		EHEDG, FDA compliant	
• Legal metrology	Type-tested for legal metrology in accordance with MID / OIML R117 or API / AGA			
• Further approvals	At www.abb.com/flow or upon request.			

* Indication of accuracy in % of the measured value



① Dual-compartment housing

② Single-compartment housing

Figure 5: Transmitter with remote mount design

Transmitter	
Housing	Integral mount design (see Figure 4, pos. ① and ②), remote mount design.
IP rating	IP 65 / IP 67, NEMA 4X
Cable length	Maximum 200 m (656 ft), with remote mount design only
Power supply	100 to 240 V AC, 50 / 60 Hz 11 to 30 V DC, nominal voltage: 24 V DC
Outputs in basic version	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
Additional optional outputs	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: • Current output (maximum two plug-in cards simultaneously) • Digital output (maximum one plug-in card) • Digital input (maximum one plug-in card) • Modbus or PROFIBUS DP interface (maximum of one plug-in card) • 24 V DC loop power supply for active outputs (maximum one plug-in card)
External output zero return	Yes
External totalizer reset	Yes
Forward / reverse flow metering	Yes
Counter	Yes
Communication	HART® protocol 7.1, Modbus® or Profibus DP® (using a plug-in card)
Empty pipe detection	Yes, via configurable density alarm
Self-monitoring and diagnosis	Yes
Local indicator	Yes
Field optimization for flow and density	Yes
Concentration measurement 'DensiMass'	Yes, optional on models FCB450 and FCH450
'FillMass' filling function	Yes, optional on models FCB450 and FCH450
'VeriMass' function	Yes, optional

4 Product identification

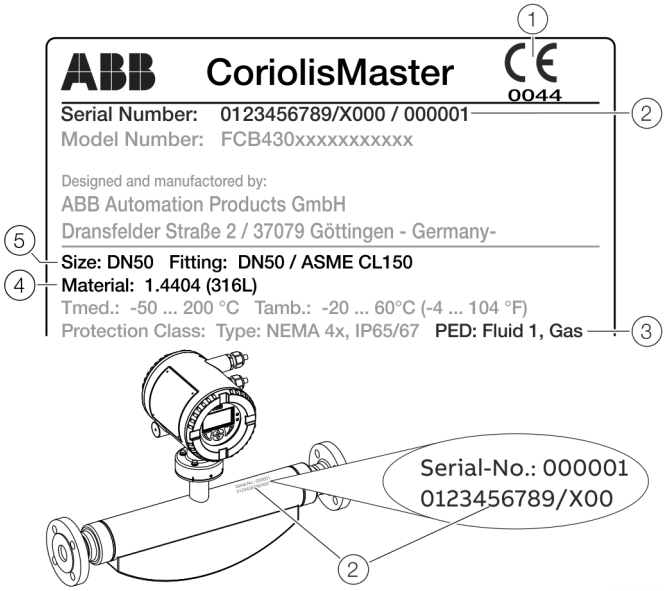
Name plate

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

1. Type designation
2. CE mark
3. Serial number
4. Order code
5. Manufacturer
6. Process connection / pressure rating
7. Ambient temperature range
8. PED marking
9. Maximum power consumption
10. 'Hot surface' symbol
11. 'Observe operating instruction' symbol
12. Year of manufacture (month / year)
13. Ex marking, such as ATEX / IECEx or FM / CSA
14. Maximum voltage at inputs and outputs
15. Power supply
16. IP rating
17. Measuring medium temperature range
18. Meter tube material
19. Nominal diameter

Figure 6: Name plate (example)

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



1. CE mark with notified body
2. Serial number of the sensor
3. Fluid group or reason for exception
4. Material of the pressure-bearing parts (wetted parts)
5. Nominal diameter / Nominal pressure rating

Figure 7: 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.

5 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.

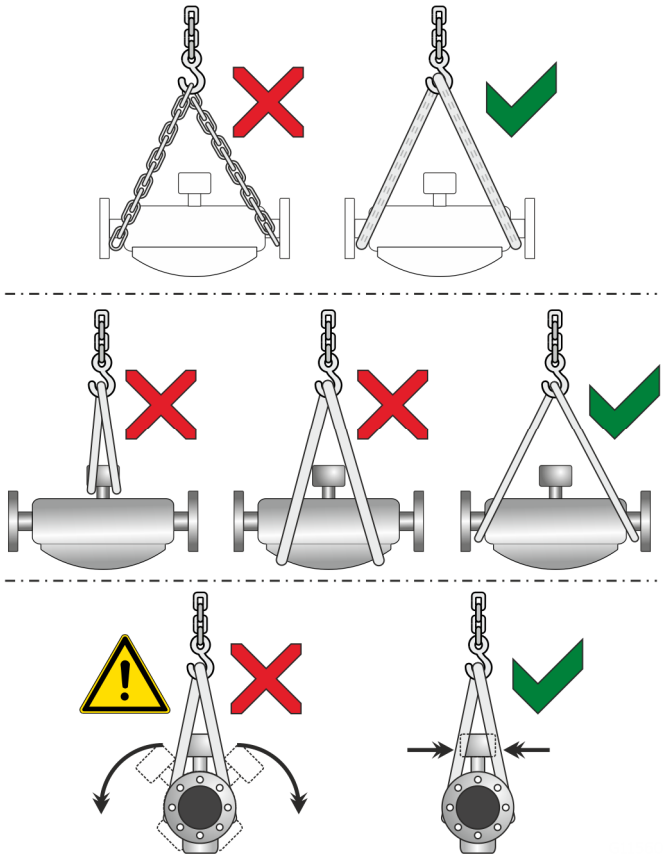


Figure 8: Transport instructions

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.

… 5 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 138.

6 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 $T_{ambient}$) 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 $T_{ambient}$ 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.

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).

… 6 Installation

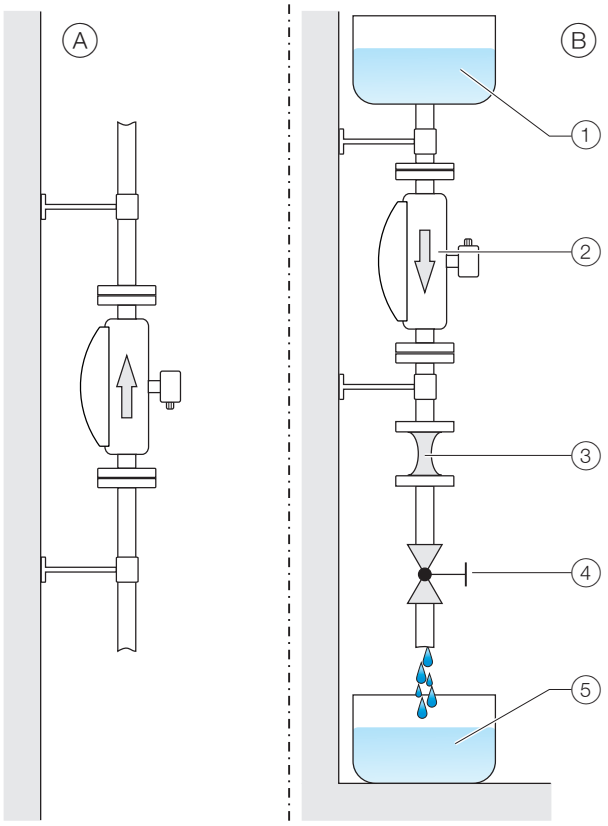
… General installation conditions

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 9: Vertical installation

(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

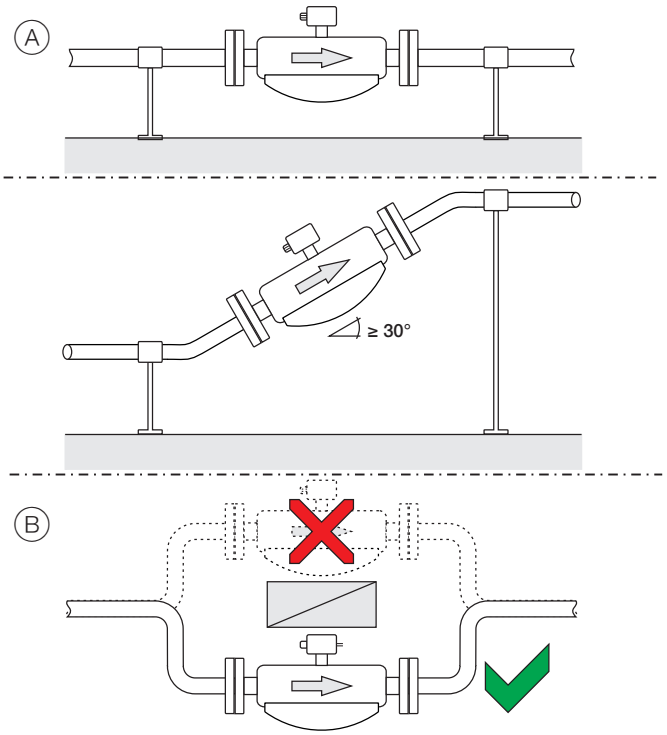


Figure 10: Horizontal installation

(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 ≥ 30°.
(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

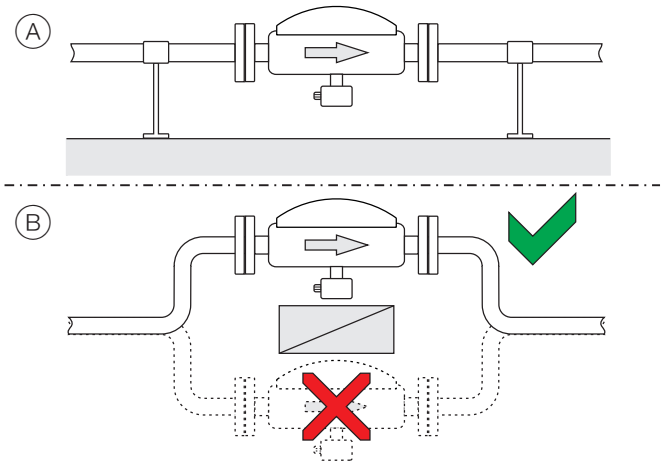
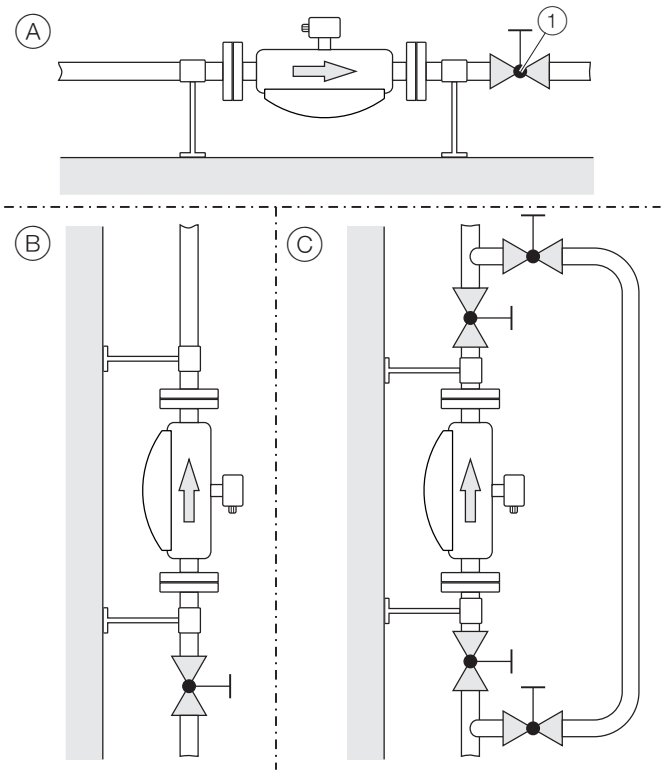


Figure 11: Horizontal installation

Ⓐ For gaseous measuring media and horizontal installation, the transmitter and terminal box must point downward.
Ⓑ 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



① Turn-off device

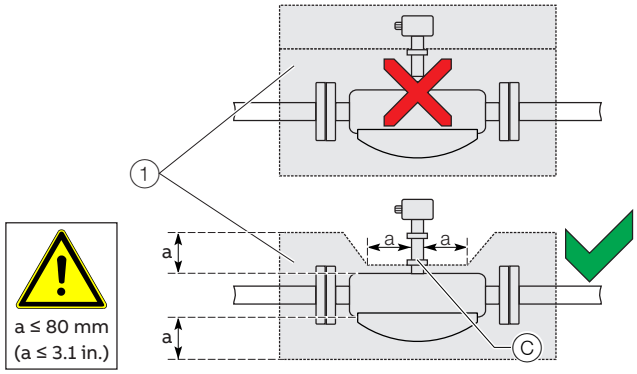
Figure 12: Mounting options for turn-off devices (example)

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.

… 6 Installation

Sensor insulation



① Insulation

Figure 13: Installation at T_{medium} −50° to 205 °C (−58 to 400 °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 13.

Heat tracing of the sensor

When operating the sensor in conjunction with heat tracing, the temperature at point Ⓒ (Figure 13) 100 °C (212 °F) must not be exceeded at any time!

Installation in EHEDG-compliant installations

⚠ WARNING

Risk of poisoning!

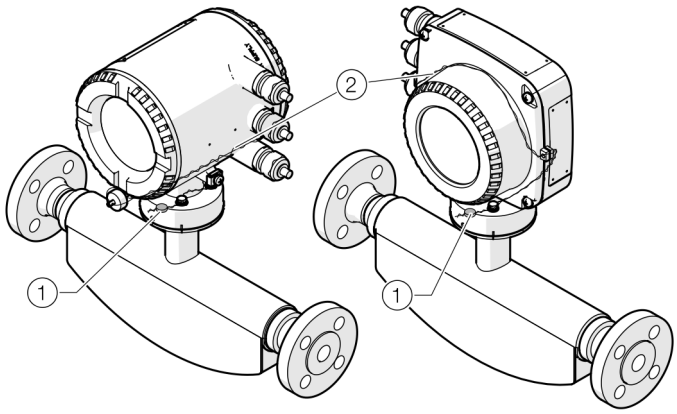
Bacteria and chemical substances can contaminate or pollute pipeline systems and the materials they are made of.

- 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° incline is used. Refer to **Liquid measuring media** on page 32.
- 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.
- The pipe fitting in accordance with DIN 11851 is approved for use in conjunction with an EHEDG-compliant gasket.

Devices for legal metrology in accordance with MID / OIML R117

The Coriolis mass flowmeters CoriolisMaster FCBx50 / FCHx50 are type-tested for legal metrology in accordance with MID / OIML R117 in accuracy class 0.3.
Additional information can be found on the corresponding certificate. The certificate is available in the download area at www.abb.com/flow.



① Lead seal
② Lead seal wire

Figure 14: Sealing in accordance with MID / OIML R117 (example)

On devices for legal metrology in accordance with MID / OIML R117, the hardware write protection must be activated after commissioning.
This prevents a change in the parameterization of the devices.
Hardware settings on page 64

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 12!

Measuring medium temperature T_{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 ≥ 65 °C (149 °F).

Ambient temperature T_{amb}.
- Standard: −20 to 70 °C (−4 to 158 °F)
- Optional: −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 26.

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
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.
- 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_{medium}) can be found on the name plate.

Design	Nominal diameter	PS_{max}	TS_{max}	TS_{min}
Pipe fitting (DIN 11851)	DN 15 to DN 40 (½ to 1½ in)	40 bar (290 psi) (580 psi)	140 °C (284 °F)	−40 °C (−40 °F)
	DN 50 to DN 100 (2 to 4 in)	25 bar (290 psi) (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 (290 psi) (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 (290 psi) (232 psi)	120 °C (248 °F)	−40 °C (−40 °F)
	DN 65 to DN 100 (2½ to 4 in)	10 bar (290 psi) (145 psi)	120 °C (248 °F)	−40 °C (−40 °F)
ASME BPE Clamp	< DN 80 (< 3 in)	17.1 bar (290 psi) (248 psi)	121 °C (249.8 °F)	−40 °C (−40 °F)
	DN 80 (< 3 in)	15.5 bar (290 psi) (224.8 psi)	121 °C (249.8 °F)	−40 °C (−40 °F)
	DN 100 (< 4 in)	12.9 bar (290 psi) (187.1 psi)	121 °C (249.8 °F)	−40 °C (−40 °F)

… 6 Installation

… Material load for process connections

Material load curves for flange devices

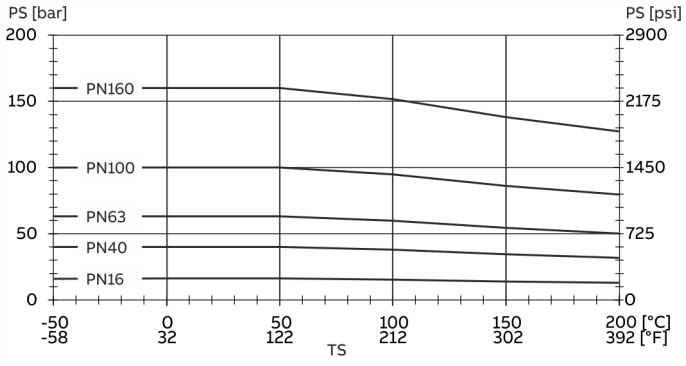


Figure 15: Stainless steel DIN flange 1.4571 / 1.4404 (316Ti / 316L) to DN 200 (8 in)

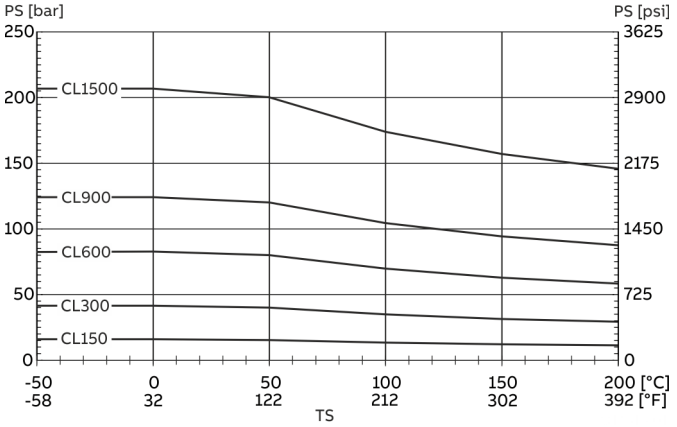


Figure 16: Stainless steel ASME flange 1.4571 / 1.4404 (316Ti / 316L) up to DN 200 (8 in.)

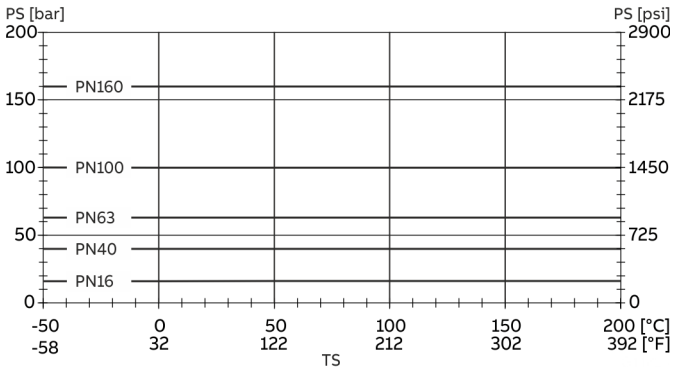


Figure 17: Nickel alloy DIN flange C4 (2.4610) or nickel alloy C22 (2.4602) up to DN 200 (8 in.)

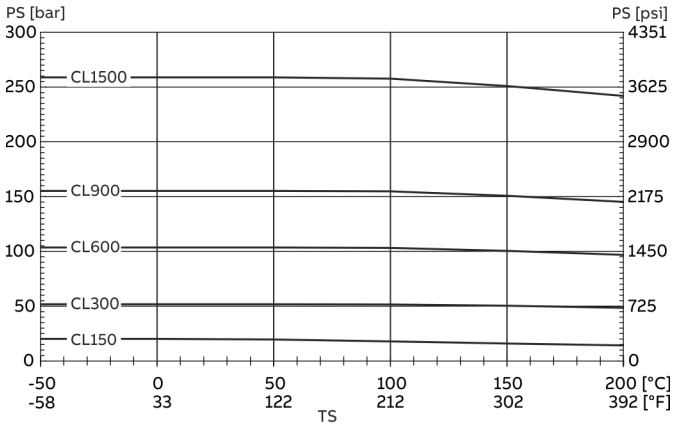


Figure 18: Nickel alloy ASME flange C4 (2.4610) or nickel alloy C22 (2.4602) up to DN 200 (in.)

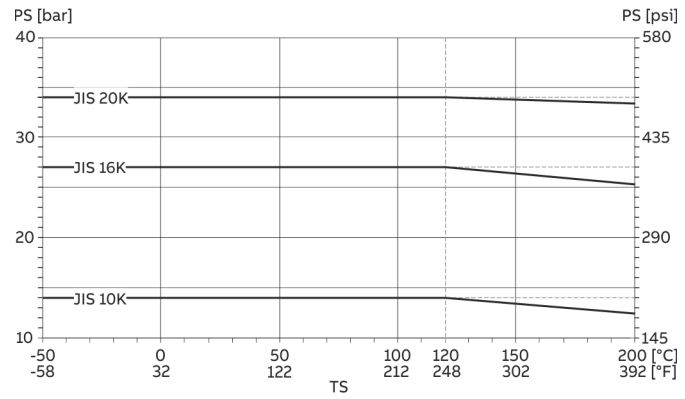


Figure 19: Stainless steel JIS B2220 flange 1.4435 or 1.4404 (AISI 316L) , nickel alloy C4 (2.4610) or nickel alloy C22 (2.4602)

Installing the sensor

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

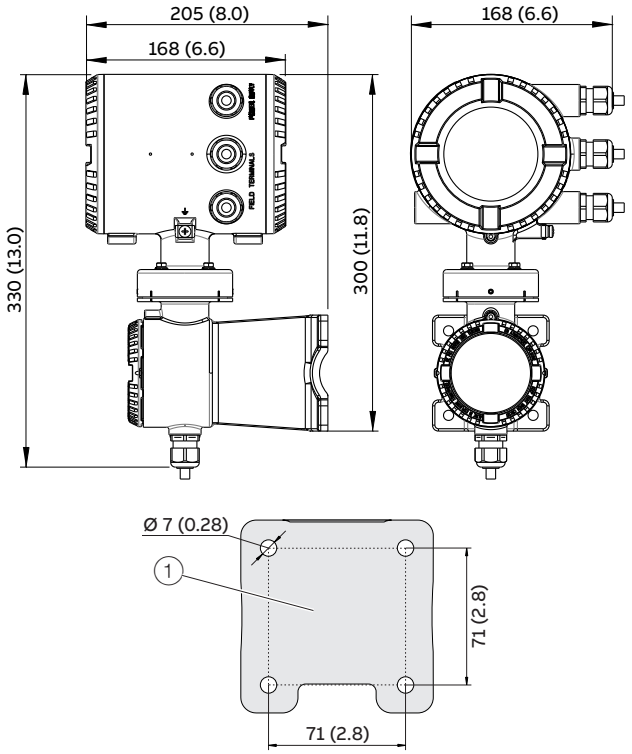
1. Insert the sensor into the piping centrally and positioned coplanar. Use suitable gaskets to seal the process connections.
2. Tighten flange screws by working on each in a crosswise manner with the maximum permissible torque.
3. Check the seal integrity of the process connections.

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.



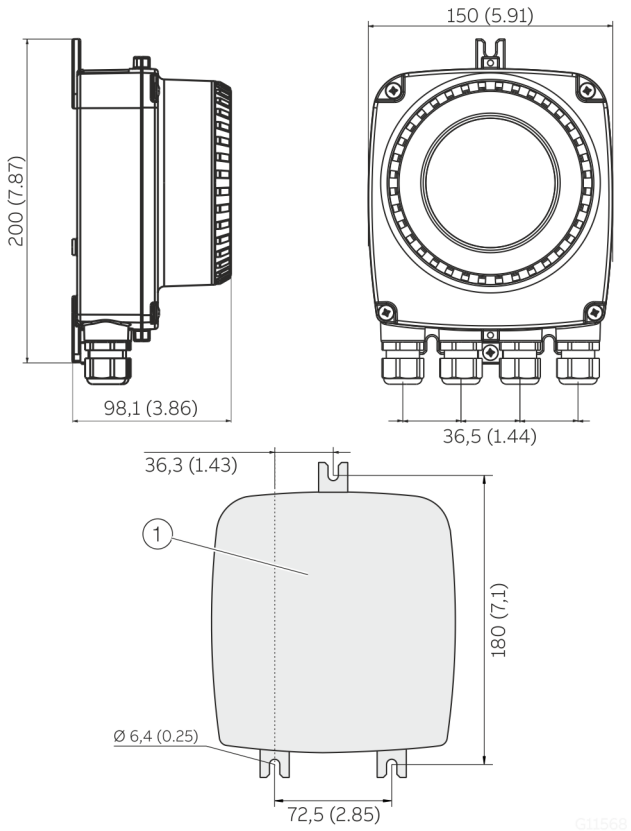
(1) Hole pattern for mounting holes

(2) Female thread (either ½ in NPT or M20 x 1.5), see model coding. In the case of a ½ in NPT, there is a plug instead of a cable gland.

Figure 20: Mounting dimensions dual-compartment housing

… 6 Installation

… Installing the transmitter in the remote mount design



① Hole pattern for mounting holes

Figure 21: 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!

While using the device in potentially explosive atmospheres before opening the transmitter housing or the terminal box, note the following points:

- A valid fire permit must be present.
- Make sure that no flammable or hazardous atmospheres are present.

⚠ WARNING

Risk of injury due to live parts!

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

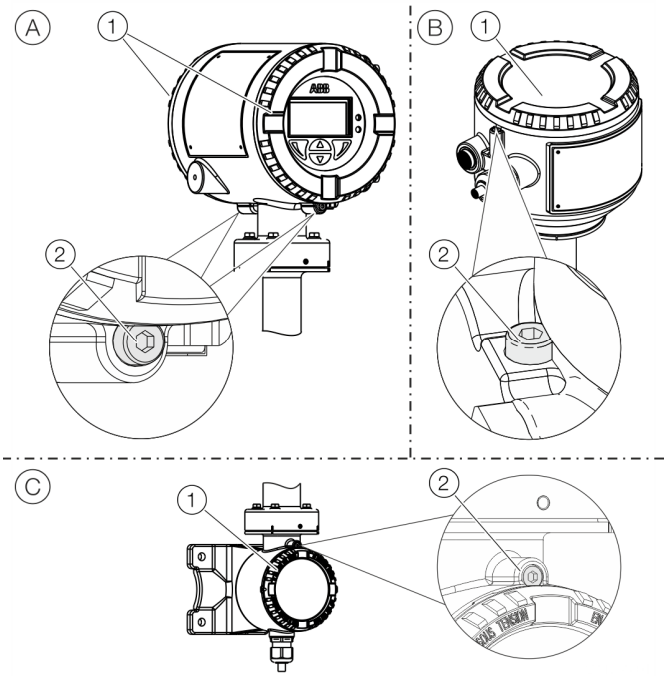
- Before opening the housing, switch off the power supply.

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



Ⓐ Integral mount design

Ⓑ Remote mount design

Ⓒ Transmitter, terminal space, signal cable

Figure 22: Cover lock (example)

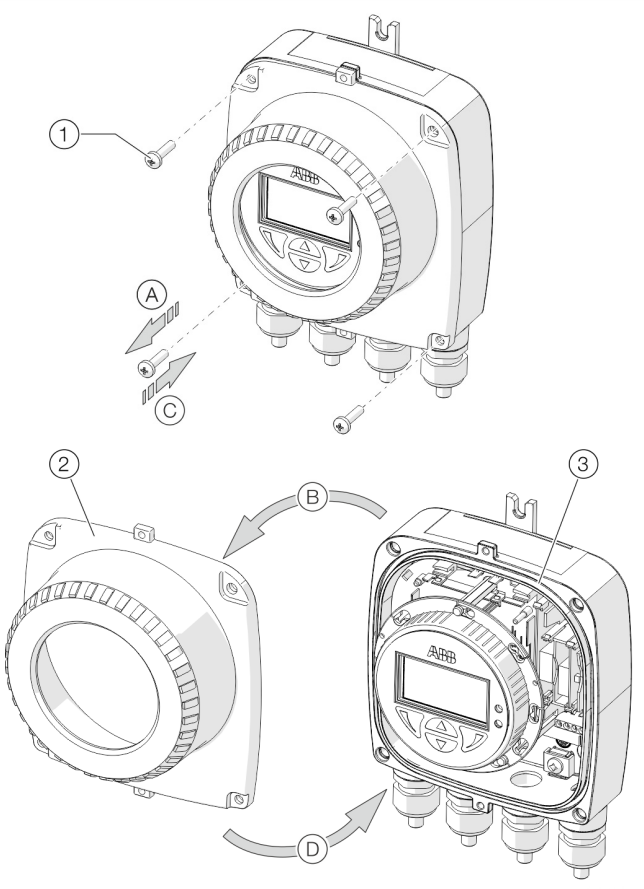
Open the housing:

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

Close the housing:

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

Single-compartment housing



① Cover screws

② Transmitter housing cover

③ Gasket

Figure 23: Open / close single-compartment housing

Open the transmitter housing:
Perform steps Ⓐ and Ⓑ.

Close the transmitter housing:
Perform steps Ⓒ and Ⓓ.

… 6 Installation

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.
Only loosen the screws shown when rotating the transmitter housing!

Rotate transmitter housing: Perform steps Ⓐ to Ⓒ.

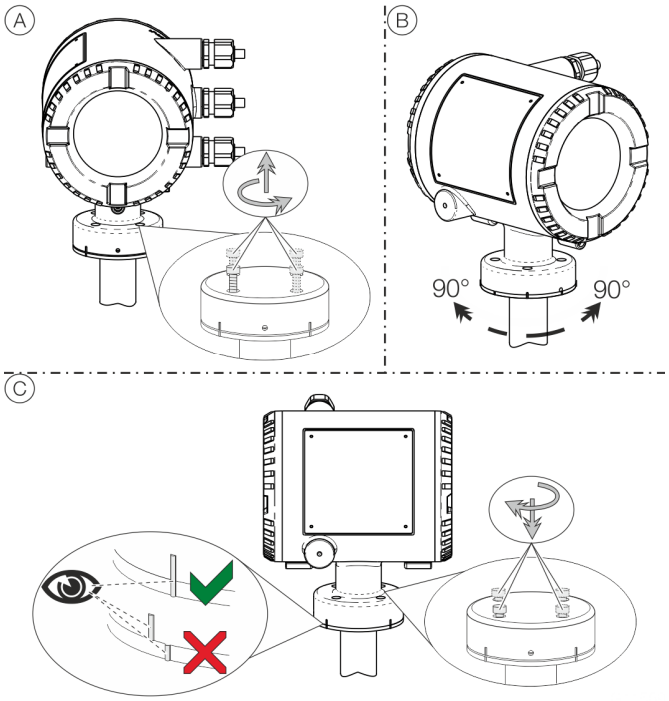


Figure 24: Rotate transmitter housing

Rotate LCD indicator – dual-compartment housing

The LCD indicator can be rotated in three increments of 90° each. To open and close the housing, refer to **Opening and closing the housing** on page 38.

Turn the LCD indicator:
Perform steps Ⓐ to Ⓕ.

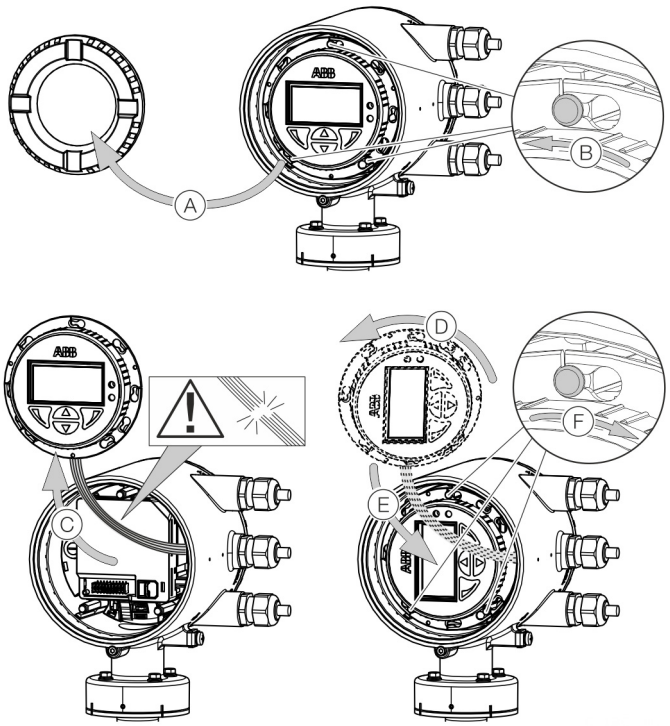


Figure 25: Rotating the LCD indicator

Rotate LCD indicator – single-compartment housing
The LCD indicator can be rotated in three increments of 90° each. To open and close the housing, refer to **Opening and closing the housing** on page 38.

Turn the LCD indicator:

Perform steps Ⓐ to Ⓕ.

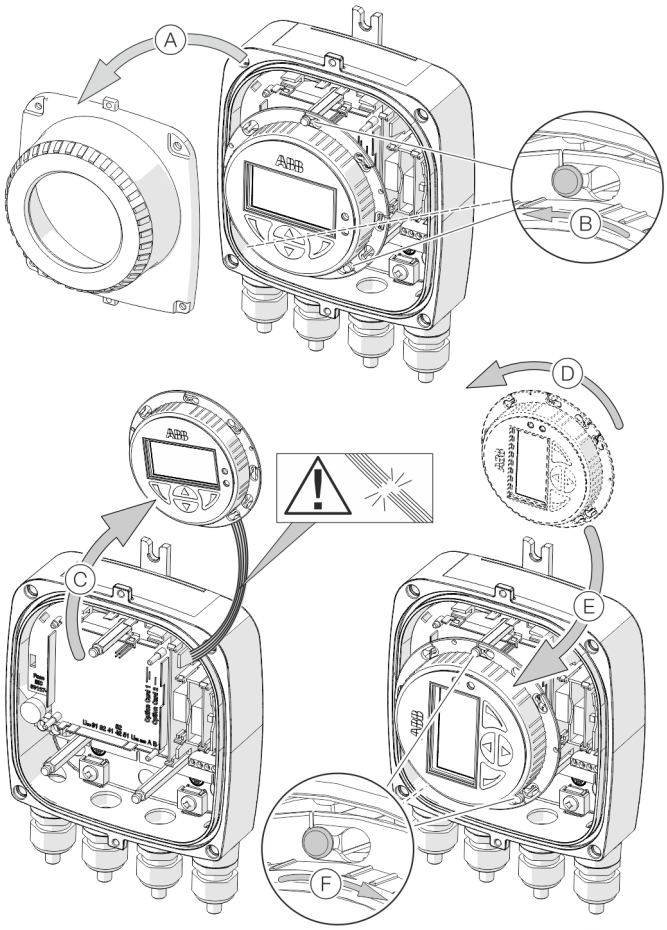


Figure 26: Rotating the LCD indicator

… 6 Installation

Installing the plug-in cards

⚠ WARNING

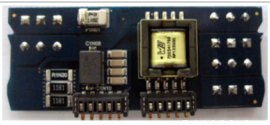
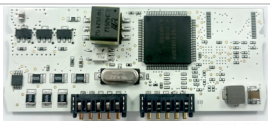
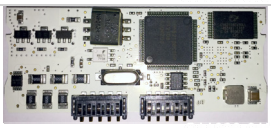
Loss of Ex Approval!

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 card	Description	Quantity*
	Current output, 4 to 20 mA passive (red) Order no.: 3KQZ400029U0100	Maximum of two plug-in cards
	Passive digital output (green) Order no.: 3KQZ400030U0100	Maximum of one plug-in card
	Passive digital input (yellow) Order no.: 3KQZ400032U0100	Maximum of one plug-in card
	Loop power supply 24 V DC (blue) Order no.: 3KQZ400031U0100	Maximum of one plug-in card
	Modbus RTU RS485 (white) Order no.: 3KQZ400028U0100	Maximum of one plug-in card
	Profibus DP (white) Order no.: 3KQZ400027U0100	Maximum of one plug-in card

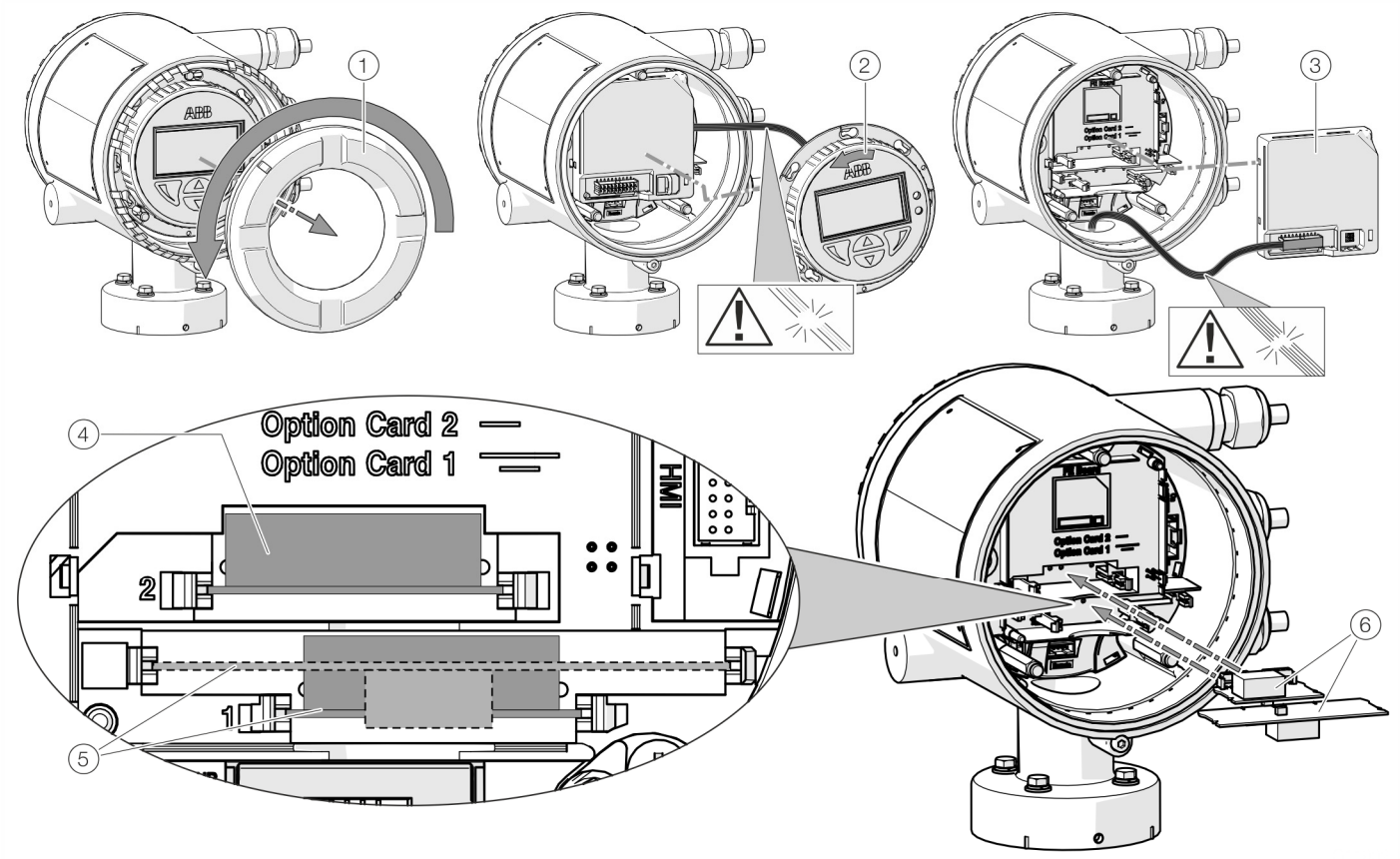
* The ‘Number’ column indicates the maximum number of plug-in cards of the same type that can be used.

The following table provides an overview of the possible plug-in card combinations that can be selected when ordering the device.

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	–	–	–	Passive current output (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)
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	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	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	DRD	DSG	Profibus DP, RS485 (white)	Passive digital output (green)

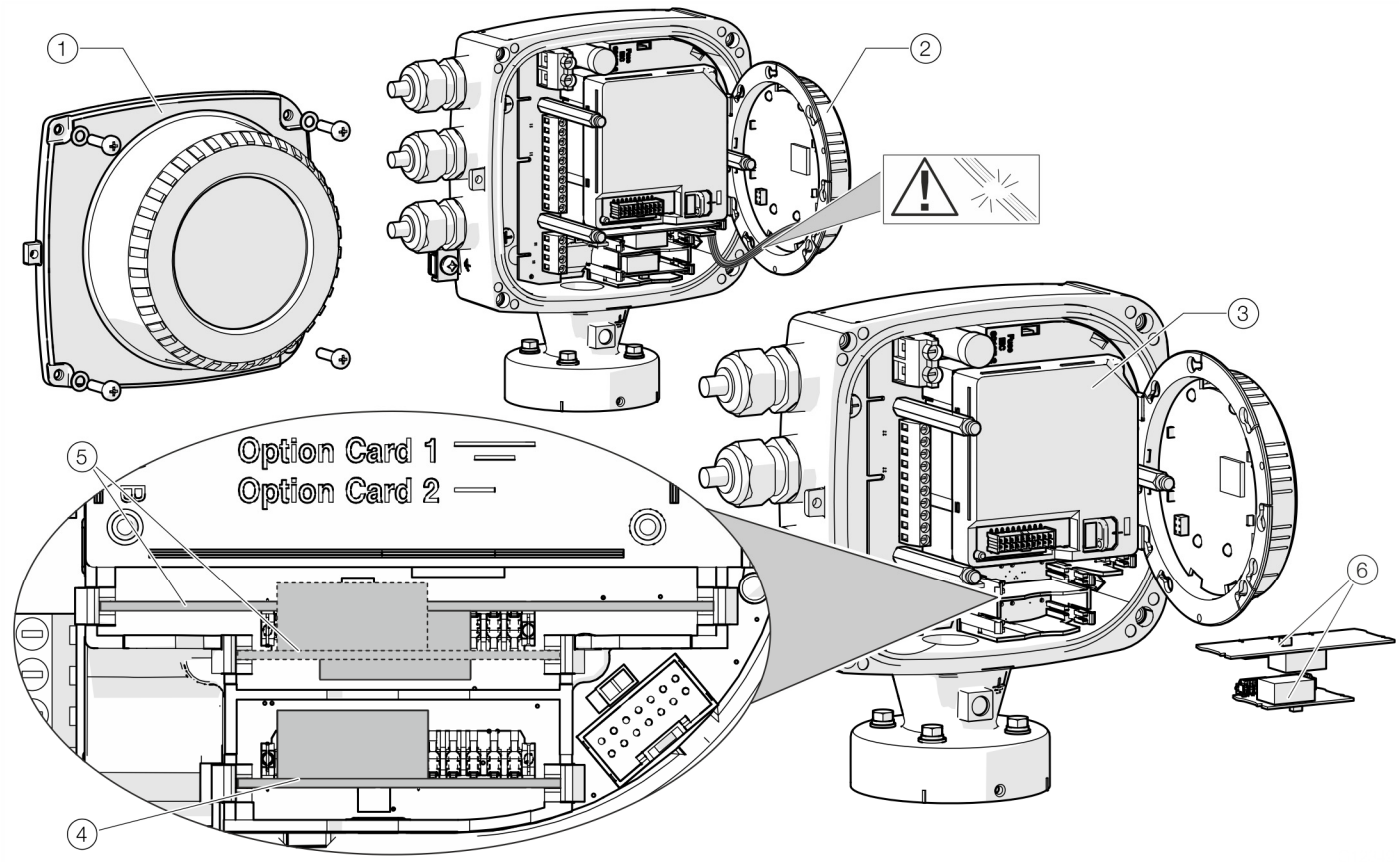
… 6 Installation

… Installing the plug-in cards



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

Figure 27: Installation of plug-in cards (example, dual-compartment housing)



1. Cover
2. LCD indicator
3. Slot OC1
4. Slot OC2
5. Plug-in cards

Figure 28: 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 46.
8. After powering up the power supply, configure the plug-in card functions.

7 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

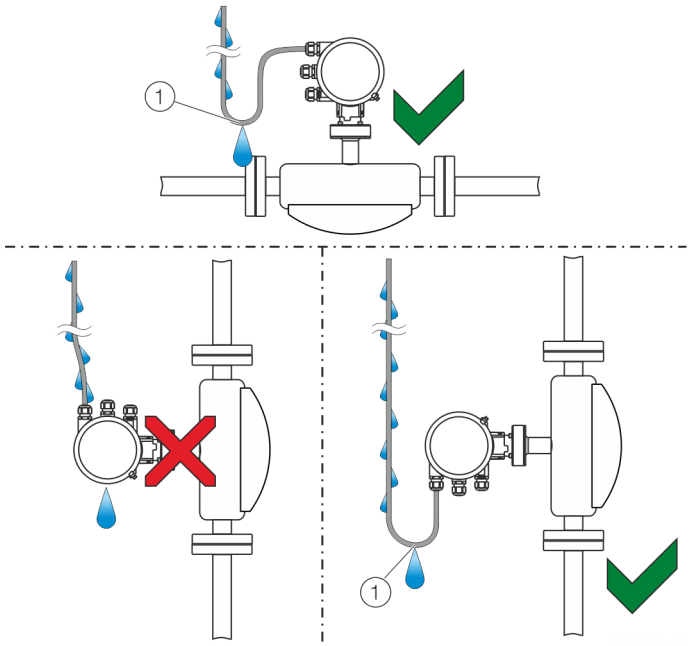
- Adhere to the limit values of the power supply in accordance with the information on the name plate.
- Observe the voltage drop for large cable lengths and small conductor cross-sections. The voltage at the terminals of the device may not down-scale the minimum value required in accordance with the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

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 29: 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 200 Ω
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 **Temperature resistance for the connecting cable** on page 12!

Maximum signal cable length	
0.25 mm² (AWG 24)	50 m (164 ft)
0.34 mm² (AWG 22)	100 m (328 ft)
0.5 mm² (AWG 20)	150 m (492 ft)
0.75 mm² (AWG 19)	200 m (656 ft)

Recommended cables

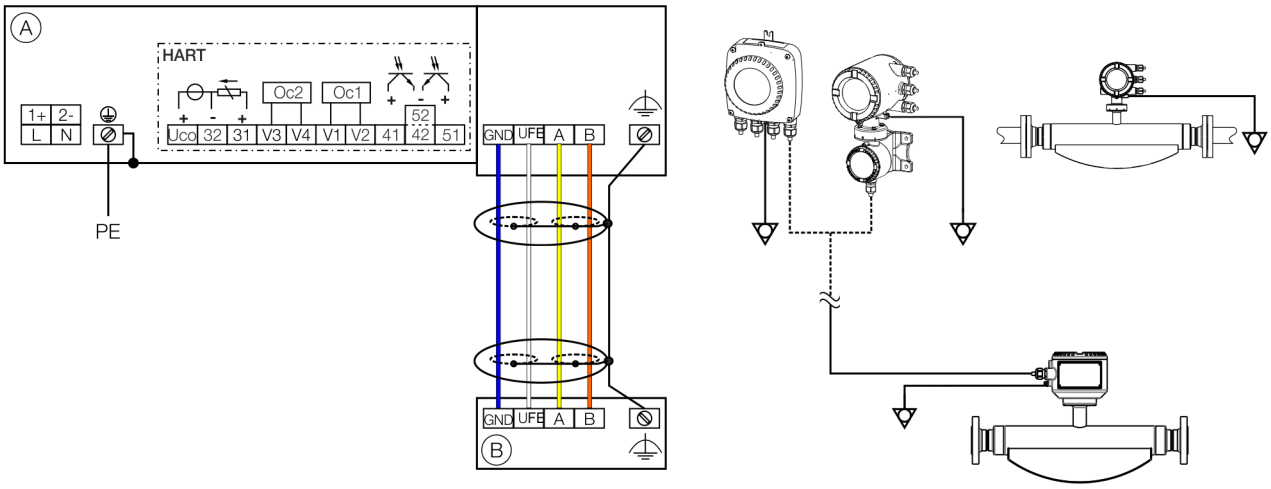
It is recommended to use an ABB signal cable for standard applications. The ABB signal cable fulfills the above-mentioned cable specification and can be utilized unrestrictedly up to an ambient temperature of $T_{amb.}$ = 80 °C (176 °F).

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).

… 7 Electrical connections

Pin assignment



Ⓐ Transmitter

Ⓑ Sensor

Figure 30: 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 42.

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_{FE}	Sensor power supply
GND	Ground
A	Data line
B	Data line
⏚	Functional earth / Shielding

… 7 Electrical connections

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 6!

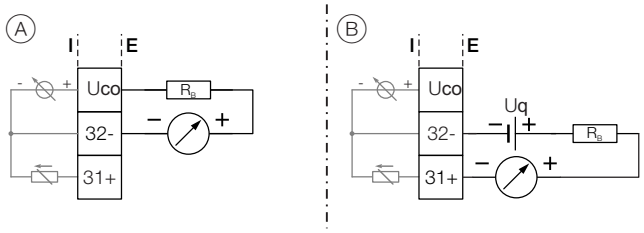
Power supply L / N, 1+ / 2–

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	11 to 30 V DC
Power consumption	20 W

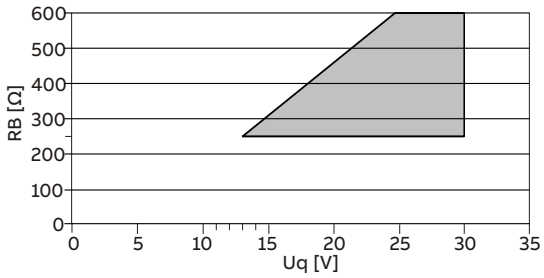
Current output 32 / Uco, 31 / 32 (basic device)

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



(A) Current output 31 / Uco, active (B) Current output 31 / 32 passive

Figure 31: (I = internal, E = external, R_B = load)



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

Figure 32: 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	4 to 20 mA
Load R_B	250 Ω ≤ R_B ≤ 300 Ω	250 Ω ≤ R_B ≤ 600 Ω
Source voltage U_q*	–	13 V ≤ U_q ≤ 30 V
Measuring error	< 0.1 % of measured value	
Resolution	0.4 µA per digit	

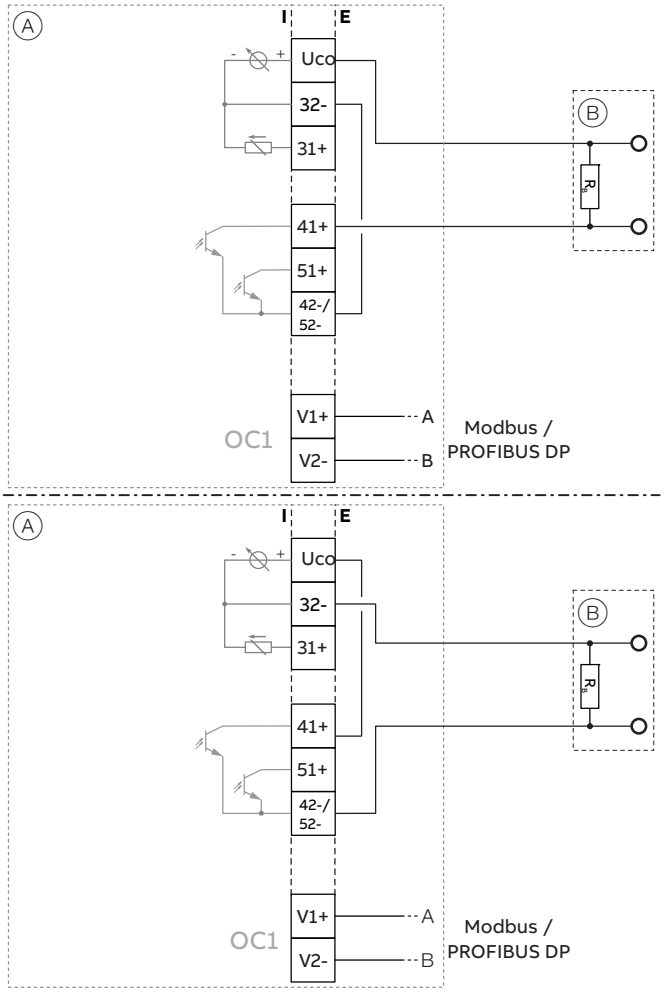
* The source voltage U_q is dependent of the load R_B and must be placed in an additional area.

For information on communication via the HART protocol, refer to **HART® Communication** on page 61.

… 7 Electrical connections

… Pin assignment

Current output Uco / 32 as loop power supply for digital output 41 / 42 or 51 / 52



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

Figure 33: Current output Uco / 32 in power mode

In the case of digital communication via Modbus / PROFIBUS DP, the current output Uco / 32 can be switched to the 'Power Mode' operating mode through the software.
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.
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 pperating mode	
Terminals	Uco / 32
Function	For active connection of passive outputs
Output Voltage	Load dependent, see **Figure 34**.
Load rating I_{max}	22.6 mA, permanently short circuit-proof

Table 1: Specification current output Uco / 32 in power mode

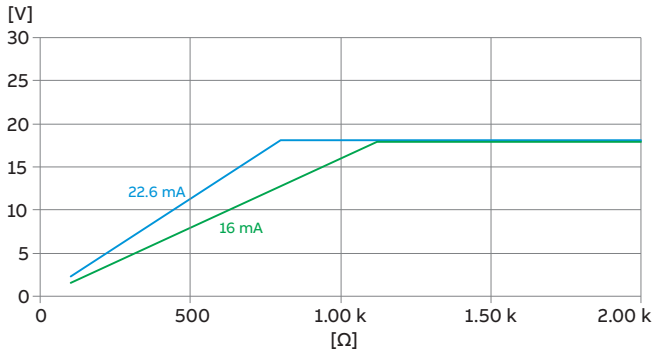
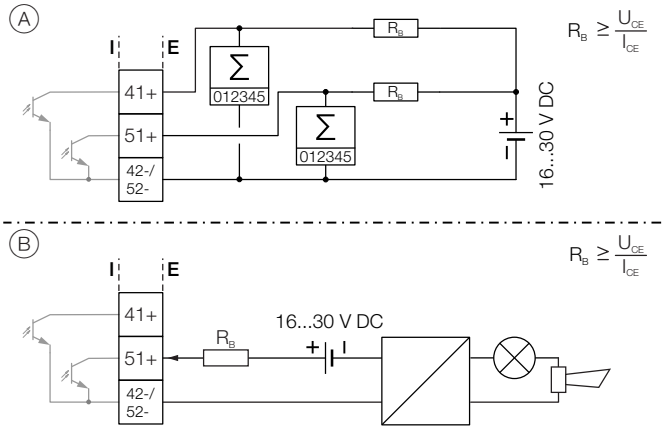


Figure 34: Output voltage dependent on load resistance

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 of frequency output

(B) Passive digital output 51 / 52 as binary output

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

Pulse / frequency output (passive)	
Terminals	41 / 42, 51 / 52
Output 'closed'	0 V ≤ U_{CEL} ≤ 3 V For f < 2.5 kHz: 2 mA < I_{CEL} < 30 mA For f > 2.5 kHz: 10 mA < I_{CEL} < 30 mA
Output 'open'	16 V ≤ U_{CEH} ≤ 30 V DC 0 mA ≤ I_{CEH} ≤ 0.2 mA
f_{max}	10.5 kHz
Pulse width	0.1 to 2000 ms

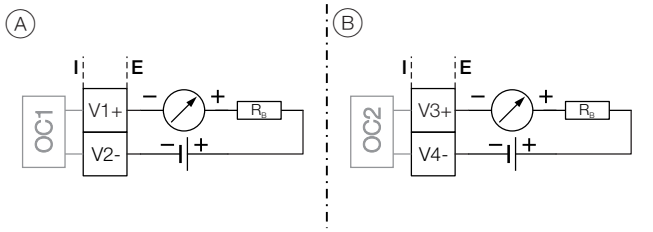
Binary output (passive)	
Terminals	41 / 42, 51 / 52
Output 'closed'	0 V ≤ U_{CEL} ≤ 3 V 2 mA ≤ I_{CEL} ≤ 30 mA
Output 'open'	16 V ≤ U_{CEH} ≤ 3 V DC 0 mA ≤ I_{CEH} ≤ 0.2 mA
Switching function	Can be configured using software. See **Menu: Input / Output** on page 107.

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 fmax ≤ 3 kHz.

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

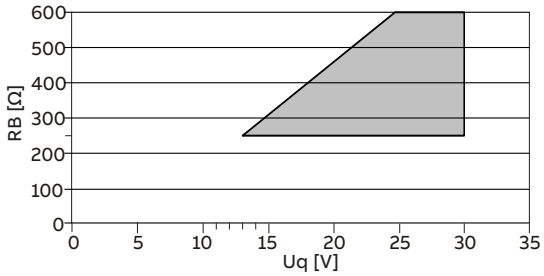
Up to two additional plug-in modules can be implemented via the 'Passive current output (red)' option module.
Can be configured for outputting mass flow, volume flow, density and temperature via on-site software.



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

Figure 36: (I = internal, E = external, R_B = load)

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



Permissible source voltage U_q for passive outputs in relation to load resistance R_B where Imax = 22 mA. = Permissible range

Figure 37: Source voltage for passive outputs

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

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

… 7 Electrical connections

… Pin assignment

Digital output V1 / V2, V3 / V4 (plug-in module)
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.

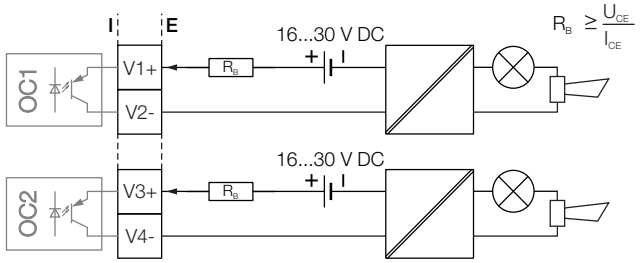


Figure 38: Plug-in card as binary output (I = internal, E = external, R_B = load)

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_{CEL} ≤ 3 V
	2 mA < I_{CEL} < 30 mA
Output 'open'	16 V ≤ U_{CEH} ≤ 30 V DC
	0 mA ≤ I_{CEH} ≤ 0.2 mA
Switching function	Can be configured using software.
	See **Menu: Input / Output** on page 107.

Digital output 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.

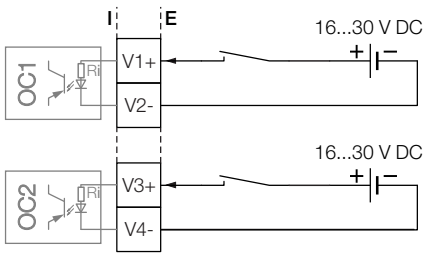


Figure 39: Plug-in card as digital input (I = internal, E = external)

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

Digital input	
Terminals	V1 / V2, V3 / V4
Input 'On'	16 V ≤ U_{KL} ≤ 30 V
Input 'Off'	0 V ≤ U_{KL} ≤ 3 V
Internal resistance R_i	6.5 kΩ
Function	Can be configured using software.
	See **Menu: Input / Output** on page 107.

24 V DC loop power supply (plug-in module)

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 53.

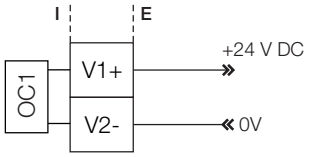


Figure 40: (I = Internal, E = External)

The plug-in module 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.

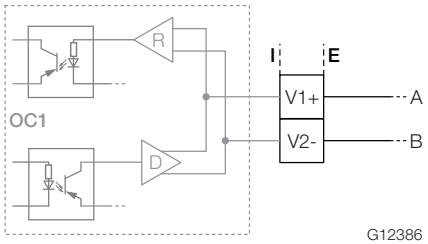


Figure 41: Plug-in card as a Modbus / PROFIBUS DP interface (I = internal, E = external)

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 61 and **PROFIBUS DP® communication** on page 62.

Connection examples

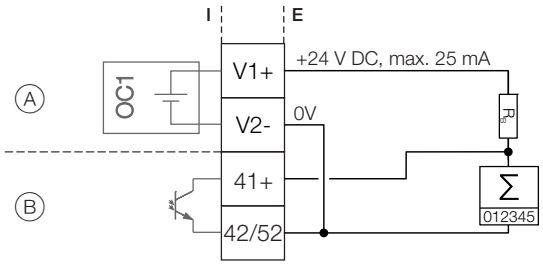
Input and output functions are configured via the device software in accordance with the desired application.
Parameter descriptions on page 95

Active digital output 41 / 42, 51 / 52, V3 / V4

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

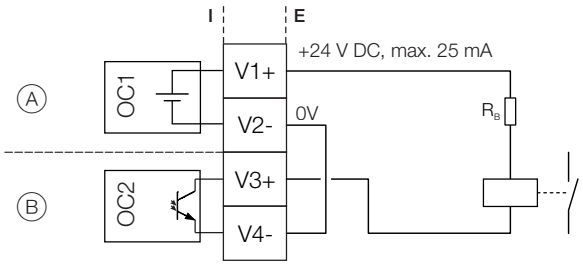
Each 'loop power supply (blue)' plug-in card must only power one output.
It must not be connected to two outputs (for example digital output 41 / 42 and 51 / 52)!



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

Figure 42: 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.



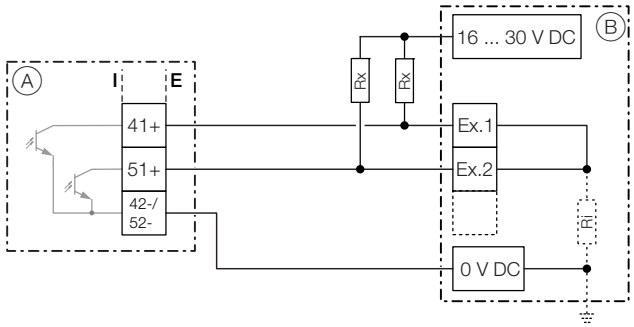
(A) 'Loop power supply (blue)' plug-in card in slot 1
(B) 'Digital output (green)' plug-in card in slot 2

Figure 43: Active digital output V3 / V4 (example)

… 7 Electrical connections

… Pin assignment

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



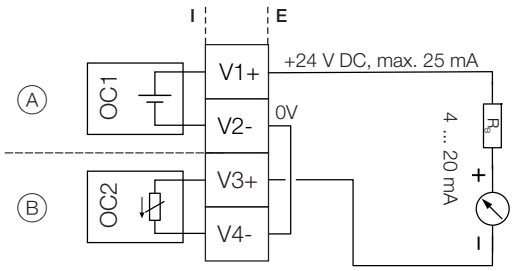
(A) Transmitter
(B) Distributed control system / Memory programmable controller
Ex. 1 Input 1
Ex. 2 Input 2
R_X Resistor for current limitation
R_I Distributed control system internal resistance

Figure 44: 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 Ω / 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.

Active current output V3 / V4

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.

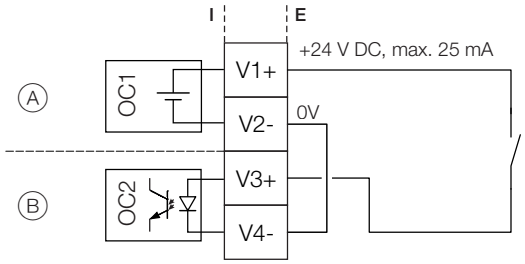


(A) 'Loop power supply (blue)' plug-in card in slot 1
(B) 'Passive current output (red)' plug-in card in slot 2

Figure 45: 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 46: 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.

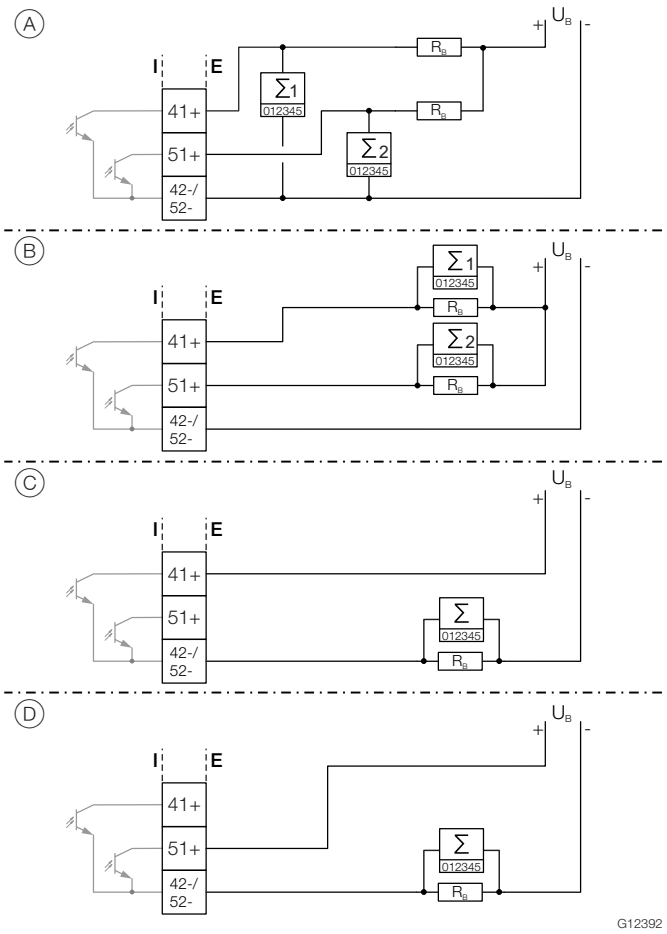


Figure 47: Connection versions digital output 41 / 42 and 51 / 52

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

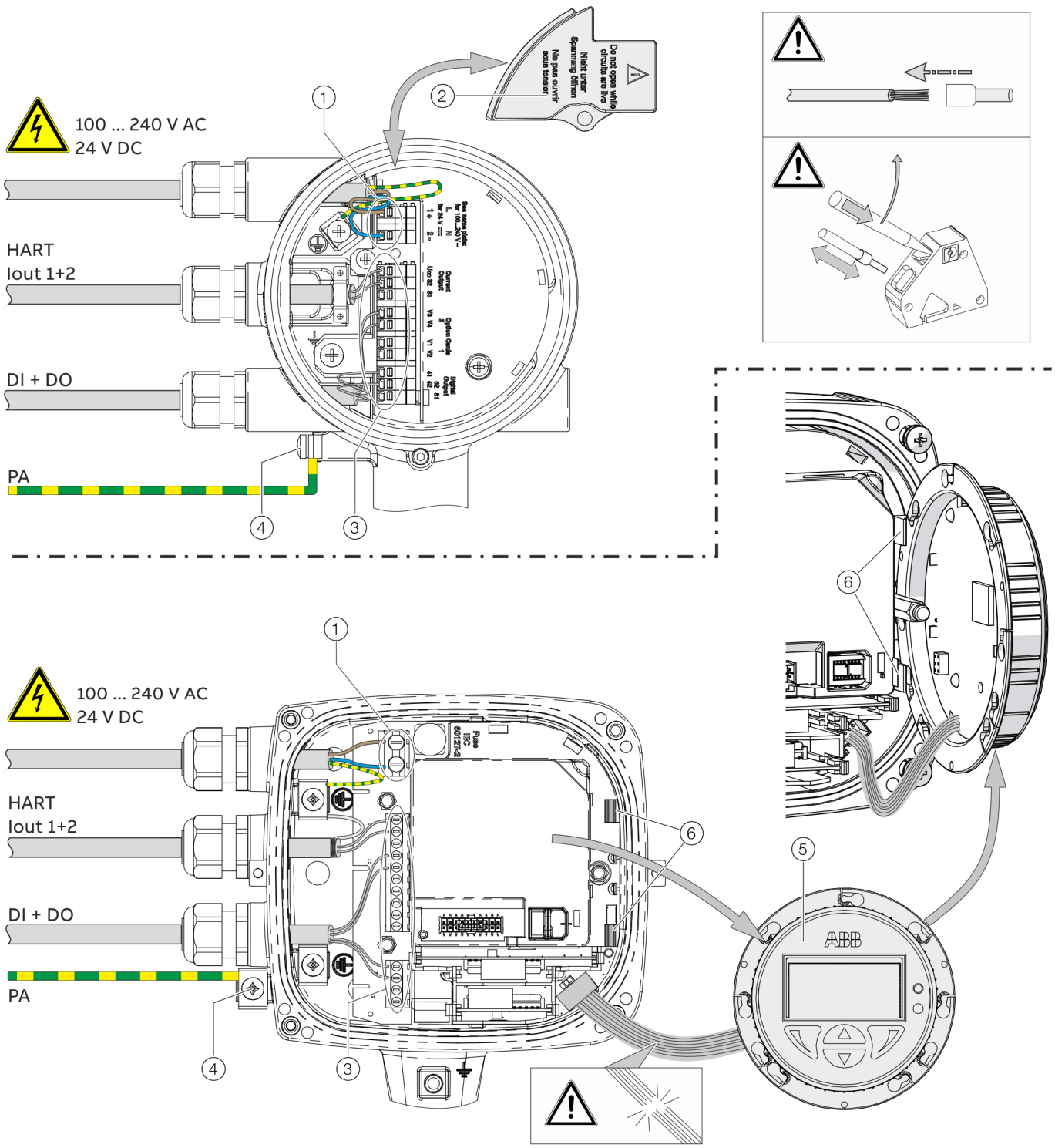
Table 2: Connection versions digital output

… 7 Electrical connections

… Pin assignment

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)

Figure 48: 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 38 to open and close the housing safely.

Observe the following points when connecting to an electrical supply:

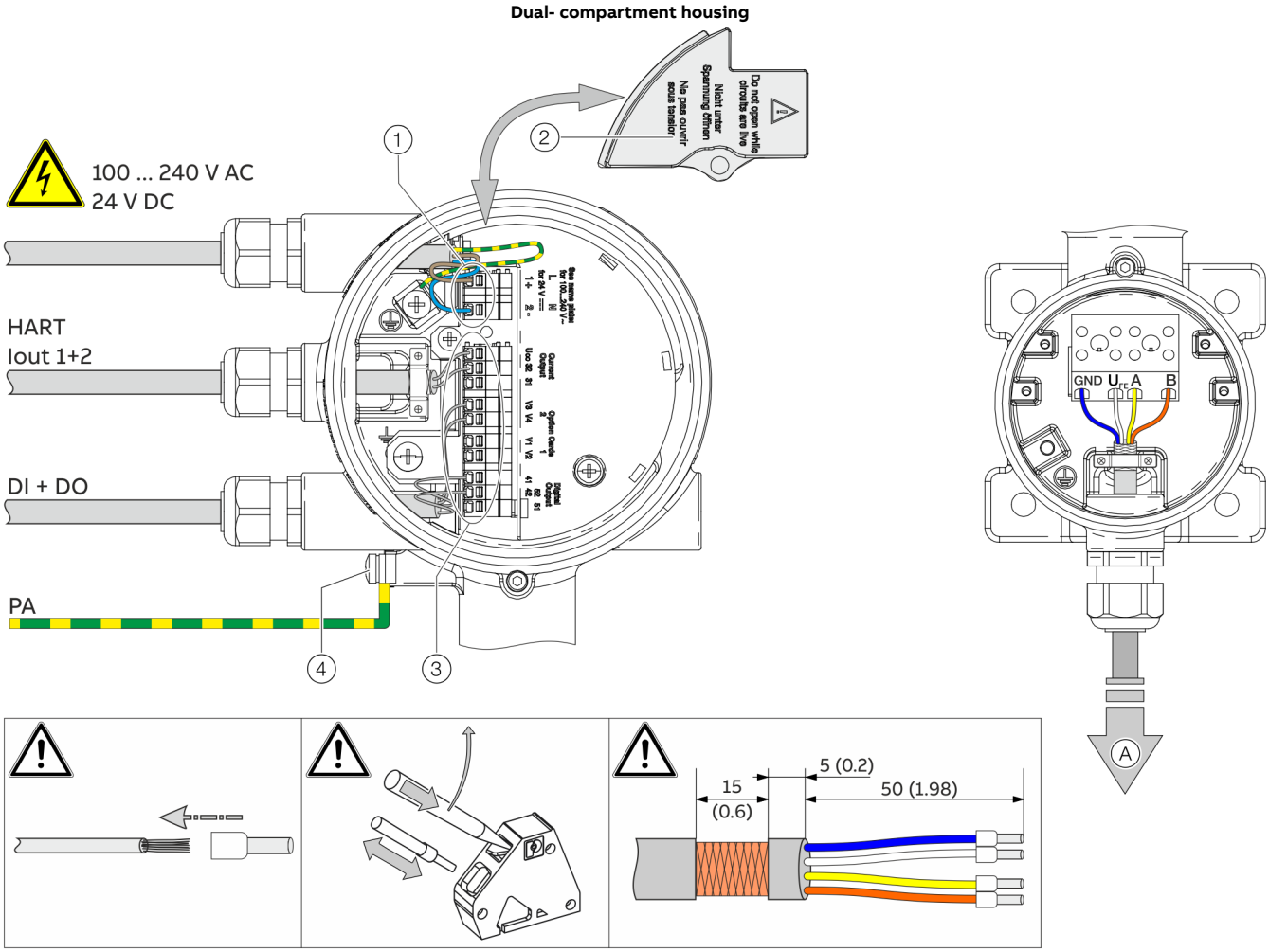
- Lead the power supply cable into the housing through the top cable entry.
- Lead the cables for signal inputs and signal outputs into the housing through the middle and, where necessary, bottom cable entries.
- Connect the cables in accordance with the electrical connection. If present, connect the 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.

… 7 Electrical connections

… Pin assignment

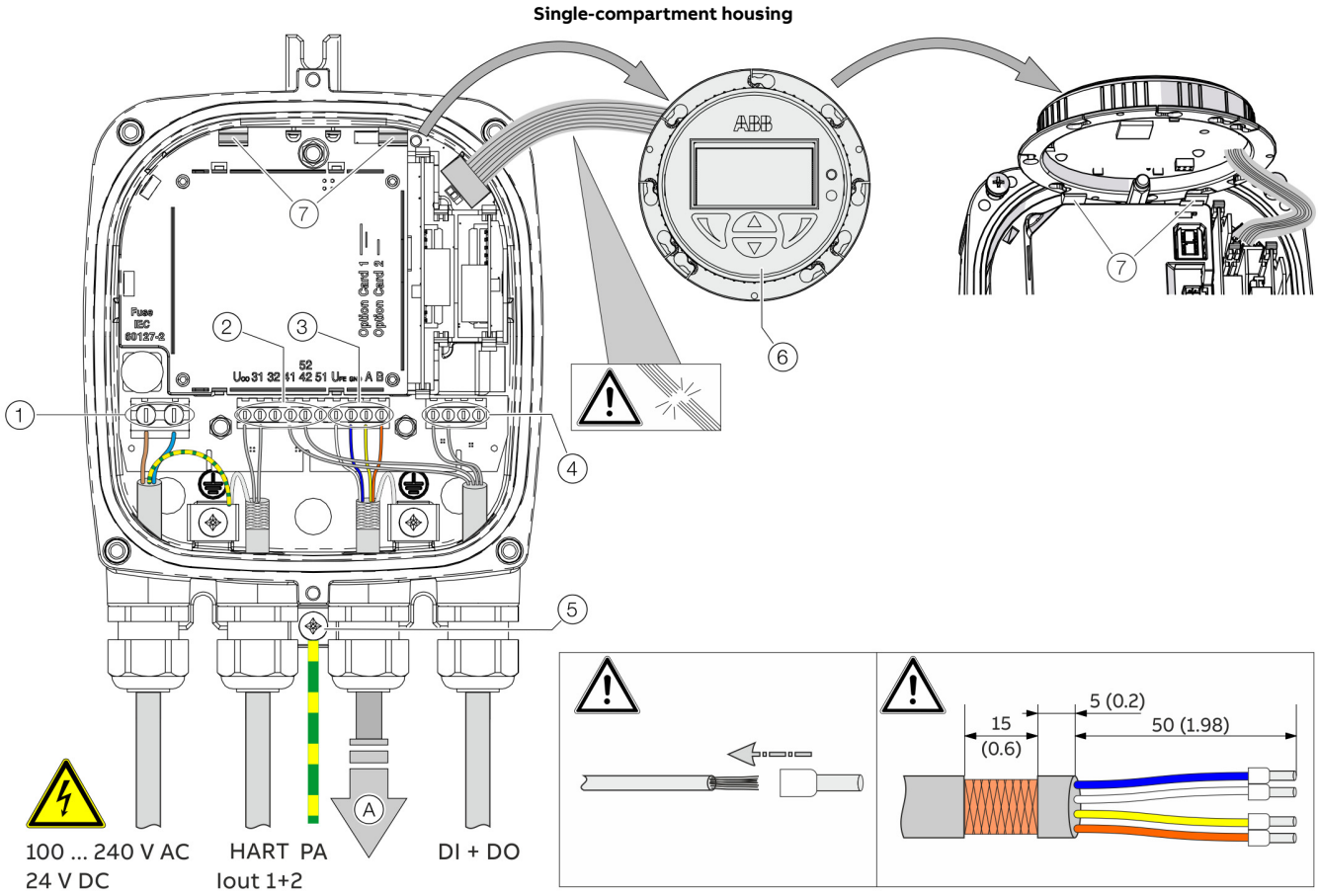
Connection to remote mount design

Transmitter



(A) Upper terminal box (back side)
(B) Lower terminal box
(C) Signal cable to sensor
(1) Terminals for power supply
(2) Cover for power supply terminals
(3) Terminals for signal cable
(4) Terminals for inputs and outputs
(5) Terminal for potential equalization

Figure 49: Electrical connection to transmitter in remote mount design [example, dimensions in mm (in)]

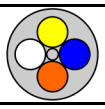
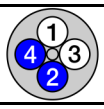


(A) Signal cable to sensor
(1) Terminals for power supply
(2) Terminals for inputs and outputs (base device)
(3) Terminals for signal cable
(4) Terminals for inputs and outputs (plug-in cards)
(5) Terminal for potential equalization
(6) LCD indicator
(7) Bracket for LCD indicator (park position)

Figure 50: 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 38 to open and close the housing safely.

Terminal	ABB signal cable 3KQZ407123U0100	HELKAMA signal cable 20522
		
GND	Blue	Blue (4)
U_{FE}	White	white (3)
A	Yellow	Blue (2)
B	Orange	white (1)

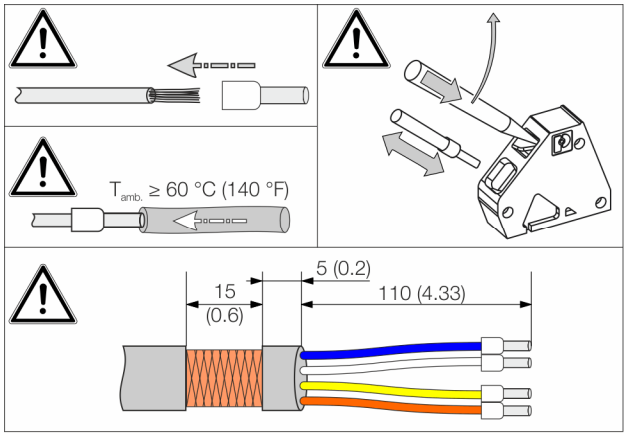
Observe the following points when connecting to an electrical supply:

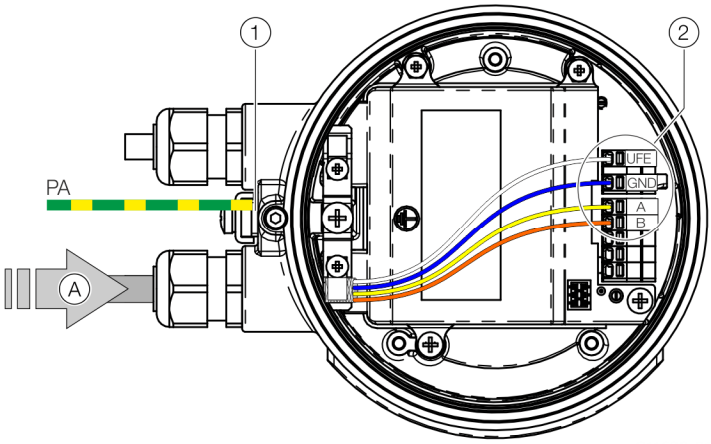
- Lead the cable for the power supply and the signal inputs and outputs into the housing as shown.
- The signal cable to the sensor is connected in the lower connection area of the transmitter.
- Connect the cables in accordance with the electrical connection diagram. If present, connect the cable shielding 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.

… 7 Electrical connections

… Pin assignment

Flowmeter sensor





(A) Signal cable from the sensor

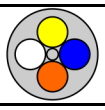
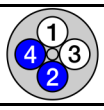
(1) Terminal for potential equalization

(2) Terminals for signal cable

Figure 51: 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 38 to open and close the housing safely.

Terminal	ABB signal cable 3KQZ407123U0100	HELKAMA signal cable 20522
		
GND	Blue	Blue (4)
U_{FE}	White	white (3)
A	Yellow	Blue (2)
B	Orange	white (1)

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 $T_{amb.}$ ≥ 60 °C (≥ 140 °F) additionally insulate the wires with the enclosed silicone hoses.
- Close unused cable entries using suited plugs.

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 (DSV401 R2).
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.

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)	p – 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

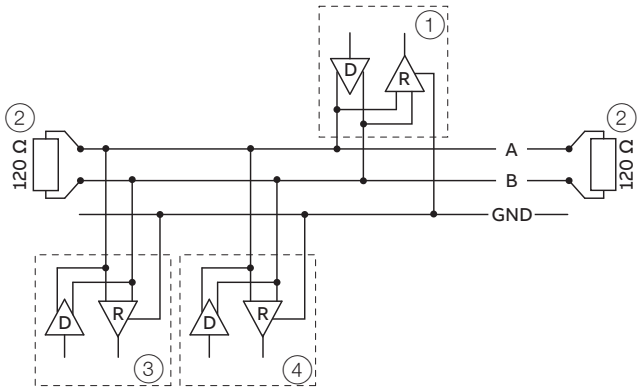
Note
The Modbus® protocol is an unsecured protocol, as such the intended application should be assessed to ensure that these protocols are suitable before implementation.

Modbus is an open standard owned and administrated by an independent group of device manufacturers styled the Modbus Organization (www.modbus.org).
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 Asset Vision Basic (DAT200) and 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

… 7 Electrical connections

… Digital communication



① Modbus master
② Terminating resistor
③ Modbus slave 1
④ Modbus slave n to 32

Figure 52: Communication with the Modbus protocol

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^2 (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 Asset Vision Basic (DAT200) and a corresponding Device Type Manager (DTM)
Transmission	In accordance with 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.

The files required for operation can also be downloaded from www.profibus.com.

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

ID number	**GSD file name**	
0x9740	PA139740.gsd	1xAI, 1xTOT
0x9700	PA139700.gsd	1AI
0x3432	ABB_3432.gsd	6xAI, 2xTOT, 1xAO, 1xDI, 1xDO

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.

See also **Ident Nr. Selector** on page 114.

Limits and rules when using ABB fieldbus accessories

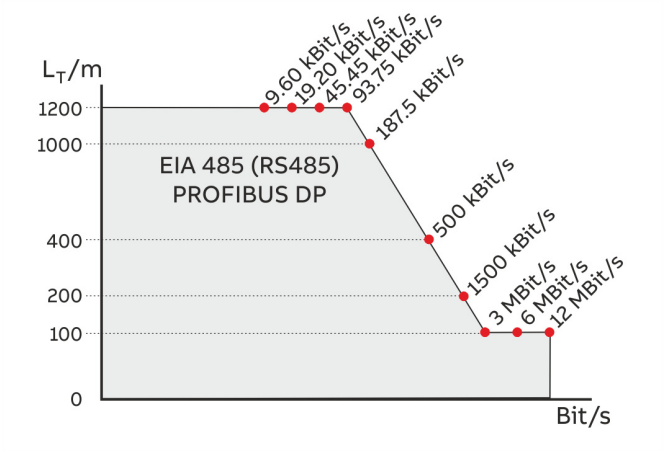


Figure 53: Bus cable length depends on the transmission rate

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 ≤ 126 (addresses 0 to 125)

Per PROFIBUS DP segment

- Number of DP nodes ≤ 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 ≥ 1500 kBit/s!
- Spur cable length (L_S), at ≤ 1500 kBit/s: LS ≤ 0.25 m, at > 1500 kBit/s: LS = 0.00 m!
- At 1500 kBit/s and ABB DP cable type A:
  - Sum of all spur cable lengths (L_S) ≤ 6.60 m, trunk cable length (L_T) > 6.60 m, total length = L_T+ (Σ L_S) ≤ 200 m, maximum 22 DP nodes (= 6.60 m / (0.25 m + 0.05 m spare))

8 Commissioning

⚠ 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 6!

⚠ CAUTION

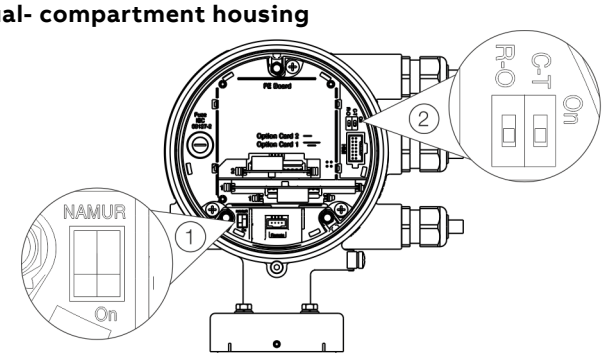
Risk of burns due to hot measuring media

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 54: 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

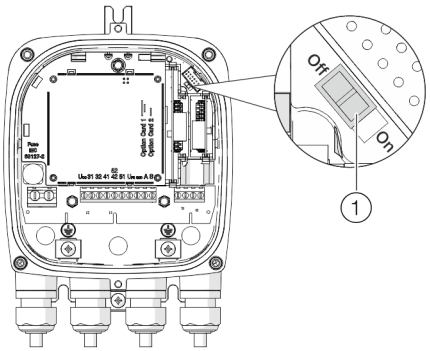
Number	Function
On	Write protection active
Off	Write protection deactivated.

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.

Single-compartment housing



(1) DIP switch, Write protection

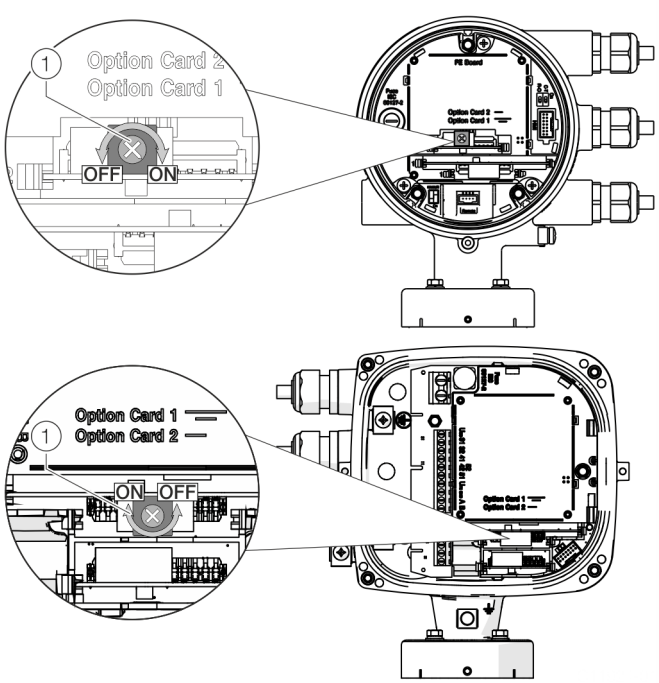
Figure 55: Position of the DIP switch

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 56: 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.

… 8 Commissioning

Checks prior to commissioning

The following points must be checked before commissioning the device:

- Correct wiring in accordance with **Electrical connections** on page 46.
- Correct grounding of the sensor.
- 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 integrated LCD indicator (see chapter **Menu: Easy Set-up** on page 70).

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 Asset Vision Basic (FCB4xx DTM)
- 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.

Installation of ABB AssetVision Basic and ABB Field Information Manager (FIM)
There are two different software packages available for configuration:

- ABB AssetVision Basic combined with the ABB CoriolisMaster Device Type Manager (DTM).
- ABB Field Information Manager (FIM) combined with the ABB CoriolisMaster Field Device Information Package (FDI package).

AssetVision Basic with the ABB CoriolisMaster Device Type Manager (DTM)

The required software and drivers can be downloaded using the adjacent download link.

Installation of the software and connection to the flowmeter:

1. Unpack the downloaded archive file to the c:\temp folder.
2. AssetVision Basic (DAT200) install '3KXD151200S0050_Tool_DAT200_Asset_Vision_Basic'.
3. HART Communication DTM install 'CWCommDTMHART_1.0.55'.
4. CoriolisMaster DTM FCXxxx install "3KXF410100S0002_DTM_FCXxxx_HART_CoriolisMaster'.
5. Connect the flowmeter with the PC / laptop, see chapter **Parameterization via the infrared service port adapter** on page 69 or **Parameterization via HART®** on page 69.
6. Power-up the power supply for the flowmeter and start AssetVision Basic on the PC / laptop
   - Select HART and 'HART Communication Version 1.0.52'.
   - Select 'Extended HART modem'.
   - Select the corresponding COM port.
   - Activate the 'Multimaster and Burst mode support' option.
   - The flowmeter is detected and the CoriolisMaster DTM starts automatically.
   - Confirm the dialog field 'Upload parameters' by selecting 'yes'.

COM settings	
Baud rate	19200
Number of Stop bits	1
RTS Control	Toggle
DTR Control	Enable
Parity	Odd
Master	Primary Master
Preamble	5
Number of communication retries	3
Start Address	0
End Address	0
Communication timeout	10 s

… 8 Commissioning

… Parameterization of the device

Field Information Manager (FIM) with the ABB CoriolisMaster Field Device Information Package

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 69 or **Parameterization via HART®** on page 69.
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.fdix' file to the ABB Field Information Manager (FIM). No special view is needed for this.
6. Right-click (1) as shown in Figure 57.

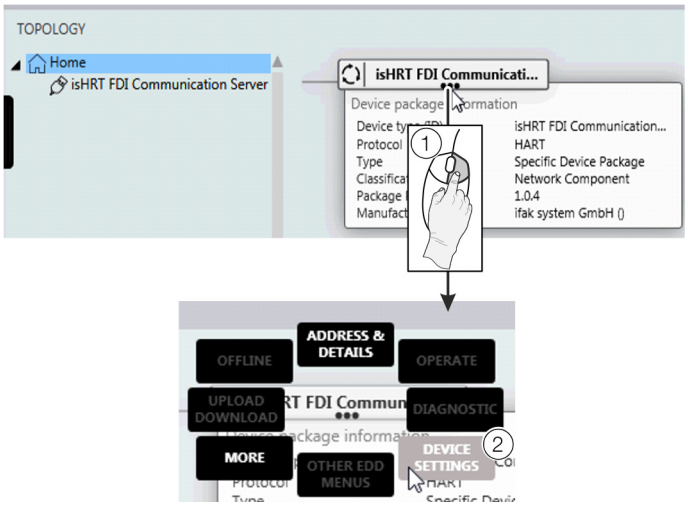


Figure 57: Select FIM – 'Device Settings'

7. Select 'DEVICE SETTINGS' (2) as shown in Figure 57.

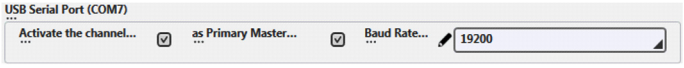


Figure 58: Select FIM – COM-Port

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

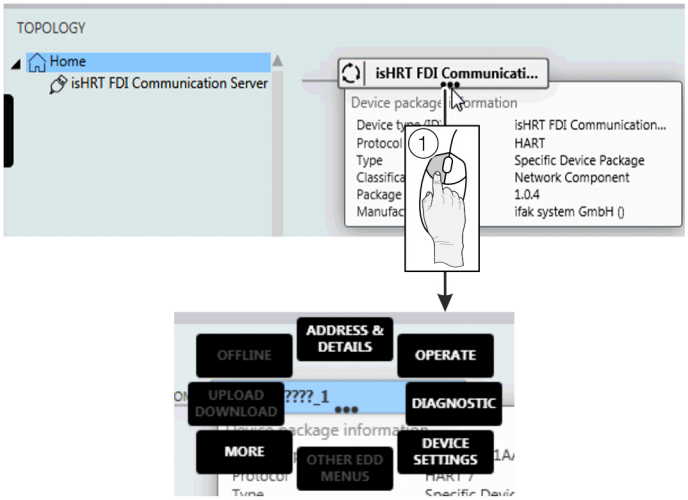
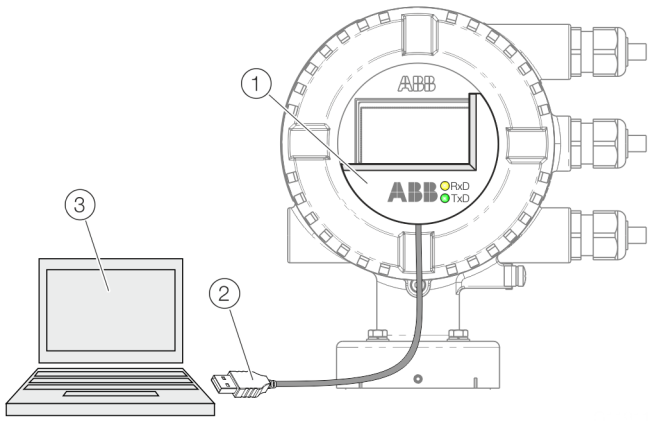


Figure 59:

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 HART-DTM and the software 'ABB AssetVision' available at www.abb.com/flow, all parameters can also be set without a HART connection.



① Infrared service port adapter
② USB-interface cable
③ PC / Notebook running ABB AssetVision and HART DTM

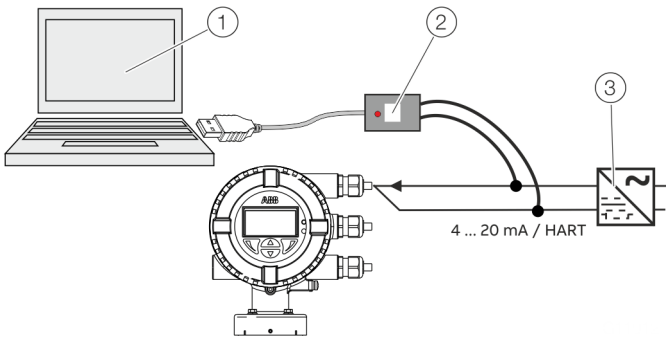
Figure 60: Infrared service port adapter on the transmitter (example)

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 ABB AssetVision and perform the parameterization of the equipment.

Detailed information on operating the software is available in the relevant operating instructions and the DTM online help.

Parameterization via HART®

Configuration via the HART interface of the device requires a PC / Notebook and a suited HART® Modem.
All parameters can also be set via the HART protocol, using the HART DTM available at www.abb.com/flow and the ABB AssetVision software.



① PC / Notebook running ABB AssetVision and HART DTM
② HART modem
③ Power supply unit

Figure 61: 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.

… 8 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 Set-up' 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 72.
For a detailed description of all menus / parameters see **Parameter descriptions** on page 95.

Menu: Easy Set-up

Menu / parameter	Description
Easy Set-up	
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 **Table 2: Units for mass flow** on page 78.
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.
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 **Table 1: Units for the volume flow rate** on page 78.
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	Selection of the unit for the density (e.g. for the associated parameters and the corresponding process values). See **Table 3: Density units** on page 78.
Density Max Density Min	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.
Unit Temperature	Selection of unit for temperature (e.g. for the associated parameters and the corresponding process values). See **Table 4: Temperature units** on page 78.
Unit Mass Totalizer	Selection of the unit for the mass counters and the pulse outputs. See **Table 6: Units for the mass totalizer** on page 79.
Unit Vol. Totalizer	Selection of the unit for the volume totalizers and the pulse outputs. See **Table 7: Units for the volume totalizer** on page 79.
Curr.Out 31 / 32 / Uco Curr.Out V1 / V2 Curr.Out V3 / V4	Selection of the process value issued via the current output. The current outputs V1 / V2 and V3 / V4 are only available if the corresponding plug-in cards are present! **Available process variables** on page 80
Dig.Out 41 / 42 Mode	Selection of the operating mode for the digital output 41 / 42. • Off: Digital output 41 / 42 deactivated. • Logic: Digital output 41 / 42 as a binary output (e.g. as an alarm output). • Pulse: Digital output 41 / 42 as a pulse output. In pulse mode, pulses per unit are output (e.g. 1 pulse per m^3). • 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.

Menu / parameter	Description
Easy Set-up	
Dig.Out 51 / 52 Mode	Selection of the operating mode for the digital output 51 / 52. • Off: Digital output deactivated. • Logic: Digital output functions as binary output (for function see parameter '„...Setup Logic Output'). • 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 51 / 52 / Outp. Flow Direction', digital output 51 / 52 is operated in pulse mode as follows: - No pulses are issued if 'Forward & Reverse' is selected. Only digital output 41 / 42 is active. - 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. - If 'Reverse' is selected, pulses for reverse flow are issued on digital output 41 / 42, while pulses for forward flow are issued on digital output 51 / 52. • 90° Shift: Output of the same pulses as for digital output 41 / 42, phase shifted by 90°. • 180° Shift: Output of the same pulses as for digital output 41 / 42, phase shifted by 180°
Dig.Out V1 / V2 Mode	Selection of the operating mode for digital output V1 / V2. Digital output V1 / V2 is only available if the corresponding plug-in card is present! • Off: Digital output V1 / V2 deactivated. • Logic: Digital output V1 / V2 as a binary output (for example, as an alarm output).
Dig.Out V3 / V4 Mode	Selection of the operating mode for digital output V3 / V4. Digital output V3 / V4 is only available if the corresponding plug-in card is present! • Off: Digital output V3 / V4 deactivated. • Logic: Digital output V3 / V4 as a binary output (for example, as an alarm output).
Dig.Out 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. **Available process variables** on page 80
Dig.Out 41 / 42 Logic	Selection of the output function for the relevant binary output. • F / R Signal: The binary output signals the flow direction.
Dig.Out 51 / 52 Logic	• 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.
Dig.Out V1 / V2 Logic	• Batch End Contact: The binary output is activated when the set fill quantity is reached (only if the FillMass function is activated).
Dig.Out V3 / V4 Logic	Only if the relevant digital output has been configured as a binary output.
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 Frequency	Sets the upper range value frequency for the digital output operating mode 'Frequency'. The entered value corresponds to 100 % flow. 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. **Note** Prior to starting the zero point adjustment, make sure that: • There is no flow through the sensor (close all valves, shut-off devices etc.) • The sensor must be filled completely with measuring medium for measurement.

9 Operation

Safety instructions

⚠ CAUTION

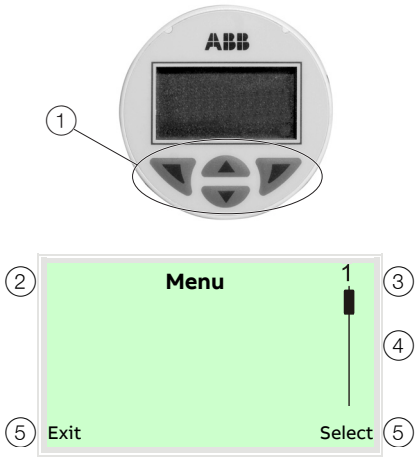
Risk of burns due to hot measuring media

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



1. Operating buttons for menu navigation
2. Menu name display
3. Menu number display
4. Marker for indicating relative position within the menu
5. Display showing the current functions of the ◥ and ◢ operating buttons

Figure 62: 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.

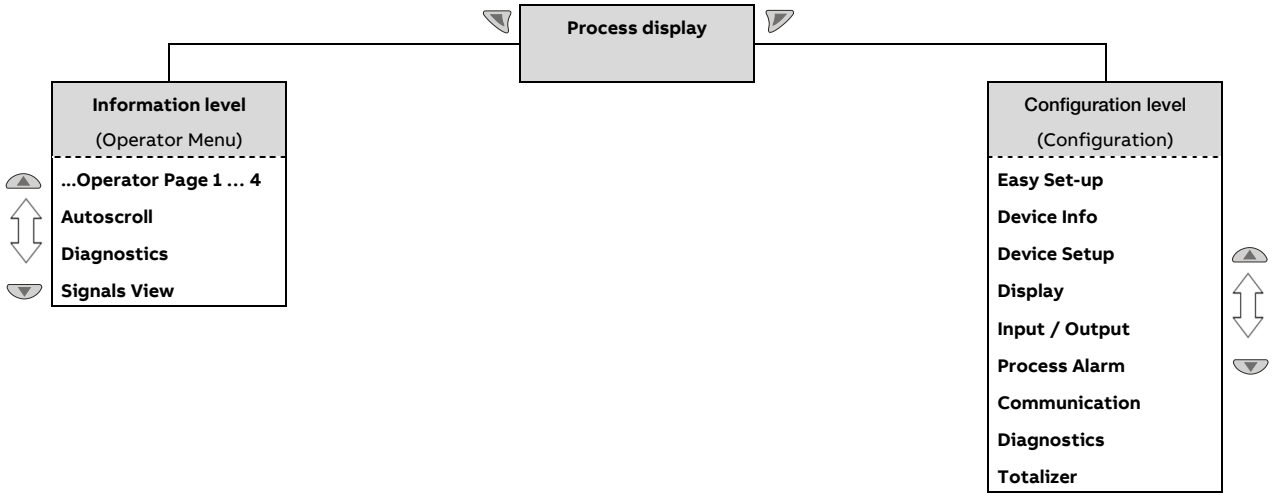
You can use the ▲ or ▼ operating buttons to browse through the menu or select a number or character within a parameter value.
Different functions can be assigned to the ◥ and ◢ operating buttons. The function (5) that is currently assigned to them is shown on the LCD display.

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



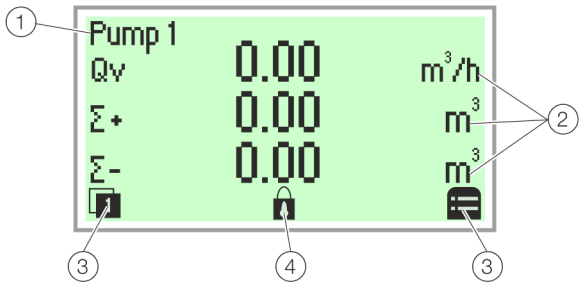
Process display
The process display shows the current process values.
From the level of the process display, you can branch out into two menu levels (information level, configuration level).

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 95.

… 9 Operation

Process display



① Measuring point tagging
② Current process values
③ 'Button function' symbol
④ 'Parameterization protected' symbol

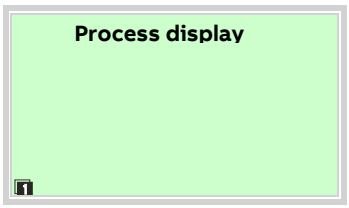
Figure 63: Process display (example)

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.

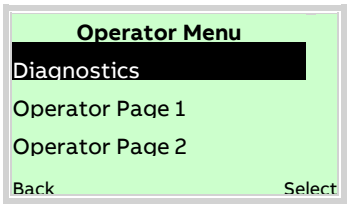
Symbol	Description
/	Call up information level. When Autoscroll mode is activated, the icon appears here and the operator pages are automatically displayed one after the other.
	Call up configuration level.
	The device is protected against changes in the parametrization.

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.

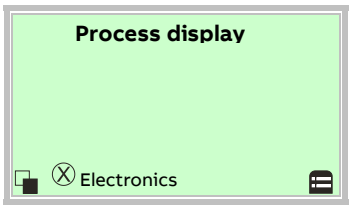


2. Select the desired submenu using / .
3. Confirm the selection with .

Menu	Description
… / Operator Menu	
Diagnostics	Selection of sub-menu 'Diagnostics'; see also **Error messages on the LCD display** on page 75.
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.
Signals View	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

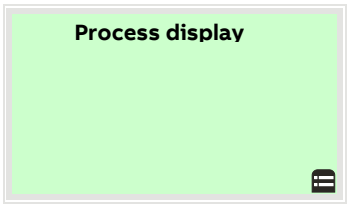
The error messages are also divided into the following areas:

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 131.

Switching to the information level

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’.

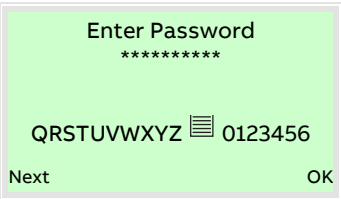
- There is no factory default password. For security reasons it is recommended to set a password.
- The password prevents access to the parameterization via the buttons on the device. For further access protection via DTM or EDD (HART®, PROFIBUS®, Modbus®) the hardware write protection switch must be set (see **Hardware settings** on page 64).

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.

… 9 Operation

… Switching to the information level

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.



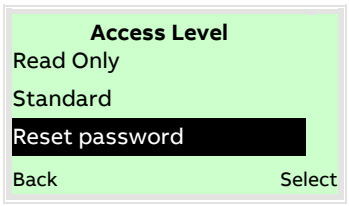
4. Enter the appropriate password. No password is preset in the factory settings. Users can switch to the configuration level without entering a password.
   The selected access level remains active for 3 minutes. Within this time period you can toggle between the process display and the configuration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

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

6. Select a menu using ▲ / ▼.
7. 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 password' then appears in the list of access levels.

1. Switch to the configuration level with ◤.



2. Use ▲ / ▼ to select the 'Reset password' entry.
3. Confirm the selection with ◤.

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

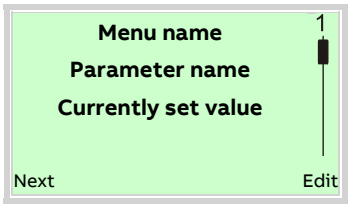
Note
The one-time password is only valid once and needs to separately requested with each password reset.

6. Confirm the input with ◤.

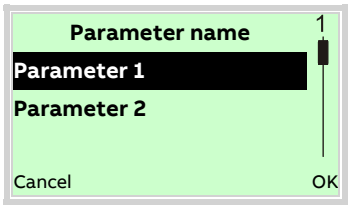
After the one-time password has been entered, the password for the 'Standard' access level is reset and can be reassigned.

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.



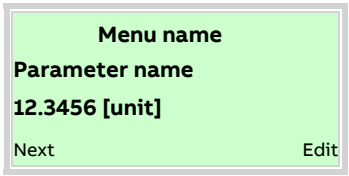
1. Select the parameters you want to set in the menu.
2. Use to call up the list of available parameter values. The parameter value that is currently set is highlighted.



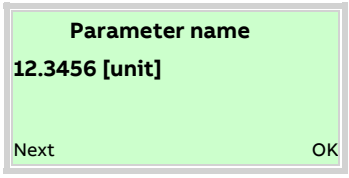
3. Select the desired value using / .
4. Confirm the selection with .

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.



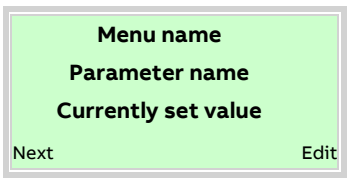
1. Select the parameters you want to set in the menu.
2. Use to call up the parameter for editing. The decimal place that is currently selected is highlighted.



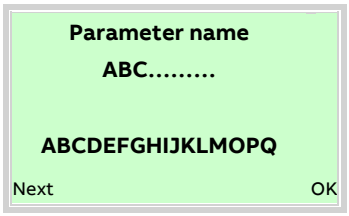
3. Use to select the decimal place to change.
4. Use / to set the desired value.
5. Use to select the next decimal place.
6. If necessary select and set additional decimal places in accordance with steps 3 to 4.
7. Use to confirm your setting.

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.

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.

… 9 Operation

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 rate

Selection	Code	Description
m^3/s	13	Cubic meters per second
m^3/min	14	Cubic meters per minute
m^3/h	15	Cubic meters per hour
m^3/d	16	Cubic meters per day
ft^3/s	29	Cubic feet per second
ft^3/min	30	Cubic feet per minute
ft^3/h	31	Cubic feet per hour
ft^3/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
Ml/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 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^3	1	Grams per cubic centimeter
kg/m^3	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^3	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)

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)
Pounds	8	Pounds (advp)
xx/yy	254	Customer unit (user-defined)

Table 7: Units for the volume totalizer

Selection	Code	Description
m^3	4	Cubic meters
ft^3	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

… 9 Operation

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]).

Process variable	Short form	Description	HMI	CO	DO [f]	DO [pulse]
Mass Flow [unit]	Qm	Mass flow in the selected mass flow unit	X	—	—	X
Mass Flow [%]	Qm	Mass flow in percent	X	X	X	—
Volume Flow [unit]	Qv	Volume flow in the selected volume unit	X	—	—	X
Volume Flow [%]	Qv	Volume flow in percent	X	X	X	—
Temperature [unit]	Tm	Temperature in the selected volume unit	X	—	—	—
Temperature [%]	Tm	Temperature in percent	X	X	X	—
Density [unit]	p	Density in the selected density unit	X	—	—	—
Density [%]	p	Density in percent	X	X	X	—
Net Mass Flow[unit]*	nQm	Net mass flow in the selected volume unit	X	—	—	X
Net Mass Flow [%]*	nQm	Net mass flow in percent	X	X	X	—
Net Vol. Flow [unit]*	nQv	Net volume flow in the selected volume unit	X	—	—	X
Net Volume Flow [%]*	nQv	Net volume flow in percent	X	X	X	—
Vol.Flow@Tref [unit]*	Q@T	Volume flow at a reference temperature.	X	—	—	X
Vol.Flow@Tref [%]*	Q@T		X	X	X	—
Density@Tref [unit]*	p@T	Density at a reference temperature.	X	—	—	—
Density @ Tref [%]*	p@T		X	X	X	—
Concentr.unit [%]*	β u	Concentration in the selected unit in percent	X	X	X	—
Concentr.unit [unit]*	β u	Concentration in the selected unit	X	—	—	—
Concentr.% [%]*	β %	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

Process variable	Short form	Description	HMI	CO	DO [f]	DO [pulse]
Totalizer Qm Fwd	∑m+	Mass flow counter reading in the forward flow direction	X	—	—	—
Totalizer Qm Rev	∑m-	Mass flow counter reading in the reverse flow direction	X	—	—	—
Totalizer Qm Diff	∑m	Mass flow counter reading for forward flow / reverse flow difference	X	—	—	—
Totalizer Qv Fwd	∑v+	Volume flow counter reading in forward flow direction	X	—	—	—
Totalizer Qv Rev	∑v-	Volume flow counter reading in reverse flow direction	X	—	—	—
Totalizer Qv Diff	∑v	Volume flow counter reading for forward flow / reverse flow difference	X	—	—	—
Total. Net Qm Fwd*	∑M+	Net mass flow counter reading in forward flow direction	X	—	—	—
Total. Net Qm Rev*	∑M-	Net mass flow counter reading in reverse flow direction.	X	—	—	—
Total. Net Qm Diff*	∑M	Net mass flow counter reading for forward flow / reverse flow difference.	X	—	—	—
Total. Net Qv Fwd*	∑V+	Net volume flow counter reading in forward flow direction.	X	—	—	—
Total. Net Qv Rev*	∑V-	Net volume flow counter reading in reverse flow direction.	X	—	—	—
Total. Net Qv Diff*	∑M	Net volume flow counter reading for forward flow / reverse flow difference.	X	—	—	—
Total.Qv@Tref Fwd*	∑T+	Volume flow counter reading in forward flow direction at a reference temperature.	X	—	—	—
Total.Qv@Tref Rev*	∑T-	Volume flow counter reading in reverse flow direction at a reference temperature.	X	—	—	—
Total.Qv@Tref Diff*	∑T	Volume flow counter reading for forward flow / reverse flow difference at a reference temperature.	X	—	—	—
Totalizer Qm Sum	∑m+-S	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	∑v+-S	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	∑M+-S	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

… 9 Operation

… Available process variables

Process variable	Short form	Description	HMI	CO	DO [f]	DO [pulse]
Total. Net Qv Sum	∑V+-S	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	∑T+-S	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.**	CBT	Current fill quantity.	X	—	—	—
Current Batch Counts**	CBC	Number of fill operations.	X	—	—	—
Tube Frequency	PF	Meter tube frequency in Hz.	X	—	—	—
Driver Output	DOC	Driver current in mA.	X	—	—	—
Sensor Singal A	SSA	Sensor amplitude of sensor A in mV	X	—	—	—
Sensor Singal B	SSB	Sensor amplitude of sensor B in mV	X	—	—	—
Specific Gravity	SG	Specific weight for liquids.	X	—	—	—
°API Gravity	API	Crude oil density in API degrees	X	—	—	—
Variable 1	Va1	External fieldbus variable 1	X	—	—	—
Variable 2	Va2	External fieldbus variable 2	X	—	—	—
Electr. (FEB) Temp	Ttx	Temperature of the frontend board.	X	—	—	—
Sensor Housing Temp	Tsx	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.

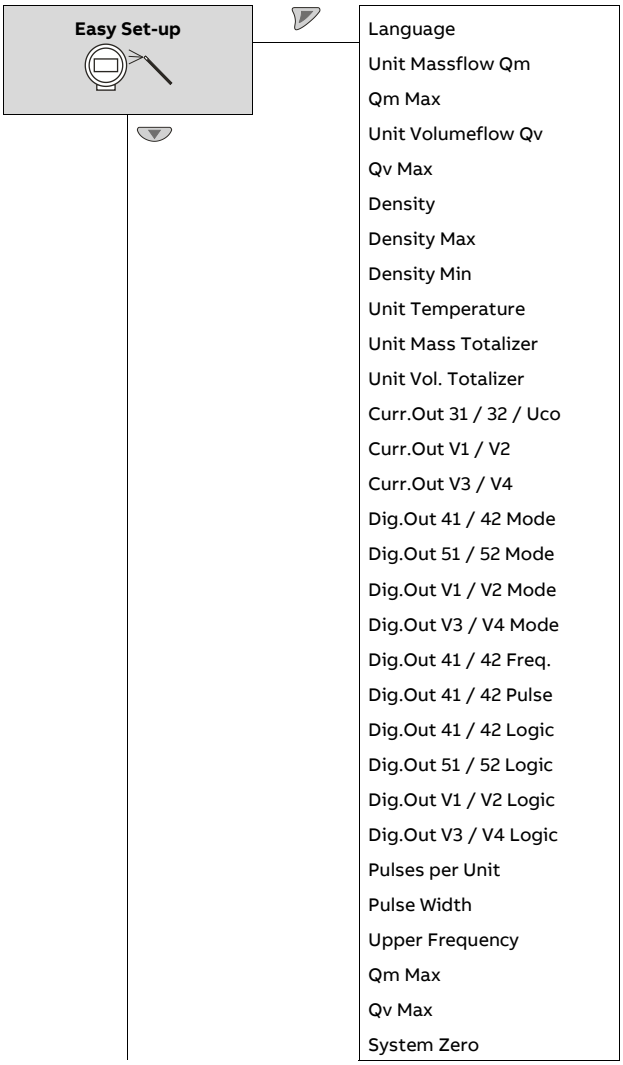
X Parameter available

— Parameter not available

Parameter overview

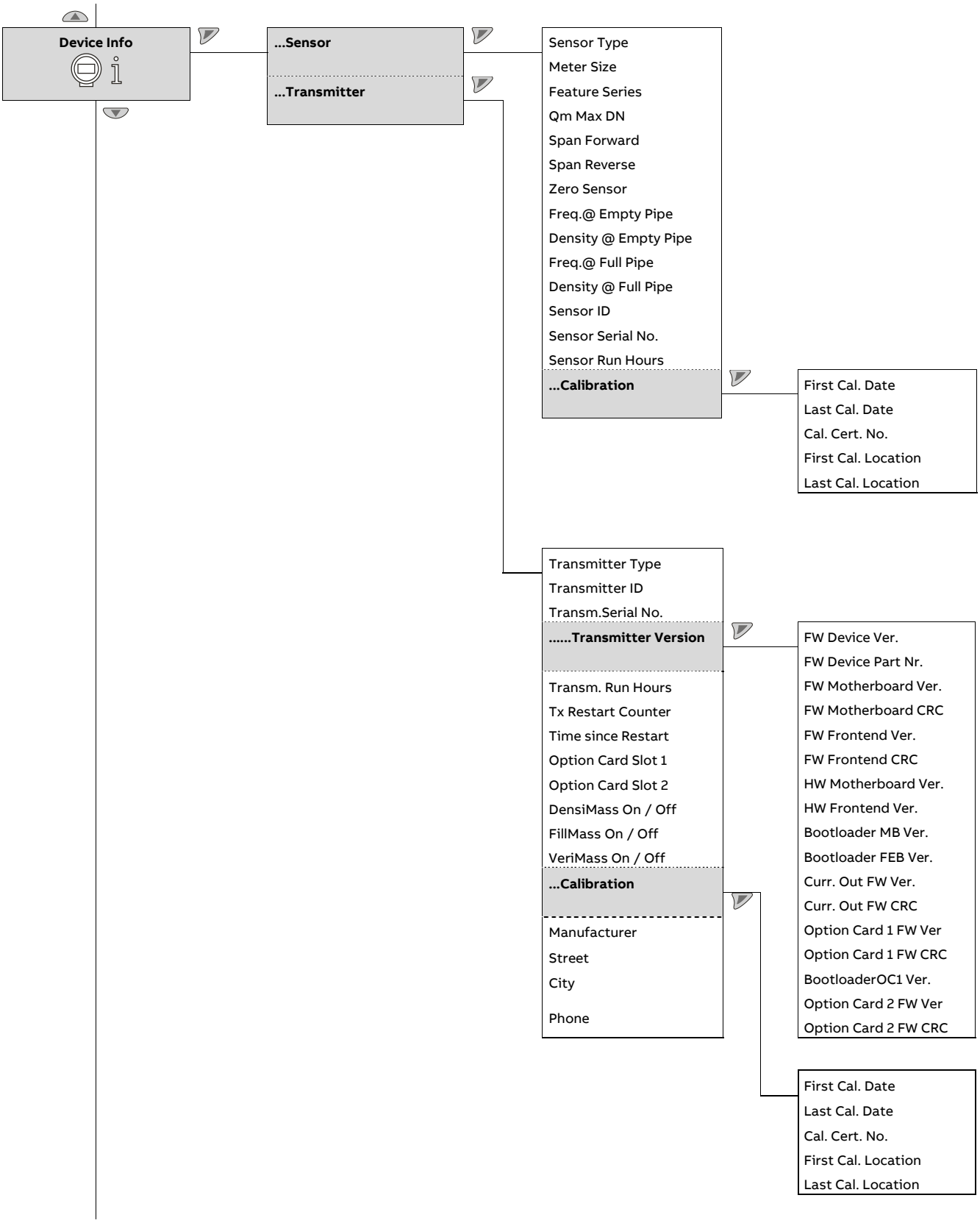
Note

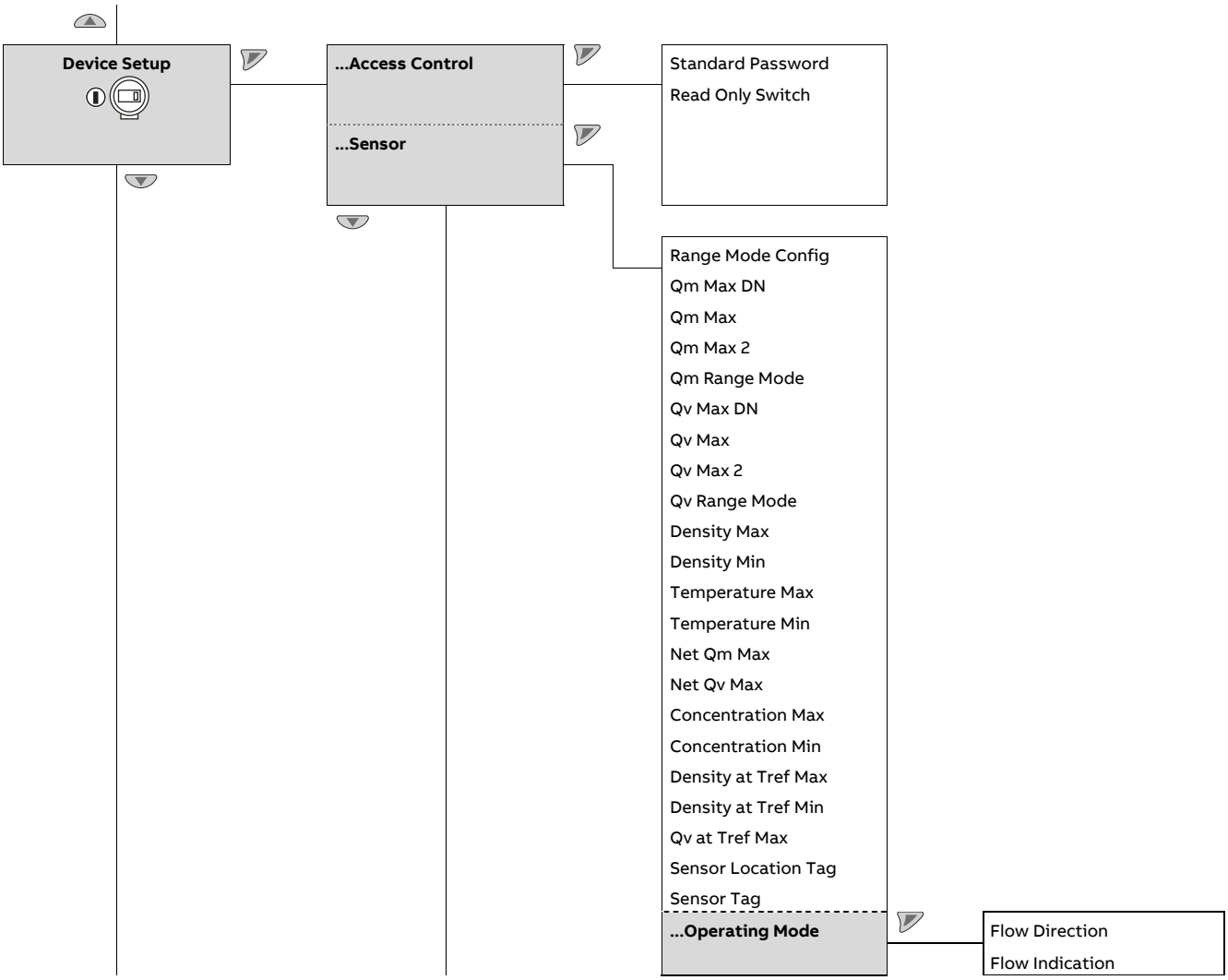
This overview of parameters shows all the menus and parameters available on the device. Depending on the version and configuration of the device, not all of the menus and parameters may be visible in it.



… 9 Operation

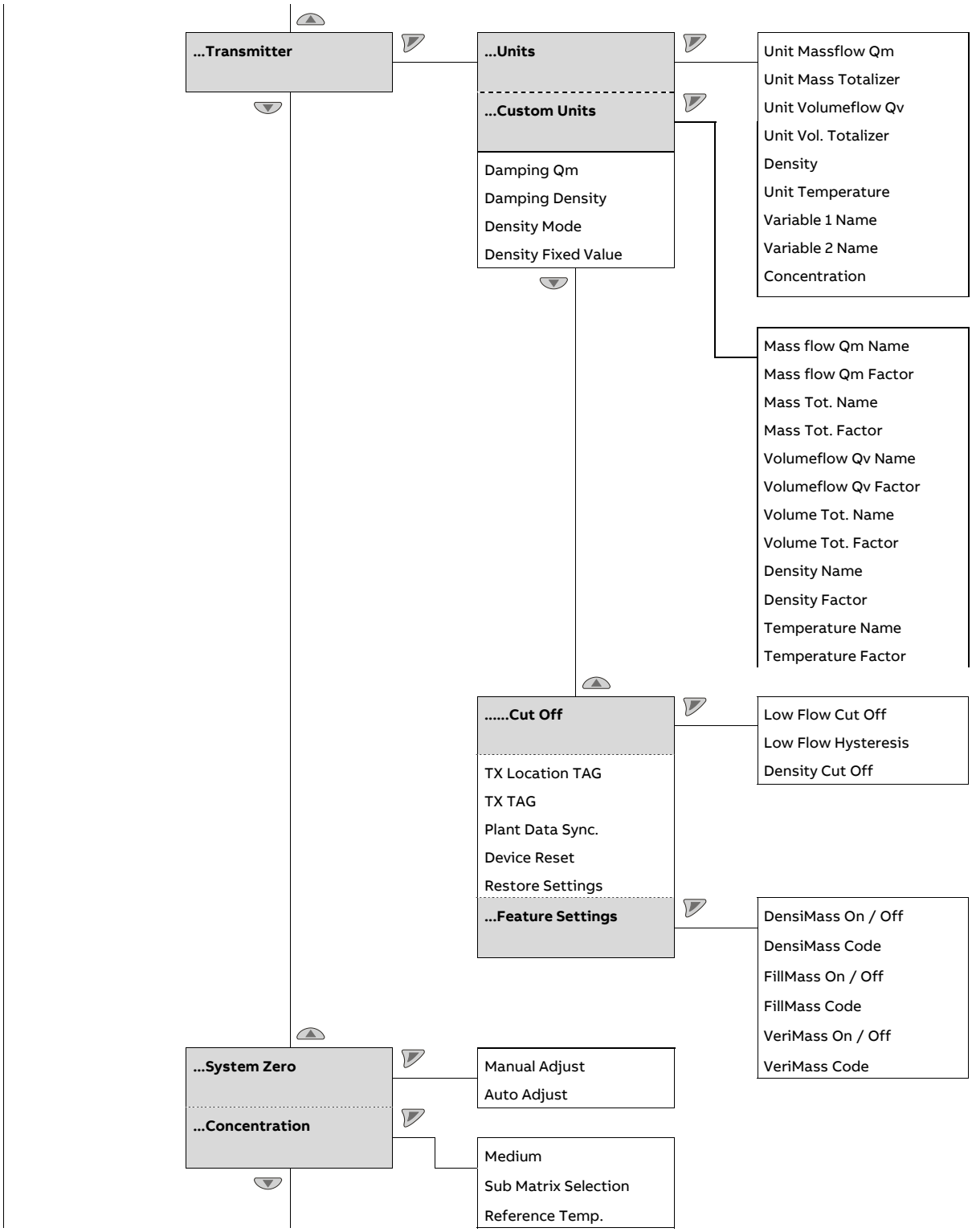
… Parameter overview

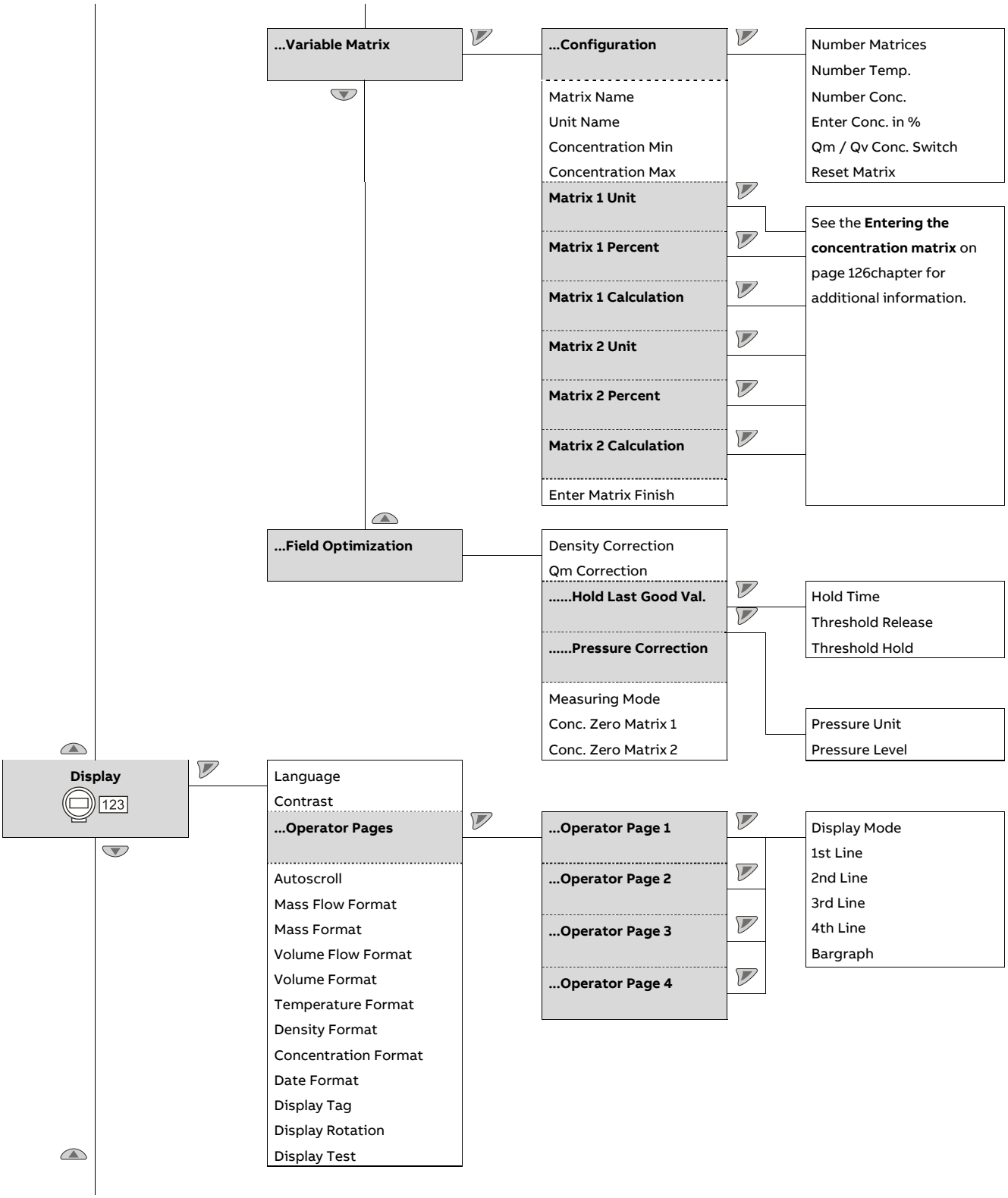



Device Setup
...Access Control
...Sensor
Standard Password
Read Only Switch
Range Mode Config
Qm Max DN
Qm Max
Qm Max 2
Qm Range Mode
Qv Max DN
Qv Max
Qv Max 2
Qv Range Mode
Density Max
Density Min
Temperature Max
Temperature Min
Net Qm Max
Net Qv Max
Concentration Max
Concentration Min
Density at Tref Max
Density at Tref Min
Qv at Tref Max
Sensor Location Tag
Sensor Tag
...Operating Mode
Flow Direction
Flow Indication

… 9 Operation

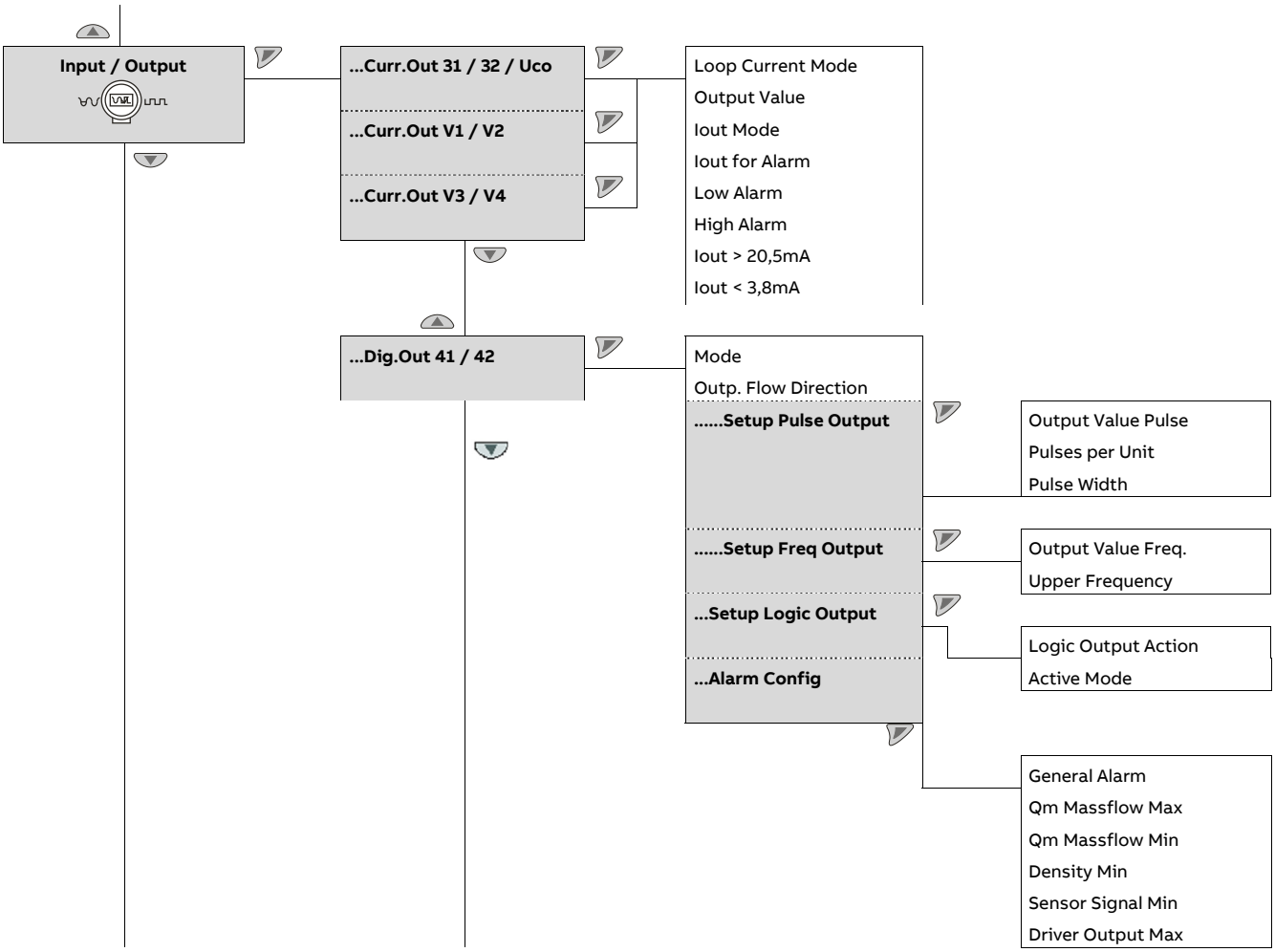
… Parameter overview

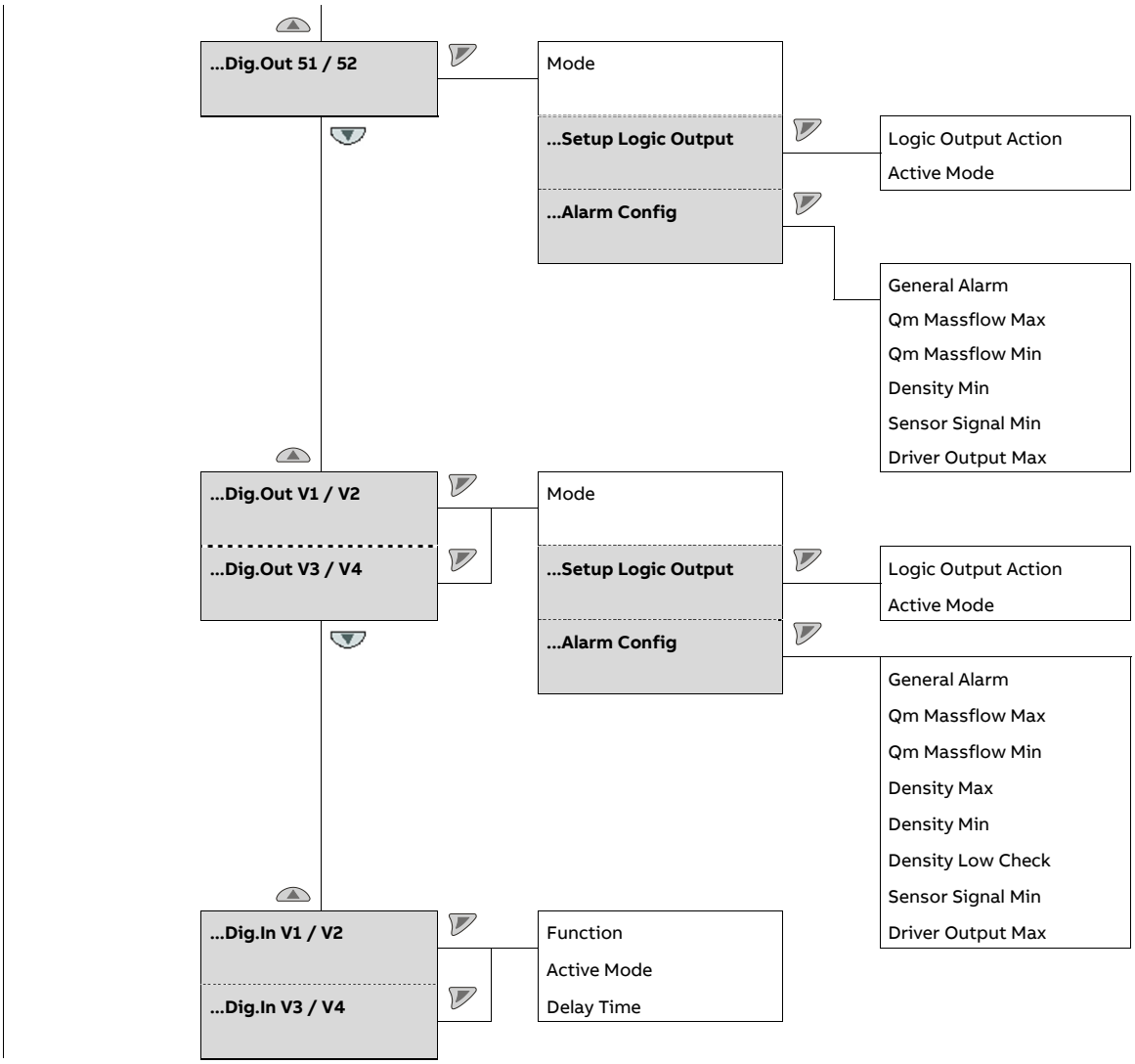



...Variable Matrix
...Configuration
Number Matrices
Number Temp.
Number Conc.
Enter Conc. in %
Qm / Qv Conc. Switch
Reset Matrix
Matrix Name
Unit Name
Concentration Min
Concentration Max
Matrix 1 Unit
Matrix 1 Percent
Matrix 1 Calculation
Matrix 2 Unit
Matrix 2 Percent
Matrix 2 Calculation
Enter Matrix Finish
See the Entering the concentration matrix on page 126chapter for additional information.
...Field Optimization
Density Correction
Qm Correction
.....Hold Last Good Val.
Hold Time
Threshold Release
Threshold Hold
.....Pressure Correction
Measuring Mode
Conc. Zero Matrix 1
Conc. Zero Matrix 2
Pressure Unit
Pressure Level
Display
123
Language
Contrast
...Operator Pages
...Operator Page 1
...Operator Page 2
...Operator Page 3
...Operator Page 4
Display Mode
1st Line
2nd Line
3rd Line
4th Line
Bargraph
Autoscroll
Mass Flow Format
Mass Format
Volume Flow Format
Volume Format
Temperature Format
Density Format
Concentration Format
Date Format
Display Tag
Display Rotation
Display Test

… 9 Operation

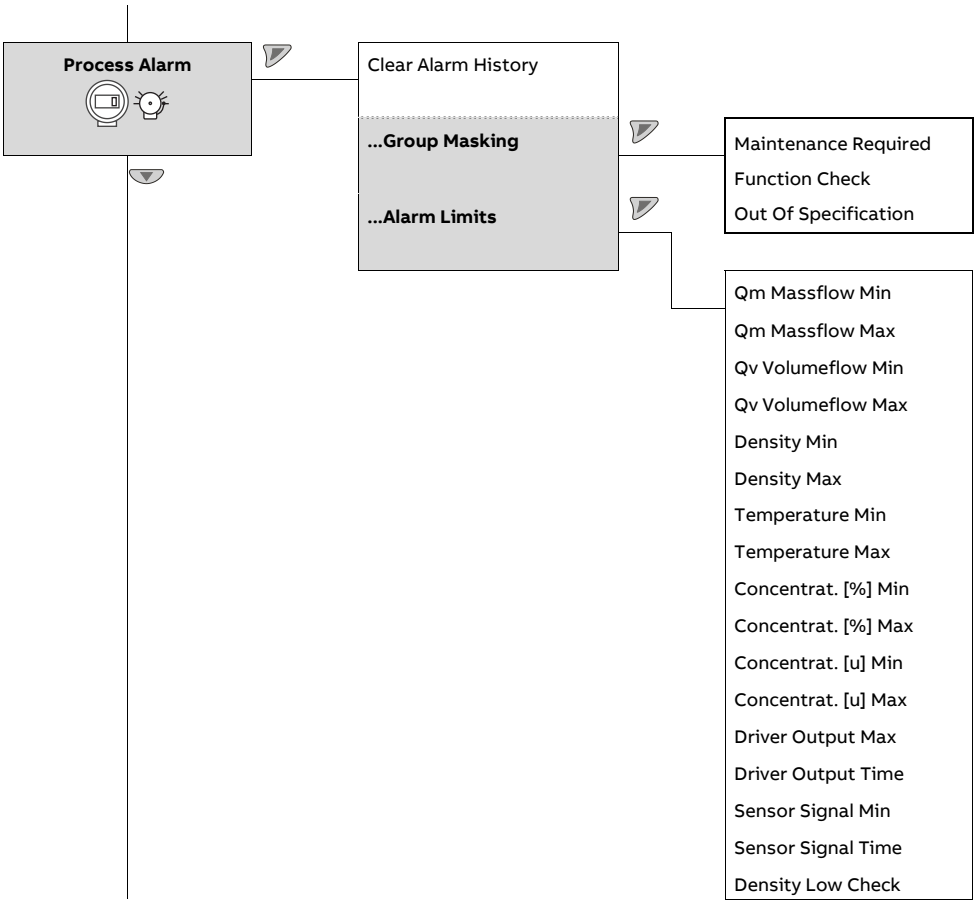
… Parameter overview

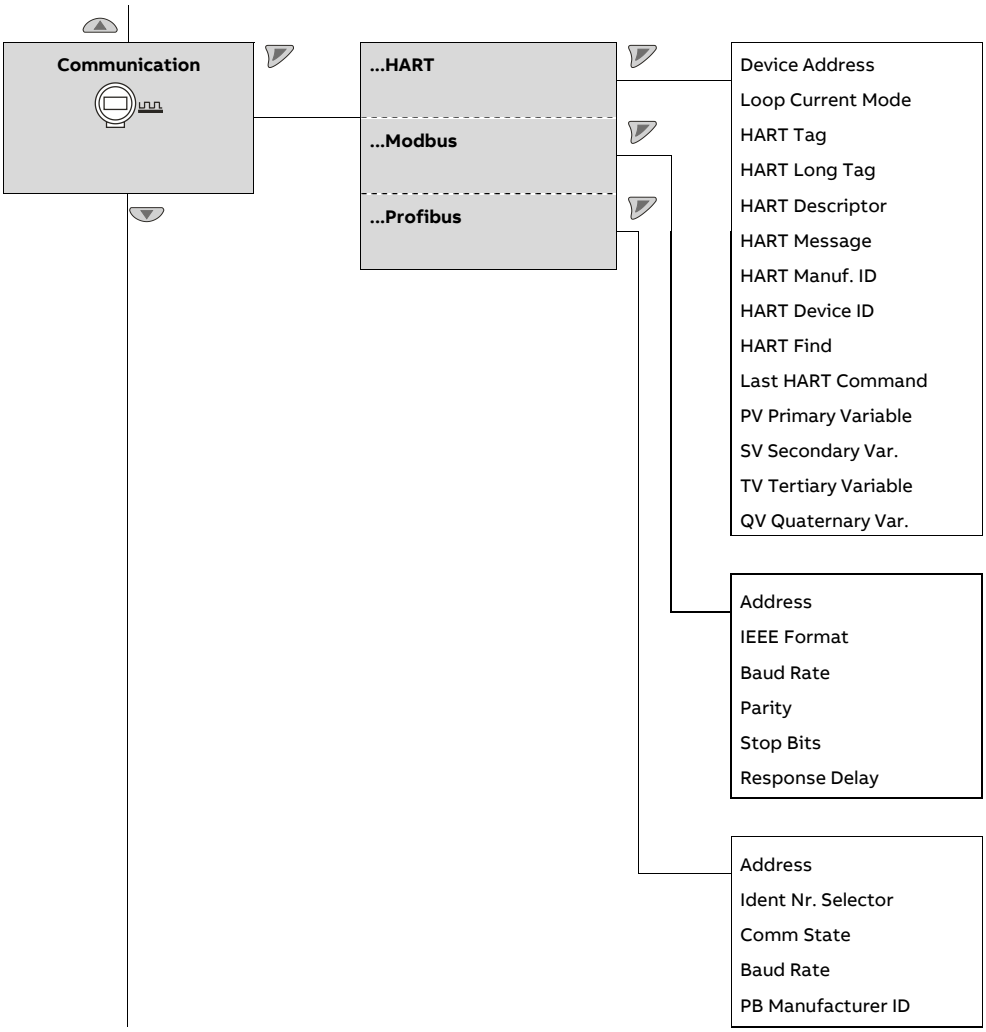



...Dig.Out 51 / 52
Mode
...Setup Logic Output
Logic Output Action
Active Mode
...Alarm Config
General Alarm
Qm Massflow Max
Qm Massflow Min
Density Min
Sensor Signal Min
Driver Output Max
...Dig.Out V1 / V2
...Dig.Out V3 / V4
Mode
...Setup Logic Output
Logic Output Action
Active Mode
...Alarm Config
General Alarm
Qm Massflow Max
Qm Massflow Min
Density Max
Density Min
Density Low Check
Sensor Signal Min
Driver Output Max
...Dig.In V1 / V2
...Dig.In V3 / V4
Function
Active Mode
Delay Time

… 9 Operation

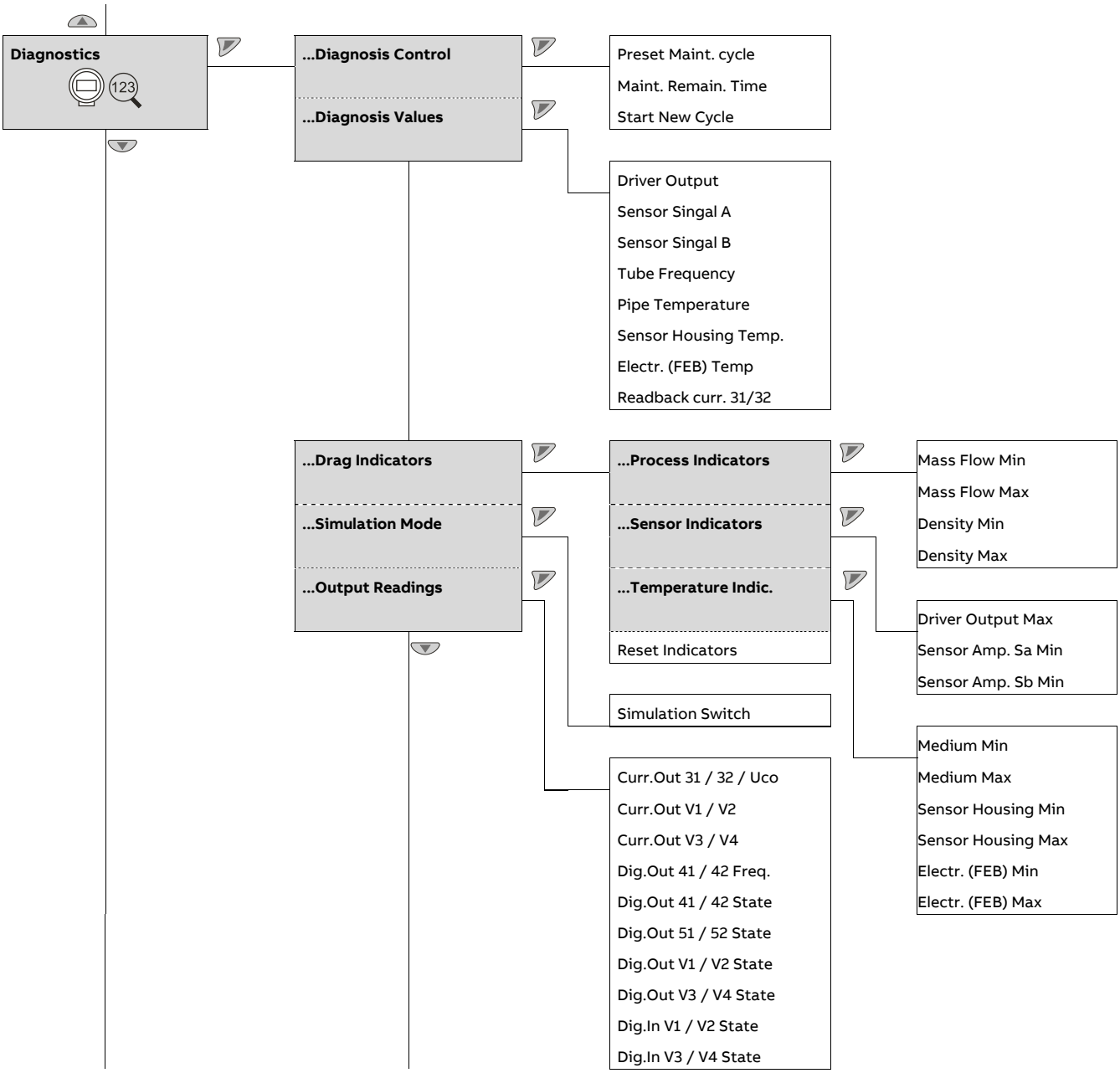
… Parameter overview

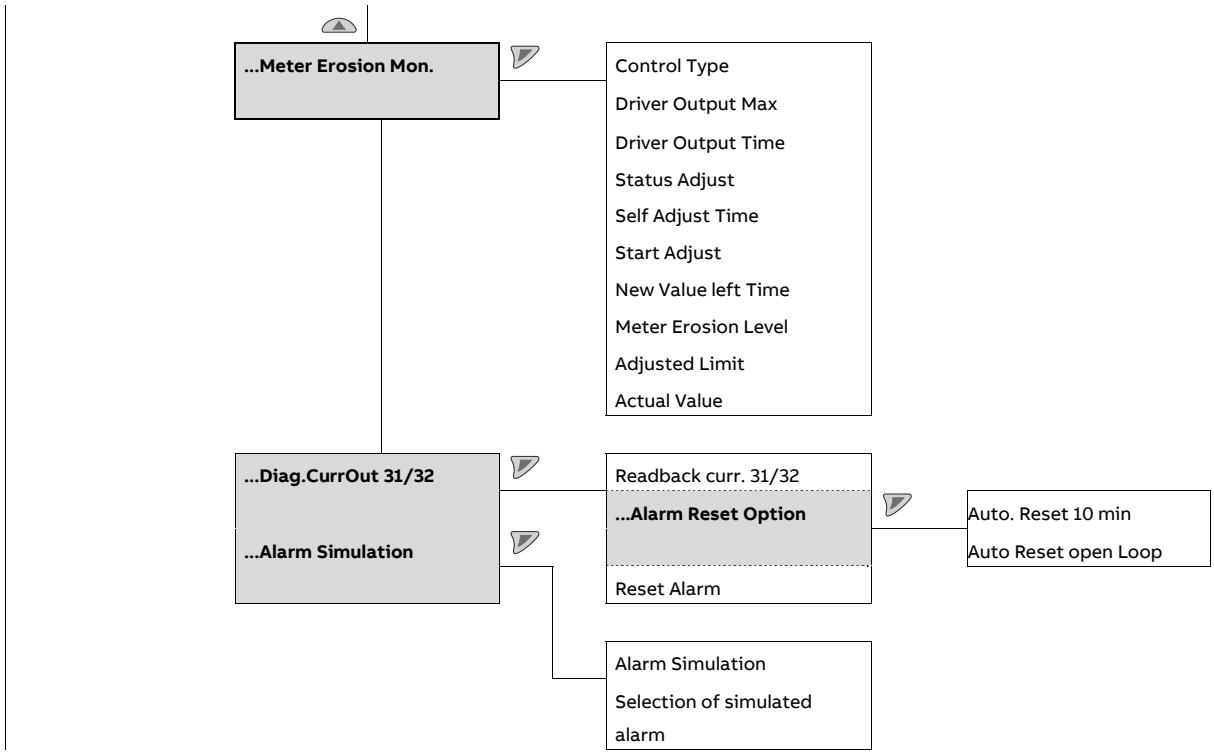



Communication
...HART
...Modbus
...Profibus
Device Address
Loop Current Mode
HART Tag
HART Long Tag
HART Descriptor
HART Message
HART Manuf. ID
HART Device ID
HART Find
Last HART Command
PV Primary Variable
SV Secondary Var.
TV Tertiary Variable
QV Quaternary Var.
Address
IEEE Format
Baud Rate
Parity
Stop Bits
Response Delay
Address
Ident Nr. Selector
Comm State
Baud Rate
PB Manufacturer ID

… 9 Operation

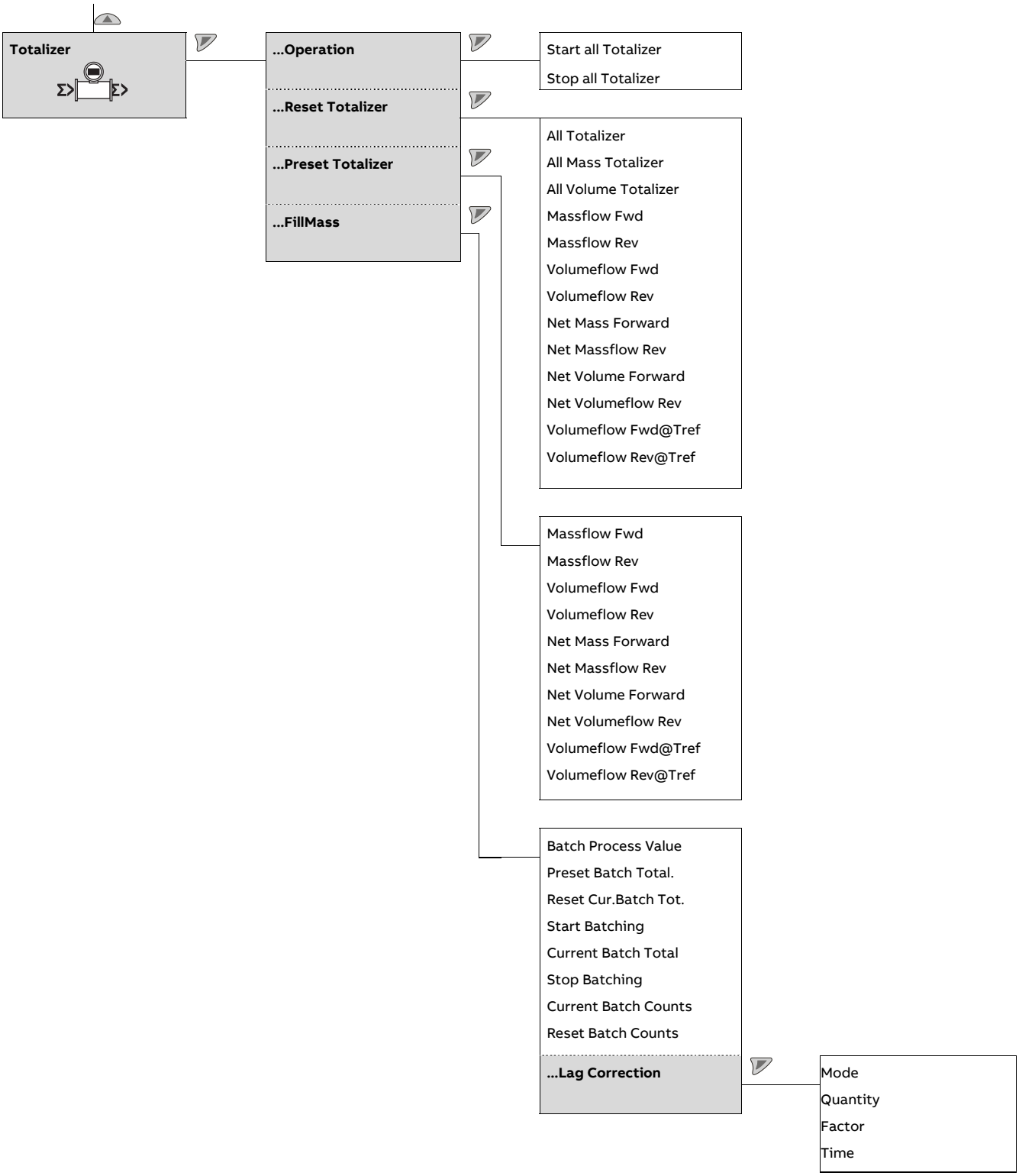
… Parameter overview




...Meter Erosion Mon.
Control Type
Driver Output Max
Driver Output Time
Status Adjust
Self Adjust Time
Start Adjust
New Value left Time
Meter Erosion Level
Adjusted Limit
Actual Value
...Diag.CurrOut 31/32
...Alarm Simulation
Readback curr. 31/32
...Alarm Reset Option
Reset Alarm
Auto. Reset 10 min
Auto Reset open Loop
Alarm Simulation
Selection of simulated alarm

… 9 Operation

… Parameter overview



Parameter descriptions

Menu: Easy Set-up

Menu / parameter	Description
Easy Set-up	
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 **Table 2: Units for mass flow** on page 78.
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.
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 **Table 1: Units for the volume flow rate** on page 78.
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	Selection of the unit for the density (e.g. for the associated parameters and the corresponding process values). See Table **Table 3: Density units** on page 78.
Density Max Density Min	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.
Unit Temperature	Selection of unit for temperature (e.g. for the associated parameters and the corresponding process values). See Table **Table 4: Temperature units** on page 78.
Unit Mass Totalizer	Selection of the unit for the mass counters and the pulse outputs. See Table **Table 6: Units for the mass totalizer** on page 79.
Unit Vol. Totalizer	Selection of the unit for the volume totalizers and the pulse outputs. See Table **Table 7: Units for the volume totalizer** on page 79.
Curr.Out 31 / 32 / Uco Curr.Out V1 / V2 Curr.Out V3 / V4	Selection of the process value issued via the current output. The current outputs V1 / V2 and V3 / V4 are only available if the corresponding plug-in cards are present! **Available process variables** on page 80
Dig.Out 41 / 42 Mode	Selection of the operating mode for the digital output 41 / 42. • Off: Digital output 41 / 42 deactivated. • Logic: Digital output 41 / 42 as a binary output (e.g. as an alarm output). • Pulse: Digital output 41 / 42 as a pulse output. In pulse mode, pulses per unit are output (e.g. 1 pulse per m^3). • 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.

… 9 Operation

… Parameter descriptions

Menu / parameter	Description
Easy Set-up	
Dig.Out 51 / 52 Mode	Selection of the operating mode for the digital output 51 / 52. • Off: Digital output deactivated. • Logic: Digital output functions as binary output (for function see parameter '„...Setup Logic Output'). • 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 51 / 52 / Outp. Flow Direction', digital output 51 / 52 is operated in pulse mode as follows: - No pulses are issued if 'Forward & Reverse' is selected. Only digital output 41 / 42 is active. - 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. - If 'Reverse' is selected, pulses for reverse flow are issued on digital output 41 / 42, while pulses for forward flow are issued on digital output 51 / 52. • 90° Shift: Output of the same pulses as for digital output 41 / 42, phase shifted by 90°. • 180° Shift: Output of the same pulses as for digital output 41 / 42, phase shifted by 180°
Dig.Out V1 / V2 Mode	Selection of the operating mode for digital output V1 / V2. Digital output V1 / V2 is only available if the corresponding plug-in card is present! • Off: Digital output V1 / V2 deactivated. • Logic: Digital output V1 / V2 as a binary output (for example, as an alarm output).
Dig.Out V3 / V4 Mode	Selection of the operating mode for digital output V3 / V4. Digital output V3 / V4 is only available if the corresponding plug-in card is present! • Off: Digital output V3 / V4 deactivated. • Logic: Digital output V3 / V4 as a binary output (for example, as an alarm output).
Dig.Out 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. **Available process variables** on page 80
Dig.Out 41 / 42 Logic	Selection of the output function for the relevant binary output. • F / R Signal: The binary output signals the flow direction. • 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. • Batch End Contact: The binary output is activated when the set fill quantity is reached (only if the FillMass function is activated).
Dig.Out 51 / 52 Logic Dig.Out V1 / V2 Logic Dig.Out V3 / V4 Logic	Only if the relevant digital output has been configured as a binary output.
Pulses per Unit Pulse Width	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.
Upper Frequency	Sets the upper range value frequency for the digital output operating mode 'Frequency'. The entered value corresponds to 100 % flow. 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. **Note** Prior to starting the zero point adjustment, make sure that: • There is no flow through the sensor (close all valves, shut-off devices etc.) • The sensor must be filled completely with measuring medium for measurement.

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
Device Info	
...Sensor	Selection of submenu '...Sensor' using .
...Transmitter	Selection of submenu '...Transmitter' 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	
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 '...Calibration' 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
Device Info / ...Transmitter	
Transmitter Type	Type of transmitter.
Transmitter ID	ID number of transmitter.
Transm.Serial No.	Serial number of transmitter.
...Transmitter Version	Selection of submenu '...Transmitter Version' 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.

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… Parameter descriptions

Menu / parameter	Description
Device Info / …Transmitter	
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.
…Calibration	Selection of submenu '…Calibration' 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
Device Setup	
...Access Control	Selection of submenu '...Access Control' using .
...Sensor	Selection of submenu '...Sensor' using .
...Transmitter	Selection of submenu '...Transmitter' using .
...System Zero	Selection of submenu '...System Zero' using .
...Concentration	Selection of submenu '...Concentration' using . The menu is only available if the DensiMass function is activated.
...Variable Matrix	Selection of submenu '...Variable Matrix' using . The menu is only available if the DensiMass function is activated.
...Field Optimization	Selection of submenu '...Field Optimization' 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 further information, see chapter **Hardware settings** on page 64.

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. • Disabled: Second measuring range for mass and volume flow rate deactivated. • Qm and Qv: Second measuring range for mass and volume flow rate activated. • Qm only: Second measuring range for mass flow activated. • Qv only: Second measuring range for volume flow activated.
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.

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… Parameter descriptions

Menu / parameter	Description
Device Setup / …Sensor	
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 Density Min	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.
Temperature Max Temperature Min	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.
Net Qm Max Net Qv Max	Sets the maximum net mass flow and net volume flow. The values are also used to calculate the corresponding percentage value. The parameters are only available when the DensiMass function is activated.
Concentration Max Concentration Min	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. The parameters are only available when the DensiMass function is activated.
Density Max at Tref Density Min at Tref	Sets the minimum and maximum density of the measuring medium at the reference temperature T_{ref}. 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.
Sensor Location Tag	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.
…Operating Mode	Selection of submenu '…Operating Mode' using .

Device Setup / …Sensor / …Operating Mode	
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. • Forward & Reverse: The device measures in both flow directions. • Forward only: The device measures only in the forward flow direction (the direction of flow corresponds to the arrow on the sensor). • Reverse only: The device measures only in the reverse flow direction (the direction of flow is opposite to the arrow on the sensor).
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
Device Setup / ...Transmitter	
...Units	Selection of submenu '...Units' using .
...Custom Units	Selection of submenu '...Custom Units' using .
Damping Qm	Sets the damping for measuring mass flow. The value set here relates to 1 τ (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 τ (Tau). The value refers to the response time for a stepwise density change.
Density Mode	Selection of operating mode for density measurement. • Density Measured: The density of the measuring medium is calculated by the transmitter. • 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. See also chapter **Measurement of standard volumes** on page 122.
Density Fixed Value	Sets the density of the measuring medium, for example, when measuring the standard volume of gases.
.....Cut Off	Selection of submenu '.....Cut Off' 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. • FEB > MB: Loading the configuration from the frontend board (FEB) of the sensor. • MB > FEB: Loads the configuration from the motherboard (MB) of the transmitter. See also chapter **Replacing the frontend board** on page 141.
Device Reset	Restarts the device. Compensates for a short interruption of the power supply.
Restore Settings	All user-accessible parameters will be reset to the factory default settings.
...Feature Settings	Selection of submenu '...Feature Settings' using .

… 9 Operation

… Parameter descriptions

Menu / parameter	Description
Device Setup / …Transmitter / …Units	
Unit Massflow Qm	Selection of unit for mass flow. Refer to **Table 2: Units for mass flow** on page 78. 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 **Table 6: Units for the mass totalizer** on page 79.
Unit Volumeflow Qv	Selection of unit for volume flow. Refer to **Table 7: Units for the volume totalizer** on page 79. 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 **Table 7: Units for the volume totalizer** on page 79.
Density	Selection of unit for the density. Refer to **Table 3: Density units** on page 78.
Unit Temperature	Selection of unit for temperature. Refer to **Table 4: Temperature units** on page 78.
Concentration	Selection of unit for concentration measurement. Refer to **Table 5: Concentration units** on page 79.
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.

Device Setup / …Transmitter / …Custom Units	
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
Device Setup / ...Transmitter / .....Cut Off	
Low Flow Cut Off	Sets the switching threshold for the low flow cut-off. 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/cm³

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_mMax.
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_mMax.

Device Setup / ...Transmitter / ...Feature Settings	
DensiMass On / Off	Indicates whether the DensiMass function is active.
DensiMass Code	Sets the device-specific code for activating the DensiMass function. To use this function subsequently, contact the ABB service team or sales organization. After entering the code, restart the device (e.g. using the parameter 'Device Reset' or by briefly switching off the power supply).
Batchflow On / Off	Indicates whether the FillMass function is active.
Batchflow Code	Sets the device-specific code for activating the FillMass function. To use this function subsequently, contact the ABB service team or sales organization. After entering the code, restart the device (e.g. using the parameter 'Device Reset' or by briefly switching off the power supply).
VeriMass On / Off	Indicates whether the VeriMass function is active.
VeriMass Code	Sets the device-specific code for activating the VeriMass function. To use this function subsequently, contact the ABB service team or sales organization. After entering the code, restart the device (e.g. using the parameter 'Device Reset' or by briefly switching off the power supply).

Menu / parameter	Description
Device Setup / ...System Zero	
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. **NOTICE** Prior to starting the zero point adjustment, make sure that: • There is no flow through the sensor (close all valves, shut-off devices etc.) • The sensor must be filled completely with measuring medium for measurement.

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… Parameter descriptions

Menu / parameter	Description
Device Setup / …Concentration	
The menu is only available if the DensiMass function is activated	
Medium	Selection of measuring medium for concentration measurement using the DensiMass function. • Variable Matrix • Sodium Hydroxide • Alcohol Water • Wheat Starch • Corn Starch • Sugar in H2O • °API Gravity
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].

Device Setup / Variable Matrix	
…Configuration	Selection of submenu '…Configuration' 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.
…Matrix 1 Unit	Selection of submenu ''**…**Matrix 1 Unit' to enter Matrix 1 using .
…Matrix 1 Percent	See chapter **Concentration measurement DensiMass** on page 125 for further information.
…Matrix 1 Calculation	
…Matrix 2 Unit	Selection of submenu '**…**Matrix 2 Unit' to enter Matrix 2 using .
…Matrix 2 Percent	See chapter **Concentration measurement DensiMass** on page 125 for further information.
…Matrix 2 Calculation	
Enter Matrix Finish	

Device Setup / Variable Matrix / …Configuration	
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 %. • Yes: Entry of the concentration values in % • No: Entry of the concentration values in a selected unit. **NOTICE** 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 %.
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. • Mass Concentration • Volume Concentration
Reset Matrix	All entered matrix values are reset to '0'.

Menu / parameter	Description
Device Setup / ...Field Optimization	
Density Correction	Sets the correction factor for field optimization of the density measurement. 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.
Qm Correction	Sets the correction factor for field optimization of the mass flow measurement. The value is entered as a percentage of the current measured value. 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.
.....Hold Last Good Val.	Selection of submenu '.....Hold Last Good Val.' using .
.....Pressure Correction	Selection of submenu '.....Pressure Correction' using .
Measuring Mode	Selection of the measurement mode (liquid / gas). The measurement method for liquids and gases can be optimized by selecting the measurement mode. • Automatic: Automatic detection of the measurement mode. Selection with changing measuring media. • Gas: Selection with pure gas measurement. • Liquids: Selection with pure liquid measurement. Optimization is necessary in the following cases only: • 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'. • 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'. In all other cases, the measurement mode can remain in the default setting of 'Automatic'.
Conc. Zero Matrix 1	Setting indicating the correction factor for concentration measurement.
Conc. Zero Matrix 2	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. 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. In the case of one fixed matrix, only one correction value is available. In case of variable matrices, both correction values are available. The parameter is only available when the DensiMass function is activated.

Device Setup / ...Field Optimization / .....Hold Last Good Val.	
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.

Device Setup / ...Field Optimization / .....Pressure Correction	
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.

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… Parameter descriptions

Menu: Display

Menu / parameter	Description
Display	
Language	Selection of menu language. Available languages: English, Deutsch, Français, Español, Português, Italiano, Chinese
Contrast	Contrast setting for the LCD display.
…Operator Pages	Selection of submenu '…Operator Pages' 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 symbol appears in the lower left-hand corner of the display. 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 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.

Display / …Operator Pages	
…Operator Page 1	Selection of submenu '…Operator Page 1' using .
…Operator Page 2	Selection of submenu '…Operator Page 2' using .
…Operator Page 3	Selection of submenu '…Operator Page 3' using .
…Operator Page 4	Selection of submenu '…Operator Page 4' using .

Display / …Operator Pages / …Operator Page 1 (n)	
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. See table **Available process variables** on page 80.
2nd Line	
3rd Line	
4th Line	
Bargraph	Selection of process variable displayed as a bar graph. • Mass Flow [%]: Mass flow in % • Volume Flow [%]: Volume flow in %

Menu: Input / Output

Menu / parameter	Description
Input / Output	
...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	Selection of the operating mode for current output 31/32/Uco. • 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. • 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. • 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 **Current output Uco / 32 as loop power supply for digital output 41 / 42 or 51 / 52** on page 50.
Output Value	Selection of process variable issued at the corresponding current output. See table **Available process variables** on page 80. The current outputs V1 / V2 and V3 / V4 are only available if the corresponding plug-in cards are present!
Iout Mode	Select the operating mode for the current output. • '4-20mA FWD': Output flow rate in the forward flow direction: 4 mA = no flow rate 20 mA = maximum flow rate). • '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 • '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).

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… Parameter descriptions

Menu / parameter	Description
Input / Output / Curr.Out 31 / 32 / Uco	
Input / Output / Curr.Out V1 / V2	
Input / Output / Curr.Out V3 / V4	
Iout 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.
Iout > 20,5mA	Behavior of current output if 20.5 mA is exceeded. • Hold Last Value: The last measured value is retained and issued. • High Alarm: The high alarm current is issued. • Low Alarm: The low alarm current is issued.
Iout < 3,8mA	Behavior of the current output if 3.8 mA is not reached. • Hold Last Value: The last measured value is retained and issued. • High Alarm: The high alarm current is issued. • Low Alarm: The low alarm current is issued. Parameter is not available if the parameter 'Iout Mode' 4-20mA FWD / REV has been selected.

Input / Output / …Dig.Out 41 / 42	
Mode	Selection of the operating mode for the digital output 41 / 42. • Off: Digital output 41 / 42 deactivated. • Logic: Digital output 41 / 42 as a binary output (e.g. as an alarm output). • Pulse: Digital output 41 / 42 as a pulse output. In pulse mode, pulses are output per unit (e.g. 1 pulse per m3). • 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.
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. • Forward & Reverse: Pulses for both flow directions are issued via digital output 41 / 42. • Forward: Only pulses in the forward flow direction (flow in the direction of the arrow) are issued via digital output 41 / 42. • Reverse: Only pulses in the reverse flow direction (flow opposite of the direction of the arrow) are issued via digital output 41 / 42.
……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.

Menu / parameter	Description
Input / Output / ...Dig.Out 41 / 42 / .....Setup Pulse Output	
Output Value Pulse	Selection of process variable that is issued via the pulse output. See table **Available process variables** on page 80.
Pulses per Unit	Sets the pulses per mass unit or volume unit (see table **Available units** on page 78) and the pulse width for the pulse output.
Pulse Width	The potential pulse width depends on the configured pulse value and is calculated dynamically.

Input / Output / ...Dig.Out 41 / 42 / .....Setup Freq Output	
Output Value Freq.	Selection of process variable that is issued via the frequency output. See table **Available process variables** on page 80.
Upper Frequency	Sets the frequency for the upper range value. The entered value corresponds to 100 % flow.

Input / Output / ...Dig.Out 41 / 42 / ...Setup Logic Output	
Logic Output Action	Selection of binary output function. • F / R Signal: The binary output signals the flow direction. • Alarm Signal: The binary output indicates an active alarm. The alarm is selected in the '„...Alarm Config' menu. • 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. • Batch End Contact: The binary output is activated when the set fill quantity is reached (only if the FillMass function is activated). • 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).
Active Mode	Select switching properties for the binary output.

Input / Output / ...Dig.Out 41 / 42 / ...Alarm Config	
General Alarm	Selection of error messages signaled via the binary output 41 / 42. Only if the parameter 'Logic Output Action' is set to Alarm Signal.
Qm Massflow Max	
Qm Massflow Min	
Density Min	
Density Low Check	
Sensor Signal Min	
Driver Output Max	

… 9 Operation

… Parameter descriptions

Menu / parameter	Description
Input / Output / …Dig.Out 51 / 52	
Mode	Selection of the operating mode for the digital output 51 / 52. The following operating mode Follow DO 41 / 42, 90° Shift, 180° Shift“ is only available if the digital output 51 / 52 has been configured as a pulse output. • Off: Digital output deactivated. • Logic: Digital output functions as binary output (for function see parameter ‘„…Setup Logic Output’). • Follow DO 41 / 42: The digital output 51 / 52 follows the pulses from digital output 41 / 42. The function depends on the setting of the parameter ‘Outp. Flow Direction’. • 90° Shift: Output of the same pulses as for digital output 41 / 42, phase shifted by 90°. • 180° Shift: Output of the same pulses as for digital output 41 / 42, phase shifted by 180°
……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.

Input / Output / …Dig.Out 51 / 52 / …Setup Logic Output	
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.

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

Input / Output / …Dig.Out V1 / V2 **Input / Output / …Dig.Out V3 / V4**	
Mode	Selection of operating mode for the digital output V1 / V2 or V3 / V4. • Off: Digital output deactivated. • Logic: Digital output functions as binary output (for function see parameter ‘„…Setup Logic Output’). 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.

Menu / parameter	Description
Input / Output / ...Dig.Out V1 / V2 / ...Setup Logic Output	
Input / Output / ...Dig.Out V3 / V4 / ...Setup Logic Output	
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.

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

Input / Output / ...Dig.In V1 / V2	
Input / Output / ...Dig.In V3 / V4	
Function	Select a function for the digital input. • Off: No function. • Reset all Totalizer: Counter reset for all counters (forward flow, reverse flow and difference totalizer) • Stop all Totalizer: External counter stop for all counters (forward flow, reverse flow and difference totalizer) • Auto. Zero Adjust:Start external zero point balancing. • Set Flowrate to zero: Sets flow measurement to 0. • Batchflow On / Off: Start / stop fill operation (only when FillMass function is activated). • Dual Range Mass: Switchover Qm Max / Qm Max 2. • Dual Range Volume: Switchover Qv Max / Qv Max 2. • Submatrix 1 or 2: Switchover for concentration matrix (only when DensiMass function is activated).
Active Mode	Select switching properties for the digital input.
Delay Time	Selection of delay time for suppressing EMC faults on the digital input. **NOTICE** 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!

… 9 Operation

… Parameter descriptions

Menu: Process Alarm

Menu / parameter	Description
Process Alarm	
Clear Alarm History	Reset of the alarm history.
…Group Masking	Selection of submenu '…Group Masking' using .
…Alarm Limits	Selection of submenu '…Alarm Limits' using .

Process Alarm / …Group Masking	
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 **Diagnosis / error messages** on page 131.

Process Alarm / …Alarm Limits	
Qm Massflow Min	Sets the minimum / maximum limit value for mass measurement. If the process value 'Mass Flow [unit]' exceeds or falls below the limit value, an alarm is triggered.
Qm Massflow Max	
Qv Volumeflow Min	Sets the minimum / maximum limit value for volume measurement. If the process value 'Volume Flow [unit]' exceeds or falls below the limit value, an alarm is triggered.
Qv Volumeflow Max	
Density Min	Sets the minimum / maximum limit value for density measurement. If the process value 'Density [unit]' exceeds or falls below the limit value, an alarm is triggered.
Density Max	
Temperature Min	Sets the minimum / maximum limit value for sensor temperature. If the process value 'Temperature [unit]' exceeds or falls below the limit value, an alarm is triggered.
Temperature Max	
Concentrat. [%] Min	Sets the minimum / maximum limit value for concentration measurement. If the process value 'Concentr.unit [%]' exceeds or falls below the limit value, an alarm is triggered.
Concentrat. [%] Max	
Concentrat. [u] Min	Sets the minimum / maximum limit value for concentration measurement. If the process value 'Concentr.unit [unit]' exceeds or falls below the limit value, an alarm is triggered.
Concentrat. [u] Max	
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/cm³' is triggered.

Menu: Communication

Menu / parameter	Description
Communication	
...HART	Selection of submenu '...HART' using .
...Modbus	Selection of submenu '...Modbus' using .
...Profibus	Selection of submenu '...Profibus' using .

Communication / ...HART	
Device Address	Selection of HART device address. **Note** The HART protocol has the option of creating a bus with up to 15 devices (1 ... 15). If an address greater than 0 is set, the device operates in multidrop mode. The current output 31 / 32 / Uco is fixed to 4 mA. HART communication takes place only through current output 31 / 32 / Uco.
Loop Current Mode	Selection of the operating mode for current output 31/32/Uco. • 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. • 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. • 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.
HART Tag	Entry of a HART TAG number as unique identifier for the device. Alphanumeric, a maximum of 8 characters, upper case only, no special characters.
HART Long Tag	Entry of a HART TAG number as unique identifier for the device. Alphanumeric, maximum of 32 characters, ASCII Only starting from HART version 7!
HART Descriptor	Entry of a HART descriptor. Alphanumeric, a maximum of 16 characters, upper case only, no special characters.
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	Select whether the transmitter must respond to the HART command 73 (Find Device). • Off: The transmitter does not respond to command 73. • Once: The transmitter responds once to command 73. • Continuous: The transmitter always responds to command 73.
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. See table **Available process variables** on page 80.
SV Secondary Var.	
TV Tertiary Variable	
QV Quaternary Var.	

… 9 Operation

… Parameter descriptions

Menu / parameter	Description
Communication / …Modbus	
Address	Setting the Modbus® device address (1 to 127).
IEEE Format	Selection of the byte order for the Modbus communication. • Enabled: If the IEEE format is activated, the data words are sent in the 'little endian' format with the lowest value word first. • Disabled: If the IEEE format is deactivated, the data words are sent in the standard Modbus 'bigendian' format. 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

Communication / …Profibus	
Address	Set the PROFIBUS DP® device address (1 to 126).
Ident Nr. Selector	Display the PROFIBUS DP® identification number • 0x9741: 2AI + 1TOT • 0x9742: 3xAI + 1xTOT • 0x3434: ABB specific
Comm State	Display the PROFIBUS communication status. • Offline: No PROFIBUS® communication. • Stop: Bus active, device not active. • Clear: Device is being initialized. • Operate: Cyclic communication is active.
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 • 26: ABB

Menu: Diagnostics

Menu / parameter	Description
Diagnostics	
...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 Singal A	Display of the current amplitude (sensor voltage) for sensor A in mV.
Sensor Singal 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.
House Temperature	Display of the current housing temperature in °C.

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	

… 9 Operation

… Parameter descriptions

Menu / parameter	Description
Diagnostics / …Drag Indicators / …Sensor Indicators	
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	

Diagnostics / …Drag Indicators / …Temperature Indic.	
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	

Diagnostics / …Simulation Mode	
Simulation Switch	Manual simulation of measured values. After selecting the value to be simulated, a corresponding parameter is displayed in the menu ‘Diagnostics / ……Simulation Mode’. The simulation value can be set here. The output values correspond to the simulated flowrate entered. Information ‘Configuration’ appears in the lower line of the display. Only one measured value / output can be selected for simulation. After power-up / restart of the device, the simulation is switched off.
Off	
Curr.Out 31 / 32 / Uco	
Curr.Out V1 / V2*	
Curr.Out V3 / V4*	
Dig.Out 41 / 42 State	
Dig.Out 41 / 42 Freq.	
Dig.Out 41 / 42 Pulse	
Dig.Out 51 / 52 State	
Dig.Out 51 / 52 Pulse	
Dig.Out V1 / V2 State*	
Dig.Out V3 / V4 State*	
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 / parameter	Description
Diagnostics / ...Output Readings	
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*	
Dig.Out 41 / 42 Freq.	
Dig.Out 41 / 42 State	
Dig.Out 51 / 52 State	
Dig.Out V1 / V2 State*	
Dig.Out V3 / V4 State*	
Dig.In V1 / V2 State*	
Dig.In V3 / V4 State*	

* Only with plug-in card present.

Diagnostics / ...Meter Erosion Mon.	
Control Type	Selection of the operating mode for the erosion monitor. — Manual: Manual input of limit values for the erosion monitor. — Auto: The transmitter calculates the limit values for the erosion monitor automatically. Factory setting: Manual.
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', alarm 'Density too low.Empty pipe, gas' is triggered. This parameter is only available if the value 'Control Type' has been selected for the parameter 'Manual'.
Driver Output Time	Sets the delay time for alarm 'Density too low.Empty pipe, gas'. This parameter is only available if the value 'Control Type' has been selected for the parameter 'Manual'.
Status Adjust	Indicates the status for automatic balancing of the erosion monitor. — Outstanding: The limit value is not set, erosion monitoring is not active. — Requested: Automatic adjustment of the erosion monitor is activated but has not yet been performed. — Processing: Automatic adjustment of the erosion monitor is active. — Done: Automatic adjustment of the erosion monitor is complete; erosion monitoring is active. This parameter is only available if the value 'Control Type' has been selected for the parameter 'Auto'.
Self Adjust Time	Sets the runtime for automatic adjustment of the erosion monitor. The setting depends on the application and should cover several days or, if necessary, weeks.
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.

… 9 Operation

… Parameter descriptions

Menu / parameter	Description
Diagnostics / …Diag.CurrOut 31/32	
Readback curr. 31/32	Activate the monitoring function for current output 31 / 32. 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 ±2 %, the current output on the alarm current of 3.3 mA is set and the 'CO 31/32 readback current deviates' error message is generated. Factory setting: Off.
…Alarm Reset Option	Selection of submenu '…Alarm Reset Option' using .
Reset Alarm	Manually resetting the 'CO 31/32 readback current deviates' error message using .

Diagnostics / …Diag.CurrOut 31/32 / …Alarm Reset Option	
Auto. Reset 10 min	Automatic reset of the 'CO 31/32 readback current deviates' error message. • Off: The error is permanently saved and must be reset manually. After the reset, the current output 31 / 32 is retested. • On: The error is automatically reset after 10 minutes. After the reset, the current output 31 / 32 is retested. Factory setting: On.
Auto Reset open Loop	Behavior in the case of an open current output 31 / 32 (interruption of the current loop). • Off: If the current loop is interrupted, the 'CO 31/32 readback current deviates' is generated. The reset of the error then depends on the setting of the 'Auto. Reset 10 min' parameter. • On: If the current loop is closed again, the error will be automatically reset. Factory setting: On.

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 131.
The following error messages can be simulated:
Off, Mass flowrate exceeds limits., Volume flowrate exceeds limits., Simulation is on. Simulating process/output value. , Flowrate to zero, Maintenance interval is reached, All totalizer stopp., Totalizer reset. Reset of one or more Totalizer, Display value is <1600h at Qmax., Device not calibrated., Sensor memory defective., NV data defect. Data storage irreparable., No Frontend Board detected, FEB communication error. EMC disturbance., Incompatible Frontend Board., NV chips defect on Motherboard., Pulse output is cut off. , Curr.Out 31/32 is saturated., Curr.Out V1/V2, V3/V4 saturated, Curr.Out 31/32 com error., Option Card 1 com error. , Option Card 2 com error. , Safety Alarm Curr.Out 31/32, Curr.Out 31/32 not calibrated., Curr.Out V1/V2 not calibrated., Curr.Out V3/V4 not calibrated., MB voltages outside range., An alarm is simulated., Communicat. card not responding, CO 31/32 readbackcurrent deviates, DSP Failure on Frontend Board., Density failure, Sensor temperature out max range, Sensor temperature measure error, Sensor amplitudeout of range., Sensor driver current to high., Density too low.Empty pipe, gas, Density exceeds min/max limits., Medium temperat exceeds limits., Density to 1g/cm³, Concentration inunit exceeds, Concentration in percent exceeds, FEB voltages outside range., Sensor amplitude out of ranges

Menu: Totalizer

Menu / parameter	Description
Totalizer	
...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 Mass Forward	
Net Massflow Rev	
Net Volume Forward	
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 Mass Forward	
Net Massflow Rev	
Net Volume Forward	
Net Volumeflow Rev	
Volumeflow Fwd@Tref	
Volumeflow Rev@Tref	

… 9 Operation

… Parameter descriptions

Menu / parameter	Description
Totalizer / …FillMass	
Batch Process Value	Selection of process variable used during the filling process. The process variables 'Net Volumeflow Fwd' and 'Net Massflow Fwd' are only available when the DensiMass function is activated. • Off: Filler deactivated. • Volume Forward: Volume flow rate in forward flow direction. • Norm Volume Forward: Standard volume flow rate in forward flow direction. • Mass Forward: Mass flow in forward flow direction. • Net Volumeflow Fwd: Net volume flow rate in forward flow direction. • Net Massflow Fwd: Net mass flow in forward flow direction.
Preset Batch Total.	Sets the fill quantity using the selected unit. When the defined fill quantity is reached, the configured binary output is activated. **Note** Before setting the fill quantity, the corresponding process value must be selected with the parameter 'Batch Process Value'.
Reset Cur.Batch Tot.	Resets the current fill quantity.
Start Batching	Manual start of the filling function. Alternatively, the digital input can be configured for starting / stopping the fill operation.
Current Batch Total	Display of the current fill quantity. 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.
Stop Batching	Manual stop of the filling function. Alternatively, the digital input can be configured for starting / stopping the fill operation.
Current Batch Counts	Display of the number of fill operations since the last reset.
Reset Batch Counts	Sets the parameter 'Batch Counts' to zero.
…Quantity	Select the '**…**Quantity' submenu.

Totalizer / …FillMass / …Quantity	
Mode	Selection of overrun correction. 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. —Auto: The overrun quantity is calculated by the transmitter automatically. —Manual: The overrun quantity must be determined manually and entered in the selected unit via the parameter 'Quantity'.
Quantity	Manual input of the overrun quantity / display of the overrun quantity detected automatically by the transmitter.
Factor	Sets the weighting of the last filling process during automatic calculation of the overrun quantity. The calculation is based on the following formula: New correction value = last correction value + (BatchAuto.Lag Corr.Factor x correction value during the last fill operation) — 0.0: No change to correction value. — 1.0: The correction value is immediately adjusted to the overrun quantity calculated during the last fill operation.
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	6/12/2015	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 01.2017	3KXF002043U01000
00:05:00	01.2018	Change	Variety of minor changes, details in document MI/FCX400/FW/102 01.2018	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 33.

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 99 and **Menu: Input / Output** on page 107.

… 9 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.

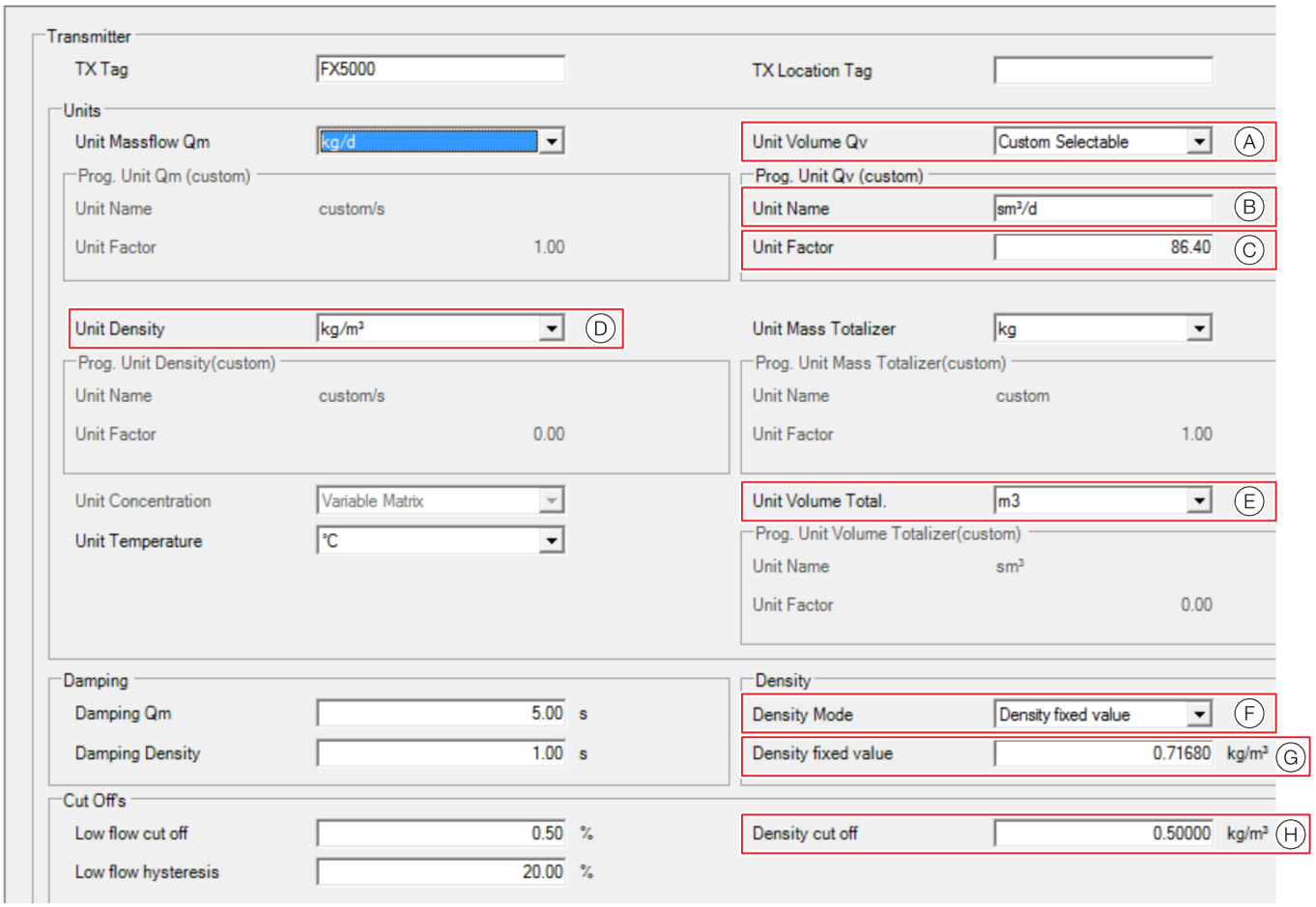
The transmitter uses the measured mass flow and the standard density entered to calculate the standard volume flow of the measuring medium.
(standard volume = mass / standard density).

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 / Density	e.g. g/l	Set the parameter 'Unit Vol. Totalizer' to the desired density unit.
Note 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 **Menu: Input / Output** on page 107 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 **Menu: Display** on page 106 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 (sm^3/d)	
Measured medium	Natural gas
Density in standard conditions	0.7168 kg/m^3
Measuring range	0 ... 10000 sm^3/d



(A) Set the parameter 'Unit Volume Qv' to 'Custom Selectable'.

(B) In parameter 'Unit Name', enter the desired names for the standard volume unit 'sm^3/d'.

(C) In parameter 'Unit Factor', enter the factor in l/s for the standard volume unit 'sm^3/d' (in the example 86.4 l/s).

(D) Set the parameter 'Unit Density' to the desired density unit (in the example kg/m^3).

(E) Set the parameter 'Unit Density' to the desired unit for the volume totalizer (in the example 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 kg/m^3).

(G) In parameter 'Density cut off', enter the density for the cutoff of the calculation (in the example 0.50 kg/m3). Adjust the parameter 'Density Low Check' afterwards as needed (see page page 112).

(G) Click on the 'Apply' button to apply the settings.

Figure 64: Screenshot from the HART DTM

… 9 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	
Self Adjust Time	Several days or weeks depending on the application

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.

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

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.

… 9 Operation

… Concentration measurement DensiMass

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 128.

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 Concentration Max	Entry of the minimum and maximum concentration limit for the matrix calculation.

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. • Yes: Calculation of concentration in % • No: Calculation of concentration in a selected unit
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 Matrix 2 Unit	Entry of the temperature, concentration and density values to calculate the concentration in the selected unit.
Matrix 1 Percent Matrix 2 Percent	Entry of the temperature, concentration and density values to calculate the concentration in %.

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.

… 9 Operation

… Concentration measurement DensiMass

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 ≤ N ≤ 20; 2 ≤ M ≤ 20; N * M ≤ 100
- With two matrices: 2 ≤ N ≤ 20; 2 ≤ M ≤ 20; N * M ≤ 50

The density values in a column must be in ascending order due to the algorithm used in the transmitter software.

Density x,1 < … < Density x,2 <…< Density x,M for 1 ≤ x ≤ M

The temperature values must be in ascending order from left to right due to the algorithm used in the transmitter software.

Temperature 1 <…< Temperature x <…< Temperature N for 1 ≤ x ≤ 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 <…< Concentr. x < … < Concentr. N for 1 ≤ x ≤ N

or

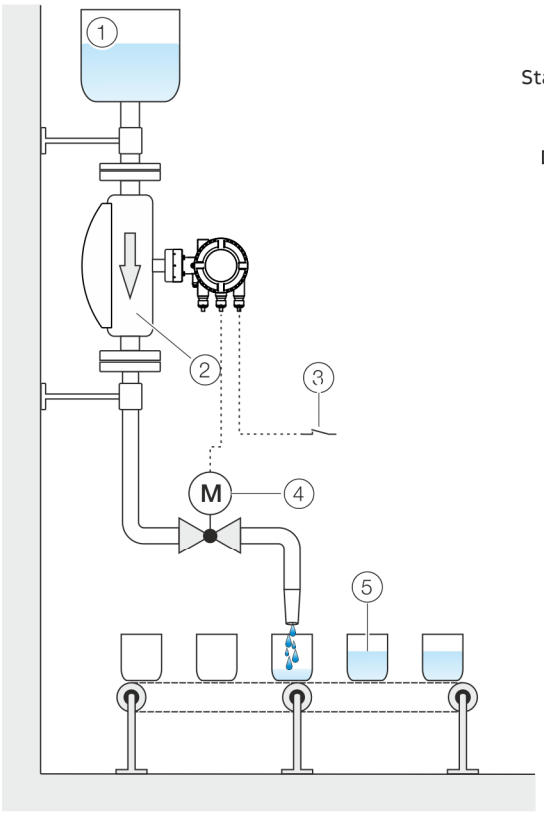
Concentr. 1 >…> Concentr. x > … > Concentr. N for 1 ≤ x ≤ N

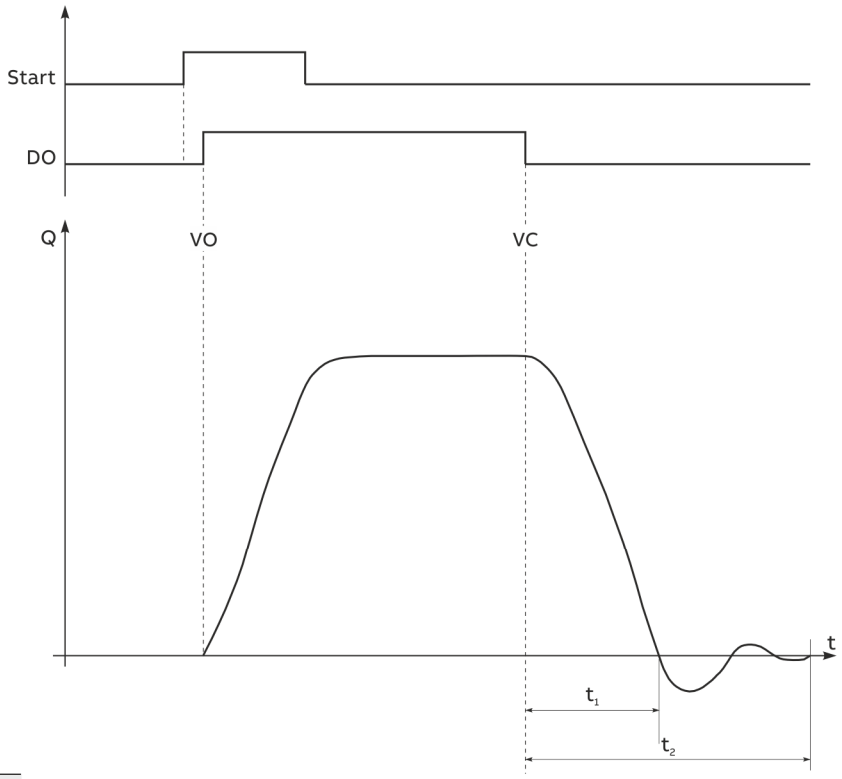
Example:

		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

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 65: 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.

… 9 Operation

… FillMass batch function

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 111)
- From the device internal processing time of 200 ms

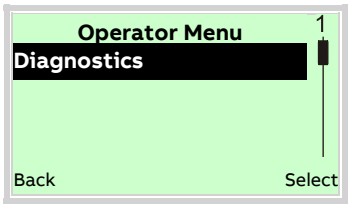
Total delay = ‘Delay Time’ + 200 ms.

10 Diagnosis / error messages

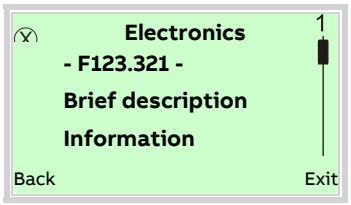
Calling up the error description

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.

… 10 Diagnosis / error messages

Overview

The counter readings and the states of the current outputs and the alarm output are represented by symbols; please see the table below.

Symbol	Description
STOP	Counter stop
—	No change, current value
1)	When the error occurs, the corresponding measurement variable is calculated with the temperature 20 °C.
2)	When the error occurs, the corresponding measurement variable is set to the value with density = 1.
HOLD	The last 'good' measured value is retained.
⚠	Alarm (general)
⚠↑	High alarm
⚠↓	Low alarm

		Process values								Counter	Current output
Priority	Error text	Qm [%, unit]	Qv [%, unit]	Density [g/cm³]	Temperature [°C]	Concentration [%]	Net mass flow	Standard density g/cm³]	Standard volume [20 °C]	All counters	
98	No Frontend Board detected	0	0	1	20	0	0	1	0	–	⚠
96	DSP Failure on Frontend Board.	0	0	1	–	0	0	1	0	–	⚠
94	Safety Alarm Curr.Out 31/32	–	–	–	–	–	–	–	–	–	–
93	Sensor amplitudeout of range.	0	0	1	–	0	0	1	0	–	⚠
92	FEB voltages outside range.	0	0	0	0	0	0	0	0	0	⚠
91	MB voltages outside range.	–	–	–	–	–	–	–	–	–	⚠
90	Sensor temperature measure error	1)	1)	1)	20	1)	1)	1)	1)	–	⚠
88	FEB communication error. EMC disturbance.	0	0	1	20	0	0	1	0	–	⚠
86	Curr.Out 31/32 com error.	–	–	–	–	–	–	–	–	–	CO1 only ⚠↓
84	NV data defect. Data storage irreparable.	0	0	1	20	0	0	1	0	–	⚠
82	Incompatible Frontend Board.	0	0	1	20	0	0	1	0	–	⚠
80	Density failure	0	0	1	20	0	0	1	0	–	⚠
78	Flowrate to zero	0	0	–	–	–	0	–	0	–	In accordance with process value
76	All totalizer stopp.	–	–	–	–	–	–	–	–	STOP	–
74	Totalizer reset. Reset of one or more Totalizer	–	–	–	–	–	–	–	–	0	–
72	Simulation is on. Simulating process/output value.	–	–	–	–	–	–	–	–	–	–
70	An alarm is simulated.	–	–	–	–	–	–	–	–	–	
65	CO 31/32 readbackcurrent deviates	–	–	–	–	–	–	–	–	–	⚠↓ < 3.3 mA
60	Sensor driver current to high.	–	–	–	–	–	–	–	–	–	–

		Process values								Counter	Current output
Priority	**Error text**	**Qm [%, unit]**	**Qv [%, unit]**	**Density [g/cm³]**	**Temperature [°C]**	**Concentration [%]**	**Net mass flow**	**Standard density g/cm³**	**Standard volume [20 °C]**	**All counters**	
59	Density too low.Empty pipe, gas	0	0	–	–	–	0	–	0	–	–
58	Density to 1g/cm³	–	2)	1	–	2)	2)	2)	2)	–	–
57	Sensor temperature out max range	1)	1)	1)	20	1)	1)	1)	1)	–	–
54	Sensor amplitude out of ranges	–	–	–	–	–	–	–	–	–	–
52	Curr.Out 31/32 is saturated.	–	–	–	–	–	–	–	–	–	CO 31 / 32, U_{CO} only: **HOLD**, ⚠↑, ⚠↓ (configurable)
51	Curr.Out V1/V2, V3/V4 saturated	–	–	–	–	–	–	–	–	–	CO V1 / V2, CO V2 / V3: **HOLD**, ⚠↑, ⚠↓ (configurable)
49	Option Card 1 com error.	–	–	–	–	–	–	–	–	–	CO V1 / V2: ⚠↓
48	Option Card 2 com error.	–	–	–	–	–	–	–	–	–	CO V2 / V3: ⚠↓
47	Pulse output is cut off.	–	–	–	–	–	–	–	–	–	–
46	Mass flowrate exceeds limits.	–	–	–	–	–	–	–	–	–	–
44	Volume flowrate exceeds limits.	–	–	–	–	–	–	–	–	–	–
43	Density exceeds min/max limits.	–	–	–	–	–	–	–	–	–	–
42	Medium temperat exceeds limits.	–	–	–	–	–	–	–	–	–	–
41	Concentration inunit exceeds	–	–	–	–	–	–	–	–	–	–
40	Concentration in percent exceeds	–	–	–	–	–	–	–	–	–	–
38	Sensor memory defective.	–	–	–	–	–	–	–	–	–	–
37	NV chips defect on Motherboard.	–	–	–	–	–	–	–	–	–	–
32	Curr.Out 31/32 not calibrated.	–	–	–	–	–	–	–	–	–	–
31	Curr.Out V1/V2 not calibrated.	–	–	–	–	–	–	–	–	–	–
30	Curr.Out V3/V4 not calibrated.	–	–	–	–	–	–	–	–	–	–
28	Display value is <1600h at Qmax.	–	–	–	–	–	–	–	–	–	–
26	Maintenance interval is reached	–	–	–	–	–	–	–	–	–	–
24	Device not calibrated.	–	–	–	–	–	–	–	–	–	⚠
20	Communicat. card not responding	–	–	–	–	–	–	–	–	–	–

… 10 Diagnosis / error messages

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. • For remote mount design: check signal cable connection between sensor and transmitter. • Restart the device. • Replace frontend board. • Contact ABB Service.	Failure
F096.029 DSP Failure on Frontend Board.	DSP error in frontend board (FEB) of the sensor. Frontend board defective. • Restart the device. • Replace frontend board. • Contact ABB Service.	Failure
F093.033 Sensor amplitudeout of range.	Gas bubbles in the measuring tube. Viscosity of the measuring medium is too high. Hardware error in sensor. • Reduce gas content, change measuring medium. • Contact ABB Service.	Failure
F092.041 FEB voltages outside range.	Frontend board power supply defective. Frontend board defective. • Replace frontend board. • Contact ABB Service.	Out of specification
F091.025 MB voltages outside range.	Motherboard power supply defective Faulty motherboard. • Contact ABB Service.	Out of specification
F090.032 Sensor temperature measure error	Internal temperature sensor measuring error / defective. • Contact ABB Service.	Failure
F088.012 FEB communication error. EMC disturbance.	Communication error to frontend board (FEB) of the sensor. Electro magnetic interference. • For remote mount design: check signal cable connection between sensor and transmitter. • Restart the device. • Contact ABB Service.	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. • Contact ABB Service.	Failure
F084.010 NV data defect. Data storage irreparable.	Error in SensorMemory. Faulty memory module. • Contact ABB Service.	Failure
F082.013 Incompatible Frontend Board.	Incompatible frontend board. The frontend board is not compatible with the motherboard in the transmitter. • Contact ABB Service.	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. • Check setting of the density parameters. • Check application, clean meter tube and check for damage due to abrasion. • Contact ABB Service.	Failure

Error code / error text	Description	NAMUR classification
C078.003 Flowrate to zero	External switch-off active via digital input. • Check status of digital input. • Check parameterization.	Functional check
C076.005 All totalizer stopp.	External switch-off active via digital input. • Check status of digital input. • Check parameterization.	Functional check
C074.006 Totalizer reset. Reset of one or more Totalizer	Reset of one or more counters. • Check status of digital input. • Check parameterization.	Functional check
C072.002 Simulation is on. Simulating process/output value.	Simulation mode is active. • Deactivate simulation mode in the 'Diagnostics / ...Simulation Mode' menu.	Functional check
C070.026 An alarm is simulated.	The alarm simulation is active. • Deactivate alarm simulation in the 'Diagnostics / ...Alarm Simulation' menu.	Functional check
S065.028 CO 31/32 readbackcurrent deviates	Current loop error current output 31 / 32. • Check current loop current output 31 / 32 (short-circuit / interruption). • Check load current output 31 / 32. • Check the power supply (voltage) of the transmitter.	Out of specification
S060.034 Sensor driver current to high.	Gas bubbles in the measuring tube. • Reduce gas content in the measuring medium. • Deactivate error message by setting the parameter 'Driver Output Max' in the 'Process Alarm / ...Alarm Limits' menu to '0'.	Out of specification
S059.035 Density too low.Empty pipe, gas	Empty measuring tube. Gas bubbles in the measuring tube. • Reduce gas content in the measuring medium. • Make sure that the meter tube is always completely full. • Deactivate error message by setting the parameter 'Density Low Check' in the 'Process Alarm / ...Alarm Limits' menu to '0'.	Out of specification
S058.038 Density to 1g/cm³	Density has been set to 1 g/cm³ by the transmitter due to an error message. • Contact ABB Service.	Out of specification
S057.031 Sensor temperature out max range	Ambient or measuring medium temperature is too high. • Check ambient or measuring medium temperature.	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. • Check the settings of the parameters in the 'Process Alarm / ...Alarm Limits' menu and adjust if necessary.	Out of specification
S052.016 Curr.Out 31/32 is saturated.	Current output 31 / 32 overshot. The flow has exceeded the set upper measuring range value. • Check the upper range value Qv Max, Qm Max in the 'Device Setup / ...Sensor' menu and correct if necessary.	Out of specification
S051.017 Curr.Out V1/V2, V3/V4 saturated	Current output V1 / V2, V3 / V4 (plug-in card) overshot. The flow has exceeded the set upper measuring range value. • Check the upper range value Qv Max, Qm Max in the 'Device Setup / ...Sensor' menu and correct if necessary.	Out of specification

… 10 Diagnosis / error messages

… Error messages

Error code / error text	Description	NAMUR classification
S049.019 Option Card 1 com error. S048.020 Option Card 2 com error.	Communication error to plug-in card. • Check that the plug-in card is installed correctly. • Replace plug-in card if necessary. • Contact ABB Service.	Out of specification
S047.0015 Pulse output is cut off.	The pulse rate or the frequency at the pulse output is outside the permissible limits. • Check configuration of the parameters for the pulse output.	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’. • Check the settings of the parameters in the ‘Process Alarm / …Alarm Limits’ menu and adjust if necessary. • Check mass flow.	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’. • Check the settings of the parameters in the ‘Process Alarm / …Alarm Limits’ menu and adjust if necessary. • Check volume flow rate.	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’. • Check the settings of the parameters in the ‘Process Alarm / …Alarm Limits’ menu and adjust if necessary. • Check density.	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’. • Check the settings of the parameters in the ‘Process Alarm / …Alarm Limits’ menu and adjust if necessary. • Check measuring medium temperature.	Out of specification
S041.039 Concentration inunit exceeds	The concentration in units is below or above the configured limit values ‘Concentrat. [u] Min’ and ‘Concentrat. [u] Max’. • Check the settings of the parameters in the ‘Process Alarm / …Alarm Limits’ menu and adjust if necessary. • Check concentration.	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’. • Check the settings of the parameters in the ‘Process Alarm / …Alarm Limits’ menu and adjust if necessary. • Check concentration.	Out of specification

Error code / error text	Description	NAMUR classification
M038.09 Sensor memory defective.	SensorMemory in frontend board defective. • Check if the SensorMemory is defective. • Contact ABB Service.	Maintenance required
M037.014 NV chips defect on Motherboard.	SensorMemory in motherboard faulty. • Check if the SensorMemory is defective. • Contact ABB Service.	Maintenance required
M032.022 Curr.Out 31/32 not calibrated.	Current output 31 / 32, Uco not calibrated. • Contact ABB Service.	Maintenance required
M031.023 Curr.Out V1/V2 not calibrated.	Current output (plug-in card) V1 / V2 or V3 / V4 not calibrated. • Check plug-in card and replace if necessary. • Contact ABB Service.	Maintenance required
M030.024 Curr.Out V3/V4 not calibrated.		Maintenance required
M028.007 Display value is <1600h at Qmax.	The current counter reading has exceeded the display resolution. • Check the unit setting for the mass counters / volume totalizers and adjust if necessary.	Maintenance required
M026.004 Maintenance interval is reached	Maintenance interval reached. • Perform maintenance work. • Start new maintenance interval in the ‘Diagnostics / ...Diagnosis Control’ menu.	Maintenance required
M024.008 Device not calibrated.	Contact ABB Service.	Maintenance required
M020.027 Communicat. card not responding	Fieldbus plug-in is not reacting. • Plug-in card is defective. • Contact ABB Service.	Maintenance required

11 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 6.

⚠ 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 138.

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.

12 Repair

Safety instructions

⚠ DANGER

Danger of explosion if the device is operated with the transmitter housing or terminal box open!
While using the device in potentially explosive atmospheres before opening the transmitter housing or the terminal box, note the following points:
- A valid fire permit must be present.
- Make sure that no flammable or hazardous atmospheres are present.

⚠ 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 6.

⚠ 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.

Spare parts

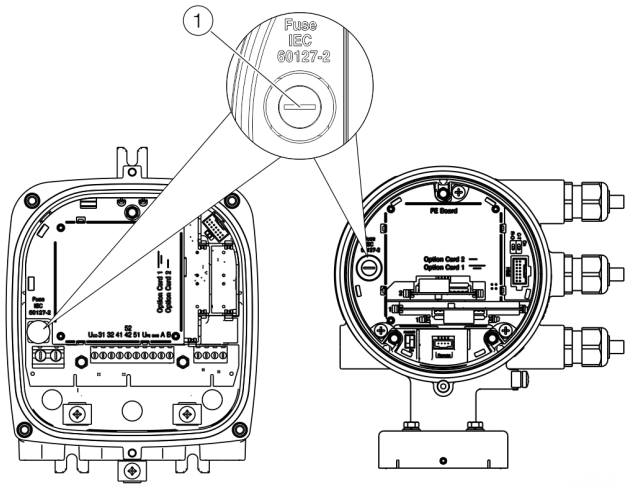
Repair and maintenance activities may only be performed by authorized customer service personnel.
When replacing or repairing individual components, use original spare parts.

Note
Spare parts can be ordered from ABB Service.
www.abb.com/contacts

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 38 to open and close the housing safely.



① Fuse holder

Figure 66: 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:

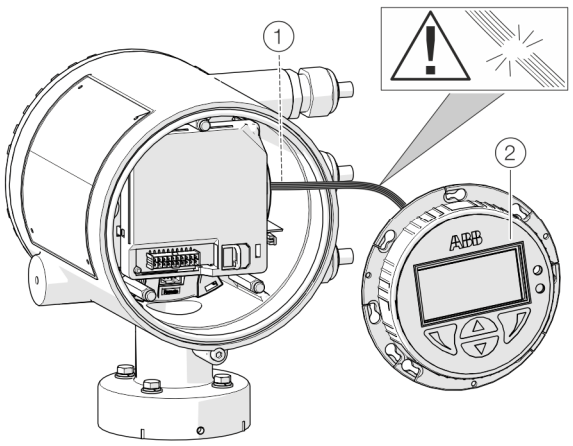
1. Switch off the power supply.
2. Open the transmitter housing.
3. Pull out the defective fuse and insert a new fuse.
4. Closing the transmitter housing.
5. Switch on the power supply.
6. Check that the device is working correctly.

If the fuse blows again on activation, the device is defective and must be replaced.

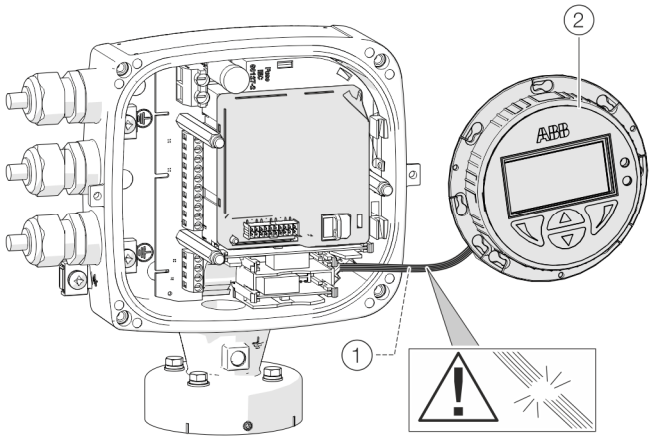
… 12 Repair

Replacing the LCD indicator

Dual-compartment housing



Single-compartment housing



① LCD indicator cable harness

② LCD indicator

Figure 67: 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 38 to open and close the housing safely.

The LCD indicator can be replaced in the event of a malfunction.

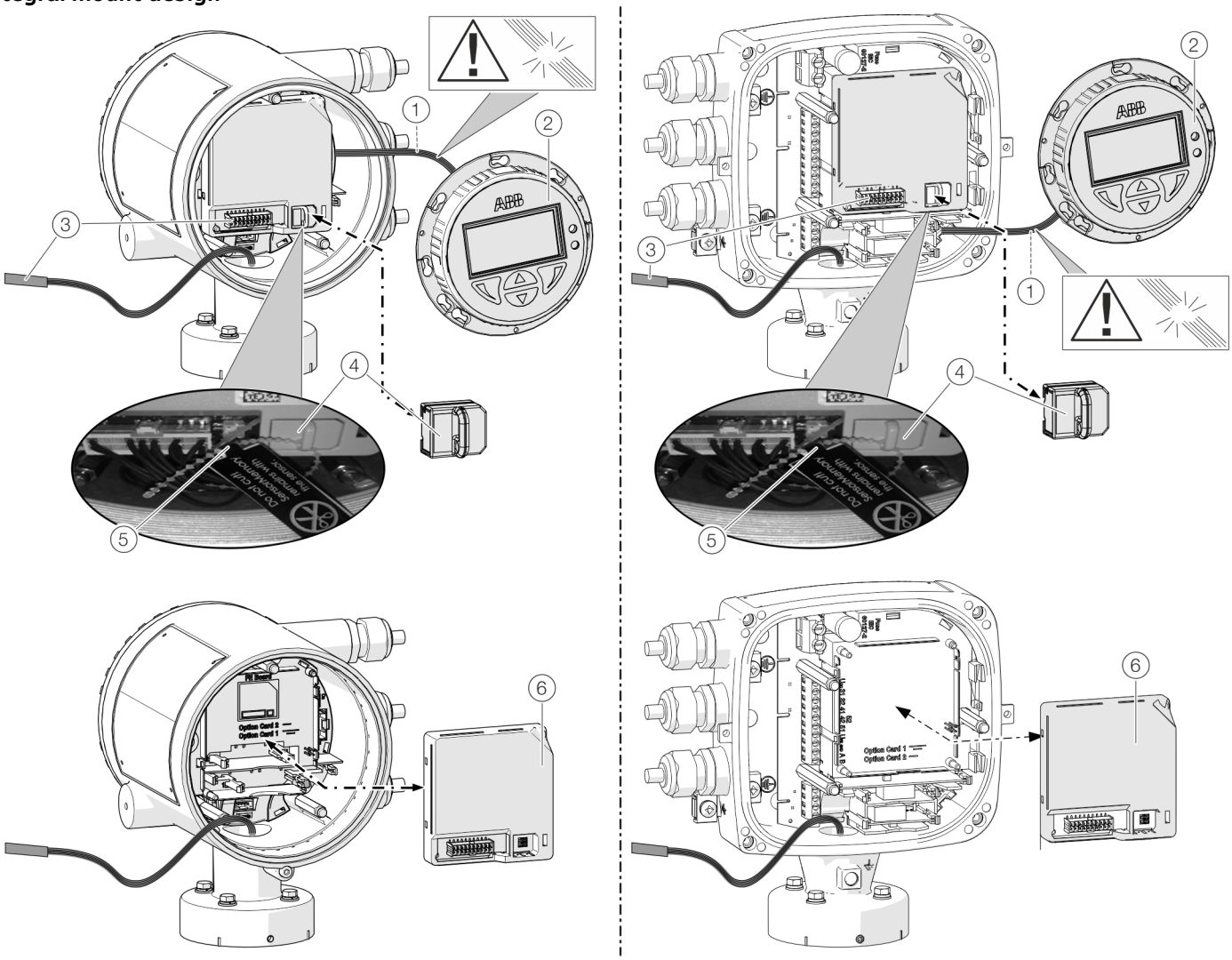
Component	Ordering number
LCD indicator (HMI) For integral mount and remote mount design	3KQZ407125U0100

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.

Replacing the frontend board

Integral mount design



① LCD indicator cable harness
② LCD indicator
③ Sensor cable harness
④ SensorMemory
⑤ Cable retainer
⑥ Frontend board

Figure 68: Replacing LCD indicator and frontend board (example)

… 12 Repair

… Replacing the frontend board

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 38 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

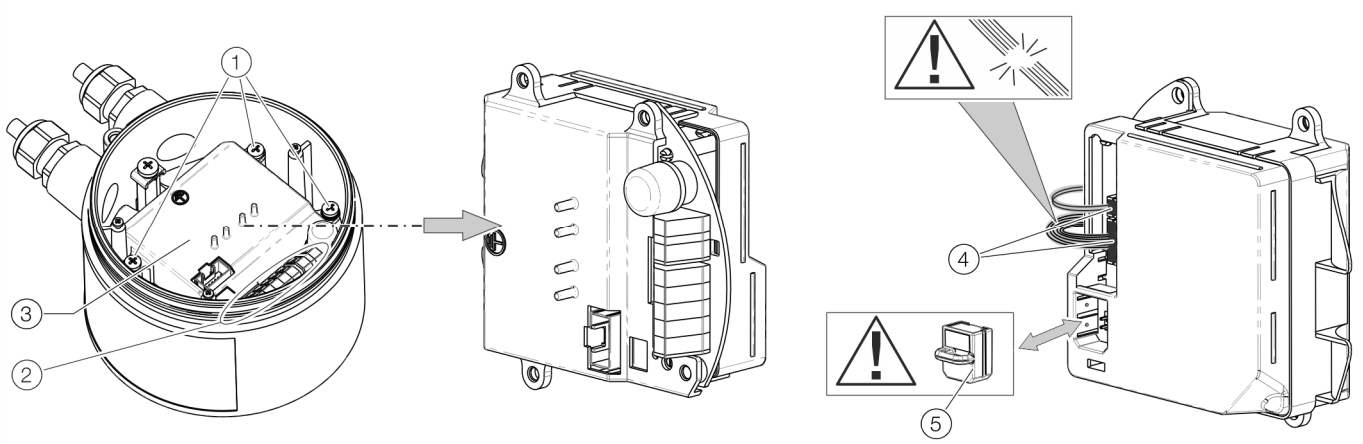
Replace the frontend board as follows:

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.

Remote mount design



1. Frontend board fixing screw
2. Terminals
3. Frontend board
4. Connections for flowmeter sensor
5. SensorMemory

Figure 69: 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 38 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 38 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 31.
5. Complete the electrical connection in accordance with **Electrical connections** on page 46.
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 147) 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.).

Address for returns:
Please contact Customer Center Service according to page 5 for nearest service location.

13 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 144.

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.

14 Specification

Note
The device data sheet is available in the ABB download area at www.abb.com/flow.

15 Additional documents

Note
All documentation, declarations of conformity, and certificates are available in ABB's download area.
www.abb.com/flow

Trademarks

HART is a registered trademark of FieldComm Group, Austin, Texas, USA

Modbus is a registered trademark of the Modbus Organization

Hastelloy C-4 is a trademark of Haynes International

Hastelloy C-22 is a trademark of Haynes International

16 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

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