ABB MEASUREMENT & ANALYTICS | OPERATING INSTRUCTION | OI/FCB100/FCH100-EN REV. J

CoriolisMaster FCB100, FCH100

Coriolis Mass Flowmeter



Device firmware version:
≥ 01.12.00

Measurement made easy

FCB130 / FCB150
FCH100 / FCH150

Introduction

The compact CoriolisMaster FCB100, FCH100 series flowmeter for system integration features low pressure drop and highflow rate and offers high-speed communication via RS485 Modbus and two binary outputs.

Additional Information

Additional documentation on CoriolisMaster FCB100, FCH100 is available for download free of charge at www.abb.com/flow.
Alternatively simply scan this code:

ENGINEERED
TO OUTRUN

Table of contents

1 Safety 4
General information and instructions 4
Warnings 4
Intended use 4
Improper use 4
Cyber security disclaimer 5
Software downloads 5
Warranty provisions 5
Manufacturer's address 5
Service address 5

2 Use in potentially explosive atmospheres 6
Device overview 6
ATEX / IECEx 6
cFMus 6
Ex marking 7
ATEX / IECEx 7
cFMus 7
Temperature data 8
Temperature resistance for the connecting cable 8
Environmental and process conditions for model FCx1xx… 8
Temperature classes and permissible measuring medium temperature 9
ATEX und IECEx electrical data 11
Modbus outputs and digital outputs 11
Special connection conditions 11
Installation instructions 12
ATEX / IECEx 12
cFMus 12
Selection and marking of the type of protection 12
Use in areas exposed to combustible dust 12
Sensor insulation 12
Opening and closing the terminal box 13
Cable entries in accordance with ATEX / IECEx 13
Cable entries in accordance with cFMus 14
Specific Conditions of Use 14
Electrical connections 15
Process sealing 15
Operating instructions 16
Protection against electrostatic discharges 16
Repair 16

3 Design and function 17
General 17
Measuring principle 17
Device designs 18

4 Product identification 20
Name plate 20

5 Transport and storage 21
Inspection 21
Transport 21
Storage 22
Returning devices 22

6 Installation 22
General installation conditions 22
Installation location and assembly 22
Liquid measuring media 23
Gaseous measuring media 24
Turn-off devices for the zero point adjustment 25
Sensor insulation 25
Devices for legal metrology 26
Process conditions 26
Temperature limits °C (°F) 26
Pressure ratings 26
IP rating 26
Material load for process connections 27
Material load curves for flange devices 27
Installing the sensor 28
Opening and closing the terminal box 29

7 Electrical connections 30
Safety instructions 30
Installing the connection cables 30
Terminal assignment 31
Electrical data for inputs and outputs 31
Power supply 31
Digital output 41 / 42, 51 / 52 32
Modbus® communication 32
Cable specification 33
Connection on the device 34

8 Commissioning and operation 35
Safety instructions 35
Operating instructions 35
Write-protection switch, service LED and local operator interface 35
Checks prior to commissioning 36
Switching on the power supply 36
Inspection after power-up of the power supply 36
Parameterization of the device 36
Parameterization via the Modbus interface 36
Parameterization via the local operating interface 37
Interface description 39
Modbus data types 39
Register tables (overview) 40
Modbus error handling (exception codes) 46
Application of the Health Indication Registers (Condensed Status Registers)) 47
Using the scan register 47
Design of the scan register (example) 48
Available units 49
Available process variables 51
Parameter descriptions 54
Software history 82
Zero point balance under operating conditions 83
Measurement of standard volumes 83
Setup 83
VeriMass erosion monitor 84
Setup 84
Standard volume measurement with SG Specific Gravity 85
Enhanced Coriolis Control (ECC)function 85
Applications in accordance with API (American Petroleum Institute) 86
Concentration measurement DensiMass 86
Calculating standard volumes and standard densities of liquids 86
Accuracy of the concentration measurement 87
Creation of the concentration matrix 87
FillMass batch function 89
Setup 90
Filling operation run 90

9 Diagnosis / error messages 92
General 92
Overview 93
Alarm status und alarm history status 95

10 Maintenance 98
Safety instructions 98
Cleaning 98
Sensor 98

11 Repair 99
Safety instructions 99
Spare parts 99
Returning devices 99
Replacing the fuse 100

12 Dismounting and disposal 100
Dismounting 100
Disposal 101

13 Specification 101

14 Additional documents 101

15 Appendix 102
Return form 102
Installation diagram 3KXF000014G0009 103

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:

- For conveying liquid and gaseous measuring media (including unstable media).
- For the direct measurement of the mass current.
- For the indirect measurement of volume flow (via density and mass flow).
- For measuring the density of the measuring medium in the case of liquids.
- For measuring the temperature of the measuring medium.

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

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

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

Improper use

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

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

Cyber security disclaimer

This product is designed to be connected to and to communicate information and data via a network interface.
It is operator's sole responsibility to provide and continuously ensure a secure connection between the product and your network or any other network (as the case may be).
Operator shall establish and maintain any appropriate measures (such as but not limited to the installation of firewalls, application of authentication measures, encryption of data, installation of anti-virus programs, etc.) to protect the product, the network, its system and the interface against any kind of security breaches, unauthorized access, interference, intrusion, leakage and/or theft of data or information.
ABB and its affiliates are not liable for damages and/or losses related to such security breaches, any unauthorized access, interference, intrusion, leakage and/or theft of data or information.

On www.abb.com/cybersecurity under 'Additional resources', 'Alerts and notifications' you will find notifications about newly discovered software vulnerabilities. It is recommended that you visit this website regularly and activate 'Subscribe to email alerts' to receive email notifications about 'ABB cyber security alerts and notifications'.

Software downloads

By visiting the web page indicated below, you will find options to download the latest software. It is recommended that you visit this web page regularly:

ABB-Library – CoriolisMaster FCx100 – Software Downloads

Warranty provisions

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

Manufacturer's address

ABB AG
Measurement & Analytics
Schillerstr. 72
32425 Minden
Germany
Tel: +49 571 830-0
Fax: +49 571 830-1806

Service address

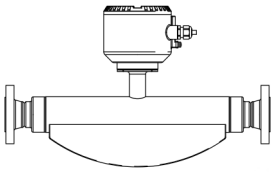
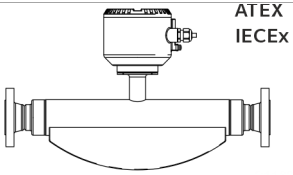
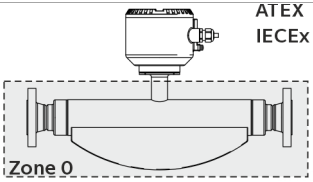
Customer service center
Tel: +49 180 5 222 580
Email: automation.service@de.abb.com

2 Use in potentially explosive atmospheres

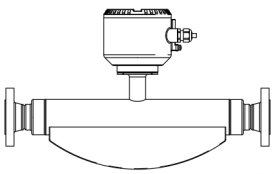
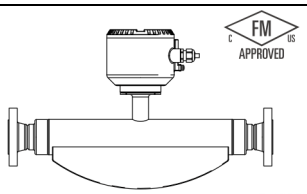
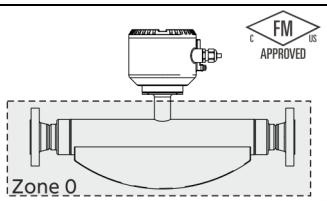
Note
Further information on the approval of devices for use in potentially explosive atmospheres can be found in the type examination certificates or the relevant certificates at www.abb.com/flow.

Device overview

ATEX / IECEx

	Standard / No explosion protection	Zone 2, 21, 22	Zone 1, 21 (Zone 0)
Model number	**FCx1xx Y0**	**FCx1xx A2**	**FCx1xx A1**
• Standard • Zone 2, 21, 22 • Zone 1, 21 • Zone 0			

cFMus

	Standard / No explosion protection	Class I Div. 2 Zone 2, 21	Class I Div. 1 Zone 0, 1, 20 ,21
Model number	**FCx1xx Y0**	**FCx1xx F2**	**FCx1xx F1**
• Standard • Class I Div. 2 • Class I Div. 1 • Zone 2, 21 • Zone 1, 21 • Zone 0, 20			

Ex marking

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.

ATEX / IECEx

Model FCx1xx-A2... in Zone 2, 21, 22	
ATEX	
Certificate (ATEX):	FM 14 ATEX0017X
II 3 G Ex ec mc IIC T6 … T2 Gc	
FM 14 ATEX0016X	
II 2 D Ex tb IIIC T85°C … T_{medium} Db	
IECEx	
Certificate:	IECEx FME 14.0003X
Ex ec mc IIC T6 … T2 Gc	
Ex tb IIIC T85°C ... T_{medium} Db	

Model FCx1xx-A1... in Zone 1, 21 (Zone 0)	
ATEX	
Certificate (ATEX):	FM 14 ATEX0016X
II 1/2 G Ex eb ia mb IIC T6 ... T2 Ga/Gb	
II 2 D Ex ia tb IIIC T85°C ... T_{medium} Db	
IECEx	
Certificate:	IECEx FME 14.0003X
Ex eb ia mb IIC T6 ... T2 Ga/Gb $T_{amb.}$max= 70°C	
Ex ia tb IIIC T85°C ... T_{medium} Db	

cFMus

Model FCx1xx-F2... in Zone 2, Div. 2	
FM (marking US)	
Certificate:	FM16US0201X
NI: CL I, DIV2, GPS ABCD, T6 … T2	
NI: CL II, III, DIV2, GPS EFG, T6 … T3B	
DIP: CL II, Div 1, GPS EFG, T6 … T3B	
DIP: CL III, Div 1, 2, T6 … T3B	
CL I, ZN 2, AEx ec IIC T6 … T2 Gc	
ZN 21 AEx tb IIIC T85°C … T165°C Db	
See Instructions for temperature class information	
FM (marking Canada)	
Certificate:	FM16CA0104X
NI: CL I, DIV2, GPS ABCD, T6 … T2	
NI: CL II, III, DIV2, GPS EFG, T6 … T3B	
DIP: CL II, Div 1, GPS EFG, T6 … T3B	
DIP: CL III, Div 1, 2, T6 … T3B	
Ex ec IIC T6 … T2 Gc	
See Instructions for temperature class information	

Model FCx1xx-F1... in Zone 1, Div. 1	
FM (marking US)	
Certificate:	FM16US0201X
XP-IS: CL I, Div 1, GPS BCD, T6 … T2	
DIP: CL II, Div 1, GPS EFG, T6 … T3B	
DIP: CL III, Div 1, 2, T6 … T3B	
CL I, ZN 1, AEx db ia IIB+H2 T6 … T2 Ga/Gb	
ZN 21 AEx ia tb IIIC T85°C to T165°C Db	
See Instructions for temperature class information and Installation Drawing No. 3KXF000014G0009	
FM (marking Canada)	
Certificate:	FM16CA0104X
XP-IS: CL I, Div 1, GPS BCD, T6 … T2	
DIP: CL II, Div 1, GPS EFG, T6 … T2	
DIP: CL III, Div 1, 2, T6 … T3B	
Ex db ia IIB+H2 T6 … T2 Gb	
Ex ia INTRINSICALLY SAFE SECURITE INTRINSEQUE	
See Instructions for temperature class information and Installation Drawing No. 3KXF000014G0009	

… 2 Use in potentially explosive atmospheres

Temperature data

Temperature resistance for the connecting cable

The temperature at the cable entries of the device is dependent on the measuring medium temperature T_{medium} and the ambient temperature $T_{amb.}$.

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

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

From an ambient temperature of $T_{amb.}$ ≥ 60 °C (≥ 140 °F) the wires in the terminal boxes must be additionally insulated using the enclosed silicone hoses.

Environmental and process conditions for model FCx1xx…

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**'

Temperature classes and permissible measuring medium temperature

Measuring medium temperature (Ex data) for model FCx1xx-A1... 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)

Measuring medium temperature (Ex data) for model FCx1xx-A2... in Zone 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

Measuring medium temperature (Ex data) for model FCx1xx-A1... in Zone 21 and FCx1xx-A2... in Zone 22

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

	Temperature class				
Ambient temperature $T_{amb.}$	**T210 °C**	**T200 °C**	**T135 °C**	**T100 °C**	**T85°C**
≤ 30 °C (≤ 86 °F)	195 °C (383 °F)	130 °C (266 °F)	95 °C (203 °F)	80 °C (176 °F)	80 °C (176 °F)
≤ 50 °C (≤ 122 °F)	140 °C (284 °F)	130 °C (266 °F)	95 °C (203 °F)	60 °C (140 °F)	—
≤ 60 °C (≤ 140 °F)	120 °C (248 °F)	120 °C (248 °F)	95 °C (203 °F)	—	—
≤ 70 °C (≤ 158 °F)	80 °C (176 °F)	80 °C (176 °F)	80 °C (176 °F)	—	—

… 2 Use in potentially explosive atmospheres

… Temperature data

Measuring medium temperature (Ex data) for model FCx1xx-F1… in Class I Div. 1, Class I 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)

Measuring medium temperature (Ex data) for model FCx1xx-F2… in Class I Div. 2, Class I Zone 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

Measuring medium temperature (Ex data) for model FCx1xx-F1… in Zone 21, Class II / III and FCx1xx-F2… in Zone 22, Class II / III
The table shows the maximum permissible measuring medium temperature as a function of ambient temperature and temperature class.

	Temperature class				
Ambient temperature $T_{amb.}$	**T210 °C**	**T200 °C**	**T135 °C**	**T100 °C**	**T85°C**
≤ 30 °C (≤ 86 °F)	195 °C (383 °F)	130 °C (266 °F)	95 °C (203 °F)	80 °C (176 °F)	80 °C (176 °F)
≤ 50 °C (≤ 122 °F)	140 °C (284 °F)	130 °C (266 °F)	95 °C (203 °F)	60 °C (140 °F)	—
≤ 60 °C (≤ 140 °F)	120 °C (248 °F)	120 °C (248 °F)	95 °C (203 °F)	—	—
≤ 70 °C (≤ 158 °F)	80 °C (176 °F)	80 °C (176 °F)	80 °C (176 °F)	—	—

ATEX und IECEx electrical data

Modbus outputs and digital outputs

Model ATEX, IECEX: FCx1xx-A1..., FCx1xx-A2...

Model: cFMus: FCx1xx-F1..., FCx1xx-F2...

	Operating values		Type of protection									
	(general)		'ec' / 'NI' (Zone 2, Div. 2)		'eb' / 'XP' (Zone 1 / Div. 1)		'ia' / 'IS' (Zone 1 / Div. 1)					
Outputs	U_N [V]	I_N [mA]	U_N [V]	I_N [mA]	U_M [V]	I_M [mA]	U_O [V]	I_O [mA]	P_O [mW]	C_O [nF]	$C_{O\,pa}$ [nF]	L_O [µH]
Modbus, active	3	30	3	30	30	30	4,2	150	150	13900	—	20
Terminals A / B							U_i [V]	I_i [mA]	P_i [mW]	C_i [nF]	C_i pa [nF]	L_i [µH]
							4,2	150	150	13900	—	20
Digital output DO1, passive	30	25	30	25	30	25	30	25	187	2,4	—	200
Terminals 41 / 42												
Digital output DO2, passive	30	25	30	25	30	25	30	25	187	20	—	200
Terminals 51 / 52												

All outputs are electrically isolated from each other and from the power supply.
Digital outputs DO1 / DO2 are not electrically isolated from each other. Terminals 42 / 52 have the same potential.

Special connection conditions

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
- If the type of protection for the explosion protection of the device has not been marked on the name plate by the manufacturer, during installation of the device, the operator must identify the type of protection used on the name plate in a permanent manner!

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

The output circuits are designed so that they can be connected to both intrinsically-safe and non-intrinsically-safe circuits.
- Combining intrinsically safe and non-intrinsically safe circuits is not permitted.
- On intrinsically safe circuits, potential equalization should be established along the entire length of the cable used for the signal outputs.
- The rated voltage of the non-intrinsically safe circuits is U_M = 30 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.
- Once output circuits are connected and have been operated for a while, a change of the protection (instrinsically safe and vice versa) is not permitted.

… 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.
When operating with combustible dusts, comply with EN 60079-31.
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.

It is essential that the temperature classes as per the approvals in '**Temperature data** on page 8' are observed.

The information in the installation diagram **3KXF000014G0009** on page 103 must be observed.

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).

It is essential that the temperature classes as per the approvals in '**Temperature data** on page 8' are observed.

The information in the installation diagram **3KXF000014G0009** on page 103 must be observed.

Selection and marking of the type of protection

- The operator needs to select the type of protection for the electric inputs and outputs before the first commissioning.
- The inputs and outputs must all be either only intrinsically safe or only non-intrinsically safe.
  - Mixing the two types of protection is not permitted.
  - Subsequent changes to the type of protection are not permitted.
- Selection of the type of protection requires corresponding electrical wiring provided by the operator.
- The selected type of protection must be permanently marked on the name plate if the marking has not already been applied by the manufacturer. See also **Name plate** on page 20.

Use in areas exposed to combustible dust

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

- The maximum surface temperature of the device may not up-scale 85 °C (185 °F).
- The process temperature of the attached piping may up-scale 85 °C (185 °F).

- Approved dust-proof cable glands must be used when operating in Zone 21, 22 or in Class II, Class III.

Sensor insulation

Observe the notes in **Sensor insulation** on page 25 if the sensor should be insulated.
Comply with the information concerning the temperature classes and cable specification in Section **Temperature classes and permissible measuring medium temperature** from page 9 onwards and **Temperature resistance for the connecting cable** from page 8 onwards.

Opening and closing the terminal box

⚠ DANGER

Danger of explosion if the device is operated with the transmitter housing or terminal box open!
Before opening the transmitter housing or the terminal box, note the following points:

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

⚠ WARNING

Risk of injury due to live parts!
When the housing is open, contact protection is not provided and EMC protection is limited.

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

See also **Opening and closing the terminal box** on page 29.

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 cable glands supplied are ATEX-/IECEx-certified.

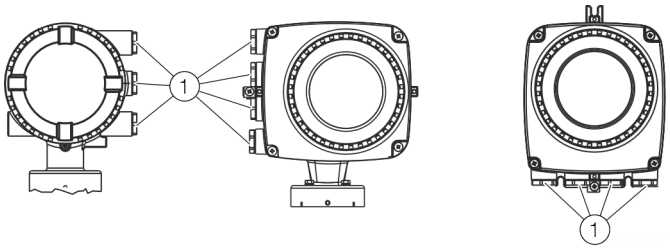
- The use of standard cable glands and closures is prohibited.
- The black plugs in the cable glands are intended to provide protection during transport. Any unused cable entries must be sealed prior to commissioning, using the seals supplied.
- The outside diameter of the connection cable must measure 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.

Note
Due to the necessary temperature resistance, devices in low-temperature design (optional, ambient temperature down to −40 °C (−40 °F) are delivered with metal cable transits. These are then also to be used in intrinsically safe circuits.

… 2 Use in potentially explosive atmospheres

… Installation instructions

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.

Specific Conditions of Use

⚠ WARNING

Special conditions for safe use!

- The painted surface of the CoriolisMaster Flowmeters may store electrostatic charge and become a source of ignition in applications with a low relative humidity (<~30%) even where the painted surface is relatively free of surface contamination such as dirt, dust, or oil.
  - Guidance on protection against the risk of ignition due to electrostatic discharge can be found in PD CLC/TR 60079-32-1 and IEC TS 60079-32-1.
  - Cleaning of the painted surface should only be done with a damp cloth.
- The section **Temperature classes and permissible measuring medium temperature** from page 9 onwards details the permitted temperature classification and ambient temperature ratings as influenced by the process medium temperature.
- Contact the manufacturer for specific flamepath joint details during repair of flameproof Ex d apparatus.
- For models with option m = C provision shall be made external to the equipment, to provide the transient protection device to be set at a level not exceeding 140 % of the peak rated voltage value of 42 V DC.

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 8.

Perform grounding of the device in accordance with **Terminal assignment** on page 31.

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

Perform grounding of the device in accordance with **Terminal assignment** on page 31.

Power supply terminal cover

Make sure that the power supply terminal cover is closed tightly, see also **Electrical connections** on page 30.

Process sealing

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

Note

- 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".

Operating limits

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

… 2 Use in potentially explosive atmospheres

Operating instructions

Protection against electrostatic discharges

⚠ DANGER

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

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

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

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.

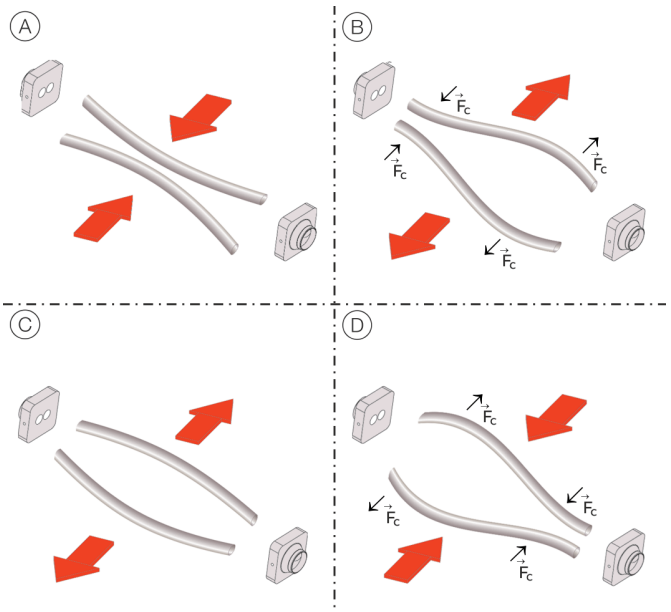
Measuring principle

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 2: Simplified representation of Coriolis forces

… 3 Design and function

Device designs

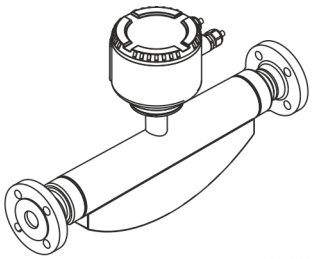


Figure 3: FCB1xx/FCH1xx

Model number	FCB1xx for standard applications	FCH1xx for hygienic applications
Process connections		
Flange DIN 2501 / EN 1092-1	DN 10 to 200, PN 40 to 100	—
Flange ASME B16.5	DN ½ to 8in, CL150 to CL1500	—
JIS flange	DN 10 to 200; JIS 10K to 20K	—
Pipe fitting DIN 11851	DN 10 to 100 (¼ to 4 in)	DN 20 to 100 (¾ 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 (½ 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	Stainless steel, polished 1.4404 (AISI 316L) or 1.4435 (AISI 316L)
Approvals and certificates		
Explosion protection ATEX, IECEx	Zone 0, 1, 2, 21, 22	Zone 0, 1, 2, 21, 22
Explosion protection conforming to cFMus	Class I Div. 1, Class I Div. 2, Zone 0, 1, 2, 21	Class I Div. 1, Class I Div. 2, Zone 0, 1, 2, 21
Hygiene approvals	FDA compliant*	FDA compliant*
Legal metrology	OIML R117, MID, devices for legal metrology in accordance with API / AGA	
Additional approvals	Available from www.abb.com/flow or upon request.	

* Material of the wetted parts: 1.4435 or 1.4404 (AISI 316L)

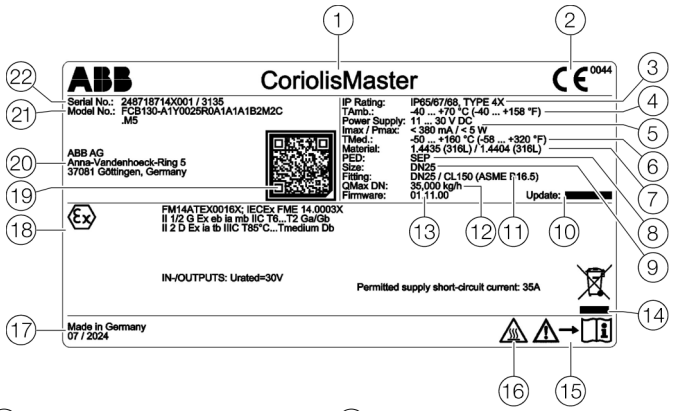
Model number	FCB130	FCB150	FCH130	FCH150
Measuring accuracy for liquids				
Mass flow*	0.4 %, 0.25 % and 0.2 %	0.1 % and 0.15 %	0.4 %, 0.25 % and 0.2 %	0.1 % and 0.15 %
Volume flow*	0.4 %, 0.25 % and 0.2 %	0.15 % and ±0.11 %	0.4 %, 0.25 % and 0.2 %	0.15 % and ±0.11 %
Density	0.01 kg/l	• 0.002 kg/l • 0.001 kg/l (optional) • 0.0004 kg/l (optional)	0.01 kg/l	• 0.002 kg/l • 0.001 kg/l (optional) • 0.0004 kg/l (optional)
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	−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)
Permissible ambient temperature	−40 to 70 °C (−40 to 158 °F)			
Power supply	11 to 30 V DC, nominal voltage: 24 V DC			
IP rating in accordance with EN 60529	IP65 / IP67 / IP68 (immersion depth: 5 m), NEMA 4X			
Communication	Modbus® RTU, RS485			
Outputs in serial production	• Digital output 1: passive • Digital output 2: passive			
External output zero return	Yes			
External totalizer reset	Yes			
Flow measurement in forward flow and reverse flow direction	Yes			
Empty pipe detection	Yes, based on preconfigured density alarm			
Self-monitoring and diagnosis	Yes			
Field optimization for flow and density	Yes			
Concentration measurement 'DensiMass'	Yes, optional on models FCB150 and FCH150			
'FillMass' filling function	Yes, optional on models FCB150 and FCH150			
"VeriMass" diagnosis function	Yes, optional			

* Indication of accuracy in % of the measured value (% of meas.val.)

4 Product identification

Name plate

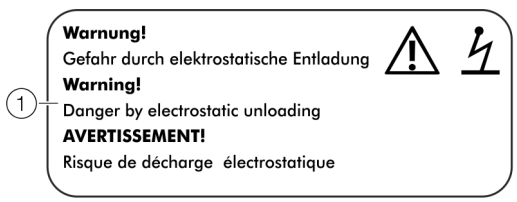
Note
The name plates displayed are examples. The device identification plates affixed to the device can differ from this representation.



1. Type designation
2. CE mark with notified body
3. IP rating
4. Ambient temperature range ($T_{amb.}$)
5. Power supply, maximum power consumption
6. Measuring medium temperature range (T_{medium})
7. Meter tube material
8. PED marking
9. Nominal diameter
10. Firmware update label
11. Process connection / pressure stage
12. Measuring range end value $Q_{max}DN$
13. Firmware version
14. WEEE label
15. 'Follow operating instruction' symbol
16. 'Hot surface' symbol
17. Year of manufacture (month / year)
18. Ex marking, such as ATEX / IECEx or FM / CSA and marking of the ignition protection type.
19. QR code
20. Manufacturer
21. Order code
22. Serial number

Figure 4: Name plate (sample)

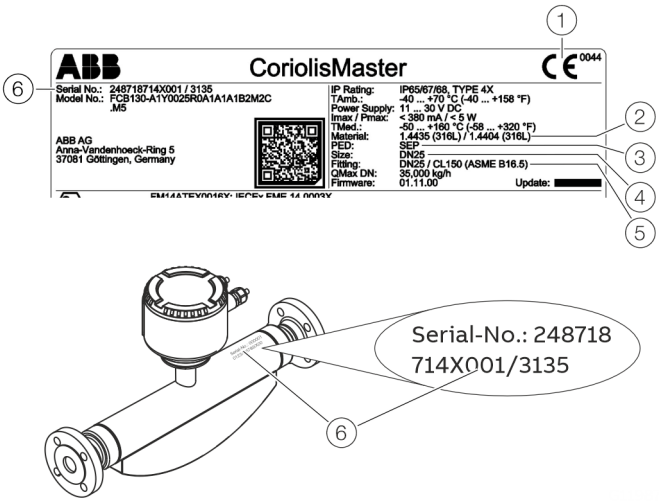
Devices which are approved for use in potentially explosive atmospheres have an additional warning plate.



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

Figure 5: Additional warning plate

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. Material of the pressure-bearing parts (wetted parts)
3. Fluid group or reason for exception
4. Nominal width meter tube
5. Nominal diameter / nominal pressure rating
6. Serial number of the sensor

Figure 6: PED marking (example)

The marking is dependent on the nominal diameter (> DN 25 or ≤ DN 25) of the sensor (also refer to article 4, paragraph 3, 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
The reason for exception in accordance with article 4 paragraph 3 of the Pressure Equipment Directive is specified under PED.
The pressure equipment is classified in the SEP (= Sound Engineering Practice) 'Good Engineering Practice' category.

5 Transport and storage

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.

Transport

⚠ 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.

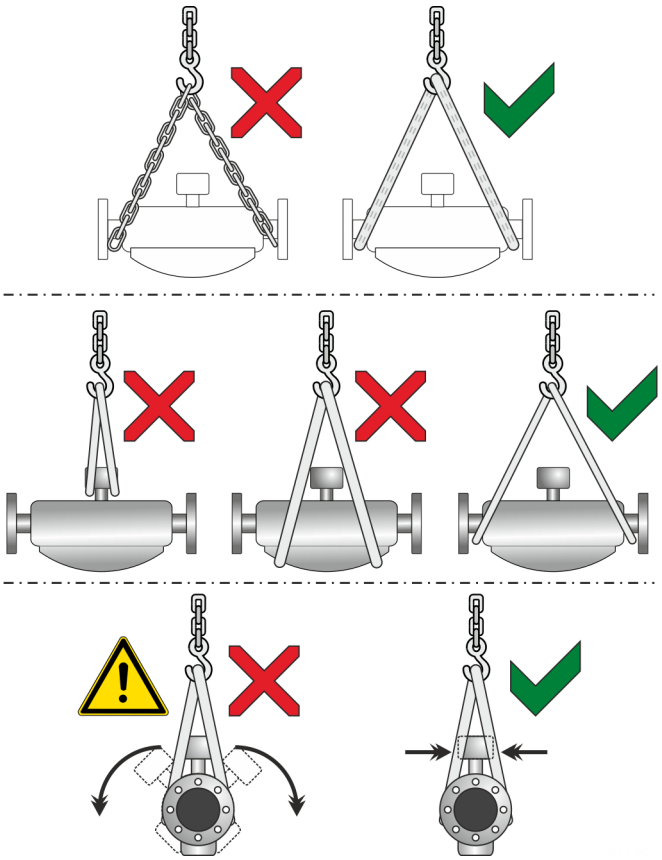


Figure 7: Transport instructions

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

Storage

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.

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 99.

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

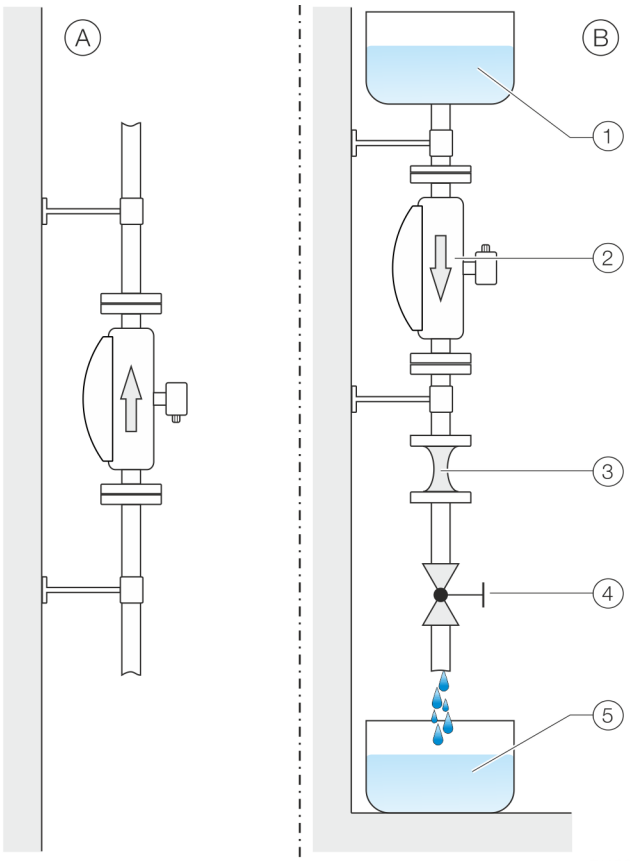
The flowmeter operates in any mounting position.
Depending on the measuring medium (liquid or gas) and the measuring medium temperature, certain mounting positions are preferable to others.For this purpose, consider the following examples.
The preferred flow direction is indicated by the arrow on the 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).

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 8: Vertical installation

… 6 Installation

… General installation conditions

Ⓐ For vertical installation in a riser, no special measures are required.
Ⓑ 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

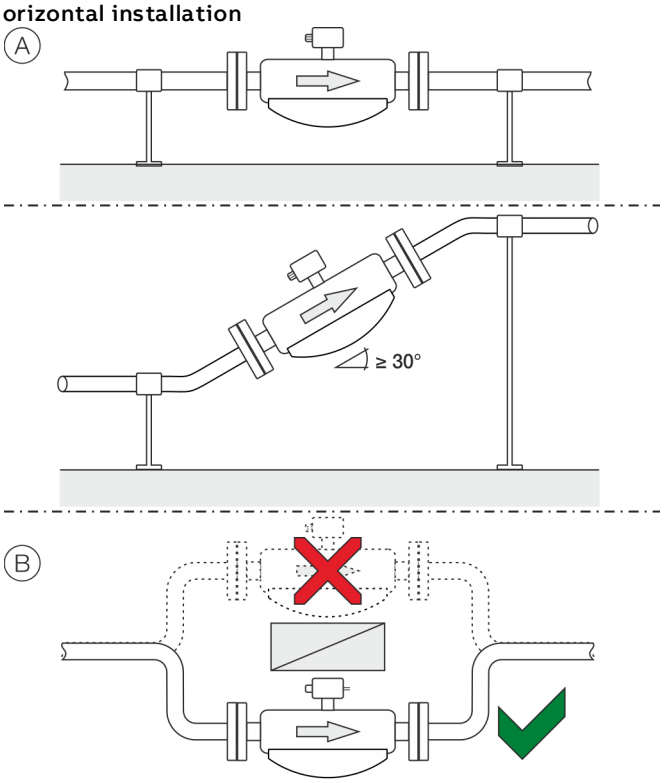


Figure 9: Horizontal installation

Ⓐ 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°.
Ⓑ 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

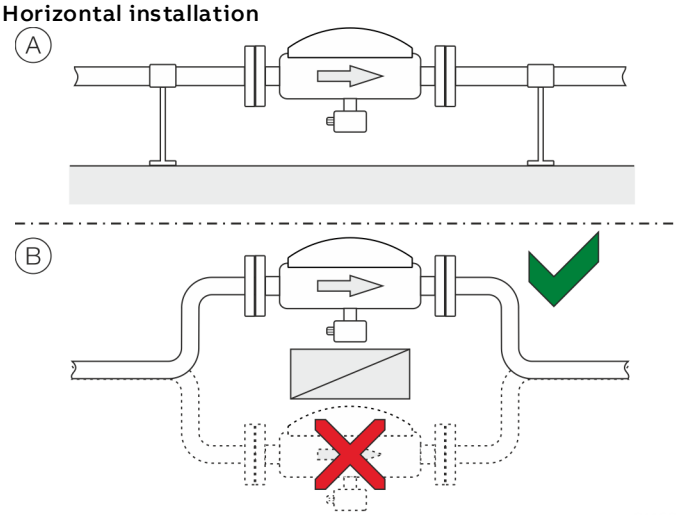
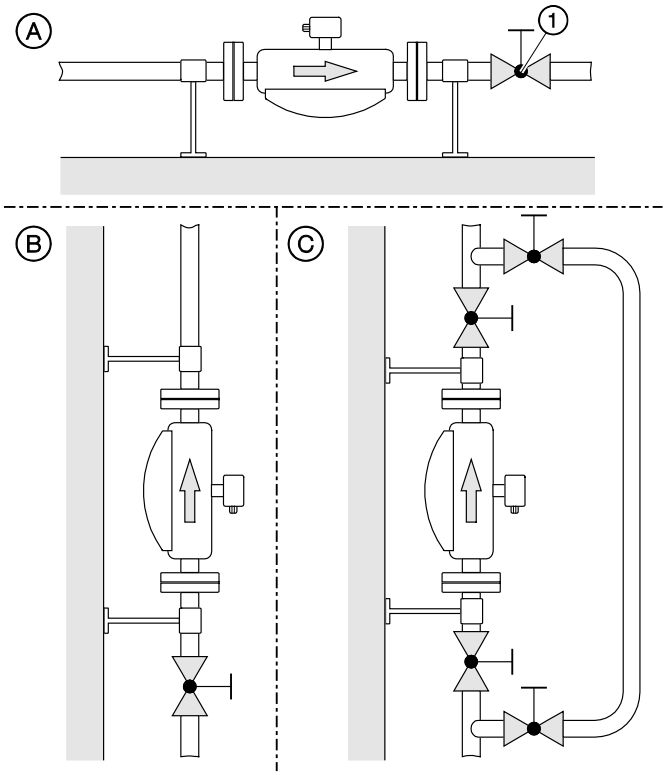


Figure 10: Horizontal installation

Ⓐ 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



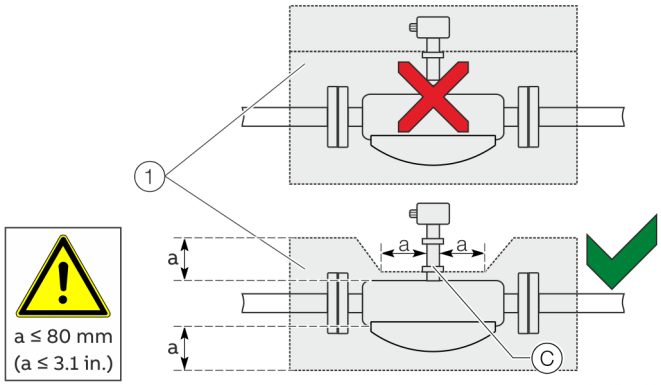
① Turn-off device

Figure 11: Mounting options for turn-off devices (example)

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

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

Sensor insulation



① Insulation

Figure 12: Installation at T_{medium} –50°to 205 °C (–58 to 400 °F)

The sensor may only be insulated in conjunction with the option TE1 'Tower length extension – meter insulation capability' or TE2 'Tower length extension – meter insulation capability, potted' as shown in Figure 12.

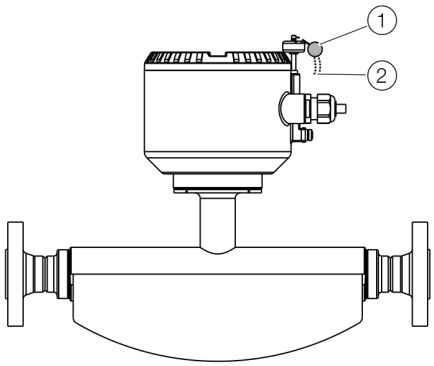
Heat tracing of the sensor

- When operating the sensor in conjunction with heat tracing, the permissible measuring medium temperature T_{medium} at point Ⓒ (Figure 12) may not be exceeded at any time!
- When used in potentially explosive atmospheres the device temperature classes, Section **Temperature classes and permissible measuring medium temperature** from page 9 onwards must be complied with!

… 6 Installation

… General installation conditions

Devices for legal metrology



① Lead seal ② Lead seal wire

Figure 13: Sealing in accordance with MID / OIML R117 (example)

On devices for legal metrology, the hardware write protection must be activated after commissioning in many cases. This prevents a change in the parameterization of the devices.
Write-protect switch on page 35

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

Note
When using the device in potentially explosive atmospheres, note the additional temperature data in **Temperature data** from page 8 onwards!

Temperature limits °C (°F)

Measuring medium temperature T_{medium}
FCx130: −50 to 160 °C (-58 to 320 °F)
FCx150: −50 to 205 °C (-58 to 401 °F)

Ambient temperature $T_{amb.}$
−40 to 70 °C (−40 to 158 °F)

Note
In devices with order code '**Extended tower length – TE3**', from an ambient temperature of ≥ 65 °C (149 °F), the measuring medium temperature must be limited to a maximum of 140 °C (284 °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 18.

Pressure Equipment Directive

Conformity assessment in accordance with Category III, fluid group 1, gas The pressure equipment is designed for load changes in accordance with the AD2000 specification sheet S1 Chapter 1.4 a) and b).
Note the corrosion resistance of the meter tube materials in relation to the measuring medium.

IP rating

In accordance with EN60529: IP65 / IP67 / IP68, NEMA 4X

Note
The flowmeter sensor is approved for an immersion depth up to 5 m (16.4 ft) in accordance with IP rating IP68.

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	DN 15 to DN 40	40 bar	140 °C	−40 °C
(DIN 11851)	(½ to 1½ in)	(580 psi)	(284 °F)	(−40 °F)
	DN 50 to DN 100	25 bar	140 °C	−40 °C
	(2 to 4 in)	(363 psi)	(284 °F)	(−40 °F)
Pipe fitting	DN 25 to DN 80	6 bar	140 °C	−40 °C
(SMS 1145)	(1 to 3 in)	(87 psi)	(284 °F)	(−40 °F)
Tri-Clamp	DN 15 to DN 50	16 bar	140 °C	−40 °C
(DIN 32676)	(½ to 2 in)	(232 psi)	(284 °F)	(−40 °F)
	DN 65 to DN 100	10 bar	140 °C	−40 °C
	(2½ to 4 in)	(145 psi)	(284 °F)	(−40 °F)
ASME BPE Clamp	< DN 80	11.4 bar	121 °C	−40 °C
	(< 3 in)	(165.3 psi)	(249,8 °F)	(−40 °F)
	DN 80	10.3 bar	121 °C	−40 °C
	(3 in)	(149.4 psi)	(249.8 °F)	(−40 °F)
	DN 100	8.6 bar	121 °C	−40 °C
	(4 in)	(124.7 psi)	(249.8 °F)	(−40 °F)
NPT female thread	DN 15 (½ in)	177 bar	150 °C	−40 °C
	CrNi steel 1.4404	(2567.2 psi)	(302 °F)	(−40 °F)
	DN 15 (½ in)	163 bar	205 °C	−40 °C
	CrNi steel 1.4404	(2364.1 psi)	(401 °F)	(−40 °F)
	DN 15 (½ in)	267 bar	150 °C	−40 °C
	HC22 2.4602	(3872.5 psi)	(302 °F)	(−40 °F)
	DN 15 (½ in)	243 bar	205 °C	−40 °C
	HC22 2.4602	(3524.4 psi)	(401 °F)	(−40 °F)

Material load curves for flange devices

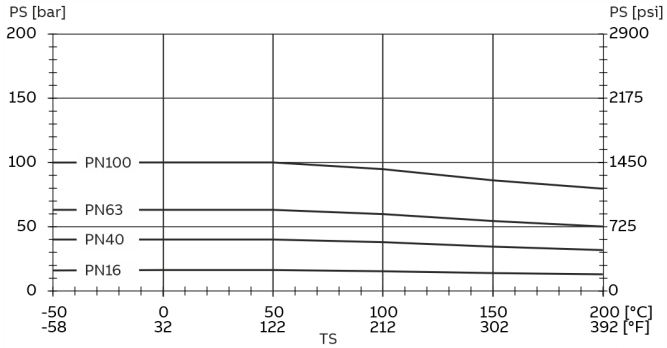


Figure 14: Stainless steel DIN flange 1.4404 (316L) up to DN 200 (8 in.)

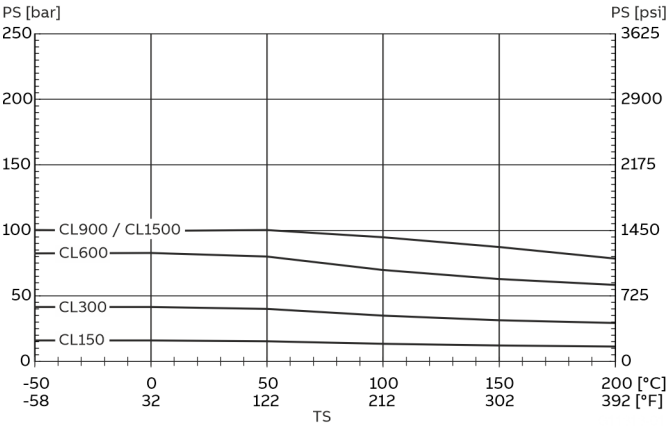
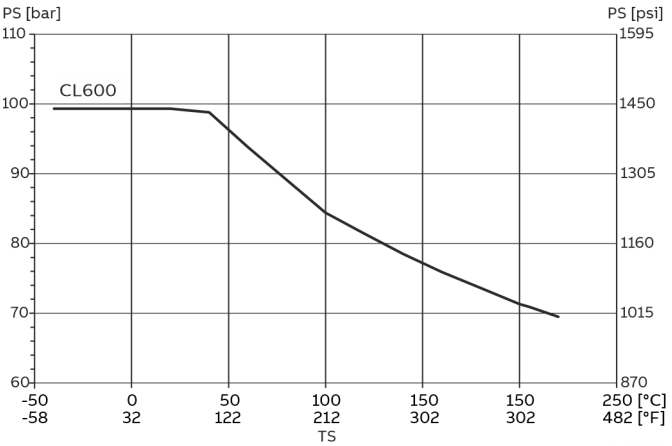


Figure 15: Stainless steel ASME flange 1.4404 (316L) up to DN 200 (8 in.)



PS bar (psi)	TS °C (°F)	PS bar (psi)	TS °C (°F)
99.3 (1440.2)	−40 (−40)	81.4 (1.180.6)	120 (248)
99.3 (1440.2)	0 (32)	78.5 (1138.5)	140 (284)
99.3 (1440.2)	20 (68)	75.9 (1100.8)	160 (320)
99.8 (1447.5)	40 (104)	73.6 (1067.5)	180 (356)
93.8 (1360.5)	60 (140)	71.3 (1034.1)	200 (392)
89.1 (1292.3)	80 (176)	70.9 (1028.3)	205 (401)
84.4 (1224.1)	100 (212)	69.5 (1008.0)	220 (428)

Figure 16: Stainless steel ASME flange 1.4401 (F316) up to DN 200 (8 in.)

… 6 Installation

… Material load for process connections

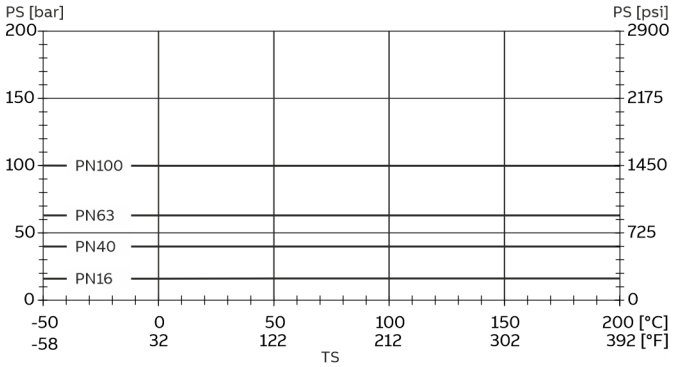


Figure 17: Nickel alloy DIN flange up to DN 200 (8 in)

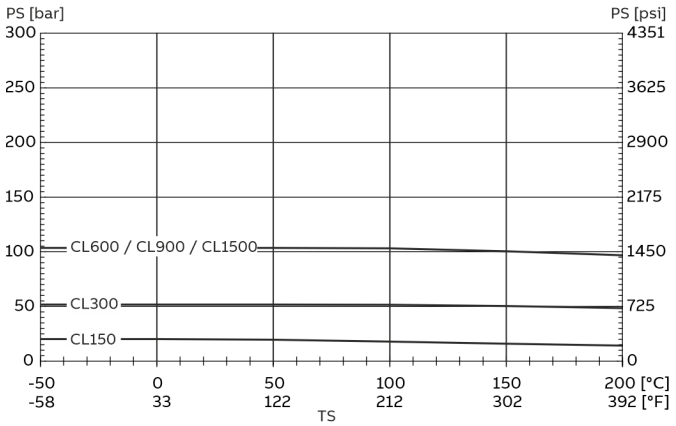


Figure 18: Nickel alloy ASME flange up to DN 200 (in.)

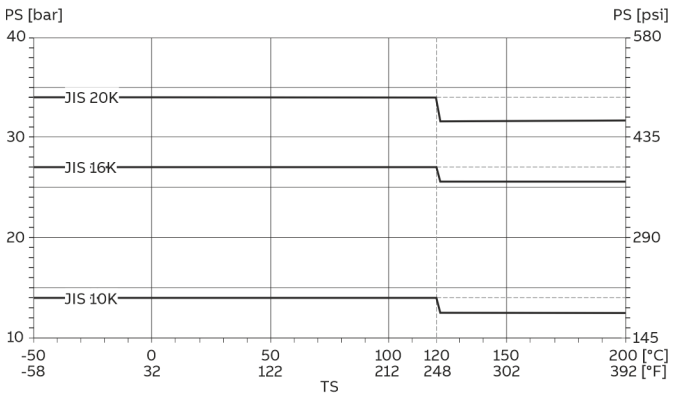


Figure 19: Stainless steel JIS B2220 flange 1.4435 or 1.4404 (AISI 316L) or nickel alloy

Installing the sensor

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

1. Insert the sensor into the piping centrally and positioned coplanar. Use suitable gaskets to seal the process connections.
2. Tighten flange screws by working on each in a crosswise manner with the maximum permissible torque. Torques for screws depend on temperature, pressure, screw and gasket materials. The relevant applicable regulations must be taken into consideration.
3. Check the seal integrity of the process connections.

Opening and closing the terminal box

⚠ DANGER

Danger of explosion if the device is operated with the transmitter housing or terminal box open!
Before opening the transmitter housing or the terminal box, note the following points:

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

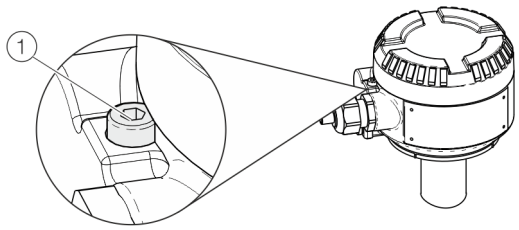


Figure 20: Cover lock (example)

⚠ DANGER

Damaging the device carries a risk of explosion!
When the screws for the transmitter housing are loosened, the explosion protection is suspended.

- Never disconnect the transmitter housing from the sensor.

NOTICE

Potential adverse effect on the IP rating

- Make sure that the cover of the power supply terminals is mounted correctly.
- 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.

To open the housing, release the cover lock by screwing in the Allen screw (1).
After closing the housing, lock the housing cover by unscrewing the Allen screw (1).

7 Electrical connections

Safety instructions

⚠ DANGER

Danger of explosion if the device is operated with the transmitter housing or terminal box open!
Before opening the transmitter housing or the terminal box, note the following points:

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

⚠ WARNING

Risk of injury due to live parts.
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.

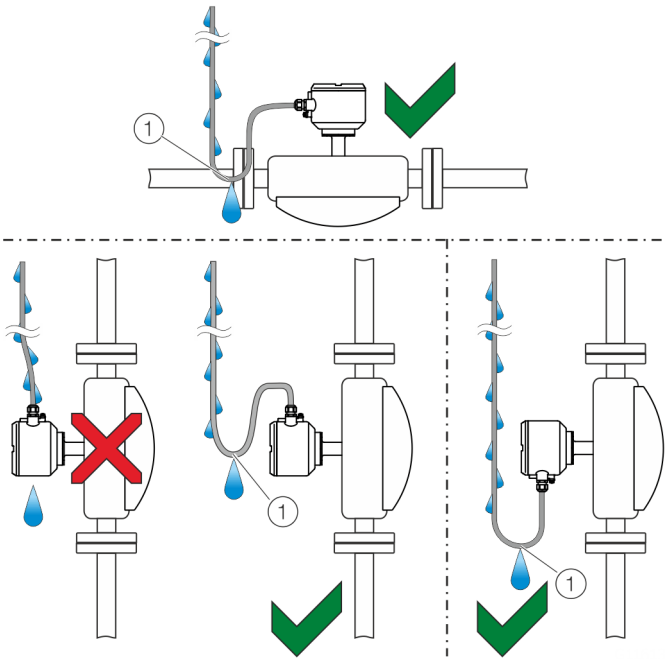
Note
This is a class A device (industrial sector). This device can cause high frequency interferences in residential areas.
In this case, the operator may be required to take appropriate measures to remedy the interference.

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.

Installing the connection cables

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

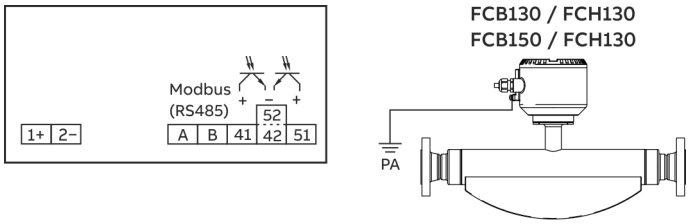


① Drip loop

Figure 21: Laying the connection cable

Terminal assignment

Models FCB130, FCB150, FCH130 and FCH150



PA Potential equalization

Figure 22: Electrical connection

Connections for the power supply

DC voltage	
Terminal	**Function / comments**
1+	+
2–	–

Connections for the outputs

Terminal	**Function / comments**
A / B	**Modbus® RTU (RS485)**
41 / 42	**Passive digital output DO1** The output can be configured as a pulse output, frequency output or switch output.
51 / 52	**Passive digital output DO2** The output can be configured as a pulse output or switch output.

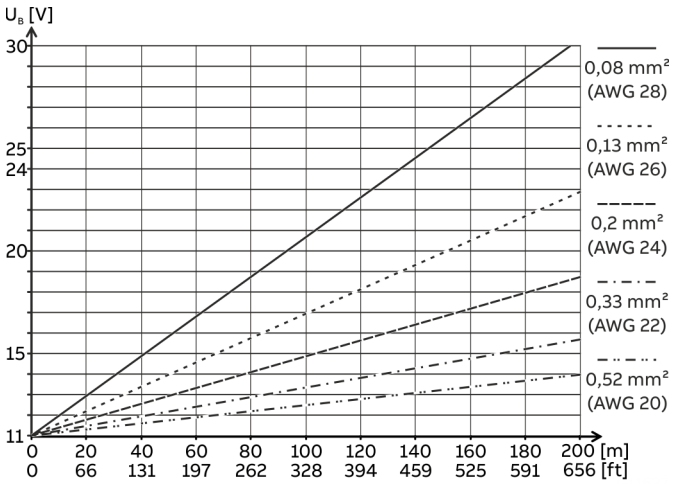
Electrical data for inputs and outputs

Note
When using the device in potentially explosive atmospheres, note the additional connection data in **Use in potentially explosive atmospheres** on page 6!

Power supply

Supply voltage	11 to 30 V DC (ripple: ≤ 5 %)
Power consumption	S ≤ 5 VA

When connecting the devices, note the voltage drop on the cable. The operating voltage on the device must not be less than 11 V.



U_B Supply voltage L Cable length

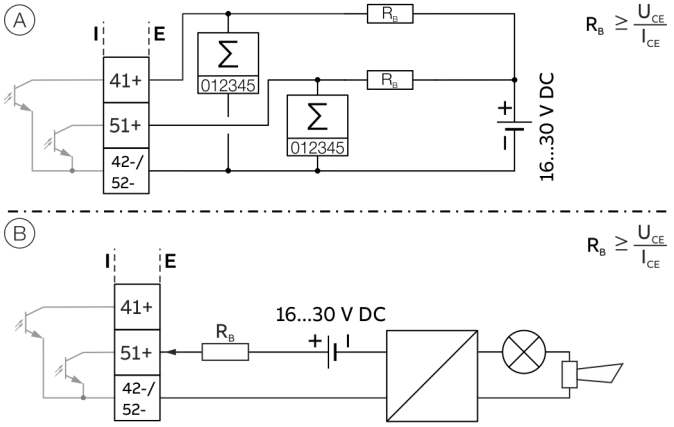
Figure 23: Maximum cable lengths (examples)

… 7 Electrical connections

… Electrical data for inputs and outputs

Digital output 41 / 42, 51 / 52

Can be configured via Modbus.



(A) Passive digital output 41 / 42 as pulse or frequency output, Passive digital output 51 / 52 as pulse output

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

Figure 24: Passive digital outputs (I = internal, E = external)

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

Binary output (passive)	
Terminals	41 / 42, 51 / 52
Output 'closed'	$0 V \leq U_{CEL} \leq 3 V$ $2 mA \leq I_{CEL} \leq 30 mA$
Output 'open'	$16 V \leq U_{CEH} \leq 30 V$ DC $0 mA \leq I_{CEH} \leq 0.2 mA$
Switching function	Configurable **Parameter range - Output** on page 65

Note

- Digital output 51 / 52 **cannot** be configured as a frequency output.
- Terminals 42 / 52 have the same potential. Digital outputs 41 / 42 and 51 / 52 are not electrically isolated from each other.
- If you are using a mechanical counter, we recommend setting a pulse width of ≥ 30 ms and a maximum frequency of $f_{max} \leq 3$ kHz.

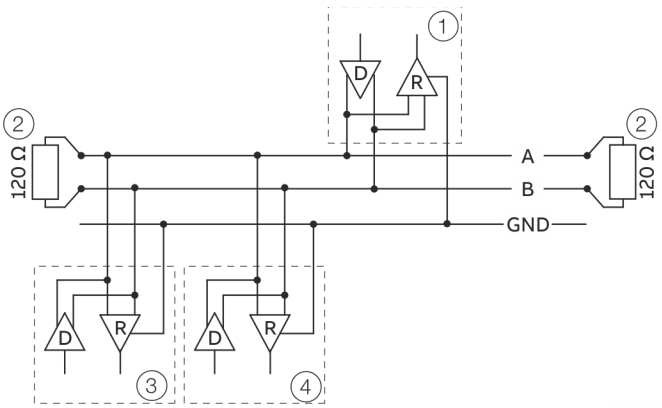
Modbus® communication

Note

The Modbus® protocol is an unsecured protocol (in terms of IT and cyber security), as such the intended application should be assessed to ensure that this protocol is 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 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 (LSB first), Big endian (MSB first) Factory setting: Big endian Big Endian -> MSB first (default) Little Endian -> LSB first
Typical response time	< 100 ms
Response delay time	0 to 200 ms Factory setting: 10 ms



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

Figure 25: Communication via Modbus protocol

Modbus response time

The typical response time of the device is normally less than 100 ms (minimum response time). The response time is calculated from the end of the request telegram from the master to the beginning of the response telegram from the slave. The response time can be increased via the parameter 'modbusResponseDelayTime'.
Refer to **Parameter range – Communication** on page 73.
The length of the response telegram is dependent upon the number of bytes read and the baud rate configured.

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.'

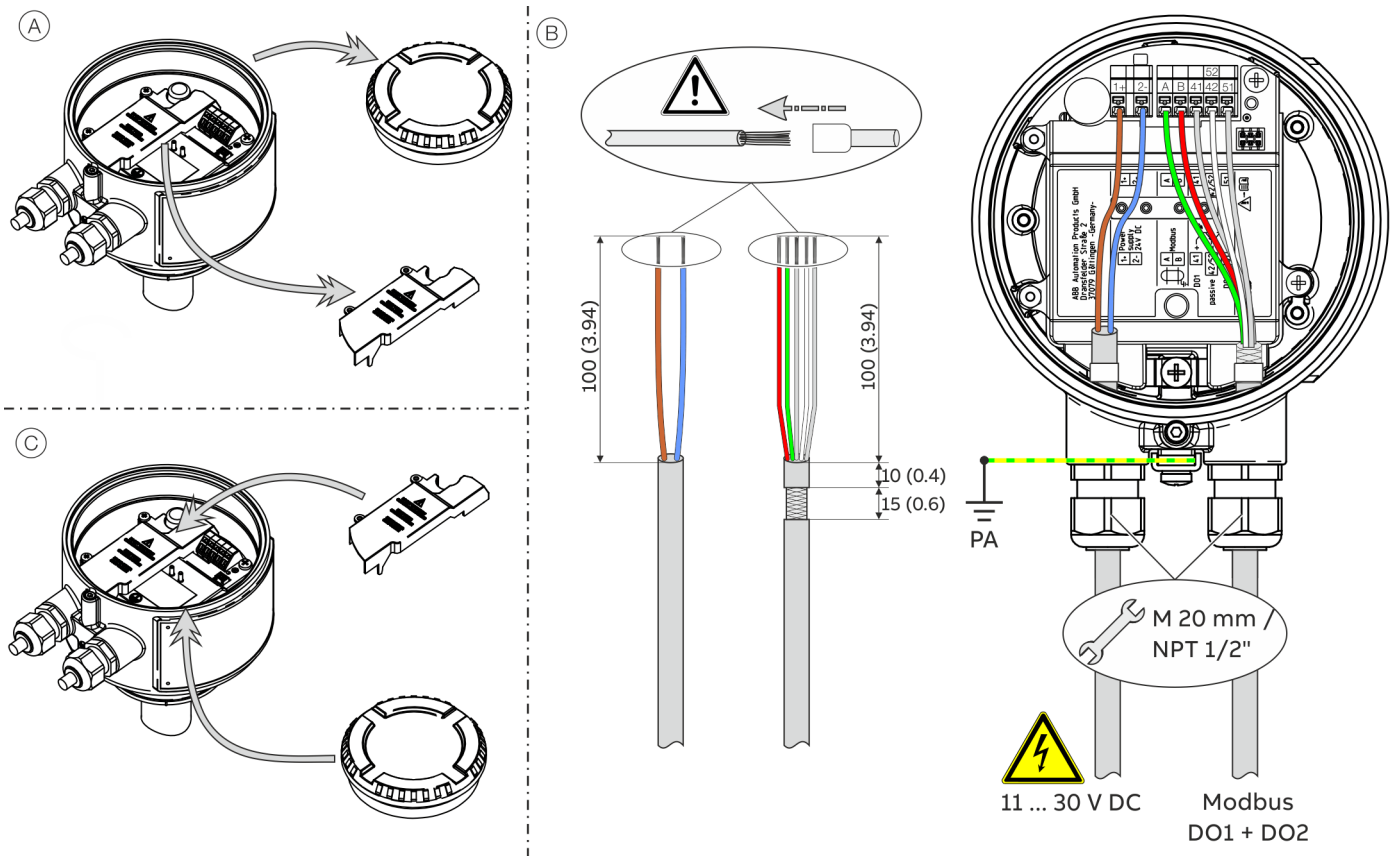
The maximum cable length depends on the type of cable used. The following standard values apply:

- 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.

… 7 Electrical connections

Connection on the device



PA Potential equalization

Figure 26: Connection to device

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.

Connecting integral mount design

Perform steps (A) to (C).

During the process, observe the following instructions:

- Lead the cable for the power supply into the terminal box through the left cable entry.
- Lead the cables for the Modbus outputs and digital outputs into the terminal box through the right cable entry.
- Connect the cables in accordance with the electrical connection. Connect the cable shields to the designated grounding clamp in the terminal box.
- Connect the potential equalization (PE) on the ground terminal to the terminal box.
- Use wire end ferrules when connecting.

Observe the following points when connecting to the power supply:

- Adhere to the limit values of the power supply in accordance with the information on the device name plate.
- The cables must comply with IEC 227 or IEC 245.
- Complete the electrical connection in accordance with the electrical connection diagram.

8 Commissioning and operation

Safety instructions

⚠ DANGER

Explosion hazard

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

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

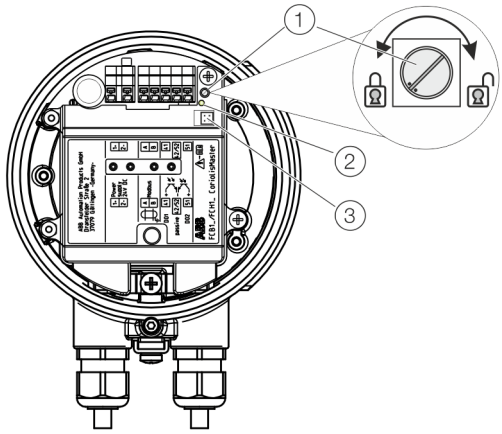
Operating instructions

When operating the device, please note the following:

- Aggressive or corrosive media can lead to damage of wetted parts. As a result, pressurized media may escape prematurely.
- Wear to the flange gasket or process connection gaskets (such as aseptic pipe fittings, Tri-Clamp, etc.) can cause pressurized media to escape.
- When using internal flat gaskets, these can become brittle as a result of CIP / SIP processes.

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

Write-protection switch, service LED and local operator interface



① Write protection switch
② Service LED
③ Local operating interface

Figure 27: Operating elements in the terminal box

Write-protect switch

The write protection switch is located in the sensor terminal box. If write protection is active, the parameterization of the device cannot be changed via Modbus or the local operating interface. Turning the write protection switch clockwise deactivates the write protection function, while turning the switch counter-clockwise activates it.

The power supply to the transmitter must be briefly interrupted in order for the modified setting to take effect.

Service LED

The service LED, which indicates the operating condition of the device, is located in the sensor terminal box.

Service LED	Description
Flashes rapidly (100 ms)	Starting sequence, device not yet ready for operation
Lit up continuously	Device operating, no critical error
Flashes slowly (1 second)	A critical error has occurred, see **Diagnosis / error messages** on page 92

Local operating interface

The sensor can also be parameterized without a Modbus connection via the local operating interface, see **Parameterization via the local operating interface** on page 37.

… 8 Commissioning and operation

Checks prior to commissioning

The following points must be checked before commissioning the device:

- Correct wiring in accordance with **Electrical connections** on page 30.
- Correct grounding of the device.
- The ambient conditions must meet the requirements set out in the specification.
- The power supply must meet the requirements set out on the name plate.

NOTICE

Damage to the device due to undervoltage.
In the event that lower voltage is supplied than indicated on the name plate, the current consumption of the device increases.
The internal fuses can be damaged as a result.

- Make sure that the minimum operating voltage of the device is not down-scaled (see also **Electrical data for inputs and outputs** on page 31).

Switching on the power supply

1. Switch on the power supply.
2. Perform parameterization of the flowmeter (see **Parameterization of the device** on page 36).

The flowmeter is now ready for operation.

Inspection after power-up of the power supply

The following points must be checked after commissioning the device:

- Parameter configuration must correspond to the operating conditions.
- The system zero point has been balanced (see **Zero point balance under operating conditions** on page 83).

Parameterization of the device

Note

- The device does not have the operating elements for parameterization on site.
- The parameterization is performed either via the Modbus interface or the local operating interface of the device.

Usually at least the following parameters must be set during commissioning:

- The Modbus slave ID, baud rate, and parity,
- The units for the mass flow, density, temperature, and the volume flow rate,
- The pulse width and the pulse factor for the pulse output,
- Massflow CutOff.

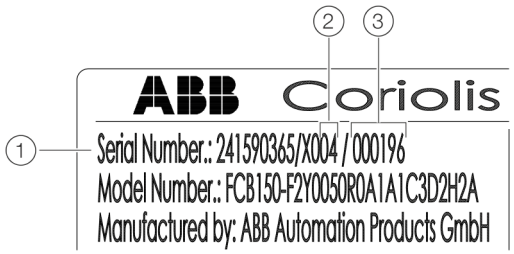
The settings for the Modbus interface and the pulse output are only necessary if the corresponding outputs are also used.

Parameterization via the Modbus interface

Note **Parameter descriptions** on page 54 when parameterizing via the Modbus interface.

Factory setting for the Modbus slave ID (address)

The Modbus Slave ID of the device is preset at the factory. The Modbus Slave ID corresponds to the last two digits of the serial number of the device on the name plate.



1 Serial number
2 Modbus slave ID
3 Sensor ID

Figure 28: Modbus-address on the name plate (example)

Changing an unknown Modbus slave ID

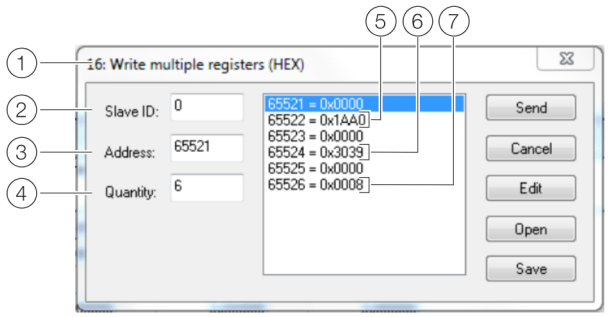
The Modbus Slave ID (address) of the device must be known for Modbus communication.

Upon delivery, the Modbus Slave ID corresponds to the last two digits of the serial number of the device (see **Parameterization via the Modbus interface** on page 36).

If the Modbus address is not known, the Modbus Slave ID can be reset via a Modbus broadcast message. To do this, the following three Modbus registers must be sent to the bus together with the function code 16 (0x10) "Write Multiple Registers".

Address / data type [register length]	Description
65521 TUSIGN32 [2]	manufacturerDeviceID The manufacturer code (ABB = 0x1A) and the device code (FCB1xx = 0xA0) must be written to the register 65522.
65523 TUSIGN32 [2]	sensorSerialID The Sensor ID of the device (on the name plate, see **Factory setting for the Modbus slave ID (address)** on page 36). The information must first be written in the high-byte (65524) of the register.
65525 TUSIGN32 [2]	slaveID The new Modbus Slave ID must be written in the high byte (65526) of the register.

The three Modbus registers must now be sent from the Modbus master to the broadcast address "0". All of the devices connected to the bus receive the message, but only the device addressed via the manufacturer code and the Sensor ID sets the Modbus Slave ID to the new required value.

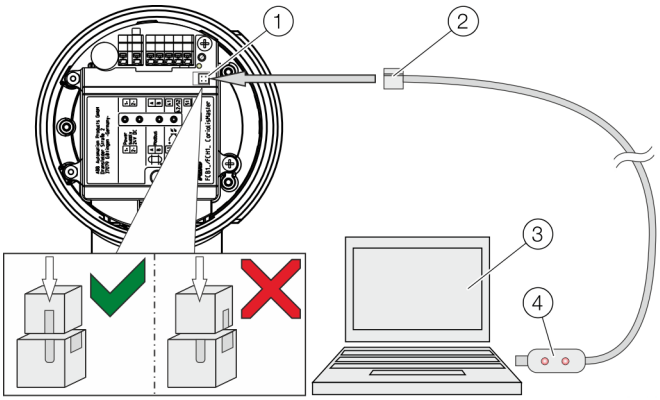


1 Functional code 16
2 Broadcast address '0'
3 Register start address
4 Number of registers
5 Manufacturer and device codes
6 Sensor ID
7 New Modbus slave ID

Figure 29: Write Multiple Registers (example)

Parameterization via the local operating interface

A PC / notebook and the USB interface cable are needed to configure the device via the device local operating interface (3KXS310000L0001).



1 Local operating interface
2 Programming plug
3 PC / Notebook
4 USB-interface cable

Figure 30: Connection to the local operating interface

Connection on the device

1. Open device terminal box.
2. Connect programming plug to the local operating interface of the device.
3. Insert USB interface cable into a free USB female connector on the PC / notebook.

Note

Any required drivers are automatically installed by Windows®. If installation of the drivers does not start automatically, search for the drivers via the Windows driver search. In case of no internet connection, use the 'Prolific driver' from the software package.

4. Switch on the device power supply.
5. Conduct parameterization of the device.

… 8 Commissioning and operation

… Parameterization of the device

Installation of the ABB Field Information Manager (FIM)

Download ABB Ability™ Smart Device Manager (SDM) V2.1 | Field Information Manager (FIM) using the following download link.

Download the ABB FDI package using the following 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 Connection on the device on page 37.
4. Power-up the power supply for the flowmeter and start the ABB Field Information Manager (FIM).
5. Drag and drop the ‘ABB.FCXxxx.02.00.00.HART.fdix’ file (or a newer version) to the ABB Field Information Manager (FIM). No special view is needed for this.
6. Right-click (1) as shown in Figure 31.

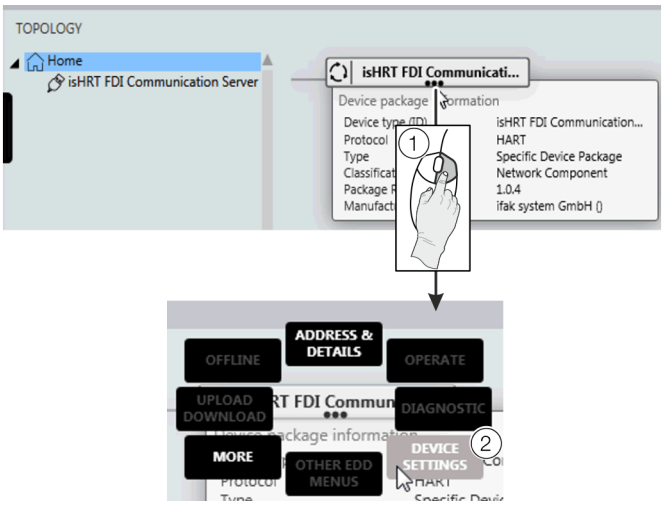


Figure 31: Select FIM – ‘Device Settings’

7. Select ‘DEVICE SETTINGS’ (2) as shown in Figure 31.

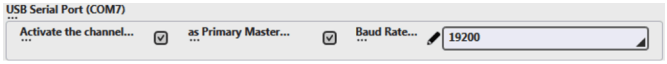


Figure 32: Select FIM – COM-Port

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’.

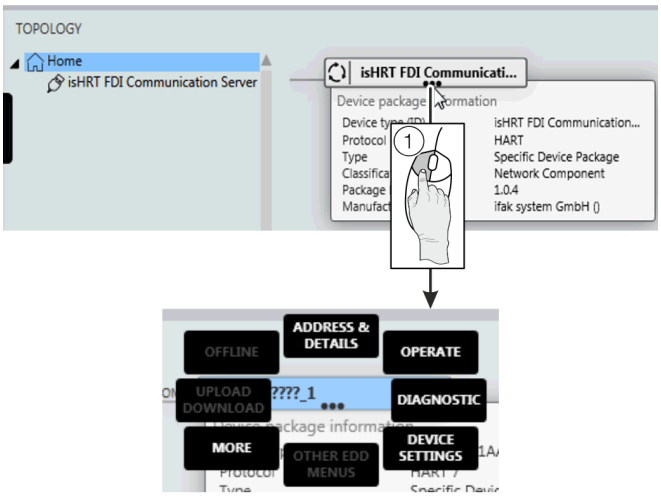


Figure 33:

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

Interface description

NOTICE

All Modbus addresses in this chapter are indicated in the format "PLC Base 1".

Modbus data types

ABB data type	Data type	Register count	Description
ACTION	unsigned char	One register	The 'ACTION' data type is used to trigger device functions. Parameters with the data type 'ACTION' have no internal memory requirements. Writing any value into the parameters triggers the corresponding device function.
TUSIGN8	unsigned char	One register	16-bit register, but only the first 8-bits are used - unsigned char.
TUSIGN16	unsigned short	One register	16-bit unsigned integer
TINT16	signed short	One register	16-bit signed integer
TUSIGN32	unsigned long	Two consecutive registers	32-bit unsigned integer
TINT32	signed long	Two consecutive registers	32-bit signed integer
TCHAR	unsigned char	One register The total length of the register depends on the object length.	16-bit register, but only the first 8-bits are used - unsigned char. The register content is interpreted as an ASCII-value.
TFLOAT	float	Two consecutive registers	32-bit IEEE floating point The device parameter 'IEEE Format' determines the order in which the data words of the data types 'float' and 'double' are interpreted. See also **Parameter range – Communication** on page 73.
TDOUBLE	double	Four consecutive registers	64-bit IEEE double-precision floating point The device parameter 'IEEE Format' determines the order in which the data words of the data types 'float' and 'double' are interpreted. See also **Parameter range – Communication** on page 73. If the parameter is set to '1' (IEEE format deactivated), the data words of the data types 'float' and 'double' are sent in the standard Modbus format 'big endian'. **Example:** The value '5.525' is returned in hex as '40, 16, 19, 99, 99, 99, 99, 9A'. If the parameter is set to '0' (IEEE format activated), the data words of the data types 'float' and 'double' are sent in the format 'little endian' with the lowest value word first. **Example:** The value '5.525' is returned in hex as '99, 9A, 99 ,99, 19, 99, 40, 16'.

… 8 Commissioning and operation

… Interface description

Register tables (overview)

Table ID [hex]	Table name	Table type	Data type	Start index	End index
Input coils					
0xD	Input Coils Table	Coil	TUSIGN8	2000	3000
Register					
0x0	8-bit register	Single	TUSIGN8	1	99
0x1	Action register	Single	ACTION	100	148
0x2	Float register	Single	TFLOAT	149	360
0x3	16-bit register	Single	TUSIGN16	361	407
0x4	Float register	Single	TFLOAT	408	450
0x5	32-bit register	Single	TUSIGN32	451	569
0x6	8-bit register	Single	TUSIGN8	570	600
0x7	16-bit config scan register 1	Single	TUSIGN16	655	686
0x8	Scan register	Single	16-bit register, The data type depends on the configuration register	687	718
0x9	16-bit config scan register 2	Single	TUSIGN16	751	782
0xA	Scan register 2	Single	16-bit register, The data type depends on the configuration register	783	814
0xB	Float register	Single	TFLOAT	963	1002
0xC	Stringregister	String	TUSIGN8	1003	1499
0xE	String register	String	TCHAR	1500	1999
0xF	Double register	Single	TDOUBLE	847	962
0x10	Slave ID register	Single	TUSIGN32	65521	65526
0x11	Float register	Single	TFLOAT	601	654
0x12	8-bit register	Single	TUSIGN8	3001	3500
0x13	Float register	Single	TFLOAT	3501	4000

The device error messages are transmitted via the Modbus® interface by means of the ‘Input Coils.’
For more detailed information, see **Diagnosis / error messages** on page 92.

Supported Modbus function codes

In this chapter, all Modbus function codes supported by CoriolisMaster FCB100, FCH100 are described.

Overview

The function codes listed below are supported by CoriolisMaster FCB100, FCH100.

Function code	Description	Applicable to register tables
0x02	Read Discrete Inputs	Alarm status Discrete Inputs
		Alarm history status Discrete Inputs
0x03	Read Holding Registers	Read-write Byte parameters
		Read-write Byte string parameters
		Read-write Float parameters
		Action parameters
0x04	Read Input Registers	Read-only Byte parameters
		Read-only Short parameters
		Read-only Integer parameters
		Read-only Float parameters
		Read-only Double parameters
		Alarm history counters
		Read-only Byte string parameters
0x06	Write Single Register	Read-write Byte parameters
		Read-write Byte string parameters
		Action parameters
0x08	Diagnostics	NA
0x10	Write Multiple Registers	Read-write Byte parameters
		Read-write Byte string parameters
		Read-write Float parameters
		Action parameters
0x11	Report Slave ID	NA

… 8 Commissioning and operation

… Interface description

0x02 Read Discrete Inputs

The 'Read Discrete Inputs' function code is used to read off register 'Discrete Inputs (Coil)' of the device.
The query telegram is designed as follows:

Byte	Description
1	Slave device code
2	Read Discrete Inputs Function Code, 0x02.
3, 4	Discrete input address. 16-bit value indicating the address of the first discrete input to be read.
5, 6	Number of discrete inputs. 16-bit value indicating the number of discrete inputs to be read.
7, 8	Check sum (CRC) of the Modbus telegram

The reply telegram to a successfully processed query is designed as follows:

Byte	Description
1	Slave device code
2	Read Discrete Inputs Function Code, 0x02.
3	Anzahl (n) der Datenbytes im Antwort-Telegramm
4 … (4+n)-1	Discrete input data. Up to 2000 discrete inputs can be read in one request, if available.
(4+n), (4+n)+1	Check sum (CRC) of the Modbus telegram

0x03 Read Holding Registers

The 'Read Holding registers' function code is used to read off the 'Read Holding Registers' of the device.
The query telegram is designed as follows:

Byte	Description
1	Slave device code
2	Read Holding Registers Function Code, 0x03.
3, 4	Holding register address. 16-bit address indicating the address of the first holding register to read.
5, 6	Holding register count. 16-bit value indicating the number of holding registers to read.
7, 8	Check sum (CRC) of the Modbus telegram

The reply telegram to a successfully processed query is designed as follows:

Byte	Description
1	Slave device code
2	Read Holding Registers Function Code, 0x03.
3	Holding register count ('n'). 8-bit value indicating the count of holding registers returned in the message.
4 … (4+n)-1	Holding register data.
(4+n), (4+n)+1	Check sum (CRC) of the Modbus telegram

0x04 Read Input Registers

The 'Read Input Registers' function code is used to read off the 'Input Register' of the device.
The query telegram is designed as follows:

Byte	Description
1	Slave device code
2	Read Input Registers Function Code, 0x04.
3, 4	Input register address. 16-bit value indicating the address of the first input register to read.
5, 6	Input register count. 16-bit value indicating the number of input registers to read.
7, 8	Check sum (CRC) of the Modbus telegram

The reply telegram to a successfully processed query is designed as follows:

Byte	Description
1	Slave device code
2	Read Input Registers Function Code, 0x04.
3	Number (n) of data bytes in the reply telegram
4 ... (4+n)-1	Input register data.
(4+n), (4+n)+1	Check sum (CRC) of the Modbus telegram

0x06 Write Single Register

The 'Write Single Register' function code is used to write a value in one of the 'Holding Register' of the device.
The query telegram is designed as follows:

Byte	Description
1	Slave device code
2	Write Single Register Function Code, 0x06.
3, 4	16-bit holding register address.
5, 6	Holding register value. 16-bit value indicating the value to write.
7, 8	Check sum (CRC) of the Modbus telegram

The reply telegram to a successfully processed query is designed as follows:

Byte	Description
1	Slave device code
2	Write Single Register Function Code, 0x06.
3, 4	Holding register address. 16-bit value indicating the address of the holding register that was written.
5, 6	Holding register value. 16-bit value indicating the value that was written to the holding register.
7, 8	Check sum (CRC) of the Modbus telegram

… 8 Commissioning and operation

… Interface description

0x08 Diagnostics

Only the subfunction 'Return Query Data (0x00, 0x00)' is supported.
If the device receives a query telegram, the telegram is sent back to the Master without changes.
The query and reply telegrams are designed as follows:

Byte	Description
1	Slave device code
2	Diagnostics Function Code, 0x08.
3, 4	Sub-query identifier, 0x00, 0x00.
5…(5+n)-1	Diagnostics query data. (Of length 'n').
(5+n) (5+n)+1	Check sum (CRC) of the Modbus telegram

0x10 Write Multiple Registers

The 'Write Multiple Register' function code is used to write a value in the 'Holding Register' of the device.
The query telegram is designed as follows:

Byte	Description
1	Slave device code
2	Write Multiple Registers Function Code, 0x10.
3, 4	Holding register address. 16-bit value indicating the address of the first holding register to write.
5, 6	Holding register count. 16-bit value indicating the number of holding registers to write
7	Byte count ('n'), number of data bytes in the request.
8…(8+n)-1	Holding register message data. The data to write to the holding registers.
(8+n) (8+n)+1	Check sum (CRC) of the Modbus telegram

The reply telegram to a successfully processed query is designed as follows:

Byte	Description
1	Slave device code
2	Write Multiple Registers Function Code, 0x10.
3, 4	Holding register address. 16-bit value indicating the address of the first holding register.
5, 6	Holding register count. 16-bit value indicating the number of holding registers written.
7, 8	Check sum (CRC) of the Modbus telegram

0x11 Report Slave ID

The 'Report Slave ID' commando is used to uniquely identify the slave device.
The query telegram is designed as follows:

Byte	Description
1	Slave device code
2	Report Slave ID Function Code, 0x11.
3, 4	Check sum (CRC) of the Modbus telegram

The reply telegram to a successfully processed query is designed as follows:

Byte	Description
1	Slave device code
2	Report Slave ID Function Code, 0x11
3	Number of data bytes
4	Manufacturer identification for ABB 0x1A
5	Device code for CoriolisMaster devices, 0xA0
6	Software version, 0x30
7	Hardware version, 0x30
8	Not used, 0x30
9...11	Reserved for future use, 0x30,0x30,0x30
12...33	Device name (Hex) 41,42,42,20,46,45,58,31,30,30,20,57,61,74,65,72,4D,61,73,74,65,72. (ASCII) 'ABB FCx 1xx CoriolisMaster
34...35	Check sum (CRC) of the Modbus telegram

… 8 Commissioning and operation

… Interface description

Modbus error handling (exception codes)

If the recipient of the message determines an error, it sends an appropriate error message back to the Master. Here the function code from query telegram 0x80 is added. An appropriate error code is sent as data. The following error codes are supported:

Error code	Name	Description
0x01	ILLEGAL_FUNCTION	Use of an unsupported function code or the device currently cannot process the query.
0x02	ILLEGAL_DATA_ADDRESS	Invalid register address is used or an attempt has been made to write to a write-protected register address.
0x03	ILLEGAL_DATA_VALUE	Use of unauthorized data values, for example an incorrect number of registers.
0x04	SLAVE_DEVICE_FAILURE	The device currently cannot process the query. Repeat the query later.

The reply telegram with error message is designed as follows:

Byte	Description
1	Slave device code
2	Function code + 0x80
3	Error code (exception code)
4,5	Check sum (CRC) of the Modbus telegram

Application of the Health Indication Registers (Condensed Status Registers))

The CoriolisMaster FCB100, FCH100 has three 'Health indication registers' (Condensed Status Registers). The 'Health indication register 365, 366 and 367 consist of 2 bytes, each containing 8 bits. Each bit represents an error.

The registers are structured as follows:

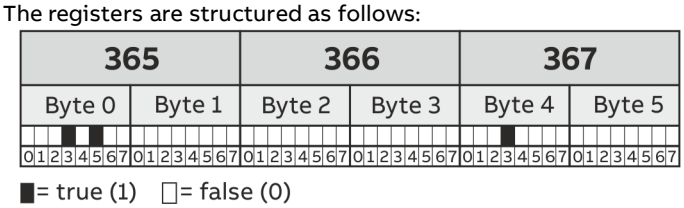


Figure 34: Health indication register (example)

The bit position is assigned to the errors in accordance with the 'Byte / Bit pos.' column in the table in the chapter **Alarm status und alarm history status** on page 95.

The following assignment applies to the example in Figure 34:

Byte / Bit	Fault message
Byte 0 / Bit 3	Flow rate set to 0
Byte 0 / Bit 5	All counters stopped
Byte 4 / Bit 3	Density too low

Using the scan register

The CoriolisMaster FCB100, FCH100 has two 'Scan Register' via which groups of parameters can be requested.
As a result, the parameters do not need to be requested individually and the bus load on the Modbus is reduced.

A scan register consists of a configuration register and the actual scan register.

Configuration register

The Modbus addresses of the parameters are entered in the configuration register. These addresses are to be requested as a group when the scan register is read. The configuration is stored in the transmitter and must only be rewritten in the event of changes. A maximum of 32 Modbus addresses may be stored.

Scan Register

When read out, the Scan Register returns the values of the parameters that were entered in the configuration register.
The scan register has a length of 32 holding registers that must be considered when entering addresses in the configuration register.
For example, a maximum of 32 addresses with a register length of [1] can be requested via the scan register.

Note

If the total register length of the addresses entered in the configuration register exceeds the register length of the scan register, the response will be shortened accordingly when read out.

Restrictions

When using the Scan Registers, observe the following points:

- The scan registers are read only. It is not possible to gain write access to the parameters entered in the configuration register.
- Action Registers cannot be addressed via the Scan Registers, as Action Registers require write access
- String Registers cannot be read out via the Scan Registers, as a String would overwrite the available register length of the Scan Register in most cases.

… 8 Commissioning and operation

… Interface description

Design of the scan register (example)

Content of the configuration register (Config scan register)

Config scan register 1, register range 655 … 686		
Config scan register 2, register range 751 … 782		
Configuration register	**Parameter address**	**Parameter descriptions**
655 / 751	247	Mass flow in the selected mass flow unit (data type float, register length 2)
656 / 752	249	Volume flow in the selected volume unit (data type float, register length 2)
657 / 753	259	Mass flow counter reading in forward flow direction (data type float, register length 2)
658 / 754	263	Volume flow counter reading in forward flow direction (data type float, register length 2)
659 / 755	365	Diagnosis State 0 (data type Usign 16, register length 1)
660 / 756	366	Diagnosis State 1 (data type Usign 16, register length 1)
661 / 757	367	Diagnosis State 2 (data type Usign 16, register length 1)
662 / 758	368	Mass flow unit Qm (data type Usign 8, register length 1)
… / …	FFF	Non-configured register spaces must be filled with FFF.
686 / 782	FFF	

Response following the scan register request

In this example, 12 registers are used in the scan register.

Scan register 1, register range 687 … 718	
Scan register 2, register range 783 … 814	
Configuration register	**Register content**
687 / 783	Mass flow (data type float, register length 2)
688 / 784	
689 / 785	Volume flow (data type float, register length 2)
690 / 786	
691 / 787	Mass flow counter reading in forward flow direction (data type float, register length 2)
692 / 788	
693 / 789	Volume flow counter reading in forward flow direction (data type float, register length 2)
694 / 790	
695 / 791	Diagnosis state 0 (data type Usign 16, register length 1)
696 / 792	Diagnosis state 1 (data type Usign 16, register length 1)
697 / 793	Diagnosis state 2 (data type Usign 16, register length 1)
698 / 794	Mass flow unit Qm (data type Usign 8, register length 1)
… / …	Non-configured register spaces remain unpopulated.
718 / 846	

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
SCFS	144	Standard cubic feet per second
SCFM	145	Standard cubic feet per minute
SCFH	146	Standard cubic feet per hour
SCFD	147	Standard cubic feet per day
MSCFM	149	Thousand standard cubic feet per minute
MSCFH	150	Thousand standard cubic feet per hour
MSCFD	151	Thousand standard cubic feet per day
MMSCFH	154	Thousand standard cubic feet per hour
MMSCFD	155	Million standard cubic feet per day
xx/yy	254	Customer unit (user-defined)

Table 2: Units for the mass flow rate

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	Kilograms 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)

… 8 Commissioning and operation

… Available units

Table 5: Concentration units

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

Table 6: Units for the mass counter

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

Table 7: Units for the volume totalizer

Selection	Code	Description
m^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)
SCF	32	Standard cubic feet
MSCF	33	Thousand standard cubic feet
MMSCF	34	Million standard cubic feet
xx/yy	254	Customer unit (user-defined)

Table 8: Pressure units

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

Table 9: Pulses per flow unit

Selection	Code	Description
1/kg	2	Per kilogram
1/g	3	Per gram
$1/m^3$	4	Per cubic meter
1/t	5	Per metric tonne
$1/ft^3$	7	Per cubic foot
1/lb	8	Per pound
1/ml	11	Per milliliter
1/l	13	Per liter
1/hl	14	Per hectoliter
1/Ml	16	Per megaliter
1/ugal	20	Per gallon (US)
1/igal	21	Per gallon (Imperial)
1/bbl	22	Per barrel (petroleum, USA)
1/Mugal	27	Per megagallon (US)
1/bls	31	Barrels (beer, USA)
1/SCF	32	Per standard cubic feet
1/MSCF	33	Per standard cubic feet
1/MMSCF	34	Per million standard cubic feet
1/xx	238	Per user-defined volume unit
1/yy	239	Per user-defined mass flow unit

Available process variables

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

Note

- Some of the process variables can be assigned to the digital outputs DO1 (terminals 41 / 42) and DO2 (terminals 51 / 52), configured as frequency [f] or pulse output [pulse].
  (Code) indicates to which value the parameters 'Output Value Freq.' and 'Output Value Pulse' must be set. See also chapter **Parameter range - Output** on page 65.
- The 'Modbus address' column indicates the Modbus register address, data type and the register length for the corresponding process variable.

Process variable	Short form	Description	DO1 / 2 [f] (Code)	DO1 / 2 [pulse] (Code)	Modbus address TFLOAT [2]	Modbus address TDOUBLE [4]
Mass Flow [unit]	Qm	Mass flow in the selected mass flow unit	—	X (1)	247	—
Mass Flow [%]	Qm	Mass flow in percent	X (1)	—	267	—
Volume Flow [unit]	Qv	Volume flow in the selected volume unit	—	X (2)	253	—
Volume Flow [%]	Qv	Volume flow in percent	X (2)	—	273	—
Temperature [unit]	Tm	Temperature in the selected volume unit	—	—	251	—
Temperature [%]	Tm	Temperature in percent	X (4)	—	271	—
Density [unit]	p	Density in the selected density unit	—	—	249	—
Density [%]	p	Density in percent	X (3)	—	269	—
Net 1 Mass Flow[unit]*	nQ1	Net mass flow 1 in the selected mass unit	—	X (8)	973	—
Net 1 Mass Flow [%]*	nQ1	Net mass flow 1 in percent	X (8)	—	977	—
Net 1 Vol.Flow [unit]*	nQ1	Net volume flow 1 in the selected volume unit	—	X (9)	979	—
Net 1 Volume Flow [%]*	nQ1	Net volume flow 1 in percent	X (9)	—	983	—
Net 2 Mass Flow[unit]*	nQ2	Net mass flow 2 in the selected mass unit	—	—	3575	—
Net 2 Vol.Flow[unit]*	nQ2	Net volume flow 2 in the selected volume unit	—	—	3577	—
Vol.Flow@Tref[unit]*	Q@T	Volume flow at a reference temperature.	—	X (10)	967	—
Vol.Flow@Tref[%]*	Q@T		X (10)	—	971	—
Density@Tref [unit]*	p@T	Density at a reference temperature.	—	—	963	—
Density@Tref [%]*	p@T		X (5)	—	965	—
Concentr.unit [%]*	β u	Concentration in the selected unit in percent	X (7)	—	987	—
Concentr.unit[unit]*	β u	Concentration in the selected unit	—	—	985	—
Concentr.% [%]*	β %	Concentration in the selected unit	X (6)	—	989	—
Totalizer Qm Fd	∑m+	Mass flow counter reading in the forward flow direction	—	—	259	851
Totalizer Qm Rev	∑m-	Mass flow counter reading in the reverse flow direction	—	—	261	855
Totalizer Qm Diff	∑m	Mass flow counter reading for forward flow / reverse flow difference	—	—	255	859
Totalizer Qv Fwd	∑v+	Volume flow counter reading in forward flow direction	—	—	263	863
Totalizer Qv Rev	∑v-	Volume flow counter reading in reverse flow direction	—	—	265	867
Totalizer Qv Diff	∑v	Volume flow counter reading for forward flow / reverse flow difference	—	—	257	871

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

X Process variable available

— Process variable not available

… 8 Commissioning and operation

… Available process variables

Process variable	Short form	Description	DO1 / 2	DO1 / 2	Modbus address	
			[f]	[pulse]	TFLOAT [2]	TDOUBLE [4]
Total. Net 1 Qm Fwd*	∑1+	Net mass flow counter reading in forward flow direction	—	—	995	887
Total. Net 1 Qm Rev*	∑1-	Net mass flow counter reading in reverse flow direction	—	—	997	891
Total. Net 1 Qm Diff*	∑1	Net mass flow counter reading for forward flow / reverse flow difference	—	—	975	895
Total. Net 1 Qv Fwd*	∑1+	Net volume flow counter reading in forward flow direction	—	—	999	899
Total. Net 1 Qv Rev*	∑1-	Net volume flow counter reading in reverse flow direction	—	—	1001	903
Total. Net 1 Qv Diff*	∑1	Net volume flow counter reading for forward flow / reverse flow difference	—	—	981	907
Total Net 2 Qm Fwd*	∑2+	Counter reading net mass flow 2 in forward flow direction	—	—	3579	831
Total Net 2 Qm Rev*	∑2-	Counter reading net mass flow 2 in return direction	—	—	3581	835
Total Net 2 Qm Diff*	∑2	Counter reading net mass flow 2 forward flow / reverse flow differential	—	—	3583	839
Total Net 2 Qv Fwd*	∑2+	Counter reading net volume flow 2 in forward flow direction.	—	—	3585	843
Total Net 2 Qv Rev*	∑2-	Counter reading net volume flow 2 in return direction.	—	—	3587	847
Total Net 2 Qv Diff*	∑2	Counter reading net volume flow 2 forward flow / reverse flow differential	—	—	3589	851
Total.Qv@Tref Fwd*	∑T+	Volume flow counter reading in forward flow direction at a reference temperature	—	—	991	875
Total.Qv@Tref Rev*	∑T-	Volume flow counter reading in reverse flow direction at a reference temperature	—	—	993	879
Total.Qv@Tref Diff*	∑T	Volume flow counter reading for forward flow / reverse flow difference at a reference temperature	—	—	969	883
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.	—	—	441	911
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.	—	—	443	915

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

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

X = process variable available, — = process variable not available.

Process variable	Short form	Description	DO1 / 2	DO1 / 2	Modbus address	
			[f]	[pulse]	TFLOAT [2]	TDOUBLE [4]
Totalizer Net Qm Sum	∑M+-S	Absolute value counter reading net 1 mass flow in forward flow direction and reverse flow direction. The counter cannot be stopped or reset.	—	—	445	919
Totalizer Net Qv Sum	∑V+-S	Absolute value counter reading net 1 volume flow rate in forward flow direction and reverse flow direction. The counter cannot be stopped or reset.	—	—	447	923
Tot. 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.	—	—	449	927
Current Batch Total**	CBT	Current fill quantity	—	—	847	—
Current Batch Counts**	CBC	Number of fill operations	—	—	465	—
Pipe frequency	PF	Meter tube frequency in Hz	—	—	275	—
Driver Output [mA]	DOC	Driver current in mA	—	—	291	—
Sensor Signal A	SSA	Sensor amplitude of sensor A in mV	—	—	283	—
Sensor Signal B	SSB	Sensor amplitude of sensor B in mV	—	—	285	—
Specific Gravity	SG	Specific weight for liquids	—	—	431	—
API Gravity	API	API level	—	—	433	—

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

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

X = process variable available, — = process variable not available.

… 8 Commissioning and operation

Parameter descriptions

Parameter range – Device info

The parameterization of the device can be read out via the Modbus addresses listed here.
All Modbus addresses specified here are read only.

Modbus register address	Parameter name	Data type [register length] / value range	Description
… / …Sensor			
1	Sensor Type	**TUSIGN8 [1]** 0: Simulator 1: FCB 2: FCH	Sensor type.
2	Meter Size	**TUSIGN8 [1]** 1: DN15 - ½ in 2: DN25 - 1 in 3: DN50 - 2 in 4: DN15 - ½ in 5: DN25 - 1 in 6: DN50 - 2 in 7: DN80 - 3 in 8: DN100 - 4 in 9: DN150 - 6 in	Nominal diameter of sensor.
3	Feature Series	**TUSIGN8 [1]** 1: Series 130 3: Series 150	Sensor model. The DensiMass and FillMass functions are only available in model FCB150 / FCH150.
165	Qm Max DN	**TFLOAT [2]**	Maximum mass flow for the selected nominal diameter. The value is set automatically via the selected nominal diameter.
407	Span Forward	**TFLOAT [2]**	Calibration value (span) in forward flow direction of the sensor.
415	Span Reverse	**TFLOAT [2]**	Correction value for 'Span Forward' (span) in reverse flow direction of the sensor. Is needed for increased accuracy.
417	Zero Sensor	**TFLOAT [2]**	Calibration value (zero point) of the sensor for the selected nominal diameter.
159	Freq.@ Empty Pipe	**TFLOAT [2]**	Meter tube frequency and density during calibration with empty meter tube. The calibration is usually performed with air as a measuring medium.
153	Density @ Empty Pipe	**TFLOAT [2]**	
161	Freq.@ Full Pipe	**TFLOAT [2]**	Meter tube frequency and density during calibration with full meter tube. The calibration is usually performed using water as a measuring medium.
155	Density @ Full Pipe	**TFLOAT [2]**	
3553	Calibration Pressure	**TFLOAT [2]**	Measuring medium pressure in the selected pressure unit during calibration.
3555	Calibration Temp.	**TFLOAT [2]**	Measuring medium temperature in °C during calibration.
451	Sensor ID	**TUSIGN32 [2]**	ID number of the sensor.
1003	Sensor Serial No.	**TCHAR [20]**	Serial number of the sensor.
455	Sensor Run Hours	**TUSIGN32 [2]**	Operating hours of the sensor.
… / …Sensor / …Calibration			
571	First Cal. Date	**TUSIGN8 [3]**	Date of first calibration of sensor (calibration of new device).
574	Last Cal. Date	**TUSIGN8 [3]**	Date of last calibration of sensor.
1029	Cal. Cert. No.	**TCHAR [20]**	Identification (number) of the relevant calibration certificate.
1049	First Cal. Location	**TCHAR [20]**	Place of first calibration of the sensor.
1069	Last Cal. Location	**TCHAR [20]**	Place of last calibration of sensor.

Modbus register address	Parameter name	Data type [register length] / value range	Description
... / ...Transmitter			
4	Transmitter Type	**TUSIGN8 [1]** 4: FCT100 10: Error	Display of the transmitter type.
453	Transmitter ID	**TUSIGN32 [2]**	ID number of transmitter.
1089	Transm.Serial No.	**TCHAR [20]**	Order number of the transmitter.
1564	All Parameters	**TCHAR [10]**	CRC 16 checksum of all device parameters
1574	Custom Parameters	**TCHAR [10]**	CRC 16 checksum of all customer parameters
1584	SIL Saftey Parameter	**TCHAR [10]**	CRC 16 checksum of all SIL-relevant safety parameters
457	Transm. Run Hours	**TUSIGN32 [2]**	Operating hours of the transmitter (frontend board).
364	Tx Restart Counter	**TUSIGN16 [1]**	Number of device restarts (switching the power supply off and on).
467	Time since Restart	**TUSIGN32 [2]**	Device operating hours since the last restart.
6	DensiMass On/Off	**TUSIGN8 [1]** 0: Off 1: A	DensiMass function present? Off: No DensiMass function present. On: DensiMass function present.
7	FillMass On/Off	**TUSIGN8 [1]** 0: Off 1: A	FillMass function present? Off: No FillMass function present. On: FillMass function present.
92	VeriMass On/Off	**TUSIGN8 [1]** 0: Off 1: A	VeriMass function present? Off: No VeriMass function present. On: VeriMass function present.
3157	CoriolisContr.On/Off	**TUSIGN8 [1]** 0: Off 1: A	CoriolisControl (ECC) function present? Off: No CoriolisControl (ECC)-function available. On: CoriolisControl (ECC)-function available.
1195	Manufacturer	**TUSIGN8 [20]**	Name of manufacturer.
1215	Street	**TUSIGN8 [20]**	Manufacturer's address (street)
1235	City	**TUSIGN8 [20]**	Manufacturer's address (city)
1255	Phone	**TUSIGN8 [20]**	Manufacturer's address (phone number)
... / ...Transmitter / ...Transmitter Version			
8	FW Frontend Ver.	**CONST_U8 [3]**	Firmware version of the transmitter (frontend board).
363	FW Frontend CRC	**TUSIGN16 [1]**	The checksum (CRC) of the firmware version of the transmitter (frontend board).
1109	HW Frontend Ver.	**TUSIGN8 [20]**	Hardware version of the transmitter (frontend board).
11	Bootloader FEB Ver.	**CONST_U8 [3]**	Firmware version of the bootloader of the transmitter (frontend board).
... / ...Transmitter / ...Calibration			
577	First Cal. Date	**TUSIGN8 [3]**	Date of first calibration of transmitter (calibration of new device).
580	Last Cal. Date	**TUSIGN8 [3]**	Date of last calibration of transmitter.
1135	Cal. Cert. No.	**TCHAR [20]**	Identification (no.) of the relevant calibration certificate.
1155	First Cal. Location	**TCHAR [20]**	Place of first calibration of transmitter.
1175	Last Cal. Location	**TCHAR [20]**	Place of last calibration of transmitter.

… 8 Commissioning and operation

… Parameter descriptions

Parameter range - config. Device

Modbus register address	Parameter name	Data type [register length] / value range	Description
… / …Access Control			
5	Read Only Switch	**TUSIGN8 [1]** 0: Off 1: A	Indicator of the position of the write protection switch. See also chapter **Write-protect switch** on page 35. This parameter is read only.
… / …Sensor			
15	Range Mode Config	**TUSIGN8 [1]** 0: Deactivated 1: Qm and Qv 2: Qm only 3: Only Qv	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). This means that it is possible to switch quickly between two measuring ranges (e. g. Qm Max and Qm Max2). The switchover is performed via the parameters "Qm Range Mode" and "Qv Range Mode".
165	Qm Max DN	**TFLOAT [2]**	Maximum mass flow for the selected nominal diameter. The value is set automatically via the selected nominal diameter. This parameter is read only.
167	Qm Max	**TFLOAT [2]** 2.0 to 0.01 QmMaxDN	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.
169	Qm Max 2	**TFLOAT [2]** 2.0 to 0.01 QmMaxDN	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.
18	Qm Range Mode	**TUSIGN8 [1]** 0: QmMax 1: QmMax2	Manual switchover between the measuring ranges Qm Max and Qm Max 2.
171	Qv Max DN	**TFLOAT [2]**	Maximum volume flow. The value indicates the calculated maximum volume flow depending on the parameters ‘Qm MaxDN’ and ‘DensityMin’. This parameter is read only.
173	Qv Max	**TFLOAT [2]** 0.01 to 2.0 Qv MaxDN	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.
175	Qv Max 2	**TFLOAT [2]** 0.01 to 2.0 Qv MaxDN	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.
19	Qv Range Mode	**TUSIGN8 [1]** 0: QvMax 1: QvMax2	Manual switchover between the measuring ranges Qv Max and Qv Max 2.
177	Density Max	**TFLOAT [2]** (Density Min + 0.01) to 3.5 g/cm³	Setting the minimum and maximum density of the measuring medium. The values are also used to calculate the corresponding percentage value.
179	Density Min	**TFLOAT [2]** 0.00 g/cm³ to (Density Max − 0.01)	

Modbus register address	Parameter name	Data type [register length] / value range	Description
... / ...Sensor			
181	Temperature Max	**TFLOAT [2]** (Temperature Min + 10 °C) to 205 °C	Setting the minimum and maximum temperature of the measuring medium. The values are also used to calculate the corresponding percentage value.
183	Temperature Min	**TFLOAT [2]** −50°C to (Temperature Max −10 °C)	
203	Net1 Qm Max	**TFLOAT [2]** 0.01 to 2.0 Qv_{Max}DN	Setting of the minimum and maximum net 1 mass flow. The values are also used to calculate the corresponding percentage value. The parameters are only available when the DensiMass function is activated.
205	Net1 Qv Max	**TFLOAT [2]** 0.01 to 2.0 Qv_{Max}DN	
207	Concentration Max	**TFLOAT [2]**	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.
209	Concentration Min	**TFLOAT [2]**	
185	Density Max at Tref	**TFLOAT [2]** (Density at Tref Min + 0.01 g/cm³) to 3.5 g/cm³	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.
187	Density at Tref Min	**TFLOAT [2]** 0.00 g/cm³ to (Density Max at Tref − 0.01 g/cm³)	
191	Qv at Tref Max	**TFLOAT [2]** 0.01 to 2.0 Qv_{Max}DN	Sets the maximum volume flow of the measuring medium at the reference temperature T_{ref}. The values are also used to calculate the corresponding percentage value. The parameter is only available when the DensiMass function is activated.
1315	Etichetta loc.sens.	**TUSIGN8 [20]** Alphanumeric, maximum 20 characters	Enter the measuring point tagging for the sensor.
1335	Sensor Tag	**TUSIGN8 [20]** Alphanumeric, maximum 20 characters	Enter the TAG number for the measuring sensor.
... / ...Sensor / ...Operating Mode			
17	Flow Direction	**TUSIGN8 [1]** 0: Forward flow direction / reverse flow direction 1: Only forward flow direction 2: Only return 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.
16	Flow Indication	**TUSIGN8 [1]** 0: Normal 1: Inverted	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.

… 8 Commissioning and operation

… Parameter descriptions

Modbus register address	Parameter name	Data type [register length] / value range	Description
… / …Transmitter			
189	Damping Qm	**TFLOAT [2]** 0.04 to 300 s (1 Tau)	Setting of the damping for the mass flow (the value relates to 1 T (Tau)). The value relates to a stepwise change of the mass flow rate. The setting of 0.04 s deactivates the damping.
193	Damping Density	**TFLOAT [2]** 0.04 to 300 s (1 Tau)	Setting of the damping for the density (the value relates to 1 T (Tau)). The value relates to a stepwise change of the density. The setting of 0.04 s deactivates the damping.
14	Density Mode	**TUSIGN8 [1]** 0: Fixed density value 1: Measured density	Select whether the measured density or a fixed default density is used. Use the fixed default density for example if the density measurement is not needed or for gaseous measuring media.
3164	SG Specific Gravity	**TUSIGN8 [1]** 0: Water 60 °F with API (15.56 °C) 1: Water 68 °C (20 °F): 2: Water 39.164 °C (4 °F) 3: Gas 68 °F (20 °C)	Selection of the reference density for SG specific density For the output of the API density '0 - water 60°F with API (15.56°C)' must be used. This is also the default setting
157	Density Fixed Value	**TFLOAT [2]** 0.01 to 3.5 g/cm³	Enter the fixed default density of the measuring medium. The value is also used to calculate the volume flow. When entering a reference density, this parameter is used to calculate the reference volume. This is particularly common for gas measurements. The parameter is available only if the parameter 'Density Mode' has been set to '0: Fixed density value'.
1275	TX Location TAG	**TUSIGN8 [20]** Alphanumeric, maximum 20 characters	Enter the measuring point tagging for the transmitter.
1295	TX TAG	**TUSIGN8 [20]** Alphanumeric, maximum 20 characters	Enter the TAG number for the transmitter.
122	Device Restart	**ACTION [1]**	Restarts the device. Compensates for a short interruption of the power supply.
91	Restore Settings	**ACTION [1]**	All user-accessible parameters will be reset to the factory default settings.
3557	Delayed Dev. Restart	**TFLOAT [2]** 0 to 30 s	Restart the device after the entered time has elapsed.

Modbus register address	Parameter name	Data type [register length] / value range	Description
... / ...Transmitter / ...Units			
47	Unit Massflow Qm	**TUSIGN8 [1]** Refer to **Table 2: Units for the mass flow rate** on page 49.	Selection of the unit for the mass flow (for example for the parameters QmMax / QmMaxDN and for the corresponding process value).
53	Unit Mass Totalizer	**TUSIGN8 [1]** Refer to **Table 6: Units for the mass counter** on page 50.	Selection of the unit for the mass counters and the pulse outputs.
50	Unit Volumeflow Qv	**TUSIGN8 [1]** Refer to **Table 1: Units for the volume flow rate** on page 49.	Selection of the unit for the volume flow (for example for the parameters QvMax / QvMaxDN and for the corresponding process value).
54	Unit Vol. Totalizer	**TUSIGN8 [1]** Refer to **Table 7: Units for the volume totalizer** on page 50.	Selection of the unit for the volume totalizers and the pulse outputs.
48	Unit Density	**TUSIGN8 [1]** Refer to **Table 3: Density units** on page 49.	Selection of the unit for density (for example for the associated parameters and the corresponding process values).
49	Unit Temperature	**TUSIGN8 [1]** Refer to **Table 4: Temperature units** on page 49.	Selection of the unit for the temperature (for example for the associated parameters and the corresponding process values).
52	Concentration	**TUSIGN8 [1]** Refer to **Table 5: Concentration units** on page 50.	Selection of the unit for the concentration (for example for the associated parameters and the corresponding process value).
1500	Mass flow Qm Name	**TCHAR [8]** Alphanumeric, maximum 7 characters	Sets the name or the abbreviation for the user-defined unit Qm.
239	Mass flow Qm Factor	**TFLOAT [2]** 0.0001 to 100000 kg/s	Sets the factor in kg/seconds for the user-defined unit Qm.
1532	Mass Tot. Name	**TCHAR [8]** Alphanumeric, maximum 7 characters	Sets the name or abbreviation of the unit for the user-defined mass counter.
423	Mass Tot. Factor	**TFLOAT [2]** 0.0001 to 100000 kg	Sets the factor of the unit for the user-defined mass counter.
1508	Volumeflow Qv Name	**TCHAR [8]** Alphanumeric, maximum 7 characters	Sets the name or abbreviation for the user-defined unit Qv.
245	Volumeflow Qv Factor	**TFLOAT [2]** 0.0001 to 100000 l/s	Sets the factor in liters/seconds for the user-defined unit Qv.
1540	Volume Tot. Name	**TCHAR [8]** Alphanumeric, maximum 7 characters	Sets the name or abbreviation of the unit for the user-defined volume totalizer.
425	Volume Tot. Factor	**TFLOAT [2]** 0.0001 to 100000 l	Sets the factor of the unit for the user-defined mass counter.
1516	Density Name	**TCHAR [8]** Alphanumeric, maximum 7 characters	Sets the name or abbreviation for the user-defined density unit.
241	Density Factor	**TFLOAT [2]** 0.0001 to 100000 g/ml	Sets the factor in g/ml for the user-defined density unit.

… 8 Commissioning and operation

… Parameter descriptions

Modbus register address	Parameter name	Data type [register length] / value range	Description
… / …Transmitter / …Cut Off			
195	Low Flow Cut Off	**TFLOAT [2]** 0.0 to 10 %	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 %
649	Low Flow Cut Off Qm	**TFLOAT [2]**	Indication of the low flow in the selected mass flow unit
651	Low Flow Cut Off Qv	**TFLOAT [2]**	Indication of the low flow in the selected volume flow unit
197	Low Flow Hysteresis	**TFLOAT [2]** 0.0 to 50 %	Sets the hysteresis for the low flow cut-off as it is defined in the parameter ‘Low Flow Cut Off’. Factory setting: 20 %
149	Density Cut Off	**TFLOAT [2]** 0.0005 to 0.5 g/cm³	Sets the low flow for density. Factory setting: 0.2 g/cm³
… / …Transmitter / …Feature Settings			
6	DensiMass On/Off	**TUSIGN8 [1]** 0: Off 1: A	DensiMass function active?* 0: Off: DensiMass function disabled. 1: On: DensiMass function activated. This parameter is read only.
361	DensiMass Code	**TUSIGN16 [1]** 0x0000 to 0xFFFF	Sets the device-specific code for activating the DensiMass function. After entering the code, restart the device (for example using the parameter ‘Device Restart’, see page 58, or by briefly switching off the power supply).
7	FillMass On/Off	**TUSIGN8 [1]** 0: Off 1: A	FillMass function active?* 0: Off: FillMass function deactivated. 1: On: FillMass function activated. This parameter is read only.
362	FillMass Code	**TUSIGN16 [1]** 0x0000 to 0xFFFF	Sets the device-specific code for activating the FillMass function. After entering the code, restart the device (for example using the parameter ‘Device Restart’, see page 58, or by briefly switching off the power supply).
92	VeriMass On/Off	**TUSIGN8 [1]** 0: Off 1: A	VeriMass function active?* 0: Off: VeriMass function deactivated. 1: On: VeriMass function activated. This parameter is read only.
368	VeriMass Code	**TUSIGN16 [1]** 0x0000 to 0xFFFF	Sets the device-specific code for activating the VeriMass function. After entering the code, restart the device (for example using the parameter ‘Device Restart’, see page 58, or by briefly switching off the power supply).
375	CoriolisContr.On/Off	**TUSIGN8 [1]** 0: Off 1: A	CoriolisControl (ECC) function active?* 0: Off: CoriolisControl (ECC) function disabled. 1: On: CoriolisControl (ECC) function activated. This parameter is read only.
3157	CoriolisControl Code	**TUSIGN16 [1]** 0x0000 to 0xFFFF	Set the device-specific code to activate the CoriolisControl (ECC) function. After entering the code, restart the device (for example using the parameter ‘Device Restart’, see page 58, or by briefly switching off the power supply).

* To use this function later on, contact the ABB service team or sales organization.

Modbus register address	Parameter name	Data type [register length] / value range	Description
... / System Zero			
227	Manual	**TFLOAT [2]** -10 to 10 % from Q_{max}DN	Sets the value for zero point adjustment in % of Q_{max}DN
100, 76, 77, 229, 231, 233, 235	Auto Adjust	**ACTION [1] (100)** **TUSIGN8 (76, 77)** **TFLOAT [2] (229, 231, 233, 235)**	Start of automatic zero point adjustment for the mass and volume flow. Adjustment lasts approx. 60 seconds. • Zero point adjustment is started via the address 100 (data type ACTION). • The progress counter (100 = adjustment complete) of zero point adjustment can be queried via the address 76 (data type TUSIGN8). • The status of adjustment is transmitted (0 = No error, 15 = Error in adjustment) via the address 77. • The values determined by the device during automatic zero point adjustment can be queried via the addresses 229 (mean value), 231 (standard deviation), 233 (max), 235 (min). The data type in each case is TFLOAT [2].
... / ...Concentration	These parameters are only available when the DensiMass function is activated.		
74	Medium	**TUSIGN8 [1]** 0: Variable matrix 1: Sodium hydroxide 2: Alcohol in water 3: Wheat starch 4: Corn starch 5: Sugar in water	Selection of the matrix for calculating concentration. For more detailed information, see chapter **Concentration measurement DensiMass** on page 86.
75	Sub Matrix Selection	**TUSIGN8 [1]** 0: Sub matrix 1 1: Sub matrix 2	Selection of the sub matrix for the DensiMass function.
331	Reference Temp.	**TFLOAT [2]** −100 to 250 °C	Sets the reference temperature for calculating the process values 'Qv @ Tref' and 'Density @ Tref'.
... / ...Field Optimization			
151	Density Correction	**TFLOAT [2]** −500 to 500 g/l	Sets the correction factor for field optimization of the density measurement. To optimize the accuracy in the flow measurement in the field, that approaches or even exceeds at least 0.1% of the measured value, this correction value can be used.
279	Qm Correction	**TFLOAT [2]** −20 to 20%	Sets the correction factor for field optimization of the mass flow measurement. Entry of a correction factor (meter – factor): Qm Correction = reference value / measured value – reference value: The benchmark, e.g. a scale or a value from a different measuring device) – measured value: The value measured by the flowmeter. **Example:** Reference value = 100 kg as well as Coriolis measured value = 99 kg Qm Correction: 100 kg / 99 kg = 1,01

… 8 Commissioning and operation

… Parameter descriptions

Modbus register address	Parameter name	Data type / value range	Description
327	Conc. Zero Matrix 1	**TFLOAT [2]**	Setting indicating the correction factor for concentration measurement.
329	Conc. Zero Matrix 2	–1000 to 1000	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.
… / …Field Optimization / …Hold Last Good Val.			
335	Hold Time	**TFLOAT [2]** 0.0 to 600.0 sec	Entry of the time for the function ‘Keep last valid measured value’. The function is deactivated by the setting of ‘0’.
337	Threshold Release	**TFLOAT [2]** Threshold Hold to 100mV	Sets the switching threshold for the function ‘Keep last valid measured value’. The current measured value is displayed if the sensor voltage is above the set value.
339	Threshold Hold	**TFLOAT [2]** 2.0mV to Threshold Release	Sets the switching threshold for the function ‘Keep last valid measured 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.

Modbus register address	Parameter name	Data type / value range	Description
... / ...Field Optimization / ...Pressure Correction			
51	Pressure Unit	**TUSIGN 8 [1]** Refer to **Table 8: Pressure units** on page 50.	Selection of the unit for the pressure (for example for the associated parameters and the corresponding process values). Factory setting: bar
333	Pressure Level	**TFLOAT [2]** 0.0 to 1000.0 [pressure unit].	Input of the process pressure of the medium in the meter tube. ABB uses a special compensation algorithm that takes various influencing effects into account. This allows the pressure influence on the vibrations of the meter tube to be compensated. The compensation factors for mass and density measurement are continuously recalculated and updated.
3549	Flow Compens. factor	**TFLOAT [2]**	Output of the current flow compensation factor used in the device to calculate the mass flow. Unit in % per selected pressure unit.
3551	Density Comp. factor	**TFLOAT [2]**	Output of the current density compensation factor that will be used in the device to calculate mass flow. Unit in % per selected pressure unit.
3162	P.Comp.Status (PECI)	**TUSIGN 8 [1]** 1: CT (On) 2: TD (Off) 3: OS (Off) 4: N/A (Off)	Selection of the pressure compensation mode. According to the API, the following states can be set. • 1: CT - compensation in the Coriolis flowmeter based on the actual pressure entered in the parameter 'Pressure Level' • 2: TD – compensation in the Coriolis flowmeter switched off – compensation is performed externally (tertiary device) • 3: OS - Compensation in the Coriolis flowmeter switched off – compensation is not performed on site (off site) • 4: NA – Compensation in the Coriolis flowmeter switched off – compensation is not considered necessary as the device operates at the pressure at which it was tested (proved).
3163	Unit	**TUSIGN 8 [1]** 101: %/Pa 104: %/kPa 108: %/bar 109: %/mbar 165: %/psi	Output of the current unit of the flow and density compensation factor. Subject to the pressure unit set.

… 8 Commissioning and operation

… Parameter descriptions

Modbus register address	Parameter name	Data type / value range	Description
… / …Field Optimization / …CoriolisControl			
3158	ECC Mode	**TUSIGN 8 [1]** 0: Off 1: On	Activating the 'CoriolisControl (ECC)' function for applications with quick density changes, for example in the case of gas bubbles in the measuring medium and for filling applications.
3159	ECC Level	**TUSIGN 8 [1]** 0: Low 1: Medium 2: High	Selection of interval for frequency estimation
3160	Flow Noise Reduction	**TUSIGN 8 [1]** 0: Off 1: Filter 1 (0.5 s) 2: Filter 2 (1.0 s) 3: Filter 3 (2.0 s) 4: Filter 4 (4.0 s) 5: Filter 5 (8.0 s)	Selection of the dead time for the noise filter for mass measurement.
3161	Density Noise Reduc.	**TUSIGN 8 [1]** 0: Off 1: Filter 1 (0.5 s) 2: Filter 2 (1.0 s) 3: Filter 3 (2.0 s) 4: Filter 4 (4.0 s) 5: Filter 5 (8.0 s)	Selection of the dead time for the noise filter for density measurement.

Parameter range - Output

Modbus register address	Parameter name	Data type [register length] / value range	Description
... / ...Dig.Out 41/42			
20	Mode	**TUSIGN8 [1]** 0: Off 1: Binary 2: Pulse 3: Frequency	Selection of the operating mode for the digital output 41 / 42. • Off: Digital output deactivated. • Binary: Digital output functions as binary output (for function, see the parameter 'Logic Output Action'). • Pulse: Digital output functions as pulse output (for process value, see the parameter 'Output Value Pulse'). In pulse mode, pulses per unit are output (e.g. 1 pulse per m^3). • Frequency: Digital output functions as frequency output (for process value see the parameter 'Output Value Freq..'). In frequency mode, a frequency proportional to the flow rate is given as output. The maximum frequency can be configured in accordance with the upper range value.
21	Outp. Flow Direction	**TUSIGN8 [1]** 0: Forward flow / reverse flow. 1: Forward flow 2: Reverse flow	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. • When '0' is selected, pulses are given in the forward flow and reverse flow directions. • When '1' is selected, pulses are given in the forward flow direction. • When '2' is selected, pulses are given in the reverse flow direction.

… 8 Commissioning and operation

… Parameter descriptions

Modbus register address	Parameter name	Data type [register length] / value range	Description
… / …Dig.Out 41/42 …	**Setup Pulse Output**		The following parameters are only available if the digital output 41 / 42 has been configured as a pulse output. The pulse output can be classically configured via the pulse value ('Pulses per Unit' parameter), alternatively you can also enter the pulse frequency at 100 % flow rate ('Frequency @ Qmax' parameter).
22	Output Value Pulse	**TUSIGN8 [1]** Refer to **Available process variables** on page 51.	Selection of the process value issued via the pulse output.
321	Pulses per Unit	**TFLOAT [2]** 0.001 to 100,000 pulses	Setting and output of pulses per mass flow unit and per pulse width for the pulse output.
323	Pulse Width	**TFLOAT [2]** 0.05 to 2000 ms	**Note** The pulse value and the pulse width are dependent on each other and on the limit frequency of the digital output and are calculated dynamically. The 'Frequency @ Qmax' parameter is also adjusted in the process.
3531	Frequency @ Qmax	**TFLOAT[2]**	Setting and output of the pulse frequency in pulses/s at 100 % flow rate (mass or volume flow) for the current configuration of the device. **Note** The value can be changed within the 'Max Range / Min Range' limits. The 'Pulses per Unit' parameter is also adjusted in the process.
3533	Max Range	**TFLOAT[2]** xx to xx	Output of the limits for the parameter 'Frequency @ Qmax'. The 'Frequency @ Qmax' parameter can be set within these limits. The limits are calculated dynamically.
3535	Min Range	**TFLOAT[2]** xx to xx	
3154	Active Mode	**TUSIGN8 [1]** 0: Active high (closed) 1: Active low (open)	Select switching properties for the pulse output.

Modbus register address	Parameter name	Data type [register length] / value range	Description
... / ...Dig.Out 41/42 / ...Setup Freq Output			The following parameters are only available if the digital output 41 / 42 has been configured as a frequency output. The frequency output can be classically configured via the frequency for 100 % flow rate ('Upper Frequency' parameter), alternatively you can also enter the pulse value at 100 % flow rate ('Pulses per Unit' parameter).
23	Output Value Freq.	**TUSIGN8 [1]** Refer to **Available process variables** on page 51.	Selection of the process value issued via the frequency output.
325	Upper Frequency	**TFLOAT** 0.25 to 10500 Hz	Set and output the frequency for the upper range value. The entered value corresponds to 100 % flow.
3537	Pulses per Unit	**TFLOAT[2]**	Set and output the pulse per flow unit. The value (in 1/unit) will be dynamically calculated from the 'Upper Frequency' parameter, the mass or volume flow rate and Q_{max}. **Note** • The value can be changed within the 'Max Range / Min Range' limits. The 'Upper Frequency' parameter is also automatically adjusted in the process. • The parameter is available only for the following process variables: Mass Flow [%], Volume Flow [%], Net1 Mass Flow [%], Net1 Vol. Flow [%], Vol. Flow @ Tref [%]
3156	Unit	**TUSIGN8 [1]** Refer to **Table 9: Pulses per flow unit** on page 50.	Output of the unit for the parameter 'Pulses per Unit'. The unit depends on the selected flow unit and the selected process variable for the frequency output. **Example:** Process variable 'Output Value Freq.' = Volume Flow [%] 'Unit' = '1/Ml (1 pulse per megaliter)' Output to the frequency output in the made with 1 pulse per megaliter.
3533	Max Range	**TFLOAT[2]** xx to xx	Output of the limits for the parameter 'Pulses per Unit'. The 'Pulses per Unit' parameter can be set within these limits. The limits are calculated dynamically.
3535	Min Range	**TFLOAT[2]** xx to xx	

… 8 Commissioning and operation

… Parameter descriptions

Modbus register address	Parameter name	Data type [register length] / value range	Description
… / …Dig.Out 41/42 / …Setup Logic Output			The following parameters are only available if the digital output 41 / 42 has been configured as a binary output.
24	Logic Output Action	**TUSIGN8 [1]** 0: Off 1: F/R signal 2: Alarm signal 3: Two measuring ranges 4: End contact fill function 5: Concentration matrix selection	Selection of binary output function. • F/R signal: the binary output signals the flow direction. • Alarm signal: the binary output functions as an alarm output. The alarm type is selected with the parameters '…Alarm Config'. • Two measuring ranges: 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. • End contact fill function: the binary output is activated when the set fill quantity is reached (only if the FillMass function is activated). • Concentration matrix selection: the binary output signals the selected concentration matrix (only with the DensiMass function activated and if the variable matrix has been selected).
25	Active Mode	**TUSIGN8 [1]** 0: Active high (closed) 1: Active low (open)	Select switching properties for the binary output.
26	Actual Value	**TUSIGN8 [1]** 0: Output low 1: Output high	Display of the current output status. The parameter is read only.
… / …Dig.Out 41/42 / …Alarm Config			
27	General Alarm	**TUSIGN8 [1]** 0: Off 1: On	Selection of error messages signaled via the binary output 41 / 42. Only if the parameter 'Logic Output Action' has been set to 2 - Alarm signal.
28	Qm Massflow Max		
29	Qm Massflow Min		
3078	Density Max		
3079	Density Min		
30	Density Low Check		
31	Sensor Signal Min		
32	Driver Output Max		

Modbus register address	Parameter name	Data type [register length] / value range	Description
... / ...Dig.Out 51/52			
55	Mode	**TUSIGN8 [1]** 0: Off 1: Binary 2: Frequency 4: Follow DO1 5: 90° phase rotation 6: 180° phase rotation 7: Follow DO 41/42 (frequency) 8: 180° phase rotation (frequency)	Selection of the operating mode for the digital output 51 / 52. The operating modes 'Follow DO1', '90°' and '180°' are only available if digital output 41 / 42 has been configured as a pulse output. • Off: Digital output deactivated. • Binary: Digital output functions as binary output (for function, see the parameter 'Logic Output Action'). • Frequency: Digital output functions as frequency output (for process value see the parameter 'Output Value Freq..'). In frequency mode, a frequency proportional to the flow rate is given as output. The maximum frequency can be configured in accordance with the upper range value. • Follow DO1: The digital output 51 / 52 follows digital output 41 / 42. Digital output 51 / 52 then also functions as a pulse output, the settings from '... / ...Dig.Out 41/42 / ...Setup Logic Output' are adopted. The output of pulses on digital output 51 / 52 depends on the setting of the register 'Outp. Flow Direction' for digital output 41 / 42: – If 'Forward & Reverse' is selected, digital output 51 / 52 follows digital output 41 / 42. • If 'Forward' is selected, pulses for forward flow are issued at digital output 41 / 42 and pulses for reverse flow are issued at digital output 51 / 52. – If 'Reverse' is selected, pulses for reverse flow are issued at digital output 41 / 42 and pulses for forward flow are issued at digital output 51 / 52. • 90° phase rotation: 90° phase rotation of output of the same pulses as for digital output 41 / 42. • 180° phase rotation: 180° phase rotation of output of the same pulses as for digital output 41 / 42. • Follow DO 41/42 (frequency): The digital output 51 / 52 follows digital output 41 / 42. Digital output 51 / 52 then also functions as a frequency output, the settings from '... / Dig.Out 41 / 42 / ...Setup Freq Output' are adopted. The output of frequency at digital output 51 / 52 depends on the setting of the 'Outp. Flow Direction' register for digital output 41 / 42: – If 'Forward' is selected, the frequency for forward flow is issued at digital output 41 / 42 and the frequency for reverse flow at digital output 51 / 52. – If 'Reverse' is selected, a frequency for reverse flow is issued at digital output 41 / 42 and a frequency for forward flow is issued at digital output 51 / 52. • 180° phase rotation (frequency): 180° phase rotation of output of the same pulses as for digital output 41 / 42. **Note** If digital output 41/42 has been configured as pulse or frequency output, digital output 51/52 can be separately configured as a binary or frequency output. Yet digital output 51 / 52 cannot be configured as a second independent pulse output.

… 8 Commissioning and operation

… Parameter descriptions

Modbus register address	Parameter name	Data type [register length] / value range	Description
… / …Dig.Out 51/52			
56	Outp. Flow Direction	**TUSIGN8 [1]** 0: Forward flow / reverse flow. 1: Forward flow 2: Reverse flow	Selection of flow direction in which the frequency output 51/52 issues the selected process value. The parameter is only available if digital output 51/52 has been configured as a frequency output. • When '0' is selected, a frequency is given in the forward flow and reverse flow directions. • When '1' is selected, a frequency is given in the forward flow direction. • When '2' is selected, a frequency is given in the reverse flow direction.
… / …Dig.Out 51/52 / …Setup Freq Output			The following parameters are only available if the digital output 51 / 52 has been configured as a frequency output.
23	Output Value Freq.	**TUSIGN8 [1]** Refer to **Available process variables** on page 51.	See description of digital output 41 / 42.
325	Upper Frequency	**TFLOAT** 0.25 to 10500 Hz	
3537	Pulses per Unit	**TFLOAT[2]**	
3156	Unit	**TUSIGN8 [1]** Refer to **Table 9: Pulses per flow unit** on page 50.	
3533	Max Range	**TFLOAT[2]** xx to xx	
3535	Min Range	**TFLOAT[2]** xx to xx	
… / …Dig.Out 51/52 / …Setup Logic Output			The following parameters are only available if the digital output 51 / 52 has been configured as a binary output.
57	Logic Output Action	**TUSIGN8 [1]**	See description of digital output 41 / 42.
58	Active Mode	**TUSIGN8 [1]**	
59	Actual Value	**TUSIGN8 [1]**	
… / …Dig.Out 51/52 / …Alarm Config			
60	General Alarm	**TUSIGN8 [1]** 0: Off 1: On	Selection of error messages signaled via the binary output 51 / 52. Only if the parameter 'Logic Output Action' has been set to 2 - Alarm signal.
61	Qm Massflow Max		
62	Qm Massflow Min		
3081	Density Max		
3080	Density Min		
63	Density Too Low		
64	Sensor Signal Min		
65	Driver Output Max		

Parameter range – Process alarm

Modbus register address	Parameter name	Data type [register length] / value range	Description
2048 to 2095	Diagnostic History	**TUSIGN8 [1]**	Display of the alarm history. See also chapter **Alarm status und alarm history status** on page 95. The addresses indicated here are read only.
120	Clear Alarm History	**ACTION [1]**	The writing of any value deletes the alarm history saved in the device.
... / ...Group Masking			
66	Maintenance Required	**TUSIGN8 [1]** 0 - Masking deactivated 1 - Masking activated	Alarm messages are divided into groups. If masking is activated for a group (On), no alarm occurs. For more detailed information, see chapter **Diagnosis / error messages** on page 92.
67	Function Check		
68	Out Of Specification		
... / ...Alarm Limits			
211	Qm Massflow Min	**TFLOAT [2]** 0 to 130 %	Setting of the alarm limits for the mass flow. If the standard volume flow up-scales or down-scales the values set in the parameters 'Qm Massflow Min' and 'Qm Massflow Max,' error message no. 46 'Mass flow too high / low' is generated.
213	Qm Massflow Max	**TFLOAT [2]** 0 to 130 %	
215	Qv Volumeflow Min	**TFLOAT [2]** 0 to 130 %	Setting of the alarm limits for the volume flow. If the volume flow up-scales or down-scales the values set in the parameters 'Qv Volumeflow Min' and 'Qv Volumeflow Max,' error message no. 44 'Volume flow too high / low' is generated.
217	Qv Volumeflow Max	**TFLOAT [2]** 0 to 130 %	
199	Density Min	**TFLOAT [2]** 0.0 to 3.5 g/cm³	Selection of the alarm limits for the density. If the density up-scales or down-scales the values set in the parameters 'Density Min' and 'Density Max,' error message no. 43 'Density too high / low' is generated.
201	Density Max	**TFLOAT [2]** 0.0 to 3.5 g/cm³	
219	Temperature Min	**TFLOAT [2]** –100 to 250 °C	Setting of the alarm limits for the measuring medium temperature. If the measuring medium temperature up-scales or down-scales the values set in the parameters 'Temperature Min' and 'Temperature Max,' error message no. 32 'Sensor temperature too high / low' is generated.
221	Temperature Max	**TFLOAT [2]** –100 to 250 °C	
287*	Concentrat. [%] Min	**TFLOAT [2]** -5 to 105.0 %	Setting of the alarm limits for the concentration measurement. If the measured concentration is less than or exceeds the values set in the parameters 'Concentrat. [%] Min' and 'Concentrat. [%] Max' or 'Concentrat. [u] Min" und „Concentrat. [u] Max', error message no. 41 'Concentration in % too low / high' or no. 40 'Concentration in unit too low / high' is generated.
289*	Concentrat. [%] Max	**TFLOAT [2]** -5 to 105.0 %	
293*	Concentrat. [u] Min	**TFLOAT [2]** 0 to 200 msec	
295*	Concentrat. [u] Max	**TFLOAT [2]** 0 to 200 msec	

* These parameters are only available when the DensiMass function is activated.

… 8 Commissioning and operation

… Parameter descriptions

Modbus register address	Parameter name	Data type [register length] / value range	Description
223	Driver Output Max	**TFLOAT [2]** 0 to 100 mA	Setting of the alarm limit for the driver current. If the driver current up-scales the value in the parameter 'Driver Output Max' for the time set in the parameter 'Driver Output Time', error message no. 35 'Driver current too high' is generated.
427	Driver Output Time	**TFLOAT [2]** 5 to 864000 sec	
225	Sensor Signal Min	**TFLOAT [2]** 0 to 100 mV	Setting of the alarm limit for the sensor amplitude. If the sensor amplitude is less than the value in the parameter 'Sensor Signal Min' for the time set in the parameter 'Sensor Signal Time', error message no. 34 'Sensor amplitude too low' is generated.
429	Sensor Signal Time	**TFLOAT [2]** 5 to 600 sec	
237	Density Low Check	**TFLOAT [2]** 0.00 to 3.5 g/cm³	Sets the alarm limit for the density alarm. If the density down-scales the value set in the parameter 'Density Low Check', the process values Qm and Qv are set to '0' and error message no. 39 'Density set to 1 g/cm³' is generated.

Parameter range – Communication

Modbus register address	Parameter name	Data type [register length] / value range	Description
... / ...Modbus			
33	Address	**TUSIGN8 [1]**	Setting of the Modbus device address. Factory setting: See chapter **Parameterization via the Modbus interface** on page 36.
34	IEEE Format	**TUSIGN8 [1]** 0: IEEE format activated 1: IEEE format deactivated	Selection of the byte order for the Modbus communication. • If the IEEE format is activated (1), the data words are sent in the 'little-endian' format, with the lowest value word transmitted first. • If the IEEE format is deactivated (0), the data words are sent in the standard Modbus 'big-endian' format. Factory setting: IEEE format activated
35	Baud Rate	**TUSIGN8 [1]** 0: 2400 Bd 1: 4800 Bd 2: 9600 Bd 3: 19200 Bd 4: 38400 Bd 5: 56000 Bd 6: 57600 Bd 7: 115200 Bd	Selection of the transmission speed (baud rate) for the Modbus communication. Factory setting: 9600 Baud.
36	Parity	**TUSIGN8 [1]** 0: None 1: Even 2: Odd	Selection of the parity for the Modbus communication. Factory setting: Odd (odd)
37	Stop Bits	**TUSIGN8 [1]** 0: One stop bit 1: Two stop bits	Selection of the stop bits for the Modbus communication. Factory setting: One stop bit
38	Response Delay	**TUSIGN8 [1]** 0 to 200 ms	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

… 8 Commissioning and operation

… Parameter descriptions

Parameter range – Diagnosis

Modbus register address	Parameter name	Data type [register length] / value range	Description
… / …Diagnosis Control			
459	Preset Maint. cycle	**TUSIGN32 [2]** 0 to 50000 h	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. Factory setting: 0 hours Setting range: 1 to 50000 h
463	Maint. Remain. Time	**TUSIGN32 [2]**	Time remaining in the maintenance interval until the error message 'Maintenance interval is reached' is set. The parameter is read only.
101	Start New Cycle	**ACTION [1]**	Resetting of the maintenance interval. By writing any value to this address, the maintenance interval is reset to the value set under 'Preset Maint. cycle'.
… / …Diagnosis Values			
291	Driver Output	**TFLOAT [2]**	Output of the current driver current in mA. The parameter is read only.
283	Sensor Signal A	**TFLOAT [2]**	Output of current amplitude (sensor voltage) for sensor A in mV. The parameter is read only.
285	Sensor Signal B	**TFLOAT [2]**	Output of the current amplitude (sensor voltage) for sensor B in mV. The parameter is read only.
275	Tube Frequency	**TFLOAT [2]**	Output of the current meter tube frequency in Hz. The parameter is read only.
277	Pipe Temperature	**TFLOAT [2]**	Output of current meter tube temperature in °C. The parameter is read only.
281	Sensor Housing Temp	**TFLOAT [2]**	Output of current housing temperature in °C. The parameter is read only.
3501	Electr. (FEB) Temp	**TFLOAT [2]**	Issue of the current frontend board temperature in °C. The parameter is read only.

Modbus register address	Parameter name	Data type [register length] / value range	Description
... / ...Drag Indicators			
124	Reset Indicators	**ACTION [1]**	Reset all drag indicators. The drag indicator is reset by writing any value to this address.
... / ...Drag Indicators / ...Process Indicators			
3503	Mass Flow Min	**TFLOAT [2]**	Display of the minimum / maximum mass flow measured value since the last reset of the drag indicators.
3505	Mass Flow Max	**TFLOAT [2]**	
3507	Density Min	**TFLOAT [2]**	Display of the minimum / maximum density measured value since the last reset of the drag indicators.
3509	Density Max	**TFLOAT [2]**	
... / ...Drag Indicators / ...Sensor Indicators			
3511	Driver Output Max	**TFLOAT [2]**	Display of the maximum transmitter driver current since the last reset of the drag indicators.
3513	Sensor Amp. Sa Min	**TFLOAT [2]**	Display of the minimum transmitter sensor amplitude since the last reset of the drag indicators.
3515	Sensor Amp. Sb Min	**TFLOAT [2]**	
... / ...Drag Indicators / ...Temperature Indic.			
3517	Medium Min	**TFLOAT [2]**	Display of the minimum / maximum measuring medium temperature since the last reset of the drag indicators.
3519	Medium Max	**TFLOAT [2]**	
3521	Sensor Housing Min	**TFLOAT [2]**	Display of the minimum / maximum sensor housing temperature since the last reset of the drag indicators.
3523	Sensor Housing Max	**TFLOAT [2]**	
3525	Electr. (FEB) Min	**TFLOAT [2]**	Display of the minimum / maximum frontend board temperature since the last reset of the drag indicators.
3527	Electr. (FEB) Max	**TFLOAT [2]**	

… 8 Commissioning and operation

… Parameter descriptions

Modbus register address	Parameter name	Data type [register length] / value range	Description
… / …Simulation Mode			
70	Simulation Switch	**TUSIGN8 [1]** 0: Off 1: Qm mass flow [unit] 2: Qm mass flow [%] 3: Qv volume flow [unit] 4: Qv volume flow [%] 5: Density [unit] 6: Density [%] 7: Temperature [unit] 8: Temperature [%] 12: Digital output 41/42 13: Digital output 51/52	Manual stimulation of measured values / outputs. The simulated output values correspond to the set measured value (Modbus addresses 71, 72, 341-359). Only one measured value / output can be selected for simulation. After power-up / restart of the device, the simulation is switched off.
341	Mass Flow [unit]	**TFLOAT [2]** 0 to 2 x QmMax DN	Setting of the simulated measured values. The simulated value is selected with the parameter ‘Simulation Switch’.
343	Mass Flow [%]	**TFLOAT [2]** -200 to 200 %	
345	Volume Flow [unit]	**TFLOAT [2]** 0 to 2 x QvMax DN	
347	Volume Flow [%]	**TFLOAT [2]** -200 to 200 %	
349	Density [unit]	**TFLOAT [2]** 0.0 to 3.5 g/cm³	
351	Density [%]	**TFLOAT [2]** -200 to 200 %	
353	Temperature [unit]	**TFLOAT [2]** -100 to 250 °C	
355	Temperature [%]	**TFLOAT [2]** -200% to 200%	
71	DO 41/42 State	**TUSIGN8 [1]** 0: Off 1: A	

Modbus register address	Parameter name	Data type [register length] / value range	Description
... / ...Simulation Mode			
357	Dig.Out 41/42 Freq. Dig.Out 41/42 Pulse	**TFLOAT [2]** 0 to 10500 Hz 0 to 10000 pulses	The respective simulated output value is dependent on the operating mode (pulse / frequency) of the digital output 41 / 42.
72	Dig.Out 51/52 State	**TUSIGN8 [1]** 0: Off 1: A	
359	Dig.Out 51/52 Freq. Dig.Out 51/52 Pulse	**TFLOAT [2]** 0 to 10500 Hz 0 to 10000 pulses	The respective simulated output value is dependent on the operating mode (pulse / frequency) of the digital output 51 / 52.
... / ...Output Readings			
419	Dig.Out 41/42 Freq.	**TFLOAT [2]** 0 to 10500 Hz	Output of the current output values. The available values are dependent on the configuration of the digital outputs. The parameters are read only.
26	DO 41/42 State	**TUSIGN8 [1]** 0: Off 1: A	
421	Dig.Out 51/52 Freq.	**TFLOAT [2]** 0 to 10500 Hz	
59	Dig.Out 51/52 State	**TUSIGN8 [1]** 0: Off 1: A	

… 8 Commissioning and operation

… Parameter descriptions

Modbus register address	Parameter name	Data type [register length] / value range	Description
… / …Meter Erosion Mon.			These parameters are only available when the VeriMass function is activated.
93	Control Type	**TUSIGN8 [1]** 0: Manual 1: Automatic	Selection of the operating mode for the erosion monitor. • Manual: Manual input of limit values for the erosion monitor. • Automatic: The transmitter calculates the limit values for the erosion monitor automatically. Factory setting: Manual.
223	Driver Output Max	**TFLOAT [2]**	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 ‘Sensor driver current to high.’ is triggered. This parameter is only available if the value ‘Manual’ has been selected for the parameter ‘Control Type’.
427	Driver Output Time	**TFLOAT [2]**	Sets the delay time for the alarm "35 - Driver current too high". This parameter is only available if the value ‘Manual’ has been selected for the parameter ‘Control Type’.
94	Status Adjust	**TUSIGN8 [1]** 0: Outstanding 1: Requested 2: Self-adjust active 3: Completed	Output of the status for automatic adjustment of the erosion monitor. • Outstanding: If the limit value is not set, the erosion monitoring is not active. • Requested: Automatic adjustment of the erosion monitor is activated but has not yet been performed. • Self-adjust active: Automatic balancing of the erosion monitor is active. • Concluded: Automatic balancing of the erosion monitor is complete; erosion monitoring is active. This parameter is only available if the value ‘Automatic’ has been selected for the parameter ‘Control Type’. The parameter is read only.
601	Self Adjust Time	**TFLOAT [2]**	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.
123	Start Adjust	**ACTION [1]**	Manual start of automatic calibration of the erosion monitor. Automatic calibration is started by writing any value to this address.
469	New Value left Time	**TUSIGN32 [2]**	Output of the time remaining for the current automatic calibration of the erosion monitor. The parameter is read only.
223	Meter Erosion Level	**TFLOAT [2]**	Output of the erosion monitor's automatically calculated erosion value. The parameter is read only.
603	Adjusted Limit	**TFLOAT [2]**	Output of the erosion monitor's automatically calculated limit value. The limit value is calculated from the erosion value from the automatic adjustment process and a tolerance value. The parameter is read only.
605	Actual Value	**TFLOAT [2]**	Output of the current erosion value for comparison with the learned limit. The parameter is read only.

Modbus register address	Parameter name	Data type [register length] / value range	Description
... / ...Alarm Simulation			
69	xxxx	**TUSIGN8 [1]** 0: Off, no alarm simulation 1: Mass flow too high. 2: Volume flow rate too high. 3: Simulation activated 4: Flow rate set to 0 5: Service interval reached 6: All counters stopped 7: Counter reset 8: Flow rate <1600h to Qmax 9: Device not calibrated 10: SensorMemory faulty 11: SensorMemory data error 16: Pulse output overrun 27: DSP error frontend board. 28: Density error 29: Sensor temperature out of spec. 30: Sensor temperature measuring error 31: Sensor amplitude too small 32: Driver current too high 33: Density too low 34: Density is too low / high. 35: Medium temperature too low / too high 36: Density set to 1 g/cm³ 37: Concentration [unit] too low / too high 38: Concentration [%] too low / too high	Manual simulation of alarms / error messages. The simulated alarm is selected by setting the parameter to the corresponding error number of the desired error. See also chapter **Alarm status und alarm history status** on page 95.

… 8 Commissioning and operation

… Parameter descriptions

Parameter range – Counter

Modbus register address	Parameter name	Data type [register length] / value range	Description
… / …Operation			
115	Start all Totalizer	**ACTION [1]**	Start all counters of the device.
116	Stop all Totalizer	**ACTION [1]**	Stop all counters of the device.
… / …Reset Totalizer			
114	All Totalizer	**ACTION [1]**	Reset the device counter
112	All Mass Totalizer		
113	All Volume Totalizer		
106	Massflow Fwd		
107	Massflow Rev		
102	Volumeflow Fwd		
103	Volumeflow Rev		
108	Net1 Massflow Fwd	**ACTION [1]**	These parameters are only available when the DensiMass function is activated.
109	Net1 Massflow Rev		
110	Net1 Volumeflow Fwd		
111	Net1 Volumeflow Rev		
104	Volumeflow Fwd@Tref		
105	Volumeflow Rev@Tref		
… / …Preset Totalizer			
305	Massflow Fwd	**TFLOAT [2]**	Default setting of the device counter.
307	Massflow Rev		
297	Volumeflow Fwd		
299	Volumeflow Rev		
309	Net1 Massflow Fwd	**TFLOAT [2]**	These parameters are only available when the DensiMass function is activated.
311	Net1 Massflow Rev		
313	Net1 Volumeflow Fwd		
315	Net1 Volumeflow Rev		
301	Volumeflow Fwd@Tref		
303	Volumeflow Rev@Tref		

Modbus register address	Parameter name	Data type [register length] / value range	Description
... / ...FillMass			These parameters are only available when the FillMass function is activated.
73	Batch Process Value	**TUSIGN8 [1]** 0: Off 64: Forward flow volumes 65: Forward flow standard volumes 66: Forward flow mass 67: Forward flow net volumes 68: Forward flow net mass	Selection of the process value used for the fill operation. The process variables 'net forward flow volume' and 'net forward flow mass' are only available when the DensiMass function is activated.
317	Preset Batch Total.	**TFLOAT [2]** XX to XX	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'.
119	Reset Cur.Batch Tot.	**ACTION [1]**	Resets the parameter 'Current Batch Total.' to zero and prepares the next fill operation.
117	Start Batching	**ACTION [1]**	Starts the fill operation by writing any value to the corresponding Modbus address.
847	Current Batch Total.	**TDOUBLE [4]** XX to XX	Output 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. This parameter is read only.
118	Stop Batching	**ACTION [1]**	Stops the fill operation by writing any value to the corresponding Modbus address.
465	Current Batch Counts	**TUSIGN32 [2]**	Output of the number of fill operations since the last reset. This parameter is read only.
121	Reset Batch Counts	**ACTION [1]**	Resets the counter 'Current Batch Counts' by writing an arbitrary value into the corresponding Modbus address.

… 8 Commissioning and operation

… Parameter descriptions

Modbus register address	Parameter name	Data type [register length] / value range	Description
… / …FillMass / …Lag Correction			These parameters are only available when the FillMass function is activated.
90	Mode	**TUSIGN8 [1]** 0 - Manual 1 - Automatic	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. • Automatic: 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.'
319	Quantity	**TFLOAT [2]** -0.0 to 100.0	Manually sets the overrun quantity correction value in the selected unit. 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. Only if the parameter 'Mode' has been set to 2 - Manual.
435	Quantity automatisch	**TFLOAT [2]** Read only or set to 0.0.	Output of the overrun quantity automatically calculated by the transmitter. Only if the parameter 'Mode' has been set to 1 - Automatic.
437	Factor	**TFLOAT [2]** 0.0 to 1.0 Factory setting: 0.25	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 + (Factor × 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.
439	Time	**TFLOAT [2]** 0.1 to 10 s Factory setting: 0.1 s	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.

FCx1xx device software

Version	Issue date	Description	Ordering number
01.00.01	05.2014	Functional improvement	3KXF000405U0100
01.01.00	08.2014	Quality & functional improvement	
01.01.01	09.2014	Quality & functional improvement	
01.02.02	03.2016	Internal diagnostic functions added	
01.03.00	01.2017	Quality & functional improvement, new Modbus register added	
01.04.02	03.2018	Drag indicator added	
01.05.00	12.2019	Second independent frequency output 51/52 added.	
01.06.00	03.2020	ECC function added.	
01.09.00	02.2022	Improvement of measuring rate in ECC mode and further diagnostic options	
01.09.02	04.2022	New DensiMass "antifreeze" medium option	

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 25.

To perform zero point adjustment via the Modbus interface, see **System Zero** on page 61.

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.

Setup

The following steps must be taken to enable the transmitter to calculate the standard volume flow for gases:

1. Set the parameter "Density Mode" to "Fixed density value".
2. Set the parameter ‘Density Fixed Value’ to the standard density of the measuring medium.
3. Volume flow (Volume Flow [unit] / Volume Flow [%]) must be selected as the process variable for the output. Selecting a standard volume will not work in this case!

See also **Parameter range - config. Device** on page 56 and **Available process variables** on page 51.

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

The calculation can also be performed for liquid measuring media.

… 8 Commissioning and 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 is 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. See also parameter range **…Feature Settings** on page 60.
2. Set the parameter "Control Type" to "Automatic". See also parameter range **VeriMass erosion monitor** on page 84.
3. Set the parameter "Self Adjust Time" to the required duration of the adjustment process. See also parameter range **VeriMass erosion monitor** on page 84.

Recommended settings	
Self Adjust Time	Several days or weeks depending on the application

4. Start the automatic adjustment 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
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. See also parameter range **...Feature Settings** on page 60.
2. Set the parameter "Control Type" to "Manual". See also parameter range **VeriMass erosion monitor** on page 84.
3. Set the parameters "Driver Current Max" and "Driver Current Time" to the required values. See also parameter range **VeriMass erosion monitor** on page 84.

Recommended settings	
Driver Current Max	Approx. 0.3 mA above the driver current under normal operating conditions
Driver Current Time	Several days or weeks depending on the application

Adjustment via Device Type Manager (DTM)
Alternatively, automatic and manual adjustment of the erosion monitor can also be performed via the local user interface with a HART DTM (see also **Parameterization via the local operating interface** on page 37).

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

Standard volume measurement with SG Specific Gravity

For the standard volume calculation, a reference density can also be selected via the '... / Device Setup / ...Transmitter / SG Specific Gravity' parameter. The following setting options are available for the reference density:

Selection for parameter SG Specific Gravity	**Reference density**
Water 60 °F with API*	0.999016 kg/l
Water 68 °F	0.9982008 kg/l
Water 39.2 °F	0.9999720 kg/l
Gas 68 °F	1.205 kg/m^3

* This reference density must be used for the output of the API density. Default setting

Enhanced Coriolis Control (ECC)function

The Enhanced Coriolis Control (ECC)function has been specially developed for demanding applications, such as:

- Liquids with gas phase
- Liquids with rapidly changing densities
- Fill operations with surge phases at the beginning or end
- Liquids with high viscosity

After the ECC function is activated, the device applies a particularly quick control algorithm to control the oscillating tubes in the device and therefore provide significantly better behavior in the applications listed above.

In addition, the ECC function offers a special noise suppression filter for mass flow measurement and density measurement.

In the case of particularly demanding applications, disruptions can thus be actively filtered and the measurement can be implemented in a considerably more stable manner.
For the filters, a variety of time constants between 0.5 s and 8 s can be selected.

Since Coriolis mass flowmeters measure the mass flow and density separately, the CoriolisMaster features a separate filter each for mass flow measurement and density measurement.

… 8 Commissioning and operation

Applications in accordance with API (American Petroleum Institute)

For applications in accordance with API Chapter 5.6, the CoriolisMaster FCB100, FCH100 provides special parameters:

- Calibration Pressure: Measuring medium pressure at which the device was calibrated at ABB.
- Calibration Temp.: Measuring medium temperature at which the device was calibrated at ABB.
- Pressure Level: Parameters for entry of the current operating pressure in the device by the user.
- Flow Compens. factor: Display / output of the current compensation factor for mass flow calculation.
- Density Comp. factor: Display / output of the current compensation factor for density calculation.
- P.Comp.Status (PECI): In accordance with API, the user can set the following states:
  - 1: CT: Compensation in the Coriolis flowmeter based on the current pressure entered in the ‘Pressure Level’ parameter.
  - 2: TD: Compensation in the Coriolis flowmeter switched off – compensation is performed externally (Tertiary Device)
  - 3: OS: Compensation in the Coriolis flowmeter switched off – compensation is not performed on site (Off Site)
  - 4: NA: Compensation in the Coriolis flowmeter switched off – compensation is not deemed to be necessary, since the device is operating at a pressure for which the device has been proved.

Concentration measurement DensiMass

Only for FCB150 / FCH150

The transmitter can calculate the current concentration from the measured density and temperature using concentration matrices.

The following concentration matrices are preconfigured in the transmitter as standard:

- Concentration of sodium hydroxide in water
- Concentration of alcohol in water
- Concentration of sugar in water
- Concentration of maize starch in water
- Concentration of wheat starch in water
- Concentration of antifreeze in water

In addition, the user can enter two user-defined matrices:

- Up to 100 values with one matrix
- Up to 50 values per matrix with two matrices

Calculating standard volumes and standard densities of liquids

If a suitable matrix is available, the DensiMass function also allows the measured volume to be corrected for any selected temperature.

The measured density can also be corrected for a given temperature.

However, this is only possible when measuring liquids and after entering an appropriate matrix.

This correction can also be performed using the default matrices (see above).

The calculated standard volumes and standard densities can also be issued for all other process variables.

The software ‘DensiMatrix’ is available for the easy input of the matrix.

Accuracy of the concentration measurement

The accuracy of the concentration measurement is determined in the first instance by the quality of the matrix data entered. However, as the calculation is based on temperature and density (the input variables), the accuracy of the concentration measurement is ultimately determined by the measuring accuracy of the temperature and the density.

Example:
Density of 0% alcohol in water at 20 °C (68 °F): 998.23 g/l
Density of 100 % alcohol in water at 20 °C (68 °F): 789.30 g/l

Concentration	Density
100 %	208.93 g/l
0.48 %	1 g/l
0.96 %	2 g/l
0.24 %	0.5 g/l

Thus, the accuracy class of the density measurement directly determines the accuracy of the concentration measurement.

Creation of the concentration matrix

The concentration matrix for the DensiMass function can be created in two ways:

- The desired ABB matrix is indicated when ordering the device. The device is then delivered with the corresponding preconfiguration.
- The matrix is created using the 'DensiMatrix' software and transferred to the device via the local operating interface.

For more information, please contact ABB Service or the sales organization.

… 8 Commissioning and 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

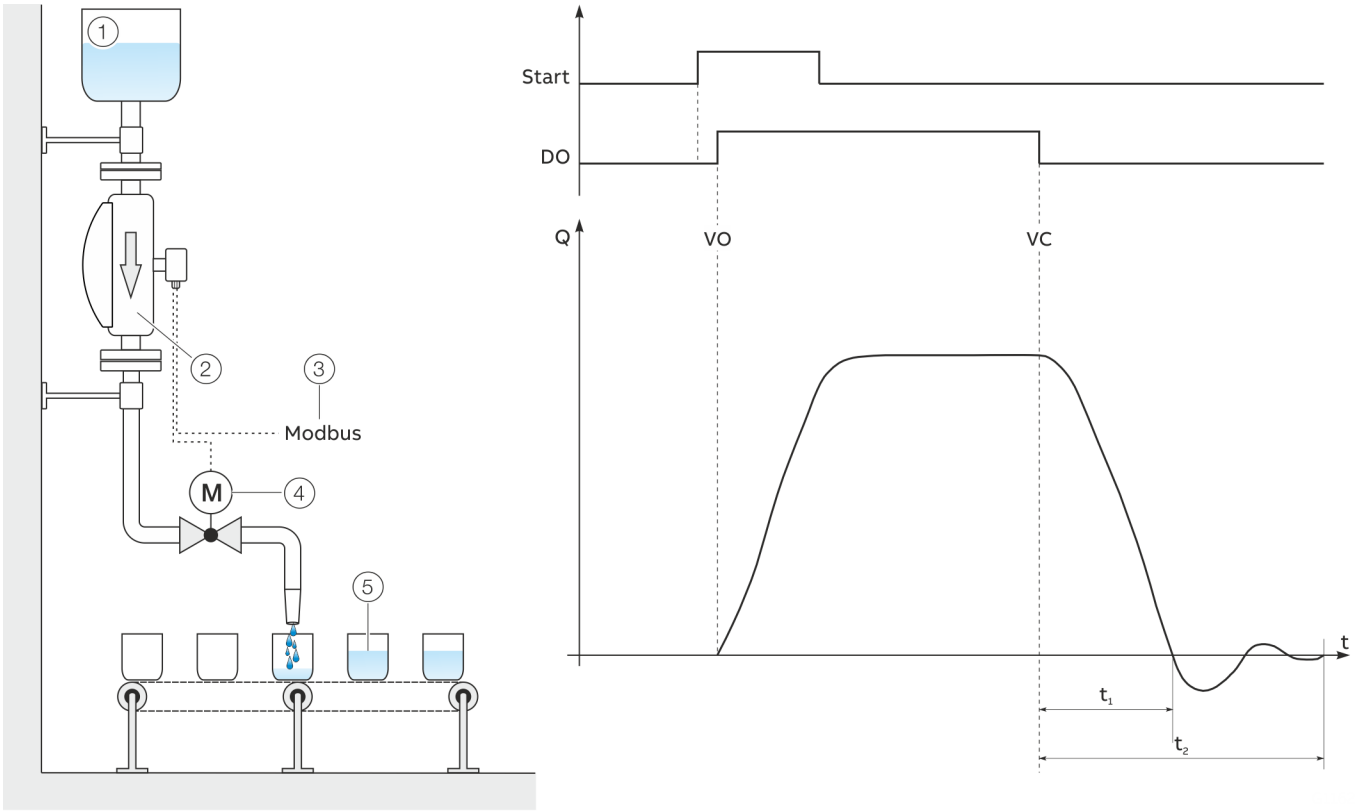
Concentr. 1 >…> Concentr. x > … > Concentr. N for 1 ≤ x ≤ N

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 FCB150 / FCH150



1. Supply tank
2. Sensor
3. Start / stop fill operation (Modbus)
4. Fill valve
5. Filling tank

Start Start of the filling operation via Modbus
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 35: FillMass fill function

The integrated FillMass fill function allows filling operations with filling times of > 3 s.
For this purpose, the filling quantity is given via an adjustable totalizer.
The Modbus interface is used to configure and control the fill function.
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.

… 8 Commissioning and 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 parameter range **…Feature Settings** on page 60.
2. One of the two digital outputs 41 / 42 or 51 / 52 must be configured as a binary output with the function "Batch end contact". See also parameter range **Parameter range - Output** on page 65.
3. The parameters for the fill mass function must be configured. See also parameter range **…FillMass** on page 81.

Note

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 parameter range **Parameter range - config. Device** on page 56.

Filling operation run

Initialization

The following steps must be performed before the initial start of a filling operation and e.g. in case of changes to the fill quantity:

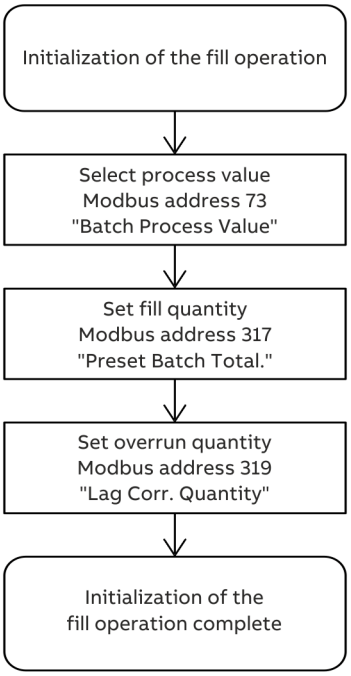


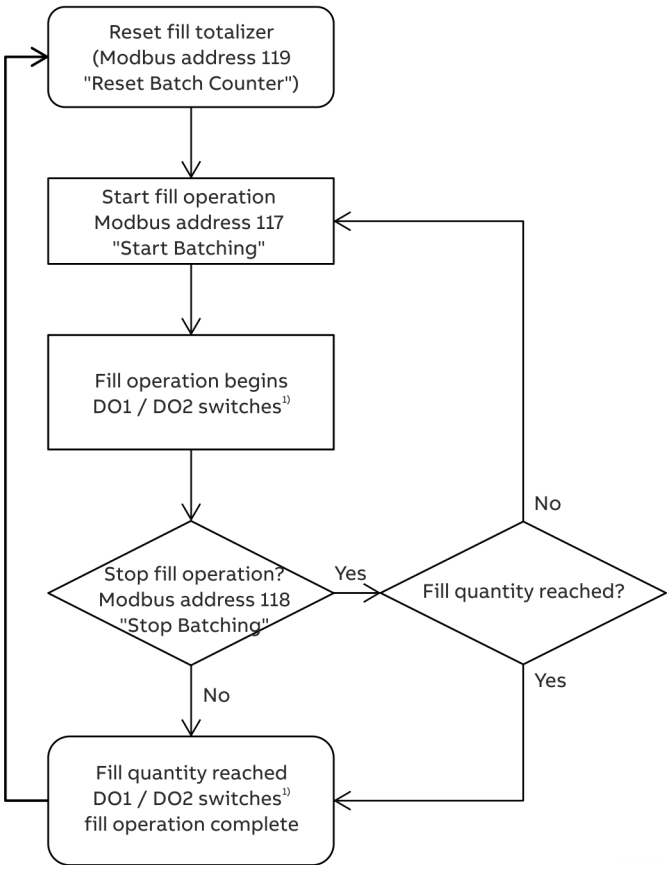
Figure 36: Initialization

Note

The value for the outflow amount “Lag Corr. Quantity“ depends on a number of factors (valve close time, flow velocity, pressure, etc.) The value must therefore be experimentally determined for every application.

Fill operation

The following steps must be performed for every fill operation:



* The digital output DO1 / DO2 must be configured as 'Batch end contact' for this purpose.

Figure 37: Filling operation

The current fill quantity for the present fill operation can be read out via the Modbus address 847 "Current Batch Total.".
The number of fill operations performed can be read out via the Modbus address 465 "Current Batch Counts". The counter can be reset via the Modbus address 119 "Reset Batch Totalizer".

9 Diagnosis / error messages

NOTICE
All Modbus addresses in this chapter are indicated in the format "PLC Base 1".

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.

The following critical errors are indicated by slow flashing (frequency: 1 second) of the service LED in the transmitter terminal box.
See also **Service LED** on page 35.

Fault message	Priority / error no.	Modbus address "Active alarm"
DSP Failure on Frontend Board.	96 / 29	2029
Sensor amplitudeout of range.	93 / 33	2033
Sensor temperature measure error	90 / 32	2032
NV data defect. Data storage irreparable.	84 / 10	2010
Density failure	80 / 30	2009
Sensor driver current to high.	60 / 34	2015
Sensor temperature out max range	57 / 31	2018
Sensor memory defective.	38 / 09	2009

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
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.
⚠	Alarm (general)
⚠↑	High alarm
⚠↓	Low alarm

			Measurement variables								Counter Pulse / frequency output			Digital output
Priority	Error no.	Error text	Qm [%]	Qv [%]	Density [g/cm³]	Temperature [°C]	Concentration [%]	Net mass flow	Standard density g/cm³]	Standard volume [20 °C]	All counters	Qm [%, unit]	Qv [%, unit]	Configured alarm
96	29	DSP Failure on Frontend Board.	0	0	1	—	0	0	1	0	—	0	0	⚠
93	33	Sensor amplitudeout of range.	0	0	—	—	—	0	—	0	—	—	—	⚠
92	41	FEB voltages outside range.	0	0	1	20 °c	0	0	1	0	—	0	0	⚠
90	32	Sensor temperature measure error	1)	1)	1)	20 °C	1)	1)	1)	1)	—	—	—	⚠
84	10	NV data defect. Data storage irreparable.	0	0	1	20 °c	0	0	1	0	—	0	0	⚠
80	30	Density failure	—	2)	1g	—	2)	2)	2)	2)	—	—	—	⚠
78	3	Flowrate to zero	0	0	—	—	—	0	—	0	—	0	0	—
76	5	All totalizer stopp.	—	—	—	—	—	—	—	—	STOP	—	—	⚠
74	6	Totalizer reset. Reset of one or more Totalizer	—	—	—	—	—	—	—	—	0	—	—	⚠
72	2	Simulation is on. Simulating process/output value.	—	—	—	—	—	—	—	—	—	—	—	—
70	26	An alarm is simulated.	—	—	—	—	—	—	—	—	—	—	—	—
60	34	Sensor driver current to high.	—	—	—	—	—	—	—	—	—	—	—	⚠
59	35	Density too low.Empty pipe, gas	0	0	—	—	—	0	—	0	—	—	—	—
58	38	Density to 1g/cm³	—	2)	1g	—	2)	2)	2)	2)	—	—	—	—
57	31	Sensor temperature out max range	1)	1)	1)	20 °C	1)	1)	1)	1)	—	—	—	—
54	41	FEB voltages outside range.	—	—	—	—	—	—	—	—	—	—	—	—

… 9 Diagnosis / error messages

… Overview

			Measurement variables								Counter	Pulse / frequency output		Digital output
Priority	Error no.	Error text	Qm [%]	Qv [%]	Density [g/cm³]	Temperature [°C]	Concentration [%]	Net mass flow	Standard density g/cm³]	Standard volume [20 °C]	All counters	Qm [%, unit]	Qv [%, unit]	Configured alarm
47	15	Pulse output is cut off.	—	—	—	—	—	—	—	—	—	—	—	—
46	0	Mass flowrate exceeds limits.	—	—	—	—	—	—	—	—	—	—	—	⚠↑⚠↓
44	1	Volume flowrate exceeds limits.	—	—	—	—	—	—	—	—	—	—	—	⚠↑⚠↓
43	36	Density exceeds min/max limits.	—	—	—	—	—	—	—	—	—	—	—	—
42	37	Medium temperat exceeds limits.	—	—	—	—	—	—	—	—	—	—	—	—
41	39	Concentration inunit exceeds	—	—	—	—	—	—	—	—	—	—	—	—
40	40	Concentration in percent exceeds	—	—	—	—	—	—	—	—	—	—	—	—
38	9	Sensor memory defective.	—	—	—	—	—	—	—	—	—	—	—	—
26	4	Maintenance interval is reached	—	—	—	—	—	—	—	—	—	—	—	⚠
24	8	Device not calibrated.	—	—	—	—	—	—	—	—	—	—	—	—

Alarm status und alarm history status

Fault message	Modbus address		Byte /	Error no. /	Description	NAMUR class
	Active	History	Bit pos.	priority		
F096.029 DSP Failure on Frontend Board.	2029	2077	3 / 5	29 / 96	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.	2033	2081	4 / 1	33 / 93	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.	2041	2089	5 / 1	41 / 92	Frontend board power supply defective. Frontend board defective. • Replace frontend board. • Contact ABB Service.	Out of specification
F090.032 Sensor temperature measure error	2032	2080	4 / 0	32 / 90	Internal temperature sensor measuring error / defective. • Contact ABB Service.	Failure
F084.010 NV data defect. Data storage irreparable.	2010	2058	1 / 2	10 / 84	Error in SensorMemory. Faulty memory module. • Contact ABB Service.	Failure
F080.030 Density failure	2030	2078	3 / 6	30 / 80	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
C078.003 Flowrate to zero	2003	2051	0 / 3	3 / 78	External switch-off active via digital input. • Check status of digital input. • Check parameterization.	Functional check
C076.005 All totalizer stopp.	2005	2053	0 / 5	5 / 76	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	2006	2054	0 / 6	6 / 74	Reset of one or more counters. • Check status of digital input. • Check parameterization.	Functional check

… 9 Diagnosis / error messages

… Alarm status und alarm history status

Fault message	Modbus address		Byte /	Error no. /	Description	NAMUR class
	Active	History	Bit pos.	priority		
C072.002 Simulation is on. Simulating process/output value.	2002	2050	0 / 2	2 / 72	Simulation mode is active. • Deactivate simulation mode in the 'Diagnostics / …Simulation Mode' menu.	Functional check
C070.026 An alarm is simulated.	2026	2074	3 / 2	26 / 70	The alarm simulation is active. • Deactivate alarm simulation in the 'Diagnostics / …Alarm Simulation' menu.	Functional check
S060.034 Sensor driver current to high.	2034	2082	4 / 2	34 / 60	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	2035	2083	4 / 3	35 / 59	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	2038	2086	4 / 6	38 / 58	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	2031	2079	3 / 7	31 / 57	Ambient or measuring medium temperature is too high. • Check ambient or measuring medium temperature.	Out of specification
S054.042 Sensor amplitude out of ranges	2042	2090	5 / 2	42 / 54	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
S047.0015 Pulse output is cut off.	2015	2063	1 / 7	15 / 47	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.	2000	2048	0 / 0	0 / 46	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

Fault message	Modbus address		Byte /	Error no. /	Description	NAMUR class
	Active	History	Bit pos.	priority		
S044.001 Volume flowrate exceeds limits.	2001	2049	0 / 1	1 / 44	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.	2036	2084	4 / 4	36 / 43	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.	2037	2085	4 / 5	37 / 42	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	2039	2087	4 / 7	39 / 41	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	2040	2088	5 / 0	40 / 40	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
M038.09 Sensor memory defective.	2009	2057	1 / 1	9 / 38	SensorMemory in frontend board defective. • Check if the SensorMemory is defective. • Contact ABB Service.	Maintenance required
M026.004 Maintenance interval is reached	2004	2052	0 / 4	4 / 26	Maintenance interval reached. • Perform maintenance work. • Start new maintenance interval in the 'Diagnostics / ...Diagnosis Control' menu.	Maintenance required
M024.008 Device not calibrated.	2008	2056	1 / 0	8 / 24	Contact ABB Service.	Maintenance required

10 Maintenance

Safety instructions

⚠ DANGER

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

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

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

⚠ WARNING

Risk of injury due to live parts!

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

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

⚠ 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.

Corrective maintenance work may only be performed by trained personnel.

- Before removing the device, depressurize it along with any adjacent lines or vessels.
- Check whether hazardous materials have been used as measuring medium before opening the device. Residual amounts of hazardous material may still be present in the device and could escape when it is opened.

Within the scope of operator responsibility, check the following as part of a regular inspection:

- pressure-carrying walls / pressure equipment liner
- the measurement-related function
- the leak tightness
- the wear (corrosion)

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.

Sensor

Essentially no maintenance is required for the sensor.

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.

11 Repair

Safety instructions

⚠ DANGER

Danger of explosion if the device is operated with the transmitter housing or terminal box open!
Before opening the transmitter housing or the terminal box, note the following points:
- A valid fire permit must be present.
- Make sure that there is no explosion hazard.
- Switch off the power supply and wait for t > 20 minutes before opening.

⚠ WARNING

Risk of injury due to live parts!
When the housing is open, contact protection is not provided and EMC protection is limited.
- Before opening the housing, switch off the power supply.

⚠ 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.

Note
For measuring devices for potentially explosive areas, observe the relevant operator guidelines.
See also **Use in potentially explosive atmospheres** on page 6.

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

Spare parts

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

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 102) 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 acc. to page 5 for nearest service location.

… 11 Repair

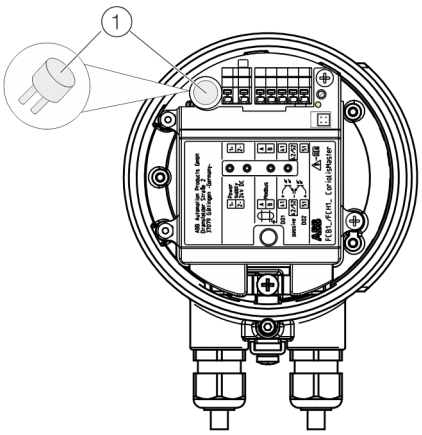
Replacing the fuse

⚠ DANGER

Danger of explosion if the device is operated with the transmitter housing or terminal box open!
Before opening the transmitter housing or the terminal box, note the following points:

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

Note
For devices for use in potentially explosive atmospheres in Zone 1 / Div. 1, the fuse is sealed and cannot be replaced.



① Fuse

Figure 38: Fuse in the terminal box

There is a fuse in the transmitter terminal box (order number: 3KQR000443U0100).

Perform the following steps to replace the fuse:

1. Switch off the power supply.
2. Open the transmitter terminal box.
3. Pull out the defective fuse and insert a new fuse.
4. Close the transmitter terminal box.
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 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 99.

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.

13 Specification

Note

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

14 Additional documents

Note

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

Trademarks

Modbus is a registered trademark of Schneider Automation Inc.

Hastelloy C-4 is a trademark of Haynes International

Hastelloy C-22 is a trademark of Haynes International

Windows is a registered trademark of Microsoft Corporation.

15 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?

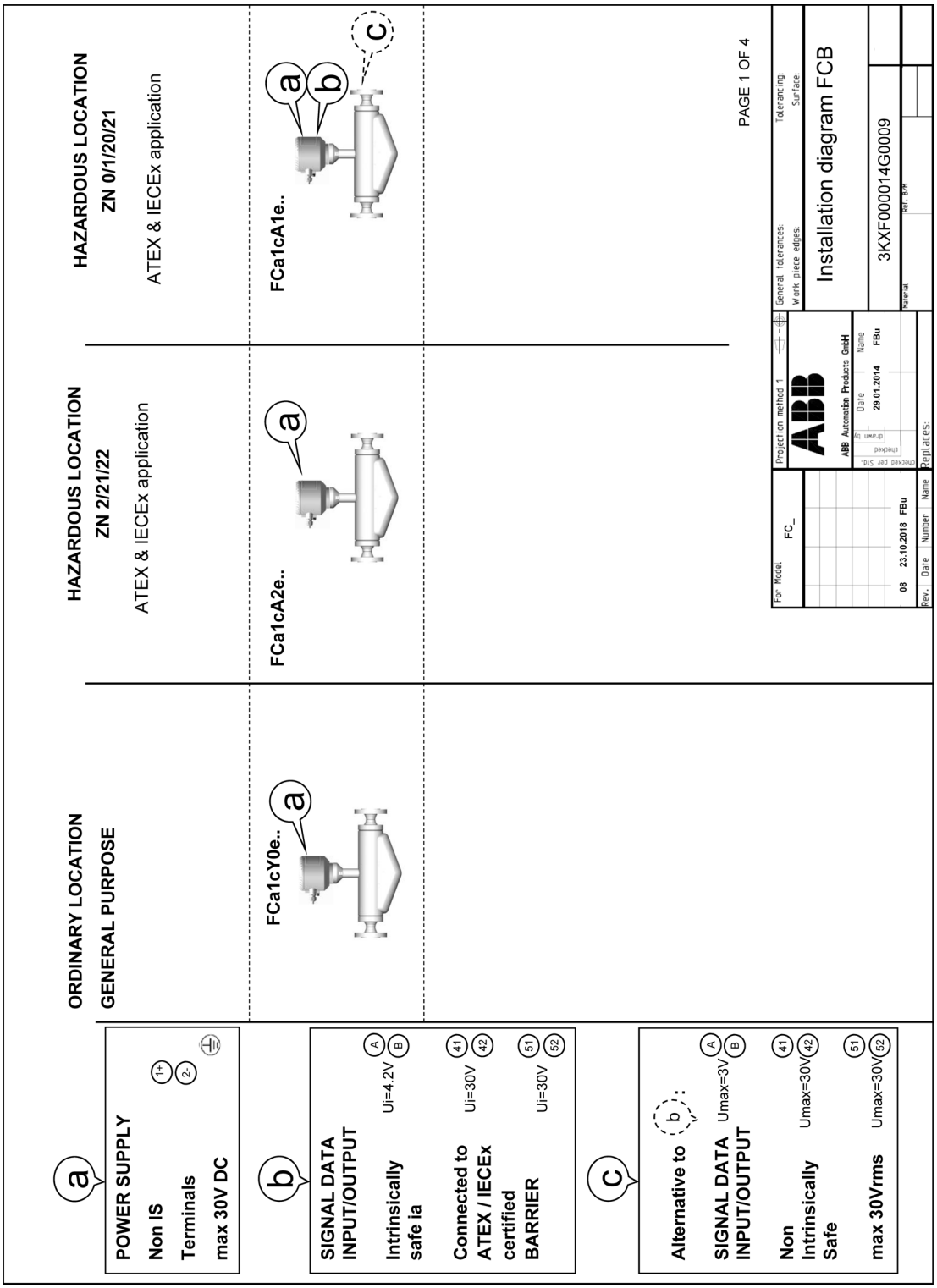
1.
2.
3.

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

Installation diagram 3KXF000014G0009

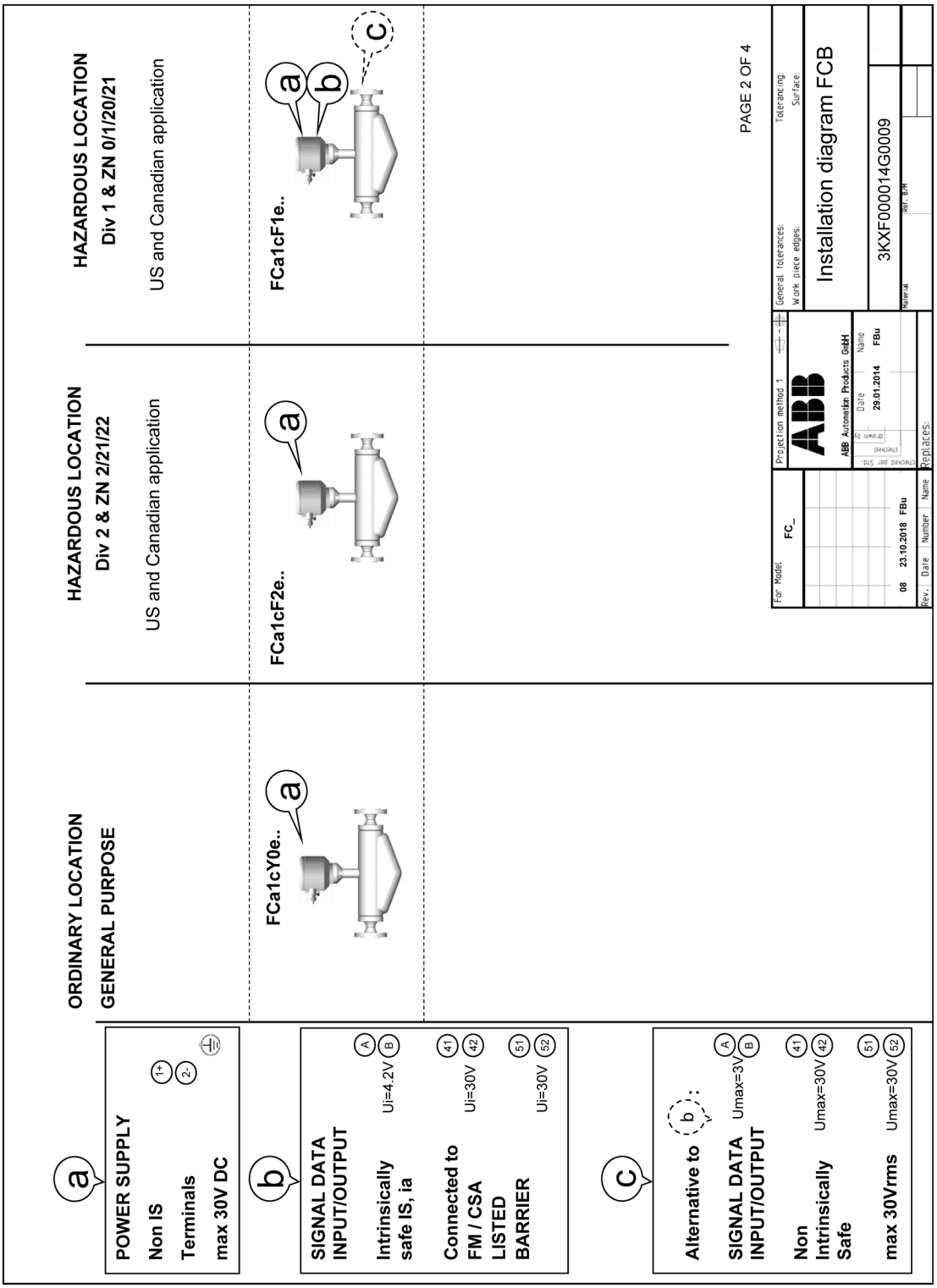
Page 1 of 4



… 15 Appendix

… Installation diagram 3KXF000014G0009

Page 2 of 4



Notes: ATEX & IECEx application

1. THE INTRINSIC SAFETY ENTITY CONCEPT ALLOWS THE INTERCONNECTION OF TWO ATEX/IECEx APPROVED INTRINSICALLY SAFE DEVICES WITH ENTITY PARAMETERS NOT SPECICALLY EXAMINED IN COMBINATION AS A SYSTEM WHEN:
   Uo OR Voc OR Vt < V MAX, Io OR Ioc OR It < I MAX;
   Ca OR Co > Ci + Ccable; La OR Lo > Li + Lcable; Po < Pi.
2. DUST-TIGHT CONDUIT SEAL MUST BE USED WHEN INSTALLED IN Zone 21/22 ENVIROMENTS.
3. CONTROL EQUIPMENT CONNECTED TO THE ASSOCIATED APPARATUS MUST NOT USE OR GENERATE MORE THAN 250 Vrms OR Vdc WITH RESPECT TO EARTH.
4. INSTALLATION SHOULD BE IN ACCORDANCE WITH THE RELEVANT INTERNATIONAL OR NATIONAL REGULATIONS „INSTALLATION OF INTRINSICALLY SAFE FOR HAZARDOUS LOCATIONS“ REGULATIONS.
5. THE CONFIGURATION OF ASSOCIATED APPARATUS MUST BE ATEX or IECEx APPROVED UNDER ENTITY CONCEPT.
6. ASSOCIATED APPARATUS MANUFACTURER´S INSTALLATION DRAWING MUST BE FOLLOWED WHEN INSTALLING THIS EQUIPMENT.
7. THE ASSOCIATED APPARATUS MUST BE INSTALLED IN ACCORDANCE WITH BARRIER MANUFACTURE´S INSTALLATION DIAGRAM
8. SELECTED ASSOCIATED APPARATUS MUST BE THIRD PARTY LISTED AS PROVIDING INTRINSICALLY SAFE CIRCUITS FOR THE APPLICATION. IT MUST MEET THE REQUIREMENTS LISTED IN TABLE OF THIS INSTALLATION DIAGRAM:

Notes: US and Canadian application

1. THE INTRINSIC SAFETY ENTITY CONCEPT ALLOWS THE INTERCONNECTION OF TWO FM AND/OR CSA APPROVED INTRINSICALLY SAFE DEVICES WITH ENTITY PARAMETERS NOT SPECICALLY EXAMINED IN COMBINATION AS A SYSTEM WHEN:
   Uo OR Voc OR Vt < V MAX, Io OR Ioc OR It < I MAX;
   Ca OR Co > Ci + Ccable; La OR Lo > Li + Lcable; Po < Pi.
2. DUST-TIGHT CONDUIT SEAL MUST BE USED WHEN INSTALLED IN CLASS II AND III ENVIROMENTS.
3. CONTROL EQUIPMENT CONNECTED TO THE ASSOCIATED APPARATUS MUST NOT USE OR GENERATE MORE THAN 250 Vrms OR Vdc WITH RESPECT TO EARTH.
4. INSTALLATION FOR U.S. AND CANADIAN APPROVED EQUIPMENT SHOULD BE IN ACCORDANCE WITH ANSI/ISA RP12.6 „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).
5. THE CONFIGURATION OF ASSOCIATED APPARATUS MUST BE FM AND/OR CSA APPROVED UNDER ENTITY CONCEPT.
6. ASSOCIATED APPARATUS MANUFACTURER´S INSTALLATION DRAWING MUST BE FOLLOWED WHEN INSTALLING THIS EQUIPMENT.
7. THE ASSOCIATED APPARATUS MUST BE INSTALLED IN ACCORDANCE WITH BARRIER MANUFACTURE´S INSTALLATION DIAGRAM
8. SELECTED ASSOCIATED APPARATUS MUST BE THIRD PARTY LISTED AS PROVIDING INTRINSICALLY SAFE CIRCUITS FOR THE APPLICATION. IT MUST MEET THE REQUIREMENTS LISTED IN TABLE OF THIS INSTALLATION DIAGRAM:

PAGE 3 OF 4

Dieses ist eine zertifizierte Zeichnung
Änderungen nur mit Zustimmung der Prüfstelle
THIS IS A CERTIFIED DRAWING
REVISIONS ONLY WITH APPROVAL OF THE NOTIFIED BODY

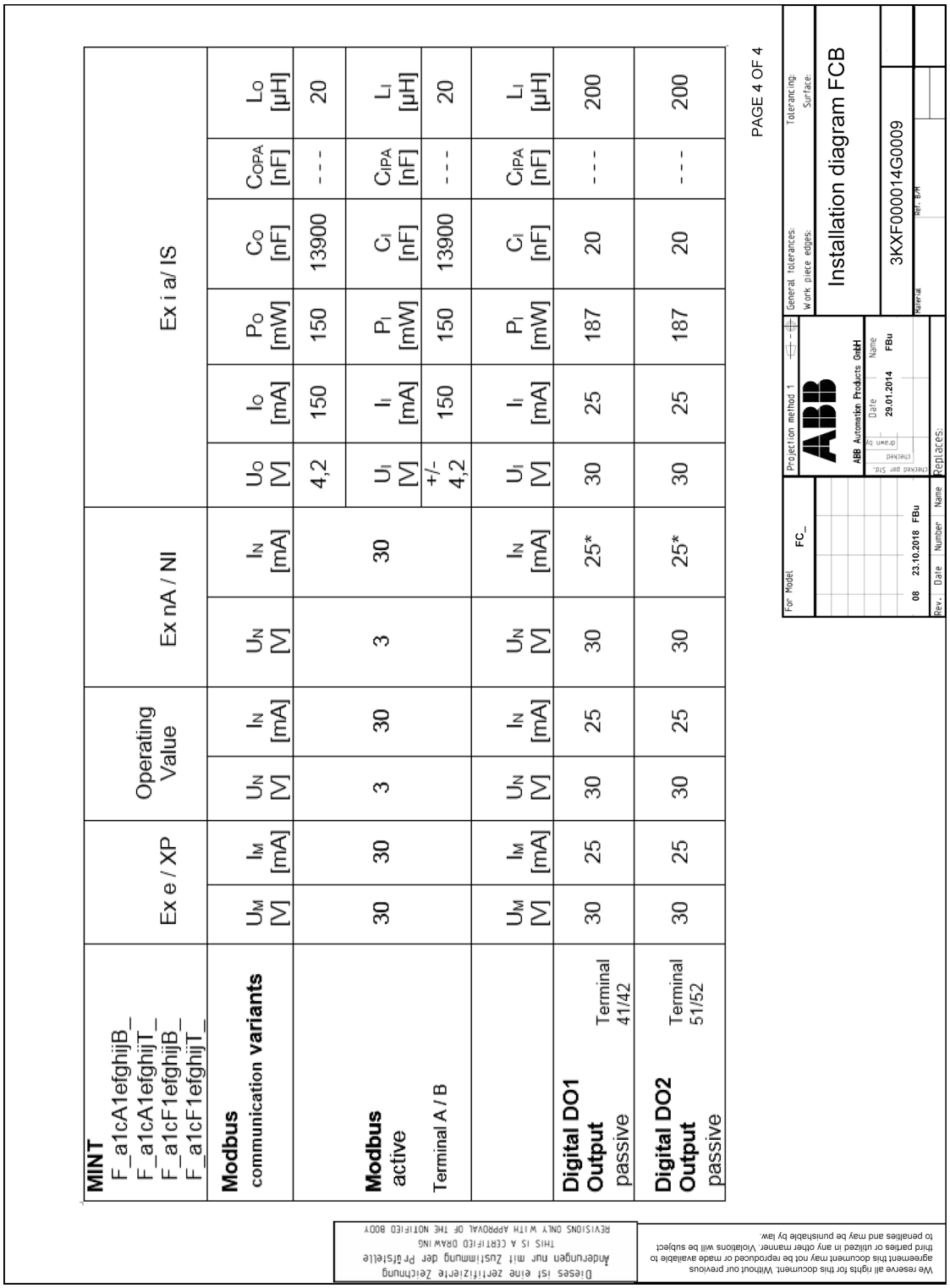
We reserve all rights for this document. Without our previous agreement this document may not be reproduced or made available to third parties or utilized in any other manner. Violations will be subject to penalties and may be punishable by law.

For Model	Projection method 1	General tolerances:	Tolerancing:
FC_	ABB Automation Products GmbH	Work piece edges:	Surface:
	Date / Name: 29.01.2014 FBu	Installation diagram FCB	
		3KXF000014G0009	
08 23.10.2018 FBu	Replaces:	Material:	Ref. B/M
Rev. Date Number Name			

… 15 Appendix

… Installation diagram 3KXF000014G0009

Page 4 of 4



Notes

ABB Measurement & Analytics

For your local ABB contact, visit:
www.abb.com/contacts

For more product information, visit:
www.abb.com/flow

We reserve the right to make technical changes or modify the contents of this document without prior notice. With regard to purchase orders, the agreed particulars shall prevail.
ABB does not accept any responsibility whatsoever for potential errors or possible lack of information in this document.

We reserve all rights in this document and in the subject matter and illustrations contained therein. Any reproduction, disclosure to third parties or utilization of its contents – in whole or in parts – is forbidden without prior written consent of ABB.

© ABB 2026

3KXF411009R4201

OI/FCB100/FCH100-EN Rev. J 03.2026