Operating Instruction OI/FCB100/FCH100-EN Rev. D

CoriolisMaster FCB130, FCB150, FCH130, FCH150
Coriolis Mass Flowmeter

Measurement made easy

Power and productivity
for a better world™

Short product description

Coriolis Mass FlowmeterFor the measurement of mass and volume flow, the density and the temperature of liquid and gaseous measuring media.

Devices firmware version: ≥ 01.02.01

Further information

Additional documentation on CoriolisMaster FCB130, FCB150, FCH130, FCH150 is available to download free of charge at www.abb.com/flow.
Alternatively simply scan this code:

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1 Safety

1.1 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.

1.2 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.

i NOTE

The signal word "NOTE" indicates useful or important information about the product.
The signal word "NOTE" is not a signal word indicating a danger to personnel. The signal word "NOTE" can also refer to material damage.

1.3 Intended use

This device is intended for the following uses:

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

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

When using media for measurement 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 safe operation of the materials of flowmeter sensor components coming into contact with these will not be adversely affected during the operating period.
- Measuring 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 can perform regular and suitable tests to ensure the safe condition of the meter.

1.4 Improper use

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

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

1.5 Warranty provisions

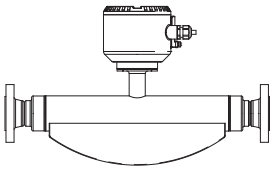
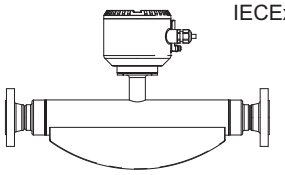
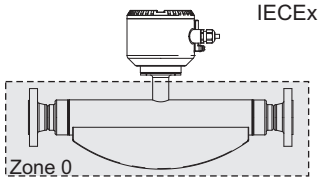
Using the device in a manner that does not fall within the scope of its intended use, disregarding this manual, using underqualified personnel, or making unauthorized alterations releases the manufacturer from liability for any resulting damage. This renders the manufacturer's warranty null and void.

2 Use in potentially explosive atmospheres according to ATEX and IECEx

NOTE

For further information on the approval of devices for use in potentially explosive atmospheres, refer to the type-examination certificates or the relevant certificates at www.abb.com/flow.

2.1 Device overview

	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	 G11604a	ATEX IECEx  G11604b	ATEX IECEx  G11604c

2.1.1 Ex-marking

NOTE

— Depending on the design, a specific marking in accordance with ATEX or IECEx applies.
— ABB reserves the right to modify the Ex-marking. Refer to the name plate for the exact marking.

NOTE

For further details on explosion protection, types of protection and device models, refer to the installation diagram in the annex!

Devices with a maximum ambient temperature $T_{amb.}$ 55 °C (131 °F)

The Ex-marking stated in the following tables only apply to devices with a maximum permitted ambient temperature of $T_{amb.}$ 55 °C (131 °F) (order code ambient temperature rangeTA8)!

Marking for model FCx1xx-A2... in Zone 2, 21, 22	
ATEX	**IECEx**
FM 14 ATEX0017X II 3 G Ex nA mc IIC T6 ... T2 Gc FM 14 ATEX0016X II 2 D Ex tb IIIC T85°C ... T_{medium} Db	IECEx FME 14.0003X Ex nA mc IIC T6 ... T2 Gc Ex tb IIIC T85°C ... T_{medium} Db

Marking for model FCx1xx-A1 in Zone 1, 21 (Zone 0)	
ATEX	**IECEx**
FM 14 ATEX0016X II 2/1 G Ex e ia mb IIC T5 ... T2 Ga/Gb $T_{amb.}$max= 55°C II 2/1 G Ex e ia mb IIC T6 ... T2 Ga/Gb $T_{amb.}$max= 50°C II 2 D Ex ia tb IIIC T85°C ... T_{medium} Db Control Installation Drawing No. 3KXF000014G0009	IECEx FME 14.0003X Ex e ia mb IIC T5 ... T2 Ga/Gb $T_{amb.}$max= 55°C Ex e ia mb IIC T6 ... T2 Ga/Gb $T_{amb.}$max= 50°C Ex ia tb IIIC T85°C ... T_{medium} Db Control Installation Drawing No. 3KXF000014G0009

Devices with a maximum ambient temperature $T_{amb.}$ 70 °C (158 °F)

The Ex-marking stated in the following tables only apply to devices with a maximum permitted ambient temperature of $T_{amb.}$ 70 °C (158 °F) (order code ambient temperature rangeTA3 / TA9)!

Marking for model FCx1xx-A2... in Zone 2, 21, 22	
ATEX	**IECEx**
FM 14 ATEX0017X II 3 G Ex nA mc IIC T6 ... T2 Gc FM 14 ATEX0016X II 2 D Ex tb IIIC T85°C ... T_{medium} Db	IECEx FME 14.0003X Ex nA mc IIC T6 ... T2 Gc Ex tb IIIC T85°C ... T_{medium} Db

Marking for model FCx1xx-A1 in Zone 1, 21 (Zone 0)	
ATEX	**IECEx**
FM 14 ATEX0016X II 2/1 G Ex e ia mb IIC T6 ... T2 Ga/Gb $T_{amb.}$max= 70°C II 2 D Ex ia tb IIIC T85°C ... T_{medium} Db Control Installation Drawing No. 3KXF000014G0009	IECEx FME 14.0003X Ex e ia mb IIC T6 ... T2 Ga/Gb $T_{amb.}$max= 70°C Ex ia tb IIIC T85°C ... T_{medium} Db Control Installation Drawing No. 3KXF000014G0009

2.2 Installation instructions

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 ignition protection types and installation techniques, concerned rules and regulations as well as general principles of zoning. The person must possess the relevant expertise for the type of works to be executed.
When operating with combustible dusts, EN 60079-31 must be complied with.
The safety instructions for electrical apparatus in potentially explosive areas must be complied with, in accordance with the directive 2014/34/EU (ATEX) and e.g. IEC 60079-14 (Installation of equipment in potentially explosive atmospheres).
To ensure safe operation, the respectively applicable requirements must be met for the protection of workers.

It is essential that the temperature classes as per the approvals contained in chapter "Temperature data" on page 10 are observed.
The information in the installation diagram "Installation diagram 3KXF000014G0009" on page 84 must be observed.

2.2.1 Use in areas exposed to combustible dust

When using the device in areas exposed to combustible dusts (dust ignition), the following points must be observed:

— The maximum surface temperature of the device must not exceed 85 °C (185 °F).
— The process temperature of the attached lead may exceed 85 °C (185 °F).

2.2.2 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:

— Check that a valid fire permit is available.
— Make sure that there is no explosion hazard.
— Before opening the device, switch off the power supply and wait for t > 2 minutes.

⚠ 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 chapter "Opening and closing the terminal box" on page 31.

For sealing original spare parts should be used only.

i NOTE

Spare parts can be ordered from ABB Service:
Please contact Customer Center Service acc. to page 2 for nearest service location.

2.2.3 Cable entries

The cable glands supplied are ATEX-/IECEx-certified.
The use of standard cable glands and seals is prohibited.
The black plugs in the cable fittings are intended to provide protection during transport. Any unused cable entry points must be sealed prior to commissioning, using the seals supplied.
The outer diameter of the connecting cable must measure between 6 mm (0.24 inch) and 12 mm (0.47 inch) to ensure the necessary seal integrity.
Black cable fittings 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

In order to provide the required temperature resistance, devices in the low-temperature design (optional, ambient temperature down to -40 °C (-40 °F) are delivered with cable glands made from metal.
These are then also to be used in intrinsically safe circuits.

2.2.4 Electrical connections

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, only use cables with sufficient temperature resistance according to the following diagram or table.

Devices with a maximum ambient temperature $T_{amb.}$ 55 °C (131 °F)

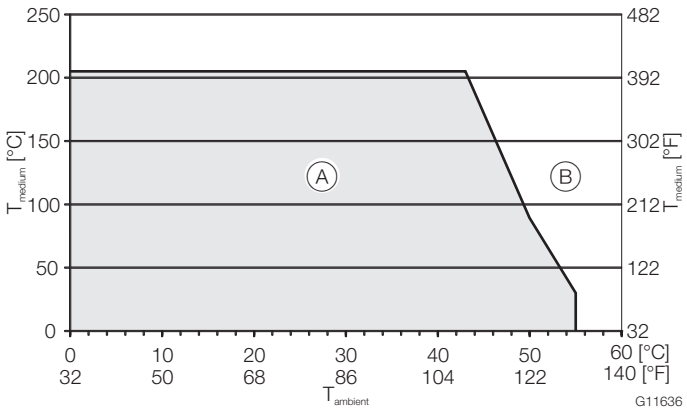


Fig. 1:Temperature range for the cable
(A) **Temperature resistance ≥ 70 °C (158 °F)**
(B) **Temperature resistance ≥ 80 °C (176 °F)**

Devices with a maximum ambient temperature $T_{amb.}$ 70 °C (158 °F)

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

Above an ambient temperature of $T_{amb.}$ ≥ 60 °C (≥ 140 °F), the wires in the connection box must be insulated with the enclosed silicone hoses.

Grounding

The sensor must be grounded in accordance with the applicable international standards.
Ground the device according to chapter "Electrical connections" on page 31.

2.3 Temperature data

Devices with a maximum ambient temperature $T_{amb.}$ 55 °C (131 °F)

The temperature data stated on this page only applies to devices with a maximum permitted ambient temperature of $T_{amb.}$ 55 °C (131 °F) (order code ambient temperature rangeTA8)!

Environmental and process conditions for model FCx1xx...

Ambient temperature		Measuring medium temperature	IP rating / NEMA rating
[$T_{amb.}$]	[$T_{amb.,\ optional}$]	[T_{medium}]	
-20 ... 55 °C (-4 ... 131 °F)	-40 ... 55 °C (-40 ... 131 °F)	-40 … 205 °C (-40 … 400 °F)	IP 64, IP 65, IP 67, IP 68 and NEMA 4X / type 4X

Measuring medium temperature (Ex data) for model FCx1xx-A1... in Zone 1

Ambient temperature [$T_{amb.}$]	≤50 °C (≤122 °F)	≤55 °C (≤131 °F)
Temperature class	Maximum permissible measuring medium temperature [T_{medium}]	
T1	205 °C (400 °F)	205 °C (400 °F)
T2	205 °C (400 °F)	205 °C (400 °F)
T3	195 °C (383 °F)	195 °C (383 °F)
T4	130 °C (266 °F)	130 °C (266 °F)
T5	95 °C (203 °F)	95 °C (203 °F)
T6	80 °C (176 °F)	—

Measuring medium temperature (Ex data) for model FCx1xx-A2... in Zone 2

Ambient temperature [$T_{amb.}$]	≤50 °C (≤122 °F)	≤55 °C (≤131 °F)
Temperature class	Maximum permissible measuring medium temperature [T_{medium}]	
T1	205 °C (400 °F)	205 °C (400 °F)
T2	205 °C (400 °F)	205 °C (400 °F)
T3	195 °C (383 °F)	195 °C (383 °F)
T4	130 °C (266 °F)	130 °C (266 °F)
T5	95 °C (203 °F)	95 °C (203 °F)
T6	80 °C (176 °F)	80 °C (176 °F)

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

Ambient temperature [$T_{amb.}$]	≤50 °C (≤122 °F)	≤55 °C (≤131 °F)
Temperature class	Maximum permissible measuring medium temperature [T_{medium}]	
T210°C	205 °C (400 °F)	205 °C (400 °F)
T200°C	195 °C (383 °F)	195 °C (383 °F)
T135°C	130 °C (266 °F)	130 °C (266 °F)
T100°C	95 °C (203 °F)	95 °C (203 °F)
T85°C	80 °C (176 °F)	—

Devices with a maximum ambient temperature $T_{amb.}$ 70 °C (158 °F)
The temperature data stated on this page only applies to devices with a maximum permitted ambient temperature of $T_{amb.}$ 70 °C (158 °F) (order code ambient temperature rangeTA3 / TA9)!

Environmental and process conditions for model FCx1xx...

Ambient temperature		Measuring medium temperature	IP rating / NEMA rating
[$T_{amb.}$]	[$T_{amb.}$, optional]	[T_{medium}]	
-20 ... 70 °C (-4 ... 158 °F)	-40 ... 70 °C (-40 ... 158 °F)	-40 ... 205 °C (-40 ... 400 °F)	IP 65, IP 67, IP 68 and NEMA 4X / type 4X

Measuring medium temperature (Ex data) for model FCx1xx-A1... in Zone 1

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

Measuring medium temperature (Ex data) for model FCx1xx-A2... in Zone 2

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

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

Ambient temperature [$T_{amb.}$]	≤30 °C (≤86 °F)	≤50 °C (≤122 °F)	≤60 °C (≤140 °F)	≤70 °C (≤158 °F)
Temperature class	Maximum permissible measuring medium temperature [T_{medium}]			
T210°C	205 °C (400 °F)	205 °C (400 °F)	205 °C (400 °F)	205 °C (400 °F)
T200°C	195 °C (383 °F)	195 °C (383 °F)	195 °C (383 °F)	195 °C (383 °F)
T135°C	130 °C (266 °F)	130 °C (266 °F)	130 °C (266 °F)	130 °C (266 °F)
T100°C	95 °C (203 °F)	95 °C (203 °F)	—	—
T85°C	80 °C (176 °F)	80 °C (176 °F)	—	—

2.4 Electrical data

2.4.1 Modbus outputs and digital outputs

Devices with a maximum ambient temperature $T_{amb.}$ 55 °C (131 °F)

The electrical data stated in the following tables only applies to devices with a maximum permitted ambient temperature of $T_{amb.}$ 55 °C (131 °F) (order code ambient temperature rangeTA8)!

Model: FCx1xx-A1, FCx1xx-A2

Outputs	Operating values (general)		Type of protection									
			"nA" (zone 2)		"e" (zone 1)		"ia" (zone 1)					
	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[mH]
Modbus, active	3	30	3	30	30	30	4.2	150	150	0	0	0
Terminals A / B							U_i [V]	I_i [mA]	P_i [mW]	C_i [nF]	C_i pa [nF]	L_i [mH]
							±4.2	150	150	0	0	0
Digital output DO1, passive	30	25	30	25	30	25	30	25	187	2.4	2.4	0.2
Terminals 41 / 42												
Digital output DO2, passive	30	25	30	25	30	25	30	25	187	10	0	0.2
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.

Devices with a maximum ambient temperature $T_{amb.}$ 70 °C (158 °F)

The electrical data stated in the following tables only applies to devices with a maximum permitted ambient temperature of $T_{amb.}$ 70 °C (158 °F) (order code ambient temperature rangeTA3 / TA9)!

Model: FCx1xx-A1, FCx1xx-A2

Outputs	Operating values (general)		Type of protection									
			"nA" (zone 2)		"e" (zone 1)		"ia" (zone 1)					
	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[mH]
Modbus, active	3	30	3	30	30	30	4.2	150	150	0	0	0
Terminals A / B							U_i [V]	I_i [mA]	P_i [mW]	C_i [nF]	C_i pa [nF]	L_i [mH]
							±4.2	150	150	0	0	0
Digital output DO1, passive	30	25	30	25	30	25	30	25	187	2.4	2.4	0.2
Terminals 41 / 42												
Digital output DO2, passive	30	25	30	25	30	25	30	25	187	20	0	0.2
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.

2.4.2 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.

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

- It is not permitted to combine intrinsically safe and non-intrinsically safe circuits.
- On intrinsically-safe circuits, equipotential bonding must be in place along the entire length of the cable used for the digital outputs.
- The rated voltage of the non-intrinsically safe circuits is U_M = 30 V.
- Provided that the rated voltage U_M = 30 V is not exceeded if connections are established to non-intrinsically safe external circuits, intrinsic safety is preserved.
- When changing the type of ignition protection, chapter "Change of the type of protection" on page 13 must be adhered to.

2.5 Operating instructions

2.5.1 Protection against electrostatic discharges

DANGER

Risk of explosion!

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

- The device is operated in environments with a relative humidity of ≤ 30 %.
- This painted surface of the device is therefore relatively free from impurities such as dirt, dust or oil.

The instructions on avoiding the ignition of hazardous areas due to electrostatic discharges in accordance with the EN TR50404 and IEC 60079-32-1 standards must be observed!

Instructions on cleaning

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

2.5.2 Repair

Contact the manufacturer for specific flamepath joint details during repair of flameproof Ex d apparatus.

2.5.3 Change of the type of protection

If you are installing in Zone 1 / Div. 1, the Modbus interface and the digital outputs of models FCB130/150 and FCH130/150 can be operated with different types of protection:

- Modbus interface and digital output in intrinsically safe ia / IS design
- Modbus interface and digital output in non-intrinsically safe design

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

Original installation	New installation	Necessary test steps
Zone 1 / Div. 1: Modbus interface and digital outputs in non-intrinsically safe design	**Zone 1 / Div. 1:** Modbus interface and digital outputs in intrinsically safe ia / IS design	— 500 V AC/1min or 500 x 1.414 = 710 V DC/1min Test between terminals A / B, 41 / 42 and 51 / 52 and terminals A, B, 41, 42, 51 and the housing. When this test is performed, no voltage flashover is permitted in or on the device. — Optical evaluation particularly of the electronic circuit boards, no visible damage or evidence of explosion.
Zone 1 / Div. 1: Modbus interface and digital outputs in intrinsically safe ia(ib) / IS design	**Zone 1 / Div. 1:** Modbus interface and digital outputs in non-intrinsically safe design	— Optical evaluation, no damage visible on the threads (cover, 1/2" NPT cable glands).

NOTE

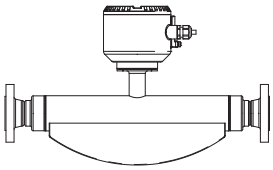
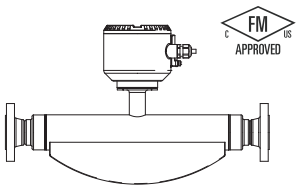
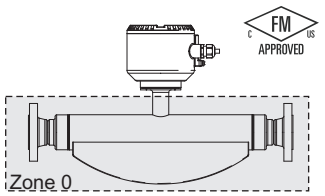
For further details on explosion protection, types of protection and device models, refer to the installation diagram in the annex!

3 Use in potentially explosive atmospheres in accordance with cFMus

NOTE

For further information on the approval of devices for use in potentially explosive atmospheres, refer to the type-examination certificates or the relevant certificates at www.abb.com/flow.

3.1 Device overview

	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	 G11605a	 G11605b	 G11605c

3.1.1 Ex-marking

NOTE

— Depending on the design, a specific marking in accordance with FM applies.
— ABB reserves the right to modify the Ex-marking. Refer to the name plate for the exact marking.

NOTE

For further details on explosion protection, types of protection and device models, refer to the installation diagram in the annex!

Marking for model FCx1xx-F2... in Zone 2, Div. 2	
FM (marking for US)	**FM (marking for Canada)**
NI: CL I, DIV2, GPS ABCD, T6 ... T2	NI: CL I, DIV2, GPS ABCD, T6 ... T2
NI: CL II, III, DIV2, GPS EFG, T6 ... T3B	NI: CL II, III, DIV2, GPS EFG, T6 ... T3B
DIP: CL II, Div 1, GPS EFG, T6 ... T3B	DIP: CL II, Div 1, GPS EFG, T6 ... T3B
DIP: CL III, Div 1, 2, T6 ... T3B	DIP: CL III, Div 1, 2, T6 ... T3B
CL I, ZN 2, AEx nA nR IIC T6 ... T2	Ex nA IIC T6 ... T2
ZN 21 AEx tb IIIC T85°C ... T165°C	See instructions for T-Class information
See instructions for T-Class information	

Marking for model FCx1xx-F1... in Zone 1, Div. 1	
FM (marking for US)	**FM (marking for Canada)**
NI: CL I, DIV2, GPS ABCD, T6 ... T2	NI: CL I, DIV2, GPS ABCD, T6 ... T2
NI: CL II, III, DIV2, GPS EFG, T6 ... T3B	NI: CL II, III, DIV2, GPS EFG, T6 ... T3B
XP-IS: CL I, Div 1, GPS BCD, T6 ... T2	XP-IS: CL I, Div 1, GPS BCD, T6 ... T2
DIP: CL II, Div 1, GPS EFG, T6 ... T3B	DIP: CL II, Div 1, GPS EFG, T6 ... T2
DIP: CL III, Div 1, 2, T6 ... T3B	DIP: CL III, Div 1, 2, T6 ... T3B
CL I, ZN 1, AEx d ia IIB+H2 T6 .. T2	Ex d ia IIB+H2 T6 .. T2
ZN 21 AEx ia tb IIIC T85°C to T165°C	Ex ia INTRINSICALLY SAFE SECURITE INTRINSEQUE
See instructions for T-Class information	See instructions for T-Class information
Control Installation Drawing No. 3KXF000014G0009	Control Installation Drawing No. 3KXF000014G0009

3.2 Installation instructions

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 contained in chapter "Temperature data" on page 17 are observed.
The information in the installation diagram " Installation diagram 3KXF000014G0009" on page 84 must be observed.

3.2.1 Use in areas exposed to combustible dust

When using the device in areas exposed to combustible dusts (dust ignition), the following points must be observed:

— The maximum surface temperature of the device must not exceed 85 °C (185 °F).
— The process temperature of the attached lead may exceed 85 °C (185 °F).

3.2.2 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:

— Check that a valid fire permit is available.
— Make sure that there is no explosion hazard.
— Before opening the device, switch off the power supply and wait for t > 2 minutes.

⚠ 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 chapter "Opening and closing the terminal box" on page 31.
For sealing original spare parts should be used only.

i NOTE

Spare parts can be ordered from ABB Service:
Please contact Customer Center Service acc. to page 2 for nearest service location.

3.2.3 Cable entries

NOTE

Devices certified in accordance with CSA are only ever supplied with 1/2" NPT threads without glands.

3.2.4 Electrical connections

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, only use cables with sufficient temperature resistance according to the following diagram or table.

Devices with a maximum ambient temperature $T_{amb.}$ 55 °C (131 °F)

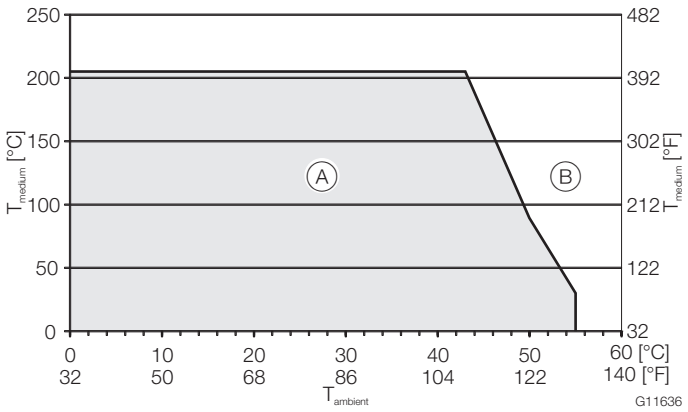


Fig. 2:Temperature range for the cable
(A) Temperature resistance ≥ 70 °C (158 °F)
(B) Temperature resistance ≥ 80 °C (176 °F)

Devices with a maximum ambient temperature $T_{amb.}$ 70 °C (158 °F)

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

Above an ambient temperature of $T_{amb.}$ ≥ 60 °C (≥ 140 °F), the wires in the connection box must be insulated with the enclosed silicone hoses.

Grounding

The sensor must be grounded in accordance with the applicable international standards.
In accordance with NEC standards, an internal ground connection is present in the device between the sensor and the transmitter.
Ground the device according to chapter "Electrical connections" on page 31.

3.2.5 Process sealing

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

NOTICE

The device is suitable for use in Canada.
A maximum surface temperature of 165 °C (329 °F) must not be exceeded when used in Class II, Groups E, F and G.
All cable conduits (conduits) must be sealed within a distance of 18 inches (457 mm) from the device.

ABB flowmeters are designed for the worldwide industrial market and are suitable for functions such as the measuring of flammable and combustible liquids and can be installed in process pipes.
Among other things, the devices with cable conduits (conduits) are connected to the electrical installation which makes it possible for process media to enter electrical systems.
To prevent process media from seeping into the electrical installation, the instruments are equipped with process seals which meet the requirements of ANSI / ISA 12.27.01.
Coriolis mass flowmeters are designed as "single seal devices".
With the TE2 "Extended tower length - dual seal" option, the devices can be used as "dual seal devices".
In accordance with the requirements of standard ANSI/ISA 12.27.01, the existing operating limits of temperature, pressure and pressure bearing parts must be reduced to the following limit values:

Limit values	
Flange or pipe material	All materials of the present model
Nominal sizes	DN 15 ... 150 (1/2" ... 6")
Operating temperature	-50 °C ... 205 °C (-58 °F ... 400 °F)
Process pressure	PN 100 / Class 600

3.3 Temperature data

Devices with a maximum ambient temperature $T_{amb.}$ 55 °C (131 °F)

The temperature data stated on this page only applies to devices with a maximum permitted ambient temperature of $T_{amb.}$ 55 °C (131 °F) (order code ambient temperature rangeTA8)!

Environmental and process conditions for model FCx1xx...

Ambient temperature		Measuring medium temperature	IP rating / NEMA rating
[T_{amb}]	[$T_{amb, optional}$]	[T_{medium}]	
-20 ... 55 °C (-4 ... 131 °F)	-40 ... 55 °C (-40 ... 131 °F)	-40 ... 205 °C (-40 ... 400 °F)	IP 64, IP 65, IP 67, IP 68 and NEMA 4X / type 4X

NOTICE

All cable conduits (conduits) must be sealed within a distance of 18 inches (450 mm) from the device.

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

Ambient temperature [T_{amb}]	≤50 °C (≤122 °F)	≤55 °C (≤131 °F)
Temperature class	Maximum permissible measuring medium temperature [T_{medium}]	
T1	205 °C (400 °F)	205 °C (400 °F)
T2	205 °C (400 °F)	205 °C (400 °F)
T3	195 °C (383 °F)	195 °C (383 °F)
T4	130 °C (266 °F)	130 °C (266 °F)
T5	95 °C (203 °F)	95 °C (203 °F)
T6	80 °C (176 °F)	80 °C (176 °F)

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

Ambient temperature [T_{amb}]	≤50 °C (≤122 °F)	≤55 °C (≤131 °F)
Temperature class	Maximum permissible measuring medium temperature [T_{medium}]	
T1	205 °C (400 °F)	205 °C (400 °F)
T2	205 °C (400 °F)	205 °C (400 °F)
T3	195 °C (383 °F)	195 °C (383 °F)
T4	130 °C (266 °F)	130 °C (266 °F)
T5	95 °C (203 °F)	95 °C (203 °F)
T6	80 °C (176 °F)	80 °C (176 °F)

Measuring medium temperature (Ex data) for model FCx1xx-F1... in Zone 21, Class II / III and FCx1xx-F2... in Zone 22, Class II / III

Ambient temperature [T_{amb}]	≤50 °C (≤122 °F)	≤55 °C (≤131 °F)
Temperature class	Maximum permissible measuring medium temperature [T_{medium}]	
T165°C	160 °C (320 °F)	160 °C (320 °F)
T135°C	130 °C (266 °F)	130 °C (266 °F)
T100°C	95 °C (203 °F)	95 °C (203 °F)
T85°C	80 °C (176 °F)	—

Devices with a maximum ambient temperature $T_{amb.}$ 70 °C (158 °F)
The temperature data stated on this page only applies to devices with a maximum permitted ambient temperature of $T_{amb.}$ 70 °C (158 °F) (order code ambient temperature rangeTA3 / TA9)!

Environmental and process conditions for model FCx1xx...

Ambient temperature		Measuring medium temperature	IP rating / NEMA rating
[$T_{amb.}$]	[$T_{amb.,\ optional}$]	[T_{medium}]	
-20 ... 70 °C (-4 ... 158 °F)	-40 ... 70 °C (-40 ... 158 °F)	-40 … 205 °C (-40 … 400 °F)	IP 65, IP 67, IP 68 and NEMA 4X / type 4X

NOTICE
All cable conduits (conduits) must be sealed within a distance of 18 inches (450 mm) from the device.

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

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

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

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

Measuring medium temperature (Ex data) for model FCx1xx-F1... in Zone 21, Class II / III and FCx1xx-F2... in Zone 22, Class II / III

Ambient temperature [$T_{amb.}$]	≤30 °C (≤86 °F)	≤50 °C (≤122 °F)	≤60 °C (≤140 °F)	≤70 °C (≤158 °F)
Temperature class	Maximum permissible measuring medium temperature [T_{medium}]			
T210°C	205 °C (400 °F)	205 °C (400 °F)	205 °C (400 °F)	205 °C (400 °F)
T200°C	195 °C (383 °F)	195 °C (383 °F)	195 °C (383 °F)	195 °C (383 °F)
T135°C	130 °C (266 °F)	130 °C (266 °F)	130 °C (266 °F)	130 °C (266 °F)
T100°C	95 °C (203 °F)	95 °C (203 °F)	—	—
T85°C	80 °C (176 °F)	80 °C (176 °F)	—	—

3.4 Electrical data

3.4.1 Modbus outputs and digital outputs

Devices with a maximum ambient temperature $T_{amb.}$ 55 °C (131 °F)

The electrical data stated in the following tables only applies to devices with a maximum permitted ambient temperature of $T_{amb.}$ 55 °C (131 °F) (order code ambient temperature rangeTA8)!

Model: FCx1xx-F1, FCx1xx-F2

Outputs	Operating values (general)		Type of protection									
			NI (Div. 2, Zone 2)		XP (Div. 1, Zone 1)		IS (Div. 1, Zone 1)					
	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[mH]
Modbus, active	3	30	3	30	30	30	4.2	150	150	0	0	0
Terminals A / B							U_i [V]	I_i [mA]	P_i [mW]	C_i [nF]	C_i pa [nF]	L_i [mH]
							±4.2	150	150	0	0	0
Digital output DO1, passive	30	25	30	25	30	25	30	25	187	2.4	2.4	0.2
Terminals 41 / 42												
Digital output DO2, passive	30	25	30	25	30	25	30	25	187	10	0	0.2
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.

Devices with a maximum ambient temperature $T_{amb.}$ 70 °C (158 °F)

The electrical data stated in the following tables only applies to devices with a maximum permitted ambient temperature of $T_{amb.}$ 70 °C (158 °F) (order code ambient temperature rangeTA3 / TA9)!

Model: FCx1xx-F1, FCx1xx-F2

Outputs	Operating values (general)		Type of protection									
			NI (Div. 2, Zone 2)		XP (Div. 1, Zone 1)		IS (Div. 1, Zone 1)					
	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[mH]
Modbus, active	3	30	3	30	30	30	4.2	150	150	0	0	0
Terminals A / B							U_i [V]	I_i [mA]	P_i [mW]	C_i [nF]	C_i pa [nF]	L_i [mH]
							±4.2	150	150	0	0	0
Digital output DO1, passive	30	25	30	25	30	25	30	25	187	2.4	2.4	0.2
Terminals 41 / 42												
Digital output DO2, passive	30	25	30	25	30	25	30	25	187	20	0	0.2
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.

3.4.2 Special connection conditions

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

- It is not permitted to combine intrinsically safe and non-intrinsically safe circuits.
- On intrinsically-safe circuits, equipotential bonding must be in place along the entire length of the cable used for the digital outputs.
- The rated voltage of the non-intrinsically safe circuits is U_M = 30 V.
- Provided that the rated voltage U_M = 30 V is not exceeded if connections are established to non-intrinsically safe external circuits, intrinsic safety is preserved.
- When changing the type of ignition protection, chapter "Change of the type of protection" on page 21 must be adhered to.

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.

3.5 Operating instructions

3.5.1 Protection against electrostatic discharges

DANGER

Risk of explosion!

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

- The device is operated in environments with a relative humidity of ≤ 30 %.
- This painted surface of the device is therefore relatively free from impurities such as dirt, dust or oil.

The instructions on avoiding the ignition of hazardous areas due to electrostatic discharges in accordance with the EN TR50404 and IEC 60079-32-1 standards must be observed!

Instructions on cleaning

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

3.5.2 Repair

Contact the manufacturer for specific flamepath joint details during repair of flameproof “XP” apparatus.

3.5.3 Change of the type of protection

The Modbus interface and the digital outputs of the models FCB130/150 and FCH130/150 can be operated with different types of protection:

— When connecting to an intrinsically safe circuit in Div. 1 as an intrinsically safe device (IS).
— When connecting to a non-intrinsically safe circuit in Div. 1 as a device with flameproof enclosure (XP).
— When connecting to a non-intrinsically safe circuit in Div. 2 as a non-sparking device (NI).

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

Original installation	New installation	Necessary test steps
Housing: XP, U_{max} = 30 V Outputs non IS	Housing: XP Outputs: IS	— 500 V AC/1min or 500 x 1.414 = 710 V DC/1min Test between terminals A / B, 41 / 42 and 51 / 52 and terminals A, B, 41, 42, 51 and the housing. When this test is performed, no voltage flashover is permitted in or on the device. — Optical evaluation particularly of the electronic circuit boards, no visible damage or evidence of explosion.
	Housings: Div 2 Outputs: NI	— 500 V AC/1min or 500 x 1.414 = 710 V DC/1min Test between terminals A / B, 41 / 42 and 51 / 52 and terminals A, B, 41, 42, 51 and the housing. When this test is performed, no voltage flashover is permitted in or on the device. — Optical evaluation particularly of the electronic circuit boards, no visible damage or evidence of explosion.
Outputs: IS Housing: XP	Housing: XP Outputs: non IS	— Optical evaluation, no damage visible on the threads (cover, 1/2" NPT cable glands).
	Housing: XP Outputs: NI	— No special measures.
Housing: XP, U_{max} = 30 V Outputs: NI	Housing: XP Outputs: IS	— 500 V AC/1min or 500 x 1.414 = 710 V DC/1min Test between terminals A / B, 41 / 42 and 51 / 52 and terminals A, B, 41, 42, 51 and the housing. When this test is performed, no voltage flashover is permitted in or on the device. — Optical evaluation particularly of the electronic circuit boards, no visible damage or evidence of explosion.
	Housing: XP Outputs: non IS	— Optical evaluation, no damage visible on the threads (cover, 1/2" NPT cable glands).

NOTE

For further details on explosion protection, types of protection and device models, refer to the installation diagram in the annex!

4 Function and System Design

4.1 General remarks

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.

4.2 Measuring principle

When a mass flows through a vibrating pipe, Coriolis forces are generated which bend and twist the pipe. These very small pipe deformations are measured by optimally mounted sensors and electronically evaluated. Because the measured phase shift of the sensor signals is proportional to the mass flow rate, the Coriolis Mass Flowmeter measures the mass flow rate in the flowmeter directly. The metering principle is independent of the density, temperature, viscosity, pressure and conductivity of the fluid.

The meter tubes always vibrate at resonance. This resonant frequency, at the operating conditions, is a function of the meter tube geometry, the characteristics of the flowmeter materials and the mass of the fluid in the meter tube, which is also vibrating. It provides an accurate measure of the density of the fluid being metered.

An integrated temperature sensor measures the fluid temperature and is utilized for corrections to temperature-dependent instrument parameters. Summarizing, it is possible to simultaneously measure the mass flow rate, fluid 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

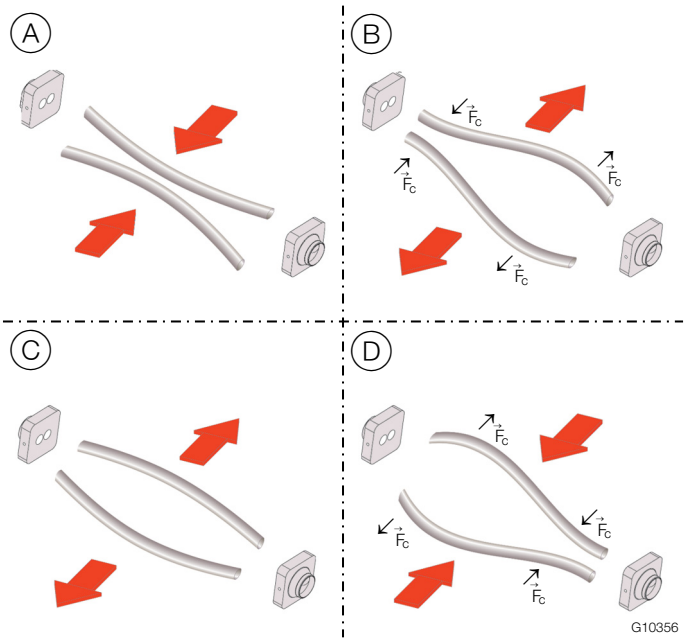


Fig. 3: Simplified representation of Coriolis forces

Fig. 3	Description
A	Movement of the pipes inward no flow
B	Direction of the Coriolis force with flow when the tubes are moving outward
C	Movement of the pipes outward no flow
D	Direction of the Coriolis force with flow when the tubes are moving inward

4.3 Device designs

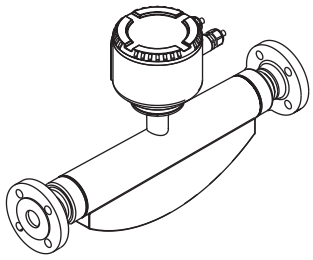


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Fig. 4: FCB1xx / FCH1xx

Model number	FCB1xx for standard applications		FCH1xx for hygienic applications	
Process connections				
— Flange DIN 2501 / EN 1092-1	DN 10 … 200, PN 40 … 100		—	
— Flange ASME B16.5	DN 1/2“ … 8“, CL150 … CL1500		—	
— Threaded pipe fitting conforming to DIN 11851	DN 10 … 100 (1/4" … 4")		DN 15 … 80 (1/2" … 3")	
— Tri-Clamp	DIN 32676 (ISO 2852) / BPE Tri-Clamp DN 10 … 100 (1/4" … 4")		DIN 32676 (ISO 2852) / BPE Tri-Clamp DN 10 … 100 (1/4" … 4")	
— Other connections	On request		On request	
Wetted material	stainless steel 1.4404 (AISI 316L) or 1.4435 (AISI 316L), nickel-alloy C4 / C22 (optional)		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 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	—		EHEDG, FDA compliant	
— Further approvals	Available on our website abb.com/flow or on request			
Measuring accuracy for liquids	FCB130	FCB150	FCH130	FCH150
— Mass flow [1]	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 [1]	0.4 %, 0.25 % and 0.2 %	0.15 %	0.4 %, 0.25 % and 0.2 %	0.15 %
— Density	0.01 kg/l	— 0.002 kg/l — 0.001 kg/l (optional) — 0.0005 kg/l [2]	0.01 kg/l	— 0.002 kg/l — 0.001 kg/l (optional) — 0.0005 kg/l [2]
— Temperature	1 K	0.5 K	1 K	0.5 K
Measuring accuracy for gases [1]	1 %	0.5 %	1 %	0.5 %
Permissible measuring medium temperature	-50 … 160 °C (-58 ... 320 °F)	-50 … 205 °C (-58 ... 400 °F)	-50 … 160 °C (-58 ... 320 °F)	-50 … 205 °C (-58 ... 400 °F)
Power supply	11 … 30 V DC			
IP rating in accordance with EN 60529	IP 65 / IP 67 / IP 68 (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" fill function	Yes, optional on models FCB150 and FCH150			
"VeriMass" diagnosis function	Yes, optional			

1) Indication of accuracy in % of the measured value (% of measured value)
2) Measuring accuracy following on-site calibration under operating conditions

5 Product identification

5.1 Name plate

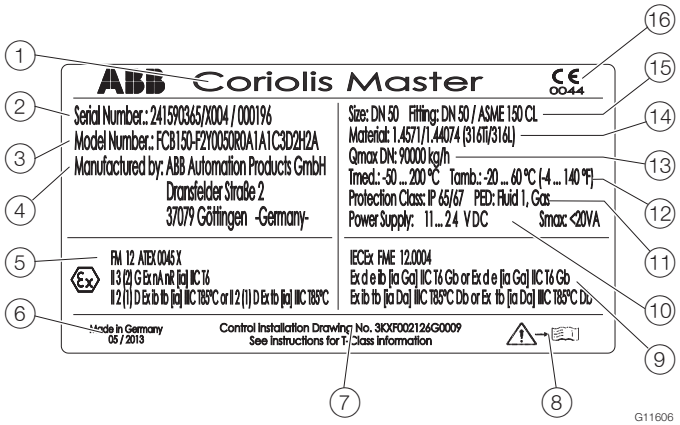

Fig. 5: Name plate (example)
(1) Type designation (2) Serial number (3) Order code
(4) Manufacturer (5) Ex-marking ATEX / IECEx
(6) Year of manufacture (month / year) (7) Installation drawing
(8) Symbol "Follow operating instructions" (9) Ex-marking cFMus
(10) Power supply / Maximum power consumption
(11) IP rating / designation of pressure equipment directive
(12) Medium temperature range / ambient temperature range
(13) Maximum flow rate (14) Measuring tube material
(15) Process connection / pressure rating (16) CE mark

i NOTE

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

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

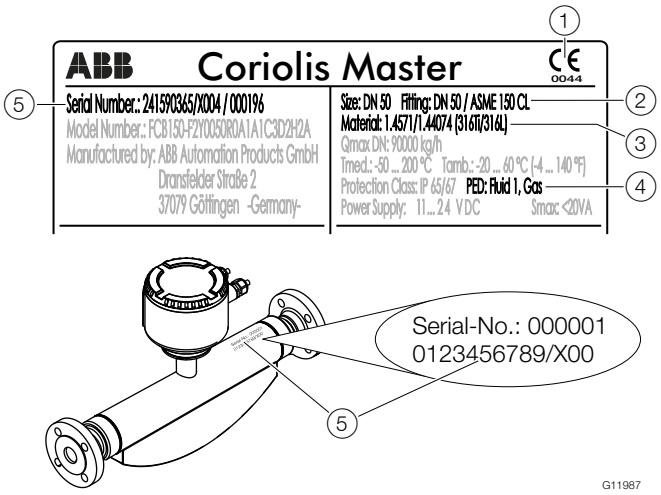

Fig. 6: PED marking (example)
(1) CE mark with the notified body (2) Nominal diameter / nominal pressure rating (3) Material of the pressure-bearing parts (wetted parts) (4) Fluid group or reason for exception (5) Serial number of the sensor

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.
According to the PED, the fluid group to be taken into account is specified in accordance with the Pressure Equipment Directive.
Example: Fluid Group 1 = hazardous fluids, gaseous.

Pressure equipment beyond the scope of the Pressure Equipment Directive

The reason for exception according to article 4, paragraph 3 of the Pressure Equipment Directive is specified under the PED.
The pressure equipment is categorized in SEP (= Sound Engineering Practice).

6 Transport and storage

6.1 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.

6.2 Transport

⚠ DANGER

Life-threatening danger due to suspended loads.
In the case of suspended loads, a danger of the load falling exists.
Remaining 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.

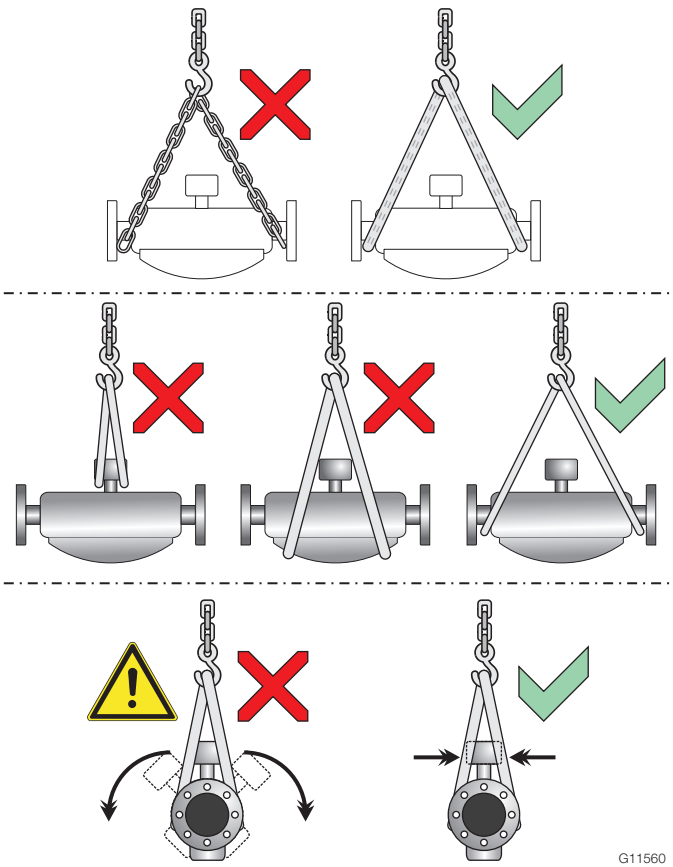

Fig. 7 Transport instructions

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

6.3 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!

6.4 Returning devices

For the return of devices, follow the instructions in the chapter "Repair" on page 81.

7 Installation

7.1 General installation conditions

7.1.1 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_{amb}) 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 the ambient temperature $T_{amb.}$ must be observed.
- 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" guidelines (in accordance with the standards referred to in the declaration of conformity).
  Maintain a suitable distance from electromagnetic fields and interference that extend beyond the usual dimensions.

Gaskets

Users are responsible for selecting and mounting suitable gaskets (material, shape).
Note the following points when selecting and mounting gaskets:

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

Calculating pressure loss

Pressure loss is determined by the properties of the medium and the flow.
Documents to help with the calculation of pressure loss can be accessed from 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" guidelines, 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 attach any supports or brackets to the flowmeter sensor housing.

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.

7.2 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).

7.2.1 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

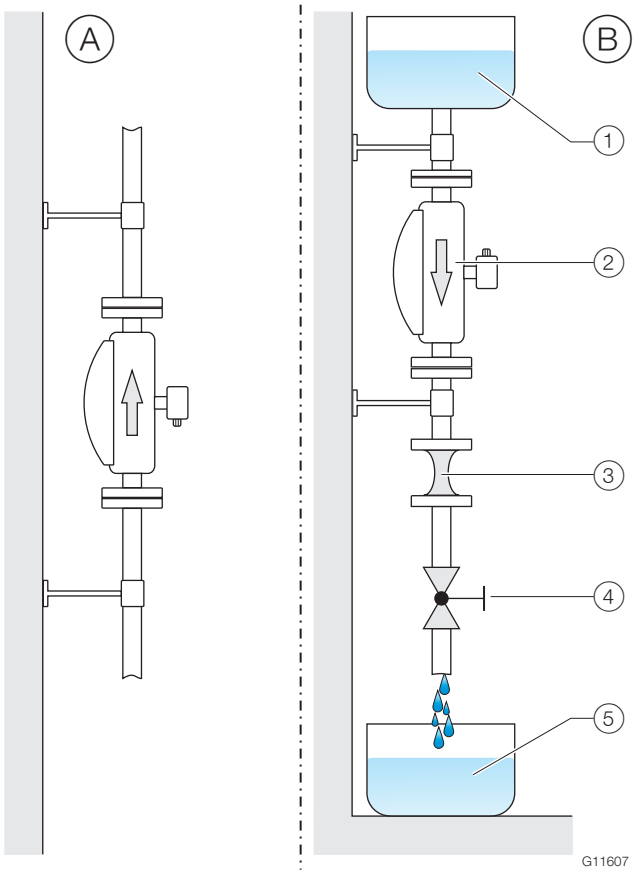

Fig. 8: Vertical installation
(1) Supply tank (2) Sensor (3) Piping constriction / orifice plate
(4) Turn-off device (5) Filling tank

(A) Vertical installation in a riser

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

(B) Vertical installation in a downpipe

For vertical installation in a downpipe, a piping constriction or an orifice plate must be installed below the sensor. Doing this prevents the sensor from draining during the measurement.

Horizontal installation

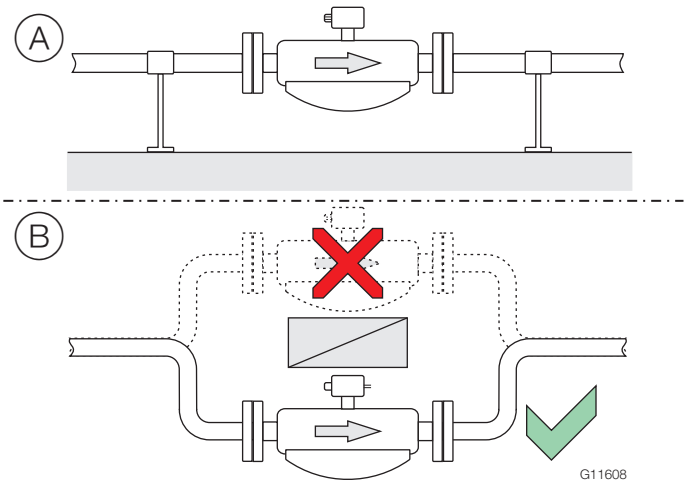

Fig. 9: Horizontal installation

(A) For liquid measuring media and horizontal installation, the transmitter and terminal box must point upward.
(B) Installing the sensor at the highest point of the piping leads to an increased number of measuring errors due to the accumulation of air or the formation of gas bubbles in the meter tube.

7.2.2 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

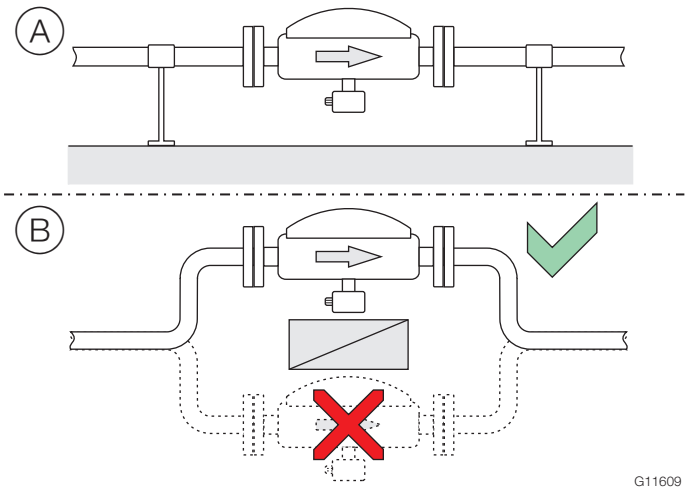

Fig. 10: Horizontal installation

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

7.2.3 Mounting position dependent on the measuring medium temperature

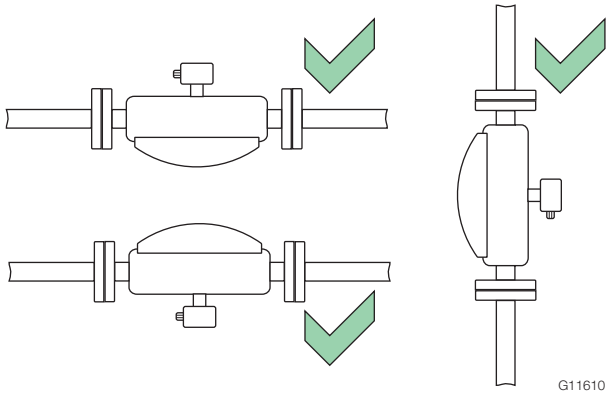

Fig. 11: Mounting positions when T_{medium} is -50 ... 120 °C (-58 ... 248 °F)

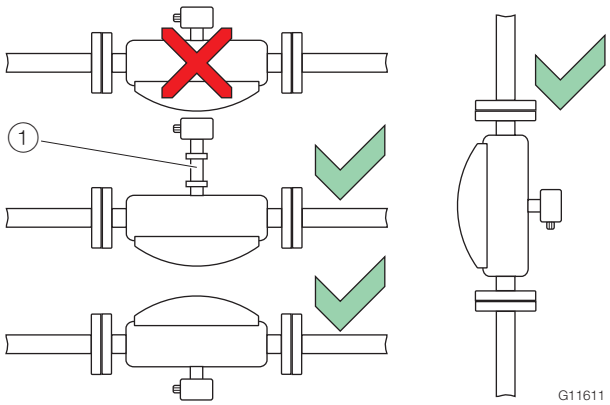

Fig. 12: Mounting positions when T_{medium} is -50 ... 205 °C (-58 ... 401 °F)
(1) Sensor with option TE1 "extended tower length"

In conjunction with option TE1 "extended tower length", the sensor can also be used at measuring medium temperatures of -50 ... 205 °C (-58 ... 401 °F) with the terminal box pointing upward.

7.2.4 Sensor insulation

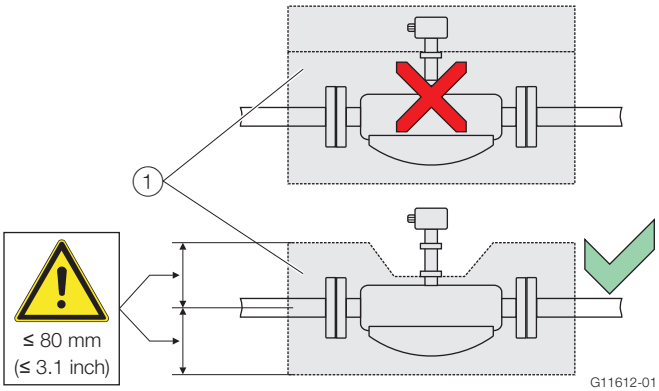

Fig. 13: Installation when T_{medium} is -50°... 205 °C (-58 ... 400 °F)
(1) Insulation

The sensor may be insulated only in conjunction with option TE1 "Tower length extension - meter insulation capability" or TE2 "Tower length extension - meter insulation capability with double sealing", as shown in Fig. 13.

7.2.5 Turn-off devices for zero point adjustment

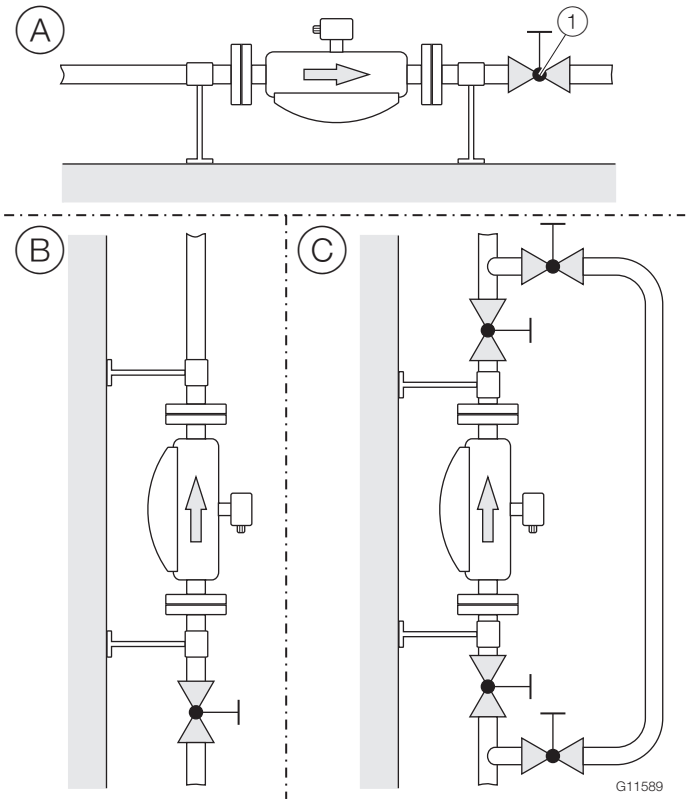

Fig. 14: Mounting options for turn-off devices (example)
(1) **Turn-off device**

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

(A) At least on the outlet side when the transmitter is mounted in horizontal position.

(B) At least on the inlet side when the transmitter is mounted in vertical position.

(C) In order to perform adjustment during an ongoing process, it is advisable to mount a bypass pipe as shown.

7.2.6 Installation in EHEDG-compliant installations

⚠ WARNING

Risk of poisoning!

Bacteria and chemical substances can contaminate or pollute pipeline systems and the materials they are made of. In EHEDG-compliant installations, the instructions below must be observed.

- The required self-draining functionality of the sensor can only be guaranteed when the vertical mounting position is used (see also Fig. 8 on page 27).
- The combination of process connections and gaskets selected by the operator may comprise only EHEDG-compliant components.Note the information in the current version of the EHEDG Position Paper entitled "Hygienic Process connections to use with hygienic components and equipment".
- The pipe fitting in accordance with DIN 11851 is approved for use in conjunction with an EHEDG-compliant gasket.

7.3 Temperature data

i NOTICE

When using the device in potentially explosive atmospheres, note the additional data in chapter "Use in potentially explosive atmospheres according to ATEX and IECEx" on page 6 and in chapter "Use in potentially explosive atmospheres in accordance with cFMus" on page 14 !

Measuring medium temperature T_{medium}

- FCx130: -50 … 160 °C (-58 … 320 °F)
- FCx150: -50 … 205 °C (-58 … 401 °F)

Ambient temperature $T_{amb.}$

The permissible ambient temperature range depends on the order code "ambient temperature range" (TA3, TA8, TA9).

- TA3: -20 … 70 °C (-4 … 158 °F)
- TA8: -40 … 55 °C (-40 … 131 °F)
- TA9: -40 … 70 °C (-40 … 158 °F)

7.4 Material load

7.4.1 Material load for process connections

Design	Nominal diameter	PS_{max}	TS_{max}	TS_{min}
Threaded pipe connection (DIN 11851)	DN 15 … 40 (1/2 … 1 1/2“)	40 bar (580 psi)	140 °C (284 °F)	-40 °C (-40 °F)
	DN 50 … 100 (2 … 4“)	25 bar (363 psi)	140 °C (284 °F)	-40 °C (-40 °F)
Tri-Clamp (DIN 32676)	DN 15 … 50 (1/2 … 2“)	16 bar (232 psi)	120 °C (248 °F)	-40 °C (-40 °F)
	DN 65 … 100 (2 1/2 … 4“)	10 bar (145 psi)	120 °C (248 °F)	-40 °C (-40 °F)

7.4.2 Material load curves for flange devices

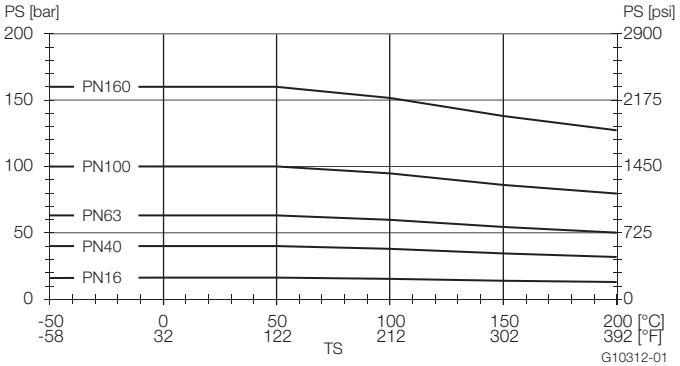

Fig. 15: Stainless steel DIN flange 1.4571 / 1.4404 (316Ti / 316L) up to DN 200 (8“)

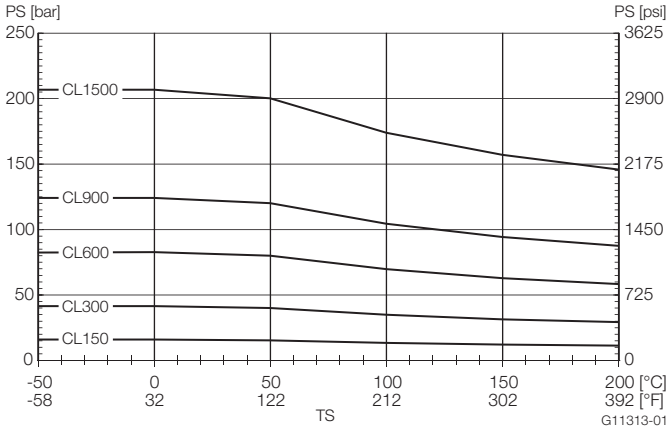

Fig. 16: Stainless steel ASME flange 1.4571 / 1.4404 (316Ti / 316L) up to DN 200 (8“)

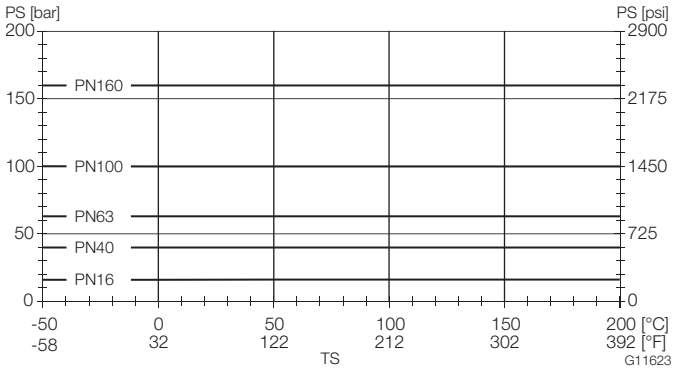

Fig. 17: DIN flange Nickel-Alloy C4 (2.4610) or Nickel-Alloy C22 up to DN 200 (8“)

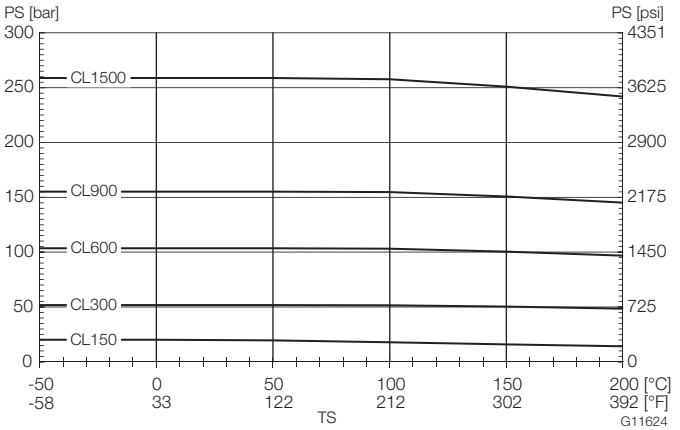

Fig. 18: ASME flange Nickel-Alloy C4 (2.4610) or Nickel-Alloy C22 up to DN 200 (8“)

7.5 Installing the sensor

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

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

7.6 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:

— Check that a valid fire permit is available.
— Make sure that there is no explosion hazard.
— Before opening the device, switch off the power supply and wait for t > 2 minutes.

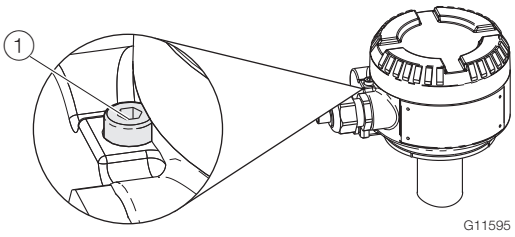

Fig. 19: Cover safety device (example)

In order to open the housing, release the cover safety device by screwing in the Allen screw (1).
After closing the housing, lock the housing cover by unscrewing the Allen screw (1).

i 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.

7.7 Electrical connections

⚠ 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.

i NOTICE

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 the manual must be observed; otherwise, the type of electrical protection may be adversely affected.
Ground the measurement system according to requirements.

7.7.1 Installing the connecting cables

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

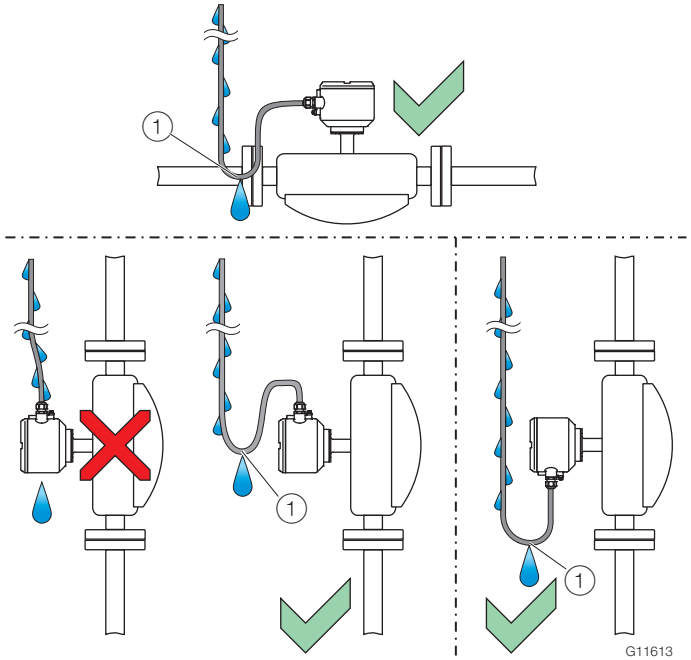

Fig. 20: Laying of the connecting cable
(1) Drip loop

7.7.2 Electrical connection

Models FCB130, FCB150, FCH130 and FCH150

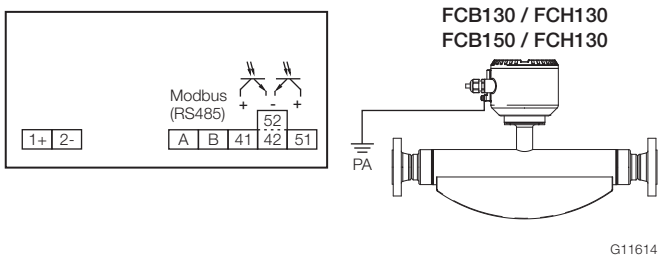

Fig. 21: Electrical connection
PA = Potential equalization

Connections for the power supply

DC voltage supply	
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.

7.7.3 Electrical data for inputs and outputs

NOTE

When using the device in potentially explosive atmospheres, follow the additional connection data in chapter "Use in potentially explosive atmospheres according to ATEX and IECEx" and chapter "Use in potentially explosive atmospheres in accordance with cFMus"!

Power supply

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

Digital output 41 / 42, 51 / 52

Can be configured via Modbus.

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} ≤ 3 kHz.

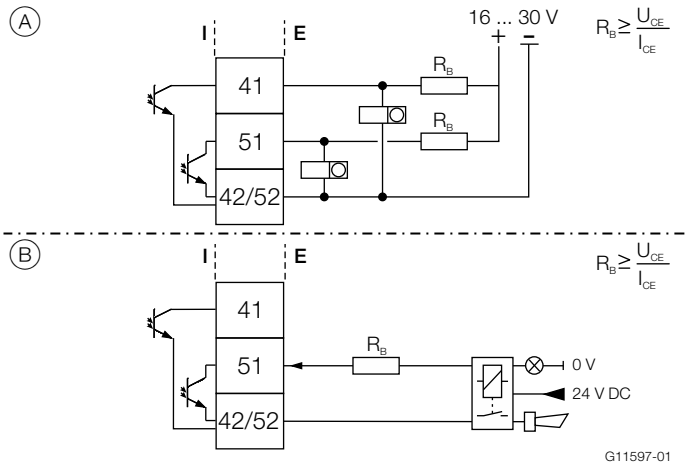

Fig. 22: Passive digital outputs (I = internal, E = external)
(A) Passive digital output 41 / 42 as pulse or frequency output, Passive digital output 51 / 52 as pulse output
(B) Passive digital output 51 / 52 as binary output

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

Binary output (passive)	
Terminals	41 / 42, 51 / 52
Output "closed"	0 V ≤ U_{CEL} ≤ 3 V 2 mA ≤ I_{CEL} ≤ 30 mA
Output "open"	16 V ≤ U_{CEH} ≤ 3 V DC 0 mA ≤ I_{CEH} ≤ 0.2 mA
Switching function	Can be configured via Modbus. "Parameter range - Output" on page 58

7.7.4 Modbus protocol

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.

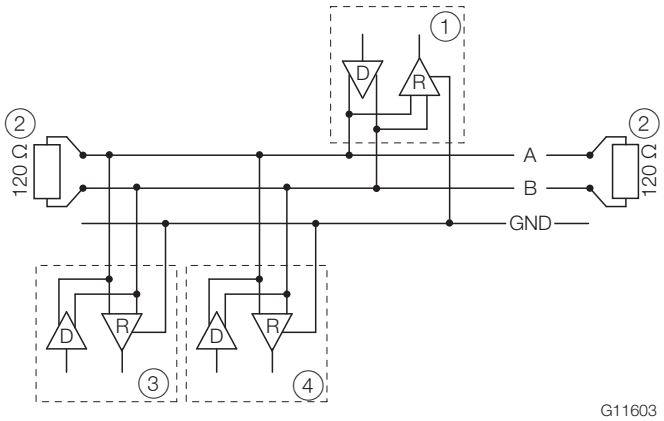

Fig. 23: Communication via the Modbus protocol
(1) Modbus master (2) Terminating resistor (3) Modbus slave 1 (4) Modbus slave n ... 32

Modbus protocol	
Configuration	Via the Modbus interface or via the local operating interface in connection with Asset Vision Basic (DAT200) and a corresponding Device Type Manager (DTM)
Transmission	Modbus RTU - RS485 serial connection
Baud rate	2400, 4800, 9600, 19,200, 38,400, 56,000, 57,600, 115,200 baud Factory setting: 9,600 baud
Parity	None, even, odd Factory setting: odd
Stop bit	One, two Factory setting: One
IEEE format	Little endian, big endian Factory setting: Little endian
Typical response time	< 100 ms
Response delay time	0 ... 200 milliseconds Factory setting: 10 milliseconds

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 (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 19,200 and above.

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".
See Chapter "Parameter range - communication" on page 62.
The length of the response telegram is dependent upon the number of bytes read and the baud rate configured.

7.7.5 Connection on the device

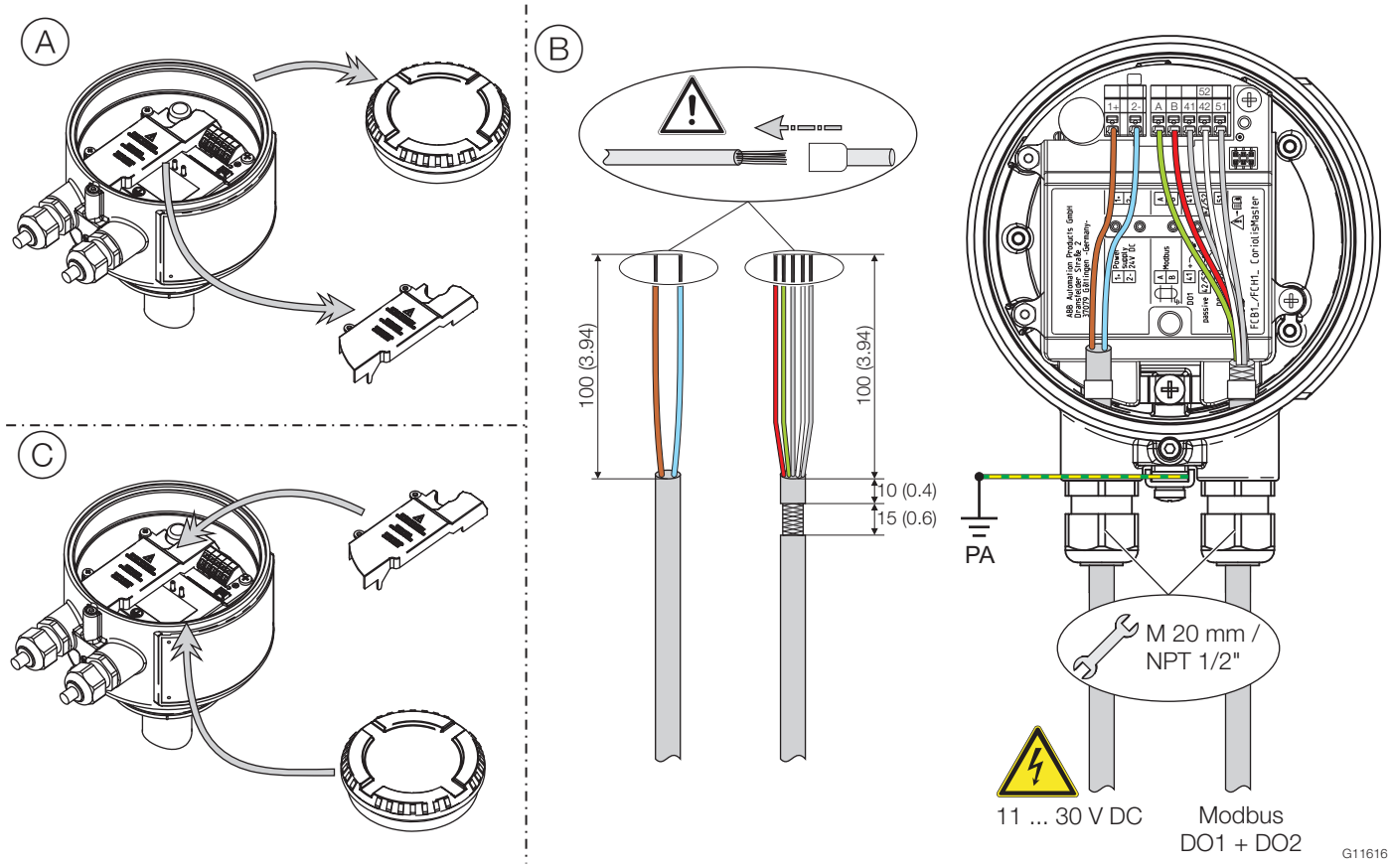

Fig. 24: Connection on the device (example), dimensions in mm (inch)
PA = potential equalization

Connect the compact design: Perform steps Ⓐ … Ⓒ.
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 diagram. 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.

NOTICE

If the O-ring gasket is seated incorrectly or is damaged, this may have an 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.

Observe the following points when connecting to the power supply:

- Adhere to the limit values of the power supply according to the information on the device identification plate.
- The leads must comply with IEC 227 and/or IEC 245.
- Complete the electrical connection according to the electrical plan.

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

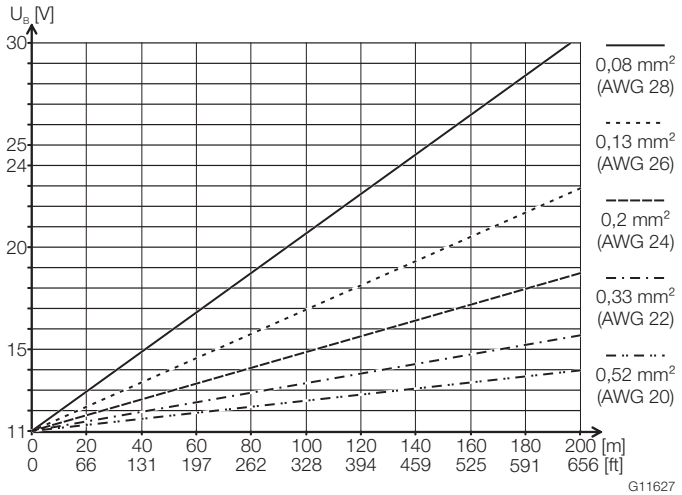

Fig. 25: Maximum cable lengths (examples)
U_B = supply voltage, L = cable length

8 Commissioning and operation

8.1 Write-protection switch, service LED and local operating interface

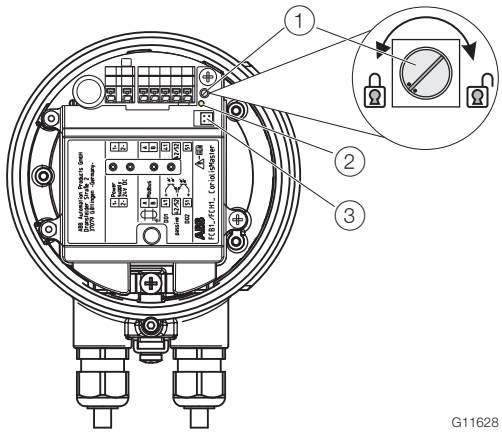

Fig. 26
(1) Write protection switch (2) Service LED
(3) Local operating interface

Write protection 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 while turning the switch counter-clockwise activates it.
For the change to the setting to take effect, the energy supply to the transmitter must be temporarily interrupted.

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 chapter "Parameter range – diagnosis" on page 63

Local operating interface

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

8.2 Checks prior to commissioning

The following points must be checked before commissioning the device:

- The wiring must have been completed as described in the chapter "Electrical connections" on page 31.
- The correct grounding of the sensor.
- The ambient conditions must meet the requirements set out in the technical data.
- The power supply must meet the requirements set out on the identification plate.

NOTE

Damage of the device due to undervoltage!
In case of lower voltage than defined on the type plate, the current draw of the device device increases.
Thus, the internal fuses may be damaged.

8.3 Switching on the power supply

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

The flowmeter is now ready for operation.

8.3.1 Inspection after switching on the power supply

The following points must be checked after commissioning the device:

- The parameter configuration must correspond to the operating conditions.
- The system zero point has been adjusted (see chapter "Zero point adjustment under operating conditions" on page 70).

8.4 Parameterization of the device

NOTE

The device does not have 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.

8.4.1 Parameterization via the Modbus interface

Note chapter "Interface description" on page 38 when parameterizing 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.

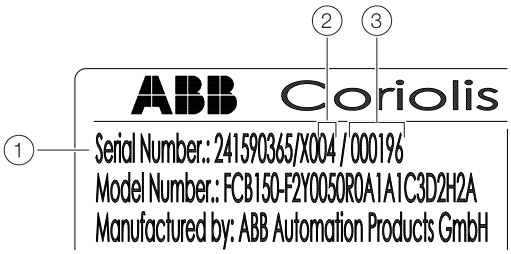

Fig. 27: Modbus address on the name plate (example)
(1) **Serial number** (2) **Modbus Salve ID** (3) **Sensor ID**

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 chapter "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 chapter "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.

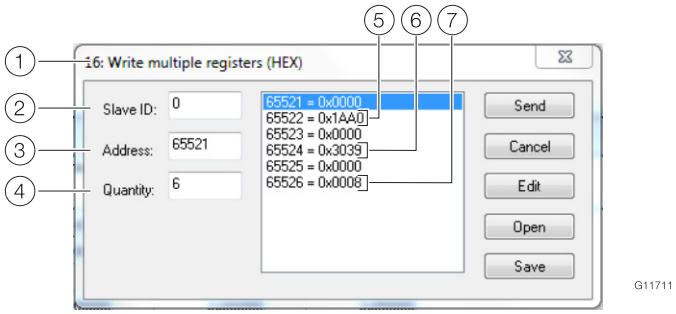

Fig. 28: Write Multiple Registers (example)
(1) **Function code 16** (2) **Broadcast address "0"**
(3) **Register start address** (4) **Register number**
(5) **Manufacturer and device codes** (6) **Sensor ID**
(7) **New Modbus Slave ID**

8.4.2 Parameterization via the local operating interface

⚠ DANGER

Risk of explosion during operation of the device with open terminal box!

Only perform parameterization of the device via the local operating interface outside the potentially explosive area!

A PC / notebook and the USB interface cable (3KXS310000L0001) are required to configure the device via the device's local operating interface.
In conjunction with the HART-DTM and the software "ABB AssetVision" available at www.abb.com/flow, all parameters can also be set without a Modbus connection.

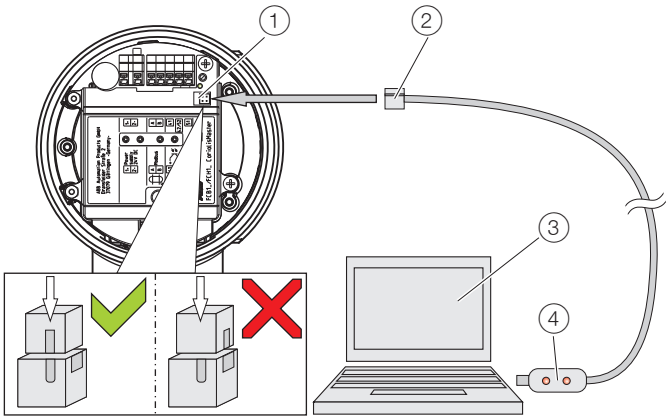

Fig. 29: Connection to the local operating interface
(1) Local operating interface (2) Programming plug
(3) PC / notebook (4) USB interface cable

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.
4. Switch on the device power supply.
5. Start ABB AssetVision and perform the parameterization of the equipment.

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

8.5 Operating instructions

Observe the following points when operating the device:

- Aggressive media may result in corrosion and abrasion of the parts that come into contact with the medium. As a result, pressurized media may escape prematurely.
- Wear to the flange gasket or process connection gaskets (e.g., aseptic threaded pipe connections, Tri-Clamp, etc.) may enable a pressurized medium to escape.
- When using internal flat gaskets, these can become embrittled through 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.

8.6 Interface description

NOTE

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

8.6.1 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	TUSIGN32	687	750
0x9	16-bit config scan register 2	Single	TUSIGN16	751	782
0xA	Scan register 2	Single	TUSIGN32	783	846
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

The device error messages are transmitted via the Modbus interface by means of the "input coils."
See the chapter "Diagnosis / error messages" on page 76 for detailed information.

8.6.2 Supported Modbus function codes

Overview

The function codes listed below are supported by CoriolisMaster FCB130, FCB150, FCH100, FCH150.

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

8.6.3 Modbus function codes

This section details the function, and request and response format for all Modbus function codes supported by the CoriolisMaster FCB130, FCB150, FCH100, FCH150.

0x02 Read Discrete Inputs

Read Discrete Inputs is used to read the state of discrete input type coil data from the slave device.
The format for a Read Discrete Inputs request is as follows.

Byte number	Description
1	Slave device identifier.
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	Message CRC.

The format of responses to successfully processed Read Discrete Input requests is as follows.

Byte number	Description
1	Slave device identifier.
2	Read Discrete Inputs Function Code, 0x02.
3	Byte count ('n'), number of data bytes in response.
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	Message CRC.

0x03 Read Holding Registers

Read Holding Registers is used to request the value of holding register data.
The request format is as follows.

Byte number	Description
1	Slave device identifier.
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	Message CRC.

The format of successfully processed Read Holding Registers requests is as follows.

Byte number	Description
1	Slave device identifier.
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	Message CRC.

0x04 Read Input Registers

Read Input Registers is used to request the value of input registers.
The request format is as follows.

Byte number	Description
1	Slave device identifier.
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	Message CRC.

Responses to successfully processed Read Input Registers requests appear as follows.

Byte number	Description
1	Slave device identifier.
2	Read Input Registers Function Code, 0x04.
3	Byte count ('n'), number of data bytes in response.
4 ... (4+n)-1	Input register data.
(4+n), (4+n)+1	Message CRC.

0x06 Write Single Register

Write Single Register is used to write a single Holding Register value.
The request format is as follows.

Byte number	Description
1	Slave device identifier.
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	Message CRC.

The format of responses to successfully processed Write Single Register requests is as follows.

Byte number	Description
1	Slave device identifier.
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	Message CRC.

0x08 Diagnostics

Only the Diagnostics sub-function Return Query Data (0x00, 0x00) is supported.
When requests of this type are received by the device, the message is echoed back to the master.
The request and response format is as follows.

Byte number	Description
1	Slave device identifier.
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	Message CRC.

0x10 Write Multiple Registers

Write Multiple Registers is used to write data to the device Holding Registers.
The request format is as follows.

Byte number	Description
1	Slave device identifier.
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	Message CRC.

When successfully processed, the format of responses to Write Multiple Registers requests is as follows.

Byte number	Description
1	Slave device identifier.
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	Message CRC.

0x11 Report Slave ID

The Report Slave ID command is used to return a unique response specific to a slave device type.
The Report Slave ID request format is as follows.

Byte number	Description
1	Slave device identifier.
2	Report Slave ID Function Code, 0x11.
3, 4	Message CRC.

The CoriolisMaster FCB130, FCB150, FCH100, FCH150 Report Slave Id response is as follows.

Byte number	Description
1	Slave device identifier.
2	Report Slave ID Function Code, 0x11.
3	Count of data bytes.
4	Unique identifier for ABB, 0x1A.
5	Unique identifier for the CoriolisMaster device type, 0xA0.
6	Software revision, 0x30.
7	Hardware revision, 0x30.
8	Unused, 0x30.
9...11	Reserved for future use, 0x30,0x30,0x30.
12...33	Device type designator. (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	Message CRC.

8.6.4 Modbus exception codes

In the event of an error occurring during processing of a request, an exception response is returned. This is characterized by 0x80 being added to the request Function Code. A single byte exception code then follows detailing the nature of the exception. The following exception codes are supported.

Exception code	Exception name	Details
0x01	ILLEGAL_FUNCTION	An unrecognized command has been received, or the device is in an incorrect state to handle the request.
0x02	ILLEGAL_DATA_ADDRESS	An invalid register/coil address has been requested.
0x03	ILLEGAL_DATA_VALUE	The request structure is incorrect, or the data in the request is invalid.
0x04	SLAVE_DEVICE_FAILURE	An internal device error occurred while processing the request.

The format for exception responses is always as follows.

Byte number	Description
1	Slave device identifier.
2	Function Code with 0x80 added.
3	Exception code.
4.5	Message CRC.

8.6.5 Modbus data types

ABB data type	Data type	Register count	Description
ACTION	unsigned char	One register	The data type "ACTION" 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 "IEEEFormat" determines the order in which the data words of the data types "float" and "double" are interpreted. See also the chapter "Parameter range - communication" on page 62.
TDOUBLE	double	Four consecutive registers	64-bit IEEE double-precision floating point. The device parameter "IEEEFormat" determines the order in which the data words of the data types "float" and "double" are interpreted. See also the chapter "Parameter range - communication" on page 62. 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".

8.6.6 Available units

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

NOTE

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

Table 1: Units for the volume flow

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

Table 2: Units for the mass flow

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

Table 3: Density units

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

Table 4: Temperature units

Selection	Code	Description
K	1	Kelvin
°C	2	Celsius
°F	3	Fahrenheit
xx/yy	254	User-definable unit

Table 5: Concentration units

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

Table 6: Units for the mass totalizer

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

Table 7: Units for the volume totalizer

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

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

8.6.7 Available process variables

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

NOTICE

- 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 58.
- 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]	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 Mass Flow[unit][1)]	nQm	Net mass flow in the selected volume unit	—	X (8)	973	—
Net Mass Flow [%][1)]	nQm	Net mass flow in percent	X (8)	—	977	—
Net Vol.Flow [unit][1)]	nQv	Net volume flow in the selected volume unit	—	X (9)	979	—
Net Volume Flow [%][1)]	nQv	Net volume flow in percent	X)9	—	983	—
Vol.Flow@Tref[unit][1)]	Q@T	Volume flow at a reference temperature.	—	X (10)	967	—
Vol.Flow@Tref[%][1)]	Q@T		X (10)	—	971	—
Density@Tref [unit][1)]	p@T	Density at a reference temperature.	—	—	963	—
Density@Tref [%][1)]	p@T		X (5)	—	965	—
Concentr.unit [%][1)]	β u	Concentration in the selected unit in percent	X (7)	—	987	—
Concentr.unit[unit][1)]	β u	Concentration in the selected unit	—	—	985	—
Concentr.% [%][1)]	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

1) Process variable is only available if the DensiMass function is activated.
X = process variable available, — = process variable not available.

Process variable	Short form	Description	DO1 / 2 [f]	DO1 / 2 [pulse]	Modbus address TFLOAT [2]	TDOUBLE [4]
Total. Net Qm Fwd[1)]	∑M+	Net mass flow counter reading in forward flow direction	—	—	995	887
Total. Net Qm Rev[1)]	∑M-	Net mass flow counter reading in reverse flow direction	—	—	997	891
Total. Net Qm Diff[1)]	∑M	Net mass flow counter reading for forward flow / reverse flow difference	—	—	975	895
Total. Net Qv Fwd[1)]	∑V+	Net volume flow counter reading in forward flow direction	—	—	999	899
Total. Net Qv Rev[1)]	∑V-	Net volume flow counter reading in reverse flow direction	—	—	1001	903
Total. Net Qv Diff[1)]	∑M	Net volume flow counter reading for forward flow / reverse flow difference	—	—	981	907
Total.Qv@Tref Fwd[1)]	∑T+	Volume flow counter reading in forward flow direction at a reference temperature	—	—	991	875
Total.Qv@Tref Rev[1)]	∑T-	Volume flow counter reading in reverse flow direction at a reference temperature	—	—	993	879
Total.Qv@Tref Diff[1)]	∑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
Totalizer Net Qm Sum	∑M+-S	Absolute value from net mass flow counter reading in forward flow and reverse flow direction. The counter cannot be stopped or reset.	—	—	445	919
Totalizer Net Qv Sum	∑V+-S	Absolute value from net volume flow counter reading in forward flow and reverse flow direction. The counter cannot be stopped or reset.	—	—	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[2)]	CBT	Current fill quantity	—	—	847	—
Current Batch Counts[2)]	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	—

1) Process variable is only available if the DensiMass function is activated.
2) Process variable is only available if FillMass function is activated.
X = process variable available, — = process variable not available.

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

The CoriolisMaster FCB130, FCB150, FCH100, FCH150 has three "Health indication registers" (Condensed Status Registers). "Health indication registers 365, 366 and 367 consist of 2 bytes, each containing 8 bits. Each bit represents an error.

The registers are structured as follows:

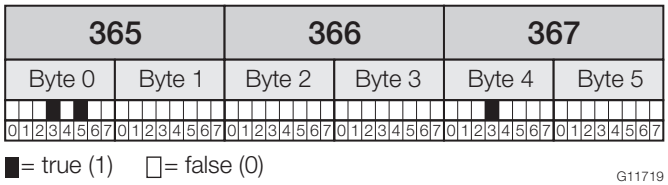

Fig. 30: Health indication register (Example)

The bit position is assigned to the errors in accordance with the "Byte / Bit pos." column in the table in the chapter "Alarm status and alarm history status" on page 78.

The following assignment applies to the example in Fig. 30:

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

8.6.9 Using the scan register

The CoriolisMaster FCB130, FCB150, FCH100, FCH150 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

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 feed flow direction (data type float, register length 2)
658 / 754	263	Volume flow counter reading in feed 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 ... 846	
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 feed flow direction (data type float, register length 2)
692 / 788	
693 / 789	Volume flow counter reading in feed 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	

8.6.10 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]** 4 - DN15 5 - DN25 6 - DN50 7 - DN80 8 - DN100 9 - DN150	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 [t/s^2]	**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 [nsec]	**TFLOAT [2]**	Calibration value (zero point) of the sensor for the selected nominal diameter.
159	Freq. @ Empty Pipe [Hz]	**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 [kg/l]	**TFLOAT [2]**	
161	Freq. @ Full Pipe [Hz]	**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 [kg/l]	**TFLOAT [2]**	
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.

Modbus register address	Parameter name	Data type [register length] / value range	Description
... / 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.
... / 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.
457	Transmitter 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 - On	DensiMass function present? 0 - Off: No DensiMass function present. 1 - On: DensiMass function present.
7	FillMass On/Off	**TUSIGN8 [1]** 0 - Off 1 - On	FillMass function present? 0 - Off: No FillMass function present. 1 - On: FillMass function present.
92	VeriMass On/Off	**TUSIGN8 [1]** 0 - Off 1 - On	VeriMass function present? 0 - Off: No VeriMass function present. 1 - On: VeriMass function present.
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 Ver. 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.

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: On	Indicator of the position of the write protection switch. See also chapter "Write protection switch" on page 35. This parameter is read only.
... / Sensor			
15	Range mode config	**TUSIGN8 [1]** 0: Deactivated 1: Qm and Qv 2: Only Qm 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 ... 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 ... 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 ... 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 Max2	**TFLOAT [2]** 0.01 ... 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]** 0.00 ... 3.5 g/cm^3	Setting the minimum and maximum density of the measuring medium. The values are also used to calculate the corresponding percentage value.
179	Denisty Min	**TFLOAT [2]** 0.00 ... 3.5 g/cm^3	
181	Temperature Max	**TFLOAT [2]** -50 ... 200 °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 ... 200 °C	
203	Net Qm Max	**TFLOAT [2]** 0.01 ... 2.0 Qv MaxDN	Setting of the minimum and maximum net mass flow volume. The values are also used to calculate the corresponding percentage value. The parameters are only available when the DensiMass function is activated.
205	Net Qv Max	**TFLOAT [2]** 0.01 ... 2.0 Qv MaxDN	

Modbus register address	Parameter name	Data type [register length] / value range	Description
... / Sensor			
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 at Tref Max	**TFLOAT [2]** 0.00 ... 3.5 g/cm^3	Setting 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 ... 3.5 g/cm^3	
191	Qv at Tref Max	**TFLOAT [2]** 0.01 ... 2.0 Qv MaxDN	Setting 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	Sensor Location Tag	**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 / reverse flow 1: Only forward flow 2: Only reverse flow	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.
... / Transmitter			
189	Damping Qm	**TFLOAT [2]** 0.04 ... 60 s (1 Tau)	Setting of the damping for the mass flow volume (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 ... 60 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 e. g. if the density measurement is not needed or for gaseous measuring media.
157	Density Fixed Value	**TFLOAT [2]** 0.01 ... 3.5 g/cm^3	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.

Modbus register address	Parameter name	Data type [register length] / value range	Description
... / Transmitter			
122	Device reset	**ACTION [1]**	Restarts the device. Compensates for a short interruption of the power supply.
91	Restore factory defaults	**ACTION [1]**	All user-accessible parameters will be reset to the factory default settings.
... / Transmitter / Units			
47	Unit Massflow Qm	**TUSIGN8 [1]** Refer to "Table 2: Units for the mass flow" on page 45.	Selection of unit for mass flow (e. g. for the parameter QmMax / QmMaxDN and for the corresponding process value).
53	Unit Mass Totalizer	**TUSIGN8 [1]** Refer to "Table 6: Units for the mass totalizer" on page 45.	Selection of the unit for the mass counters and the pulse outputs.
50	Unit Volume Qv	**TUSIGN8 [1]** Refer to "Table 1: Units for the volume flow" on page 45.	Selection of unit for volume flow (e. g. for the parameter QvMax / QvMaxDN and for the corresponding process value).
54	Unit Volume Totalizer	**TUSIGN8 [1]** Refer to "Table 7: Units for the volume totalizer" on page 46.	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 45.	Selection of unit for the density (e. g. for the associated parameters and the corresponding process values).
49	Unit Temperature	**TUSIGN8 [1]** Refer to "Table 4: Temperature units" on page 45.	Selection of unit for temperature (e. g. for the associated parameters and the corresponding process values).
52	Unit Concentration	**TUSIGN8 [1]** Refer to "Table 5: Concentration units" on page 45.	Selection of unit for concentration (e. g. for the associated parameter and the corresponding process value).
1500	Cust. Qm Unit Name	**TCHAR [8]** Alphanumeric, maximum 7 characters	Sets the name or the abbreviation for the user-defined unit Qm.
239	Cust. Qm Unit Factor	**TFLOAT [2]** 0.0001 ... 100,000 kg/s	Sets the factor in kg/seconds for the user-defined unit Qm.
1532	Cust. Tot. Qm Unit Name	**TCHAR [8]** Alphanumeric, maximum 7 characters	Sets the name or abbreviation of the unit for the user-defined mass counter.
423	Cust. Tot. Qm Unit Factor	**TFLOAT [2]** 0.0001 ... 100,000 kg	Sets the factor of the unit for the user-defined mass counter.
1508	Cust. Qv Unit Name	**TCHAR [8]** Alphanumeric, maximum 7 characters	Sets the name or abbreviation for the user-defined unit Qv.
245	Cust. Qv Unit Factor	**TFLOAT [2]** 0.0001 ... 100,000 l/s	Sets the factor in liters/seconds for the user-defined unit Qv.
1540	Cust. Tot. Qv Unit Name	**TCHAR [8]** Alphanumeric, maximum 7 characters	Sets the name or abbreviation of the unit for the user-defined volume totalizer.
425	Cust. Tot. Qv Unit Factor	**TFLOAT [2]** 0.0001 ... 100,000 l	Sets the factor of the unit for the user-defined mass counter.
1516	Cust. Dens Unit Name	**TCHAR [8]** Alphanumeric, maximum 7 characters	Sets the name or abbreviation for the user-defined density unit.
241	Cust. Dens Unit Factor	**TFLOAT [2]** 0.0001 ... 100,000 g/ml	Sets the factor in g/ml for the user-defined density unit.

Modbus register address	Parameter name	Data type [register length] / value range	Description
... / Transmitter / Cut offs			
195	Low Flow Cut Off	**TFLOAT [2]** 0.0 ... 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 %
197	Low Flow Hysteresis	**TFLOAT [2]** 0.0 ... 50 %	Sets the hysteresis for the low flow cut-off as defined in the parameter "low flow cut off". Factory setting: 20 %
149	Density Cut Off	**TFLOAT [2]** 0.0005 ... 0.5 g/cm^3	Sets the low flow for density. Factory setting: 0.2 g/cm^3
... / Transmitter / Feature Settings			
6	DensiMass On/Off	**TUSIGN8 [1]** 0: Off 1: On	DensiMass function active? 0: Off: DensiMass function deactivated. 1: On: DensiMass function activated. This parameter is read only.
361	DensiMass Code	**TUSIGN16 [1]** 0x0000 ... 0xFFFF	Sets the device-specific code for activating the DensiMass function. To use this function subsequently, contact the ABB service team or sales organization. The device is restarted after inserting the code (e.g. through setting the parameter „Device reset“, see page 54, or through a brief shutting off of the energy source).
7	FillMass On/Off	**TUSIGN8 [1]** 0: Off 1: On	FillMass function active? 0: Off: FillMass function deactivated. 1: On: FillMass function activated. This parameter is read only.
362	FillMass code	**TUSIGN16 [1]** 0x0000 ... 0xFFFF	Sets the device-specific code for activating the FillMass function. To use this function subsequently, contact the ABB service team or sales organization. The device is restarted after inserting the code (e.g. through setting the parameter „Device reset“, see page 54, or through a brief shutting off of the energy source).
92	VeriMass On/Off	**TUSIGN8 [1]** 0: Off 1: On	VeriMass function active? 0: Off: VeriMass function deactivated. 1: On: VeriMass function activated. This parameter is read only.
368	VeriMass Code	**TUSIGN16 [1]** 0x0000 ... 0xFFFF	Sets the device-specific code for activating the FillMass function. To use this function subsequently, contact the ABB service team or sales organization. The device is restarted after inserting the code (e.g. through setting the parameter „Device reset“, see page 54, or through a brief shutting off of the energy source).

Modbus register address	Parameter name	Data type [register length] / value range	Description
... / System Zero			
227	Manual Adjust	**TFLOAT [2]** -10 ... 10 % of 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: Maize starch 5: Sugar in water	Selection of the matrix for calculating concentration. For more detailed information, see chapter "DensiMass concentration measurement" on page 72.
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 ... 250 °C	Sets the reference temperature for calculating the process values "Qv @ Tref" and "Density @ Tref".
... / Field Optimization			
151	Density Correction	**TFLOAT [2]** -0.5 ... 0.5 g/l	Sets the correction factor for field optimization of the density measurement. This factor can be used to perform optimization in the field in order to achieve a degree of accuracy in the density measurement that closely approximates a repeatability of 0.0001 g/ml.
279	Qm Correction	**TFLOAT [2]** -5 ... 5 %	Sets the correction factor for field optimization of the mass flow measurement. The value is entered as a percentage of the current measured value. This factor can be used to perform optimization in the field in order to achieve a degree of accuracy in the flow measurement that closely approximates or even exceeds a repeatability of at least 0.1 % of the measured value.

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. 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.
329	Conc. Zero Matrix 2	-1000 ... 1000	
... / Field Optimization / Hold Last Good Val.			
335	Hold Time	**TFLOAT [2]** 0.0 ... 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 ... 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 ... 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.
... / Field Optimization / Pressure Correction			
51	Pressure Unit	**TUSIGN 8 [1]** Refer to "Table 8: Pressure units" on page 46.	Selection of unit for pressure (e. g. for the associated parameters and the corresponding process values). Factory setting: bar
333	Pressure Level	**TFLOAT [2]** 0.0 ... 1000.0 [pressure unit].	Input of the process pressure of the medium in the meter tube. The value is used to compensate for the influence of pressure on the measurement of the mass flow and the density.

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 "Output Value Logic"). — Pulse: Digital output functions as pulse output (for process value, see the parameter "Output Value Pulse"). In pulse mode, pulses per unit are given as 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	Output of 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.
... / 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.
22	Output Value Pulse	**TUSIGN8 [1]** Refer to "Available process variables" on page 46.	Selection of the process value issued via the pulse output.
321	Pulses per Unit	**TFLOAT [2]** 0.001 ... 100,000 pulses	Setting of pulses per mass flow unit and per pulse width for the pulse output. 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.
323	Pulse Width	**TFLOAT [2]** 0.05 ... 2000 ms	
... / Dig.Out 41 / 42 / Setup Frequency Output			The following parameters are only available if the digital output 41 / 42 has been configured as a frequency output.
23	Output Value Freq.	**TUSIGN8 [1]** Refer to "Available process variables" on page 46.	Selection of the process value issued via the frequency output.
325	Upper Frequency	**TFLOAT** 0.25 ... 10500 Hz	Sets the frequency for the upper range value. The entered value corresponds to 100 % flow.

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	Output Value Logic	**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 State	**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 "Output Value Logic" has been set to 2 - Alarm signal.
28	Qm Massflow Max		
29	Qm Massflow Min		
30	Density Min		
31	Sensor voltage min		
32	Driver Current 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 4: Follow DO1 5: 90° phase rotation 6: 180° phase rotation	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 "Output Value Logic"). — Follow DO1: Digital output 51 / 52 follows digital output 41 / 42. Digital output 51 / 52 then also functions as a pulse output; the settings under "… / Dig.Out 41 / 42 / Setup Pulse Output" are assumed. The output of pulses at digital output 51 / 52 depends on the setting of the register "21: Output of flow direction" for digital output 41 / 42: No pulses are issued when "Forward flow / reverse flow" is selected. Only digital output 41 / 42 is active. When "Forward flow" is selected, pulses are given for the forward flow at digital output 41 / 42; at digital output 51 / 52, pulses are issued for the reverse flow. When "Reverse flow" is selected, pulses are issued for the reverse flow at digital output 41 / 42; at digital output 51 / 52, pulses are issued for the forward flow. — 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. **NOTE** Digital output 51 / 52 cannot be configured as a second frequency output.
56	Output of flow direction	**TUSIGN8 [1]**	No function.
… / 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	Output Value Logic	**TUSIGN8 [1]**	See description of digital output 41 / 42.
58	Active Mode	**TUSIGN8 [1]**	
59	Actual State	**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 "Output Value Logic" has been set to 2 - Alarm signal.
61	Qm Massflow Max		
62	Qm Massflow Min		
63	Density Min		
64	Sensor Voltage Min		
65	Driver Current Max		

Parameter range - process alarm

Modbus register address	Parameter name	Data type [register length] / value range	Description
2048 ... 2095	Diagnostic History	**TUSIGN8 [1]**	Display of the alarm history. See also chapter "Alarm status and alarm history status" on page 78. 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 detailed information see chapter "Diagnosis / error messages" on page 76.
67	Function Check		
68	Out Of Specification		
... / Alarm limits			
211	Qm Massflow Min	**TFLOAT [2]** 0 ... 130 %	Setting of the alarm limits for the mass flow. If the mass flow is less than or exceeds 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 ... 130 %	
215	Qv Volumeflow Min	**TFLOAT [2]** 0 ... 130 %	Setting of the alarm limits for the volume flow. If the volume flow is less than or exceeds the values set in the parameters "Qv volume flow min" and "Qv volume flow max", error message no. 44 "Volume flow too high / low" is generated.
217	Qv Volumeflow Max	**TFLOAT [2]** 0 ... 130 %	
199	Density Min	**TFLOAT [2]** 0.0 ... 3.5 g/cm^3	Selection of the alarm limits for the density. If the density is less than or exceeds 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 ... 3.5 g/cm^3	
219	Temperature Min	**TFLOAT [2]** -100 ... 250 °C	Setting of the alarm limits for the measuring medium temperature. If the measuring medium temperature is less than or exceeds 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 ... 250 °C	
287[1)]	Concentrat.[%] Min	**TFLOAT [2]** -5 ... 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, respectively, "Concentrat. [unit] min" and "Concentrat. [unit] max", error message no. 41 "Concentration in % too low / high" or, respectively, no. 40 "Concentration in unit too low / high" is generated.
289[1)]	Concentrat.[%] Max	**TFLOAT [2]** -5 ... 105.0 %	
293[1)]	Concentrat.[unit] Min	**TFLOAT [2]** 0 ... 200 msec	
295[1)]	Concentrat.[unit] Max	**TFLOAT [2]** 0 ... 200 msec	
223	Driver Current Max	**TFLOAT [2]** 0 ...100 mA	Setting of the alarm limit for the driver current. If the driver current exceeds the value in the parameter "Driver current max" for the time set in the parameter "Driver current time", error message no. 35 "Driver current too high" is generated.
427	Driver Current Time	**TFLOAT [2]** 5 ... 864000 sec	
225	Sensor Amplitude Min	**TFLOAT [2]** 0 ...100 mV	Setting of the alarm limit for the sensor amplitude. If the sensor amplitude is less than the value in the parameter "Sensor amplitude min" for the time set in the parameter "Sensor amplitude time", error message no. 34 "Sensor amplitude too low" is generated.
429	Sensor Amplitude Time	**TFLOAT [2]** 5 ... 300 sec	
237	Density Low Check	**TFLOAT [2]** 0.00 ... 3.5 g/cm^3	Setting of the alarm limit for the density alarm. If the density is less than 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.

1) These parameters are only available if the DensiMass function is activated.

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 format "little endian" with the lowest value word first. — If the IEEE format is deactivated (0), the data words are sent in the standard Modbus format "big endian". 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
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 … 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

Parameter range – diagnosis

Modbus register address	Parameter name	Data type [register length] / value range	Description
... / Diagnosis Control			
459	Preset Maint. cycle	**TUSIGN32 [2]** 0 … 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 h
463	Maint. Remaining 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 Current	**TFLOAT [2]**	Output of the current driver current in mA. The parameter is read only.
283	Sensor Amplitude Sa	**TFLOAT [2]**	Output of current amplitude (sensor voltage) for sensor A in mV. The parameter is read only.
285	Sensor Amplitude Sb	**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	House Temperature	**TFLOAT [2]**	Output of current housing temperature in °C. The parameter is read only.
... / 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.

Modbus register address	Parameter name	Data type [register length] / value range	Description
341	Qm Massflow [unit]	**TFLOAT [2]** 0 ... 2 x QmMax DN	Setting of the simulated measured values. The simulated value is selected with the parameter "Simulation Switch".
343	Qm Massflow [%]	**TFLOAT [2]** -200 … 200 %	
345	Qv Volumeflow [unit]	**TFLOAT [2]** 0 ... 2 x QvMax DN	
347	Qv Volumeflow [%]	**TFLOAT [2]** -200 … 200 %	
349	Density [unit]	**TFLOAT [2]** 0.0 … 3.5 g/cm^3	
351	Density [%]	**TFLOAT [2]** -200 … 200 %	
353	Temperature [unit]	**TFLOAT [2]** -100 … 250 °C	
355	Temperature [%]	**TFLOAT [2]** -200 … 200 %	
71	Dig.Out 41/42 State	**TUSIGN8 [1]** 0 - Off 1 - On	
357	Dig.Out 41/42 Freq. Dig.Out 41/42 Pulse	**TFLOAT [2]** 0 … 10500 Hz 0 … 10500 pulses	The respective simulated output value is dependent on the operating mode (pulse / frequency) of the digital output 41 / 42.
72	Dig.Out 51/42 State	**TUSIGN8 [1]** 0 - Off 1 - On	
359	Dig.Out 51/42 Pulse	**TFLOAT [2]** 0 … 10500 pulses	Only if the digital output 51 / 52 has been configured as a pulse output.
... / Output readings			
419	Dig.Out 41/42 Freq.	**TFLOAT [2]** 0 … 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	Dig.Out 41/42 State	**TUSIGN8 [1]** 0 - Off 1 - On	
59	Dig.Out 51/53 State	**TUSIGN8 [1]** 0 - Off 1 - On	

Modbus register address	Parameter name	Data type [register length] / value range	Description
... / Meter Erosion Monitor (VeriMass)			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 Current 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 Current Time", alarm "35 - Driver current too high" is triggered. This parameter is only available if the value "Manual" has been selected for the parameter "Control Type".
427	Driver Current 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 - Complete	Output of the status for automatic adjustment of the erosion monitor. — Outstanding: 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 adjustment of the erosion monitor is active. — Complete: Automatic adjustment 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 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 overshot 27 - DSP error frontend board 28 - Density error 29 - Sensor temperature outside of specified range 30 - Sensor temperature measuring error 31 - Sensor amplitude too small 32 - Driver current too high 33 - Density too low 34 - Density too low / high. 35 - Medium temperature too low / high 36 - Density set to 1 g/cm³ 37 - Concentration [unit] too low / high 38 - Concentration [%] too low / 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 chapter "Alarm status and alarm history status" on page 78.

Parameter range – Counter

Modbus register address	Parameter name	Data type [register length] / value range	Description
... / Operation			
115	Start All Totalizers	**ACTION [1]**	Start all counters of the device.
116	Stop All Totalizers	**ACTION [1]**	Stop all counters of the device.
... / Reset Totalizers			
114	All Totalizers	**ACTION [1]**	Reset the device counter
112	All Mass Totalizers		
113	All Volume Totalizers		
106	Massflow Fwd		
107	Massflow Rev		
102	Volumeflow Fwd		
103	Volumeflow Rev		
108	Net Massflow Fwd	**ACTION [1]**	These parameters are only available when the DensiMass function is activated.
109	Net Massflow Rev		
110	Net Volumeflow Fwd		
111	Net Volumeflow Rev		
104	Volumeflow Fwd @Tref		
105	Volumeflow Rev @Tref		
... / Preset Totalizers			
305	Massflow Fwd	**TFLOAT [2]**	Default setting of the device counter.
307	Massflow Rev		
297	Volumeflow Fwd		
299	Volumeflow Rev		
309	Net Massflow Fwd	**TFLOAT [2]**	These parameters are only available when the DensiMass function is activated.
311	Net Massflow Rev		
313	Net Volumeflow Fwd		
315	Net 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 ... 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.	**TFLOAT [2]** XX ... 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 Current Batch Counts	**ACTION [1]**	Resets the counter "Current Batch Counts" by writing an arbitrary value into the corresponding Modbus address.

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	Batch Lag Corr.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 "Lag Corr.Quantity".
319	Lag Corr. Quantity	**TFLOAT [2]** -0.0 ... 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 "Batch Lag Corr.mode" has been set to 2 - Manual.
435	AutoBatch LagCorr. Quantity	**TFLOAT [2]** Read only or set to 0.0.	Output of the overrun quantity automatically calculated by the transmitter. Only if the parameter "Batch Lag Corr.mode" has been set to 1 - Automatic.
437	BatchAuto. LagCorr. Factor	**TFLOAT [2]** 0.0 ... 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 + (BatchAuto.Lag Corr.Factor x correction value during the last fill operation) — 0.0: No change to correction value. — 1.0: The correction value is immediately adjusted to the overrun quantity calculated during the last fill operation.
439	Batch Lag Corr Time	**TFLOAT [2]** 0.1 ... 10 s Factory setting: 0.1 s	Sets the time for the overrun quantity correction after the fill valve is closed.

8.6.11 Software history

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

Device software package FCx1xx (Device Firmware Package)				
Version	**Issue date**	**Type of change**	**Description**	**Order number**
00.01.xx	2013	New release	—	3KXF000405U0100
00.02.xx	06.2015	Update	Adding VeriMass feature	3KXF000405U0100

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

In case of an increased zero point (> 0.1 %), check the installation for "best practice" and make sure that no gas content is contained in liquids, or liquids or particles in gases. See also chapter "Turn-off devices for zero point adjustment" on page 29.

To perform zero point adjustment via the Modbus interface, see chapter "System Zero" on page 56.

8.8 Measuring 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.

8.8.1 Configuration

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!

Also refer to chapters "Parameter range - config. Device" on page 52 and "Available process variables" on page 46.

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.

8.9 VeriMass erosion monitor

The integrated VeriMass diagnosis function 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, e.g. 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 balanced manually.
For more information please contact ABB Service or the sales organization.

8.9.1 Configuration

The following process conditions must be observed to ensure that the transmitter can perform the adjustment process successfully:

- The measuring medium has a viscosity similar to that of water and below 10 cP.
- For liquid measuring media, no gas bubbles or air pockets may be present in the meter tube.
- The pressure and temperature in the meter tube correspond to normal operating conditions.
- The process conditions during the adjustment period correspond to the normal 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 55.
2. Set the parameter "Control Type" to "Automatic". See also parameter range "Meter Erosion Monitor (VeriMass)" on page 65.
3. Set the parameter "Self Adjust Time" to the required duration of the adjustment process. See also parameter range "Meter Erosion Monitor (VeriMass)" on page 65.

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 via the transmitter menu

For more information please contact ABB Service or the sales organization.
The following steps must be performed when adjusting the erosion monitor manually:

1. The VeriMass function must be active. See also parameter range "Feature Settings" on page 55.
2. Set the parameter "Control Type" to "Manual". See also parameter range "Meter Erosion Monitor (VeriMass)" on page 65.
3. Set the parameters "Driver Current Max" and "Driver Current Time" to the required values. See also parameter range "Meter Erosion Monitor (VeriMass)" on page 65.

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 chapter "Parameterization via the local operating interface" on page 37).

You can find more detailed information on operating the software in the relevant operating instructions and the DTM online help.

8.10 DensiMass concentration measurement

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

The user can enter two more user-defined matrices containing up to 100 values.

8.10.1 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.

8.10.2 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

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

8.10.3 Creation of the concentration matrix

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

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

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

8.10.4 Structure of the concentration matrix

The software supports two different concentration values:

1. Concentration in unit (e.g., % or °Bé)
   The range of values is not restricted, the value can be output at the current output, the value can be selected in the Units submenu.
2. Concentration in percent (%)
   The range of values is restricted to 0 ... 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 ... 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:

— One matrix: $2 \le N \le 20$; $2 \le M \le 20$; $N * M \le 100$
— Two matrices: $2 \le N \le 20$; $2 \le M \le 20$; $N * M \le 50$

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 $1 \le x \le M$

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 $1 \le x \le N$

The concentration values must be monotonically nondecreasing or monotonically nonincreasing from top to bottom due to the algorithm used in the transmitter software.
Concentr. 1 <…< Concentr. x <…< Concentr. N for $1 \le x \le N$
or
Concentr. 1 >…> Concentr. x > … > Concentr. N for $1 \le x \le N$

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

8.11 FillMass batch function

Only for FCB150 / FCH150

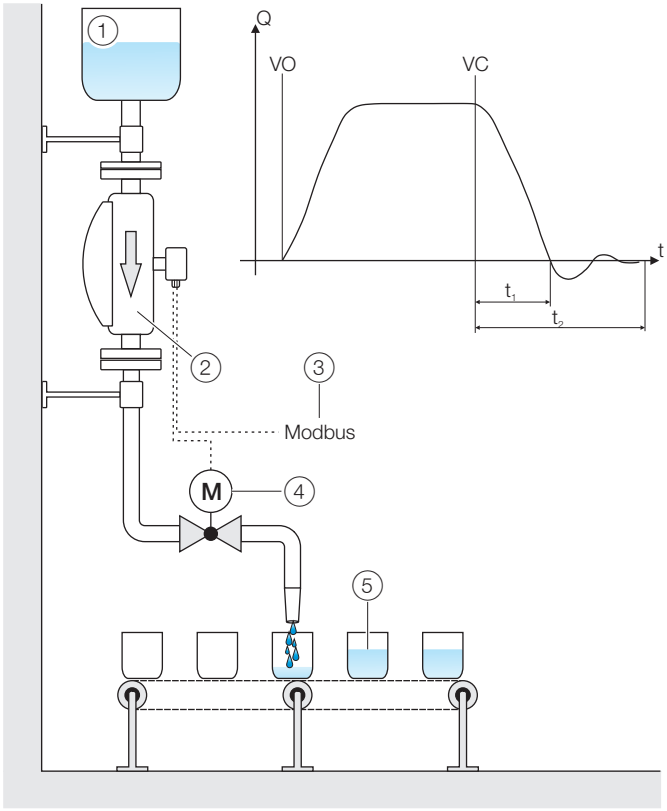

Fig. 31: FillMass batch function
(1) **Supply tank** (2) **Sensor**
(3) **Filling start / stop switch** (4) **Filling valve** (5) **Filling tank**

Diagram key	
VO	Valve open (filling started)
VC	Valve closed (fill quantity reached)
t_1	Valve closing time
t_2	Overrun time

The integrated FillMass batch function allows filling processes to be recorded in > 3 seconds.
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.

8.11.1 Configuration

For the configuration of the fill mass function, the following steps must be performed:

1. The fill mass function must be active. See also parameter range "Feature Settings" on page 55.
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 58.
3. The parameters for the fill mass function must be configured. See also parameter range "FillMass" on page 68.

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 52.

8.11.2 Course of a fill operation

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:

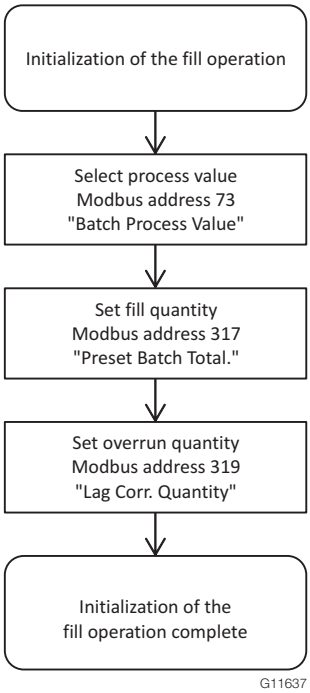

Fig. 32: Initialization

NOTE

The value for the overrun quantity "Lag Corr. Quantity" depends on many influences (valve closing 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:

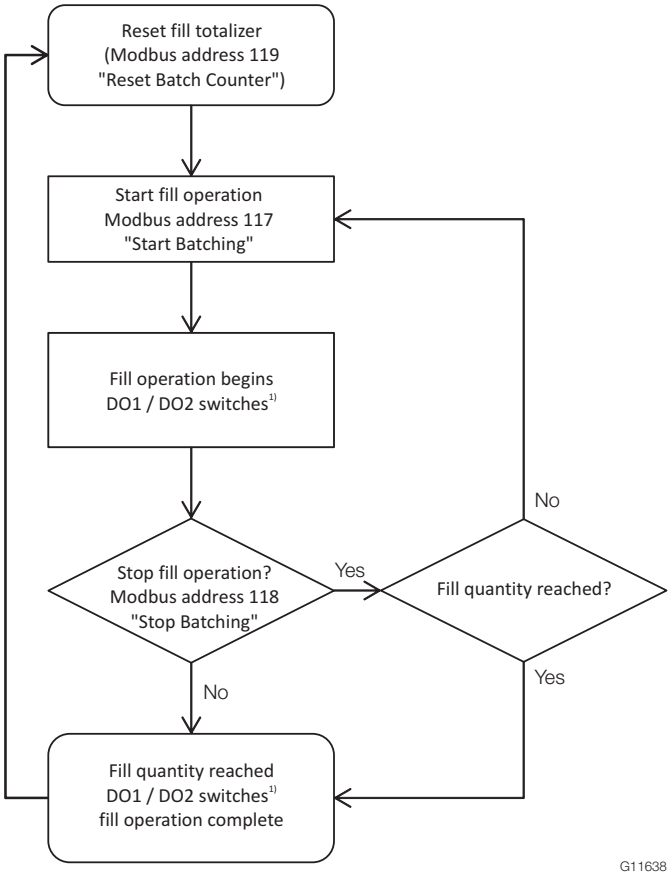

Fig. 33: Fill operation

1) The digital output DO1 / DO2 must be configured as "Batch end contact" for this purpose.

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

NOTE

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

9.1 General remarks

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 chapter "Service LED" on page 35.

Fault message	Priority / error no.	Modbus address "Active alarm"
DSP error frontend board	96 / 30	2029
Sensor amplitude too small	93 / 34	2033
Sensor temperature measuring error	90 / 33	2032
Data error in the SensorMemory	84 / 11	2010
Density error	80 / 31	2009
Driver current is too high.	60 / 35	2015
Sensor temperature is too high	57 / 32	2018
Damaged SensorMemory	38 / 10	2009

9.2 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

			Measurements								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	30	DSP error frontend board	0	0	0	—	0	0	0	0	—	0	0	⚠
93	34	Sensor amplitude too small	0	0	—	—	—	0	—	0	—	—	—	⚠
90	33	Sensor temperature measuring error	1)	1)	1)	20 °C	1)	1)	1)	1)	—	—	—	⚠
80	31	Density error	—	2)	1 g	—	2)	2)	2)	2)	—	—	—	⚠
78	4	Flow rate set to 0	0	0	—	—	—	0	—	0	—	0	0	—
76	6	All counters stopped	—	—	—	—	—	—	—	—	STOP	—	—	⚠
74	7	Counter reset	—	—	—	—	—	—	—	—	0	—	—	⚠
70	27	An alarm is being simulated	—	—	—	—	—	—	—	—	—	—	—	—
60	35	Driver current too high	—	—	—	—	—	—	—	—	—	—	—	⚠
59	36	Density too low	0	0	—	—	—	0	—	0	—	—	—	—
58	39	Density set to 1g/cm³	—	2)	1 g	—	2)	2)	2)	2)	—	—	—	—
57	32	Sensor temperature is too high	1)	1)	1)	20 °C	1)	1)	1)	1)	—	—	—	—
54	42	FEB voltage is too high / low	—	—	—	—	—	—	—	—	—	—	—	—
47	16	Pulse output is cut	—	—	—	—	—	—	—	—	—	—	—	—
46	1	Mass flow is too high / low	—	—	—	—	—	—	—	—	—	—	—	⚠↑ ⚠↓
44	2	Volume flow is too high / low	—	—	—	—	—	—	—	—	—	—	—	⚠↑ ⚠↓
43	37	Density is too low / high.	—	—	—	—	—	—	—	—	—	—	—	—
42	38	Measuring medium temperature is too high / low	—	—	—	—	—	—	—	—	—	—	—	—
41	40	Concentration in unit is too high / low	—	—	—	—	—	—	—	—	—	—	—	—
40	41	Concentration in % is too high / low	—	—	—	—	—	—	—	—	—	—	—	—
38	10	SensorMemory faulty	—	—	—	—	—	—	—	—	—	—	—	—
26	5	Service interval reached	—	—	—	—	—	—	—	—	—	—	—	⚠
24	9	Device not calibrated	—	—	—	—	—	—	—	—	—	—	—	—

9.3 Alarm status and alarm history status

Modbus address		Byte /	Error no. /	Error text	Description	NAMUR
Active	History	bit pos.	priority			classification
2029	2077	3 / 5	30 / 96	DSP error frontend board	Internal communication error. Frontend board defective. — Restart the device. — Replace frontend board. — Contact ABB Service.	Out of specification S051.018
2033	2081	4 / 1	34 / 93	Sensor amplitude too small	Gas bubbles in the measuring tube. Viscosity of the measuring medium is too high. — Reduce gas content, change measuring medium. — Contact ABB Service.	Failure F093.034
2032	2080	4 / 0	33 / 90	Sensor temperature measuring error	Internal temperature sensor measuring error / defective. — Check sensor connection. — Contact ABB Service.	Failure F090.033
2030	2078	3 / 6	31 / 80	Density error	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 measuring tube and check for damage due to abrasion. — Contact ABB Service.	Failure F080.031
2003	2051	0 / 3	4 / 78	Flow rate set to 0	External shut-off is active. — Check parameterization.	Functional check C078.004
2005	2053	0 / 5	6 / 76	All counters stopped	External counter stop is active. — Check parameterization.	Functional check C076.006
2006	2054	0 / 6	7 / 74	Counter reset	External counter reset is active. — Check parameterization.	Functional check C074.007
2026	2074	3 / 2	27 / 70	An alarm is being simulated	The alarm simulation is active. — Deactivate alarm simulation.	Functional check C070.027
2034	2082	4 / 2	35 / 60	Driver current too high	Gas bubbles in the measuring tube. — Reduce gas content in the measuring medium. — Deactivate "Driver current max" parameter by setting it to "0".	Out of specification S060.035
2035	2083	4 / 3	36 / 59	Density too low	Empty measuring tube. Gas bubbles in the measuring tube. — Reduce gas content in the measuring medium. — Make sure that the measuring tube is always completely full. — Deactivate "Density low check" parameter by setting it to "0".	Out of specification S059.036
2038	2086	4 / 6	39 / 58	Density set to 1 g/cm^3	Due to an error message by the transmitter, the density has been set to 1 g/cm^3. — Contact ABB Service.	Out of specification S058.039
2031	2079	3 / 7	32 / 57	Sensor temperature is too high	Ambient or measuring medium temperature is too high. — Check ambient or measuring medium temperature.	Out of specification S057.032
2041	2089	5 / 1	42 / 54	FEB voltage too high / low	Frontend board defective. — Replace frontend board. — Contact ABB Service.	Out of specification S054.042

Modbus address		Byte /	Error no. /	Error text	Description	NAMUR
Active	History	bit pos.	priority			classification
2015	2063	1 / 7	16 / 47	Pulse output overshot	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 S047.0016
2000	2048	0 / 0	1 / 46	Mass flow is too high / low	The mass flow is below or above the parameterized limit values "Qm massflow min" and "Qm massflow max". — Increase the parameter "Qm massflow min" or reduce "Qm massflow max". — Check mass flow.	Out of specification S044.002
2001	2049	0 / 1	2 / 44	Volume flow too high / low	The volume flow is below or above the parameterized limit values "Qv volume flow min" and "Qv volume flow max". — Increase the parameter "Qv volume flow min" or reduce "Qv volume flow max". — Check volume flow rate.	Out of specification S044.002
2036	2084	4 / 4	37 / 43	Density is too high / low	The density is below or above the parameterized limit values "Density min" and "Density max". — Increase the parameter "Density min" or reduce "Density max". — Check density.	Out of specification
2037	2085	4 / 5	38 / 42	Measuring medium temperature is too high / low	The measuring medium temperature is below or above the parameterized limit values "Temperature Min" and "Temperature Max". — Increase the parameter "Temperature Min" or reduce "Temperature Max". — Check measuring medium temperature.	Out of specification S058.039
2039	2087	4 / 7	40 / 41	Concentration in unit is too high / low	The concentration in the unit is below or above the parameterized limit values "Concentration[u] Min" and "Concentration[u] Max". — Increase the parameter "Concentration[u] Min" or reduce "Concentration[u] Max". — Check concentration.	Out of specification S041.040
2040	2088	5 / 0	41 / 40	Concentration in % is too high / low	The concentration in % is below or above the parameterized limit values "Concentration[%] Min" and "Concentration[%] Max". — Increase the parameter "Concentration[%] Min" or reduce "Concentration[%] Max". — Check concentration.	Out of specification S040.041
2009	2057	1 / 1	10 / 38	SensorMemory faulty	SensorMemory defective. — Check if the SensorMemory is defective. — Contact ABB Service.	Maintenance required M038.010
2004	2052	0 / 4	5 / 26	Service interval reached	Maintenance interval reached. — Perform maintenance work. — Start new maintenance interval. Set the parameter "Preset Maint. Cycle" to "0".	Maintenance required M026.005
2008	2056	1 / 0	9 / 24	Device not calibrated	Contact ABB Service.	Maintenance required M024.009

10 Maintenance

10.1 Safety instructions

⚠ 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.

i NOTE

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 and any adjacent lines or containers.
- Check whether hazardous materials have been used as materials to be measured 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:

- the pressure-carrying walls / lining of the pressure device
- the measurement-related function
- the leak tightness
- the wear (corrosion)

10.2 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.

10.3 Flowmeter sensor

Essentially no maintenance is required for the sensor.

The following items should be checked annually:

- Ambient conditions (air circulation, humidity),
- Seal integrity of the process connections,
- Cable entry points and cover screws,
- Operational reliability of the power supply feed, the lightning protection, and the station ground.

11 Repair

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

NOTE

Spare parts can be ordered from ABB Service:
Please contact Customer Center Service acc. to page 2 for nearest service location.

NOTE

For measuring devices for potentially explosive areas, observe the relevant operator guidelines. See also chapters "Use in potentially explosive atmospheres according to ATEX and IECEx" on page 6 and "Use in potentially explosive atmospheres in accordance with cFMus" on page 14.

11.1 Fuse replacement

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:

— Check that a valid fire permit is available.
— Make sure that there is no explosion hazard.
— Before opening the device, switch off the power supply and wait for t > 2 minutes.

NOTE

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

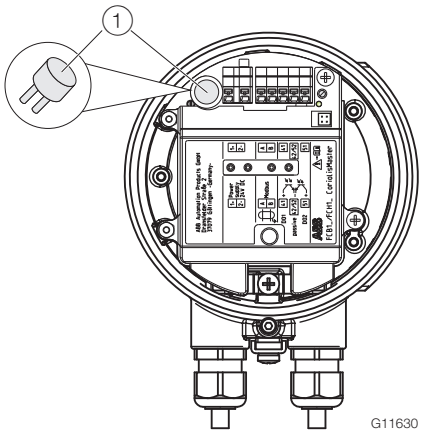

Fig. 34
(1) **Fuse**

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 burns through again on activating, the device is defective and must be replaced.

11.2 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 the Appendix) and include this with the device.
According to the EU Directive governing hazardous materials, the owner of hazardous waste is responsible for its disposal or must observe the following regulations for shipping purposes: All devices delivered to ABB must be free from any hazardous materials (acids, alkalis, solvents, etc.).

Please contact Customer Center Service acc. to page 2 for nearest service location.

12 Recycling and disposal

12.1 Dismounting

⚠ WARNING

Risk of injury due to process conditions.

The process conditions, e.g. high pressures and temperatures, toxic and aggressive measuring media, can give rise to hazards when dismantling the device.

- If necessary, wear suitable personal protective equipment during disassembly.
- Before disassembly, ensure 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 appropriate tools to dismantle 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.
- See the information in chapter "Returning devices" on page 81.

12.2 Disposal

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:

- This product is not subject to WEEE Directive 2002/96/EC or relevant national laws (e.g. ElektroG in Germany).
- The product must be surrendered to a specialist recycling company. Do not use municipal garbage collection points. According to WEEE Directive 2002/96/EC, only products used in private applications may be disposed of at municipal garbage collection points.
- If it is not possible to dispose of old equipment properly, ABB Service can take receipt of and dispose of returns for a fee.

i NOTE

Products that are marked with this symbol may not be disposed of through municipal garbage collection points.

12.3 Information on ROHS Directive 2011/65/EC

The products provided by ABB Automation Products GmbH do not fall within the current scope of regulations on hazardous substances with restricted uses or the directive on waste electrical and electronic equipment according to ElektroG.

If the necessary components are available on the market at the right time, in the future these substances will no longer be used in new product development.

13 Specifications

i NOTE

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

14 Declaration of conformity

i 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 the Modbus Organization

™ Hastelloy C-4 is a Haynes International trademark

™ Hastelloy C-22 is a Haynes International trademark

15 Appendix

15.1 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:	E-Mail:

Device details:

Typ:	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	☐	Explosiv	☐	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

15.2 Installation diagram 3KXF000014G0009

$T_{amb.}$ 55 °C (131 °F), Order-Code TA8

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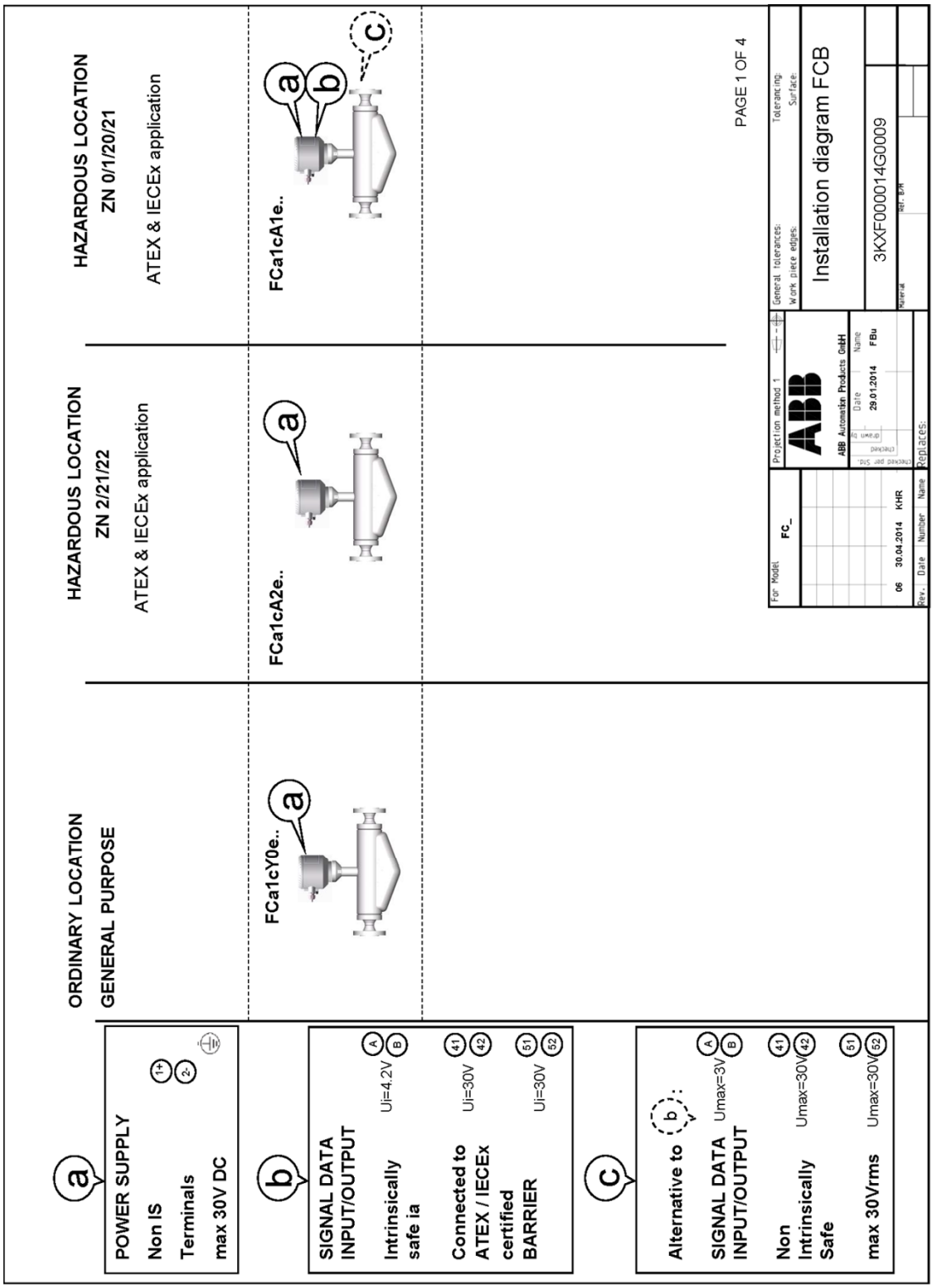

$T_{amb.}$ 55 °C (131 °F), Order-Code TA8

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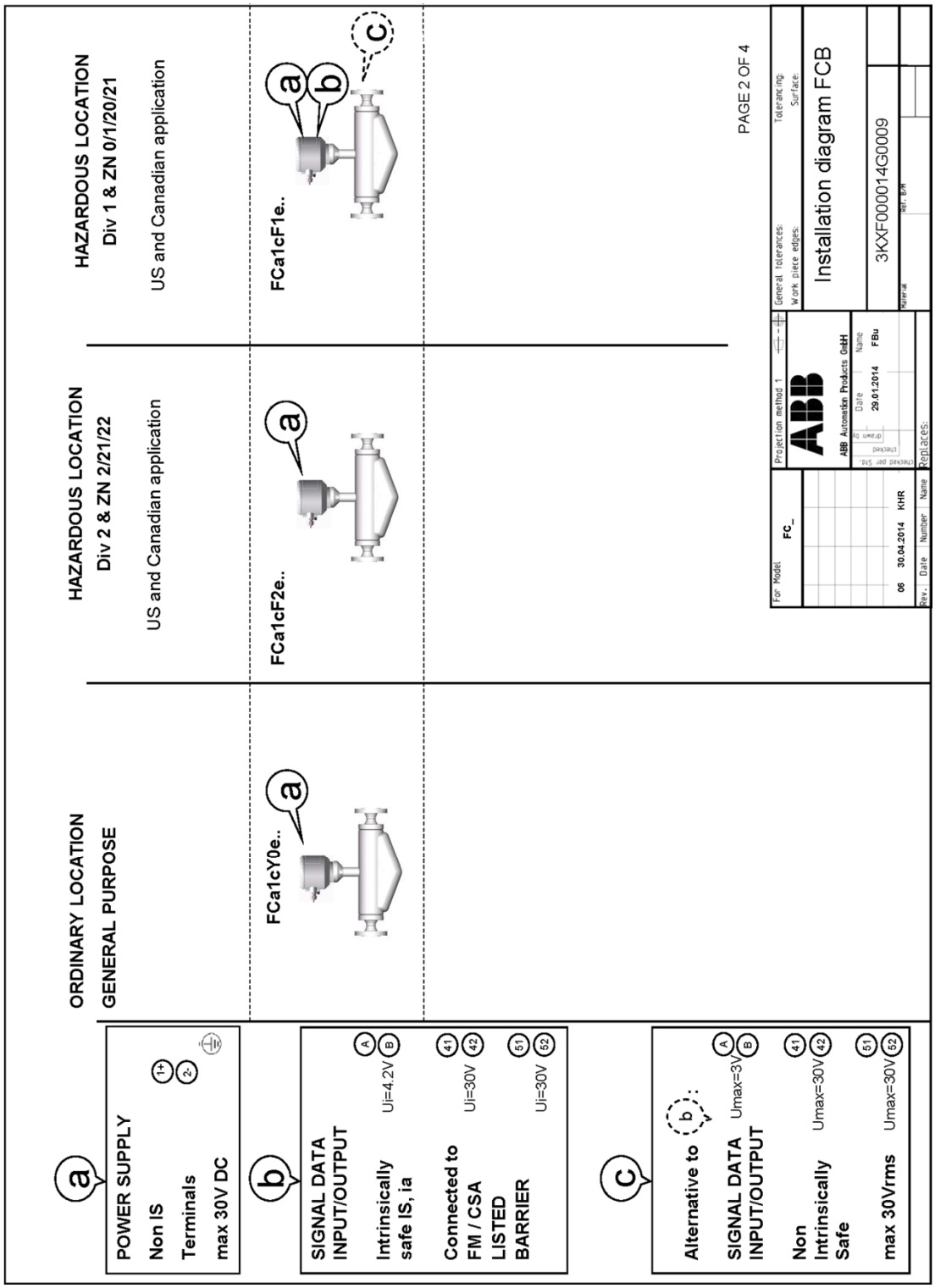

Notes: ATEX & IECEx application

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.
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PAGE 3 OF 4

For Model: FC_
06 | 30.04.2014 | KHR
Rev. | Date | Number | Name
Projection method 1
ABB Automation Products GmbH
Date: 29.01.2014 | Name: FBu
Checked per Std. / Checked / drawn by
Replaces:
General tolerances: / Work piece edges: / Toleranc ing: / Surface:
Installation diagram FCB
3KXF000014G0009
Material / Ref. B/H

$T_{amb.}$ 55 °C (131 °F), Order-Code TA8

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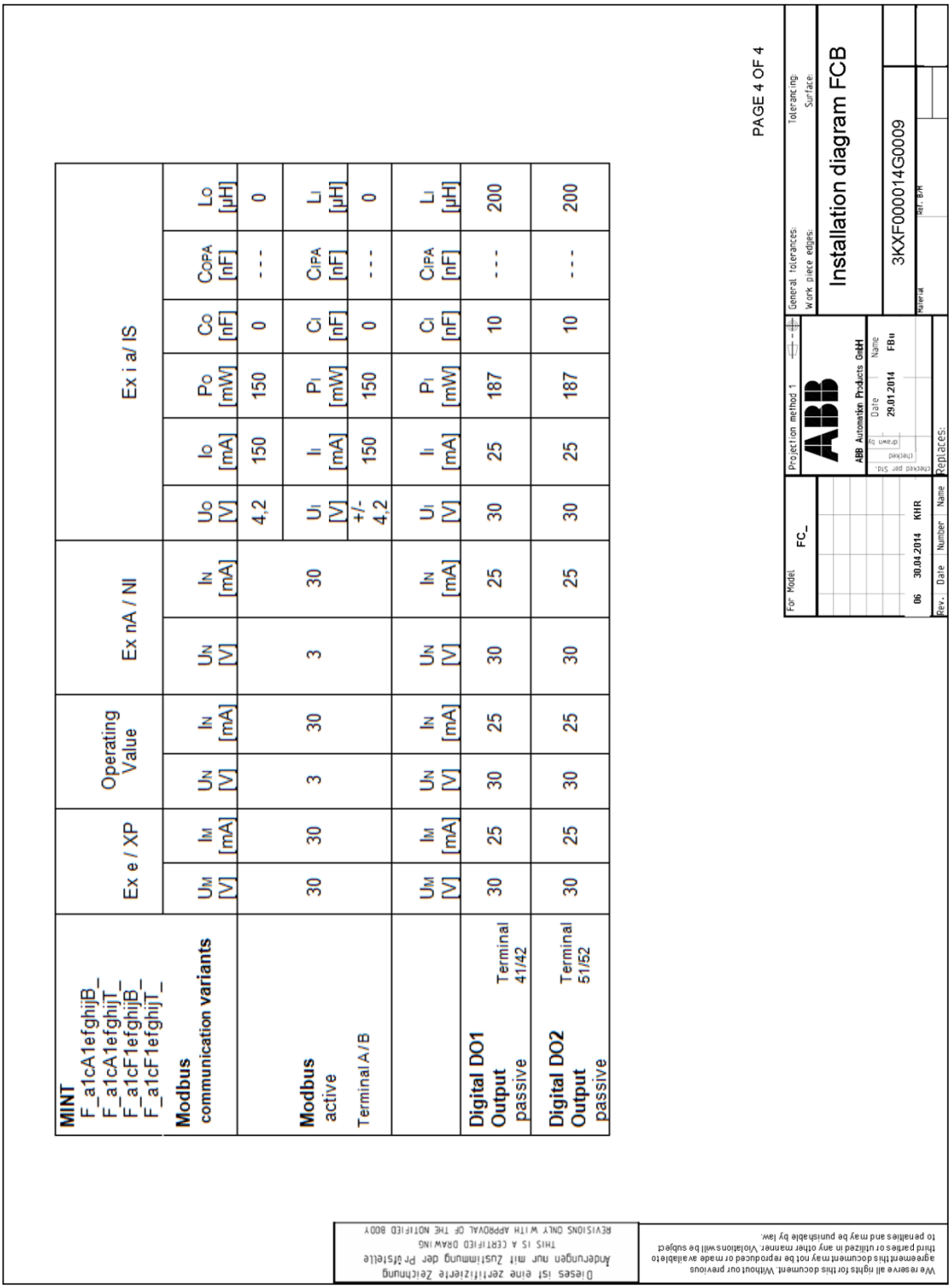

MINT F_a1cA1efghijB_ F_a1cA1efghijT_ F_a1cF1efghijB_ F_a1cF1efghijT_	Ex e / XP		Operating Value		Ex nA / NI		Ex i a/ IS							
Modbus communication variants	U_M [V]	I_M [mA]	U_N [V]	I_N [mA]	U_N [V]	I_N [mA]	U_O [V]	I_O [mA]	P_O [mW]	C_O [nF]	C_{OPA} [nF]	L_O [µH]
							4,2	150	150	0	---	0
Modbus active	30	30	3	30	3	30	U_I [V]	I_I [mA]	P_I [mW]	C_I [nF]	C_{IPA} [nF]	L_I [µH]
Terminal A/B							+/- 4,2	150	150	0	---	0
	U_M [V]	I_M [mA]	U_N [V]	I_N [mA]	U_N [V]	I_N [mA]	U_I [V]	I_I [mA]	P_I [mW]	C_I [nF]	C_{IPA} [nF]	L_I [µH]
Digital DO1 **Output** passive Terminal 41/42	30	25	30	25	30	25	30	25	187	10	---	200
Digital DO2 **Output** passive Terminal 51/52	30	25	30	25	30	25	30	25	187	10	---	200

$T_{amb.}$ 70 °C (158 °F), Order-Code TA3 / TA9

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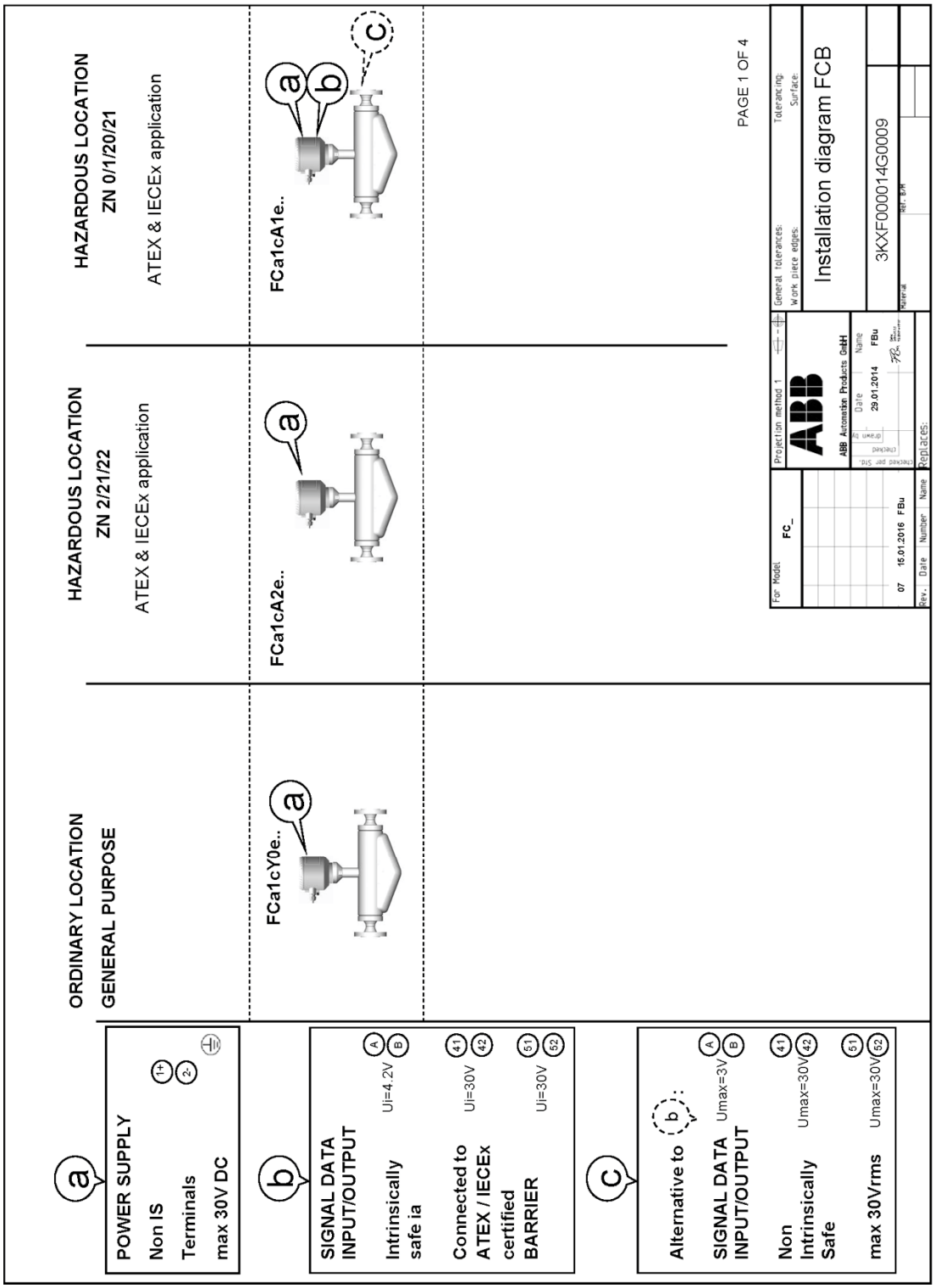
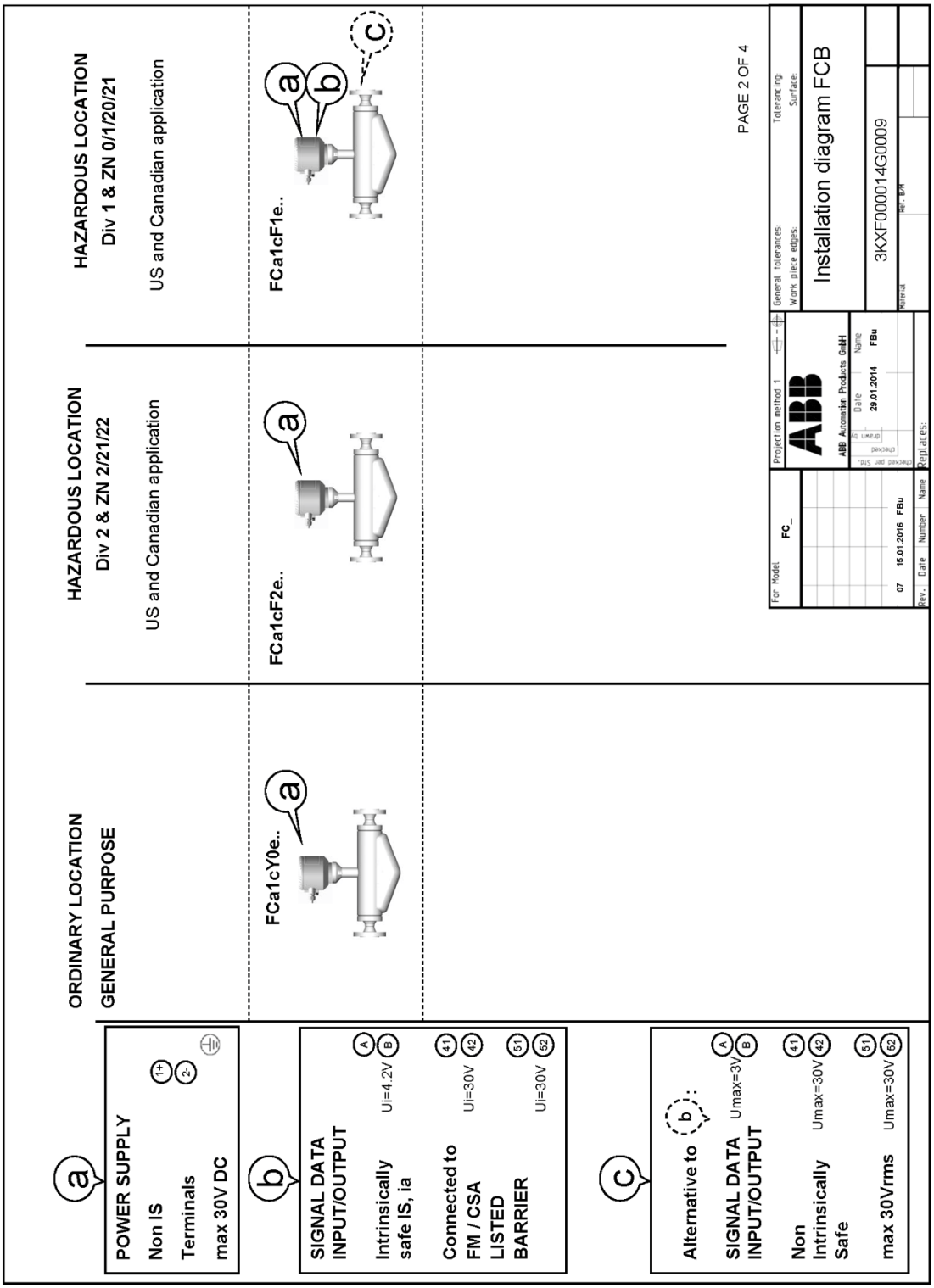


$T_{amb.}$ 70 °C (158 °F), Order-Code TA3 / TA9

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.
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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:
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   Ca OR Co > Ci + Ccable; La OR Lo > Li + Lcable; Po < Pi.
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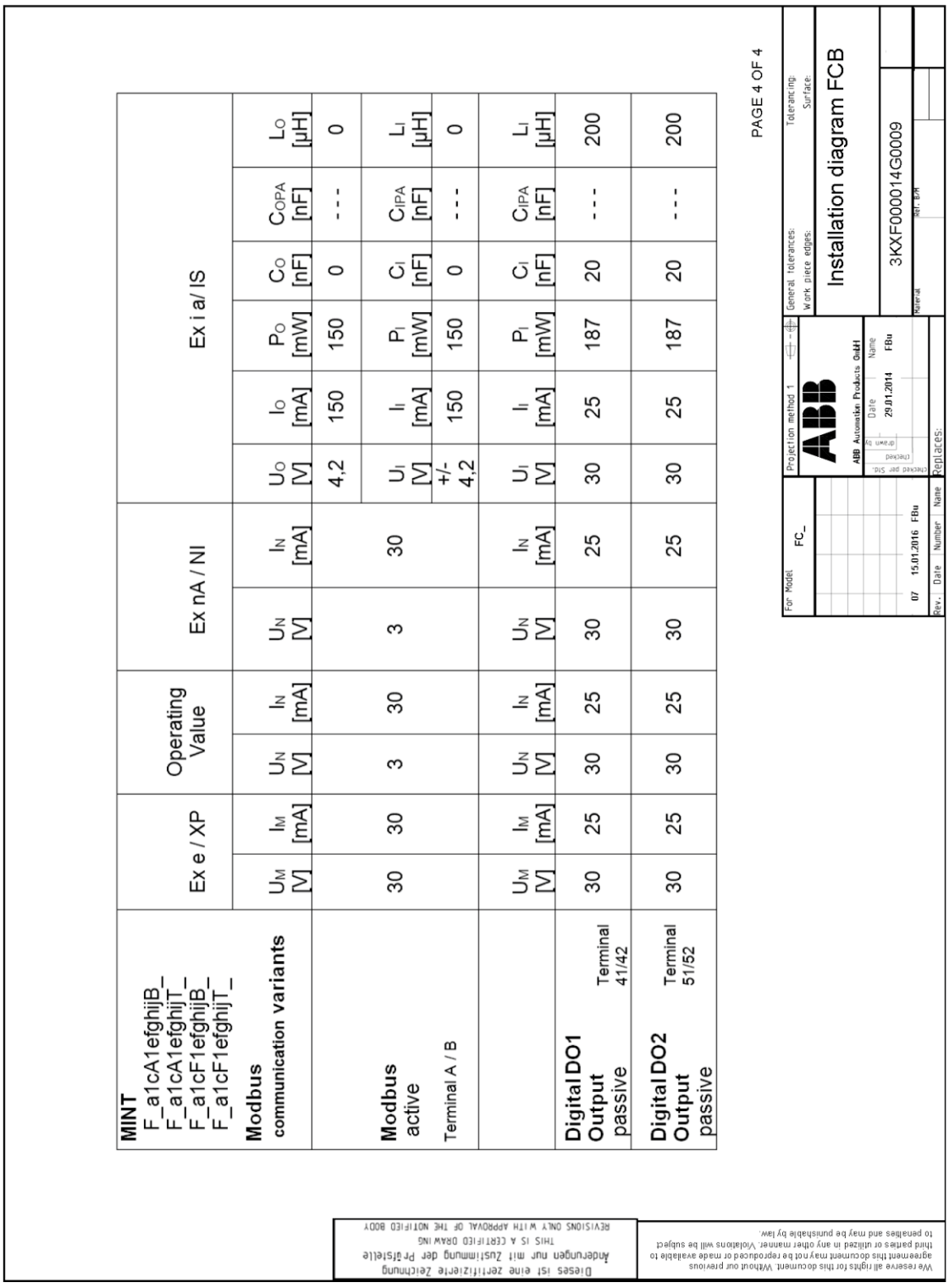
PAGE 3 OF 4

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

For Model: FC_	Projection method 1	General tolerances:	Tolerancing:
	ABB Automation Products GmbH	Work piece edges:	Surface:
07 / 15.01.2016 / FBu	drawn by: Date 29.01.2014, Name FBu	Installation diagram FCB	
Rev. / Date / Number / Name	Replaces:	3KXF000014G0009	



MINT F_a1cA1efghijB_ F_a1cA1efghijT_ F_a1cF1efghijB_ F_a1cF1efghijT_	Ex e / XP		Operating Value		Ex nA / NI		Ex i a/ IS							
Modbus communication variants	U_M [V]	I_M [mA]	U_N [V]	I_N [mA]	U_N [V]	I_N [mA]	U_O [V]	I_O [mA]	P_O [mW]	C_O [nF]	C_{OPA} [nF]	L_O [µH]
							4,2	150	150	0	- - -	0
Modbus active	30	30	3	30	3	30	U_I [V]	I_I [mA]	P_I [mW]	C_I [nF]	C_{IPA} [nF]	L_I [µH]
Terminal A / B							+/- 4,2	150	150	0	- - -	0
	U_M [V]	I_M [mA]	U_N [V]	I_N [mA]	U_N [V]	I_N [mA]	U_I [V]	I_I [mA]	P_I [mW]	C_I [nF]	C_{IPA} [nF]	L_I [µH]
Digital DO1 **Output** passive Terminal 41/42	30	25	30	25	30	25	30	25	187	20	- - -	200
Digital DO2 **Output** passive Terminal 51/52	30	25	30	25	30	25	30	25	187	20	- - -	200

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For Model: FC_ | Projection method 1 | ABB Automation Products GmbH | General Tolerances: Work piece edges: Tolerancing: Surface:

Installation diagram FCB

3KXF000014G0009

Rev.	Date	Number	Name
07	15.01.2016		FBu

Checked per Std.: Checked | drawn by | Date 29.01.2014 | Name FBu | Material | Repl.-Art.-Nr.

Replaces:

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REVISIONS ONLY WITH APPROVAL OF THE NOTIFIED BODY

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