

SensyMaster FMT230, FMT250

Thermal mass flowmeter



Precise and dynamic direct mass flow measurement of gas in OEM applications

Device firmware version: 01.02.00

Measurement made easy

SensyMaster FMT230
SensyMaster FMT250

Introduction

The SensyMaster FMT230 is a top-quality cost-effective solution for the precise and direct dynamic mass flow measurement of gases at low and medium operating pressure levels. The model is delivered preconfigured, ready for use by OEM customers.

In addition, the FMT250 offers the highest level of accuracy and extended functionality for demanding industrial applications.

Additional Information

Additional documentation on SensyMaster FMT230, FMT250 is available for download free of charge at www.abb.com/flow.

Alternatively simply scan this code:



Table of contents

1 Safety	4	3 Use in hazardous areas in accordance with EAC TR-CU-012	20
General information and instructions.....	4	4 Product identification	21
Warnings.....	4	Name plate.....	21
Intended use.....	4	Plates and symbols.....	21
Improper use.....	5	5 Transport and storage	22
Cyber security disclaimer.....	5	Inspection.....	22
Software downloads.....	5	Transport.....	22
Manufacturer's address.....	5	Storing the device.....	22
Service address.....	5	Ambient conditions.....	22
2 Use in potentially explosive atmospheres	6	Returning devices.....	22
Device overview.....	6	6 Installation	23
ATEX, IECEx and UKEX.....	6	Safety instructions.....	23
cFMus.....	6	Installation conditions.....	23
Ex marking: flowmeter.....	7	Installation location and assembly.....	23
ATEX, IECEx and UKEX.....	7	Inlet and outlet sections.....	24
cFMus.....	7	Installation at high ambient temperatures.....	25
Ex marking pipe components and integrated hot tap fitting.....	8	Sensor insulation.....	25
ATEX, IECEx and UKEX.....	8	Ambient conditions.....	25
cFMus.....	8	Ambient temperature.....	25
Temperature data.....	9	Process conditions.....	25
Temperature resistance for the connecting cable.....	9	Measured medium temperature.....	25
Environmental and process conditions for model FMT2xx.....	9	Material loads for process connections.....	26
Ambient and process conditions for pipe components and integrated hot tap fitting.....	12	Assembly of the pipe component.....	27
Electrical data.....	13	Wafer type design (FMT091) and partial measuring section (FMT092).....	28
Modbus outputs and digital outputs.....	13	Assembly of the welding adapter with flange or threaded connector.....	29
Special connection conditions.....	13	Welding adapter with flange connector.....	29
Installation instructions.....	14	Weld-on adapter with ball valve.....	30
ATEX, IECEx and UKEX.....	14	Welding adapter with threaded connection in accordance with DIN 11851.....	31
cFMus.....	14	Mounting.....	32
Use in areas exposed to combustible dust.....	14	Assembly of the welding adapter with compression ring fitting.....	33
Sensor insulation.....	14	Mounting.....	34
Opening and closing the terminal box.....	14	Assembly of the welding adapter with hot tap fitting... ..	37
Cable entries in accordance with ATEX/IECEx and UKEX.....	15	Installing the sensor.....	38
Cable entries in accordance with cFMus.....	15	Wafer type design and welding adapter.....	39
Electrical connections.....	16	Installation / Disassembly of the sensor in connection with the hot tap fitting.....	40
Process sealing.....	16	Safety instructions.....	40
Operating instructions.....	17	Overview.....	40
Protection against electrostatic discharges.....	17	Disassembly of the sensor.....	41
Repair.....	17		
Changing the type of protection – ATEX, IECEx and UKEX.....	18		
Changing the type of protection – cFMus.....	19		

7	Electrical connections	44
	Safety instructions.....	44
	Installing the connection cables.....	44
	Opening and closing the housing	45
	Position of the terminals	45
	Terminal assignment.....	46
	Electrical data for inputs and outputs	46
	Modbus® communication	47
	Connection on the device	48
8	Commissioning and operation	49
	Safety instructions.....	49
	Write-protection switch, service LED and local operator interface.....	49
	Checks prior to commissioning	50
	Switching on the power supply	50
	Parameterization of the device	50
	Parameterization via the Modbus interface.....	50
	Parameterization via the local operating interface	52
	Software history.....	54
9	Maintenance	55
	Safety instructions.....	55
10	Recycling and disposal	55
	Dismounting	55
	Disposal	56
11	Specification	56
12	Additional documents	56
13	Appendix	57
	Return form	57
	FMT200 Installation diagram 3kxf000094G0009.....	58

1 Safety

General information and instructions

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

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

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

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

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

Information and symbols on the product must be observed.

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

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

Warnings

The warnings in these instructions are structured as follows:

DANGER

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

WARNING

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

CAUTION

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

NOTICE

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

Note

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

Intended use

This device can be used in the following applications:

- As an insertion sensor for flange mounting pipe component in piping with nominal diameters DN 25 to 200 (1 to 8 in).
- Through a welding adapter directly in piping of nominal diameter DN 100 (4 in) and above, as well as for non-circular cross-sections.

This device is intended for the following uses:

- for direct mass flow measurement of gases and gas mixtures in closed pipelines.
- for indirect measurement of volume flows (through standard density and mass flow).
- for measuring the temperature of the measuring medium.

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

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

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

Improper use

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

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

Cyber security disclaimer

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

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

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

Software downloads

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

www.abb.com/cybersecurity

[ABB-Library – SensyMaster FMT200 – Software Downloads](#)



Manufacturer's address

ABB AG
Measurement & Analytics

Schillerstr. 72
32425 Minden
Germany

Tel: +49 571 830-0

Fax: +49 571 830-1806

Service address

Customer service center

Tel: +49 180 5 222 580

Email: automation.service@de.abb.com

2 Use in potentially explosive atmospheres

Note

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

Device overview

ATEX, IECEx and UKEX

	Standard / No explosion protection	Zones 2, 22	Zone 1, 21 (Zone 0)
Model number	FMT2xx Y0	FMT2xx A2, U2	FMT2xx A1, A3, U1, U4
<ul style="list-style-type: none"> • Standard • Zone 2, 22 • Zone 1, 21 • Zone 0 			

cFMus

	Standard / No explosion protection	Class I Div. 2 Zone 2, 22	Class I Div. 1 Zone 1, 21
Model number	FMT2xx Y0	FMT2xx F2	FMT2xx F1
<ul style="list-style-type: none"> • Standard • Class I Div. 2 • Class I Div. 1 • Zone 2, 22 • Zone 1, 21 			

G12639a

Ex marking: flowmeter

Note

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

ATEX, IECEx and UKEX

Model FMT2xx-A2, U2... in Zone 2, 22

Certificate (Atex)	FM19ATEX0178X
Certificate (IECEX)	IECEX FMG 19.0025X
Certificate (UKEX)	FM21UKEX0136X
II 3G Ex ec mc IIC T6...T2 Gc	
II 3D Ex tc IIIC T85°C...T _{medium} Dc	

Model FMT2xx-A1, U1... in Zone 1, 21

Certificate (Atex)	FM19ATEX0177X
Certificate (IECEX)	IECEX FMG 19.0025X
Certificate (UKEX)	FM21UKEX0135X
II 2G Ex eb ia mb IIC T6...T2 Gb	
II 2G Ex ia IIC T6...T1 Gb	
II 2D Ex ia tb IIIC T85°C...T _{medium} Db	
permitted supply short-circuit current: 35A	

Model FMT2xx-A3, U4... in Zone 0, 1, 21

Certificate (Atex)	FM19ATEX0177X
Certificate (IECEX)	IECEX FMG 19.0025X
Certificate (UKEX)	FM21UKEX0135X
II 1/2 G Ex eb ia mb IIC T6...T2 Ga/Gb	
II 1G Ex ia IIC T6...T1 Ga	
II 2D Ex ia tb IIIC T85°C...T _{medium} Db	
permitted supply short-circuit current: 35A	

cFMus

Designation for model FMT2xx-F2... in Division 2

FM (marking for US)

Certificate	FM19US0110X
NI: CL I, Div 2, GPS ABCD, T6...T2	
NI: CL II,III Div 2, GPS EFG, T6...T3B	
DIP: CL II, Div 1, GPS EFG, T6...T3B	
DIP: CL III, Div 1,2, T6...T3B	
CL I, ZN 2, AEx ec IIC T6...T2 Gc	
ZN 21, AEx tb IIIC T85°C...T165°C Db	
See handbook for temperature class information	

FM (marking for Canada)

Certificate	FM19CA0055X
NI: CL I, Div 2, GPS ABCD, T6...T2	
NI: CL II,III Div 2, GPS EFG, T6...T3B	
DIP: CL II, Div 1, GPS EFG, T6...T3B	
DIP: CL III, Div 1,2, T6...T3B	
CL I, ZN 2, Ex ec IIC T6...T2 Gc	
Ex tb IIIC T85°C...T165°C Db	
ANSI/ISA 12.27.01: Dual Seal	

Designation for model FMT2xx-F1... in Division 1

FM (marking for US)

Certificate	FM19US0110X
XP-IS: CL I, Div 1, GPS BCD, T6...T2	
DIP: CL II,III, Div 1, GPS EFG, T6...T3B	
CL I, ZN 1, AEx db ia IIB+H2 T6...T2 Ga/Gb	
ZN21, AEx ia tb IIIC T85°C...T165°C Db	
Permitted supply short-circuit current: 35A	
See handbook for temperature class information and installation drawing 3kxf000094G0009	

FM (marking for Canada)

Certificate	FM19CA0055X
XP-IS: CL I, Div 1, GPS BCD, T6...T2	
DIP: CL II,III, Div 1, GPS EFG, T6...T3B	
CL I, ZN 1, Ex db ia IIB+H2 T6...T2 Ga/Gb	
Ex ia tb IIIC T85°C...T165°C Db	
IN-/OUTPUTS: U-rated=30V	
Ex ia INTRINSICALLY SAFE	
SECURITE INTRINSEQUE	

... 2 Use in potentially explosive atmospheres

Ex marking pipe components and integrated hot tap fitting

Note

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

ATEX, IECEx and UKEX

Model number for use in Zone 2, 22	Ex marking	Certificate
FMT091_ (j=SCA, SCB, SCC) SensyMaster FMT091 pipe component type 1, wafer type Optional with ball valve or integrated hot tap fitting	II 3 G Ex h IIC T6...T3 Gc II 3 D Ex h IIIC T85°C ... T150°C Dc	ATEX: FM19ATEX0178X IECEx: IECEx FMG 19.0025X
FMT092_ (j=SCA, SCB, SCC) SensyMaster FMT092 pipe component type 2, partial measuring section Optional with ball valve or integrated hot tap fitting		UKEX: FM21UKEX0136X
FMT094_ (j=SCA, SCD) SensyMaster FMT094 pipe component type 4, partial measuring section Optional with ball valve or integrated hot tap fitting		

Model number for use in Zone 0/1, 21	Ex marking	Certificate
FMT091_ (j=SCA, SCB, SCC) SensyMaster FMT091 pipe component type 1, wafer type	II 2 G Ex h IIC T6...T3 Gb II 2 D Ex h IIIC T85°C ... T150°C Db	ATEX: FM19ATEX0177X IECEx: IECEx FMG 19.0025X
FMT092_ (j=SCA, SCB, SCC) SensyMaster FMT092 pipe component type 2, partial measuring section		UKEX: FM21UKEX0135X
FMT094_ (j=SCA, SCD) SensyMaster FMT094 pipe component type 4, partial measuring section Optional with ball valve or integrated hot tap fitting		

Notice regarding the integrated hot tap fitting

The integrated hot tap fitting has been designed in accordance with the DIN EN 80079-36 and DIN EN 80079-37 standards and the 'c – constructional safety' type of protection.

cFMus

The pipe components do not have any marking in accordance with cFMus. The pipe components can be used in accordance with cFMus in the following areas:

- Div. 1
- Div. 2, Zone 1, 2, 21

Temperature data

Temperature resistance for the connecting cable

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

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

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

From an ambient temperature of $T_{\text{amb.}} \geq 60\text{ °C}$ ($\geq 140\text{ °F}$), the wires in the connection boxes with the enclosed silicone hoses need to be additionally insulated.

Note

The signal cable supplied by ABB can be used without restrictions up to an ambient temperature of $\leq 80\text{ °C}$ ($\leq 176\text{ °F}$).

Environmental and process conditions for model FMT2xx...

Ambient temperature $T_{\text{amb.}}$	-20 to 70 °C (-4 to 158 °F)
	-40 to 70 °C (-40 to 158 °F)*
Measuring medium temperature T_{medium}	-20 to 150 °C (-4 to 302 °F)
	-40 to 150 °C (-40 to 302 °F)*
IP rating / NEMA rating	IP 65, IP 67 / NEMA 4X, Type 4X

* Low temperature design (optional)

... 2 Use in potentially explosive atmospheres

... Temperature data

Measuring medium temperature (Ex data) for model FMT2x0-A1... in Zone 1, Zone 21

The table shows the maximum permissible measuring medium temperature as a function of ambient temperature and temperature class. The permissible measuring medium temperature specified in Environmental and process conditions for model FMT2xx... must not be up-scaled!

Ambient temperature T_{amb}	Temperature class					
	T1	T2	T3	T4	T5	T6
-40 °C to 40 °C (-40 °F to 104 °F)	280 °C (536 °F)	185 °C (365 °F)	90 °C (194 °F)	90 °C (194 °F)	—	—
-40 °C to 50 °C (-40 °F to 122 °F)	280 °C (536 °F)	185 °C (365 °F)	90 °C (194 °F)	90 °C (194 °F)	—	—
-40 °C to 60 °C (-40 °F to 140 °F)	280 °C (536 °F)	185 °C (365 °F)	90 °C (194 °F)	90 °C (194 °F)	—	—
-40 °C to 70 °C (-40 °F to 158 °F)	280 °C (536 °F)	185 °C (365 °F)	90 °C (194 °F)	90 °C (194 °F)	—	—

Measuring medium temperature (Ex data) for model FMT2x0-A2... in Zone 2, Zone 22

The table shows the maximum permissible measuring medium temperature as a function of ambient temperature and temperature class. The permissible measuring medium temperature specified in Environmental and process conditions for model FMT2xx... must not be up-scaled!

Ambient temperature T_{amb}	Temperature class					
	T1	T2	T3	T4	T5	T6
-40 °C to 40 °C (-40 °F to 104 °F)	300 °C (572 °F)	290 °C (554 °F)	195 °C (383 °F)	130 °C (266 °F)	95 °C (203 °F)	80 °C (176 °F)
-40 °C to 50 °C (-40 °F to 122 °F)	300 °C (572 °F)	290 °C (554 °F)	195 °C (383 °F)	130 °C (266 °F)	95 °C (203 °F)	—
-40 °C to 60 °C (-40 °F to 140 °F)	300 °C (572 °F)	290 °C (554 °F)	195 °C (383 °F)	130 °C (266 °F)	—	—
-40 °C to 70 °C (-40 °F to 158 °F)	300 °C (572 °F)	290 °C (554 °F)	195 °C (383 °F)	130 °C (266 °F)	—	—

Measuring medium temperature (Ex data) for model FMT2x0-F1... in Class I Division 1 and Class II Division 1

The table shows the maximum permissible measuring medium temperature as a function of ambient temperature and temperature class. The permissible measuring medium temperature specified in **Environmental and process conditions for model FMT2xx...** on page 9 must not be up-scaled!

Ambient temperature T_{amb}	Temperature class					
	T1	T2	T3	T4	T5	T6
-40 °C to 40 °C (-40 °F to 104 °F)	280 °C (536 °F)	185 °C (365 °F)	90 °C (194 °F)	90 °C (194 °F)	—	—
-40 °C to 50 °C (-40 °F to 122 °F)	280 °C (536 °F)	185 °C (365 °F)	90 °C (194 °F)	90 °C (194 °F)	—	—
-40 °C to 60 °C (-40 °F to 140 °F)	280 °C (536 °F)	185 °C (365 °F)	90 °C (194 °F)	90 °C (194 °F)	—	—
-40 °C to 70 °C (-40 °F to 158 °F)	280 °C (536 °F)	185 °C (365 °F)	90 °C (194 °F)	90 °C (194 °F)	—	—

Measuring medium temperature (Ex data) for model FMT2x0-F1... in Class I Division 2 and Class II Division 2

The table shows the maximum permissible measuring medium temperature as a function of ambient temperature and temperature class. The permissible measuring medium temperature specified in **Environmental and process conditions for model FMT2xx...** on page 9 must not be up-scaled!

Ambient temperature T_{amb}	Temperature class					
	T1	T2	T3	T4	T5	T6
-40 °C to 40 °C (-40 °F to 104 °F)	300 °C (572 °F)	290 °C (554 °F)	195 °C (383 °F)	130 °C (266 °F)	95 °C (203 °F)	80 °C (176 °F)
-40 °C to 50 °C (-40 °F to 122 °F)	300 °C (572 °F)	290 °C (554 °F)	195 °C (383 °F)	130 °C (266 °F)	95 °C (203 °F)	—
-40 °C to 60 °C (-40 °F to 140 °F)	300 °C (572 °F)	290 °C (554 °F)	195 °C (383 °F)	130 °C (266 °F)	—	—
-40 °C to 70 °C (-40 °F to 158 °F)	300 °C (572 °F)	290 °C (554 °F)	195 °C (383 °F)	130 °C (266 °F)	—	—

... 2 Use in potentially explosive atmospheres

... Temperature data

Ambient and process conditions for pipe components and integrated hot tap fitting

Measuring medium temperature T_{medium}	Standard: -20 to 150 °C (-4 to 302 °F)
Ambient temperature T_{amb} , for pipe components without ball valve or integrated hot tap fitting.	Standard: -20 to 70 °C (-4 to 158 °F), optional: -40 to 70 °C (-40 to 158 °F) Depending on the selected ambient temperature range (TA3/TA9) of the sensor and O-ring design.
Ambient temperature T_{amb} , for pipe components with ball valve or integrated hot tap fitting	Standard: -20 to 70 °C (-4 to 158 °F)

(Sensor connection options: SCA, SCB, SCD)

Measuring medium temperature (Ex data) for pipe components and integrated hot tap fitting

The table shows the maximum permissible measuring medium temperature as a function of ambient temperature and temperature class. The permissible measuring medium temperature specified in the table above must not be up-scaled!

Ambient temperature T_{amb}	Options	Temperature class			
		T3	T4	T5	T6
-20 °C to 70 °C (-4 °F to 158 °F)	Pipe component without ball valve or integrated hot tap fitting	150 °C (302 °F)	135 °C (275 °F)	100 °C (212 °F)	85 °C (185 °F)
-40 °C to 70 °C (-40 °F to 158 °F)	Pipe component without ball valve or integrated hot tap fitting	150 °C (302 °F)	135 °C (275 °F)	100 °C (212 °F)	85 °C (185 °F)
-20 °C to 70 °C (-4 °F to 158 °F)	Pipe component with ball valve or integrated hot tap fitting	150 °C (302 °F)	135 °C (275 °F)	100 °C (212 °F)	85 °C (185 °F)

Integrated hot tap fitting – maximum surface temperature

The maximum surface temperature of the integrated hot tap fitting is 85 °C to 150 °C (185 °F to 302 °F) depending on the measuring medium temperature.

Electrical data

Modbus outputs and digital outputs

ATEX/IECEx model: FMT2xx-A1..., FMT2xx-A2..., FMT2xx-A3...

cFMus model: FMT2xx-F1..., FMT2xx-F2...

Outputs	Operating values				Type of protection							
	(general)		'Ex ec' / 'NI' (Zone 2, 22) (Div. 2, Zone 2)		'Ex e' / 'XP' (Zone 1, 21) (Div. 1, Zone 1)		'Ex ia' / 'IS' (Zone 1, 21) (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 [μH]
Modbus, active							4,2	150	150	13900	—	20
Terminals A / B	30	30	30	30	30	100	U_i [V]	I_i [mA]	P_i [mW]	C_i [nF]	$C_{i_{pa}}$ [nF]	L_i [μH]
							4,2	150	150	13900	—	20
Digital output DO1, passive												
Terminals 41 / 42	30	30	30	30	30	100	30	25	187	20	—	200
Digital output DO2, passive												
Terminals 51 / 52	30	30	30	30	30	100	30	25	187	20	—	200

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

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

Special connection conditions

Note

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

Note

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

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

- Combining intrinsically safe and non-intrinsically safe circuits is not permitted.
- On intrinsically safe circuits, potential equalization should be established along the entire length of the cable used for the signal outputs.
- The rated voltage of the non-intrinsically safe circuits is $U_M = 30$ V.
- Intrinsic safety is preserved if the rated voltage $U_M = 30$ V is not up-scaled when connections are established to non-intrinsically safe external circuits.
- The information in **Changing the type of protection – ATEX, IECEx and UKEX** on page 18 must be observed when changing the type of protection.

... 2 Use in potentially explosive atmospheres

Installation instructions

ATEX, IECEx and UKEX

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

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

Observe the safety instructions for electric apparatus for potentially explosive atmospheres in accordance with Directive 2014/34/EU (ATEX) or British Regulations (UKEX) and for example IEC 60079-14 (installation of electric equipment in potentially explosive atmospheres).

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

It is essential that the temperature classes as per the approvals in 'Temperature data on page 9' are observed.

The information in the installation diagram **3kxf000094G0009** on page 58 must be observed.

cFMus

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

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

It is essential that the temperature classes as per the approvals in 'Temperature data on page 9' are observed.

The information in the installation diagram **3kxf000094G0009** on page 58 must be observed.

Use in areas exposed to combustible dust

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

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

Sensor insulation

Observe the notes in **Sensor insulation** on page 25 if the sensor should be insulated.

Observe the information in **Temperature data** on page 9 regarding temperature class and cable specification.

Opening and closing the terminal box

DANGER

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

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

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

WARNING

Risk of injury due to live parts!

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

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

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

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

Note

Spare parts can be ordered from ABB Service.

www.abb.com/contacts

Cable entries in accordance with ATEX/IECEX and UKEX

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 entries must be sealed prior to commissioning, using the seals supplied.

The outside diameter of the connection cable must measure between 6 mm (0.24 in) and 12 mm (0.47 in) to guarantee the required tightness.

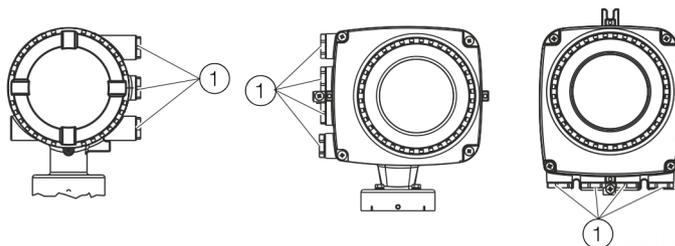
Black cable fittings are installed by default when the device is supplied. If signal outputs are connected to intrinsically safe circuits, replace the black cap on the corresponding cable gland with the blue one supplied.

Note

In order to provide the required temperature resistance, devices in the low-temperature design (optional – in preparation, ambient temperature up to -40 °C [40 °F]) are delivered with metal cable glands.

These are then also to be used in intrinsically safe circuits.

Cable entries in accordance with cFMus



① Transport protection plugs

Figure 1: Cable entry

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

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

Note

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

... 2 Use in potentially explosive atmospheres

... Installation instructions

Electrical connections

Note

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

For the electric connection of the device, use only cables with sufficient temperature resistance in accordance with the tables at **Temperature resistance for the connecting cable** on page 9.

Grounding

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

Perform grounding of the device in accordance with **Terminal assignment** on page 46.

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

Perform grounding of the device in accordance with **Terminal assignment** on page 46.

Power supply terminal cover

Make sure that the power supply terminal cover is closed tightly, see also **Connection on the device** on page 48.

Process sealing

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

Note

The device is suitable for use in Canada.

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

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

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

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

SensyMaster flowmeters are designed 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	No limitations
Nominal sizes	DN 25 to 2000 (1 to 78 in)
Operating temperature	
– Standard design	–20 °C to 150 °C (–4 °F to 302 °F)
– Low temperature design	–40 °C to 150 °C (–40 °F to 302 °F)
Process pressure	PN 40 / Class 300

Operating instructions

Protection against electrostatic discharges

⚠ DANGER

Explosion hazard due to electrostatic charging!

The painted surface of the device can store electrostatic charges.

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

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

Instructions on cleaning

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

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

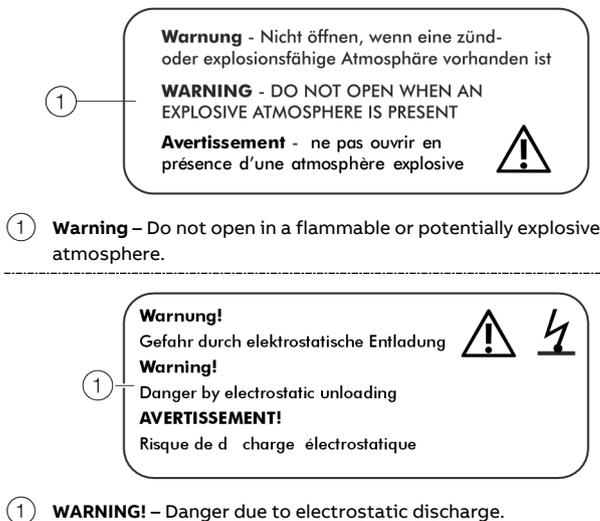


Figure 2: Warning signs on the device

Repair

Contact ABB before commencing repair work.

... 2 Use in potentially explosive atmospheres

... Operating instructions

Changing the type of protection – ATEX, IECEx and UKEX

When installing in Zone 1, the Modbus interface and digital outputs of the FMT230/250 models can be operated with different types of protection:

- Modbus interface and digital output with intrinsically safe ia 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: Modbus interface and digital outputs in non-intrinsically safe design	Zone 1: Modbus interface and digital outputs in intrinsically safe ia / IS design	<ul style="list-style-type: none"> • $500 \times 1.414 = 710$ V DC/1min • Test between terminals A / B, 41 / 42 as well as 51 / 52 and the 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: Modbus interface and digital outputs in intrinsically safe ia(ib) / IS design	Zone 1: Modbus interface and digital outputs in non-intrinsically safe design	<ul style="list-style-type: none"> • Visual inspection, no damage visible on the threads (cover, ½ in NPT cable glands).

Note

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

Changing the type of protection – cFMus

The Modbus interface and the digital outputs of the models FMT230/250 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, $U_{max} = 30\text{ V}$ Outputs non IS	Housing: XP Outputs: IS	<ul style="list-style-type: none"> • $500 \times 1.414 = 710\text{ V DC/1min}$ Test between terminals A / B, 41 / 42 as well as 51 / 52 and the 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	<ul style="list-style-type: none"> • $500 \times 1.414 = 710\text{ V DC/1min}$ Test between terminals A / B, 41 / 42 as well as 51 / 52 and the 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	<ul style="list-style-type: none"> • Visual inspection, no damage visible on the threads (cover, $\frac{1}{2}$ in NPT cable glands).
	Housing: XP Outputs: NI	<ul style="list-style-type: none"> • No special measures.
Housing: XP, $U_{max} = 30\text{ V}$ Outputs: NI	Housing: XP Outputs: IS	<ul style="list-style-type: none"> • $500 \times 1.414 = 710\text{ V DC/1min}$ Test between terminals A / B, 41 / 42 as well as 51 / 52 and the 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	<ul style="list-style-type: none"> • Visual inspection, no damage visible on the threads (cover, $\frac{1}{2}$ in 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 hazardous areas in accordance with EAC TR-CU-012

Note

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

The icon on the name plate indicates the following:



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



<INF/FMT200/FMT400/EAC-Ex-X8>

4 Product identification

Name plate

Note

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



- ① Type designation
- ② CE mark/UKCA mark with notified body
- ③ Power supply
- ④ IP- / NEMA IP rating
- ⑤ Ambient temperature range (T_{amb}) wetted material
- ⑥ Sensor element design
- ⑦ Sensor installation length
- ⑧ Sensor connection
- ⑨ Measuring medium temperature range (T_{medium})
- ⑩ 'Read operating instruction' symbol
- ⑪ 'Hot surface' symbol
- ⑫ 'Disposal' symbol
- ⑬ Manufacturer address
- ⑭ Manufacturing date (month/year)
- ⑮ Ex marking
- ⑯ Device firmware update field
- ⑰ Device firmware revision
- ⑱ Order code
- ⑲ Serial number

Figure 3: Name plate (example)

Note



Products that are marked with the adjacent symbol may **not** be disposed of as unsorted municipal waste (domestic waste).

They should be disposed of through separate collection of electric and electronic devices.

Plates and symbols

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

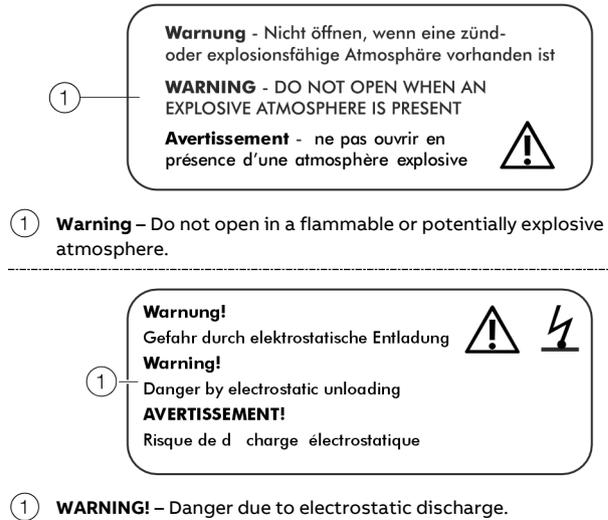


Figure 4: Warning signs on the device

5 Transport and storage

Inspection

Check the devices immediately after unpacking for possible damage that may have occurred from improper transport.

Details of any damage that has occurred in transit must be recorded on the transport documents.

All claims for damages must be submitted to the shipper without delay and before installation.

Transport

DANGER

Life-threatening danger due to suspended loads.

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

- Standing under suspended loads is prohibited.

WARNING

Risk of injury due to device slipping.

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

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

Storing the device

Bear the following points in mind when storing devices:

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

Observe the following instructions:

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

If the original packaging material is no longer available, wrap the device in bubble wrap or corrugated cardboard and place it in a box of sufficient size lined with a shock-absorbing material (e.g., foam rubber). The thickness of the padding should be appropriate for the device weight and type of shipment. The box must be labeled as “fragile”.

For overseas shipment, always add a desiccant (e.g., silica gel) and hermetically seal the device plus desiccant in a layer of polythene that is 0.2 mm thick. Use an amount of desiccant that is appropriate for the packing volume and the expected transport time (at least for three months). You should also line the box with a layer of union paper.

Ambient conditions

Storage temperature range

Standard design:

–20 to 85 °C (–4 to 185 °F),

Low temperature design:

–40 to 85 °C (–40 to 185 °F)

Relative humidity

Maximum 85 % RH, annual average ≤ 65 % RH

Returning devices

Use the original packaging or a secure transport container of an appropriate type if you need to return the device for repair or recalibration purposes.

Fill out the return form (see **Return form** on page 57) and include this with the device.

In accordance with the EU Directive governing hazardous materials, the owner of hazardous waste is responsible for its disposal or must observe the following regulations for shipping purposes:

All devices delivered to ABB must be free from any hazardous materials (acids, alkalis, solvents, etc.).

Address for returns:

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

6 Installation

Safety instructions

DANGER

Danger to life due to piping under pressure!

Sensors which may eject during installation or removal in piping remaining under pressure may pose a danger to life.

- Install or remove a sensor only if the piping is depressurized.
- As an alternative, use a pipe component with an integrated hop tap fitting.

WARNING

Risk of injury due to process conditions.

The process conditions, for example high pressures and temperatures, toxic and aggressive measuring media, can give rise to hazards when working on the device.

- Before working on the device, make sure that the process conditions do not pose any hazards.
- If necessary, wear suited personal protective equipment when working on the device.
- Depressurize and empty the device / piping, allow to cool and purge if necessary.

Installation conditions

Installation location and assembly

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

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

Seals

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

Note the following points when selecting and mounting gaskets:

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

... 6 Installation

... Installation conditions

Inlet and outlet sections

The figures below show the recommended inlet and outlet sections for various installations.

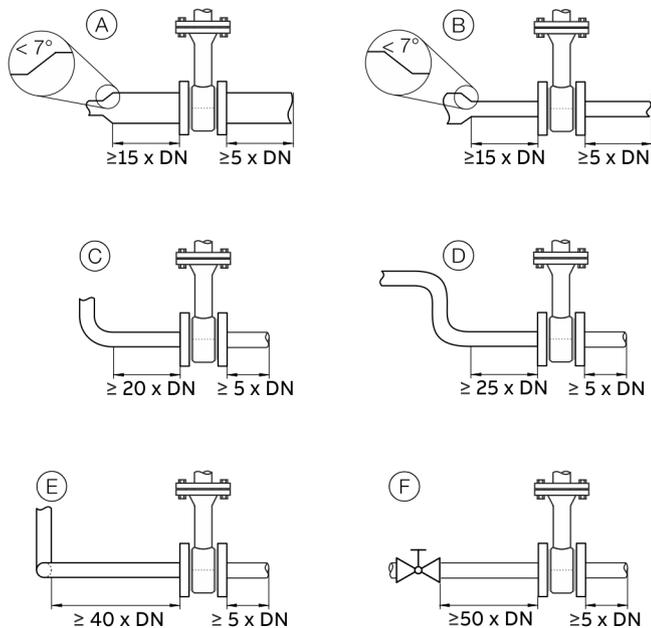


Figure 5: Inlet and outlet sections

Installation	Inlet section	Outlet section
(A) Pipe extension	min. 15 × DN	min. 5 × DN
(B) Pipe reduction	min. 15 × DN	
(C) 90° Pipe elbow	min. 20 × DN	
(D) 2 × 90° pipe elbow in one level	min. 25 × DN	
(E) 2 × 90° pipe elbow in two levels	min. 40 × DN	
(F) Control Valve	min. 50 × DN	

To achieve the specified measuring accuracy, the indicated inlet and outlet sections are required.

In case of combinations of several inlet-side effects, e.g. valve and reduction, the longer inlet section must be taken into account.

In case of confined spaces at the installation site, the outlet section can be shortened to 3 × DN. However, reducing the specified inlet section will reduce the achievable level of accuracy.

A high repeatability of the measured value is maintained.

In case of insufficient inlet and outlet sections, a special calibration may be possible. To do this, a detailed reconciliation is necessary for individual cases.

The specified inlet and outlet sections must be doubled for gases with a very low density (hydrogen, helium).

Installation at high ambient temperatures

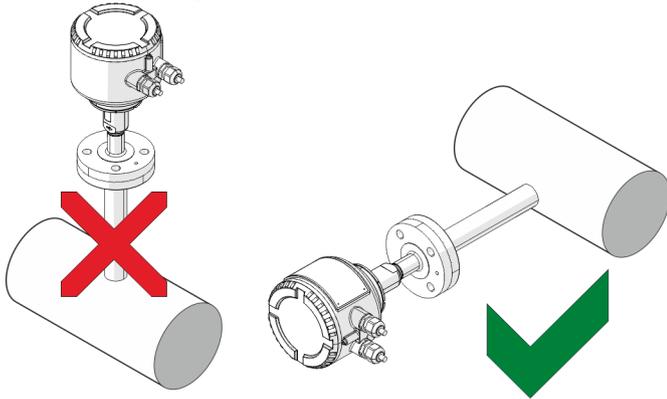
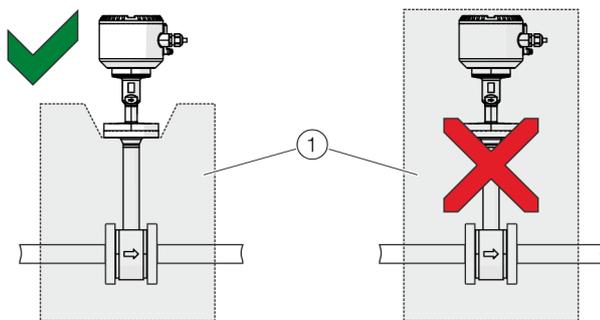


Figure 6: Mounting position at high ambient temperatures

Under high but permissible ambient temperatures, avoid additional thermal stress from heat convection or radiation, since these sources of heat may exceed the permissible ambient temperature on the equipment surface.

If the device needs to be installed directly on a hot, horizontal piping, we recommend installing it on the side. In such cases, you should avoid installing it in the 12 o'clock position, otherwise the warm air that rises up will cause additional heating of the electronics.

Sensor insulation



① Insulation

Figure 7: Isolation of the sensor

The sensor may be insulated as shown in **Figure 7**.

Ambient conditions

Ambient temperature

- Standard: -20 to 70 °C (-4 to 158 °F)
- Optional: -40 to 70 °C (-40 to 158 °F)

Relative humidity

Maximum 85 % RH, annual average ≤ 65 % RH

IP rating

In accordance with EN 60529: IP 65 / IP 67

NEMA IP rating

NEMA 4X

Process conditions

Note

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

Measured medium temperature

Devices with ceramic sensor element and flanged connection:

Design	T_{medium}
Standard and explosion-proof design	-20 to 150 °C (-4 to 302 °F)
High temperature design*	-20 to 300 °C (-4 to 572 °F)
Low temperature design	-40 to 150 °C (-40 to 302 °F)
DVGW Version	-20 to 100°C (-4 to 212 °F)

* Not in connection with explosion-proof design.

The approved measuring medium temperature T_{medium} also depends on the selected sensor connection and the design of the pipe components.

The following temperature specifications apply:

Sensor connection	T_{medium}
Flange DN25	-40 to maximum 300 °C (-40 to maximum 508 °F)
Threaded connection DIN 11851	-20 to 140 °C (-4 to 284 °F)
Clamp ring fitting	-40 to 150 °C (-40 to 302 °F)
Pipe components with ball valve	Maximum 150 °C (302 °F)
Integrated hot tap fitting	-20 to 150 °C (-4 to 302 °F)

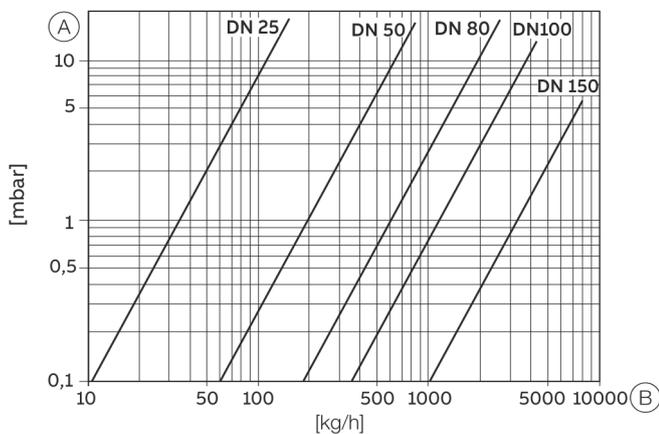
... 6 Installation

... Process conditions

Maximum operating pressure

Sensor connection	Maximum measuring medium pressure P_{medium}
Flange in accordance with DIN EN 1092, PN 40	4 MPa, 40 bar (580 psi)
Threaded connection DIN 11851	1.6 MPa, 16 bar (232 psi)
Clamp ring fitting	2 MPa, 20 bar (290 psi)
Integrated hot tap fitting	See Integrated hot tap fitting on page 26

Pressure loss



(A) Pressure loss (B) Mass flow

Figure 8: Pressure loss in logarithmic representation

Material loads for process connections

DIN and ASME flanges

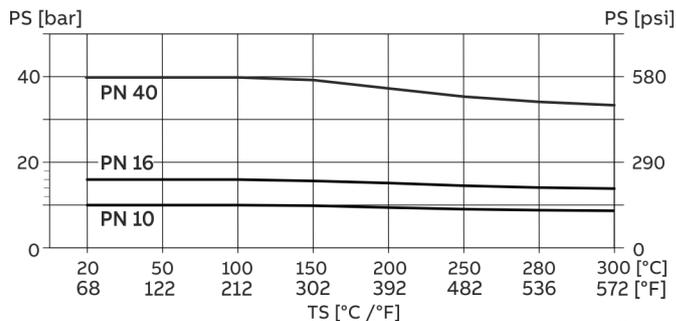


Figure 9: DIN flange process connection

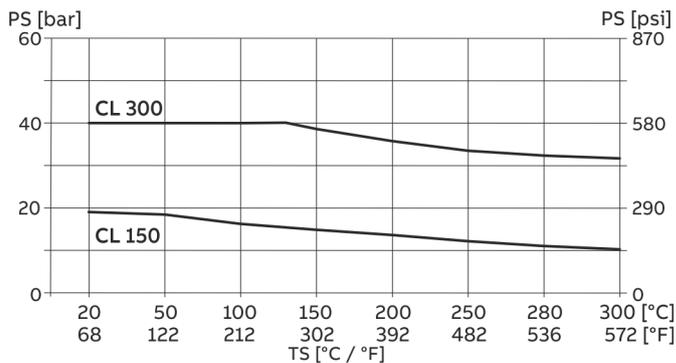


Figure 10: ASME flange process connection

The maximum approved operating pressure for CL 300 is limited to 40 bar (580 psi).

Integrated hot tap fitting

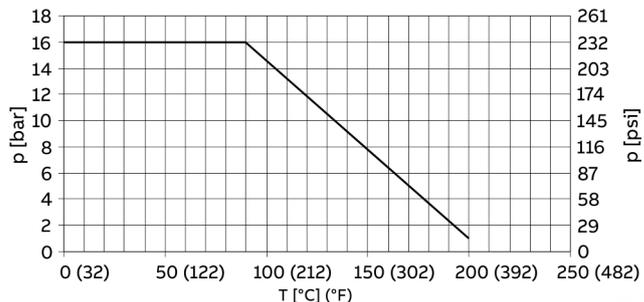


Figure 11: Maximum pressure/temperature values for integrated hot tap fitting

Assembly of the pipe component

When installing the pipe components, observe the following points:

- During installation, it is important to ensure that the flow direction corresponds to the attached label.
- When welding the welding adapter, remember to observe the relevant welding instructions. The amount of heat introduced must be kept to an absolute minimum to prevent warping of the mounting flange's sealing surface.
- In the case of flanged connections, install gaskets which are in perfect condition and resistant to measuring media.

ABB recommends the use of spiral gaskets in accordance with DIN EN 1514-2 or ASME B16.20

- Before installing pipe components or sensors, check all components and gaskets for damage.
- Pipe components must not be installed under tension, otherwise the piping may exert impermissible forces on the device.
- When assembling the flanged connections, use screws that have the required strength and dimensions, quality class A2-70 or A4-70.
- The screws must be tightened evenly and to the required torque.
- Once the pipe components have been installed, the insertion connection must be sealed by means of a blind flange plus gasket or by closing a shut-off device (if present).

... 6 Installation

Wafer type design (FMT091) and partial measuring section (FMT092)

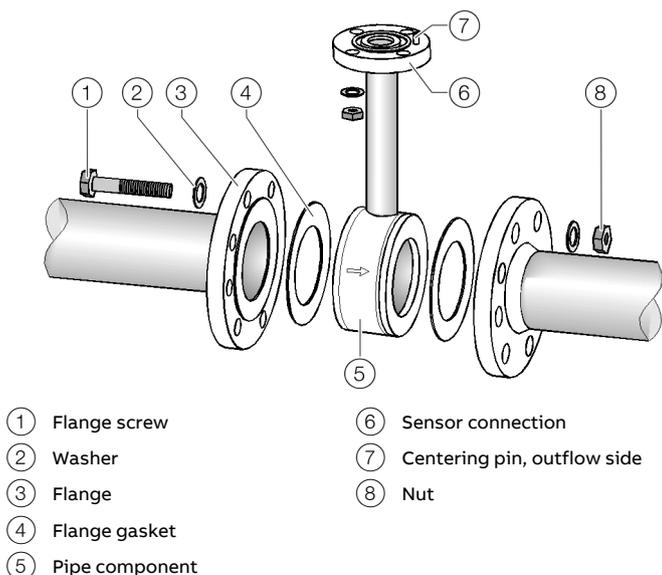


Figure 12: Installing a pipe component (example, wafer type design)

1. Position the pipe component coplanar and centered between the piping. The flow direction must correspond to the arrow indicated on the pipe component. The centering pin on the pipe component must be located on the outflow side (behind the measuring point).
2. Install gaskets between the sealing surfaces.

Note

For achieve the best measurement results, make sure the gaskets fit concentrically with the pipe component.

- The inside diameter of the pipe and flange must precisely match in the wafer type design. Any differences in levels or edges, or untidy weld seams, will reduce the measuring accuracy.
- To guarantee that the flow profile is not distorted, the gaskets must not protrude into the piping.

3. Use the appropriate screws for the holes.
4. Slightly grease the threaded nuts.
5. Tighten the nuts in a crosswise manner in accordance with the figure. First tighten the nuts to approx. 50 % of the maximum torque, then to 80 %, and finally a third time to the maximum torque.

Note

Torques for screws depend on temperature, pressure, screw and gasket materials. The relevant applicable regulations must be taken into consideration.

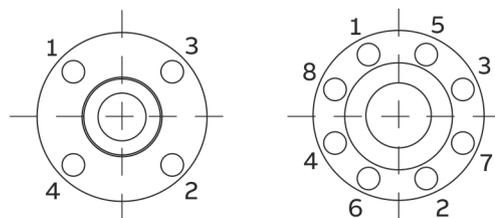
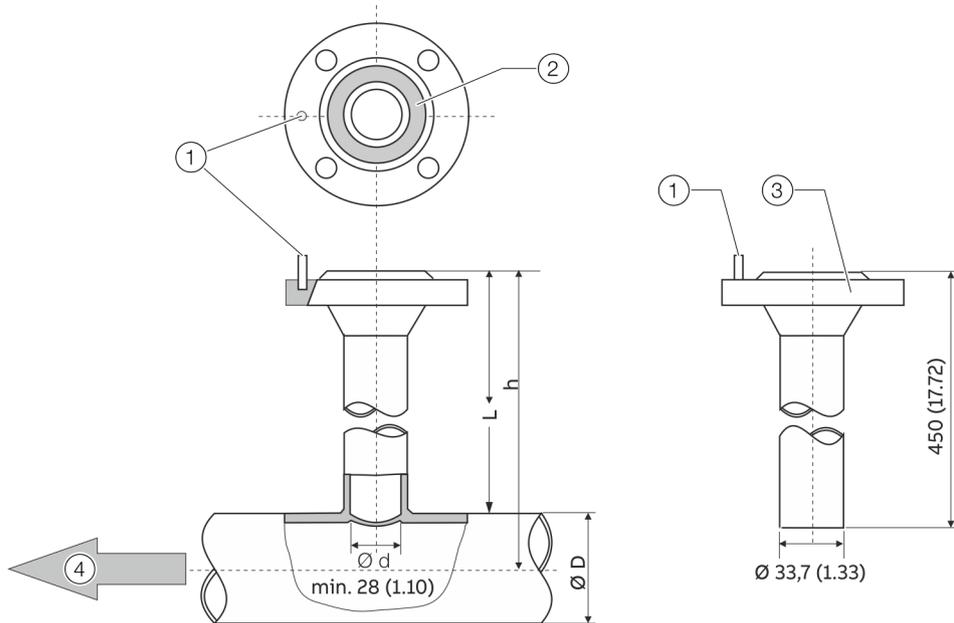


Figure 13: Tightening sequence for the flange screws

Assembly of the welding adapter with flange or threaded connector

Welding adapter with flange connector

Dimensions in mm (in)



- ① Centering pin
- ② Groove for O-ring
- ③ Connection flange DN 25 (1 in)
- ④ Flow direction

Figure 14: Dimensions in mm (in)

h – sensor length	Ø D – outer pipe diameter
263 (10.35)	80 to 350 (3.24 to 13.78)
425 (16.73)	> 350 to 700 (> 13.78 to 27.56)
775 (30.51)	> 700 to 1400 (> 27.56 to 55.12)*

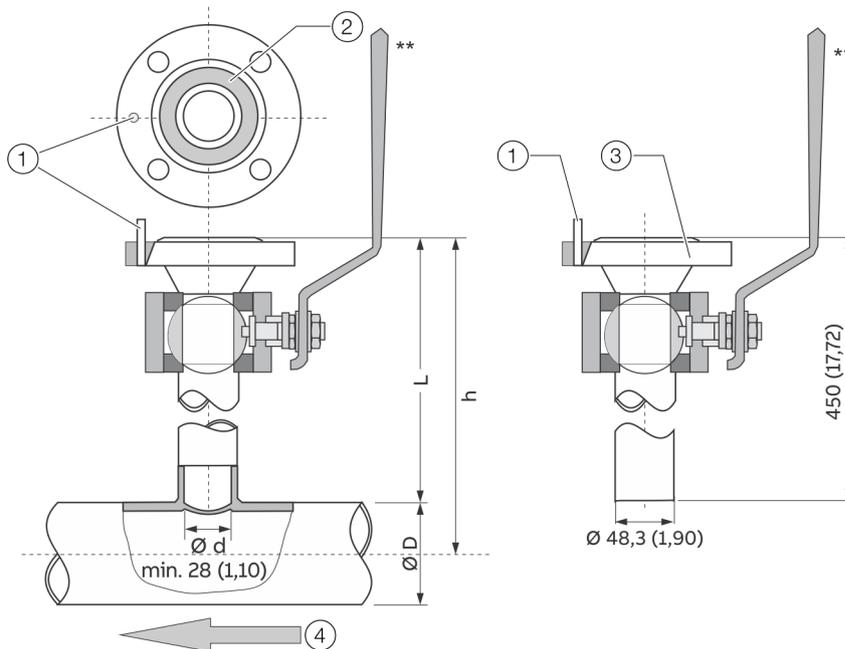
* The limitation of the maximum pipe diameter only applies for installations with a sensor element in the middle of the pipe. In case of larger or non-round cross-sections, a non-centered position of the measuring element in the piping is considered in the calibration.

... 6 Installation

... Assembly of the welding adapter with flange or threaded connector

Weld-on adapter with ball valve

Dimensions in mm (in)



① Centering pin

② Groove for O-ring

③ Connection flange DN 25 (1 in)

④ Flow direction

Figure 15: Dimensions in mm (in)

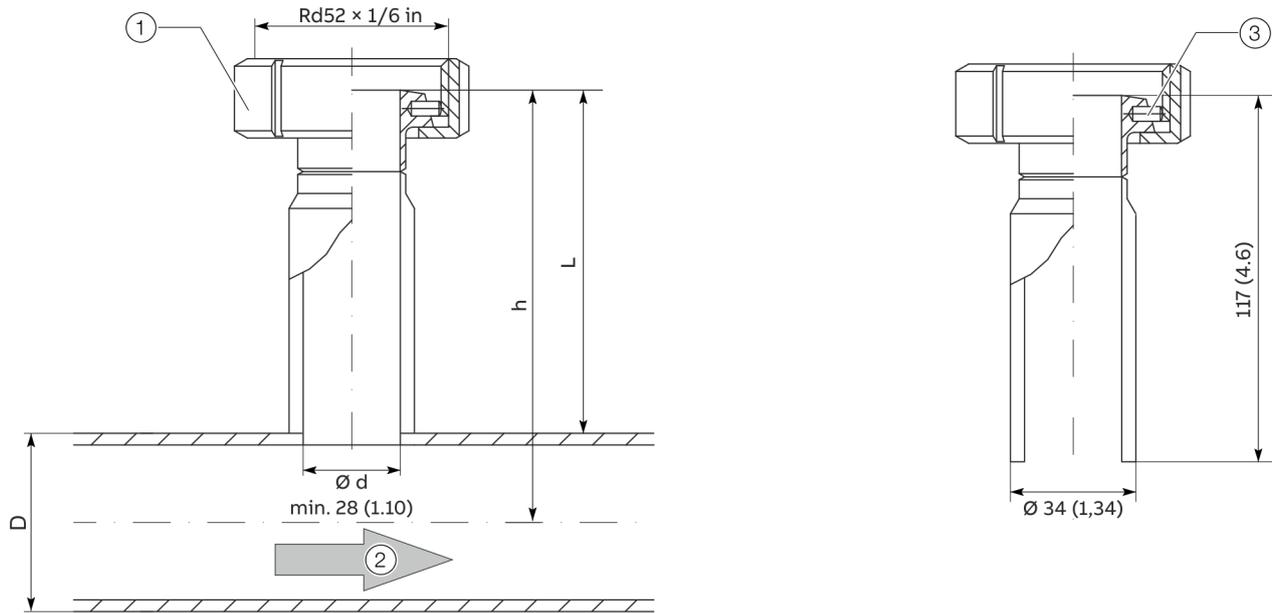
h – sensor length	Ø D - outer pipe diameter
263 (10.35)	80 to 150 (3.24 to 5.91)
425 (16.73)	> 150 to 500 (> 5.91 to 19.69)
775 (30.51)	> 500 to 1150 (> 19.69 to 45.28)*

* The limitation of the maximum pipe diameter only applies for installations with a sensor element in the middle of the pipe. In case of larger or non-round cross-sections, a non-centered position of the measuring element in the piping is considered in the calibration.

** Ball valve T_{medium}: maximum 150 °C (302 °F), explosion protection approval for use in ATEX/IECEx/UKEX Zone 2 or cFMus Div. 2.

Welding adapter with threaded connection in accordance with DIN 11851

Dimensions in mm (in)



① Union nut

② Flow direction

③ Centering pin

Figure 16: Dimensions in mm (in)

... 6 Installation

... Assembly of the welding adapter with flange or threaded connector

Mounting

Consider the following points when installing the welding adapter in the piping:

- After welding, the welding adapter must have a length of L (see chapter **Welding adapter with flange connector** on page 29 and **Welding adapter with threaded connection in accordance with DIN 11851** on page 31).

$$L = h - (1/2 \times D)$$

L Length of the welding adapter

h Installation length of the sensor

D Outside diameter of the pipeline

- Shorten the length of the welding adapter as needed before welding it on. After welding, the welding adapter may protrude into the piping no more than 10 mm (0.39 in).
- Observe thickness of pipeline wall and degree of shrinkage when welding!
- The distance h from the upper edge of the adapter flange to the pipe central axis must be within a tolerance of ± 2 mm (0.08 in).
- Maintain a right angle to the pipe axis (max. tolerance 2°).
- The adapter centering pin must be aligned with the pipe axis in the flow direction (outflow side, behind the measuring point).
- Once welding is complete, there must be free clearance of at least 28 mm (1.10 in) to install the sensor; drill to create clearance as needed.

Additional instructions for welding adapter with ball valve

DANGER

Danger to life due to improper installation!

During welding, the gaskets in the ball valve may overheat. This can lead to the measuring medium escaping in an uncontrolled manner. This can result in severe injuries or death.

- Remove the ball valve before welding.

Versions featuring a ball valve enable the flowmeter sensor to be installed and disassembled at low gauge pressures in the pipeline with minimal gas leakage.

The design with ball valve is installed as described above, but the following indications must be observed in addition:

- To install the sensor, the ball valve must be opened completely. Then, the flowmeter sensor can be installed along with the appropriate gasket and screwed into place.
- Before disassembling the sensor, make sure that the pipeline has been depressurized. Then, you can release the screws on the flange, remove the flowmeter sensor and close the ball valve.

NOTE

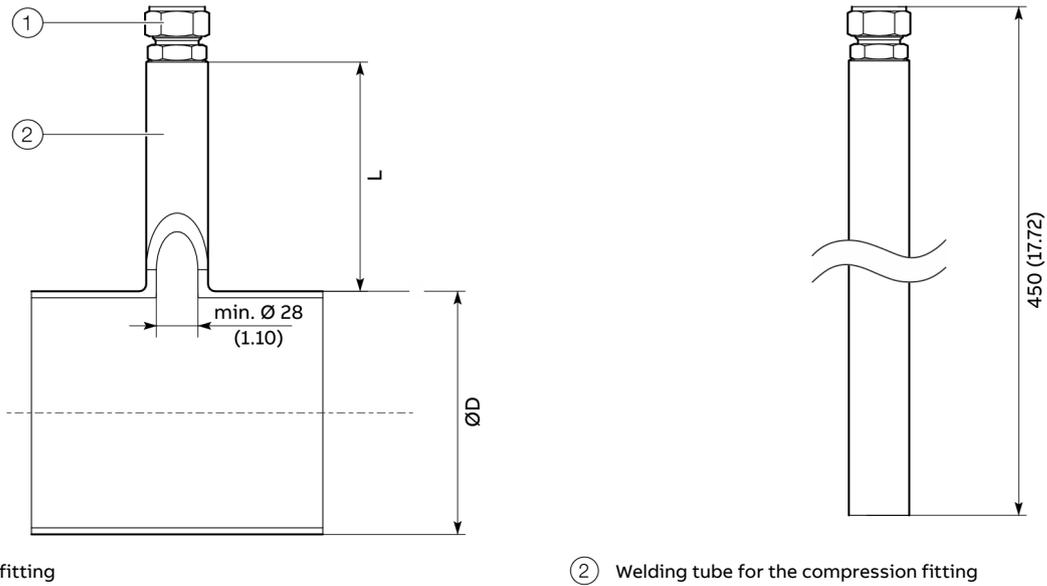
Damage to the sensor.

Closing the ball valve before you remove the sensor can seriously damage the protective cage or the sensor elements.

- Do not close the ball valve until the sensor has been removed.

Assembly of the welding adapter with compression ring fitting

All dimensions in mm (in)



① Compression fitting

② Welding tube for the compression fitting

Figure 17: Welding adapter with compression fitting

h – sensor length	h3 – installation length	$L = h3 - (\frac{1}{2} \times \text{ØD})$	Ø D – outer pipe diameter*
263 (10.35)	244 (9.61)	to be calculated	≥ 80 to 350 (≥ 3.24 to 13.78)
425 (16.73)	406 (15.98)		> 350 to 700 (> 13.78 to 27.56)
775 (30.51)	756 (29.76)		> 700 to 1400 (> 27.56 to 55.12)

Table 1: Dimensions of welding adapter with compression fitting

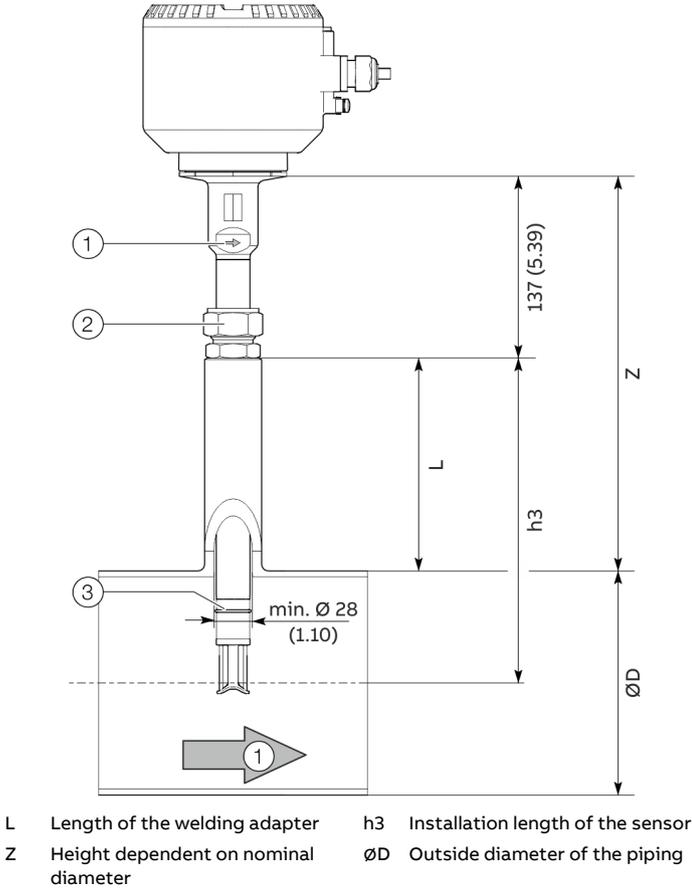
* The limitation of the maximum pipe diameter only applies for installations with thermal sensor elements in the middle of the pipe. In case of larger or non-round cross-sections, a non-centered position of the thermal sensor elements in the piping is considered in the calibration.

... 6 Installation

... Assembly of the welding adapter with compression ring fitting

Mounting

Calculation of mounting dimensions



- ① Flow direction (arrow marker on the protection tube)
- ② Compression fitting
- ③ Safety snap ring

Figure 18: Calculating mounting dimensions

Calculations (mm)

$$L = h3 - (\frac{1}{2} \times \text{ØD})$$

$$Z = (h3 + 137 \text{ mm}) - (\frac{1}{2} \times \text{ØD})$$

Calculations (in)

$$L = h3 - (\frac{1}{2} \times \text{ØD})$$

$$Z = (h3 + 5.39 \text{ in}) - (\frac{1}{2} \times \text{ØD})$$

Preparing the sensor

⚠ DANGER

Fire hazard in oxygen applications

Fire hazard in oxygen applications due to the use of unapproved thread sealing compound.

- Use only approved thread sealing compound for oxygen applications!

⚠ WARNING

Risk of injury

Risk of injury due to the sensor ejecting because of a missing safety ring.

- Mount the sensor with compression fitting only with the safety ring in place.

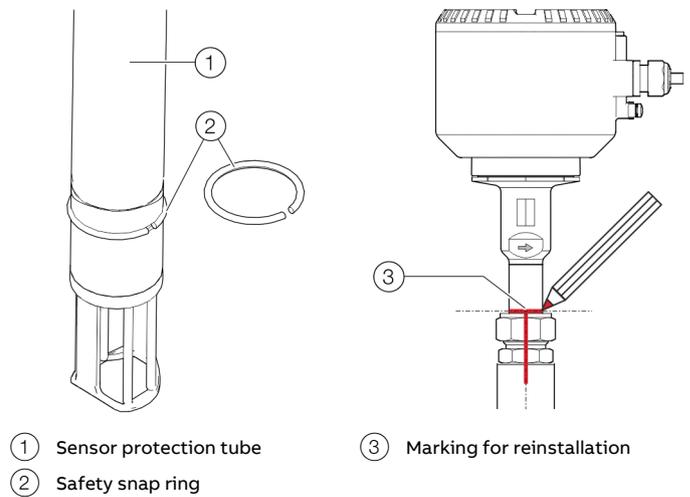


Figure 19: Snap ring and marking

1. Slide the compression fitting onto the sensor and tighten by hand so that the compression fitting can still be moved.
2. Insert the safety snap ring using mounting pliers (see Figure 19, Pos. ②).

Note

For gas-tight sealing of the NPT thread of the compression fitting, you can for example use special thread sealing compounds by Swagelok such as SWAK™, Silver Goop™, PTFE-Free, etc., or PTFE thread sealing tape.

First installation of the sensor

When mounting the sensor, a distinction is made between **first installation** and reinstallation. We will address **first installation** below.

Please also follow the 'An Installer's Pocket Guide for Swagelok® Tube Fittings – MS-13-151.pdf' available at www.swagelok.de/en.

Required tools

- Open-end wrench, width across flats 35 mm (1³/₈ in)
- Open-end wrench, width across flats 38 mm (1¹/₂ in)
- Caliper gage or comparable measurement tool
- Marker pen (permanent marker) for marking

Description of first installation

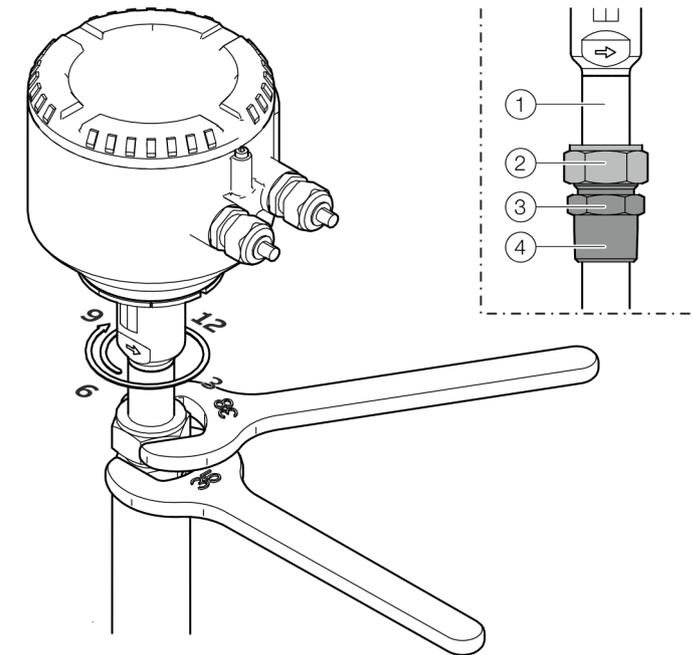
1. Carefully insert the prepared sensor into the welding adapter.

NOTICE

Damage to the device

Mechanical damage to the sensor element can occur due to improper installation.

- When inserting into the welding adapter, the sensor protection frame must not hit the bottom of the piping.
2. Screw in the compression fitting (with thread sealing compound) into the welding adapter, first by hand and then tighten with 1.5 to 2.5 turns.
 3. Move the sensor to the correct height for the calculated 'Z' dimension (see Figure 18) and secure the compression fitting against shifting by tightening the union nut by hand.
 4. Align the sensor such that the lateral flow arrow on the upper sensor protection tube end points in the exact direction of the flow.
 5. Using a suited marker pen, mark the orientation and height of the sensor on the sensor protection tube, compression fitting and the welding adapter (see Figure 19, pos. ③). The marking on the union nut is also used as a starting position (6 o'clock position, see Figure 20) for the tightening of the compression fitting
 6. Using an open-end wrench, hold the fitting body in position and with another open-end wrench, tighten the union nut by 1¹/₄ turns clockwise to the 9 o'clock position. In the process, check the orientation of the sensor with the help of the markings and correct as needed. To achieve maximum measuring accuracy, the 'Z' dimension must be set with a tolerance of ±2 mm (±0.08 in) during installation of the sensor.



- | | |
|--------------------------|----------------|
| ① Sensor protection tube | ③ Fitting body |
| ② Union nut | ④ Thread |

Figure 20: Tighten sensor

Note

Before commissioning, the tightness and compressive strength of the measuring point must be guaranteed!

- In addition, check the fittings using a suited leak detection spray.

... 6 Installation

... Assembly of the welding adapter with compression ring fitting

Disassembly and reinstallation of the sensor

When mounting the sensor, a distinction is made between first installation and **reinstallation**. We will address **reinstallation** below.

Please also follow the 'An Installer's Pocket Guide for Swagelok® Tube Fittings – MS-13-151.pdf' available at www.swagelok.de/en.

Required tools

- Open-end wrench, width across flats 35 mm (1⅜ in)
- Open-end wrench, width across flats 38 mm (1½ in)
- Marker pen (permanent marker) for marking

Disassembly of the sensor

WARNING

Risk of injury due to process conditions

The process conditions, for example high pressures and temperatures, toxic and aggressive measuring media, can give rise to hazards when working on the device.

- Before working on the device, make sure that the process conditions do not pose any hazards.
- If necessary, wear suited personal protective equipment when working on the device.
- Depressurize and empty the device / piping, allow to cool and purge if necessary.

1. Depressurize and empty the device / piping, allow to cool and purge if necessary.
2. Switch off the power supply of the sensor and remove the connection cable.
3. Using a suited marker pen, mark the orientation and height of the sensor on the sensor protection tube, compression fitting and the welding adapter (see Figure 19, pos. ③).
4. Carefully loosen the union nut of the compression fitting and hold the sensor while doing so to prevent the sensor protection frame from hitting the bottom of the piping.

NOTICE

Damage to the device

Mechanical damage to the sensor element can occur due to improper disassembly.

- The sensor protection frame must not hit the bottom of the piping.

5. Loosen the fitting body of the compression fitting on the welding adapter and pull out together with the sensor.

Note

Very high clamping forces are exerted on the clamp ring when the compression fitting is tightened. As a result, the clamp ring is slightly pressed into the sensor protection tube. The compression fitting can no longer be moved on the sensor protection tube and the 'Z' dimension can be easily adjusted again.

Reinstallation of the sensor

WARNING

Risk of injury

Risk of injury due to the sensor ejecting because of a missing safety ring.

- Mount the sensor with compression fitting only with the safety ring in place.

1. Make sure that the safety snap ring is inserted in the provided snap ring groove (see Figure 19, pos. ②).
2. Apply sealing compound to the pipe thread of the fitting body.
3. Carefully insert the sensor into the welding adapter.

NOTICE

Damage to the device

Mechanical damage to the sensor element can occur due to improper installation.

- When inserting into the welding adapter, sensor protection frame must not hit the bottom of the piping.

4. Screw in the compression fitting (with thread sealing compound) into the welding adapter, first by hand and then tighten with 1.5 to 2.5 turns.
5. Align the sensor in accordance with the marking (height and direction of flow) and tighten the union nut up to the marked position.

Assembly of the welding adapter with hot tap fitting

⚠ DANGER

Explosion hazard

Explosion hazard during installation or operation of the integrated hot tap fitting in potentially explosive atmospheres of Zone 0.

- Install and operate the integrated hot tap fitting only outside of potentially explosive atmospheres or in Zone 2 / Div.2 or Zone 1 / Div. 1.

Wafer type design

Installation of the wafer type design is performed as explained in **Wafer type design (FMT091) and partial measuring section (FMT092)** on page 28.

Explosion protection approval

The integrated hot tap fitting is approved for use in potentially explosive atmospheres of ATEX/IECEX/UKEX Zone 1 and Zone 2 or cFMus Div. 1 and Div. 2.

Use in Zone 0 is not permitted!

Measured medium temperature

Refer to **Measured medium temperature** on page 25.

Welding design

⚠ DANGER

Danger to life!

Danger to life caused by changes to the hot tap fitting. This can lead to the measuring medium escaping in an uncontrolled manner.

- Do not shorten hot tap fitting components or interfere with the design.

The welding version of the integrated changing device is available in two installation lengths:

- for nominal diameters DN 100 to 125 (4 to 5 in) and
- for nominal diameters DN 150 to 300 (6 to 12 in).

Note

- The sensor length **h** is 425 mm (16.73 in) respectively.
- The installation depth **Y** depends on the pipe diameter and must be calculated individually.

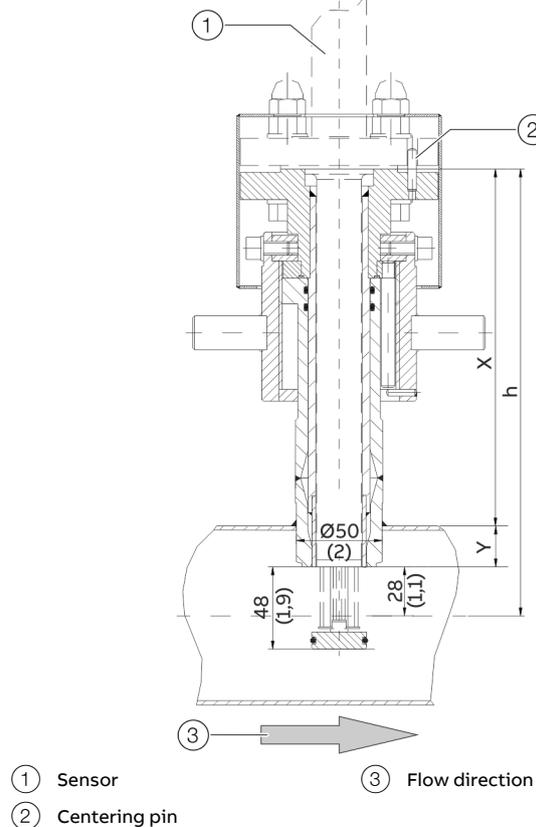


Figure 21: Integrated hot tap fitting in measurement position, dimensions in mm (in)

... 6 Installation

... Assembly of the welding adapter with hot tap fitting

Calculation of the installation length X and installation depth Y

$$X = h - (D/2)$$

$$Y = (D/2) - 28 \text{ mm (1.1 inch)}$$

- X Outside length of the integrated changing device
 Y Installation depth of the integrated changing device
 h Sensor length
 D Outside diameter of the pipeline

Example

- Sensor length h = 425 mm (16.73 in)
- Pipe with outside diameter of 210 mm (8.27 in)
- The hot tap fitting is in measurement position

$$X = 425 \text{ mm} - (210 \text{ mm} / 2) = 320 \text{ mm}$$

$$Y = (210 \text{ mm} / 2) - 28 \text{ mm} = 77 \text{ mm}$$

Consider the following points when installing the welding version in the piping:

- Maintain a right angle to the pipe axis (max. tolerance 2°).
- The adapter centering pin must be aligned with the pipe axis in the flow direction (outflow side, behind the measuring point).

NOTE

Damage to components

If the welded joints become hot, warping of the sealing surfaces and / or damage to the O-rings can occur.

- Pause occasionally to allow the fitting to cool.

NOTE

Impact on measuring accuracy

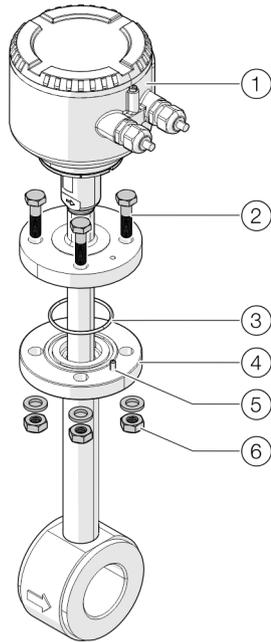
Deviations from the stated dimension and position tolerances have an impact on measuring accuracy.

Installing the sensor

When installing the sensor, observe the following points:

- Installation in the pipe component or welding adapter is only possible if the sensor data matches the measuring point specifications.
- The sensor may be sealed only by using the O-ring supplied in the scope of delivery. The O-ring must be placed in the designated groove on the sensor connection.
- The sensor elements may not be damaged when inserting the sensor into the pipe component.
- If you are using an integrated hot tap fitting, you must check that the hot tap fitting is in the disassembly position before releasing the fixing screws.

Wafer type design and welding adapter



- | | |
|-----------------|---------------------|
| ① Sensor | ④ Sensor connection |
| ② Flange screws | ⑤ Centering pin |
| ③ O-ring | ⑥ Washers and nuts |

Figure 22: Installing a sensor (example)

Installing the sensor:

1. Place the supplied O-ring in the groove of the sensor connection.
2. Carefully slide the sensor into the pipe component. Observe correct alignment to the centering pin in the process
3. Fasten the sensor to the sensor connection using screws. Tighten the flange screws simultaneously by applying the required torque (torque for supplied screws, non-lubricated, without use of spring washers: 87 Nm).

... 6 Installation

Installation / Disassembly of the sensor in connection with the hot tap fitting

Safety instructions

⚠ DANGER

Danger to life due to piping under pressure!

If the hot tap fitting is in the measurement position during disassembly of the sensor, this may pose a danger to life due to the possibility of the sensor being ejected.

- Disassemble the sensor only if the hot tap fitting is in the disassemble position.

⚠ DANGER

Danger to life due to leaking measuring medium!

If the changing device is in the measurement position during disassembly of the sensor or gaskets in the changing device are damaged, leaking measuring medium may pose a danger to life.

- Make sure that the hot tap fitting is in the disassemble position.
- If measuring medium should start to leak in spite of this, immediately stop disassembly of the sensor and tighten the fixing screws.
- Drain and rinse the piping before disassembling the sensor, check and repair the hot tap fitting.

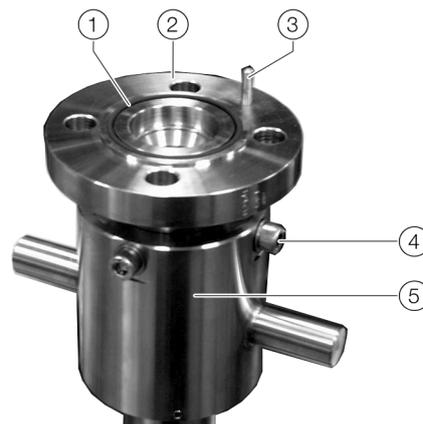
NOTICE

Damage to the changing device

Using tools or other devices to operate the lock nut can damage the hot tap fitting.

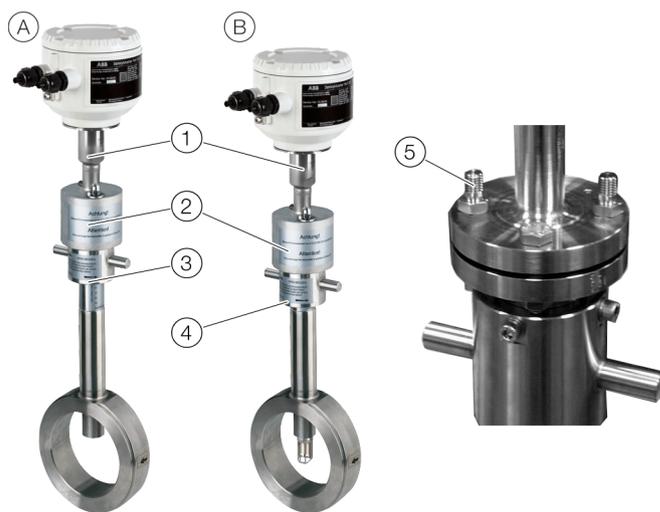
- Operate the union nut by hand only.

Overview



- ① O-ring
- ② Sensor connection
- ③ Centering pin
- ④ Screws for securing the guide tube
- ⑤ Union nut

Figure 23: Sensor connection on the hot tap fitting



- Ⓐ Integrated hot tap fitting in disassembly position
- Ⓑ Integrated hot tap fitting in measurement position
- ① Sensor
- ② Protection cap
- ③ Union nut in disassembly position
- ④ Union nut in measurement position
- ⑤ Special screws for protection cap

Figure 24: Sensor installation and disassembly

Disassembly of the sensor

⚠ DANGER

Danger to life due to leaking measuring medium!

Depending on the pressure in the piping, up to one liter of measuring medium can escape during disassembly of the sensor.

- Make sure that no hazardous atmosphere results from the escaping medium.
- Use safety equipment appropriate to the medium (poisonous, explosive, flammable, corrosive, toxic, etc.)

⚠ DANGER

Danger to life!

Danger to life due to leaking measuring medium from the disassembled sensor and the piping in operation.

- Secure the hot tap fitting against unintended use with a blind flange.
- Attach a warning label.

Initial position

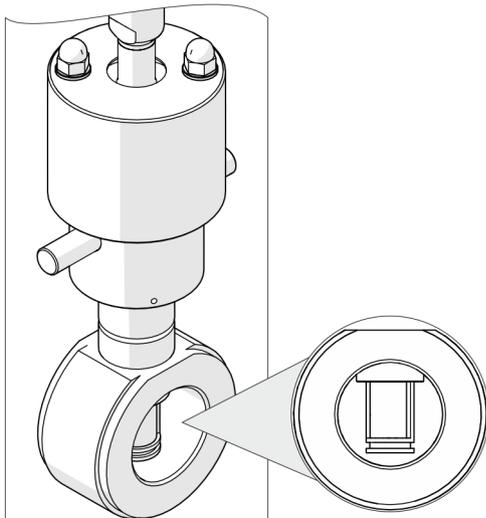


Figure 25: Integrated hot tap fitting in measurement position

The integrated hot tap fitting is in the measurement position, the sensor element fully protrudes in the piping cross-section.

Disassembly of the sensor

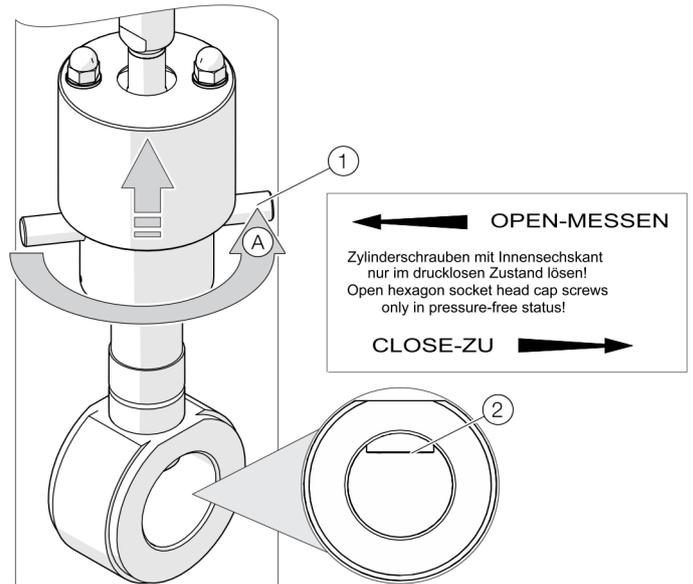


Figure 26: Setting the integrated hot tap fitting in disassembly position

1. Disconnect the electrical connections on the sensor.
2. Turn the sensor with the union nut ① in the disassembly position. The lower edge of the union nut indicates the position of the sensor. The sensor will not be in the disassemble position **0 - CLOSE - ZU** and the hot tap fitting will not be gasketed from the process ② until the disassembly position is reached (the upper limit stop of the union nut).

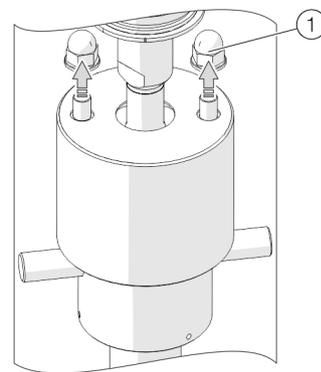


Figure 27: Loosening the cap nuts of the protection cap

3. Screw off the cap nuts ① and washers of the protection cap.

... 6 Installation

... Installation / Disassembly of the sensor in connection with the hot tap fitting

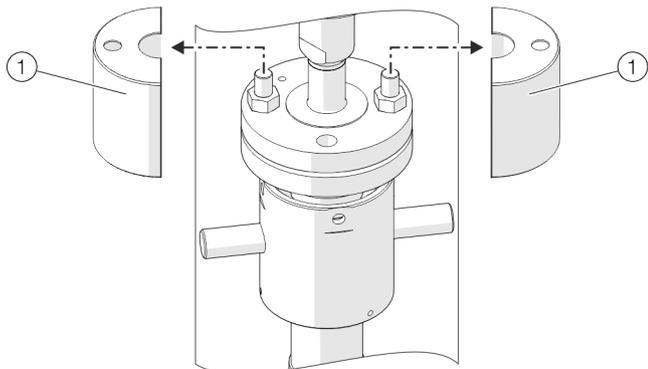


Figure 28: Removing the protection caps

4. Remove the protection caps (1).

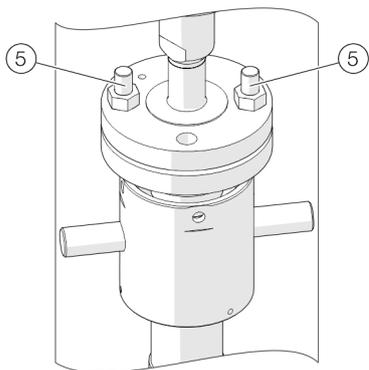


Figure 29: Removing the flange screws

5. Remove the flange screws (5).

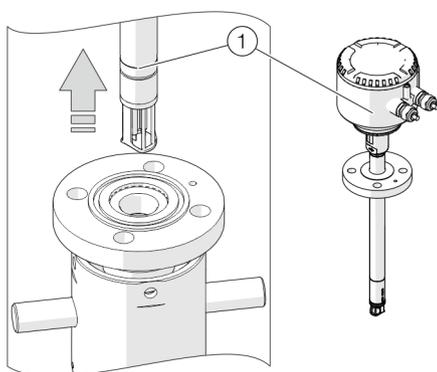


Figure 30: Removing the sensor

6. Carefully pull the sensor (1) out of the hot tap fitting (do not tip to the side).
7. Secure the hot tap fitting against unintended use with a blind flange. Additionally, attach a warning label.

Installing the sensor

Note

The changing device must be in the disassembly position before disassembling the sensor, the sensor connection is sealed.

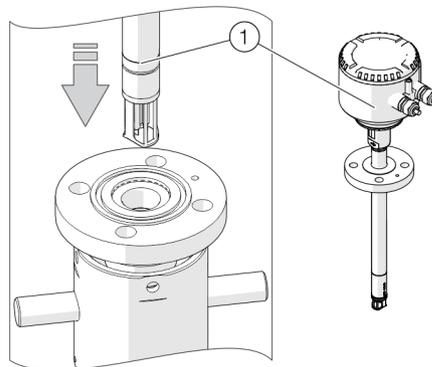


Figure 31: Inserting the sensor

1. Place the supplied O-ring in the groove of the sensor connection.
2. Carefully slide the sensor into the changing device. Observe correct alignment to the centering pin in the process.

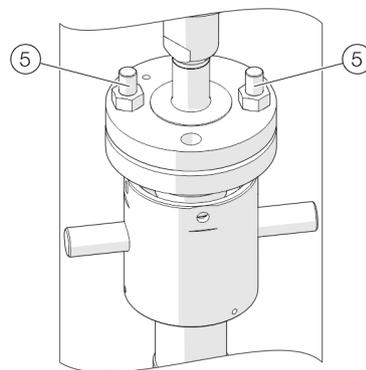


Figure 32: Screwing in the flange screws

3. Fasten the sensor to the sensor connection using screws. Use the supplied M12 screws, as well as two extended special screws (5).

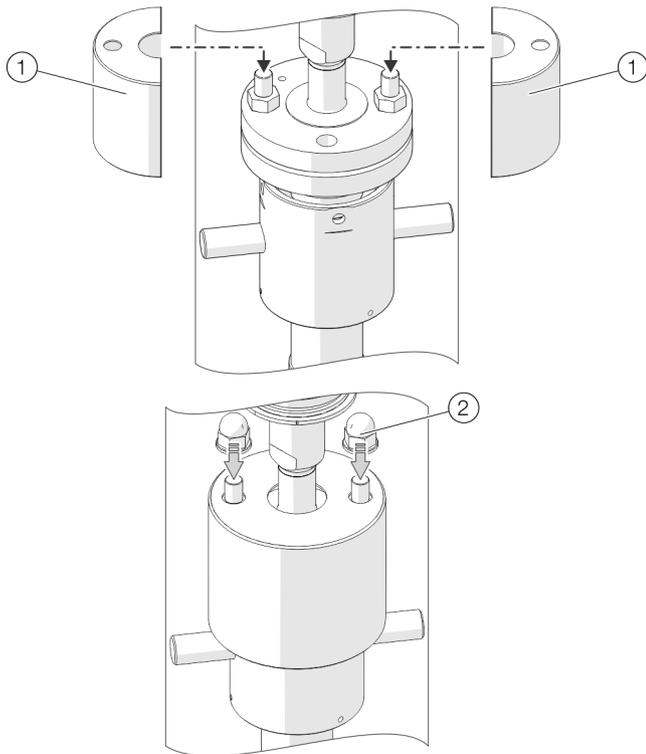


Figure 33: Placing the protection caps

- Place the protection caps ① onto the special screws and tighten using cap nuts ② with washers.

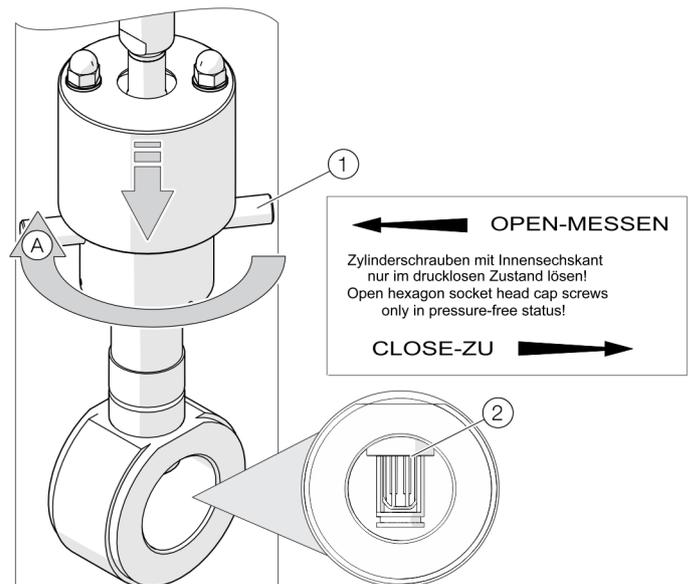


Figure 34: Setting the integrated hot tap fitting in measurement position

- Turn the transmitter with the union nut ① into the measurement position ②. The lower edge of the union nut indicates the position of the sensor. Only when the measuring position is reached **50 - OPEN - MESSEN** (the lower limit stop of the union nut) will the sensor be in the middle of the piping and precise values can be provided.
- Carry out the electrical connection

7 Electrical connections

Safety instructions

⚠ DANGER

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

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

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

⚠ WARNING

Risk of injury due to live parts.

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

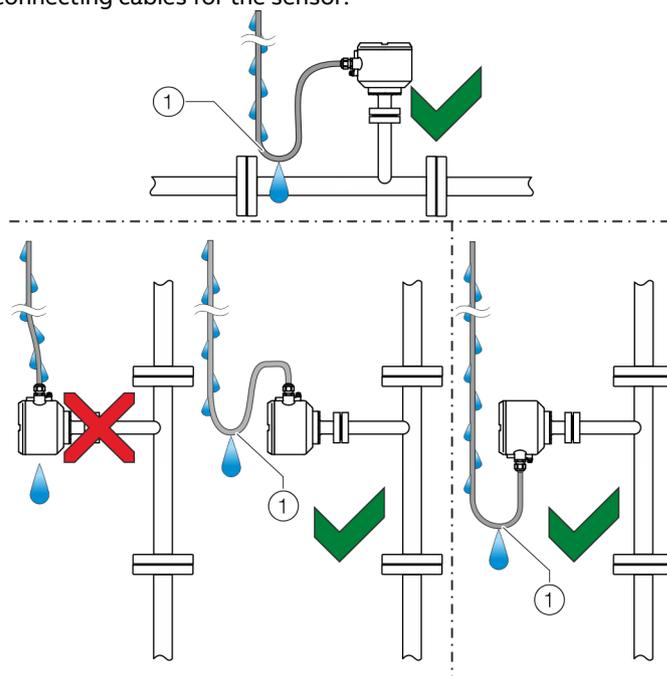
- Connect the device only with the power supply switched off.
- Observe the applicable standards and regulations for the electrical connection.

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

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

Installing the connection cables

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



① Drip loop

Figure 35: Laying the connection cable

Opening and closing the housing

⚠ WARNING

Risk of injury due to live parts!

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

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

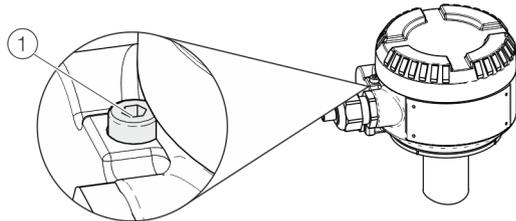


Figure 36: Cover lock (example)

NOTICE

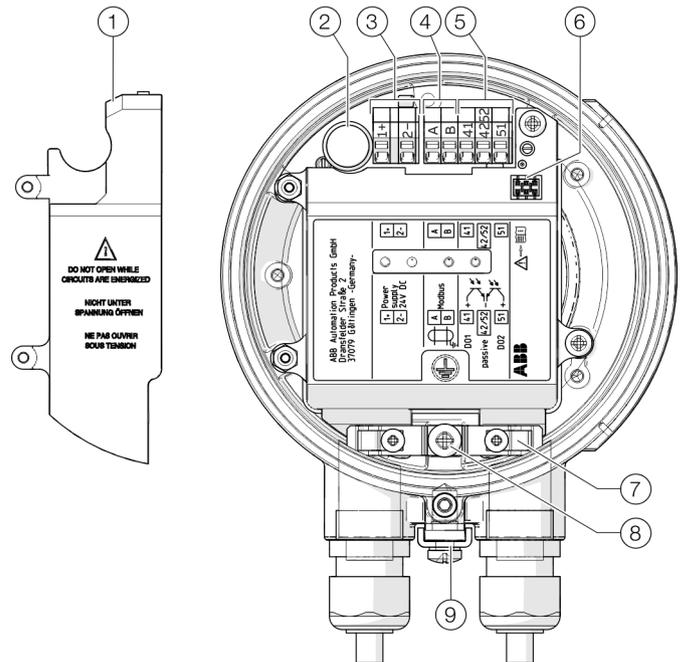
Potential adverse effect on the IP rating

- Make sure that the cover of the power supply terminals is mounted correctly.
- Check the O-ring gasket for damage and replace it if necessary before closing the housing cover.
- Check that the O-ring gasket is properly seated when closing the housing cover.

To open the housing, release the cover lock by screwing in the Allen screw ①.

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

Position of the terminals



- ① Terminal cover power supply
- ② Fuse
- ③ Terminals for power supply
- ④ Terminals for Modbus®
- ⑤ Terminals for digital outputs
- ⑥ Local operating interface
- ⑦ Clamp for shielding and strain relief
- ⑧ Internal ground terminal (shielding)
- ⑨ External ground terminal (potential equalization / functional ground)

Figure 37: Terminals on the device

... 7 Electrical connections

Terminal assignment

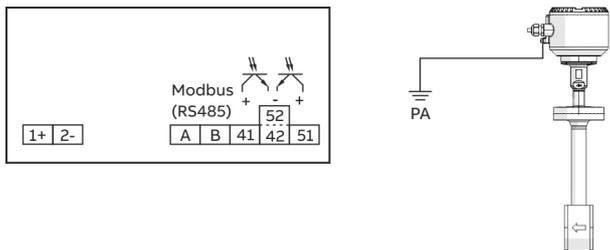


Figure 38: Electrical connection PA = functional ground (potential equalization)

Connections for the power supply

DC voltage	
Terminal	Function / comments
1+	+
2-	-

Connections for the outputs

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

Electrical data for inputs and outputs

Note

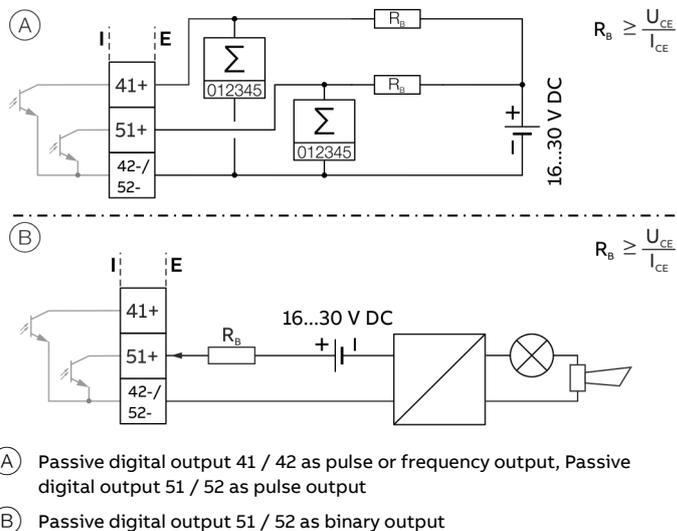
When using the device in potentially explosive atmospheres, note the additional connection data in **Use in potentially explosive atmospheres** on page 6!

Power supply

Supply voltage	24 V DC ± 20 % (ripple: ≤ 5 %)
Power consumption	P ≤ 10 W

Digital output 41 / 42, 51 / 52

Can be configured via Modbus.



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

Figure 39: Passive digital outputs (I = internal, E = external)

Pulse / frequency output (passive)

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

Binary output (passive)

Terminals	41 / 42, 51 / 52
Output 'closed'	0 V ≤ U _{CEL} ≤ 3 V 2 mA ≤ I _{CEL} ≤ 30 mA
Output 'open'	16 V ≤ U _{CEH} ≤ 30 V DC 0 mA ≤ I _{CEH} ≤ 0.2 mA
Switching function	Configurable

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.

Modbus® communication

Note

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

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

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

Modbus protocol

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

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 mm² (AWG 26), the maximum length is 1000 m (3280 ft).
- When using a 4-core cable as a 2-wire wiring system, the maximum length must be halved.
- The spur lines must be short, a maximum of 20 m (66 ft).
- When using a distributor with 'n' connections, each branch must have a maximum length of 40 m (131 ft) divided by 'n.'

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

The following standard values apply:

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

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

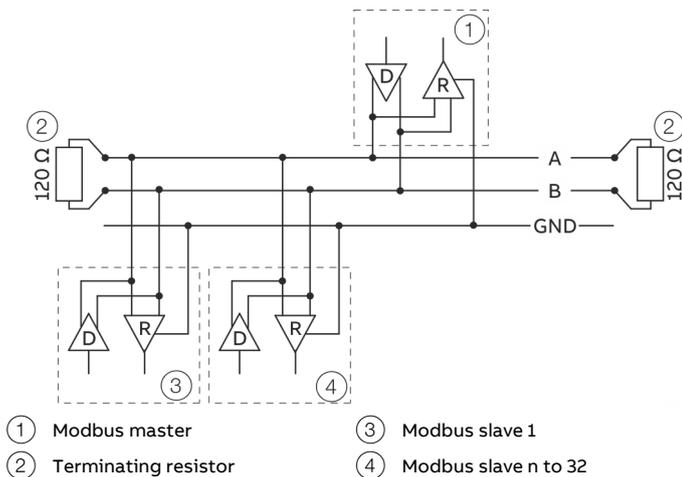
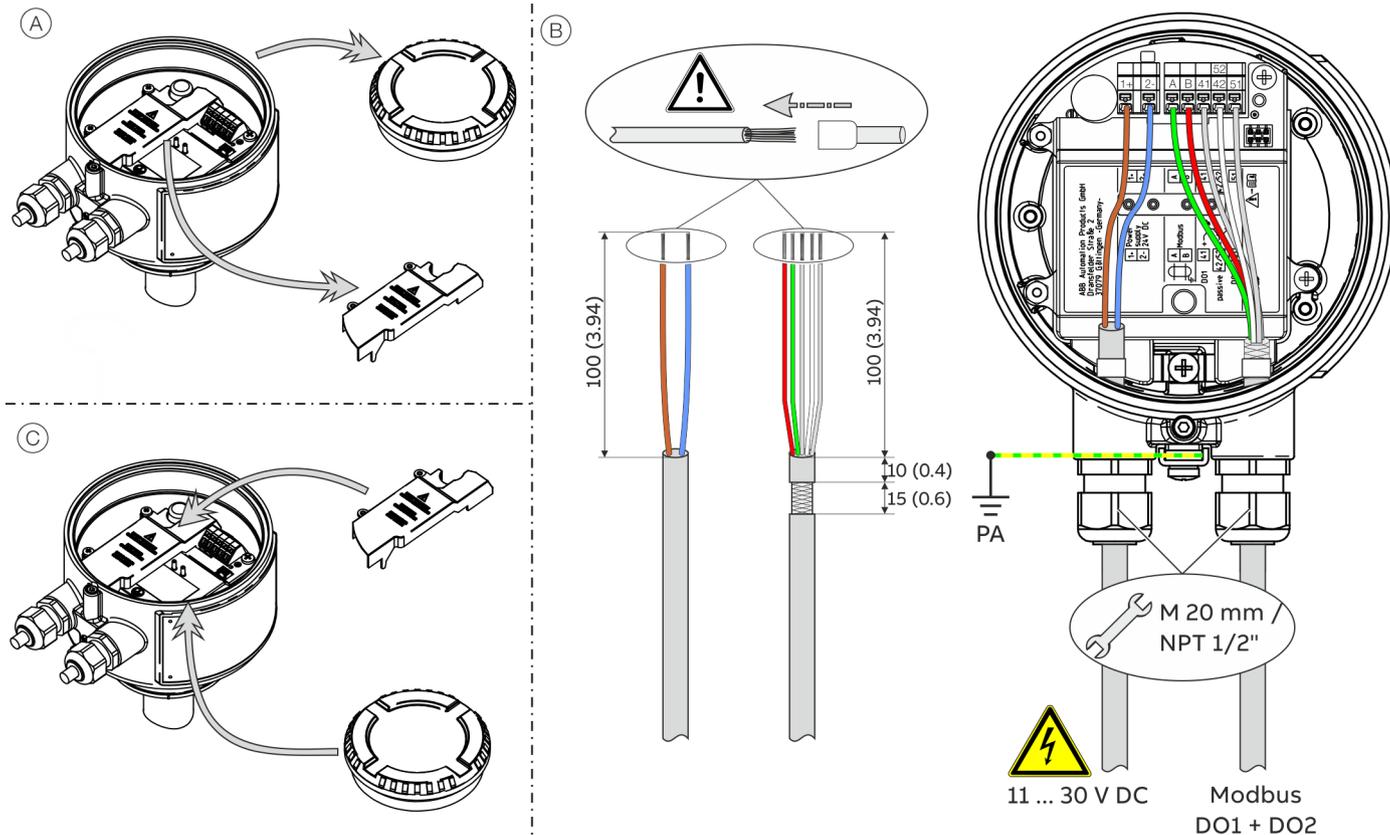


Figure 40: Communication with the Modbus protocol

... 7 Electrical connections

Connection on the device



PA Potential equalization

Figure 41: Connection to device

Connecting integral mount design

Perform steps (A) to (C).

During the process, observe the following instructions:

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

Observe the following points when connecting to the power supply:

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

8 Commissioning and operation

Safety instructions

⚠ DANGER

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

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

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

⚠ 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.

Aggressive or corrosive media may lead to the damage of wetted parts of the sensor. As a result, measuring medium under pressure can leak out.

Wear to the flange gasket or process connection gaskets (e.g. flange fitting or pipe fitting) may cause a pressurized measuring medium to escape.

If pressure surges above the permissible nominal pressure of the device occur permanently during operation, this may affect the service life of the device.

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

Note

For detailed information on the operation and parameterization of the device, consult the associated operating instructions (OI)!

Write-protection switch, service LED and local operator interface

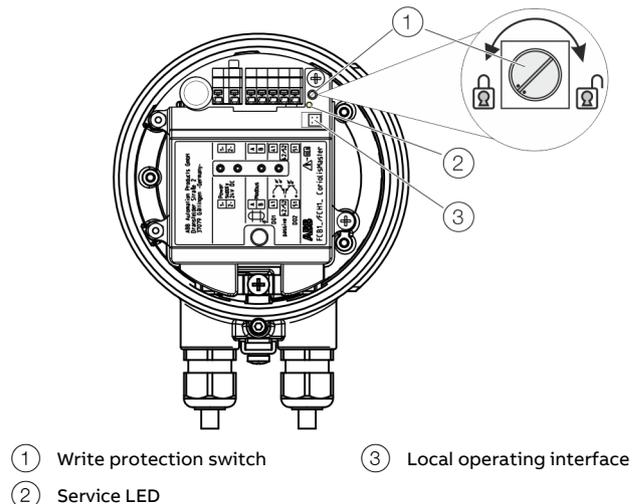


Figure 42: Operating elements in the terminal box

Write-protect switch

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

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

Service LED

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

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

Local operating interface

The sensor can also be parameterized without a Modbus connection via the local operating interface, see **Parameterization via the local operating interface** on page 52.

... 8 Commissioning and operation

Checks prior to commissioning

The following points must be checked before commissioning the device:

- Correct wiring in accordance with **Electrical connections** on page 44.
- Correct grounding of the device.
- The ambient conditions must meet the requirements set out in the specification.
- The power supply must meet the requirements set out on the name plate.

NOTICE

Damage to the device due to undervoltage.

In the event that lower voltage is supplied than indicated on the name plate, the current consumption of the device increases.

The internal fuses can be damaged as a result.

- Make sure that the minimum operating voltage of the device is not down-scaled (see also **Electrical data for inputs and outputs** on page 46).

Switching on the power supply

1. Switch on the power supply.
2. Perform parameterization of the flowmeter (see **Parameterization of the device** on page 50).

The flowmeter is now ready for operation.

Inspection after power-up of the power supply

The following points must be checked after commissioning the device:

- Parameter configuration must correspond to the operating conditions.

Parameterization of the device

Note

For detailed information on the operation and parameterization of the device, consult the associated operating instructions (OI)!

Note

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

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

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

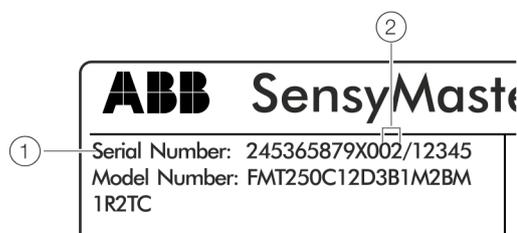
The settings for the Modbus interface and the pulse output are only necessary if the corresponding outputs are also used.

Parameterization via the Modbus interface

Note **Interface description** in the operating instruction when parameterizing via the Modbus interface.

Factory setting for the Modbus slave ID (address)

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



① Serial number

② Modbus slave ID when delivered

Figure 43: Modbus-address on the name plate (example)

Changing an unknown Modbus slave ID

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

Upon delivery, the Modbus Slave ID corresponds to the last two digits of the serial number of the device (see Figure 43, item ②).

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.'

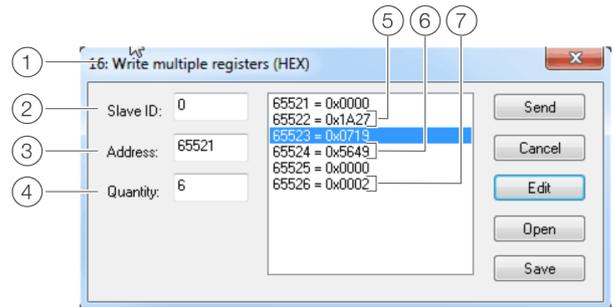
To set the Modbus Slave ID the Sensor ID of the device from the calibration certificate will be needed.



Figure 44: Sensor ID on the calibration certificate

Address / data type [register length]	Description
65521 TUSIGN32 [2]	manufacturerDeviceID The manufacturer code (ABB = 0x1A) and the device code (FMT = 0x27) must be written to register 65522.
65523 TUSIGN32 [2]	sensorSerialID The Sensor ID of the device (on the calibration certificate). The information must first be written in the high-byte (65524) of the register.
65525 TUSIGN32 [2]	slaveID The new Modbus Slave ID must be written in the high byte (65526) of the register.

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



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

Figure 45: Write Multiple Registers (example)

... 8 Commissioning and operation

... Parameterization of the device

Parameterization via the local operating interface

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

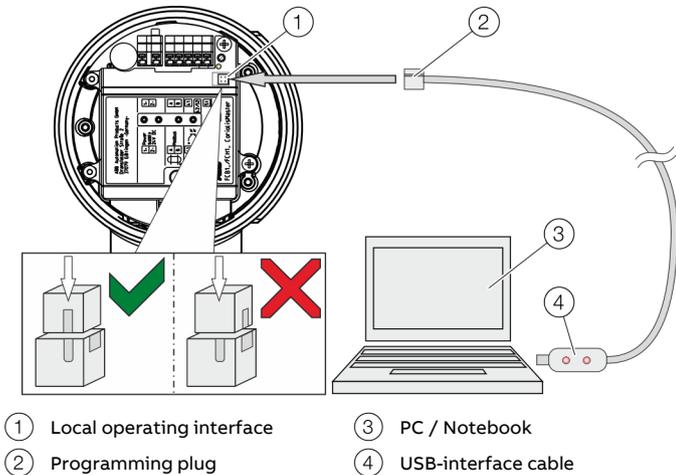


Figure 46: Connection to the local operating interface

Connection on the device

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

Note

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

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

Installation of the ABB Field Information Manager (FIM)

A software package is available for configuration:

- ABB Field Information Manager (FIM) combined with the ABB SensyMaster Field Device Information Package (FDI package).

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



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



Download the ABB FDI package using the adjacent download link.

Installation of the software and connection to the flowmeter:

1. Install ABB Field Information Manager (FIM).
2. Unpack the ABB FDI package into the c:\temp folder.
3. Connect the flowmeter with the PC / laptop, see Connection on the device on page 52.
4. Power-up the power supply for the flowmeter and start the ABB Field Information Manager (FIM).
5. Drag and drop the 'ABB.FMT2xx_FMT4xx.01.00.01.HART.fdi' file (or newer version) to the ABB Field Information Manager (FIM). No special view is needed for this.
6. Right-click ① as shown in Figure 47.

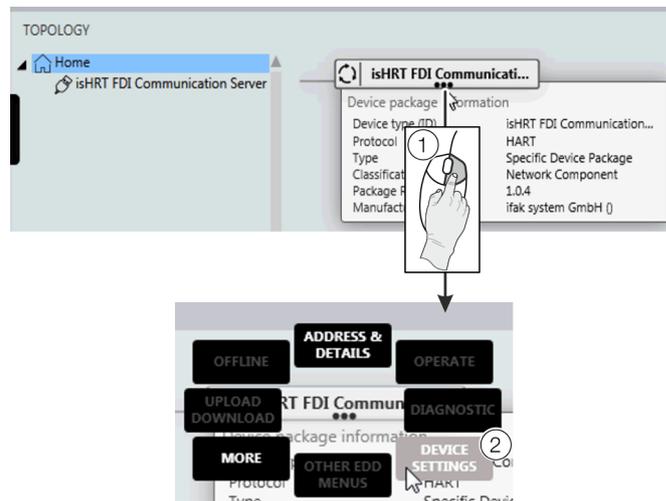


Figure 47: Select FIM – 'Device Settings'

7. Select 'DEVICE SETTINGS' ② as shown in Figure 47.

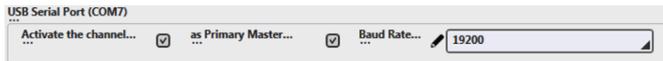


Figure 48: Select FIM – COM-Port

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

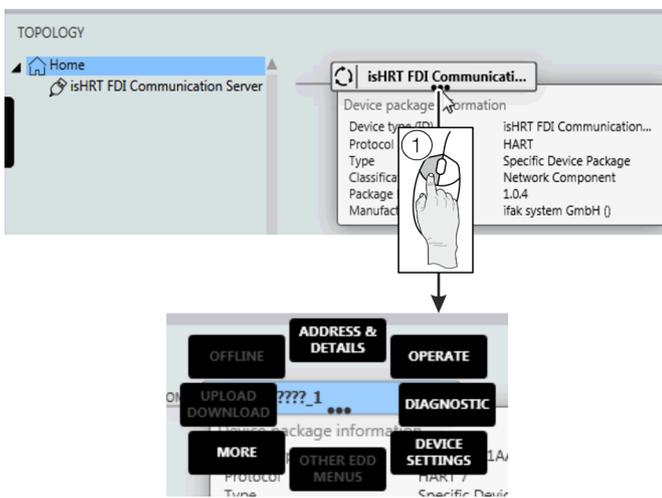


Figure 49:

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

... 8 Commissioning and operation

... Parameterization of the device

Software history

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

Device software package FMT2xx

Version	Issue date	Type of change	Description	Ordering number
01.00.07	28.08.2017	First publication	—	3KXF002045U0100_01.00.07
01.00.08	06.11.2018	Change	Minor debugging	3KXF002045U0100_01.00.08
01.01.00	04.2020	Change	Function extension and minor debugging	3KXF002045U0100_01.01.00
01.02.00	07.2022	Change	Optimization of Modbus communication and minor troubleshooting	3KXF002045U0100_01.02.00

9 Maintenance

Safety instructions

DANGER

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

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

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

DANGER

Danger to life due to piping under pressure!

Sensors which may eject during installation or removal in piping remaining under pressure may pose a danger to life.

- Install or remove a sensor only if the piping is depressurized.
- As an alternative, use a pipe component with an integrated hop tap fitting.

WARNING

Risk of injury due to live parts!

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

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

CAUTION

Risk of burns due to hot measuring media

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

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

NOTICE

Damage to components!

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

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

Note

For detailed information on the maintenance of the device, consult the associated operating instructions (OI)!

10 Recycling and disposal

Dismounting

WARNING

Risk of injury due to process conditions.

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

- If necessary, wear suited personal protective equipment during disassembly.
- Before disassembly, make sure that the process conditions do not pose any safety risks.
- Depressurize and empty the device / piping, allow to cool and purge if necessary.

Bear the following points in mind when dismantling the device:

- Switch off the power supply.
- Disconnect electrical connections.
- Allow the device / piping to cool and depressurize and empty. Collect any escaping medium and dispose of it in accordance with environmental guidelines.
- Use suited tools to disassemble the device, taking the weight of the device into consideration.
- If the device is to be used at another location, the device should preferably be packaged in its original packing so that it cannot be damaged.
- Observe the notices in **Returning devices** on page 22.

... 10 Recycling and disposal

Disposal

Note



Products that are marked with the adjacent symbol may **not** be disposed of as unsorted municipal waste (domestic waste).

They should be disposed of through separate collection of electric and electronic devices.

This product and its packaging are manufactured from materials that can be recycled by specialist recycling companies.

Bear the following points in mind when disposing of them:

- As of 8/15/2018, this product will be under the open scope of the WEEE Directive 2012/19/EU and relevant national laws (for example, ElektroG - Electrical Equipment Act - in Germany).
- The product must be supplied to a specialist recycling company. Do not use municipal waste collection points. These may be used for privately used products only in accordance with WEEE Directive 2012/19/EU.
- If there is no possibility to dispose of the old equipment properly, our Service can take care of its pick-up and disposal for a fee.

11 Specification

Note

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

12 Additional documents

Note

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

13 Appendix

Return form

Statement on the contamination of devices and components

Repair and/or maintenance work will only be performed on devices and components if a statement form has been completed and submitted.

Otherwise, the device/component returned may be rejected. This statement form may only be completed and signed by authorized specialist personnel employed by the operator.

Customer details:

Company: _____

Address: _____

Contact person: _____

Telephone: _____

Fax: _____

Email: _____

Device details:

Type: _____

Serial no.: _____

Reason for the return/description of the defect: _____

Was this device used in conjunction with substances which pose a threat or risk to health?

Yes No

If yes, which type of contamination (please place an X next to the applicable items):

<input type="checkbox"/> biological	<input type="checkbox"/> corrosive / irritating	<input type="checkbox"/> combustible (highly / extremely combustible)
<input type="checkbox"/> toxic	<input type="checkbox"/> explosive	<input type="checkbox"/> other toxic substances
<input type="checkbox"/> 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

... 13 Appendix

FMT200 Installation diagram 3kxf000094G0009

Installation diagram FMT200

ORDINARY LOCATION GENERAL PURPOSE	HAZARDOUS LOCATION Zone 2/22 Division 2 & ZN 2/22	HAZARDOUS LOCATION Zone 1/21 Zone 0 (inside pipe) Division 1 & ZN 1/21
<p>ATEX: - IECEX: -</p> <p>US: - CDN: -</p>	<p>ATEX: II 3 G & II 3 D IECEX: Gc & Dc</p> <p>US: DIV2 & ZN2 CDN: DIV2 & ZN2</p>	<p>ATEX: II 1/2 G & II 2 D IECEX: Gb (Ga) & Db Gb & Db</p> <p>US: DIV1 & ZN1 & ZN0 inside Pipe CDN: DIV1 & ZN1</p>

<p>a</p> <p>POWER SUPPLY Non IS Terminals max 30V DC</p>	<p>b</p> <p>SIGNAL DATA INPUT/OUTPUT</p> <p>Intrinsically safe Ia (A) Ui=4.2V (B)</p> <p>Connected to ATEX / IECEX or FM / CSA certified BARRIER (41) Ui=30V (42)</p> <p>(51) Ui=30V (52)</p>	<p>c</p> <p>Alternative to b :</p> <p>SIGNAL DATA INPUT/OUTPUT (A) Umax=3V (B)</p> <p>Non Intrinsically Safe (41) Umax=30V (42)</p> <p>max 30Vrms (51) Umax=30V (52)</p>
--	--	--

Version FMT200

PAGE 13 OF 17

For Model	Projection method 1	General Tolerances	Tolerancing Surface
FMT200	ABB ABB Automation Products GmbH Date: 01.12.2019 Name: FBU	Work piece edges:	Installation diagram SensyMaster FMT
01.12.2019 FBU	01.12.2019 FBU	Normal	3kxf000094G0009
Rev.:	Date:	Number:	Name:

<p>Notes: ATEX & IECEx application</p> <ol style="list-style-type: none"> THE INTRINSIC SAFETY ENTITY CONCEPT ALLOWS THE INTERCONNECTION OF TWO ATEX/IECEx APPROVED INTRINSICALLY SAFE DEVICES WITH ENTITY PARAMETERS NOT SPECIFICALLY EXAMINED IN COMBINATION AS A SYSTEM WHEN: Uo OR Vdc OR Vt < V MAX, Io OR loc OR It < I MAX, Ca OR Co > Ci + Ccable, La OR Lo > Li + Lcable, Po < Pi. DUST-TIGHT CONDUIT SEAL MUST BE USED WHEN INSTALLED IN Zone 21/22 ENVIRONMENTS. CONTROL EQUIPMENT CONNECTED TO THE ASSOCIATED APPARATUS MUST NOT USE OR GENERATE MORE THAN 250 Vrms OR Vdc WITH RESPECT TO EARTH. INSTALLATION SHOULD BE IN ACCORDANCE WITH THE RELEVANT INTERNATIONAL OR NATIONAL REGULATIONS "INSTALLATION OF INTRINSICALLY SAFE FOR HAZARDOUS LOCATIONS" REGULATIONS. THE CONFIGURATION OF ASSOCIATED APPARATUS MUST BE ATEX or IECEx APPROVED UNDER ENTITY CONCEPT. ASSOCIATED APPARATUS MANUFACTURER S INSTALLATION DRAWING MUST BE FOLLOWED WHEN INSTALLING THIS EQUIPMENT. THE ASSOCIATED APPARATUS MUST BE INSTALLED IN ACCORDANCE WITH BARRIER MANUFACTURE S INSTALLATION DIAGRAM 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: 	<p>Notes: US and Canadian application</p> <ol style="list-style-type: none"> THE INTRINSIC SAFETY ENTITY CONCEPT ALLOWS THE INTERCONNECTION OF TWO FM AND/OR CSA APPROVED INTRINSICALLY SAFE DEVICES WITH ENTITY PARAMETERS NOT SPECIFICALLY EXAMINED IN COMBINATION AS A SYSTEM WHEN: Uo OR Vdc OR Vt < V MAX, Io OR loc OR It < I MAX, Ca OR Co > Ci + Ccable, La OR Lo > Li + Lcable, Po < Pi. DUST-TIGHT CONDUIT SEAL MUST BE USED WHEN INSTALLED IN CLASS II AND III ENVIRONMENTS. CONTROL EQUIPMENT CONNECTED TO THE ASSOCIATED APPARATUS MUST NOT USE OR GENERATE MORE THAN 250 Vrms OR Vdc WITH RESPECT TO EARTH. INSTALLATION FOR U.S. AND CANADIAN APPROVED EQUIPMENT SHOULD BE IN ACCORDANCE WITH ANSI/ISA RP126 "INSTALLATION OF INTRINSICALLY SAFE SYSTEMS FOR HAZARDOUS (CLASSIFIED) LOCATIONS", THE NATIONAL ELECTRICAL CODE (ANSI/NFPA 70) SECTIONS 504, 505 AND THE CANADIAN ELECTRICAL CODE (C22.1-02). THE CONFIGURATION OF ASSOCIATED APPARATUS MUST BE FM AND/OR CSA APPROVED UNDER ENTITY CONCEPT. ASSOCIATED APPARATUS MANUFACTURER S INSTALLATION DRAWING MUST BE FOLLOWED WHEN INSTALLING THIS EQUIPMENT. THE ASSOCIATED APPARATUS MUST BE INSTALLED IN ACCORDANCE WITH BARRIER MANUFACTURE S INSTALLATION DIAGRAM 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: 	<p>Version FMT200 PAGE 14 OF 17</p> <p>Revisions only with approval of the notified body. THIS IS A CERTIFIED DRAWING Änderungen nur mit Zustimmung der Prüfstelle</p> <p>Dieses ist eine zertifizierte Zeichnung</p> <p>I reserve all rights for this document. Without our previous agreement this document may not be reproduced or made available to third parties or utilized in any other manner. Violators will be subject to penalties and may be punished by law.</p> <table border="1"> <tr> <td>For Model</td> <td>FMT200</td> <td>Projection method 1</td> <td>General tolerances:</td> <td>Tolerancing</td> </tr> <tr> <td></td> <td></td> <td></td> <td>Work piece edges:</td> <td>Surface</td> </tr> <tr> <td></td> <td></td> <td></td> <td colspan="2" style="text-align: center;">Installation diagram</td> </tr> <tr> <td></td> <td></td> <td></td> <td colspan="2" style="text-align: center;">SensyMaster FMT</td> </tr> <tr> <td>Rev.</td> <td>Date</td> <td>Number</td> <td>Name</td> <td>Part No.</td> </tr> <tr> <td>01</td> <td>12.11.2019</td> <td>FBu</td> <td></td> <td>3KX1000094G0009</td> </tr> </table>	For Model	FMT200	Projection method 1	General tolerances:	Tolerancing				Work piece edges:	Surface				Installation diagram					SensyMaster FMT		Rev.	Date	Number	Name	Part No.	01	12.11.2019	FBu		3KX1000094G0009
For Model	FMT200	Projection method 1	General tolerances:	Tolerancing																												
			Work piece edges:	Surface																												
			Installation diagram																													
			SensyMaster FMT																													
Rev.	Date	Number	Name	Part No.																												
01	12.11.2019	FBu		3KX1000094G0009																												

... 13 Appendix

... FMT200 Installation diagram 3kxf000094G0009

Zone 2/21 & Division 2

Model code
 FMT2bcY0
 FMT2bcA2
 FMT2bcF2
 HART Communication

Indication	Abbr.	Status Active or Passive	Option Chosen Option depending on Model Number (MN)	Terminal if "or" occurs Terminal depends on MN	Operating Value		
					U _{nom} [V]	I _{nom} [mA]	Ex ec / NI U _{nom} [mA]
On board							
Modbus	---	A		A / B	30	30	30
Digital Output 1	DO1	P		41/42	30	30	30
Digital Output 2	DO2	P		51/52	30	30	30

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

Wir reservieren uns alle Rechte für dieses Dokument. Ohne unser vorheriges
 Einverständnis dürfen diese Informationen nicht reproduziert oder weitergegeben
 werden.

For Model FMT200	Projection method 1 1st angle	General tolerances - work piece edges Tolerancing Surface	Installation diagram SensyMaster FMT
ABB Automation Products GmbH Date: 01.12.2019 Name: FBu		3kxf000094G0009 Material:	
01.12.2019 Rev. Date FBu Name	01.12.2019 Date FBu Name	3kxf000094G0009 Material	

Zone 1/21 & Division 1

Model code FMT2bcA1, FMT2bcA3, FMT2bcA5, FMT2bcB5
FMT2bcF1

HART Communication

Indication	Abbr.	Status	Option	Terminal	Operating Value													
					Ex e / XP	Ex ia / IS	U _M	I _M	U _o	I _o	I _i	P _o	P _i	C _o	C _i	C _{OPPA}	L _o	L _i
		Active or Passive	Chosen Option depending on Model Number (MN)	If "or" occurs Terminal depends on MN	On board													
Modbus	---	A		A / B	30	0,1	4,2	150	150	150	150	150	13900	13900	-	-	20	20
Digital Output 1	DO1	P		41/42	30	0,1	-	30	-	25	-	187	20	-	-	-	200	200
Digital Output 2	DO2	P		51/52	30	0,1	-	30	-	25	-	187	20	-	-	-	200	200

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

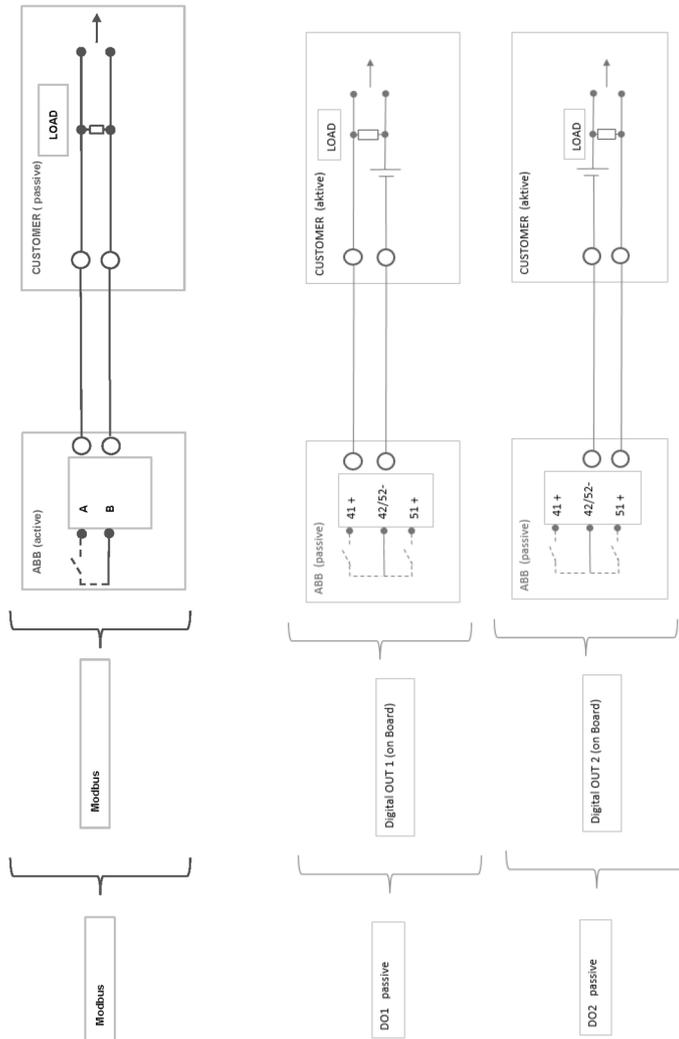
We reserve all rights for this document. Without our previous agreement this document may not be reproduced or made available to third parties or utilized in any other manner. Violations will be subject to penalties and may be punishable by law.

For Model	FMT200	Projection method 1	General tolerances: work piece edges:	Tolerancing Surface:
		ABB Automation Products GmbH Date: 01.12.2019 Name: FBu		
Rev.	Date	Number	Name	Replaces:
	01.12.2019	FBu		
Version FMT200 PAGE 16 OF 17		Installation diagram SensyMaster FMT 3kx1000094G0009 Material:		

... 13 Appendix

... FMT200 Installation diagram 3kxf000094G0009

Allowed I/O connections:



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

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

For Model	FMT200	Projection method 1	General tolerances: work piece edges:	Tolerancing Surface:
Rev.	Date	Name	Installation diagram	
01	12.11.2019	FBu	SensyMaster FMT	
01	12.11.2019	FBu	3kxf000094G0009	
...	Normal	
...	Normal	

Trademarks

Modbus is a registered trademark of Schneider Automation Inc.

Swagelok is a registered trademark of the Swagelok Company

ABB Measurement & Analytics

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

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

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

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