

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

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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:



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1 Safety

General information and instructions

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

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

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

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

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

Information and symbols on the product must be observed.

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

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

Warnings

The warnings in these instructions are structured as follows:

DANGER

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

WARNING

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

CAUTION

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

NOTICE

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

Note

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

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.

Warranty provisions

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

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](#)



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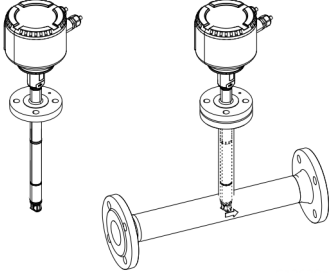
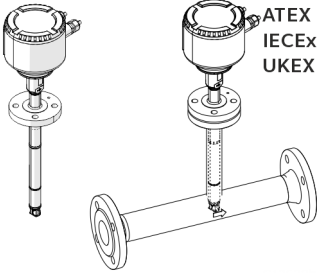
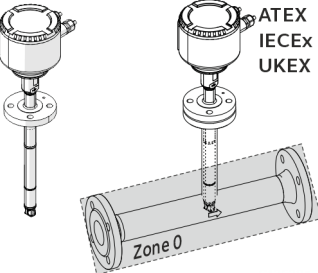
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Note

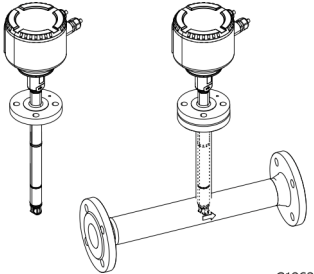
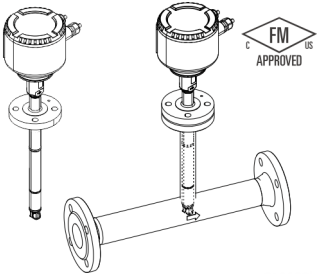
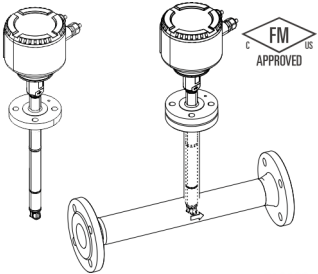
Further information on the approval of devices for use in potentially explosive atmospheres can be found in the type examination certificates or the relevant certificates at www.abb.com/flow.

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: Urated=30V	
Ex ia INTRINSICALLY SAFE	
SECURITE INTRINSEQUE	

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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 [μ H]
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 [μ H]
							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 111 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 111 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 29 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 49.

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.

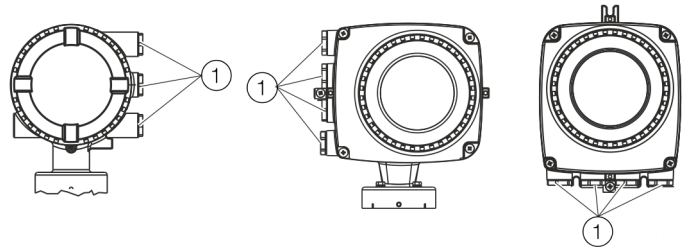
Black cable fittings are installed by default when the device is supplied. If signal outputs are connected to intrinsically safe circuits, replace the black cap on the corresponding cable gland with the blue one supplied.

Note

In order to provide the required temperature resistance, devices in the low-temperature design (optional – in preparation, ambient temperature up to $-40\text{ }^{\circ}\text{C}$ [$40\text{ }^{\circ}\text{F}$]) 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 50.

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 50.

Power supply terminal cover

Make sure that the power supply terminal cover is closed tightly, see also **Connection on the device** on page 52.

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.

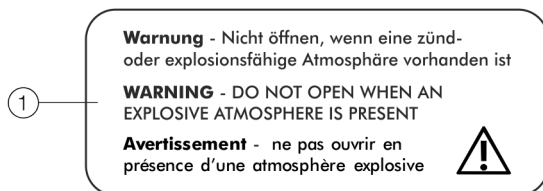
As a result, the housing can form an ignition source due to electrostatic discharges in the following conditions:

- 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!

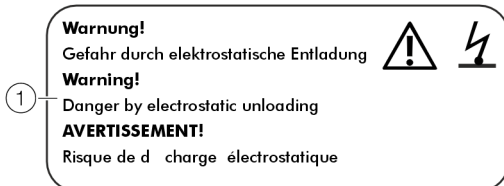
Instructions on cleaning

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.



- ① **Warning** – Do not open in a flammable or potentially explosive atmosphere.



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

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 Design and function

Overview

Sensor

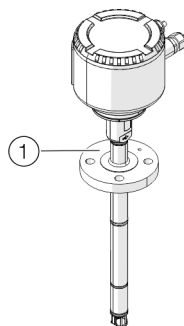


Figure 3: Sensor FMT230, FMT250 (example)

Model	FMT230	FMT250
Measuring media	Gas and gas mixtures with known composition, see table Available gas types on page 67	
Measuring accuracy for gases*	±1.2 % of Q_m in the range of 10 to 100 % of the standard measuring range;	±0.6 % of the measured value ± 0.05 % of the Q_{maxDN} possible in the nominal diameter
Air	±0.12 % of the Q_{maxDN} possible in the nominal diameter in the range of 0 to 10 % of the measuring range	
Other gases (with optional operating gas calibration)	—	±1.6 % of the measured value ±0.1 % of the Q_{maxDN} possible in the nominal diameter
Extended measuring range	Yes, optional (depending on the gas type, with limited measuring accuracy possibly)	Yes, optional (depending on the gas type, with limited measuring accuracy possibly)
Measuring medium temperature T_{medium}	Standard and explosion-proof design: -20 to 150 °C (-4 to 302 °F)	Standard and explosion-proof design: -20 to 150 °C (-4 to 302 °F)
Ambient temperature $T_{ambient}$	Standard: -20 to 70 °C (-4 to 158 °F) Optional: -40 to 70 °C (-40 to 158 °F)	Temperature information for high temperature**, low temperature and DVGW design, see Measured medium temperature on page 29.
Sensor connection (1)	Flange DN 25 – PN 40, threaded connection DIN 11851, compression fitting	
Wetted materials	Stainless steel, ceramic sensor element	
Power supply	24 V DC, ±20 %	
IP rating	In accordance with EN 60529: IP 65 / IP 67	
NEMA rating	In accordance with NEMA 4X	
Communication	Modbus® RTU, RS485	
Outputs in serial production	Two passive digital outputs	
ApplicationSelector	Yes, up to 2 applications	Yes, up to 8 applications
Preconfigured applications	Yes, up to 2 applications	Yes, up to 4 applications
Freely configurable applications	No	Yes, up to 4 applications
Selectable nominal diameters	Yes	Yes
Selectable gas type	No	Yes
Filling function	No	Yes, optional
"VeriMass" diagnosis function	Yes, optional	Yes, optional
Approvals and certificates		
ATEX/IECEx/UKEX explosion protection	Zone 0, 1, 2, 21, 22	Zone 0, 1, 2, 21, 22
Explosion protection conforming to cFMus	Class I Div. 1, Class I Div. 2, Zone 1, 2, 21	Class I Div. 1, Class I Div. 2, Zone 1, 2, 21
Additional approvals	Available on our website abb.com/flow or on request	

* The stated measuring accuracy only applies under the reference conditions in the stated standard measuring range.

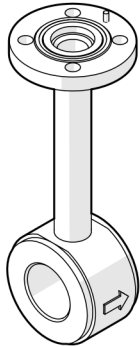
** Not in connection with explosion-proof design.

... 4 Design and function

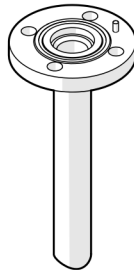
... Overview

Process connections

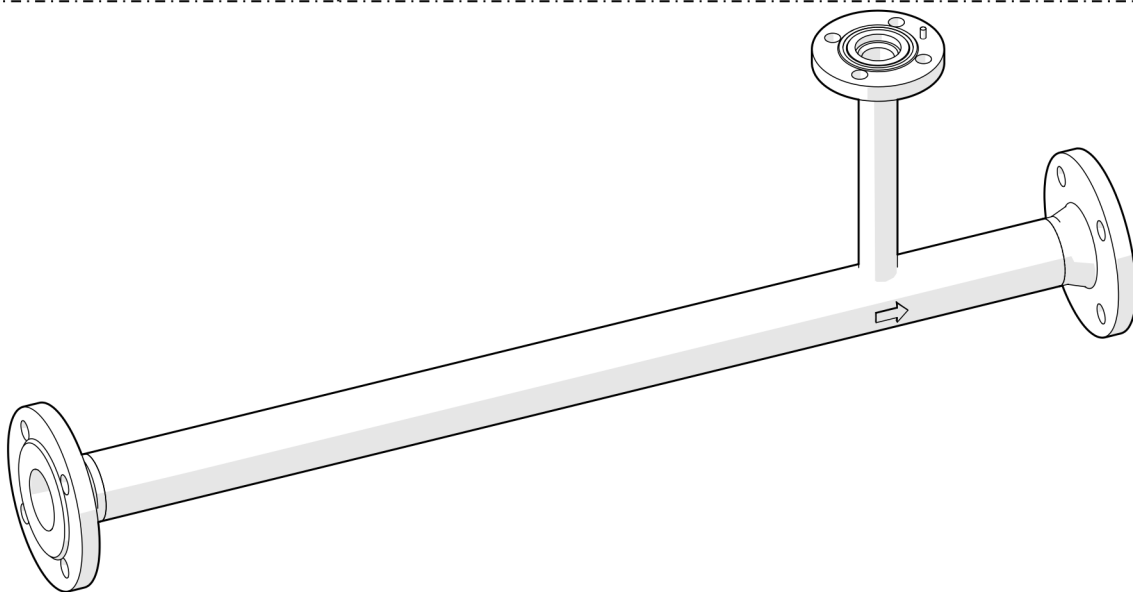
FMT091 – Wafer type design



FMT094 – Weld-on adapter



FMT094 – Weld-on adapter with clamp ring threading



FMT092 – Partial measuring section

Figure 4: Pipe components (examples)

Pipe components

FMT091 – Wafer type design	In accordance with EN 1092-1: DN 40 to 200, PN 40 In accordance with ASME B16.5: 1½ to 8 in, CL 150 to 300
FMT092 – Partial measuring section	Flange in accordance with EN 1092-1: DN 25 to 100 (larger nominal diameters on request), PN 10 to 40 Flange in accordance with ASME B16.5: 1½ to 8 in, CL 150 to 300 Male thread DN 25 to 80, R1 to 3 in
FMT094 – Weld-on adapter	For rectangular ducts or pipe diameters ≥ DN 80 (3 in.), PN 16 to 40
Options	With ball valve (order code SCA) or integrated hot tap fitting (order code SCB, SCC, SCD)
ATEX/IECEX/UKEX explosion protection	Zone 1, 2, 21, 22
Explosion protection conforming to cFMus	Can be used in Div. 1, Div. 2, Zone 1, 2, 21

Wetted materials for pipe components

Stainless steel, galvanized

Temperature data for pipe components

Measuring medium temperature T_{medium} Standard: -20 to 150 °C (-4 to 302 °F)

Ambient temperature T_{amb} for pipe components Standard: -20 to 70 °C (-4 to 158 °F), optional: -40 to 70 °C (-40 to 158 °F)

without ball valve or integrated hot tap fitting. Depending on the selected **ambient temperature range (TA3/TA9)** of the sensor and O-ring design.

Ambient temperature T_{amb} for pipe components Standard: -20 to 70 °C (-4 to 158 °F)

with ball valve or integrated hot tap fitting

(Sensor connection options: SCA, SCB, SCD)

... 4 Design and function

Device description

The SensyMaster FMT230, FMT250 works in accordance with the measuring principle of a hot-film anemometer. This measurement method allows for direct measurement of the gas mass flow.

Taking into account the standard density, the norm volume flow can be displayed without the need for additional pressure and temperature compensation.

The device is equipped with a Modbus® interface and two fast digital outputs that can be configured as pulse, frequency or binary outputs.

The SensyMaster FMT230, FMT250 is used in the process industry for the flow measurement of gases and gas mixtures.

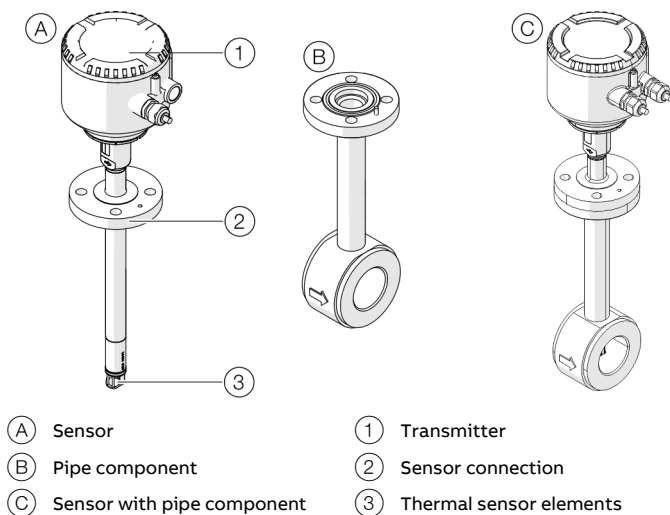


Figure 5: Sensor (example, wafer type design)

The SensyMaster FMT230, FMT250 is composed of the components sensor and pipe component (process connection). The pipe component can be delivered in various designs. In addition, a weld-on adapter makes it possible to install the flowmeter sensor in rectangular ducts or pipelines with any diameter.

Measuring principle

Thermal flow metering procedures use different ways to evaluate the flow dependent cooling of a heated resistor as measuring signal.

In a hotfilm anemometer with constant temperature difference control, the heated platinum resistor is maintained at a constant overtemperature in relation to an unheated platinum sensor inside the gas flow.

The heating power required for maintaining the overtemperature depends directly on the flow rate and the material properties of the gas. With a known (and constant) gas composition the mass-flow can be determined by electronically evaluating the heater current / mass-flow curve without additional pressure and temperature compensation.

Together with the standard density of the gas this results directly in the standard volume flow.

Considering the high measuring range dynamics up to 1:100, an accuracy smaller than 1 % of the measuring value is achieved.

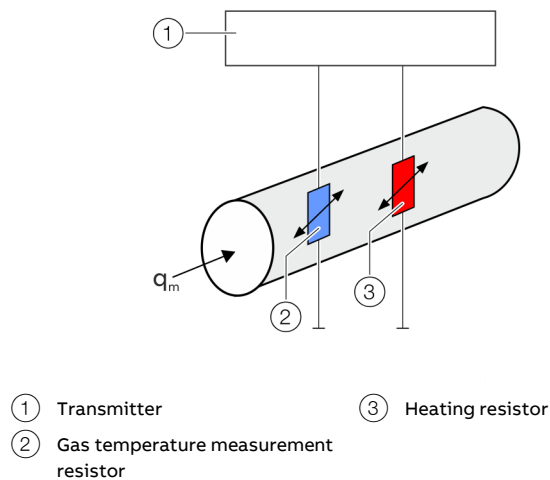


Figure 6: Measuring principle (simplified)

The transmitter has three signals available. In addition to the heating power, the temperatures of the measuring medium and the heater resistance are included herein, which can be used to compensate the temperature dependency of gas parameters.

By storing the gas data in the transmitter the optimal tailoring can be calculated and performed at any operating point.

5 Product identification

Name plate

Note

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



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

Figure 7: Name plate (example)

Note

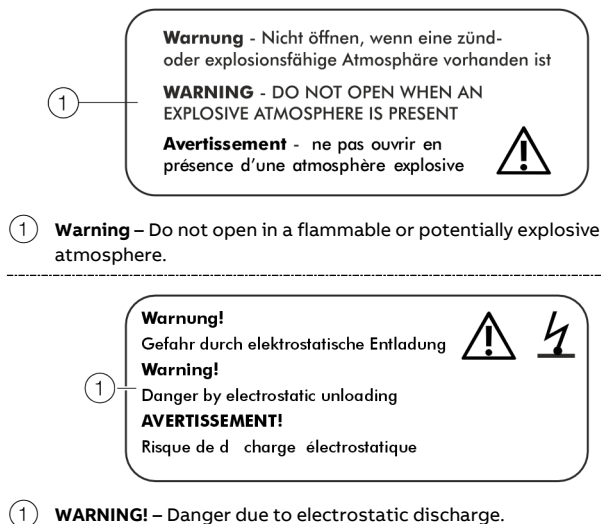


Products that are marked with the adjacent symbol may **not** be disposed of as unsorted municipal waste (domestic waste).

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.



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

Figure 8: Warning signs on the device

6 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

For the return of devices, follow the instructions in **Returning devices** on page 107.

7 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.

... 7 Installation

... Installation conditions

Inlet and outlet sections

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

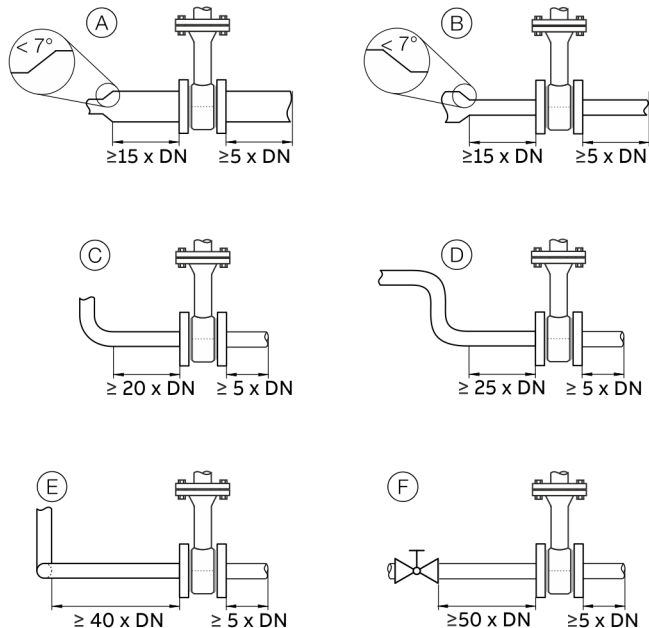


Figure 9: Inlet and outlet sections

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

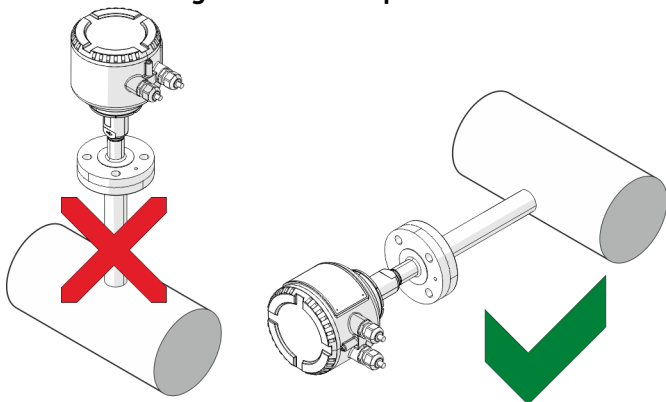
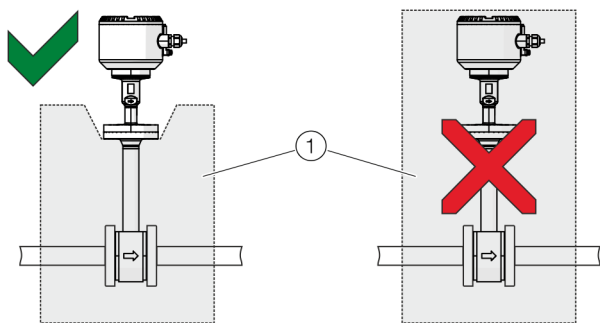


Figure 10: Mounting position at high ambient temperatures

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 11: Isolation of the sensor

The sensor may be insulated as shown in **Figure 11**.

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 \leq 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 connection 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)

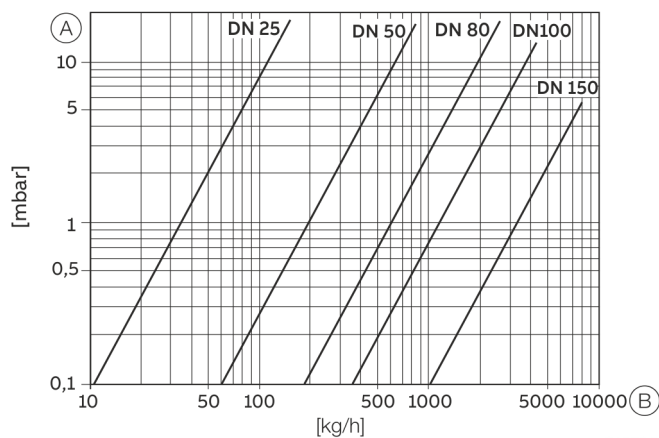
... 7 Installation

... 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 30

Pressure loss



(A) Pressure loss (B) Mass flow

Figure 12: Pressure loss in logarithmic representation

Material loads for process connections

DIN and ASME flanges

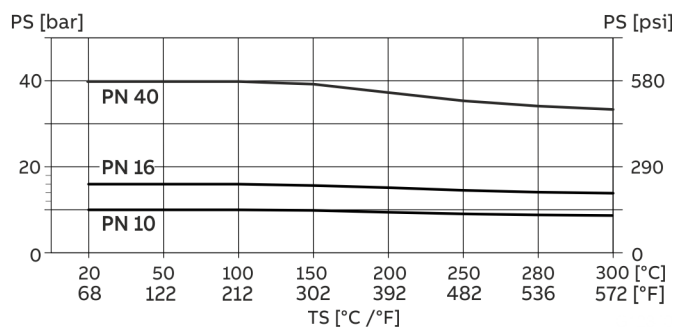


Figure 13: DIN flange process connection

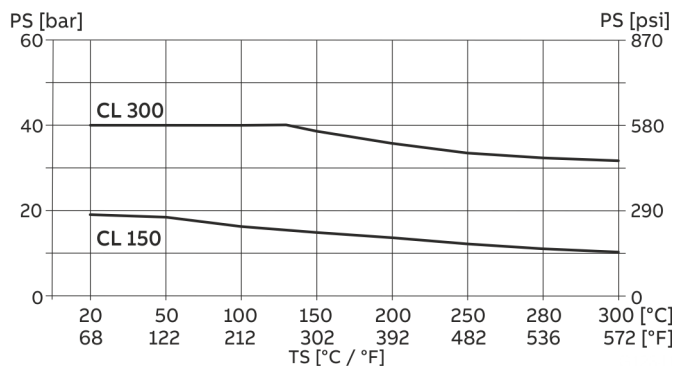


Figure 14: ASME flange process connection

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

Integrated hot tap fitting

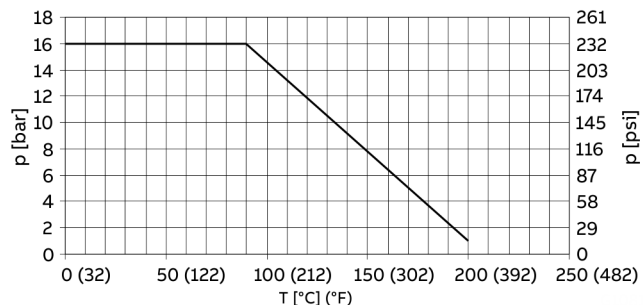


Figure 15: Maximum pressure/temperature values for integrated hot tap fitting

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).

... 7 Installation

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

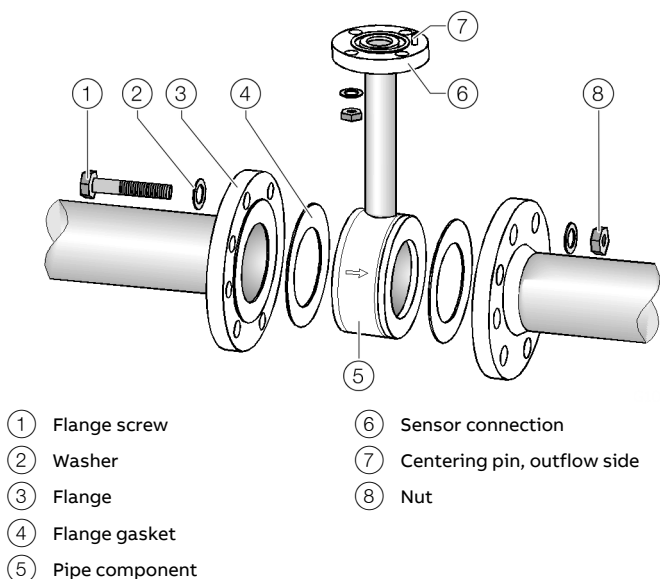


Figure 16: Installing a pipe component (example, wafer type design)

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.

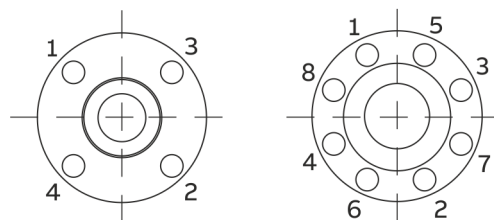


Figure 17: Tightening sequence for the flange screws

Assembly of the welding adapter with flange or threaded connector

Welding adapter with flange connector

Dimensions in mm (in)

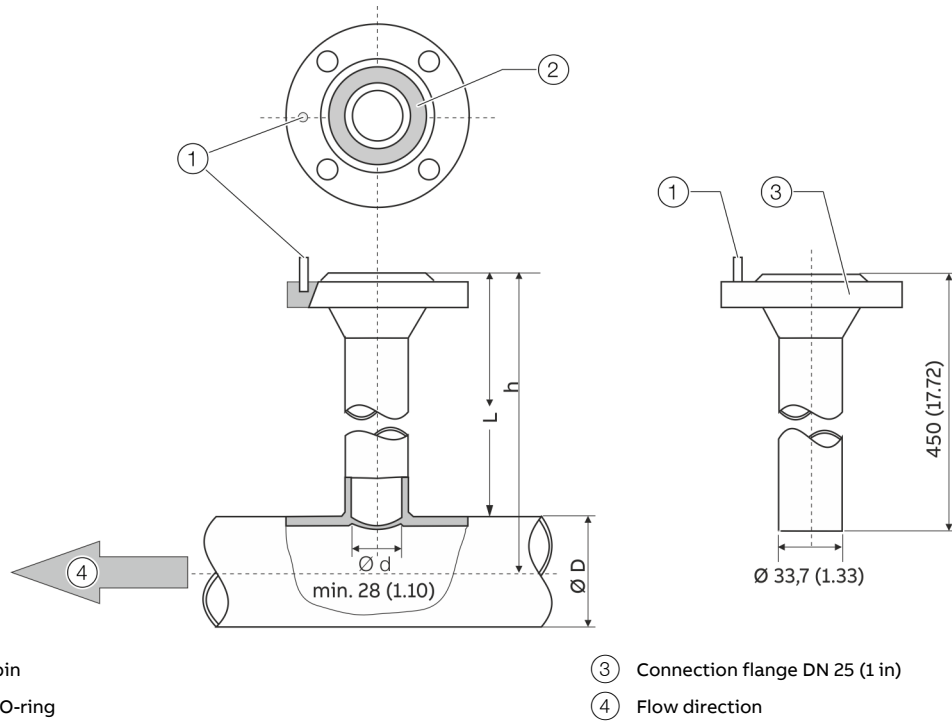


Figure 18: Dimensions in mm (in)

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)*

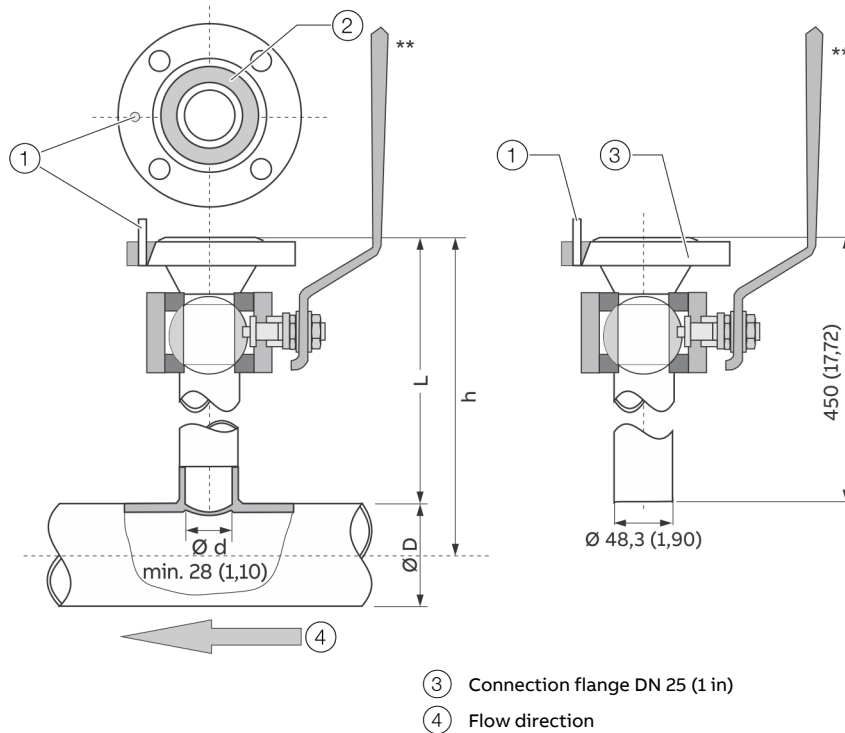
* The limitation of the maximum pipe diameter only applies for installations with a sensor element in the middle of the pipe. In case of larger or non-round cross-sections, a non-centered position of the measuring element in the piping is considered in the calibration.

... 7 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 19: Dimensions in mm (in)

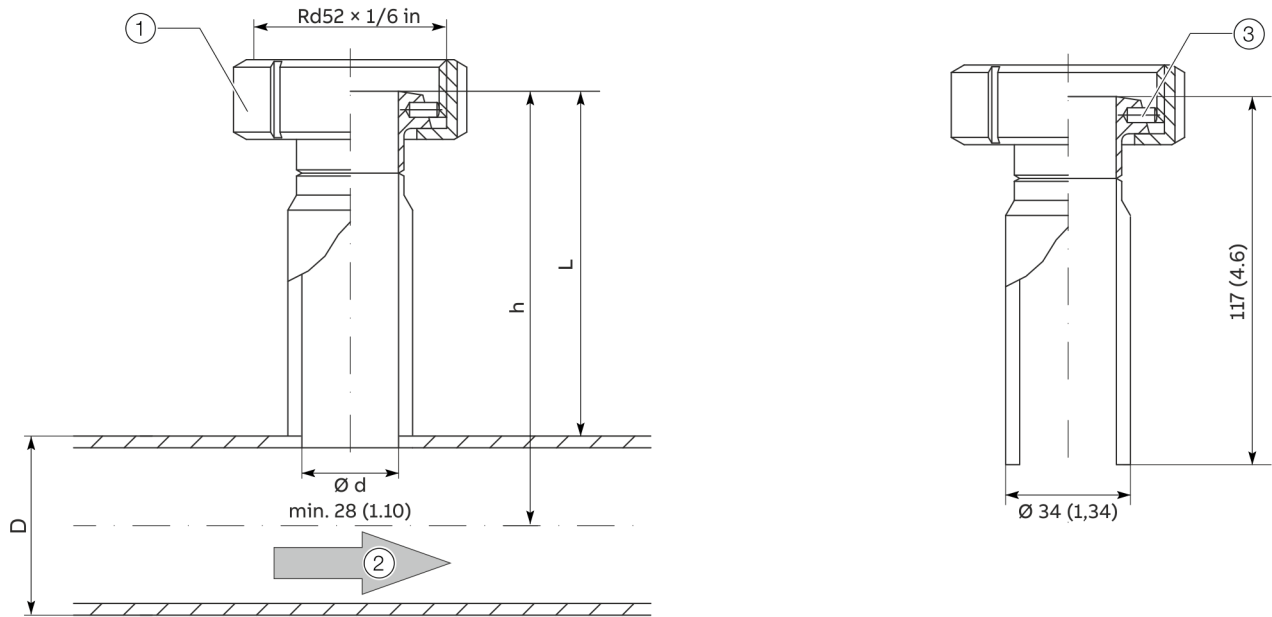
h – sensor length	Ø D - outer pipe diameter
263 (10.35)	80 to 150 (3.24 to 5.91)
425 (16.73)	> 150 to 500 (> 5.91 to 19.69)
775 (30.51)	> 500 to 1150 (> 19.69 to 45.28)*

* 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 20: Dimensions in mm (in)

... 7 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 33 and **Welding adapter with threaded connection in accordance with DIN 11851** on page 35).

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

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)

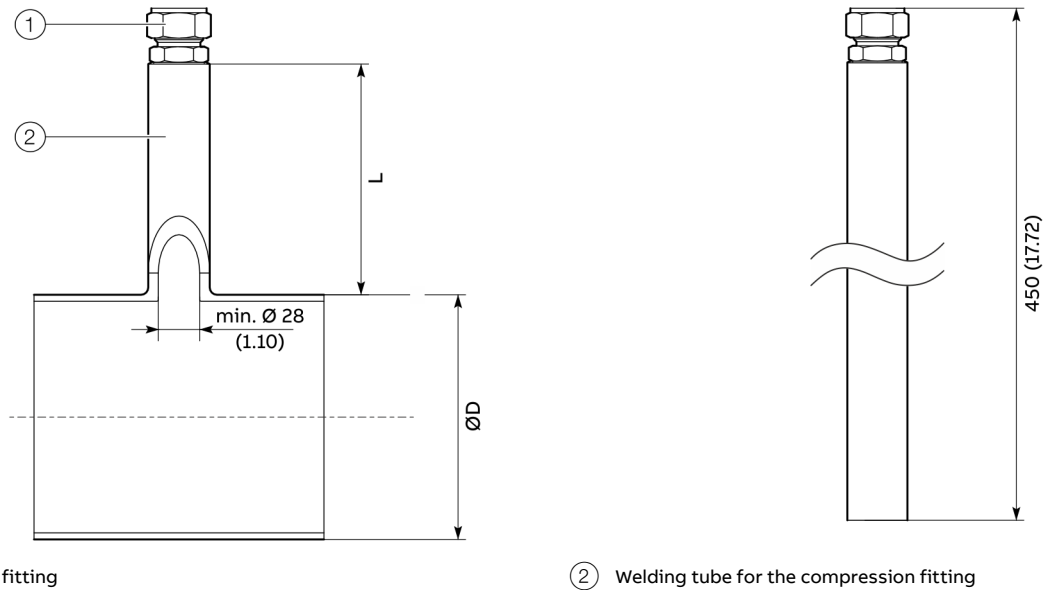


Figure 21: Welding adapter with compression fitting

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.

... 7 Installation

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

Mounting

Calculation of mounting dimensions

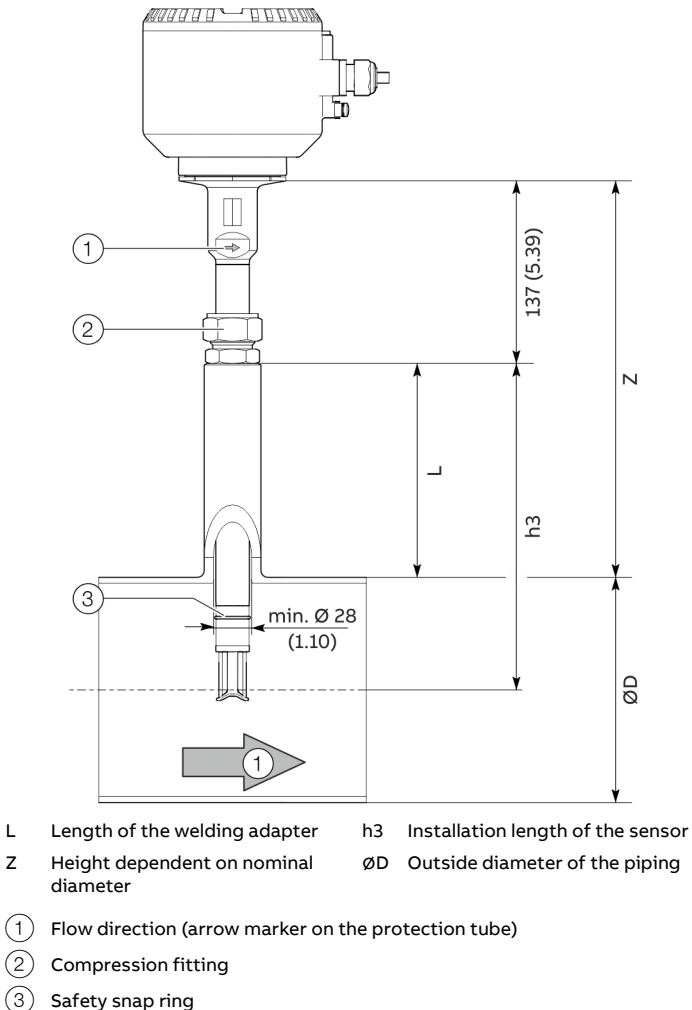


Figure 22: Calculating mounting dimensions

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.

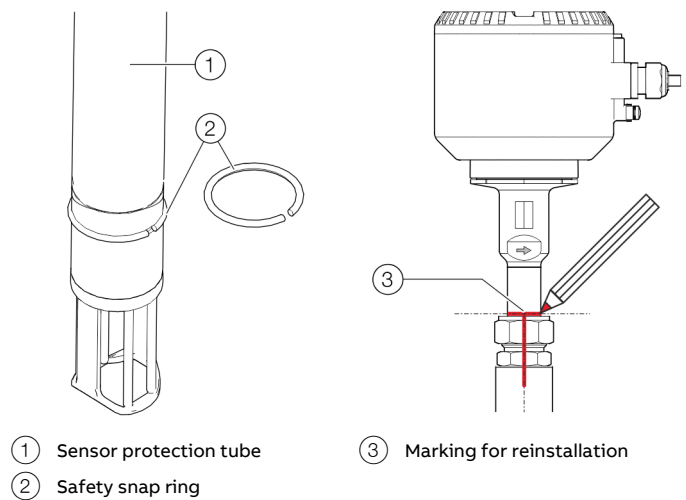


Figure 23: Snap ring and marking

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 23, 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 22) 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 23, pos. ③). The marking on the union nut is also used as a starting position (6 o'clock position, see Figure 24) 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.

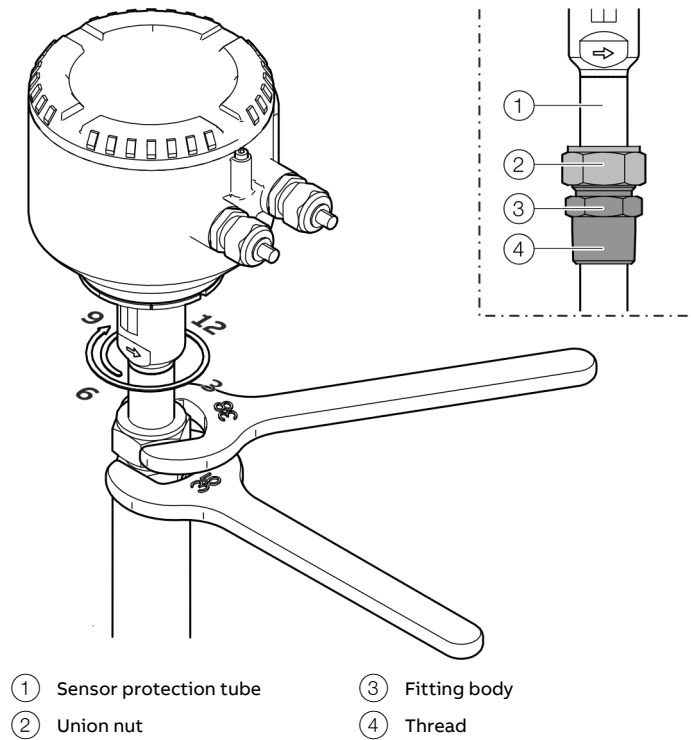


Figure 24: Tighten sensor

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.

... 7 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 (1³/₈ in)
- Open-end wrench, width across flats 38 mm (1¹/₂ 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 23, 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 23, 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 32.

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 29.

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.

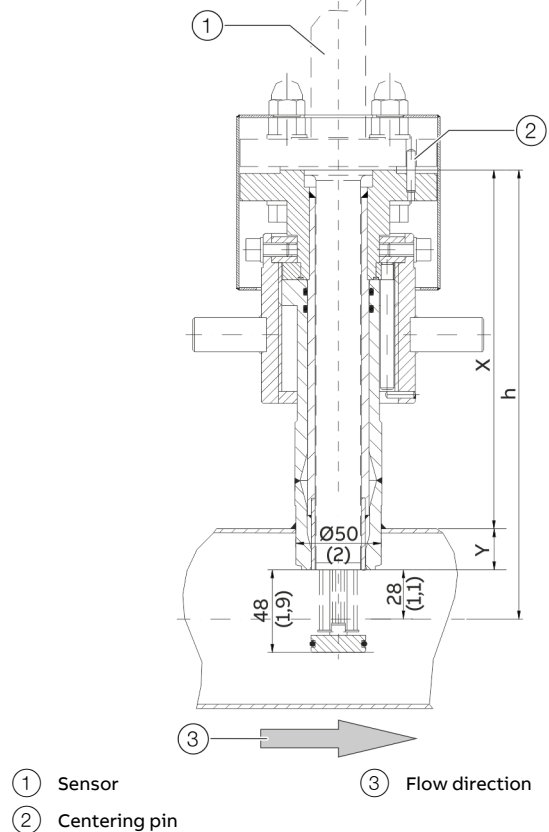


Figure 25: Integrated hot tap fitting in measurement position, dimensions in mm (in)

... 7 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

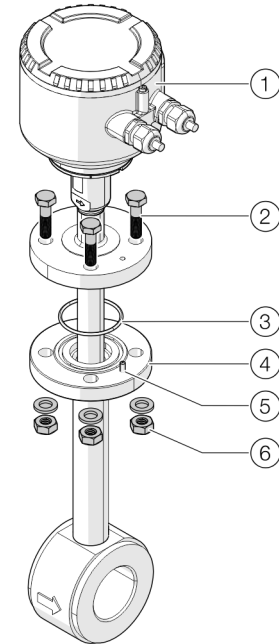
Deviations from the stated dimension and position tolerances have an impact on measuring accuracy.

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 26: 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).

... 7 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.

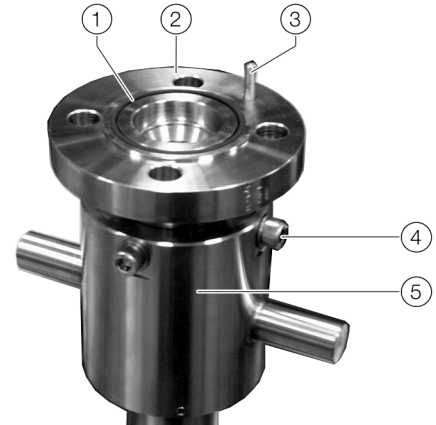
NOTICE

Damage to the changing device

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

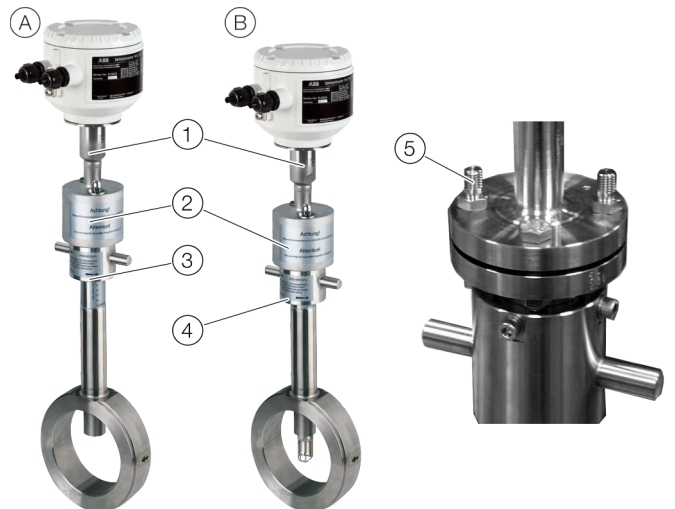
- Operate the union nut by hand only.

Overview



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

Figure 27: 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 28: 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

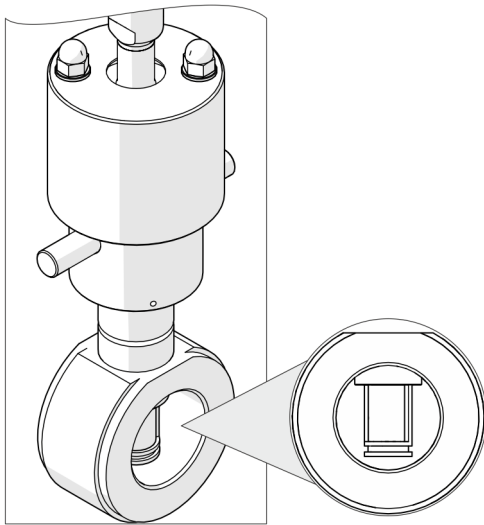


Figure 29: Integrated hot tap fitting in measurement position

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

Disassembly of the sensor

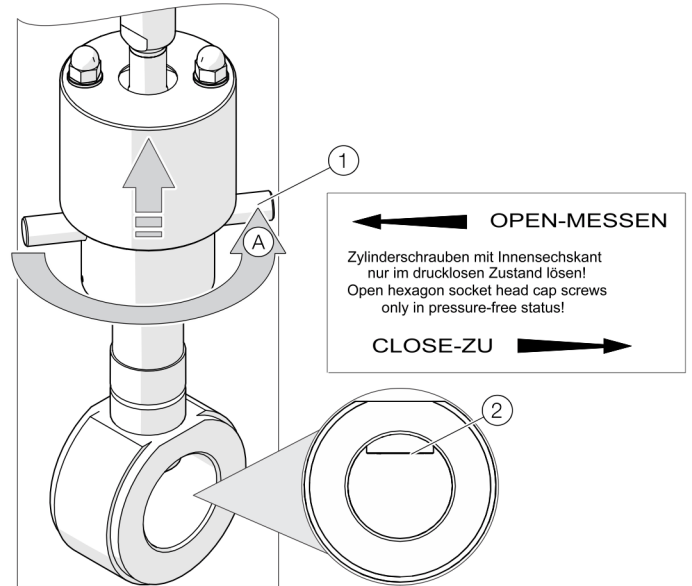


Figure 30: Setting the integrated hot tap fitting in disassembly position

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).

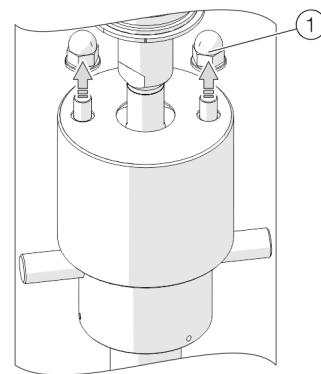


Figure 31: Loosening the cap nuts of the protection cap

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

... 7 Installation

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

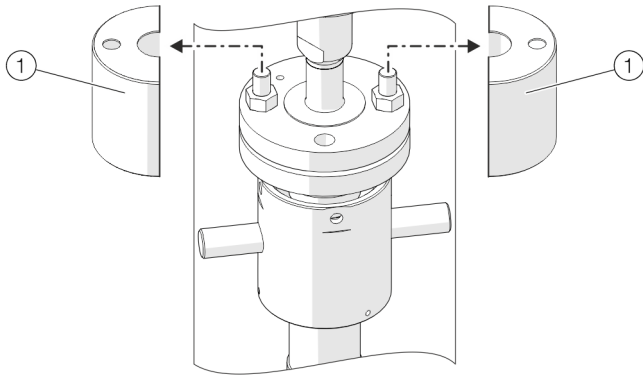


Figure 32: Removing the protection caps

4. Remove the protection caps (1).

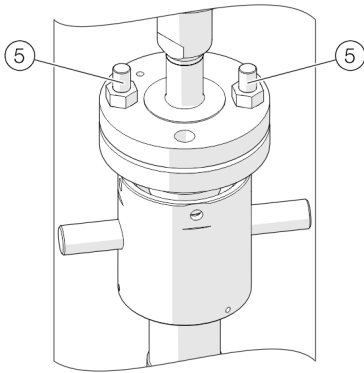


Figure 33: Removing the flange screws

5. Remove the flange screws (5).

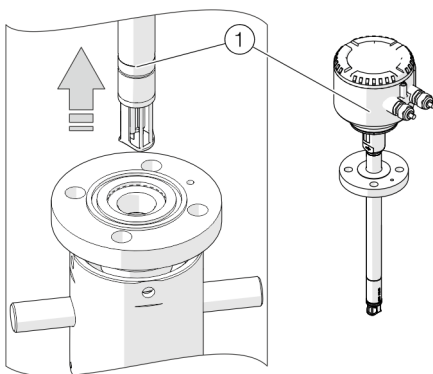


Figure 34: Removing the sensor

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.

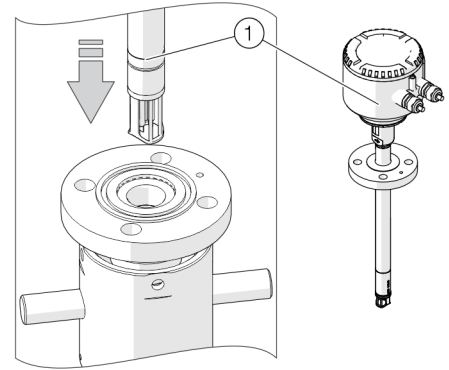


Figure 35: Inserting the sensor

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.

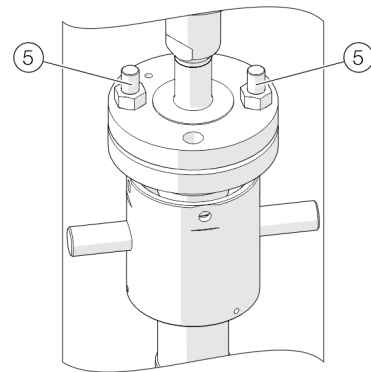


Figure 36: Screwing in the flange screws

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

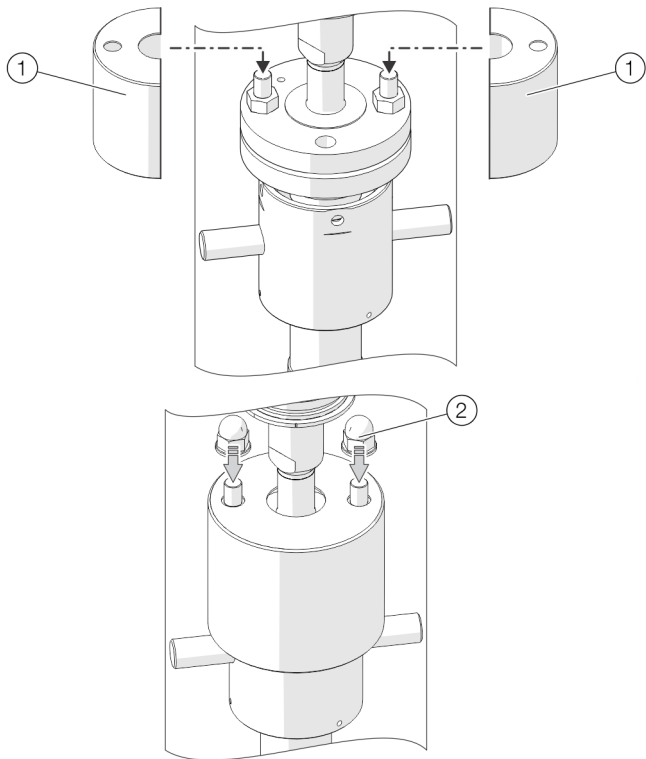


Figure 37: Placing the protection caps

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

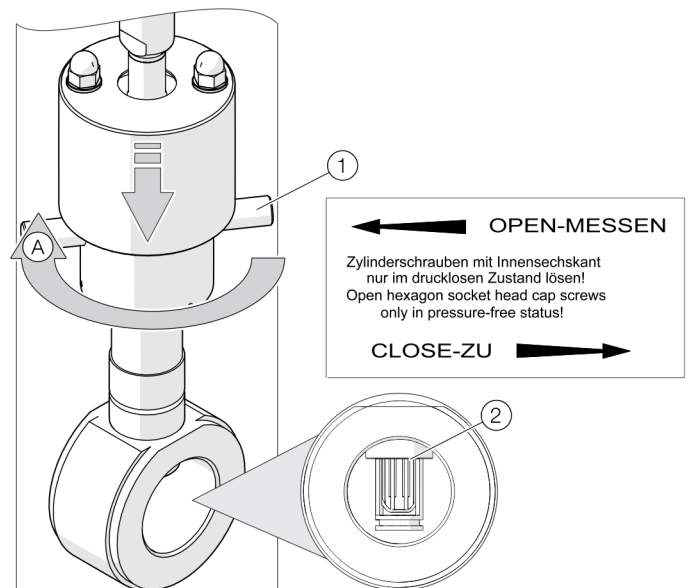


Figure 38: Setting the integrated hot tap fitting in measurement position

- 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

8 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.

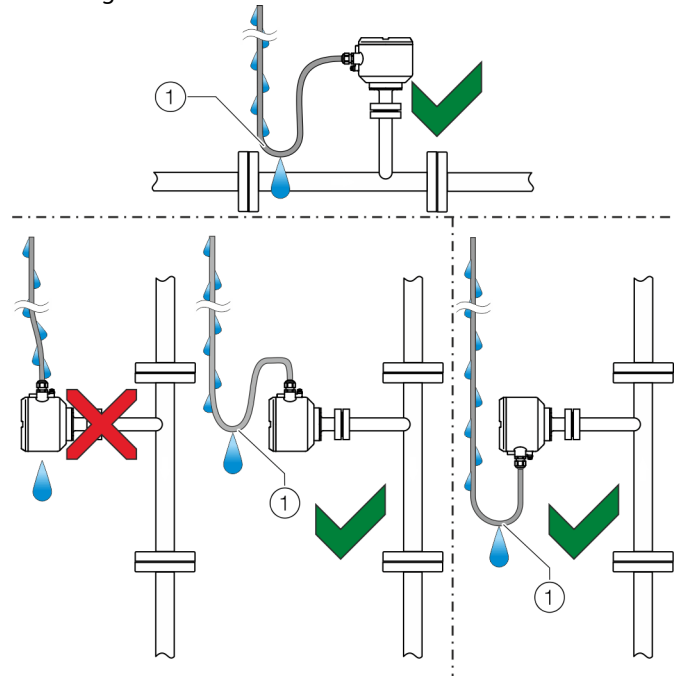
- Connect the device only with the power supply switched off.
- Observe the applicable standards and regulations for the electrical connection.

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 39: 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.

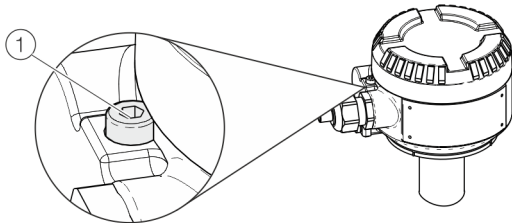


Figure 40: Cover lock (example)

NOTICE

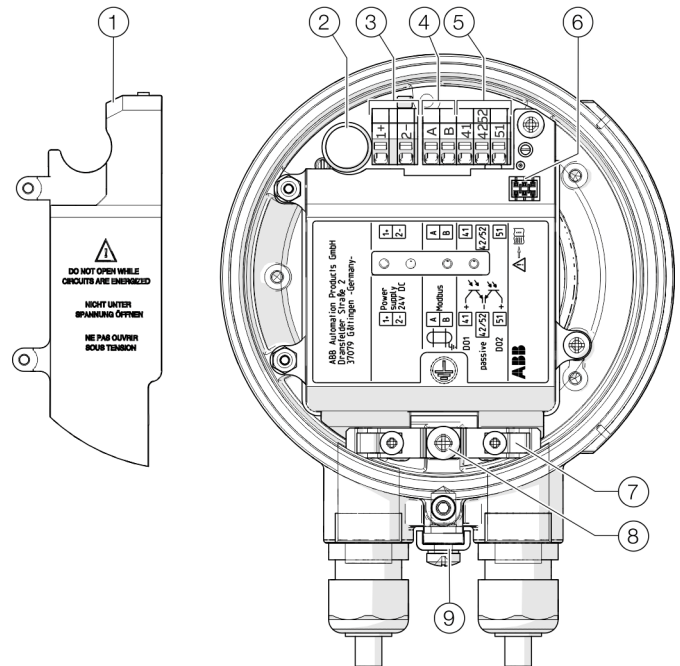
Potential adverse effect on the IP rating

- 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 41: Terminals on the device

... 8 Electrical connections

Terminal assignment

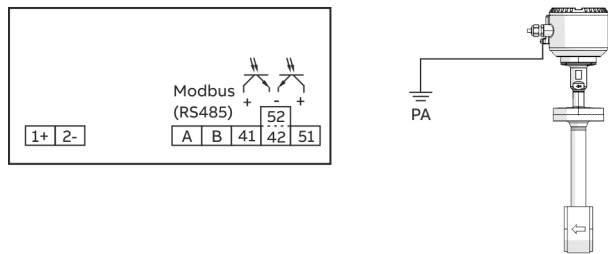


Figure 42: Electrical connection PA = functional ground (potential equalization)

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

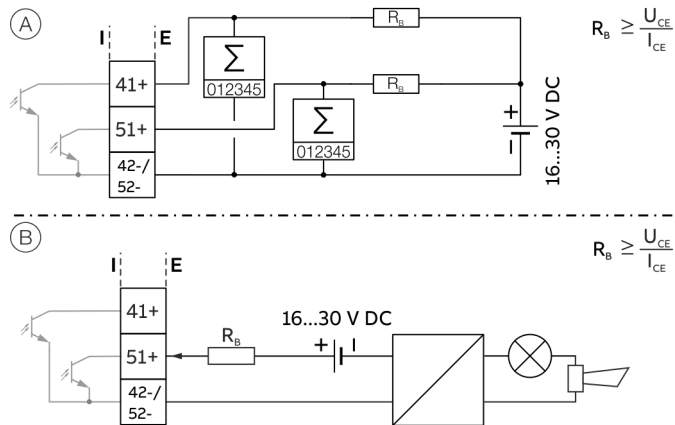
When using the device in potentially explosive atmospheres, note the additional connection data in **Use in potentially explosive atmospheres** on page 6!

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 43: 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

Parameter range - Output on page 85

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.

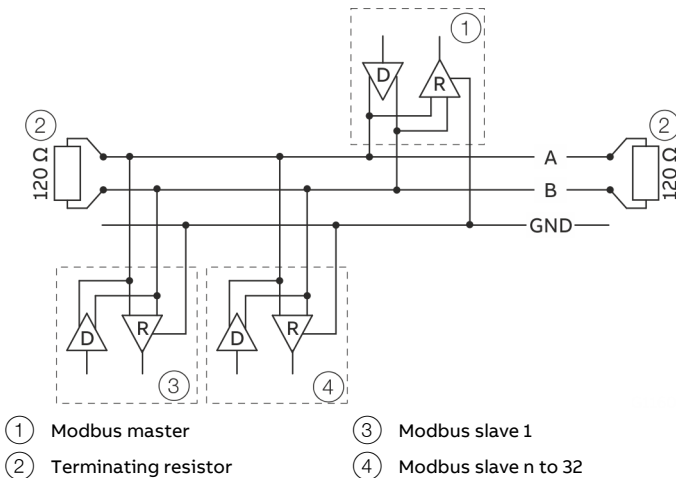
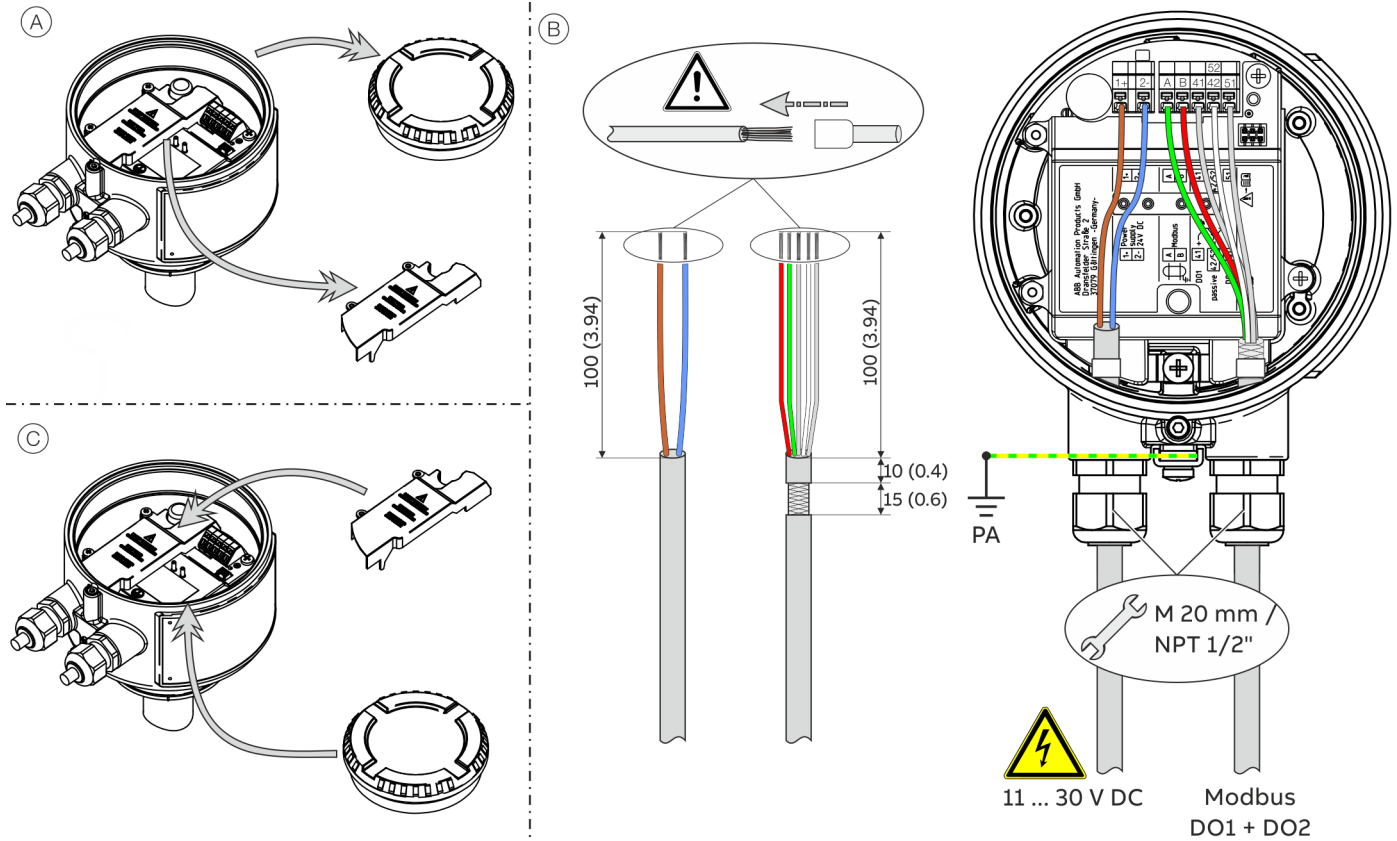


Figure 44: Communication with the Modbus protocol

... 8 Electrical connections

Connection on the device



PA Potential equalization

Figure 45: 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.

9 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.

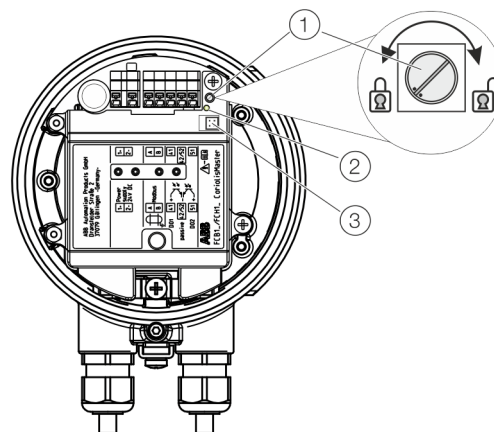
Aggressive or corrosive media may lead to the damage of wetted parts of the sensor. As a result, measuring medium under pressure can leak out.

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.

Write-protection switch, service LED and local operator interface



- ① Write protection switch ③ Local operating interface
② Service LED

Figure 46: Operating elements in the terminal box

Write-protect switch

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

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

Service LED

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

Service LED	Description
Flashes rapidly (100 ms)	Starting sequence, device not yet ready for operation
Lit up continuously	Device operating, no critical error
Flashes slowly (1 second)	A critical error has occurred, see Diagnosis / error messages on page 98

Local operating interface

The sensor can also be parameterized without a Modbus connection via the local operating interface, see **Connection on the device** on page 56.

... 9 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 48.
- 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 50).

Switching on the power supply

1. Switch on the power supply.
2. Perform parameterization of the flowmeter (see **Parameterization of the device** on page 54).

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

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

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

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

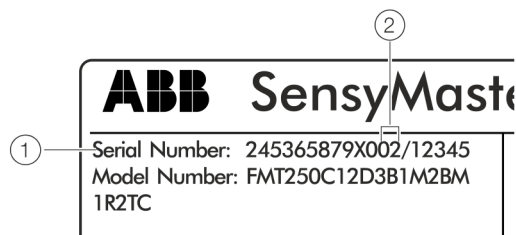
The settings for the Modbus interface and the pulse output are only necessary if the corresponding outputs are also used.

Parameterization via the Modbus interface

Note **Parameter descriptions** on page 71 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 47: 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 47, 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.’

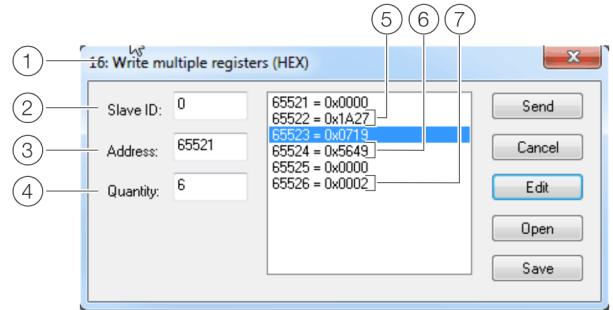
To set the Modbus Slave ID the Sensor ID of the device from the calibration certificate will be needed.



Figure 48: 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 65521.
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

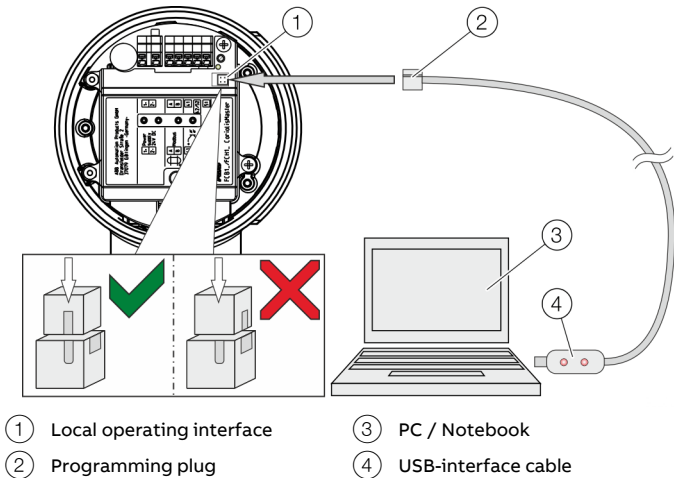
Figure 49: Write Multiple Registers (example)

... 9 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).



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

Figure 50: 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 56.
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 51.

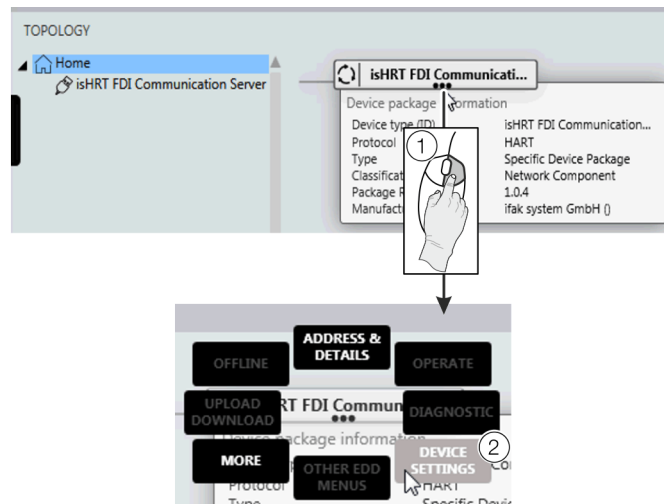


Figure 51: Select FIM – 'Device Settings'

7. Select 'DEVICE SETTINGS' ② as shown in Figure 51.

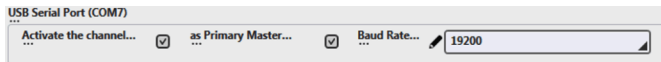



Figure 52: Select FIM – COM-Port

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’.

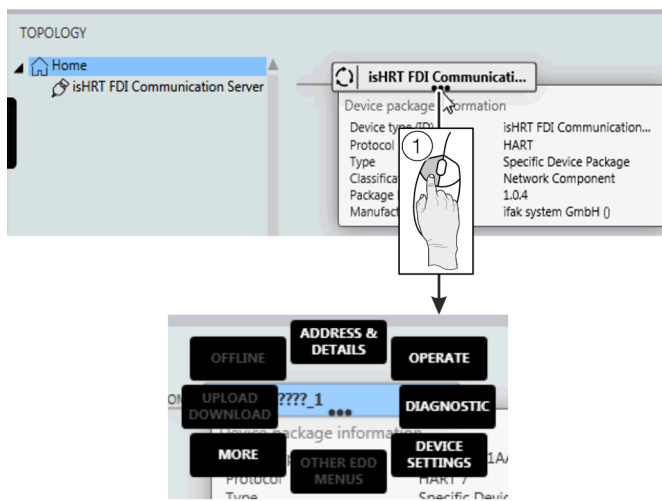


Figure 53:

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

... 9 Commissioning and operation

Interface description

NOTICE

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

Register tables (overview)

Table ID [hex]	Table name	Table type	Data type	Start index	End index
Input coils					
0xD	Diagnostic and error messages	Coil	TUSIGN8	1	1998
Register					
0x0	Dynamic 8-bit integer values	Single	TUSIGN8	1	124
0x1	Action objects	Single	ACTION	9001	9999
0x2	32-bit float values (read only)	Single	TFLOAT	2201	2499
0x3	16-bit integer values (read only)	Single	TUSIGN16	2101	2199
0x4	32-bit float values, basis parameter	Single	TFLOAT	5001	5999
0x5	32-bit integer values, basis parameter	Single	TUSIGN32	3301	3399
0x6	8-bit integer values, basis parameter	Single	TUSIGN8	4001	4999
0x7	Scan Register 1 configuration	Single	TUSIGN16	3101	3150
0x8	Read Scan Register 1	Single	TUSIGN16	1101	1200
0x9	Scan Register 2 configuration	Single	TUSIGN16	3201	3250
0xA	Read Scan Register 2	Single	TUSIGN16	1201	1300
0xB	Application 1 to 8: floating point parameter	Single	TFLOAT	7001	8999
0xC	Character strings (read only)	String	TUSIGN8	2501	2999
0xE	Editable character strings	String	TCHAR	3401	4000
0xF	Dynamic 64-bit double values, mainly counter readings	Single	TDOUBLE	401	525
0x10	Set Modbus address (slave ID) with device code and sensor ID. Refer to Changing an unknown Modbus slave ID on page 55.	Single	TUSIGN32	65521	65526
0x11	Dynamic 32-bit float values, mainly process values	Single	TFLOAT	201	324
0x12	8-bit integer values (read only)	Single	TUSIGN8	2001	2099
0x13	Application 1 to 8: byte parameter	Single	TUSIGN8	6001	6999

The device error messages are transmitted via the Modbus® interface by means of the 'Input Coils.'
For more detailed information, see **Diagnosis / error messages** on page 98.

Supported Modbus function codes

Overview

The function codes listed below are supported by SensyMaster FMT230, FMT250.

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

... 9 Commissioning and operation

... Interface description

Modbus function codes

In this chapter, all Modbus function codes supported by SensyMaster FMT230, FMT250 are described.

0x02 Read Discrete Inputs

The 'Read Discrete Inputs' function code is used to read off register 'Discrete Inputs (Coil)' of the device.

The query telegram is designed as follows:

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

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

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

0x03 Read Holding Registers

The 'Read Holding registers' function code is used to read off the 'Read Holding Registers' of the device.

The query telegram is designed as follows:

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

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

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

0x04 Read Input Registers

The 'Read Input Registers' function code is used to read off the 'Input Register' of the device.

The query telegram is designed as follows:

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

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

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

0x06 Write Single Register

The 'Write Single Register' function code is used to write a value in one of the 'Holding Register' of the device.

The query telegram is designed as follows:

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

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

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

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0x08 Diagnostics

Only the subfunction 'Return Query Data (0x00, 0x00)' is supported.

If the device receives a query telegram, the telegram is sent back to the Master without changes.

The query and reply telegrams are designed as follows:

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

0x10 Write Multiple Registers

The 'Write Multiple Register' function code is used to write a value in the 'Holding Register' of the device.

The query telegram is designed as follows:

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

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

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

0x11 Report Slave ID

The 'Report Slave ID' commando is used to uniquely identify the slave device.

The query telegram is designed as follows:

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

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

Byte	Description
1	Slave device code
2	Report Slave ID Function Code, 0x11
3	Number of data bytes
4	Manufacturer identification for ABB 0x1A
5	Device code for SensyMaster devices, 0x27
6	Software version, 0x30
7	Hardware version, 0x30
8	Not used, 0x30
9 to 11	Reserved for future use, 0x30,0x30,0x30
12 to 33	Device name (Hex) "41 42 42 20 46 4d 54 34 78 78 20 53 65 6e 73 79 4d 61 73 74 65 72" (ASCII) 'ABB FMT2xx SensyMaster'
34 to 35	Check sum (CRC) of the Modbus telegram

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Modbus error handling (exception codes)

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

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

The reply telegram with error message is designed as follows:

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

Modbus data types

ABB data type	Data type	Register count	Description
ACTION	unsigned char	One register	The data type 'ACTION' is used to trigger device functions. Parameters with the data type 'ACTION' have no internal memory requirements. Writing any value into the parameters triggers the corresponding device function.
TUSIGN8	unsigned char	One register	16-bit register, but only the first 8-bits are used - unsigned char.
TUSIGN16	unsigned short	One register	16-bit unsigned integer
TINT16	signed short	One register	16-bit signed integer
TUSIGN32	unsigned long	Two consecutive registers	32-bit unsigned integer
TINT32	signed long	Two consecutive registers	32-bit signed integer
TCHAR	unsigned char	One register. The total length of the register depends on the object length.	16-bit register, but only the first 8-bits are used - unsigned char. The register content is interpreted as an ASCII-value.
TFLOAT	float	Two consecutive registers	32-bit IEEE floating point. The device parameter 'IEEE Number Format' determines the order in which the data words of the data types 'float' and 'double' are interpreted. See also Parameter range – Communication on page 89.
TDOUBLE	double	Four consecutive registers	64-bit IEEE double-precision floating point. The device parameter 'IEEE Number Format' determines the order in which the data words of the data types 'float' and 'double' are interpreted. See also Parameter range – Communication on page 89. If the parameter is set to '1' (IEEE format deactivated), the data words of the data types 'float' and 'double' are sent in the standard Modbus format 'big endian'. Example: The value '5.525' is returned in hex as '40, 16, 19, 99, 99, 99, 99, 9A'. If the parameter is set to '0' (IEEE format activated), the data words of the data types 'float' and 'double' are sent in the format 'little endian' with the lowest value word first. Example: The value '5.525' is returned in hex as '99, 9A, 99, 99, 19, 99, 40, 16'.

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Available units

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

Note

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

Table 1: Units for the standard volume flow

Selection	Code	Description
m ³ /s	13	Cubic meters per second
m ³ /min	14	Cubic meters per minute
m ³ /h	15	Cubic meters per hour
m ³ /d	16	Cubic meters per day
ft ³ /s	29	Cubic feet per second
ft ³ /min	30	Cubic feet per minute
ft ³ /h	31	Cubic feet per hour
ft ³ /d	32	Cubic feet per day
l/s	48	Liters per second
l/min	49	Liters per minute
l/h	50	Liters per hour
l/d	51	Liters per day
xx/yy	254	User-defined unit

Table 2: Units for the mass flow

Selection	Code	Description
g/s	1	Grams per second
g/min	2	Grams per minute
g/h	3	Grams per hour
kg/s	5	Kilograms per second
kg/min	6	Kilograms per minute
kg/h	7	Kilograms per hour
kg/d	8	Kilograms per day
lb/s	9	Pounds (avdp) per second
lb/min	10	Pounds (avdp) per minute
lb/h	11	Pounds (avdp) per hour
lb/d	12	Pounds (avdp) per day
t/s	29	Metric tons per second
t/min	30	Metric tons per minute
t/h	31	Metric tons per hour
t/d	32	Metric tons per day
xx/yy	254	User-definable unit

Table 3: Standard density units

Selection	Code	Description
g/cm ³	1	Grams per cubic centimeter
g/m ³	3	Grams per cubic meter
kg/m ³	4	Kilograms per cubic meter
g/l	10	Grams per liter
kg/l	11	Kilograms per liter
lb/ft ³	13	Pounds (avdp) per cubic foot
xx/yy	254	User-definable unit

Table 4: Standard conditions

Code	Description
1	Temperature = 0 °C, pressure = 1.01325 bar
2	Temperature = 20 °C, pressure = 1.01325 bar
3	Temperature = 60°F, pressure = 1.01325 bar
4	Temperature = 70°F, pressure = 1.01325 bar
5	Temperature = 15°C, pressure = 1.01325 bar
6	Temperature = 20°C, pressure = 1.00000 bar
7	Temperature = 25°C, pressure = 1.00000 bar
8	Temperature = 25°C, pressure = 1.01325 bar
9	Temperature = 15°C, pressure = 1.00000 bar
254	User-defined standard conditions

Table 5: Temperature units

Selection	Code	Description
K	1	Kelvin
°C	2	Celsius
°F	3	Fahrenheit

Table 6: Length units

Selection	Code	Description
mm	4	Millimeters
inch	13	in.

Table 7: Units for the mass totalizer

Selection	Code	Description
kg	2	Kilograms
g	3	Grams
t	5	Tons (metric)
lb	8	Pounds (avdp)
xx	254	User-definable unit

Table 8: Units for the standard volume totalizer

Selection	Code	Description
m ³	4	Cubic meters
ft ³	7	Cubic feet
l	13	Liters
xx	254	User-definable unit

Table 9: Pressure units

Selection	Code	Description
Pa	1	Pascals
kPa	4	Kilopascals
Bar	8	Bar
mBar	9	Millibar
inH ² O@4C	51	Inches water column at 4 °C
mmH ² O@4C	54	mm water column at 4 °C
atm	64	Atmospheric gauge pressure
psi	65	Pounds per square inch
kp/cm ²	69	Kilogram-force per cm ²

Available gas types

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

Note

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

Table: Gas types for the ApplicationSelector

Name / Formula	Code		
	HEX	DEZ	
No selection	—	0	0
Air		1	1
Acetylene	C ₂ H ₂	1E	30
Acetone	C ₃ H ₆ O	24	36
Ammonia	NH ₃	27	39
Argon	Ar	2A	42
Biogas Type 1	—	30	48
1.2 Butadiene	C ₄ H ₆	3C	60
1.3 Butadiene	C ₄ H ₆	3F	63
1 Butene	C ₄ H ₈	42	66
Butane	C ₄ H ₁₀	45	69
Carbon dioxide	CO ₂	48	72
Carbon monoxide	CO	4B	75

Table: Gas types for the ApplicationSelector

Name / Formula	Code		
	HEX	DEZ	
Diketene	C ₄ H ₄ O ₂	66	102
Ethane	C ₂ H ₆	6C	108
Ethanol	C ₂ H ₅ OH	6F	111
Ethylene	C ₂ H ₄	72	114
Formaldehyde	CH ₂ O	75	117
Helium	He	78	120
Hexane	C ₆ H ₁₄	7B	123
Hydrogen	H ₂	84	132
Hydrogen sulfide	H ₂ S	87	135
Methane	CH ₄	90	144
Methanol	CH ₃ OH	93	147
MethylEthylKetone		96	150
Natural gas Type 1	—	99	153
Neon	Ne	AF	175
Nitrogen monoxide	NO	B2	178
Nitrogen	N ₂	B5	181
Oxygen	O ₂	BB	187
Ozone	O ₃	BE	190
Pentane	C ₅ H ₁₂	C1	193
Propadiene	C ₃ H ₄	CA	202
Propane	C ₃ H ₈	CD	205
Propene/Propylene	C ₃ H ₆	D0	208
Water vapor	H ₂ O	E8	232

Note

In the case of hydrogen and helium gas types as pure gas or as a component of a gas mixture with a concentration of over 10 %, an optional process gas calibration should always be additionally ordered.

That way, additional measuring errors due to the special characteristics of gases are avoided.

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Available process variables

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

Note

- Some of the process variables can be assigned to the digital outputs DO1 (terminals 41 / 42) and DO2 (terminals 51 / 52), configured as frequency [f] or pulse output [pulse].
(Code) indicates to which value the parameters 'Output Value Freq.' and 'Output Value Pulse' must be set. See also **Parameter range - Output** on page 85.
- The 'Modbus address' column indicates the Modbus register address, data type and the register length for the corresponding process variable.

Process variable	Short form	Description	DO1 / 2	DO1 / 2	Modbus address	
			[f] (Code)	[pulse] (Code)	TFLOAT [2]	TDOUBLE [4]
Mass Flow [unit]	Qm	Mass flow in the selected mass flow unit	–	X (1)	201	–
Mass Flow [%]	Qm	Mass flow in percent	X (1)	–	209	–
Volume Flow @ [unit]	Qv@	Standard volume flow in the selected volume unit	–	X (2)	205	–
Volume Flow @ [%]	Qv@	Standard volume flow in percent	X (2)	–	213	–
Temperature [unit]	Tm	Temperature in the selected standard volume unit	–	–	203	–
Temperature [%]	Tm	Temperature in percent	X (3)	–	211	–
Density @	p@	Standard density in the selected density unit	–	–	207	–
Totalizer Qm	Σm	Mass flow counter reading in the selected unit	–	–	215	409
Totalizer Qv @	Σv@	Standard volume flow counter reading in the selected unit	–	–	217	413
Current Batch Total*	CBT	Current fill quantity	–	–	219	405
Current Batch Counts*	CBC	Number of fill operations	–	–	3315	–
					TUSIGN32 [2]	

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

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

Application of the Health Indication Registers (Condensed Status Registers)

The OI_FMT230_250_EN_D has three 'Health indication registers' (Condensed Status Registers). The 'Health indication register 2104, 2105 and 2106 consist of 2 bytes, each containing 8 bits. Each bit represents an error.

The registers are structured as follows:

2104		2105		2106	
Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5
01234567	01234567	01234567	01234567	01234567	01234567
■	■			■	

■ = true (1) □ = false (0)

Figure 54: Health indication register (example)

The bit position is assigned to the errors in accordance with column 'Byte / Bit pos.' of the table in **Alarm status and alarm history status** on page 100.

The following assignment applies to the example in Figure 54:

Byte / Bit	Fault message
Byte 0 / Bit 3	Flowrate to zero
Byte 0 / Bit 5	All totalizer stopp.
Byte 4 / Bit 5	Medium temperat exceeds limits.

Using the scan register

The SensyMaster FMT230, FMT250 has two 'Scan Register' via which groups of parameters can be requested.

As a result, the parameters do not need to be requested individually and the bus load on the Modbus is reduced.

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

Configuration register

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

Scan Register

When read out, the Scan Register returns the values of the parameters that were entered in the configuration register. The scan register has a length of 32 holding registers that must be considered when entering addresses in the configuration register.

For example, a maximum of 32 addresses with a register length of [1] can be requested via the scan register.

Note

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

Restrictions

When using the Scan Registers, observe the following points:

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

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Design of the scan register (example)

Content of the configuration register (Config scan register)

Config scan register 1, register range address 3101 to 3132

Config scan register 2, register range address 3201 to 3232

Configuration register	Parameter address	Parameter descriptions
3101 / 3201	201	Mass flow in the selected mass flow unit (data type float, register length 2)
3102 / 3202	205	Volume flow in the selected volume unit (data type float, register length 2)
3103 / 3203	215	Mass flow counter reading in forward flow direction (data type float, register length 2)
3104 / 3204	217	Volume flow counter reading in forward flow direction (data type float, register length 2)
3105 / 3205	2104	Diagnosis State 0 (data type Usign 16, register length 1)
3106 / 3206	2105	Diagnosis State 1 (data type Usign 16, register length 1)
3107 / 3207	2106	Diagnosis State 2 (data type Usign 16, register length 1)
3108 / 3208	4013	Mass flow unit Qm (data type Usign 8, register length 1)
... / ...	0	Non-configured register spaces must be filled with FFF.
3132 / 3232	0	

Response following the scan register request

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

Scan register 1, register range address 1100 to 1199

Scan register 2, register range address 1200 to 1299

Configuration register	Register content
1101 / 1201	Mass flow (data type float, register length 2)
1102 / 1202	
1103 / 1203	Volume flow (data type float, register length 2)
1104 / 1204	
1105 / 1205	Mass flow counter reading in forward flow direction (data type float, register length 2)
1106 / 1206	
1107 / 1207	Volume flow counter reading in forward flow direction (data type float, register length 2)
1108 / 1208	
1109 / 1209	Diagnosis state 0 (data type Usign 16, register length 1)
1110 / 1210	Diagnosis state 1 (data type Usign 16, register length 1)
1111 / 1211	Diagnosis state 2 (data type Usign 16, register length 1)
1112 / 1212	Mass flow unit Qm (data type Usign 8, register length 1)
... / ...	Non-configured register spaces remain unpopulated.
1132 / 1232	

Parameter descriptions

Parameter range – Device Info

The parameterization of the device can be read out via the Modbus addresses listed here.

All Modbus addresses specified here are read only.

Modbus register address	Parameter name	Data type [register length] / value range	Description
... / Sensor			
3421	Sensor Location Tag	TCHAR [20]	Sensor measuring point tagging
3401	Sensor Tag	TCHAR [20]	Tag number of the sensor
2013	Sensor Element Type	TUSIGN8 [1] 0: Unknown 1: Standard ceramics 2: Ceramics high temperature design 3: Standard stainless steel 4: Hygienic stainless steel 5: Other	Sensor element type
2233	Sensor Length	TFLOAT [2]	Installation length of the sensor
2012	Feature Series	TUSIGN8 [1] 50: FMT230 60: FMT250 90: FMT410 100: FMT430 110: FMT450	Sensor model. Specific functions such as the filling function are available depending on the selection
3301	Sensor ID	TUSIGN32 [2]	ID number of the sensor.
2501	Sensor Serial No.	TCHAR [20]	Serial number of the sensor.
3303	Sensor Run Hours	TUSIGN32 [2]	Operating hours of the sensor.
... / Sensor / Calibration			
2016	First Cal. Date	TUSIGN8 [3]	Date of first calibration of sensor (calibration of new device).
2022	Last Cal. Date	TUSIGN8 [3]	Date of last calibration of sensor.
2521	Cal. Cert. No.	TCHAR [20]	Identification (number) of the relevant calibration certificate.
2541	First Cal. Location	TCHAR [20]	Place of first calibration of the sensor.
2561	Last Cal. Location	TCHAR [20]	Place of last calibration of sensor.
... / Sensor / ...Application Selector			
6081	Application	TUSIGN8 [1] 1: Application 1 ... 8: Application 8	Display of the selected application (type of measuring medium)

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Note

The numbers in brackets (1 to 8) in the Modbus register addresses correspond to the associated application 1 to 8.

Modbus register address (application)	Parameter name	Data type [register length] / value range	Description
... / Sensor / ...Application 1 ... 8			
3521 (1), 3553 (2), 3585 (3), 3617 (4), 3649 (5), 3681 (6), 3713 (7), 3745 (8)	Description	TCHAR [32]	Name of the application 1 to 8.
... / Sensor / ...Application 1 ... 8 / ...A1...Flow meas. – ...A8...Flow meas.			
2201 (1), 2203 (2), 2205 (3), 2207(4), 2209 (5), 2211 (6), 2213 (7), 2215 (8)	Qm Max. DN	TFLOAT [2]	Maximum mass flow for the selected nominal diameter.
7177 (1), 7223 (2), 7269 (3), 7315 (4), 7361 (5), 7407 (6), 7453 (7), 7499 (8)	Qm Max	TFLOAT [2]	Set measuring range, maximum mass flow
7179 (1), 7225 (2), 7271 (3), 7317 (4), 7363 (5), 7409 (6), 7455 (7), 7501 (8)	Qm Min	TFLOAT [2]	Set measuring range, minimum mass flow
2217 (1), 2219 (2), 2221 (3), 2223 (4), 2225 (5), 2227 (6), 2229 (7), 2231 (8)	Qv@ Max. DN	TFLOAT [2]	Maximum volume flow for the selected nominal diameter at Qm Max. DN.
7189 (1), 7235 (2), 7281 (3), 7327 (4), 7373 (5), 7419 (6), 7465 (7), 7511 (8)	Qv@ Max	TFLOAT [2]	Set measuring range, maximum standard volume flow
7191 (1), 7237 (2), 7283 (3), 7329 (4), 7375 (5), 7421 (6), 7467 (7), 7513 (8)	Qv@ Min	TFLOAT [2]	Set measuring range, minimum standard volume flow
7175 (1), 7221 (2), 7267 (3), 7313 (4), 7359 (5), 7405 (6), 7451 (7), 7497 (8)	Damping Q	TFLOAT [2]	Damping for flow measurement.
7181 (1), 7227 (2), 7273 (3), 7319 (4), 7365 (5), 7411 (6), 7457 (7), 7503 (8)	Low Flow Cut Off	TFLOAT [2]	Threshold to activate the low flow cut-off.
7183 (1), 7229 (2), 7275 (3), 7321 (4), 7367 (5), 7413 (6), 7459 (7), 7505 (8)	LowFlow Hysteresis	TFLOAT [2]	Hysteresis for low flow cut-off.

Modbus register address (application)	Parameter name	Data type [register length] / value range	Description
... / Sensor / ...Application 1 ... 8 / ...A1...Temp. meas. – ...A8...Temp. meas.			
7199 (1), 7245 (2), 7291 (3), 7337 (4), 7383 (5), 7429 (6), 7475 (7), 7521 (8)	Tm Max	TFLOAT [2]	Set measuring range, maximum measuring medium temperature.
7201 (1), 7247 (2), 7293 (3), 7339 (4), 7385 (5), 7431 (6), 7477 (7), 7523 (8)	Tm Min	TFLOAT [2]	Set measuring range, minimum measuring medium temperature.
7197 (1), 7243 (2), 7289 (3), 7335 (4), 7381 (5), 7427 (6), 7473 (7), 7519 (8)	Damping Tm	TFLOAT [2]	Damping for temperature measurement.
... / Sensor / ...Application 1 ... 8 / ...A1...Pipe type – ...A8...Pipe type			
6085 (1), 6086 (2), 6087 (3), 6088 (4), 6089 (5), 6090 (6), 6091 (7), 6092 (8)	Shape and probe pos.	TUSIGN8 [3] 220: round cross-section, sensor centered 235: round cross-section 245: rectangular cross-section	Piping form and sensor position.
7165 (1), 7211 (2), 7257 (3), 7303 (4), 7349 (5), 7395 (6), 7441 (7), 7487 (8)	Inside diameter	TFLOAT [2]	Inside diameter of the piping.
7165 (1), 7211 (2), 7257 (3), 7303 (4), 7349 (5), 7395 (6), 7441 (7), 7487 (8)	Duct inner height	TFLOAT [2]	Inside height of the channel with rectangular cross-section.
7169 (1), 7215 (2), 7261 (3), 7307 (4), 7353 (5), 7399 (6), 7445 (7), 7491 (8)	Insertion depth	TFLOAT [2]	Insertion depth of the sensor with regard to the inside diameter or the inside height. This parameter is relevant only if the sensor position is not centered.
7167 (1), 7213 (2), 7259 (3), 7305 (4), 7351 (5), 7397 (6), 7443 (7), 7489 (8)	Duct inner width	TFLOAT [2]	Inside width of the channel with rectangular cross-section.

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Modbus register address (application)	Parameter name	Data type [register length] / value range	Description
... / Sensor / ...Application 1 ... 8 / ...A1...Gas data – ...A8...Gas data			
7163 (1), 7209 (2), 7255 (3), 7301 (4), 7347 (5), 7393 (6), 7439 (7), 7485 (8)	Mean Operating Temp.	TFLOAT [2]	Average measuring medium temperature of the application.
7161 (1), 7207 (2), 7253 (3), 7299 (4), 7345 (5), 7391 (6), 7437 (7), 7483 (8)	Mean Operating Press	TFLOAT [2]	Average measuring medium pressure of the application.
6001 (1), 6011 (2), 6021 (3), 6031 (4), 6041 (5), 6051 (6), 6061 (7), 6071 (8)	Gas Type 1	TUSIGN8 [1] Refer to Available gas types on page 67.	Gas type and concentration for gas components 1 to 10 of a gas mix.
7001 (1), 7021 (2), 7041 (3), 7061 (4), 7081 (5), 7101 (6), 7121 (7), 7041 (8)	Concentr. Gas Type 1	TFLOAT[2] 10 to 100 %	
6002 (1), 6012 (2), 6022 (3), 6032 (4), 6042 (5), 6052 (6), 6062 (7), 6072 (8)	Gas Type 2	TUSIGN8 [1]	
7003 (1), 7023 (2), 7043 (3), 7063 (4), 7083 (5), 7103 (6), 7123 (7), 7043 (8)	Concentr. Gas Type 2	TFLOAT[2] 0 to 50 %, depending on residual quantity	
6003 (1), 6013 (2), 6023 (3), 6033 (4), 6043 (5), 6053 (6), 6063 (7), 6073 (8)	Gas Type 3	TUSIGN8 [1]	
7005 (1), 7025 (2), 7045 (3), 7065 (4), 7085 (5), 7105 (6), 7125 (7), 7045 (8)	Concentr. Gas Type 3	TFLOAT[2] 0 to 33.33 %, depending on residual quantity	
6004 (1), 6014 (2), 6024 (3), 6034 (4), 6044 (5), 6054 (6), 6064 (7), 6074 (8)	Gas Type 4	TUSIGN8 [1]	
7007 (1), 7027 (2), 7047 (3), 7067 (4), 7087 (5), 7107 (6), 7127 (7), 7047 (8)	Concentr. Gas Type 4	TFLOAT[2] 0 to 25 %, depending on residual quantity	
6005 (1), 6015 (2), 6025 (3), 6035 (4), 6045 (5), 6055 (6), 6065 (7), 6075 (8)	Gas Type 5	TUSIGN8 [1]	
7009 (1), 7029 (2), 7049 (3), 7069 (4), 7089 (5), 7109 (6), 7129 (7), 7049 (8)	Concentr. Gas Type 5	TFLOAT[2] 0 to 20 %, depending on residual quantity	

Modbus register address (application)	Parameter name	Data type [register length] / value range	Description
6006 (1), 6016 (2), 6026 (3), 6036 (4), 6046 (5), 6056 (6), 6066 (7), 6076 (8)	Gas Type 6	TUSIGN8 [1]	Gas type and concentration for gas components 1 to 10 of a gas mix.
7011 (1), 7031 (2), 7051 (3), 7071 (4), 7091 (5), 7111 (6), 7131 (7), 7051 (8)	Concentr. Gas Type 6	TFLOAT[2] 0 to 16.67 %, depending on residual quantity	
6007 (1), 6017 (2), 6027 (3), 6037 (4), 6047 (5), 6057 (6), 6067 (7), 6077 (8)	Gas Type 7	TUSIGN8 [1]	
7013 (1), 7033 (2), 7053 (3), 7073 (4), 7093 (5), 7113 (6), 7133 (7), 7053 (8)	Concentr. Gas Type 7	TFLOAT[2] 0 to 14.29 %, depending on residual quantity	
6008 (1), 6018 (2), 6028 (3), 6038 (4), 6048 (5), 6058 (6), 6068 (7), 6078 (8)	Gas Type 8	TUSIGN8 [1]	
7015 (1), 7035 (2), 7055 (3), 7075 (4), 7095 (5), 7115 (6), 7135 (7), 7055 (8)	Concentr. Gas Type 8	TFLOAT[2] 0 to 12.5 %, depending on residual quantity	
6009 (1), 6019 (2), 6029 (3), 6039 (4), 6049 (5), 6059 (6), 6069 (7), 6079 (8)	Gas Type 9	TUSIGN8 [1]	
7017 (1), 7037 (2), 7057 (3), 7077 (4), 7097 (5), 7117 (6), 7137 (7), 7057 (8)	Concentr. Gas Type 9	TFLOAT[2] 0 to 11.11 %, depending on residual quantity	
6010 (1), 6010 (2), 6030 (3), 6040 (4), 6050 (5), 6060 (6), 6070 (7), 6080 (8)	Gas Type 10	TUSIGN8 [1]	
7019 (1), 7039 (2), 7059 (3), 7079 (4), 7099 (5), 7119 (6), 7139 (7), 7059 (8)	Concentr. Gas Type 10	TFLOAT[2] 0 to 10 %, depending on residual quantity	
... / Sensor / ...Application 1 ... 8 / ...A2...Field Optim. – ...A8...Field Optim.			
7171 (1), 7217 (2), 7263 (3), 7309 (4), 7355 (5), 7401 (6), 7447 (7), 7493 (8)	Offset Qm	TFLOAT [2]	Offset correction of the flow rate measured value.
7173 (1), 7219 (2), 7265 (3), 7311 (4), 7357 (5), 7403 (6), 7449 (7), 7495 (8)	Corr.Factor Qm	TFLOAT [2]	Correction factor for the flow measured value.

... 9 Commissioning and operation

... Interface description

Modbus register address	Parameter name	Data type [register length] / value range	Description
... / ...Transmitter			
2011	Transmitter Type	TUSIGN8 [1] 4: FMT2xx	Display of the transmitter type.
3305	Transmitter ID	TUSIGN32 [2]	ID number of transmitter.
2581	Transm.Serial No.	TCHAR [20]	Order number of the transmitter.
3307	Transm. Run Hours	TUSIGN32 [2]	Operating hours of the transmitter (frontend board).
2110	Tx Restart Counter	TUSIGN16 [1]	Number of device restarts (switching the power supply off and on).
3309	Time since Restart	TUSIGN32 [2]	Device operating hours since the last restart.
2028	FillMass On/Off	TUSIGN8 [1] 0: Off 1: On	FillMass function present? 0 - Off: No FillMass function present. 1 - On: FillMass function present.
2029	VeriMass On/Off	TUSIGN8 [1] 0: Off 1: On	VeriMass function present? 0 - Off: No VeriMass function present. 1 - On: VeriMass function present.
2661	Manufacturer	TUSIGN8 [20]	Name of manufacturer.
2681	Street	TUSIGN8 [20]	Manufacturer's address (street)
2701	City	TUSIGN8 [20]	Manufacturer's address (city)
2721	Phone	TUSIGN8 [20]	Manufacturer's address (phone number)
... / ...Transmitter / ...Transmitter Version			
2001	FW Device Ver.	TUSIGN8 [3]	Firmware version package
2004	FW Frontend Ver.	TUSIGN8 [3]	Firmware version frontend board
2101	FW Frontend CRC	TUSIGN16 [1]	Checksum firmware frontend board
2007	HW Frontend Ver.	TUSIGN8 [1]	Hardware version frontend board
2008	Bootloader FEB Ver.	TUSIGN8 [3]	Bootloader version frontend board
... / ...Transmitter / Calibration			
2019	First Cal. Date	TUSIGN8 [3]	Date of first calibration of transmitter (calibration of new device).
2025	Last Cal. Date	TUSIGN8 [3]	Date of last calibration of transmitter.
2601	Cal. Cert. No.	TCHAR [20]	Identification (no.) of the relevant calibration certificate.
2621	First Cal. Location	TCHAR [20]	Place of first calibration of transmitter.
2641	Last Cal. Location	TCHAR [20]	Place of last calibration of transmitter.

Parameter range – Device Setup

Modbus register address	Parameter name	Data type [register length] / value range	Description
... / Access Control			
11	Read Only Switch	TUSIGN8 [1] 0: Off 1: On	Indicator of the position of the write protection switch. See also Write-protect switch on page 53. This parameter is read only.
... / Sensor			
3421	Sensor Location Tag	TCHAR [20]	Set the measuring point tagging for the sensor.
3401	Sensor Tag	TCHAR [20]	Set the TAG number of the sensor.
... / Sensor / ...Application Selector			
6081	Dig.In 0 Application	TUSIGN8 [1]	Display of the application assignment to the optional digital inputs.
6082	Dig.In 1 Application	1: Application 1	
6083	Dig.In 2 Application	...	
6084	Dig.In1+2Application	8: Application 8	

... 9 Commissioning and operation

... Interface description

Note

The numbers in brackets (1 to 8) in the Modbus register addresses correspond to the associated application 1 to 8.

Modbus register address (application)	Parameter name	Data type [register length] / value range	Description
... / Sensor / ...Application 1 ... 8			
3521 (1), 3553 (2), 3585 (3), 3617 (4), 3649 (5), 3681 (6), 3713 (7), 3745 (8)	Description	TCHAR [32]	Enter the name of the application 1 to 8.
... / Sensor / ...Application 1 ... 8 / ...A1...Flow meas. – ...A8...Flow meas.			
2201 (1), 2203 (2), 2205 (3), 2207(4), 2209 (5), 2211 (6), 2213 (7), 2215 (8)	Qm Max. DN	TFLOAT [2]	Maximum mass flow for the selected nominal diameter. This parameter is read only
7177 (1), 7223 (2), 7269 (3), 7315 (4), 7361 (5), 7407 (6), 7453 (7), 7499 (8)	Qm Max	TFLOAT [2]	Set the measuring range, maximum mass flow.
7179 (1), 7225 (2), 7271 (3), 7317 (4), 7363 (5), 7409 (6), 7455 (7), 7501 (8)	Qm Min	TFLOAT [2]	Set the measuring range, minimum mass flow.
2217 (1), 2219 (2), 2221 (3), 2223 (4), 2225 (5), 2227 (6), 2229 (7), 2231 (8)	Qv@ Max. DN	TFLOAT [2]	Maximum volume flow for the selected nominal diameter at Qm Max. DN. This parameter is read only
7189 (1), 7235 (2), 7281 (3), 7327 (4), 7373 (5), 7419 (6), 7465 (7), 7511 (8)	Qv@ Max	TFLOAT [2]	Set the measuring range, maximum standard volume flow.
7191 (1), 7237 (2), 7283 (3), 7329 (4), 7375 (5), 7421 (6), 7467 (7), 7513 (8)	Qv@ Min	TFLOAT [2]	Set the measuring range, minimum standard volume flow.
7175 (1), 7221 (2), 7267 (3), 7313 (4), 7359 (5), 7405 (6), 7451 (7), 7497 (8)	Damping Q	TFLOAT [2]	Set the damping for flow measurement.
7181 (1), 7227 (2), 7273 (3), 7319 (4), 7365 (5), 7411 (6), 7457 (7), 7503 (8)	Low Flow Cut Off	TFLOAT [2]	Set the threshold to activate the low flow cut-off.
7183 (1), 7229 (2), 7275 (3), 7321 (4), 7367 (5), 7413 (6), 7459 (7), 7505 (8)	LowFlow Hysteresis	TFLOAT [2]	Set the hysteresis for the low flow cut off.

Modbus register address (application)	Parameter name	Data type [register length] / value range	Description
... / Sensor / ...Application 1 ... 8 / ...A1...Temp. meas. – ...A8...Temp. meas.			
7199 (1), 7245 (2), 7291 (3), 7337 (4), 7383 (5), 7429 (6), 7475 (7), 7521 (8)	Tm Max	TFLOAT [2]	Set the measuring range, maximum measuring medium temperature.
7201 (1), 7247 (2), 7293 (3), 7339 (4), 7385 (5), 7431 (6), 7477 (7), 7523 (8)	Tm Min	TFLOAT [2]	Set the measuring range, minimum measuring medium temperature.
7197 (1), 7243 (2), 7289 (3), 7335 (4), 7381 (5), 7427 (6), 7473 (7), 7519 (8)	Damping Tm	TFLOAT [2]	Set the damping for temperature measurement.
... / Sensor / ...Application 1 ... 8 / ...A1...Pipe type – ...A8...Pipe type			
6085 (1), 6086 (2), 6087 (3), 6088 (4), 6089 (5), 6090 (6), 6091 (7), 6092 (8)	Shape and probe pos.	TUSIGN8 [1] 220: round cross-section, sensor centered 235: round cross-section 245: rectangular cross-section	Select the piping form and sensor position.
7165 (1), 7211 (2), 7257 (3), 7303 (4), 7349 (5), 7395 (6), 7441 (7), 7487 (8)	Inside diameter	TFLOAT [2]	Set the inside diameter of the piping.
7165 (1), 7211 (2), 7257 (3), 7303 (4), 7349 (5), 7395 (6), 7441 (7), 7487 (8)	Duct inner height	TFLOAT [2]	Set the inside height of the channel with rectangular cross-section.
7169 (1), 7215 (2), 7261 (3), 7307 (4), 7353 (5), 7399 (6), 7445 (7), 7491 (8)	Insertion depth	TFLOAT [2]	Set the insertion depth of the sensor with regard to the inside diameter or the inside height. This parameter is relevant only if the sensor position is not centered.
7167 (1), 7213 (2), 7259 (3), 7305 (4), 7351 (5), 7397 (6), 7443 (7), 7489 (8)	Duct inner width	TFLOAT [2]	Set the inside width of the channel with rectangular cross-section.

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Modbus register address (application)	Parameter name	Data type [register length] / value range	Description
... / Sensor / ...Application 1 ... 8 / ...A1...Gas data – ...A8...Gas data			
7163 (1), 7209 (2), 7255 (3), 7301 (4), 7347 (5), 7393 (6), 7439 (7), 7485 (8)	Mean Operating Temp.		Set the average measuring medium temperature of the application.
7161 (1), 7207 (2), 7253 (3), 7299 (4), 7345 (5), 7391 (6), 7437 (7), 7483 (8)	Mean Operating Press		Set the average measuring medium pressure of the application.
6001 (1), 6011 (2), 6021 (3), 6031 (4), 6041 (5), 6051 (6), 6061 (7), 6071 (8)	Gas Type 1	TUSIGN8 [1] See table Available gas types on page 67.	Gas type and concentration for gas components 1 ... 10 of a gas mix.
7001 (1), 7021 (2), 7041 (3), 7061 (4), 7081 (5), 7101 (6), 7121 (7), 7041 (8)	Concentr. Gas Type 1		
6002 (1), 6012 (2), 6022 (3), 6032 (4), 6042 (5), 6052 (6), 6062 (7), 6072 (8)	Gas Type 2		
7003 (1), 7023 (2), 7043 (3), 7063 (4), 7083 (5), 7103 (6), 7123 (7), 7043 (8)	Concentr. Gas Type 2		The value range depends on the concentration of gas types with a smaller index. Maximum 0 ... 50 %
6003 (1), 6013 (2), 6023 (3), 6033 (4), 6043 (5), 6053 (6), 6063 (7), 6073 (8)	Gas Type 3		
7005 (1), 7025 (2), 7045 (3), 7065 (4), 7085 (5), 7105 (6), 7125 (7), 7045 (8)	Concentr. Gas Type 3		The value range depends on the concentration of gas types with a smaller index. Maximum 0 ... 33.33 %.
6004 (1), 6014 (2), 6024 (3), 6034 (4), 6044 (5), 6054 (6), 6064 (7), 6074 (8)	Gas Type 4		
7007 (1), 7027 (2), 7047 (3), 7067 (4), 7087 (5), 7107 (6), 7127 (7), 7047 (8)	Concentr. Gas Type 4		The value range depends on the concentration of gas types with a smaller index. Maximum 0 ... 25 %.
6005 (1), 6015 (2), 6025 (3), 6035 (4), 6045 (5), 6055 (6), 6065 (7), 6075 (8)	Gas Type 5		
7009 (1), 7029 (2), 7049 (3), 7069 (4), 7089 (5), 7109 (6), 7129 (7), 7049 (8)	Concentr. Gas Type 5		The value range depends on the concentration of gas types with a smaller index. Maximum 0 ... 20 %

Modbus register address (application)	Parameter name	Data type [register length] / value range	Description
6006 (1), 6016 (2), 6026 (3), 6036 (4), 6046 (5), 6056 (6), 6066 (7), 6076 (8)	Gas Type 6		Gas type and concentration for gas components 1 ... 10 of a gas mix.
7011 (1), 7031 (2), 7051 (3), 7071 (4), 7091 (5), 7111 (6), 7131 (7), 7051 (8)	Concentr. Gas Type 6		The value range depends on the concentration of gas types with a smaller index. Maximum 0 ... 16.67 %.
6007 (1), 6017 (2), 6027 (3), 6037 (4), 6047 (5), 6057 (6), 6067 (7), 6077 (8)	Gas Type 7		
7013 (1), 7033 (2), 7053 (3), 7073 (4), 7093 (5), 7113 (6), 7133 (7), 7053 (8)	Concentr. Gas Type 7		The value range depends on the concentration of gas types with a smaller index. Maximum 0 ... 14.29 %.
6008 (1), 6018 (2), 6028 (3), 6038 (4), 6048 (5), 6058 (6), 6068 (7), 6078 (8)	Gas Type 8		
7015 (1), 7035 (2), 7055 (3), 7075 (4), 7095 (5), 7115 (6), 7135 (7), 7055 (8)	Concentr. Gas Type 8		The value range depends on the concentration of gas types with a smaller index. Maximum 0 ... 12.5 %
6009 (1), 6019 (2), 6029 (3), 6039 (4), 6049 (5), 6059 (6), 6069 (7), 6079 (8)	Gas Type 9		
7017 (1), 7037 (2), 7057 (3), 7077 (4), 7097 (5), 7117 (6), 7137 (7), 7057 (8)	Concentr. Gas Type 9		The value range depends on the concentration of gas types with a smaller index. Maximum 0 ... 11.11 %
6010 (1), 6010 (2), 6030 (3), 6040 (4), 6050 (5), 6060 (6), 6070 (7), 6080 (8)	Gas Type 10		
7019 (1), 7039 (2), 7059 (3), 7079 (4), 7099 (5), 7119 (6), 7139 (7), 7059 (8)	Concentr. Gas Type 10		The value range depends on the concentration of gas types with a smaller index. Maximum 0 ... 10 %
... / Sensor / ...Application 1 ... 8 / ...A2...Field Optim. – ...A8...Field Optim.			
7171 (1), 7217 (2), 7263 (3), 7309 (4), 7355 (5), 7401 (6), 7447 (7), 7493 (8)	Offset Qm	TFLOAT [2]	Offset correction of the flow rate measured value.
7173 (1), 7219 (2), 7265 (3), 7311 (4), 7357 (5), 7403 (6), 7449 (7), 7495 (8)	Corr.Factor Qm	TFLOAT [2]	Correction factor for the flow measured value.

... 9 Commissioning and operation

... Interface description

Modbus register address	Parameter name	Data type [register length] / value range	Description
... / ...Transmitter			
3461	TX Location TAG	TUSIGN8 [20] Alphanumeric, maximum 20 characters	Enter the measuring point tagging for the transmitter.
3441	TX TAG	TUSIGN8 [20] Alphanumeric, maximum 20 characters	Enter the TAG number for the transmitter.
9011	Perform Device Reset	ACTION [1]	Restarts the device. Compensates for a short interruption of the power supply.
4110	Restore Factory Def.	ACTION [1]	All user-accessible parameters will be reset to the factory default settings.
... / ...Transmitter / ...Feature Settings			
2028	FillMass On/Off	TUSIGN8 [1] 0: Off 1: On	FillMass function present? Off: No FillMass function present. On: FillMass function present.
3233	FillMass Code	TUSIGN16 [1] 0x0000 ... 0xFFFF	Sets the device-specific code for activating the FillMass function. To use this function subsequently, contact the ABB service team or sales organization.
2029	VeriMass On/Off	TUSIGN8 [1] 0: Off 1: On	VeriMass function present? Off: No VeriMass function present. On: VeriMass function present.
3234	VeriMass Code	TUSIGN16 [1] 0x0000 ... 0xFFFF	Sets the device-specific code for activating the VeriMass function. To use this function subsequently, contact the ABB service team or sales organization.

Modbus register address	Parameter name	Data type [register length] / value range	Description
... / ...Transmitter / ...Units			
4013	Unit Massflow Qm	TUSIGN8 [1] Refer to Table 2: Units for the mass flow on page 66.	Selection of unit for mass flow (e.g. for the associated parameters and the corresponding process values).
4014	Mass Totalizer	TUSIGN8 [1] Refer to Table 7: Units for the mass totalizer on page 66.	Selection of the unit for the mass counters and the pulse outputs.
4015	Volume flow Qv	TUSIGN8 [1] Refer to Table 1: Units for the standard volume flow on page 66.	Selection of unit for standard volume flow (e.g. for the associated parameters and the corresponding process values).
4016	Volume Totalizer	TUSIGN8 [1] Refer to Table 8: Units for the standard volume totalizer on page 67.	Selection of the unit for the standard volume totalizer and the pulse outputs.
4018	Std. Conditions Vol@	TUSIGN8 [1] Refer to Table 4: Standard conditions on page 66.	Set the standard state for calculation of the standard volume flow and standard volume counter.
5075	Special Cond. fact.	TFLOAT [2]	Enter the factor by which the standard state 0 °C 1 atm is multiplied to define an individual standard state.
3497	Volumeflow Qv@ Name	TCHAR [8] Alphanumeric, maximum 7 characters	Enter a name for the standard volume flow. If the first character is a space, the standard notation is used.
3505	Volume@ Tot. Name	TCHAR [8] Alphanumeric, maximum 7 characters	Enter a name for the standard volume counter. If the first character is a space, the standard notation is used.
4017	Unit Temperature	TUSIGN8 [1] Refer to Table 5: Temperature units on page 66.	Selection of the unit for the temperature (for example for the associated parameters and the corresponding process values).
4020	Pressure	TUSIGN8 [1] Refer to Table 9: Pressure units on page 67.	Selection of the unit for the pressure (for example for the associated parameters and the corresponding process values).
4019	Length	TUSIGN8 [1] Refer to Table 6: Length units on page 66.	Selection of the unit for length (e.g. for the associated parameters and the corresponding process values).
4021	Density@	TUSIGN8 [1] Refer to Table 3: Standard density units on page 66.	Selection of the unit for density (e.g. for the associated parameters and the corresponding process values).
3513	Density@ Name	TCHAR [8] Alphanumeric, maximum 7 characters	Enter a name for standard density. If the first character is a space, the standard notation is used.

... 9 Commissioning and operation

... Interface description

Modbus register address	Parameter name	Data type [register length] / value range	Description
... / ...Transmitter / ...Custom Units			
3481	Mass flow Qm Name	TCHAR [8] Alphanumeric, maximum 7 characters	Enter a name for the user-defined unit Qm.
5071	Mass flow Qm Factor	TFLOAT [2] 0.0001 ... 100,000 kg/s	Set the factor in kg/h for the user-defined unit Qm.
3489	Mass Tot. Name	TCHAR [8] Alphanumeric, maximum 7 characters	Enter the name of the unit for the user-defined mass counter.
5059	Mass Tot. Factor	TFLOAT [2] 0.0001 ... 100,000 kg	Sets the factor of the unit for the user-defined mass counter.
3497	Volumeflow Qv@ Name	TCHAR [8] Alphanumeric, maximum 7 characters	Enter a name for the user-defined unit Qv@.
5073	Volumeflow Qv@ Fact.	TFLOAT [2] 0.0001 ... 100000 m ³ /s@	Set the factor in m ³ /h for the user-defined unit Qv@.
3505	Volume@ Tot. Name	TCHAR [8] Alphanumeric, maximum 7 characters	Enter the name of the user-defined counter unit for standard volume flow
5063	Volume@ Tot. Factor	TFLOAT [2] 0.0001 ... 100000 m ³ in standard conditions	Enter the factor for the user-defined totalizer unit for standard volume flow.
3513	Density@ Name	TCHAR [8] Alphanumeric, maximum 7 characters	Enter a name for the user-defined standard density unit.
5067	Density@ Factor	TFLOAT [2] 0.0001 ... 100000 g/cm ³	Set the factor in kg/m ³ for the user-defined unit standard density.

Parameter range - Output

Modbus register address	Parameter name	Data type [register length] / value range	Description
... / ...Dig.Out 41/42			
4043	Mode	TUSIGN8 [1] 0: Off 1: Pulse output 2: Frequency output 3: Binary output	Selection of the operating mode for the digital output 41 / 42. <ul style="list-style-type: none"> Off: Digital output deactivated. Binary: Digital output functions as binary output (for function, see the parameter 'Signal Source Binary'). Pulse: Digital output functions as pulse output (for process value, see the parameter „Signal Source Pulse“). In pulse mode, pulses per unit are output (e.g. 1 pulse per m3). Frequency: Digital output functions as frequency output (for process value see the parameter „Signal Source Freq.“). In frequency mode, a frequency proportional to the flow rate is given as output.
... / ...Dig.Out 41/42 / ...Puls.Out 41/42			
The following parameters are only available if the digital output 41 / 42 has been configured as a pulse output.			
4026	Signal Source Pulse	TUSIGN8 [1] 1: Mass Flow 2: Volume Flow@	Selection of the process value issued via the pulse output.
5027	Quantity Pulses	TFLOAT [2] 0.001 to 100,000 pulses	Set the pulses per mass unit or volume unit (see table) for the pulse output.
5031	Quantity Mass orQuantity Volume@	TFLOAT [2]	The pulse value is a result of the ratio of “Quantity Pulses” per “Quantity Mass” or “Quantity Pulses” per “Quantity Volume@”.
5029	Pulse Width	TFLOAT [2] 0.05 to 2000 ms	Set the pulse width (low signal) for the pulse output. The parameter directly limits the maximum possible output rate of pulses, e.g. max. 500 pulses/sec at 1 ms. If the calculation of the current output rate leads to an up-scale, the pulses are buffered and output with a delay.
... / ...Dig.Out 41/42 / ...Freq.Out 41/42			
The following parameters are only available if the digital output 41 / 42 has been configured as a frequency output.			
4022	Signal Source Freq.	TUSIGN8 [1] 1: Mass Flow [%] 2: Volume Flow@ [%] 3: Temperature [%]	Selection of the process value issued via the frequency output.
5023	Upper Range Value	TFLOAT [2] 0 to 10000 Hz	Sets the frequency for the upper range value. The entered value corresponds to 100 %.
5025	Lower Range Value	TFLOAT [2] 0 to 10000 Hz	Set the frequency for the lower range value. The entered value corresponds to 0 %.

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... Interface description

Modbus register address	Parameter name	Data type [register length] / value range	Description
... / ...Dig.Out 41/42 / ...Binary Out 41/42			
The following parameters are only available if the digital output 41 / 42 has been configured as a binary output.			
4024	Signal Source Binary	TUSIGN8 [1] 2: Alarm signal 4: End contact fill function	Selection of binary output function. <ul style="list-style-type: none"> Alarm signal: the binary output functions as an alarm output. The alarm type is selected with the parameters „...Alarm Cfg. 41/42“. End contact fill function: the binary output is activated when the set fill quantity is reached (only if the FillMass function is activated).
4045	Active Mode	TUSIGN8 [1] 0: Active high (closed) 1: Active low (open)	Select switching properties for the binary output.
... / ...Dig.Out 41/42 / ...Alarm Cfg. 41/42			
4029	General Alarm	TUSIGN8 [1]	Selection of error messages signaled via the binary output 41 / 42.
4030	Qm Massflow Max	0: Off	Only if the parameter „Signal Source Binary“ has been set to 2 - Alarm signal.
4031	Qm Massflow Min	1: On	
4032	Qv@ Volumeflow Max		
4033	Qv@ Volumeflow Min		
4027	Tm Temperature Max		
4028	Tm Temperature Min		
4034	Sensor Soiling		
... / ...Dig.Out 51/52			
4044	Mode	TUSIGN8 [1] 0: Off 1: Binary output 2: Frequency output 5: 90° phase rotation 6: 180° phase rotation	Selection of the operating mode for the digital output 51 / 52. The operating modes 'Follow DO1', '90°' and '180°' are only available if digital output 41 / 42 has been configured as a pulse output. <ul style="list-style-type: none"> Off: Digital output deactivated. Binary: Digital output functions as binary output (for function, see the parameter 'Signal Source Binary'). Frequency: Digital output functions as frequency output (for process value see the parameter 'Signal Source Freq.'). In frequency mode, a frequency proportional to the flow rate is given as output. 90° phase rotation: 90° phase rotation of output of the same pulses as for digital output 41 / 42. 180° phase rotation: 180° phase rotation of output of the same pulses as for digital output 41 / 42.

Modbus register address	Parameter name	Data type [register length] / value range	Description
... / ...Dig.Out 51/52 / ...Freq.Out 51/52			
The following parameters are only available if the digital output 51 / 52 has been configured as a frequency output.			
4023	Signal Source Freq.	TUSIGN8 [1] 1: Mass Flow [%] 2: Volume Flow@ [%] 3: Temperature [%]	Selection of the process value issued via the frequency output.
5033	Upper Range Value	TFLOAT 0 to 10000 Hz	Sets the frequency for the upper range value. The entered value corresponds to 100 %.
5035	Lower Range Value	TFLOAT 0 to 10000 Hz	Set the frequency for the lower range value. The entered value corresponds to 0 %.
... / ...Dig.Out 51/52 / ...Binary Out 51/52			
The following parameters are only available if the digital output 51 / 52 has been configured as a binary output.			
4025	Signal Source Binary	TUSIGN8 [1] 2: Alarm signal 4: End contact fill function	Selection of binary output function. <ul style="list-style-type: none"> Alarm signal: the binary output functions as an alarm output. The alarm type is selected with the parameters '...Alarm Cfg. 51/52'. End contact fill function: the binary output is activated when the set fill quantity is reached (only if the FillMass function is activated).
4046	Active Mode	TUSIGN8 [1] 0: Active high (closed) 1: Active low (open)	Select switching properties for the binary output.
... / Dig.Out 51 / 52 / Alarm Config			
4037	General Alarm	TUSIGN8 [1]	Selection of error messages signaled via the binary output 51 / 52.
4038	Qm Massflow Max	0: Off	Only if the parameter 'Signal Source Binary' has been set to 2 - Alarm signal.
4039	Qm Massflow Min	1: On	
4040	Qv@ Volumeflow Max		
4041	Qv@ Volumeflow Min		
4035	Tm Temperature Max		
4036	Tm Temperature Min		
4042	Sensor Soiling		

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... Interface description

Parameter range – Process Alarm

Modbus register address	Parameter name	Data type [register length] / value range	Description
0 to 95	Diagnosis register	TUSIGN8 [1]	Display of the alarm history. See also chapter Alarm status and alarm history status on page 100. The addresses indicated here are read only.
9012	Clear Alarm History	ACTION [1]	The writing of any value deletes the alarm history saved in the device.
... / ...Group Masking			
4069	Maintenance Required	TUSIGN8 [1]	Alarm messages are divided into groups. If masking is activated for a group (On), no alarm occurs. For more detailed information, see chapter Diagnosis / error messages on page 98.
4068	Function Check	0 - Masking deactivated	
4070	Out Of Specification	1 - Masking activated	
... / ...Alarm Limits / ...Application 1			
... / ...Alarm Limits / ...Application 8			
The numbers in brackets (1 to 8) in the Modbus register addresses correspond to the associated application 1 to 8.			
7187 (1), 7233 (2), 7279 Qm Massflow Min (3), 7325 (4), 7371 (5), 7417 (6), 7463 (7), 7509 (8)		TFLOAT [2] 0 to 110 % Factory setting: 0 %	Setting of the alarm limits for the mass flow. If the standard volume flow up-scales or down-scales the values set in the parameters 'Qm Massflow Min' and 'Qm Massflow Max,' error message no. 1 'Mass flow too high / low' is generated.
7185 (1), 7231 (2), 7277 Qm Massflow Max (3), 7323 (4), 7369 (5), 7415 (6), 7461 (7), 7507 (8)		TFLOAT [2] 0 to 130 % Factory setting: 110 %	
7195 (1), 7241 (2), 7287 Qv@ Volumeflow Min (3), 7333 (4), 7379 (5), 7425 (6), 7471 (7), 7517 (8)		TFLOAT [2] 0 to 110 % Factory setting: 0 %	Setting of the alarm limits for the volume flow. If the volume flow up-scales or down-scales the values set in the parameters 'Qv@ Volumeflow Min' and 'Qv@ Volumeflow Max,' error message no. 2 'Volume flow too high / low' is generated.
7193 (1), 7239 (2), 7285 Qv@ Volumeflow Max (3), 7331 (4), 7377 (5), 7423 (6), 7469 (7), 7515 (8)		TFLOAT [2] 0 to 130 % Factory setting: 110 %	
7205 (1), 7251 (2), 7297 Tm Min (3), 7343 (4), 7389 (5), 7435 (6), 7481 (7), 7527 (8)		TFLOAT [2] -100 to 250 °C Factory setting: -20 °C	Setting of the alarm limits for the measuring medium temperature. If the measuring medium temperature up-scales or down-scales the values set in the parameters 'Tm Min' and 'Tm Max,' error message no. 38 'Sensor temperature too high / low' is generated.
7203 (1), 7249 (2), 7295 (3), 7341 (4), 7387 (5), 7433 (6), 7479 (7), 7525 (8)	Tm Max	TFLOAT [2] -50 to 300 °C Factory setting: 200 °C	

Parameter range – Communication

Modbus register address	Parameter name	Data type [register length] / value range	Description
... / ...Modbus			
4007	Device Address	TUSIGN8 [1] 1 to 247	Setting of the Modbus device address. Factory settings: see Parameterization via the Modbus interface on page 54.
4012	IEEE Number Format	TUSIGN8 [1] 0: IEEE-format activated 1: IEEE-format disabled	Selection of the byte order for the Modbus communication. <ul style="list-style-type: none"> If the IEEE format is activated (1), the data words are sent in the 'little-endian' format, with the lowest value word transmitted first. If the IEEE format is deactivated (0), the data words are sent in the standard Modbus 'big-endian' format. Factory setting: IEEE format activated.
4008	Baud Rate	TUSIGN8 [1] 0: 2400 Bd 1: 4800 Bd 2: 9600 Bd 3: 19200 Bd 4: 38400 Bd 5: 56000 Bd 6: 57600 Bd 7: 115200 Bd	Selection of the transmission speed (baud rate) for the Modbus communication. Factory setting: 9600 baud.
4009	Parity	TUSIGN8 [1] 0: None 1: Even 2: Odd	Selection of the parity for the Modbus communication. Factory setting: Odd (odd)
4010	Stop Bits	TUSIGN8 [1] 0: One stop bit 1: Two stop bits	Selection of the stop bits for the Modbus communication. Factory setting: One stop bit
4011	Reponse Delay	TUSIGN8 [1] 0 to 200 ms	Setting of the pause time in milliseconds after receiving a Modbus command. The device sends a response no earlier than expiration of the set pause time. Factory setting: 10 ms

... 9 Commissioning and operation

... Interface description

Parameter range – Diagnostics

Modbus register address	Parameter name	Data type [register length] / value range	Description
... / ...Diagnosis Control			
3313	Preset Maint. cycle	TUSIGN32 [2] 0 to 99999 h	Sets the service interval. After the maintenance interval has expired, the corresponding error message 'Maintenance interval is reached' is set. The setting '0' deactivates the maintenance interval. Factory setting: 0 h
3311	Maint. Remain. Time	TUSIGN32 [2]	Time remaining in the maintenance interval until the error message 'Maintenance interval is reached' is set. The parameter is read only.
9001	Start New Cycle	ACTION [1]	Resetting of the maintenance interval. By writing any value to this address, the maintenance interval is reset to the value set under 'Preset Maint. cycle'.
... / ...Diagnosis Values			
247	Gas Temperature	TFLOAT [2]	Output of current meter tube temperature in °C. The parameter is read only.
223	Transmitter Temp.FE	TFLOAT [2]	Output of current housing temperature in °C. The parameter is read only.
bis / ...Simulation Mode			
4001	Simulation Switch	TUSIGN8 [1] 0: Off 1: Qm mass [unit] 2: Temperature [unit] 3: Qv @Vol.flow [Unit] 4: Density@ [unit] 50: Qm mass [%] 51: Temperature [%] 52: Qv @Vol.flow [%] 120: Digital output 41/42 121: Digital output 51/52	Manual stimulation of measured values / outputs. The simulated output values correspond to the set measured value (see Setting of the simulated measured values on page 91). Only one measured value / output can be selected for simulation. After power-up / restart of the device, the simulation is switched off.

Modbus register address	Parameter name	Data type [register length] / value range	Description
Setting of the simulated measured values. The simulated value is selected with the parameter 'Simulation Switch'.			
4003	Dig.Out 41/42 State	TUSIGN8 [1] 0 - Off 1 - On	The respective simulated output value is dependent on the operating mode (pulse / frequency) of the digital output 41 / 42.
5017	Freq.Out 41/42 Puls.Out 41/42	TFLOAT [2] 0 to 10500 Hz 0 to 10500 pulses	
4004	Dig.Out 51/52 State	TUSIGN8 [1] 0 - Off 1 - On	
5019	Dig.Out 51/52 Pulse	TFLOAT [2] 0 to 10500 pulses	Only if the digital output 51 / 52 has been configured as a pulse output.
5003	Mass Flow [unit]	TFLOAT [2] 0 to 2 x QmMax DN	Setting of the simulated measured values. The simulated value is selected with the parameter 'Simulation Switch'.
5011	Mass Flow [%]	TFLOAT [2] -200 to 200 %	
5007	Qv@ Vol.flow [unit]	TFLOAT [2] 0 to 2 x QvMax DN	
5015	Qv@ Vol.flow [%]	TFLOAT [2] -200 to 200 %	
5001	Temperature [unit]	TFLOAT [2] -100 to 250 °C	
5009	Temperature [%]	TFLOAT [2] -200 to 200 %	
... / ...Output Readings			
239	Freq.Out 41/42	TFLOAT [2] 0 to 10500 Hz	Output of the current output values. The available values are dependent on the configuration of the digital outputs.
18	Dig.Out 41/42 State	TUSIGN8 [1] 0 - Off 1 - On	The parameters are read only.
241	Freq.Out 51/52	TFLOAT [2] 0 to 10500 Hz	
19	Dig.Out 51/52 State	TUSIGN8 [1] 0 - Off 1 - On	

... 9 Commissioning and operation

... Interface description

Modbus register address	Parameter name	Data type [register length] / value range	Description
... / ...SensorCheck			These parameters are only available when the VeriMass function is activated.
... / ...SensorCheck / ...Verify Fingerprint			
9015	Verify	ACTION [1]	Fingerprint testing manual start. The test is started by writing any value to this address. The process takes approx. 12 minutes. It must be ensured that during this time there is no flow through the sensor (e.g. by shutting off or sealing off).
2047	Result Pass	TUSIGN8 [1] 0: Incomplete 1+2: Process running 3: complete 128: General error 129: Sensor temperature error 130: Occupied error 131: Memory access error	Read fingerprint status
2235	Value TDC1	TFLOAT [2]	Read VeriMass parameters.
2237	Value TDC2		See ' SensorCheck ' diagnosis function on page 102 for additional information on assessing the results.
2239	Value HDC1		2035: Temperature change TDC1
2241	Value HDC2		2037: Temperature change TDC2 2039: Heat emission change HDC1 2041: Heat emission change HDC2
... / ...SensorCheck / ...Install Fingerprint			
9014	Determine	ACTION [1]	Create the commissioning fingerprint. The commissioning fingerprint is created by writing any value to this address. The process takes approx. 12 minutes. It must be ensured that during this time there is no flow through the sensor (e.g. by shutting off or sealing off).
9013	Delete (New)	ACTION [1]	Delete the commissioning fingerprint. The commissioning fingerprint is deleted by writing any value to this address.

Modbus register address	Parameter name	Data type [register length] / value range	Description
... / ...Alarm Simulation			
4002	Alarm Simulation	TUSIGN8 [1] 0: Aus 1: Mass flowrate exceeds limits. 2: Volume flowrate exceeds limits. 3: Simulation is on! Simulating process/output value 4: Flowrate to zero 5: Maintenance interval is reached 6: All totalizer stopp. 7: Totalizer reset. Reset of one or more Totalizers. 8: Display value is <1600h at Qmax. 9: Device not calibrated. 10: Sensor memory defective. 11: NV data defect. Data storage irreparable. 12: No Frontend Board detected. Wrong connection. Defect Frontend. 13: FEB communication error. 14: Incompatible Frontend Board. 15: NV chips defect on Motherboard. 16: Dig.Out 41/42 is saturated. 27: ADC Failure on Frontend Board. 28: Electronics failFrontend Board. 29: Sensor temperature out of range. 30: Frontend temp. out of range. 31: Sensor failure or disconnected. 32: Sensor heat emission limit. 33: Medium temperat exceeds limits. 34: Invalid Sensor configuration 35: Std.Volume flow exceeds limits. 36: Sensor soiling detected. 37: FEB voltages outside range. 38: Dig.Out 51/52 is saturated.	Manual simulation of alarms / error messages. The simulated alarm is selected by setting the parameter to the corresponding error number of the desired error. See also chapter Alarm status and alarm history status on page 100.

... 9 Commissioning and operation

... Interface description

Parameter range – Totalizer

Modbus register address	Parameter name	Data type [register length] / value range	Description
... / ...Operation			
9007	Start all Totalizer	ACTION [1]	Start all counters of the device.
9009	Stop all Totalizer	ACTION [1]	Stop all counters of the device.
... / ...Reset Totalizer			
9002	All Totalizer	ACTION [1]	Reset the device counter.
9003	Massflow Qm		
9004	Volumeflow Qv@		
... / ...Preset Totalizer			
5055	Massflow Qm	TFLOAT [2]	Default setting of the device counter.
5057	Volumeflow Qv@		
... / ...FillMass			
These parameters are only available when the FillMass function is activated.			
4108	Batch Process Value	TUSIGN8 [1] 0: Off 65: Standard volumes 66: Mass	Selection of the process value used for the fill operation.
5053	Preset Batch Total.	TFLOAT [2] XX ... XX	Sets the fill quantity using the selected unit. When the defined fill quantity is reached, the configured binary output is activated. Note Before setting the fill quantity, the corresponding process value must be selected with the parameter 'Batch Process Value'.
9006	Reset Cur.Batch Tot.	ACTION [1]	Resets the parameter 'Current Batch Total.' to zero and prepares the next fill operation.
9008	Start Batching	ACTION [1]	Starts the fill operation by writing any value to the corresponding Modbus address.
401	Current Batch Total	TFLOAT [2] XX ... XX	Output of the current fill quantity. Once a fill operation has been started, the quantity already filled is shown here. The counter restarts at zero for each fill operation initiated and then counts up to the set fill quantity. This parameter is read only.
9010	Stop Batching	ACTION [1]	Stops the fill operation by writing any value to the corresponding Modbus address.
3315	Current Batch Counts	TUSIGN32 [2]	Output of the number of fill operations since the last reset. This parameter is read only.
9005	Reset Batch Counts	ACTION [1]	Resets the counter 'Current Batch Counts' by writing an arbitrary value into the corresponding Modbus address.

Modbus register address	Parameter name	Data type [register length] / value range	Description
... / ...FillMass / ...Lag Correction			These parameters are only available when the FillMass function is activated.
4107	Mode	TUSIGN8 [1] 0 - Manual 1 - Automatic	Selection of overrun correction. Closing the fill valve takes some time and as a consequence more liquid is added, even though the fill quantity is reached and the contact for closing the valve is actuated. <ul style="list-style-type: none"> Automatic: The overrun quantity is calculated by the transmitter automatically. Manual: The overrun quantity must be determined manually and entered in the selected unit via the parameter 'Quantity.'
5049	Quantity	TFLOAT [2] -0.0 to 100.0	Manually sets the overrun quantity correction value in the selected unit. Closing the fill valve takes some time and as a consequence more liquid is added, even though the fill quantity is reached and the contact for closing the valve is actuated. Only if the parameter 'Mode' has been set to 2 - Manual.
5047	Quantity	TFLOAT [2] Read only or set to 0.0.	Output of the overrun quantity automatically calculated by the transmitter. Only if the parameter 'Mode' has been set to 1 - Automatic.
5045	Factor	TFLOAT [2] 0.0 to 1.0 Factory setting: 0.25	Sets the weighting of the last filling process during automatic calculation of the overrun quantity. The calculation is based on the following formula: New correction value = last correction value + (Factor x correction value during the last fill operation) <ul style="list-style-type: none"> 0.0: No change to correction value. 1.0: The correction value is immediately adjusted to the overrun quantity calculated during the last fill operation.
5051	Time	TFLOAT [2] 0.1 to 10 s Factory setting: 0.1 s	Sets the time for the overrun quantity correction after the fill valve is closed.

Software history

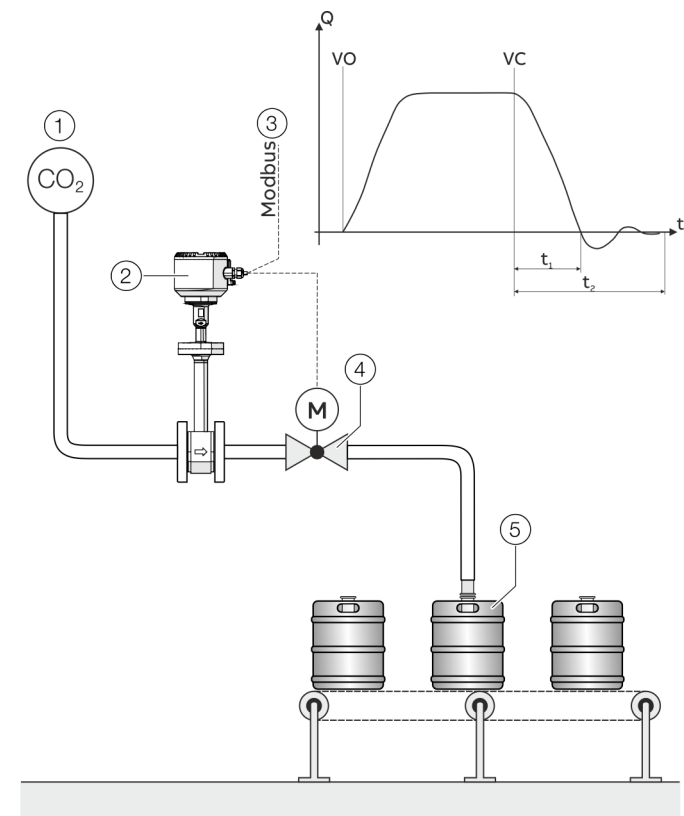
In accordance with NAMUR recommendation NE53, ABB offers a transparent and traceable software history.

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 Commissioning and operation

FillMass batch function

Only with FMT250



- | | |
|--|----------------|
| ① Gas pipeline (CO ₂) | ④ Fill valve |
| ② Sensor | ⑤ Filling tank |
| ③ Start / stop fill operation (via Modbus) | |

Figure 55: FillMass filling function (example CO₂ fill)

Diagram legend

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

The integrated FillMass fill function allows filling operations with filling times of > 3 s.

For this purpose, the filling quantity is given via an adjustable totalizer.

The Modbus interface is used to configure and control the fill function.

The valve is triggered via one of the digital outputs and closed again once the preset filling quantity is reached.

The transmitter measures the overrun quantity and calculates the overrun correction from this.

Additionally, the low flow cut-off can be activated if required.

Setup

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

1. The FillMass function must be active. See also parameter range **...Feature Settings** on page 82.
2. One of the two digital outputs 41 / 42 or 51 / 52 must be configured as a binary output with the function "Batch end contact". See also parameter range **Parameter range - Output** on page 85.
3. The parameters for the fill mass function must be configured. See also parameter range **...FillMass** on page 94.

Note

During fast filling processes, the damping should be set to the minimum value to ensure the greatest possible accuracy of the fill quantity.

See also parameter range **Parameter range – Device Setup** on page 77.

Filling process run

Initialization

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

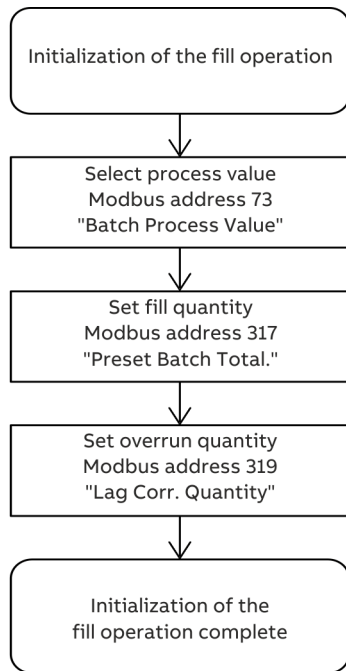


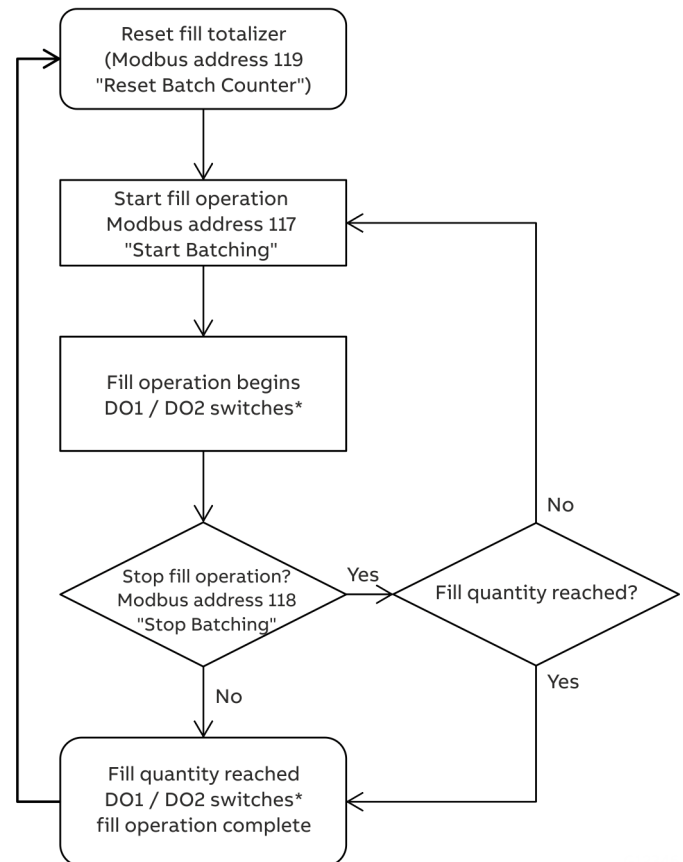
Figure 56: Initialization

Note

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

Fill operation

The following steps must be performed for every fill operation:



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

Figure 57: Fill operation

The current fill quantity for the present fill operation can be read out via the Modbus address 401 "Current Batch Total.". The number of fill operations performed can be read out via the Modbus address 3315 "Current Batch Counts". The counter can be reset via the Modbus address 9006 "Reset Batch Totalizer".

10 Diagnosis / error messages

NOTICE

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

General

Errors encountered are itemized in tabular form on the following pages. The response of the transmitter on error detection is described therein.

The table lists all possible errors together with a description of their impact on the value of measurement variables, the properties of current outputs and the alarm output.

If no entry is indicated in the table field, there is no effect on the measurement variable or no alarm signal for the particular output.

The sequence of the errors in the table corresponds to the error priorities.

The first entry has the highest priority and the last has the lowest.


If multiple errors are detected simultaneously, the error with the highest priority determines the alarm condition of the measurement variable and the current output. If an error with a higher priority does not affect the measurement variable or the output status, the error with the next highest priority determines the status of the measurement variable and the output.


The following critical errors are indicated by slow flashing (frequency: 1 second) of the service LED in the transmitter terminal box. Refer to **Service LED** on page 53.

Fault message	Error no.	Modbus address "Active alarm"
Sensor memory defective.	M038.009	10
NV data defect. Data storage irreparable.	F084.010	11
ADC Failure on Frontend Board.	F096.029	30
Electronics failFrontend Board.	F092.030	31
Sensor temperature out of range.	S090.031	32
Sensor failure or disconnected.	F093.033	34
Invalid Sensor configuration	M059.038	39
FEB voltages outside range.	F081.041	42

Overview

The states of the process variables and counters are represented by symbols; please see the table below.

Symbol	Description	
	Counter stop	
–	No change, current value	

Priority	Failure	Error text	Process variables				Counter
			Qm [%]	Qv@ [%]	Temperature [°C]	Standard density [kg/m ³]@ 0°C, 1atm	
96	F096.029	ADC Failure on Frontend Board.	0	0	20	1,293	–
93	F093.033	Sensor failure or disconnected.	0	0	20	1,293	–
92	F092.030	Electronics failFrontend Board.	0	0	20	1,293	–
90	S090.031	Sensor temperature out of range.	0	0	20	1,293	–
84	F084.010	NV data defect. Data storage irreparable.	0	0	20	1,293	–
81	F081.041	FEB voltages outside range.	–	–	–	–	–
78	C078.003	Flowrate to zero	0	0	–	–	–
76	C076.005	All totalizer stopp.	–	–	–	–	
74	C074.006	Totalizer reset. Reset of one or more Totalizers.	–	–	–	–	0
70	C070.026	An alarm is simulated.	–	–	–	–	–
59	M059.038	Invalid Sensor configuration	–	–	–	–	–
58	M058.040	Sensor soiling detected.	–	–	–	–	–
55	S055.032	Frontend temp. out of range.	–	–	–	–	–
47	S047.015	Dig.Out 41/42 is saturated.	–	–	–	–	–
46	S046.042	Dig.Out 51/52 is saturated.	–	–	–	–	–
45	S045.034	Sensor heat emission limit.	–	–	–	–	–
44	S044.000	Mass flowrate exceeds limits.	–	–	–	–	–
42	S042.037	Medium temperat exceeds limits.	–	–	–	–	–
41	S041.039	Std.Volume flow exceeds limits.	–	–	–	–	–
38	M038.009	Sensor memory defective.	–	–	–	–	–
28	M028.007	Display value is<1600h at Qmax.	–	–	–	–	–
26	M026.004	Maintenance interval is reached	–	–	–	–	–
24	M024.008	Device not calibrated.	–	–	–	–	–

... 10Diagnosis / error messages

Alarm status and alarm history status

Modbus address		Byte /	Error no.	Error text	Description	NAMUR classification
Active	History	bit pos.				
11	59	1 / 2	F084.010	NV data defect. Data storage irreparable.	SensorMemory defective <ul style="list-style-type: none"> Contact ABB Service 	Failure
30	78	3 / 5	F096.029	ADC Failure on Frontend Board.	Analog-digital converter in frontend board defective <ul style="list-style-type: none"> Contact ABB Service 	Failure
31	79	3 / 6	F092.030	Electronics failFrontend Board.	Electronic unit in frontend board defective <ul style="list-style-type: none"> Contact ABB Service 	Failure
34	82	4 / 1	F093.033	Sensor failure or disconnected.	Sensor electrical connection incorrect <ul style="list-style-type: none"> Check electrical connection Contact ABB Service 	Failure
42	90	5 / 1	F081.041	FEB voltages outside range.	Voltage on frontend board outside of the permissible range <ul style="list-style-type: none"> Contact ABB Service 	Failure
2	50	0 / 1	S044.000	Mass flowrate exceeds limits.	Mass flow outside of set alarm threshold <ul style="list-style-type: none"> Check parameterization (see Parameter range – Process Alarm on page 88) 	Out of specification
17	65	2 / 0	S047.015	Dig.Out 41/42 is saturated.	Digital output 41 / 42 (pulse output) maximum pulse rate up-scaled. <ul style="list-style-type: none"> Check parameterization (see Parameter range – Output on page 85) 	Out of specification
33	81	4 / 0	S090.031	Sensor temperature out of range.	Measuring medium temperature outside of the set alarm threshold or permissible limit values <ul style="list-style-type: none"> Check parameterization (see Parameter range – Process Alarm on page 88) Check measuring medium temperature (see chapter Process conditions on page 29) 	Out of specification
34	82	4 / 1	S055.032	Frontend temp. out of range.	Device temperature outside of permissible limit values <ul style="list-style-type: none"> Check ambient temperature (see Ambient conditions on page 26) 	Out of specification
36	84	4 / 3	S045.034	Sensor heat emission limit.	Heat emission limits of the measuring element up-scaled. Flow rate too high, incorrect measuring medium <ul style="list-style-type: none"> Check the process conditions 	Out of specification
39	87	4 / 6	S042.037	Medium temperat exceeds limits.	Measuring medium temperature outside of the set alarm threshold or permissible limit values <ul style="list-style-type: none"> Check parameterization (see Parameter range – Process Alarm on page 88) Check measuring medium temperature (see chapter Process conditions on page 29) 	Out of specification
41	89	5 / 0	S041.039	Std.Volume flow exceeds limits.	Standard volume flow outside of set alarm threshold. <ul style="list-style-type: none"> Check parameterization (see Parameter range – Process Alarm on page 88) 	Out of specification

Modbus address		Byte / bit pos.	Error no.	Error text	Description	NAMUR classification
Active	History					
44	92	5 / 3	S046.042	Dig.Out 51/52 is saturated.	Digital output 51 / 52 (pulse output) maximum pulse rate up-scaled. <ul style="list-style-type: none"> Check parameterization (see Parameter range - Output on page 85) 	Out of specification
4	52	0 / 3	C072.002	Simulation is on! Simulating process/output value	Manual process control (simulation) active. <ul style="list-style-type: none"> Deactivate simulation (see Parameter range - Diagnostics on page 90) 	Functional check
5	53	0 / 4	C078.003	Flowrate to zero	External output switch-off active.	Functional check
7	55	0 / 6	C076.005	All totalizer stopp.	External counter stop is active.	Functional check
8	56	0 / 7	C074.006	Totalizer reset. Reset of one or more Totalizers.	External counter reset is active.	Functional check
28	76	3 / 3	C070.026	An alarm is simulated.	Alarm simulation active. <ul style="list-style-type: none"> Deactivate simulation (see Parameter range - Diagnostics on page 90) 	Functional check
6	54	0 / 5	M026.004	Maintenance interval is reached	Maintenance interval reached <ul style="list-style-type: none"> Conduct maintenance of the device Maintenance interval start new cycle (see Parameter range - Diagnostics on page 90) 	Maintenance required
10	58	1 / 1	M024.008	Device not calibrated.	Device not calibrated <ul style="list-style-type: none"> Contact ABB Service 	Maintenance required
11	59	1 / 2	M038.009	Sensor memory defective.	SensorMemory faulty <ul style="list-style-type: none"> Replace SensorMemory 	Maintenance required
40	88	4 / 7	M059.038	Invalid Sensor configuration	Parameterization (configuration) of the device is incorrect. <ul style="list-style-type: none"> Check parameterization (configuration) Contact ABB Service 	Maintenance required
42	90	5 / 1	M058.040	Sensor soiling detected.	Thermal measuring element contaminated. <ul style="list-style-type: none"> Check thermal sensor elements and clean as needed (see chapter Maintenance on page 103) 	Maintenance required

... 10Diagnosis / error messages

‘SensorCheck’ diagnosis function

SensorCheck compares the characteristic values of the installation fingerprint with those of the current device fingerprint. As a result, changes to the sensor element such as contamination or damage, for example, can be detected early on and the integrity of the measurement can be guaranteed.

Note

The SensorCheck lasts approx. 12 min. Make sure that during the test there is no flow through the sensor (e.g. by shutting or sealing it off).

Modbus register address	Parameter	Description
9015	Verify	Fingerprint testing manual start. The test is started by writing any value to this address.
2047	Result	Read fingerprint status <ul style="list-style-type: none"> in progress: SensorCheck is running. incomplete: SensorCheck has been aborted. done: SensorCheck has successfully completed. If an error of the SensorCheck should occur, restart it at a later time. If the SensorCheck still cannot be completed successfully, contact ABB Service.
2235	Value TDC1	Read VeriMass parameters.
2237	Value TDC2	<ul style="list-style-type: none"> Value TDC1: Temperature change TDC1
2239	Value HDC1	<ul style="list-style-type: none"> Value TDC2: Temperature change TDC2
2241	Value HDC2	<ul style="list-style-type: none"> Value HDC1: Heat emission change HDC1 Value HDC2: Heat emission change HDC2

Assessment of the result

Assessment of the results of the VeriMass parameters TDC1, TDC2, HDC1, HDC2 must be conducted individually and depending on the application. The following table provides values for a rough estimation.

Parameters	Description / recommended measures
Value TDC1	A deviation of > ± 2 K indicates a defect of the sensor elements, the HDC characteristic values are not longer certain. <ul style="list-style-type: none"> Disassemble the sensor, check the sensor element. Contact ABB Service, if necessary.
Value TDC2	A deviation of > ± 10 % indicates a defect of the sensor elements, the HDC characteristic values are not longer certain. <ul style="list-style-type: none"> Disassemble the sensor, check the sensor element. Contact ABB Service, if necessary.
Value HDC1	A deviation of > ± 100 % indicates contamination of the sensor element, but the effect on the measured values is minimal in a normal situation. <ul style="list-style-type: none"> Check the sensor element and clean as needed.
Value TDC2	A deviation of > ± 100 % indicates contamination of the sensor element, the effect on the measured values is large in this case. <ul style="list-style-type: none"> Check the sensor element and clean as needed.

11 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

Loss of Ex-approval!

Loss of Ex approval due to replacement of components in devices for use in potentially explosive atmospheres.

- Devices for use in potentially explosive atmospheres may be serviced and repaired by qualified ABB personnel only.
- For measuring devices for potentially explosive atmospheres, observe the relevant operator guidelines. See also **Table of contents** on page 2.

WARNING

Risk of injury due to live parts!

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

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

CAUTION

Risk of burns due to hot measuring media

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

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

NOTICE

Damage to components!

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

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

Corrective maintenance work may only be performed by trained personnel.

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

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

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

Sensor

The flowmeter essentially requires no maintenance.

The following items should be checked annually:

- Ambient conditions (air circulation, humidity),
- Tightness of the process connections,
- Cable entries and cover screws,
- Operational reliability of the power supply, lightning protection, and station ground.

Repairs to the flowmeter

If repairs to the flowmeter are required, observe **Repair** on page 106.

... 11 Maintenance

Cleaning

When cleaning the exterior of meters, make sure that the cleaning agent used does not corrode the housing surface and the seals.

To avoid static charge, a damp cloth must be used for cleaning.

Cleaning the sensor element

It can be necessary to clean the thermal measuring element when measuring gases with damp contamination.

The cleaning interval depends on the degree of contamination of the measuring element and must be individually defined.

NOTE

Damage to the sensor due to improper cleaning!

- Do not clean the sensor element with hard objects (screwdrivers, tweezers or wire brushes).
- Do not clean the sensor element in an ultrasonic bath.
- Do not clean or dry the measuring element with pressurized air.

1. Switch off the power supply.
2. Disconnect electrical connections.
3. Disassemble the sensor from the pipe component or hot tap fitting, as described in **Wafer type design (FMT091) and partial measuring section (FMT092)** on page 32 and **Installing the sensor** on page 46.

4. Carefully clean the measuring element with warm water or an alcohol solution using a soft brush or cotton swab.
5. Allow the sensor to dry or carefully dry with warm air.
6. Check that the gasket between the sensor and pipe component or welding adapter is clean and in good condition; if necessary replace it with a new gasket (O-Ring \varnothing 55 mm \times 3 mm (2.16 in \times 0.12 in).
7. Install the sensor in the pipe component or hot tap fitting, as described in chapter **Assembly of the pipe component** on page 31 and **Disassembly of the sensor** on page 45.
8. Perform electrical connection (see **Electrical connections** on page 48).
9. Perform commissioning (see **Commissioning and operation** on page 53).

Integrated hot tap fitting

Replace the O-ring gaskets

DANGER

Danger of injury due to improper maintenance!

Danger of injury due to leaking measuring medium during disassembly of the changing device with piping under pressure.

- Before starting maintenance, depressurize the piping and rinse.

DANGER

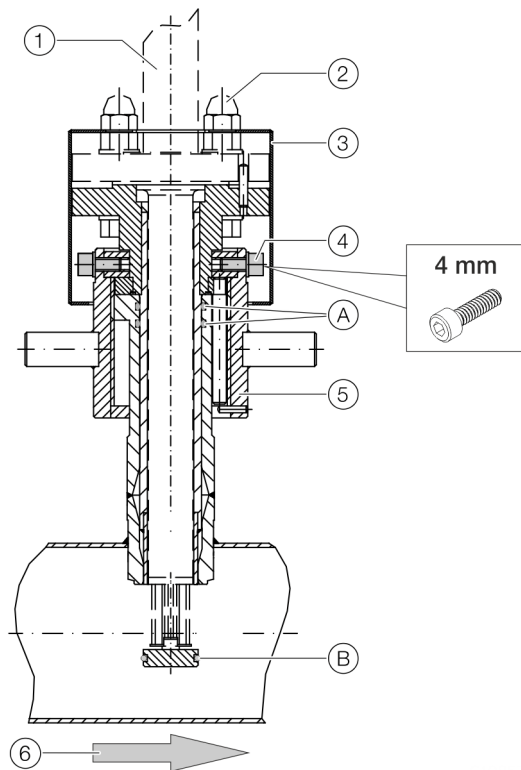
Risk of fire!

Risk of fire due to the use of non-permissible grease for oxygen applications.

- Only use permissible fitting grease for oxygen applications (e.g. Krytox GPL-226).

After approx. 100 sensor installation and disassembly procedures, the O-ring gaskets on the changing device must be replaced. If you are working with dusty, abrasive or aggressive measuring media, it may be necessary to replace these more frequently.

O-ring gaskets may only be replaced by the manufacturer's service department or by qualified personnel employed by the operator.



- | | |
|------------------|-------------------------------------|
| ① Sensor | ④ Fixing screws for union nuts (4×) |
| ② Special screws | ⑤ Union nut |
| ③ Protection cap | ⑥ Flow direction |

Figure 58: Gaskets on the hot tap fitting

O-ring seals

Pos.	Quantity	Design
① A	2	O-ring $\varnothing 36 \times 3$ mm (1.42 \times 0.12 in), Viton
① B	1	O-ring $\varnothing 26 \times 3$ mm (1.02 \times 0.12 in), Viton

1. Disassemble the sensor (see **Disassembly of the sensor** on page 45).
2. Loosen the fixing screws of the union nut and pull the guide tube out of the changing device. Clean the guide tube if necessary.
3. Replace both inside O-rings on the changing device and the O-ring of the guide tube. Lightly lubricate the O-rings as well as the threads of the union nut and slip ring of the guide tube.
4. Insert the guide tube in the changing device and tighten the fixing screws of the union nut as far as the limit stop in exactly the same position as during disassembly.
5. Verify correct installation by rotating the lock nut into measuring and disassembly positions.
6. Install the sensor (see chapter **Installation / Disassembly of the sensor in connection with the hot tap fitting** on page 44).

12 Repair

Safety instructions

DANGER

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

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

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

WARNING

Loss of Ex-approval!

Loss of Ex approval due to replacement of components in devices for use in potentially explosive atmospheres.

- Devices for use in potentially explosive atmospheres may be serviced and repaired by qualified ABB personnel only.
- For measuring devices for potentially explosive atmospheres, observe the relevant operator guidelines. See also **Use in potentially explosive atmospheres** on page 6.

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.

Spare parts

Repair and maintenance activities may only be performed by authorized customer service personnel.

When replacing or repairing individual components, use original spare parts.

Note

Spare parts can be ordered from ABB Service.

www.abb.com/contacts

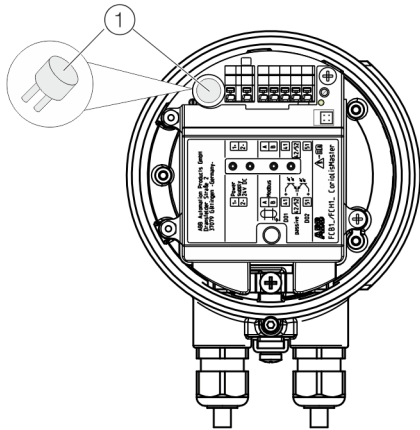
Replacing the fuse

NOTICE

If the O-ring gasket is seated incorrectly or damaged, this may have an adverse effect on the housing protection class. Follow the instructions in **Opening and closing the housing** on page 49 to open and close the housing safely.

Note

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



① Fuse

Figure 59: Fuse in the terminal box

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

Perform the following steps to replace the fuse:

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

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

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 110) and include this with the device.

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

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

Address for returns:

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

13 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 107.

Disposal

Note



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

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

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

Bear the following points in mind when disposing of them:

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

14 Specification

Note

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

15 Additional documents

Note

All documentation, declarations of conformity, approvals, certificates and additional documentation are available in the ABB download area.

www.abb.com/flow

Trademarks

Modbus is a registered trademark of Schneider Automation Inc.

Swagelok is a registered trademark of the Swagelok Company

16 Appendix

Return form

Statement on the contamination of devices and components

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

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

Customer details:

Company: _____

Address: _____

Contact person: _____ Telephone: _____

Fax: _____ Email: _____

Device details:

Type: _____ Serial no.: _____

Reason for the return/description of the defect: _____

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

Yes No

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

biological corrosive / irritating combustible (highly / extremely combustible)

toxic explosive other toxic substances

radioactive

Which substances have come into contact with the device?

1. _____

2. _____

3. _____

We hereby state that the devices/components shipped have been cleaned and are free from any dangerous or poisonous substances.

Town/city, date

Signature and company stamp

FMT200 Installation diagram 3kxf000094G0009

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**ORDINARY LOCATION
GENERAL PURPOSE**

ATEX: -
IECEX: -

US: -
CDN: -

**HAZARDOUS LOCATION
Zone 2/22
Division 2 & ZN 2/22**

ATEX: II 3 G & II 3 D
IECEX: Gc & Dc

US: DIV2 & ZN2
CDN: DIV2 & ZN2

**HAZARDOUS LOCATION
Zone 1/21
Zone 0 (inside pipe)
Division 1 & ZN 1/21**

ATEX: II 1/2 G & II 2 D
IECEX: II 2 G & II 2 D
US: Gb (Ga) & Db
Gb & Db

US: DIV1 & ZN1 & ZN0 inside Pipe
CDN: DIV1 & ZN1

a

POWER SUPPLY
Non IS
Terminals
max 30V DC

b

SIGNAL DATA INPUT/OUTPUT

Intrinsically safe Ia
Ui=4.2V

Connected to ATEX / IECEX or FM / CSA certified BARRIER
Ui=30V

Ui=30V

c

Alternative to b:

SIGNAL DATA INPUT/OUTPUT
Umax=3V

Non Intrinsically Safe
Umax=30V

max 30Vrms
Umax=30V

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

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... FMT200 Installation diagram 3kxf000094G0009

<p>Notes: ATEX & IECEx application</p> <ol style="list-style-type: none"> 1. 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 Voc OR Vt < V MAX, Io OR loc OR It < I MAX, Ca OR Co > Ci + Ccable; La OR Lo > Li + Lcable; Po < Pi. 2. DUST-TIGHT CONDUIT SEAL MUST BE USED WHEN INSTALLED IN Zone 21/22 ENVIROMENTS. 3. CONTROL EQUIPMENT CONNECTED TO THE ASSOCIATED APPARATUS MUST NOT USE OR GENERATE MORE THAN 250 Vrms OR Vdc WITH RESPECT TO EARTH. 4. INSTALLATION SHOULD BE IN ACCORDANCE WITH THE RELEVANT INTERNATIONAL OR NATIONAL REGULATIONS "INSTALLATION OF INTRINSICALLY SAFE FOR HAZARDOUS LOCATIONS" REGULATIONS. 5. THE CONFIGURATION OF ASSOCIATED APPARATUS MUST BE ATEX or IECEx APPROVED UNDER ENTITY CONCEPT. 6. ASSOCIATED APPARATUS MANUFACTURER S INSTALLATION DRAWING MUST BE FOLLOWED WHEN INSTALLING THIS EQUIPMENT. 7. THE ASSOCIATED APPARATUS MUST BE INSTALLED IN ACCORDANCE WITH BARRIER MANUFACTURE S INSTALLATION DIAGRAM 8. SELECTED ASSOCIATED APPARATUS MUST BE THIRD PARTY LISTED AS PROVIDING INTRINSICALLY SAFE CIRCUITS FOR THE APPLICATION. IT MUST MEET THE REQUIREMENTS LISTED IN TABLE OF THIS INSTALLATION DIAGRAM: 	<p>Notes: US and Canadian application</p> <ol style="list-style-type: none"> 1. 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 Voc OR Vt < V MAX, Io OR loc OR It < I MAX, Ca OR Co > Ci + Ccable; La OR Lo > Li + Lcable; Po < Pi. 2. DUST-TIGHT CONDUIT SEAL MUST BE USED WHEN INSTALLED IN CLASS II AND III ENVIROMENTS. 3. CONTROL EQUIPMENT CONNECTED TO THE ASSOCIATED APPARATUS MUST NOT USE OR GENERATE MORE THAN 250 Vrms OR Vdc WITH RESPECT TO EARTH. 4. INSTALLATION FOR U.S. AND CANADIAN APPROVED EQUIPMENT SHOULD BE IN ACCORDANCE WITH ANSI/ISA RP12.6 "INSTALLATION OF INTRINSICALLY SAFE SYSTEMS FOR HAZARDOUS (CLASSIFIED) LOCATIONS", THE NATIONAL ELECTRICAL CODE (ANSI/NFPA 70) SECTIONS 504, 505 AND THE CANADIAN ELECTRICAL CODE (C22.1-02). 5. THE CONFIGURATION OF ASSOCIATED APPARATUS MUST BE FM AND/OR CSA APPROVED UNDER ENTITY CONCEPT. 6. ASSOCIATED APPARATUS MANUFACTURER S INSTALLATION DRAWING MUST BE FOLLOWED WHEN INSTALLING THIS EQUIPMENT. 7. THE ASSOCIATED APPARATUS MUST BE INSTALLED IN ACCORDANCE WITH BARRIER MANUFACTURE S INSTALLATION DIAGRAM 8. SELECTED ASSOCIATED APPARATUS MUST BE THIRD PARTY LISTED AS PROVIDING INTRINSICALLY SAFE CIRCUITS FOR THE APPLICATION. IT MUST MEET THE REQUIREMENTS LISTED IN TABLE OF THIS INSTALLATION DIAGRAM: 																																								
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<p>Version FMT200 PAGE 14 OF 17</p>																																									
<table border="1" style="width: 100%;"> <tr> <td style="width: 20%;">For Model</td> <td style="width: 20%;">FMT200</td> <td style="width: 20%;">Projection method 1</td> <td style="width: 20%;">General tolerances:</td> <td style="width: 20%;">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></td> <td></td> <td></td> <td style="text-align: center;">3kxf000094G0009</td> <td></td> </tr> <tr> <td></td> <td></td> <td></td> <td style="text-align: center;">Normal</td> <td style="text-align: center;">REF: B08</td> </tr> <tr> <td>Rev.</td> <td>Date</td> <td>Number</td> <td>Name</td> <td>REPLACES:</td> </tr> <tr> <td></td> <td>01 12.11.2019</td> <td>FBu</td> <td></td> <td></td> </tr> </table>		For Model	FMT200	Projection method 1	General tolerances:	Tolerancing				Work piece edges:	Surface				Installation diagram					SensyMaster FMT					3kxf000094G0009					Normal	REF: B08	Rev.	Date	Number	Name	REPLACES:		01 12.11.2019	FBu		
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Rev.	Date	Number	Name	REPLACES:																																					
	01 12.11.2019	FBu																																							


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]	U _{nom} [V]	I _{nom} [mA]
On board								
Modbus	---	A		A / B	30	30	30	30
Digital Output 1	DO1	P		41/42	30	30	30	30
Digital Output 2	DO2	P		51/52	30	30	30	30

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For Model FMT200	Projection method 1  ABB Automation Products GmbH Date: 01.12.2019 Name: FBu	General tolerances: work piece edges: Tolerancing Surface:
01.12.2019 FBu	Checked by: [] Rev. Date Number Name 01.12.2019 FBu	Installation diagram SensyMaster FMT
Rev. Date Number Name	01.12.2019 FBu	3kx10000094G0009
Rev. Date Number Name	01.12.2019 FBu	Normal

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Zone 1/21 & Division 1


Model code FMT2bcA1, FMT2bcA3, FMT2bcA5, FMT2bcB5
FMT2bcF1

HART Communication

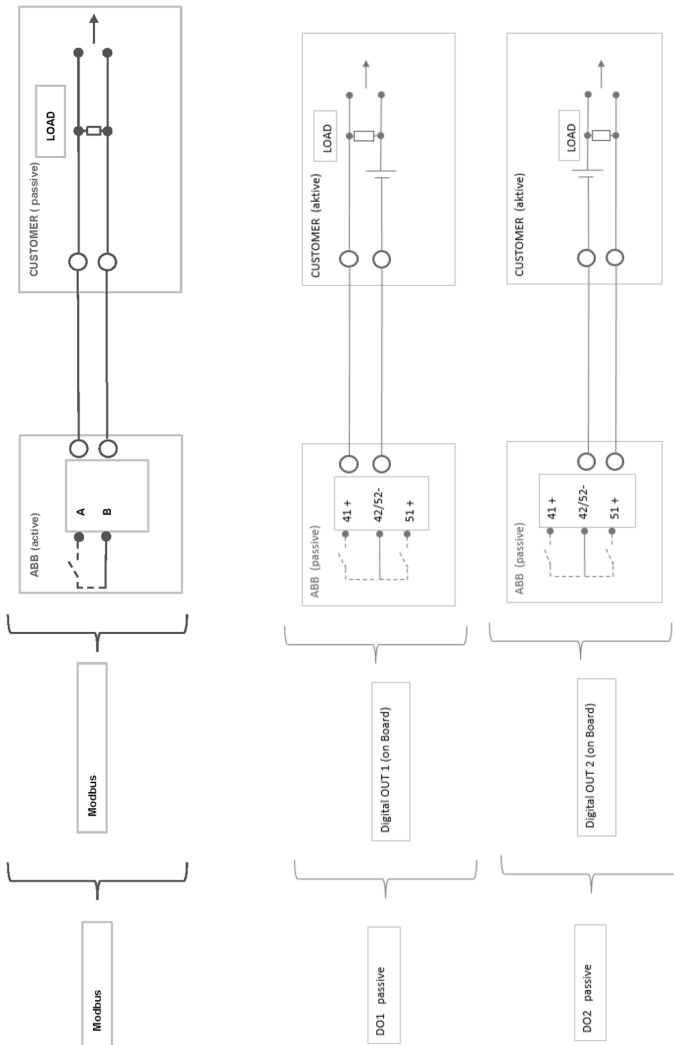
Indication	Abbr.	Status	Option	Terminal	Operating Value																	
					Active or Passive	Chosen Option depending on Model Number (MN)	If "or" occurs Terminal depends on MN	Ex e / XP	U _M [V]	I _M [A]	U _o [V]	U _i [V]	I _o [mA]	I _i [mA]	P _o [mW]	P _i [mW]	C _o [nF]	C _i [nF]	C _{oPA} [nF]	C _{iPA} [nF]	L _o [mH]	L _i [μH]
Modbus	---	A		A / B	On board							4.2	150	150	150	150	13900	13900	-	-	20	20
Digital Output 1	DO1	P		41/42								30	0.1	-	30	-	25	-	187	20	-	200
Digital Output 2	DO2	P		51/52								30	0.1	-	30	-	25	-	187	20	-	200

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 ABB Automation Products GmbH Date: 01.12.2019 Name: FBu		Installation diagram SensyMaster FMT 3kxf000094G0009		
Rev.	Date	Number	Name	Replaces:
	01.12.2019	FBu		

Allowed I/O connections:



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		ABB Automation Products GmbH	Installation diagram	
Rev.	01	Date	SensyMaster FMT	
Number	12.11.2019	Name	3KX1000094G0009	
Name	FBU	Checked per SIS	Normal	
Name	FBU	Checked per SPS	Normal	
Name	FBU	Checked per BOM	Normal	

ABB Measurement & Analytics

For your local ABB contact, visit:
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For more product information, visit:
www.abb.com/flow

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